Recreation Site, Informal Trail, and Dispersed Campsite Impact Baseline Assessment and Procedures: Joe's Valley Bouldering Area, Utah

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INTRODUCTION

Joe's Valley, Utah, a combination of US Forest Service (USFS), Bureau of Land Management (BLM), State of Utah School and Institutional Trust Lands Administration (SITLA), and private lands, accommodates diverse outdoor recreational opportunities such as hiking, camping, kayaking, mountain biking, fishing, hunting, and Off-Highway Vehicle use. While these recreational activities draw a population to visit the area, the recreational activity of bouldering has positioned Joe's Valley as a premier rock climbing destination. During the peak seasons of spring and fall, climbers from Utah, neighboring states, and traveling climbers visit Joe's Valley to climb the numerous sandstone boulders scattered throughout the area.

Bouldering and associated camping at Joe's Valley have contributed to recreation resource impacts throughout the area. Multiple informal trails, soil erosion, bare soil, vegetation trampling, and numerous fire sites are common impacts that can easily be observed. These impacts may have an effect on the aesthetics of the climbing area, which may decrease the climbers' experience. More importantly, land managers must evaluate these impacts for acceptability and develop management strategies to mitigate these impacts.

This report has been developed for the Price Ranger District of the Manti-La Sal National Forest, the Bureau of Land Management Price Field Office, and the Salt Lake Climbers Alliance in response to concerns about resource conditions at bouldering sites, related informal trails, and dispersed campsites within Joe's Valley. The USFS, along with the BLM administers public lands within Joe's Valley, which includes managing a variety of resource inventories such as range, timber, energy, watershed, wildlife, cultural resources, and recreation. The Salt Lake Climbers Alliance is a local climbing organization, based in Salt Lake City, which has been instrumental in providing advocacy at this rural climbing destination. Information derived from this report can be used by these entities to evaluate the acceptability of current conditions; develop management goals, objectives, and policies; and to meet desired future conditions.

This assessment project has five objectives:

1. Develop and refine assessment procedures for bouldering sites, informal trails, and dispersed campsites based on current visitor-use associated resource impact assessment methodologies.

2. Assess and document visitor-use related resource impacts at bouldering sites, associated informal trails, and dispersed campsites.

3. Provide baseline data on the location, number, density, and resource impact indicators for bouldering sites, informal trails, dispersed campsites, and parking areas used to access bouldering sites.

4. Present quantitative analysis of inventory and impact indicators at bouldering sites, informal trails, dispersed campsites, and parking.

5. Provide management recommendations to mitigate, minimize, and avoid resource impacts at bouldering sites, informal trails, and dispersed campsites.

The remaining sections of this report contain the following:

- Literature Review. An examination of visitor-use resource impacts, indicators and selection criteria, and types of recreation site and trail assessment methodologies;

- Study Area. A brief description of Joe's Valley;

- Methods. A summary of the assessment procedures used;

- Results. A review of the findings;

- Management Recommendations. An examination of management techniques to mitigate visitor-use associated resource impacts; and

- Appendices. Contains maps, the Bouldering Recreation Site Assessment Manual, the Informal Trail Assessment Manual, and the Dispersed Campsite Impact Assessment Manual.

LITERATURE REVIEW

Visitation Resource Impacts

Increase of recreational activities, such as climbing, biking, hiking, and camping within our public lands contributes to undesirable changes in soil, vegetation, wildlife, and water. These visitor-related disturbances resulting from recreational use are called resource or ecological impacts. Each of these resource impacts does not occur alone; one activity can cause multiple impacts while each impact becomes exacerbated or compensates additional changes. Land managers need to comprehend this interrelationship since the solution for mitigating one impact could potentially cause another dilemma (Hammitt & Cole, 1998).

This assessment procedure includes trampling-related impacts to soil and vegetation at bouldering sites, associated informal trails, and dispersed campsites. The following section will review recreation site impacts, trail impacts, and other issues that pose aesthetic and ecological concerns.

Recreation Site Impacts

Recreation resource impacts associated with trampling can have a number of direct or indirect effects on vegetation and soil. Vegetation cover is directly affected where trampling abrades ground cover, which can lead to loss of trees, shrubs, and ground vegetation; reduced plant vigor, height, and reproduction capabilities; and introduction of exotic plant species. Indirect effects on vegetation include an altered composition that changes to trampling-resistant species, and altered microclimates. Direct effects of trampling on soil consist of loss of organic material, soil exposure, compaction, and erosion. Indirect effects include reduced pore space and moisture, and increased water runoff. Out of all the soil impacts, erosion is the most permanent and serious problem. Even though water and wind actually perform the eroding, recreational activities provide the condition for it to occur (Hammitt & Cole, 1998; Marion & Carr, 2007).

For this assessment process, recreation sites are bouldering sites and dispersed campsites. Specifically for bouldering recreation sites, the staging area, the area under the climbs, and in some circumstances, the areas under the descent are considered the recreation sites. These impacted areas are concentrated, follow a node and linkage configuration, and can be extremely small or fairly large, depending on factors including access and location of the boulder, size of the boulder, number of problems, difficulty of climbs, and overall popularity (Manning, 1979; Marion & Carr, 2007). The area under climbing routes along with the staging area will show evidence of soil compaction; loss of organic litter, ground vegetation, shrubs, and trees; and in steeper locations erosion. Most of these impacts are due to intensive trampling from placement of bouldering pads, use of spotters, users socializing around boulders, and possible modifications such as leveling the ground, removing rocks, and cutting tree branches to enhance the bouldering experience or make it safer (Access Fund, 2004; Pyke, 2001).

Dispersed campsites are classified as campsites that can be accessed by a vehicle and are outside of a developed campground. These sites are usually primitive, do not provide amenities such as

tables, fire grates, or trash removal, but toilets may be present in some circumstances. Dispersed campsites are usually adjacent to roads or may connect to the main road by a short informal road. Campsite sizes can be large to accommodate numerous vehicles and groups of visitors or might be small enough to accommodate one vehicle. Concerns with large dispersed campsites include: soil displacement even on flat terrain due to sheet erosion, loss of regeneration of vegetation, and disturbed sites which provide a hospitable niche for invasive vegetation (Marion & Hockett, 2008). Finally, direct and indirect impacts are similar to what was previously described under bouldering site impacts with the addition of trampling impacts due to motorized use within the campsite boundary.

Additional site impacts of concern at bouldering sites and dispersed campsites include: mechanical damage to mature trees such as driving in nails, striking trees with axes, or felling trees; profile truncation; and campfire impacts (Hammitt & Cole, 1998). Campfire related-impacts include: fire pits, tree damage, trampling impacts, site searching for wood, wood removal, ash, unburned trash, and charred rocks when campfires are built adjacent to boulders, under rock overhangs, or inside caves (Reid & Marion, 2005).

Trail Impacts

Trails are an additional recreational resource that allow users access to non-roaded areas, provide recreational opportunities such as hiking, horse riding, and biking, and protect natural resources by focusing users on resistant tread (Marion & Leung, 2001). Most visitor resource impacts to trails are caused by trampling and are similar to those described as recreation site impacts. Other significant and common trail related impacts include trail widening, parallel trails, and proliferation of visitor-created trails (Hammitt & Cole, 1998; Marion & Carr, 2007). Trails can also contribute to diminished and fragmented wildlife habitats, while trails adjacent to water bodies may increase sedimentation and water turbidity impacts on invertebrates and fish populations (Fritz, 1993; Knight & Cole, 1995).

Trails can be defined into two groups—informal trails and formal trails. Informal trails (also referred as social trails) are visitor-created trails that are usually not designed, constructed, or maintained by professionals. These trails are more of a concern to management due to the increase of potential impacts resulting from inadequate designs, such as several trails accessing the same area, parallel alignments to slopes, and locating trails through fragile substrates, vegetation, and vulnerable wildlife habitats. These design attributes increase the susceptibility of soil erosion, profile truncation, tread widening, and muddiness. Formal trails are designated trails that can be professionally designed, the product of user-created trails, or trails that have been inadequately designed and constructed compared to current standards. These trails face the same predicament as informal trails, and even when formal trails are adequately designed, trail impacts can still occur (Marion & Carr, 2007).

A common occurrence at bouldering areas is the proliferation of informal trails and their associated impacts. These user-created paths are created as climbers pioneer a trail to a new bouldering area that may not be accessible by a formal trail. These trails develop along the fastest route to the bouldering site from the parking area and between different boulders within a site (Pyke, 2001). These trails are often steep, minimally improved, and can include washes,

animal runs, and other natural paths (Access Fund, 2006). Once these informal trails are established and frequency of use increases, it is highly probable that soil erosion, vegetation trampling, and multiple trails, along with other trail impacts will occur.

Additional Issues

Litter

While not a resource impact, litter can be considered an aesthetic impact at bouldering sites and dispersed campsites. Most litter found around boulder formations will be micro-trash, such as pieces of athletic tape, cigarette butts, candy wrappers, or food scraps. Dispersed campsites will have similar types of trash but can also have excessive litter including broken glass, bottles, aluminum cans, and other larger forms of trash.

Human Waste Disposal

The presence of human waste around bouldering areas and dispersed campsites is aesthetically unpleasing and can possibly be a source of contamination to water sources. During the assessment process, if excessive human waste is noticed, new management strategies can be designed such as locating new restrooms and promoting minimum impact waste disposal practices.

Indicators and Selection Criteria

When developing a monitoring and assessment system for recreation site and trail impacts, appropriate indicators must be selected. These indicators "are measurable physical, ecological, or social variables used to track trends in conditions caused by human activity so that progress toward goals and desired conditions can be assessed" (Marion & Carr, 2007, p. 17). A monitoring system based on measuring multiple indicators is preferable to a single measurement system, since the overall condition of sites and trails is the summation of many characteristics. These multiple indicators are usually the evaluation of soil, vegetation, or aesthetic qualities of a recreation site or trail (Marion & Carr, 2007). An acceptable monitoring system should provide management a reliable baseline of resource conditions, tell how serious problems are, and identify changes (Cole, 1989; Hammitt & Cole, 1998).

Criteria for selecting indicators have been reviewed in Cole (1989), Hammitt and Cole (1998), Marion (1991), Marion and Carr (2007), and Merigliano (1990) and can be summarized into five characteristics. First, meaningful measures should be selected. The quality of this information will be based on the scale of measurement: either an ordinal measurement of change, such as condition classes, or a measurement-based system that relies on numeric values to provide ratio measurements of change. Second, indicators should be accurate. Accuracy describes if the measurement is close to the indicator's true condition. Third, indicators should be precise. Precision describes how close a common value is approximated by many individuals, which is important to adequately document trends over time. Fourth, indicators should be measured with efficiency. Efficiency is the time, equipment, and expertise that are needed to measure the

indicator's condition. Finally, indicators should be sensitive. Sensitivity describes how much of a subtle change can occur, allowing management an early warning before the resource condition becomes unacceptable. All of these criteria should be considered when selecting indicators with the understanding that there will be trade-offs between accuracy and precision, since each puts constraints on efficiency.

By employing these indicator criteria and the understanding of recreation impacts on vegetation, soil, and aesthetics, managers can select desired indicators for recreation site and trail conditions. Common indicators for recreation sites include the number of visitor-created recreation sites and the site size. In these sites, exposed soil and the number of trees with exposed roots can indicate the amount of organic horizon disturbances, soil compaction, and erosion (Marion & Carr, 2007). Damage to ground cover vegetation is routinely monitored by measuring reduction in vegetation density, composition, and the area of denuded vegetation (Cole, 1989). Marion and Carr (2007) states that aesthetic and behavior indicators are dynamic and pose difficulties in assessing them, yet indicators that are important to visitors' concerns and management objects have been selected, such as number of informal trails radiating from the recreation site, number of damaged trees, presence of human waste, trash, and campfire remnants. For trails, common indicators include number, length, and density of social trails, along with measuring tread width, soil erosion, and muddiness through point sampling or problem census techniques (Marion & Carr, 2007).

Types of Recreation Impact Assessment Methodology

Since bouldering site and dispersed campsite impacts follow a predictable pattern similar to backcountry campsites, the following assessment approaches and systems can be applied with some modifications. Assessment systems for recreation sites will vary depending on indicators, methods, and time (Marion 1991). There are many assessment procedures that have been developed, which can be grouped into three systems: photographic, condition class, and multi-indicators. The following will briefly summarize these systems (see Cole [1989], Marion [1991], and Leung and Marion [2000] for more detailed information).

Photographic assessment systems were some of the first attempts at documenting trampling effects at backcountry sites (Magill & Twiss, 1965). Advantages of photographic methods include ease of establishing the system, precision is high, and photographs provide easily understandable visual records. Disadvantages include inadequate quantitative measurements of specific indicators, misleading impressions from different vantage points, and inconsistent photographic quality leading to poor comparability (Cole, 1989; Marion, 1991; Marion & Carr, 2007). Brewer and Berrier (1984) provide the most comprehensive review on photographic techniques and conclude that photographs should be used as a supplement to a monitoring system based on field measurements.

Condition class assessment systems consist of assigning recreation impact sites a descriptive statement that reflects the level of resource change. Observers assess the absence, presence, or degree of change in important indicators and compare it to the descriptive condition classes that closely match the site condition. Frissell (1978) developed a commonly used five class system

based on tree mortality, erosion, vegetation loss, mineral soil exposure, and tree root exposure. The advantage of this system is that it is quick to apply and provides a simple overview of the resource condition. Disadvantages of this type of assessment system include: the classes are not quantitative measurements, observations are subjective, and the data allows limited analysis since the difference of classes are not linearly related, but ordinally related (Cole, 1989; Marion, 1991; Marion & Carr, 2007).

Multi-indicator systems consist of assessing individual resource indicators through different approaches, such as rapid survey methods (multiple parameter ratings) or time-consuming precise measurement methods (multiple parameter measurements) (Hammitt & Cole, 1998; Marion & Carr, 2007). Multiple parameter rating systems have been developed by Parsons and MacLeod (1980), Cole (1983b), Marion (1984), and McEwen, Cole, and Simon (1996), which are based on multiple categorical impact indicators, each assigned with three to five quantitatively defined impact ratings. The observer assigns a rating based on an ordinal scale to each impact indicator, and these ratings are totaled to obtain an overall impact rating. Advantages of this type of system are that only minimum training is required and field work can be accomplished efficiently. Unfortunately, the disadvantage of this system is that the impact ratings are based on an ordinal scale and therefore not statistically accurate, which can lead to improper results (Leung & Marion, 2000; Marion, 1991).

A multiple parameter measurement system is the best option for acquiring accurate, quantitative data for recreation site impacts. Some of these systems, developed by Cole (1982), Marion (1984), Stohlgren and Parsons (1986), and Cole and Marion (1988) rely on research-level methodology requiring expertise, time, and the use of quadrates and fixed radial transects to obtain exact measurements for soil and vegetation changes that can be replicated precisely in the future. These types of assessment procedures are more appropriate for research studies rather than monitoring programs due to its high cost (Cole, 1989).

Marion (1991) has devised a multi-indicator procedure that uses a variable radial transect method, which results in greater accuracy, along with a rapid assessment system for vegetation cover, soil exposure, and other indicators. Marion's system also uses condition class and photographic assessments. This assessment system has been successfully used for documenting recreation impacts at cliff and rock outcrops in Shenandoah National Park (Marion & Carr, 2007), a modified version of this system was used to research the variation of environmental impacts at rock climbing areas at the Red River Gorge Geological Area located in Daniel Boone National Forest, Kentucky (Carr, 2007), and an adapted version was also used to develop a bouldering recreation site assessment procedure for Little Cottonwood Canyon, Utah (Porucznik, 2009).

Types of Trail Impact Assessment Methodology

Trail impact assessments provide managers a tool to document formal and informal trail resource conditions and associated impacts. Trail routes can be mapped along with the location, number, and effectiveness of trail features such as water bars and check dams. Conditions of the trail can be assessed for the type, location, and extensiveness of resource impacts. Information derived

from trail assessments can be used to evaluate the acceptability of current conditions; analyze resource changes over time; understand the relationship between trail conditions, design conditions, and environmental conditions; identify, plan, and budget appropriate trail management actions; and evaluate the effectiveness of past management actions (Hammitt & Cole, 1998; Marion & Leung, 2001).

Three categories of trail assessment procedures, condition class ratings, sample-based, and census-based, have been described, reviewed, and compared by Cole (1983a) and Leung and Marion (2000). Condition class ratings (Cole, Watson, Hall, & Spildie, 1997; Nepal, 2003) assign descriptive classes to trail segments and pose similar advantages and disadvantages as condition class ratings for recreation sites. A sample-based approach to trail assessments includes either a systematic point sampling system, where measurements are taken at a fixed interval along the trail (Cole, 1991; Marion & Carr, 2007), or a point-quadrant sampling system where the site measurements vary with distinct indicators such as vegetation type or level of use (Hall & Kuss, 1989). The advantage of these assessment systems is the collection of quantitative data, while the disadvantages are field time and relocating of sampling points. A census-based approach includes two different evaluation systems. The first is the sectional evaluation system, where the trail is divided into specific sections and assessed (Bratton, Hickler, & Graves, 1979). Advantages of this system include the quickness of assessing trail conditions and their spatial variations, while the limiting factor is actually defining the trail sections. Finally, the problem assessment system predefines impact indicators, which are recorded at every occurrence along the trail (Cole, 1983a; Marion, 1994; Nepal, 2003). The problem assessment evaluation system provides information on the extent, frequency, and distribution of trail impacts, but is limited on quantifying the impact definitions.

Trail impact assessments for informal trails have received less attention than formal trail systems in the past. This was due to the nature of informal trails—short, numerous, braided, and difficult to assess through point sampling or problem assessment systems (Marion, Wimpey, & Park, 2011). Initial assessment procedures to document informal trails have measured the number of informal trails present, rather than the condition of the trail. Marion (1994) and Leung, Shaw, Johnson, and Duhaime (2002) included informal trails as an indicator in their visitor impact studies, where the level of proliferation was assessed by recording the number of informal trails extending from formal trails or recreation sites. Alternatively, Cole et al (1997), Leung et al (2002), Marion et al (2011), and Wimpey and Marion (2011) inventoried and mapped sections or the entire informal trail network of a park along with the use of condition class ratings. These condition class ratings usually are five categories starting from an undistinguishable trail while levels increase to barren areas and severe erosion (Marion et al, 2011). Leung et al (2002), Marion et al (2011), along with Wolper, Mohamed, Burt, and Young (1994), have shown that the use of Global Positioning System (GPS) and Geographic Information Systems (GIS) databases provide an additional tool to display and analyze trail locations, trail maintenance structures, and other trail resource indicators (Marion, Leung, & Nepal, 2006). Currently there is a greater emphasis by land managers in conjunction with researchers to document informal trails, access their spatial and resource conditions, and develop appropriate assessment procedures (Marion et al, 2011).

STUDY AREA

Area Description

Joe's Valley is located in central Utah, technically within the graben that splits the Wasatch Plateau from its northwest to southeast margins (Stokes, 1988). However, the nomenclature of Joe's Valley is used generally within this report to describe the regions relevant for bouldering. These bouldering areas can be categorized into three geographical regions: Left Fork (Straight Canyon), Right Fork (Cottonwood Canyon), and New Joes (see Appendix A and http://bit.ly/1r4dWW1).

Land ownership within Joe's Valley is a mixture of various federal, state, and private parcels (see Appendix A and http://bit.ly/1r4dWW1). Specifically, Left Fork contains private parcels, BLM property, and USFS property. Right Fork contains private parcels, BLM property, SITLA lands, and USFS property. Finally, New Joes contains SITLA lands, BLM property, and USFS property.

Left Fork and Right Fork are characterized by perennial and intermittent creeks running through the canyon bottoms surrounded by yellowish, brownish, whitish, and grayish horizontally layered cliffs and steep slopes. New Joes is characterized by open sloped terrain with a backdrop of similar steep slopes and cliffs. Specific rock types include: sandstone, siltstone, shale, mudstone, claystone, conglomerate sandstone, and sparse limestone. Coal seams are also visibly present (Utah Geological Survey, 2014). Sandstone boulders are scattered throughout the landscapes, noticeably within the canyon bottoms, in washes, and perched on dry rocky slopes. Vegetation types vary with changes in elevation, topography, soils, aspect, and past and current land use. Vegetation zones include: riparian zone adjacent to Lower Seeley Creek in Left Fork and Cottonwood Creek in the Right Fork; woodland zone located on the lower slopes dominated by pinyon pine and juniper, sparsely intermixed with grasses, annuals, and sagebrush; and montane zone where ponderosa pines, Douglas firs, and aspens occur (Bailey, 1995). Lower Seeley Creek is an important watershed, supplying municipal water to the towns of Castle Dale and Orangeville (US Forest Service, 1986). Past and current mineral extraction is prominent in all three areas. While coal mining is currently inactive, active oil and gas operations are especially evident around New Joes and Right Fork.

Bouldering Sites

Joe's Valley has been regarded by climbers as a premier bouldering destination due to its concentration of high-quality sandstone boulders, classic problems, moderate to hard grades, scenic views, and rural setting. While climbers potentially visit and recreate at Joe's Valley for some of these reasons, climbing at Joe's Valley is not a current phenomenon. According to Baldwin, Beck, and Russo (2003), the earliest climbing that occurred in Joe's Valley was 1975–1978. During this time one of the first climbers in Joe's Valley were Joe Frank and Gene Ellis. Frank and Ellis worked for the US Geological Survey and climbed boulders situated around Joe's Valley Reservoir and in the Left Fork. In the early 1990s a rediscovery of Joe's Valley

occurred and local climbers from the Salt Lake City and Provo areas began visiting, exploring, and establishing many bouldering areas and problems in Left Fork and Right Fork. In the late 1990s New Joes was discovered and subsequent climbing activity began there (Baldwin et al., 2003). Since then, climbers have acquired information on the development and location of bouldering sites from three published guidebooks (Baldwin et al., 2003; Grijalva, Bigwood, & Pegg, 2003; Caldiero, 2011), websites (e.g., Mountain Project, 2014), social media, videos, and local climbers. Although plenty of information on Joe's Valley bouldering areas has been published, some newly developed areas are not officially documented, and the potential for future development is still present.

This survey identified 188 bouldering sites within Joe's Valley. While many of the bouldering areas are easily accessible from the main roads, other areas require a steep long approach. Bouldering sites in Joe's Valley exhibit similar spatial attributes recognized at other bouldering areas such as primitive approach trails, staging areas, and descent routes. Due to the steepness of the areas, especially in Left Fork and Right Fork, site modifications are a common occurrence. These modifications are the design and building of primitive retaining structures, constructed out of local dead trees, branches, or rocks (see Figure 1). These retaining structures provide a flat area for climbers to establish new lines, provide safe landing zones for placement of crash pads, used as a staging area, and additionally, mitigate potential soil erosion.

Figure 1. An example of a primitive retaining structure constructed out of a log and rocks at a bouldering site.

Informal Trails

Joe's Valley has an extensive network of informal trails to access the bouldering areas. This report assessed a total of 9.7 miles of informal trails that access bouldering sites within the three areas of Joe's Valley. Generally, all the informal trails are user-created, but in New Joes and Right Fork old abandoned roadbeds are incorporated to access boulders. Due to the sparse vegetation traveling off-trail is easy and in turn the establishment of new trails can occur. On steep slopes, unstable soil and the tendency to travel straight up the fall line can cause a new trail to develop quickly even with little foot traffic. Professional and sanctioned trail design or maintenance is non-existent in these areas which have led to unsustainable trails, soil erosion, and multiple trails.

Dispersed Campsites

Dispersed campsites are located in all three geographical regions of Joe's Valley. This report identified and assessed a total of 94 dispersed campsites within Left Fork, Right Fork, and New Joes that are currently being used by climbers or has the potential to be used due to their proximity to the climbing resources. Right Fork contains the popular dispersed camp areas commonly known as Mansize, Buoux, and UMWA due to their proximity to the named boulders. Further up Right Fork numerous dispersed campsites can be located adjacent to the road or in Dairy Canyon. Left Fork has the Angler Access campsites, along with a few sites on the north side of the road known as Cougar Camp 1, Cougar Camp 2, and Rock Camp. Finally, New Joes has a multitude of dispersed campsites, the most popular being New Joes Camp, Transformer Camp, and 9 Mile Camp.

METHODS

This section will describe the different impact assessment procedures that were designed and applied to document recreation impacts at all bouldering recreation sites, associated informal trails, and all known dispersed campsites in Left Fork, Right Fork, and New Joes that were in the general area of the bouldering resources. In addition, parking areas were assessed for inventory indicators. Given the time-frame, resources available, and scale of Joe's Valley Bouldering Area, the design parameters emphasis efficiency and a rapid-assessment approach. Field staff consisting of Jonathan Knight, Jeff Porucznik, and Justin Wood gathered data over the period of April 24–29, 2014, while Jonathan Knight and Jeff Porucznik gathered additional data on June 9, 2014.

Bouldering Recreation Site Assessment Procedures

The bouldering recreation site assessment procedure needed to provide land managers reliable information for a baseline on bouldering resource conditions, which will assist in the development of resource protection objectives. Therefore it was necessary to provide an assessment procedure that will collect measurable data for impact indicators that are important to management and users' concerns. Development of the assessment procedure was based on previous recreation impact studies along with discussions with land managers concerning their objectives and long-term goals. While a multi-indicator system based on precise measurements would be beneficial for a long-term monitoring program, the goal of this assessment was to quickly and efficiently document the number, density, and spatial data of bouldering sites, while providing a general overall picture of the site's condition.

The standardized procedures that were developed for assessing recreation impacts around boulders in Joe's Valley were based on Marion and Carr's (2007) monitoring procedures for cliff site visitor impacts and modified from Porucznik's (2009) monitoring procedures for bouldering recreation site impacts. Two general approaches were used for assessing boulder site conditions: a condition class assessment and a rapid multi-indicator assessment of fire sites and litter. In addition, photographs were taken for sites assessed as highly impacted to provide land managers visual documentation for short-term resource protection planning and mitigation purposes. A field manual detailing the bouldering site assessment procedures, along with a monitoring form and photographs from the Marion (1991) manual is in Appendix B. The assessment procedure was accomplished by following these standardized steps.

Data collection began by choosing a documented bouldering region that had been previously recorded in guidebooks and on-line sources, along with personal knowledge from the field staff. Field staff carried a tape measure, clinometer, resource-grade GPS unit, blank monitoring forms, digital camera, and copies of previously developed bouldering area maps. Once at a chosen bouldering area, GPS coordinates were recorded, and general site information was documented within the GPS data dictionary and on the Bouldering Site Impact Monitoring Form. This included: date, surveyors, region, boulder code, and boulder name if known. Information for land ownership was determined post-processing using GIS. The next step was to record the inventory

indicators, which included: site slope and use level. Following this, impact indicators were recorded. This process began by visually defining the site boundaries which are pronounced changes in vegetation cover, height distribution, composition, topography, and organic litter (Marion and Carr, 2007). The overall condition class for the site was then recorded using six descriptive classes (see Table 1). Finally, field staff counted the number of fire sites if present and recorded the extent of litter by assigning it to a category indicating none, small, medium, or large.

Table 1. Bouldering recreation site condition class descriptions.

Class 0: Site barely distinguishable; no or minimal disturbance of vegetation and/or organic litter. Often an old site that has not seen recent use.
Class 1: Site barely distinguishable; slight loss of vegetation cover and/or minimal disturbance of organic litter.
Class 2: Site obvious; vegetation cover lost and/or organic litter pulverized in primary use areas.
Class 3: Vegetation cover lost and/or organic litter pulverized on much of the site, some bare compacted soil exposed in primary use areas (i.e., under boulder problems).
Class 4: Nearly complete or total loss of vegetation cover and organic litter, bare compacted soil widespread. Very minor erosion localized under bouldering problems may be present.
Class 5: Soil erosion obvious, as indicated by exposed tree roots and rocks and/or gullying.

Once all impact indicators were recorded and if the site's overall condition class was 5, the field staff photographed the site and recorded specific information on the Bouldering Site Impact Monitoring Form. Documentation included: photo identification number, photo direction, and any pertinent notes.

Informal Trail Assessment Procedures

The informal trail assessment needed to provide land managers documentation of the number, lineal extent, spatial distribution, and resource condition of all informal trails accessing bouldering areas in Joe's Valley. Development of the assessment procedure was designed from current survey methods for inventorying informal trails, which were based on Wimpey and Marion's (2011) monitoring procedures for informal trails. This procedure was based on a rapid assessment survey model utilizing a resource-grade GPS unit to gather trail spatial data, applying condition class ratings to assess current resource conditions, and documenting average width of trail segments. This system was efficient, simple to learn, and importantly, data was recorded quickly in the field. The assessment procedure was accomplished by following these standardized steps.

Data collection began by choosing a documented bouldering region. Field staff needed to carry a tape measure, mapping-grade GPS unit, digital camera, and copies of previously developed bouldering area maps. The assessment started at the beginning of an informal trail segment that entered a bouldering region (e.g., off of a road or designated trail). Field staff began an informal trail segment using the informal trail data dictionary and designated a condition class descriptor for the appropriate condition. Condition classes were based on a range of 0–5 with an increase of value as natural conditions of soil, vegetation, and organic matter diminished (see Table 2). Field

staff continued walking the segment, gathering data until a change of condition class occurred or a junction was reached. At the completion of a section, the trail segment's average width was recorded, the segment was closed, and new segment was started (Wimpey & Marion, 2011). In addition, representative photos of typical views of trails, sections that require urgent repair, maintenance features, safety concerns, or any other pertinent issues were documented. For detailed field procedures see Appendix C.

Table 2. Informal trail condition class descriptions.

Class 0: Trail slightly distinguishable; faint access route; trail follows drainage/wash; or trail is underlain by bedrock.
Class 1: Trail distinguishable; slight loss of vegetation cover and /or minimal disturbance of organic litter.
Class 2: Trail obvious; vegetation cover lost and/or organic litter pulverized in primary use areas.
Class 3: Vegetation cover lost and/or organic litter pulverized within the center of the tread, some bare compacted soil exposed.
Class 4: Nearly complete or total loss of vegetation cover and organic litter within the tread, bare compacted soil widespread.
Class 5: Soil erosion obvious, as indicated by exposed roots and rocks and/or gullying.

Dispersed Campsite Assessment Procedures

The dispersed campsite assessment was developed to provide land managers a baseline for the number, density, and current resource conditions for dispersed campsites within Joe's Valley that are currently utilized or could potentially be used by climbers. The procedures were based on Marion and Hockett's (2008) backcountry campsite monitoring protocols with a modification for inventory indicators that reflect dispersed campsites and using GIS to calculate the site area. Two general approaches were used to assess a dispersed campsite condition: a condition class assessment and a rapid multi-indicator assessment for predefined impact indicators. In addition, photographs were taken to provide land managers general visual documentation, but without the installation of permanent reference points. A field manual detailing the dispersed campsite assessment procedures, necessary equipment, along with monitoring forms, and photographs documenting campsite boundaries, vegetation ground cover classes, soil exposure, tree damage, and root exposure is in Appendix C. The assessment procedure was accomplished by following these standardized steps.

Data collection began by establishing a starting point and observing from the main and secondary roads established and potential dispersed campsites. Dispersed campsites were defined as areas of easily observed disturbed vegetation, organic litter, or soils caused by overnight camping activities that are accessible by vehicles. In addition, campsites were identified by the presence of fire sites. Once a site was located field staff recorded general campsite information including: date, surveyors, campsite tag number, location information, and a waypoint with the use of a resource-grade GPS unit. Inventory indicators were then recorded which included: distance to nearest campsites, if other campsites are visible, if the site is visible from the main

road, site expansion potential, maximum number of vehicles, distance to water, type of water, site slope, and tree canopy cover. Campsite boundaries were identified by following previously identified indicators such as changes in vegetation cover, vegetation disturbances, trampling and absence of organic litter, and topography (Marion & Hockett, 2008). The campsite boundary was then recorded using GPS, which provided a measurement for the site area. Islands of undisturbed vegetation, satellite areas, and barren core areas were also measured with the use of GPS. Impact indicators were then recorded beginning with designating the campsite a condition class represented by six descriptor classes (see Table 3). A rapid assessment was accomplished by estimating vegetative ground cover on-site, off-site, and exposed soil by estimating the percentage within six categories. Tree damage and root exposure were tallied and given a damage rating class of non/slight, moderate, or severe. A quick count of the number of tree stumps, fire sites, access trails, and human waste was then recorded. Finally, litter was documented with four rating classes: none, small, medium, or large.

Table 3. Dispersed campsite condition class descriptors.

Class 0: Campsite barely distinguishable; no or minimal disturbance of vegetation and/or organic litter. Often an old site that has not seen recent use.
Class 1: Campsite barely distinguishable; slight loss of vegetation cover and/or minimal disturbance of organic litter.
Class 2: Campsite obvious; vegetation cover lost and/or organic litter pulverized in primary use areas.
Class 3: Vegetation cover lost and/or organic litter pulverized on much of the site, some bare soil exposed in primary use areas.
Class 4: Nearly complete or total loss of vegetation cover and organic litter, bare soil widespread.
Class 5: Soil erosion obvious, as indicated by exposed tree roots and rocks and/or gullying.

Once the assessment for all impacts had been accomplished, the campsite was photographed from the best vantage point. A photo ID was recorded along with a photo direction and any relevant comments.

Parking Assessment Procedures

Parking accessing bouldering areas were documented in the GPS data dictionary for indicators of number and destiny of sites along with the potential number of paralleled parked vehicles that could be accommodated. Field staff assessed these sites at every noticeable pull-out before or after conducting the assessment procedures for informal trails and bouldering recreation sites.
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GPS and GIS Methods

In preparation for the impact assessment, a data dictionary was developed to facilitate data collection for boulder sites, dispersed camping sites, and informal trails. Based on feature types, assessment procedures, indicators, and desired information, GPS data collection was designed to

compliment paper field forms and accelerate the process. Using Trimble Pathfinder Office software, the Impact Assessment data dictionary was built and transferred to a Trimble 6000 Series, GeoXH, resource-grade GPS running Trimble Terrasync software. Timing, narrow canyons, tree canopy, and the proximity of boulders can constrain optimal satellite geometry, so a Trimble Tornado antenna was employed with the GPS unit to maximize the precision and accuracy of recorded positions.

GPS settings were optimized to record positions of sub-meter accuracy, generally relying on real-time differential correction. Point features were based on a 20 position average, and the Position Dilution of Precision (PDOP) threshold was set at 6. Lines and polygons were based on a distance traveled of 1 meter. Refer to the corresponding impact assessment manual for more detailed GPS data collection procedures by feature type.

GPS data were transferred, post-processed, and exported in the NAD 83 UTM Zone 12 projection to an ArcGIS format using Trimble Pathfinder Office. Only positions not differentially corrected in real time were corrected in post-processing. Further post processing of informal trails and campsite delineations was performed in GIS to snap trail segment anchor points and clean up outlying polygon vertices. GIS attribute tables were reconciled and populated with data recorded on field forms based on unique feature ID's. Area and distance calculations as well as ownership of features were populated in GIS before the generation of reporting tables. Final versions of the spatial data were stored in a geodatabase for future reference or reporting, and shapefiles were generated for upload to the ArcGIS Online, Joe's Valley Impact Assessment 2014 web map (http://bit.ly/1r4dWW1).

RESULTS

Bouldering Recreation Sites

Data analysis for bouldering recreation sites was accomplished for 188 sites within Joe's Valley. While this represents 95% of the known bouldering sites, some sites were omitted from the assessment due to access issues and data collection error. Specifically, five sites were not inventoried, five sites have been mapped but data was not collected, and three sites have data collection but waypoints were missing (see Table 4). Only sites that have complete inventory and impact indicators were analyzed for this assessment report.

Table 4. Bouldering site omissions and waypoint and data collection errors by locations.

Location	No Waypoints/No Data	Waypoints/No Data	Data/No Waypoints
Left Fork	Moment of Truth Vendetta Little Mermaid	Wrinkle in Time	Kraken
Right Fork	Joint Ravine Dairy Queen	Wash Block Unknown Imperial Stout Fast Twitch	No Name Blue Jeans

Land Ownership

Administrative designation of bouldering sites was a mixture of USFS, BLM, SITLA, and private lands depending on the geographic region. Overall, 60.6% of the bouldering sites were located within USFS administered lands, 24.5% of the sites were located on BLM lands, and the remaining 14.9% of the sites were located on SITLA and private lands. Specifically, the USFS and the BLM had a majority of the bouldering sites within all three areas, SITLA had a total of 10 sites within Right Fork, and the 18 sites inventoried within private lands were located in Left Fork and Right Fork (see Table 5, Appendix A, and http://bit.ly/1r4dWW1).

Table 5. Number and percent of bouldering sites by ownership.

Ownership	Left Fork (n=74)		Right Fork (n=76)		New Joes (n=38)		Total (n=188)	
	#	%	#	%	#	%	#	%
USFS	56	75.7	36	47.4	22	57.9	114	60.6
BLM	9	12.2	21	27.6	16	42.1	46	24.5
SITLA	0	0.0	10	13.2	0	0.0	10	5.3
Private	9	12.2	9	11.8	0	0.0	18	9.6

Inventory Indicators

Site Slope

The site slope at a bouldering site characterizes the steepness of the recreation site and can also be indicative of where the boulder is located relative to the topography. The majority of bouldering sites within Left Fork and Right Fork were >10%. This is predictable since many of the boulders within these areas were located on steep slopes. The remaining bouldering sites were distributed in areas that were 5–10% and <5%. The majority of bouldering sites at New Joes were 5–10%. While there are more bouldering sites within this slope range, New Joes still has a significant number of bouldering sites with >10% grade (see Table 6).

Use Level

Use level characterizes the amount of climbing that has occurred and is based on the level of chalk present, polished holds, and if applicable, local knowledge of the popularity of the bouldering site. In Left Fork over 50% of the bouldering sites had a low level of use. A little over 25% had heavy use and the remainder had moderate use. Right Fork had a majority of sites (38.2%) with a low level of use, while the remaining sites were almost equal in moderate and heavy level use. New Joes had an equal amount of low and heavy use (44.7%), with the remainder at a moderate level of use (see Table 6).

Table 6. Number and percent of bouldering site inventory indicators by regions.

Inventory Indicators	Left Fork (n=74)		Right Fork (n=76)		New Joes (n=38)		Total (n=188)	
	#	%	#	%	#	%	#	%
Site Slope								
<5%	13	17.6	16	21.1	7	18.4	36	19.1
5-10%	12	16.2	11	14.5	18	47.4	41	21.8
>10%	49	66.2	49	64.5	13	34.2	111	59.0
Use Level								
Low	38	51.4	29	38.2	17	44.7	84	44.7
Moderate	17	23.0	24	31.6	4	10.5	45	23.9
Heavy	19	25.7	23	30.3	17	44.7	59	31.4

Impact Indicators

Condition Class

Bouldering sites were assessed a condition class (CC) depending on the degree of resource changes. In all three areas, the majority of the bouldering sites were assessed as CC4 (bare compacted soil widespread). While 19% of the bouldering sites were identified as CC-1 to CC1 and 16% rated as CC2 to CC3, the most concerning is that 64% of the bouldering sites were assessed as CC4 to CC5; sites that show widespread compacted soil, total loss of vegetation cover, and/or soil erosion (see Table 7, Appendix A, and http://bit.ly/1r4dWW1). Extent of these

impacts ranged from small and localized under boulder problems to large and expanding into the surrounding area around the boulder (see Figure 2).

Figure 2. The left image shows localized site impacts beneath the boulder problem while the right image shows an increase in the area size where impacts are occurring.

Litter

Litter was characterized by the type and extent that was located at the bouldering site and could visually be seen in adjacent areas. Within all three areas the majority of bouldering sites had no litter present. Out of 74 sites in Left Fork, 29 sites had small litter (micro-trash) and the only site with large litter (excessive and wide spread). Right Fork's 76 sites had 18 sites with small litter and 2 sites with medium litter (obvious, not wide spread). New Joes was similar, out of 38 sites 13 sites had small litter and 1 site medium litter (see Table 7).

Table 7. Number and percent of bouldering site impact indicators by regions.

Impact Indicators	Left Fork (n=74)		Right Fork (n=76)		New Joes (n=38)		Total (n=188)	
	#	%	#	%	#	%	#	%
Condition Class								
-1	2	2.7	0	0.0	0	0.0	2	1.1
0	2	2.7	6	7.9	5	13.2	13	6.9
1	7	9.5	5	6.6	9	23.7	21	11.2
2	9	12.2	1	1.3	1	2.6	11	5.9
3	12	16.2	6	7.9	2	5.3	20	10.6
4	28	37.8	31	40.8	13	34.2	72	38.3
5	14	18.9	27	35.5	8	21.1	49	26.1
Litter								
None	44	59.5	56	73.7	24	63.2	124	66.0
Small	29	39.2	18	23.7	13	34.2	60	31.9
Medium	0	0.0	2	2.6	1	2.6	3	1.6
Large	1	1.4	0	0.0	0	0.0	1	0.5

Fire Sites

The number of fire sites within the bouldering site was recorded. This included fire pits, charred rocks, blackened soil, and ash. Forty-nine fire sites were identified with 20 in Left Fork, 16 in Right Fork, and 13 in New Joes (see Table 8). The number of fire sites most commonly varied from 1 to 2 within a bouldering site, but Left Fork had a bouldering site with 4 fire sites and New Joes had a bouldering site with 6 fire sites.

Table 8. Number of fire sites at bouldering sites by regions.

Impact Indicators	Left Fork (n=74)	Right Fork (n=76)	New Joes (n=38)	Total (n=188)
Fire Sites (#)				
Mean	0.3	0.2	0.3	0.3
Median	0.0	0.0	0.0	0.0
Sum	20	16	13	49
Range	0 - 4	0 - 2	0 - 6	0 - 6

Informal Trails

Land Ownership

A total of 9.7 miles of informal trails that access bouldering sites were identified with the majority of trails (51.2%) on USFS lands. Left Fork had a total of 3.2 miles of informal trails assessed with the majority located on USFS lands followed by private and BLM lands. Right Fork had 3.9 miles of informal trails identified which were located within all administrative lands. Finally, New Joes' 2.6 miles of informal trails were a mixture of USFS and BLM land (see Table 9, Appendix A, and http://bit.ly/1r4dWW1).

Table 9. Linear extant and percentage of informal trails by ownership.

Ownership	Left Fork		Right Fork		New Joes		Total	
	Linear Extent (miles)	%	Linear Extent (miles)	%	Linear Extent (miles)	%	Linear Extent (miles)	%
USFS	2.0	61.8	1.6	41.9	1.4	52.3	5.0	51.2
BLM	0.6	18.5	1.4	36.0	1.3	47.7	3.2	33.4
SITLA	0.0	0.0	0.2	5.6	0.0	0.0	0.2	2.2
Private	0.6	19.7	0.6	16.5	0.0	0.0	1.3	13.1
Overall	3.2	100.0	3.9	100.0	2.6	100.0	9.7	100.0

Informal Trail Condition Indicators

Informal trails were assigned a condition class ranging from 0 to 5, depending on the overall resource condition of the trail segment, and an average width (see Table 10, Appendix A, and http://bit.ly/1r4dWW1). The majority of informal trails (3.1 miles) were identified as CC3 trails (some bare compacted soil, organic litter pulverized), followed by 2.9 miles of CC5 trails (soil erosion obvious). Totals for informal trails' condition classes based on ownership were variable (see Table 11). While USFS and private lands had the highest percentage of CC5 trails, BLM's majority was CC3 trails and SITLA's majority was CC0 trails. For all regions and condition classes the mean trail width was 11.2 inches and ranged from 0 to 16 inches.

Table 10. Summary of informal trail condition class by location**.**

Location	Condition Class	Segment Count (#)	Mean Length (ft)	Linear Extent (ft)	Mean Trail Width (in)	% By Length*
Left Fork	CC0	44	68.2	2,999.2	0.0	17.8
	CC1	7	77.2	540.7	11.0	3.2
	CC2	4	74.2	296.7	13.0	1.8
	CC3	42	85.5	3,589.0	13.0	21.3
	CC4	40	43.9	1,757.2	14.0	10.4
	CC5	98	78.1	7,651.5	15.0	45.5
	Total	235	71.2	16,834.3	11.0	32.9**
Right Fork	CC0	14	169.4	2,371.7	3.0	11.5
	CC1	9	171.6	1,544.1	11.0	7.5
	CC2	10	112.6	1,125.6	13.0	5.5
	CC3	41	106.3	4,360.3	14.0	21.2
	CC4	45	99.7	4,487.4	16.0	21.8
	CC5	94	70.8	6,652.8	16.0	32.4
	Total	213	121.7	20,541.9	12.2	40.1**
New Joes	CC0	8	260.2	2,081.6	0.0	15.0
	CC1	0	0.0	0.0	0.0	0.0
	CC2	5	247.5	1,237.5	16.0	8.9
	CC3	44	197.9	8,708.7	16.0	62.8
	CC4	11	58.1	639.4	15.0	4.6
	CC5	17	70.0	1,189.3	16.0	8.6
	Total	85	139.0	13,856.5	10.5	27.0**
Overall	CC0	66	165.9	7,452.5	1.0	14.5
	CC1	16	82.9	2,084.8	7.3	4.1
	CC2	19	144.8	2,659.8	14.0	5.2
	CC3	127	129.9	16,658.0	14.3	32.5
	CC4	96	67.2	6,884.0	15.0	13.4
	CC5	209	73.0	15,493.6	15.7	30.2
	Total	533	110.6	51,232.7	11.2	100.0**

* % Informal Trail for Location ** % of Informal Trail Overall Total

Note. Adapted from "Formal and Informal Trail Monitoring Protocols and Baseline Conditions: Great Falls Park and Potomac Gorge" by. J. Wimpey & J. L. Marion, 2011, p. 50.

Table 11. Summary of informal trail condition class by ownership.

Ownership	Condition Class	Segment Count	Lineal Extent (ft.)	% by Length*
USFS	CC0	31	3,173.9	12.1
	CC1	10	1,189.9	4.5
	CC2	9	1,227.7	4.7
	CC3	58	8,603.2	32.8
	CC4	42	2,322.9	8.8
	CC5	128	9,738.5	37.1
	Total	278	26,256.1	51.2 **
BLM	CC0	22	3,260.7	19.0
	CC1	1	436.9	2.6
	CC2	4	1,054.7	6.2
	CC3	50	5,872.1	34.3
	CC4	39	3,114.6	18.2
	CC5	50	3,381.0	19.7
	Total	166	17,120.0	33.4**
SITLA	CC0	2	325.5	28.4
	CC1	3	264.8	23.1
	CC2	2	80.6	7.0
	CC3	3	159.7	13.9
	CC4	1	53.7	4.7
	CC5	4	262.5	22.9
	Total	15	1,146.8	2.2**
Private	CC0	11	692.4	10.3
	CC1	2	193.2	2.9
	CC2	4	296.7	4.4
	CC3	16	2,022.9	30.1
	CC4	14	1,393.0	20.8
	CC5	27	2,111.5	31.5
	Total	74	6,709.7	13.1**
Overall	CC0	66	7,452.5	14.5
	CC1	16	2,084.8	4.1
	CC2	19	2,659.7	5.2
	CC3	127	16,657.9	32.5
	CC4	96	6,884.2	13.4
	CC5	209	15,493.5	30.2
	Total	533	51,232.6	100.0**

* % Informal Trail for Ownership ** % of Informal Trail Overall Total

Note. Adapted from "Formal and Informal Trail Monitoring Protocols and Baseline Conditions: Great Falls Park and Potomac Gorge" by. J. Wimpey & J. L. Marion, 2011, p. 50.

Specifically, in Left Fork all condition classes were present, with the majority of informal trails (1.4 miles) rated as CC5. Typically, these segments of trails were located on fall line alignments and many identified trails in this condition class began from the main road. These trails are the most problematic segments due to there unsustainable grades which can cause ruts and gullies, trail widening, and braided trails (see Figure 3). The remaining 1.7 miles of informal trails in Left Fork ranged from CC0 (trail not distinguishable, faint access route, drainage or wash route) to CC4 (bare compacted soil widespread, almost total loss of vegetation). Right Fork also had a majority of informal trails (1.3 miles) assigned as CC5 which were similarly located on fall line alignments. The remaining 2.5 miles ranged from CC0 to CC4. New Joes' informal trails were in better condition with the majority of trails (1.6 miles) assigned as CC3. Many trail segments within this condition class were located on old roadbeds which were relatively parallel to the contour of the slope. The additional .9 miles of trail segments in New Joes were identified within the other condition classes, with the exception of CC1 trails.

Figure 3. An example of a typical informal trail that is aligned on the fall line. Notice how water is able to channel down the tread causing increased soil erosion.

Dispersed Campsites

Land Ownership

A total of 94 dispersed campsites were inventoried within Joe's Valley. Out of these 94 sites, 42 were located in New Joes, 40 were located in Right Fork, and 12 were located in Left Fork. Overall, the BLM administers 56.4% of all the assessed dispersed campsites with a majority of them located in New Joes. The USFS had a total of 17 sites identified in Left Fork and Right Fork with the majority of them in Upper Right Fork and the Angler Access camp area in Left Fork. Twenty campsites were identified within SITLA lands, 9 in Right Fork and 11 in New Joes. These sites included the popular UMWA, Buoux, and 9 Mile dispersed camp areas. Dispersed campsites were also identified within private property; specifically the Cougar Camps and a campsite in Right Fork (see Table 12, Appendix A, and http://bit.ly/1r4dWW1).

Table 12. Number and percent of dispersed campsites by ownership.

Ownership	Left Fork (n=12)		Right Fork (n=40)		New Joes (n=42)		Total (n=94)	
	#	%	#	%	#	%	#	%
USFS	4	75.7	13	32.5	0	0.0	17	18.1
BLM	5	41.7	17	42.5	31	73.8	53	56.4
SITLA	0	0.0	9	22.5	11	26.2	20	21.3
Private	3	25.0	1	2.5	0	0.0	4	4.3

Inventory Indicators

Distance and Visibility to Campsites

Distances to nearest campsites varied from regions with a majority (33%) of the 94 inventoried dispersed campsites at <10 yards. This majority reflects both Left Fork (50%) and Right Fork (35%), but in New Joes the majority (33.3%) of the campsites were >60 yards. The remaining campsites' distance to other campsites in New Joes ranged from <10 to 60 yards, while in Left Fork and Right Fork the remaining campsites' distances were 11 to >60 yards (see Table 13).

Visible Campsites

Inventoried campsites' visibility to other campsites was extremely variable from each region (see Table 13). In Left Fork 2 campsites were identified that did not have another campsite visible. The remaining 10 campsites had a range of 1–3 visible campsites. Right Fork had 9 campsites that were located without other visible campsites with the remaining 32 campsites having a range of 1 to 4 campsites. Finally, New Joes had 16 campsites that were identified with zero visibility to other campsites. The additional 26 campsites had a range from 1 to 6 dispersed campsites visible.

Visibility from Road

The majority of inventoried campsites (68.1%) were visible from the main road that accesses each specific geographical area (see Table 13). Specifically, Left Fork had 10 campsites that could be seen from the road and only 2 campsites that were not visible. Right Fork had 31 campsites that were visible and another 9 campsites that could not be observed. Finally, New Joes had 23 campsites that were visible from the road with the remaining 19 inventoried campsites not visible.

Expansion Potential

Expansion potential for dispersed campsites varied depending on the topography, vegetation types, and proximity to other campsites. Campsites in Left Fork had the least potential for site expansion with 9 campsites rated with low potential (see Table 13). Three other campsites were identified with medium potential of expansion, yet there were no campsites with high potential expansion possibilities. Right Fork had 15 sites with low potential and 15 sites ranging from moderate to high expansion potential. New Joes had 26 sites that were identified with a moderate or high potential of expansion. The remaining 16 sites were assessed with low potential of expansion.

Maximum Vehicles

Estimation on the number of vehicles that each dispersed campsite could potentially accommodate was calculated. The majority of campsites (70%) within all three areas could contain a range of 2 to 4 vehicles (see Table 13). Right Fork and New Joes had campsites that could only accommodate 1 vehicle, while a total of 9 campsites could hold 5 to 6 vehicles in all three regions. Finally, New Joes had a campsite that could hold 8 vehicles and Right Fork had a site that could also accommodate this many vehicles, plus a dispersed campsite that had the capacity for 20 vehicles.

Table 13. Number and percentage of dispersed campsite inventory indicators by regions.

Inventory Indicators	Left Fork (n=12)		Right Fork (n=40)		New Joes (n=42)		Total (n=94)	
	#	%	#	%	#	%	#	%
Distance to Campsite								
<10 yds	6	50.0	14	35.0	11	26.2	31	33.0
11-20 yds	4	33.3	4	10.0	9	21.4	17	18.1
21-40 yds	1	8.3	9	22.5	5	11.9	15	16.0
41-60 yds	0	0.0	3	7.5	3	7.1	6	6.4
>60 yds	1	8.3	10	25.0	14	33.3	25	26.6
Visible Campsites (#)								
0	2	16.7	9	22.0	16	38.1	27	28.4
1	2	16.7	10	24.4	7	16.7	19	20.0
2	0	0.0	16	39.0	10	23.8	26	27.4
3	8	66.7	1	2.4	3	7.1	12	12.6
4	0	0.0	5	12.2	4	9.5	9	9.5
5	0	0.0	0	0.0	0	0.0	0	0.0
6	0	0.0	0	0.0	2	4.8	2	2.1
Visibility from Road								
Yes	10	83.3	31	77.5	23	54.8	64	68.1
No	2	16.7	9	22.5	19	45.2	30	31.9
Expansion Potential								
Low	9	75.0	25	62.5	16	38.1	50	53.2
Moderate	3	25.0	6	15.0	21	50.0	30	31.9
High	0	0.0	9	22.5	5	11.9	14	14.9
Maximum Vehicles								
1	0	0.0	4	10.0	8	19.0	12	12.8
2	4	33.3	13	32.5	14	33.3	31	33.0
3	1	8.3	10	25.0	8	19.0	19	20.2
4	5	41.7	8	20.0	7	16.7	20	21.3
5	1	8.3	2	5.0	2	4.8	5	5.3
6	1	8.3	1	2.5	2	4.8	4	4.3
7	0	0.0	0	0.0	0	0.0	0	0.0
8	0	0.0	1	2.5	1	2.4	2	2.1
9 - 20	0	0.0	1	2.5	0	0.0	1	1.1
Distance to Water								
<10 yds	0	0.0	19	47.5	1	2.4	20	21.3
11-20 yds	4	33.3	12	30.0	2	4.8	18	19.1
21-40 yds	0	0.0	5	12.5	1	2.4	6	6.4
41-60 yds	0	0.0	1	2.5	0	0.0	1	1.1
>60 yds	8	66.7	3	7.5	38	90.5	49	52.1
Type of Water								
Perennial	12	100.0	5	12.5	0	0.0	17	18.1
Intermittent	0	0.0	33	82.5	42	100.0	75	79.8
Spring	0	0.0	2	5.0	0	0.0	2	2.1
Lake	0	0.0	0	0.0	0	0.0	0	0.0

Inventory Indicators	Left Fork (n=12)		Right Fork (n=40)		New Joes (n=42)		Total (n=94)	
	#	%	#	%	#	%	#	%
Site Slope								
<5%	11	91.7	31	77.5	22	52.4	64	68.1
5-10%	1	8.3	9	22.5	15	35.7	25	26.6
>10%	0	0.0	0	0.0	5	11.9	5	5.3
Tree Canopy Cover								
0-5%	12	100.0	37	92.5	39	92.9	88	93.6
6-25%	0	0.0	1	2.5	3	7.1	4	4.3
26-50%	0	0.0	1	2.5	0	0.0	1	1.1
51-75%	0	0.0	0	0.0	0	0.0	0	0.0
76-95%	0	0.0	0	0.0	0	0.0	0	0.0
96-100%	0	0.0	1	2.5	0	0.0	1	1.1

Note. Adapted from "Trail and Campsite Monitoring Protocols: Zion National Park" by J. L. Marion & K. Hockett, 2008, p. 29.

Distance to Water

The distance to the nearest water source at dispersed campsites was variable in each area. Campsites that were located >60 yards from water included 38 campsites in New Joes, 8 campsites in Left Fork, and only 3 in Right Fork (see Table 13). Right Fork was identified with 19 campsites that had a distance of <10 yards to a water source and New Joes was assessed with 1 site at this distance. The remaining campsites in all regions were located within a range of 11 to 60 yards.

Type of Water

Types of water source identified in New Joes were perennial streams, intermittent streams, and springs. In Left Fork the closest water source at all 12 campsites was perennial and in New Joes the closest water source for all 42 campsite were intermittent. Right Fork was identified with 33 campsites near intermittent water sources, 5 near perennial sources, and 2 spring sources (see Table 13).

Site Slope

The majority of dispersed campsites (68.1%) inventoried in all the regions had a slope <5% (see Table 13). The remaining campsites were located on a slope of 5 to 10%, except 5 sites within New Joes that were situated on a slope >10%.

Tree Canopy Cover

A quick estimate of tree canopy cover was accomplished with a majority of dispersed campsites (93.6%) having a 0 to 5% canopy cover rating (see Table 13). This included all of the campsites in Left Fork, 37 campsites in Right Fork, and 39 campsites in New Joes. Four of the remaining campsites' canopy coverage ranged from 6 to 50% with an additional campsite in Right Fork with a 96 to 100% canopy coverage rating.

Impact Indicators

Campsite Size

Dispersed campsite sizes were highly variable, ranging from 255 to 16,501 ft² with a mean of 2,995 ft² (see Table 14). Right Fork had the highest mean of 3,448 ft², followed by New Joes at 2,882 ft² and Left Fork at 1,880 ft². The combined sum of disturbed areas due to recreational use in all regions was 281,530.5 ft², an equivalent to 6.5 acres.

Vegetation Loss

Total estimated vegetation loss ranged from 0 to 83% with a mean of 14.6% (see Table 14). The majority (71%) of campsites' on-site vegetation cover was extremely bare at 0 to 5%, yet the average off-site vegetation cover for these sites was only 20%. Specifically, Right Fork had 33 sites that lost less than 35.5% and 7 sites that lost more than 57.5%; Left Fork had 8 sites that lost less than 3% and 4 sites that lost more than 47.5%; and New Joes had 38 sites that lost 0% and 4 sites that lost more than 32%. Overall the mean vegetation loss for Left Fork was 25.5%, Right Fork was 23.5%, and New Joes was 3%.

Exposed Soil

Total estimate of exposed soil at dispersed campsites ranged from 2.5 to 98% with a mean of 61.8% (see Table 14). Within all three regions, 60 campsites had soil exposure ranging from 63 to 98% and 34 campsites ranged from 2.5 to 38%. Overall means included Left Fork at 88%, Right Fork at 61.2%, and New Joes at 54.8%.

Damaged Trees, Root Exposure, and Stumps

The assessment identified 65 campsites that had no moderately to severely damaged trees and 29 campsites that had a total of 73 damaged trees. Left Fork had 2 sites each with 1 damaged tree, Right Fork had 49 damaged trees within 16 campsites (the highest concentration was 10 damaged trees), and New Joes had 11 campsites with a total of 22 damaged trees.

The sum of trees with exposed roots was much lower with a total of 13 trees identified as moderate to severe. Campsites had a range of 0 to 3 trees with exposed roots (see Table 14). Specifically, Left Fork had 1 tree with exposed roots, Right Fork had 9, and New Joes had 3.

Total number of stumps was 69 with a range of 0 to 9 stumps at each campsite (see Table 14). Right Fork had the most campsites with stumps (14) and also had a campsite with the highest concentration of stumps (9). Left Fork had 4 campsites each with 1 stump and New Joes had 12 campsites with a total of 29 stumps (range of 1 to 6).

Fire Sites

Total fire sites at dispersed campsites had a range of 0 to 5 with a mean of 1.3 (see Table 14). Size and impact of fire sites varied. Many fire sites were simple rock rings with little ash, while other fire sites had multi-tiered rocks, were full of ash, and had blackened rocks (see Figure 4). Left Fork had 15 fire sites with 2 campsites having multiple fire sites (2 to 3). Right Fork had 55 fire sites within 39 dispersed campsites, with 9 campsites having 2 to 5 fire sites (the majority at Buoux, Porta Pot, and UMWA Camp Areas). New Joes was similar to Right Fork having 55 fire sites within 41 campsites. Twelve of these campsites had multiple fire sites ranging from 2 to 4. The sum of fire sites for all inventoried dispersed campsites was 125.

Figure 4. An example of a large fire site with multi-tiered rocks holding in the ash.

Access Trails

Total access trails at dispersed campsites had a range of 0 to 3 with a mean of .8 (see Table 14). Specifically, Right Fork had 36 access trails (22 campsites), Left Fork had 9 (6 campsites), and New Joes had 29 (20 campsites). The total number of access trails was 74.

Human Waste

The presence of human waste was identified at 10 dispersed campsites with a total sum of 15 waste sites (see Table 14). Right Fork was identified as having the most waste sites (8) with a range of 1 to 4 (6 of these waste sites are located at Porta Pot Camp). Left Fork had 2 waste sites located at the Rock Camp and New Joes had 1 waste site identified.

Table 14. Dispersed campsite impact indicators by regions.

Impact Indicators	Left Fork (n=12)	Right Fork (n=40)	New Joes (n=42)	Total (n=94)
Campsite Size (ft^2)				
Mean	1,879.7	3,448.2	2,882.0	2,995.0
Median	1,787.7	2,572.6	2,310.1	2,289.1
Sum	22,556.9	137,928.1	121,045.5	281,530.5
Range	816.6 - 3,096.6	795 - 16,501.1	254.6 - 1,1072.3	254.6 - 16,501.1
Vegetation Loss (%)				
Mean	23.5	23.5	3.0	14.6
Median	3.0	18.8	0.0	0.0
Range	0 - 83	0 - 80	0 - 57.5	0 - 80
Exposed Soil (%)				
Mean	88.0	61.2	54.8	61.8
Median	98.0	85.5	63.0	85.5
Range	38 - 98	2.5 - 98	5.5 - 98	2.5 - 98
Damaged Trees (#)				
Mean	0.2	1.2	0.5	0.8
Median	0.0	0.0	0.0	0.0
Sum	2	49	22	73
Range	0 - 1	0 - 10	0 - 5	0 - 10
Root Exposure (#)				
Mean	0.1	0.2	0.1	0.1
Median	0.0	0.0	0.0	0.0
Sum	1	9	3	13
Range	0 - 1	0 - 3	0 - 2	0 - 3
Stumps (#)				
Mean	0.3	0.9	0.7	0.7
Median	0.0	0.0	0.0	0.0
Sum	4	36	29	69
Range	0 - 1	0 - 9	0 - 6	0 - 9
Fire Sites (#)				
Mean	1.3	1.4	1.3	1.3
Median	1.0	1.0	1.0	1.0
Sum	15	55	55	125
Range	1 - 3	0 - 5	0 - 4	0 - 5
Access Trails (#)				
Mean	0.8	0.9	0.7	0.8
Median	0.5	1.0	0.5	1.0
Sum	9	36	29	74
Range	0 - 3	0 - 3	0 - 3	0 - 3
Human Waste (#)				
Mean	0.2	0.3	0.0	0.2
Median	0.0	0.0	0.0	0.0
Sum	2	12	1	15
Range	0 - 2	0 - 4	0 - 1	0 - 4

Note. Adapted from "Trail and Campsite Monitoring Protocols: Zion National Park" by J. L. Marion & K. Hockett, 2008, p. 32.

Litter

Litter was assessed by type and extent present while standing in the impacted zone. In Left Fork, 7 campsites had small litter (micro-trash) and 5 campsites had medium litter (obvious, not wide spread) (see Table 15). Right Fork had 3 campsites with no litter, 15 campsites with small litter, 16 with medium litter, and 6 with large litter (excessive and wide spread). The large litter sites were located at Buoux, UMWA, Porta Pot, and Mansize Camp Areas. New Joes was slightly different from the other regions by having a majority (43%) of campsites with no litter (18), yet there were still 11 campsites that had small litter, 6 that had medium litter, and 7 that had large litter.

Condition Class

Dispersed campsites were assessed a condition class according to changes in soil and vegetation resources. The majority of campsites (50%) aggregated were assessed a CC4 (bare soil widespread, almost total loss of vegetation), 17% were identified as CC0 to CC1 (campsites barely distinguishable), and 32.9% identified as CC2 to CC3 (campsites obvious). There were no identified CC5 campsites (soil erosion obvious) (see Table 15, Appendix A, and http://bit.ly/1r4dWW1).

Table 15. Dispersed campsite litter and condition class impact indicators by regions.

Impact Indicators	Left Fork (n=12)		Right Fork (n=40)		New Joes (n=42)		Total (n=94)	
	#	%	#	%	#	%	#	%
Litter								
None	0	0.0	3	7.5	18	42.9	21	22.3
Small	7	58.3	15	37.5	11	26.2	33	35.1
Medium	5	41.7	16	40.0	6	14.3	27	28.7
Large	0	0.0	6	15.0	7	16.7	13	13.8
Condition Class								
0	0	0.0	4	10.0	5	11.9	9	9.6
1	0	0.0	4	10.0	3	7.1	7	7.4
2	2	16.7	4	10.0	4	9.5	10	10.6
3	0	0.0	10	25.0	11	26.2	21	22.3
4	10	83.3	18	45.0	19	45.2	47	50.0
5	0	0.0	0	0.0	0	0.0	0	0.0

Parking

Land Ownership

Total number of parking areas specific to accessing bouldering areas was 48 within Joe's Valley. The USFS had the highest number of parking areas with 15 in Left Fork, 11 in Right Fork, and 2

in New Joes. The BLM had a couple of parking areas in Left Fork, 9 in Right Fork, and 1 in New Joes. Parking in SITLA lands were 5 in Right Fork and 3 parking areas were located on private lands (see Table 16, Appendix A, and http://bit.ly/1r4dWW1).

Table 16. Number and percent of parking areas by ownership.

Ownership	Left Fork (n=18)		Right Fork (n=26)		New Joes (n=3)		Total (n=48)	
	#	%	#	%	#	%	#	%
USFS	15	78.9	11	42.3	2	66.7	28	58.3
BLM	2	10.5	9	34.6	1	33.3	12	25.0
SITLA	0	0.0	5	19.2	0	0.0	5	10.4
Private	2	10.5	1	3.8	0	0.0	3	6.3

Inventory Indicators

Estimation on the maximum number of vehicles that could utilize a parking area was calculated with the assumption that vehicles were paralleled parked. Overall, an estimated 249 vehicles could potentially be parked throughout the regions with 105 in Left Fork, 126 in Right Fork, and 18 at New Joes (see Table 17). Additionally, total number of vehicles would increase if vehicles were parked at dispersed campsites and if parking areas were used as pull-in sites.

Table 17. Maximum number of parking spaces by regions.

Maximum Number of Parking Spaces	Left Fork		Right Fork		New Joes		Total	
	Parking Areas (#)	Max Vehicle (#)	Parking Areas (#)	Max Vehicle (#)	Parking Areas (#)	Max Vehicle (#)	Parking Areas (#)	Max Vehicle (#)
1	0	0	1	1	0	0	1	1
2	5	10	0	0	1	2	6	12
3	1	3	7	21	0	0	8	24
4	1	4	5	20	0	0	6	24
5	3	15	7	35	0	0	10	50
6	4	24	2	12	1	6	7	42
7	2	14	1	7	0	0	3	21
8	1	8	1	8	0	0	2	16
9	0	0	0	0	0	0	0	0
10	0	0	1	10	1	10	2	20
11	0	0	0	0	0	0	0	0
12	1	12	1	12	0	0	2	24
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	1	15	0	0	0	0	1	15
Overall	19	105	26	126	3	18	48	249

MANAGEMENT RECOMMENDATIONS

Land agencies should further analyze the results of this assessment along with management plans, environmental concerns, social impacts, and cultural factors to evaluate the acceptability of these documented impacts at bouldering sites, informal trails, and dispersed campsites. Land agencies have the opportunity to manage these impacts by utilizing direct to indirect management tactics. Direct management techniques include: setting user capacity, establishing specific rules (e.g., groups sizes, permits, prohibiting fires), and developing management zones. Indirect management techniques include: site management strategies and visitor management strategies. Site management strategies minimize unacceptable impacts by manipulating the site or controlling were the use is occurring. This can be accomplished through facility development, site design, and maintenance. Visitor management strategies attempt to minimize impacts by altering users' behaviors through education and regulations. These strategies are the most indirect management techniques that can be employed by land agencies and should be the first tactic that is utilized to minimize recreation impacts. It is preferable that land agencies develop a management framework with an emphasis on indirect strategies, yet the acceptability and mitigation of recreation impacts might require the development of direct management strategies. This section will provide an overview of management techniques that land managers can apply to reduce recreation impacts at bouldering sites, informal trails, and dispersed campsites.

Bouldering Recreation Sites

This report provides land managers an overall condition class for each boulder along with site slope, use level, presence of litter, occurrence of fire sites, and number, density, and spatial extent. This provides managers different options when assessing the acceptability of these sites. The most concerning issue are the 49 CC5 bouldering sites that have currently active or past evidence of soil erosion. Managers should review the acceptability of these sites, along with all other bouldering sites, and decide if impacts need to be addressed. For example, sites with excessively large impacted areas, severe erosion, large litter, or fire rings are issues that potentially should be addressed and prioritized. When prioritizing these sites for possible mitigation managers should consider the location and use level. For instance, a bouldering site that is not easily accessible, not part of a large concentration of boulders, and has low use level might not be a high priority opposed to a bouldering site that is quickly accessed and has a high level of use. The following are a few management techniques that can be employed by land mangers to address impacts at bouldering sites.

Provide site maintenance. Since many of the bouldering sites are located on steep slopes, erosion is a common occurrence and can be mitigated by constructing rock retaining walls to level the landing area under the boulder or stabilize eroded areas adjacent to the boulder. This strategy has successfully been used at the base of climbing routes where similar impacts occur and has been implemented at other bouldering areas such as Moe's Valley, Utah (see Figure 5). Another site modification is hardening and leveling the landing under boulders by embedding flat rocks into the impacted zone (see Figure 6). This technique would be beneficial to develop a resistant landing zone that is periodically muddy or slightly sloped. Bouldering sites that are situated on a

low slope might have the potential for site expansion where natural barriers are not present. Mangers might consider controlling this by installing physical barriers such as rocks and piles of wood on the preferred boundary line. This barrier is intended to keep the recreational use in the most disturbed area.

Figure 5. The left image shows the impacted area with soil compaction and some slight erosion occurring. Construction of a rock retaining wall in the right image has leveled the landing area and stabilized potential future erosion (Access Fund).

Figure 6. The left image shows the impacted area before site modification. In the right image, the placement of rocks has made the area more resistant to muddiness and trampling related impacts (Access Fund).

Develop an educational component. Educational messaging for bouldering sites should be based on rational management decisions and expectations. Messaging can include basic Leave No Trace practices, concentrating use on established bouldering sites, minimize group sizes, prevent dragging of bouldering pads, cleaning tick marks, preventing fire sites, proper disposal of human waste, and controlling pets. Delivery of these educational messages can be on-site with properly located signs or kiosks and off-site through website information (e.g., public land agencies, local climbing organizations, and national climbing organizations), social media, educational brochures, and coordination with local climbing gyms and outdoor retailers to provide educational material and information.

Informal Trails

This assessment identified a total of 9.7 miles of informal trails and provides managers a condition class designation for each section of trail, an average width, along with the number, density, and spatial extent. While the majority of the informal trails were assessed as CC3, managers should be concerned with the 2.9 miles of CC5 trails, and to a lesser extent, the 1.3 miles of CC4 trails. Managers should further analyze the condition and location of all informal trails in relation to bouldering sites and decide if they are acceptable. Acceptability of the condition of informal trails should be based on management objects, in addition to environmental factors and user-related factors. For example, informal trails ascending the fall line are susceptible to soil erosion and therefore are less acceptable than an informal trail that is contoured on the hillside. Informal trails that pass through critical wildlife habitat or rare and threatened species habitat are less acceptable than if the trail was located in a different area. Soil contribution to water sources would also be unacceptable. In addition, proliferation of redundant trails to bouldering sites, shortcutting trails, and the development of new informal trails due to poorly defined trails could be considered unacceptable (Wimpey & Marion, 2011).

Unlike recreational areas that have a formal network of trails that can be solely used to access specific recreational attractions or activities, access to boulders in Joe's Valley is completely dependent on informal trails or off-trail traveling. Therefore, land managers must acknowledge that some type of trail needs to be acceptable and appropriate for climbers to fulfill their recreational activity. Managing informal trails will be challenging for land managers, but by adopting specific management options, mitigation of impacts can occur, and the amount of informal trails could be lessened.

In Wimpey and Marion (2011), Marion provides comprehensive guidance to managing informal trails and readers are urged to refer to this for a better understanding of management frameworks and strategies. The following are some informal trail management suggestions based on this work that managers could implement to effectively manage informal trail network specifically for bouldering sites.

Develop a formalized trail system. Since trails are a necessity for climbers to reach their destination, land managers should consider formalizing these informal trails. An initial strategy is to systematically analyze informal trails based on identified clusters for acceptability. Since many of the user-created trails were not designed by well-informed trail experts, many sections

of trail might be considered unacceptable (e.g., trails parallel to the slope, trails located in fragile substrate, multiple trails). Sections of trails that are acceptable could be included in a formalized trail system while unacceptable sections could be closed and rehabilitated with a new realignment planned by professional trail designers. Location of parking areas, trailhead feasibility, and potential interconnectivity between multiple bouldering clusters and camp areas should also be analyzed when planning a formalized trail system.

Design and construct sustainable trails. Sections of informal trails are poorly designed which would require extensive long-term maintenance to deal with erosion and degradation. An alternative to leaving and using these types of trails is to properly plan, design, and construct sustainable trails. Specifically, sustainable trails have minimal environmental impacts, provide minimal user conflicts, and have minimal long-term maintenance. To achieve these parameters a trail must be properly designed and constructed. Trail planning should follow current land agency management plans, design parameters, and specifications along with trail planning guidelines. These include: trail grade has a direct bearing on how much design, construction, and maintenance work will be needed to establish a sustainable tread; high-use trails should be designed within a 5–10% grade range; the maximum grade should not exceed 15% grade; trails should be designed as a contour trail with full-bench construction (see Figure 7); trails should be outsloped at 5%; and grade reversals should be built into new trails to facilitate diversion of water.

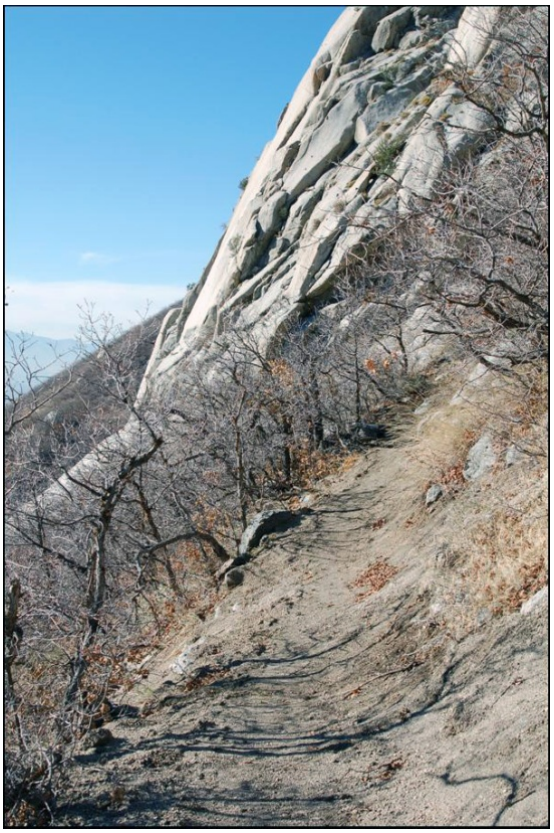

Figure 7. Contour trails gently traverse the side slope which minimizes erosion by preventing high velocity of water from carrying away topsoil.

Maintain informal or formal trails. In circumstances were a new trail alignment is not feasible, sections of informal trails are acceptable, or informal trails are converted to formal trails, managers should address current and future trail impacts through trail maintenance practices. Maintenance includes: defining and reestablishing tread; surface water control such as the installation of waterbars and rolling grade dips; and installation of retaining walls to support tread on steep slopes or hold steep backslope in place. Trail that has a slope of >20% will likely require hardened surfaces or steps. Individual or overlapping steps can be constructed out of on-site material such as rocks or off-site material such as timber and is a common technique implemented at other climbing areas (see Figure 8). These techniques are useful especially on short sections of trail where elevation can be gained in a short distances and realignment is not feasible, yet on extensive steep linear segments, realignment will be a more cost effective long-term solution.

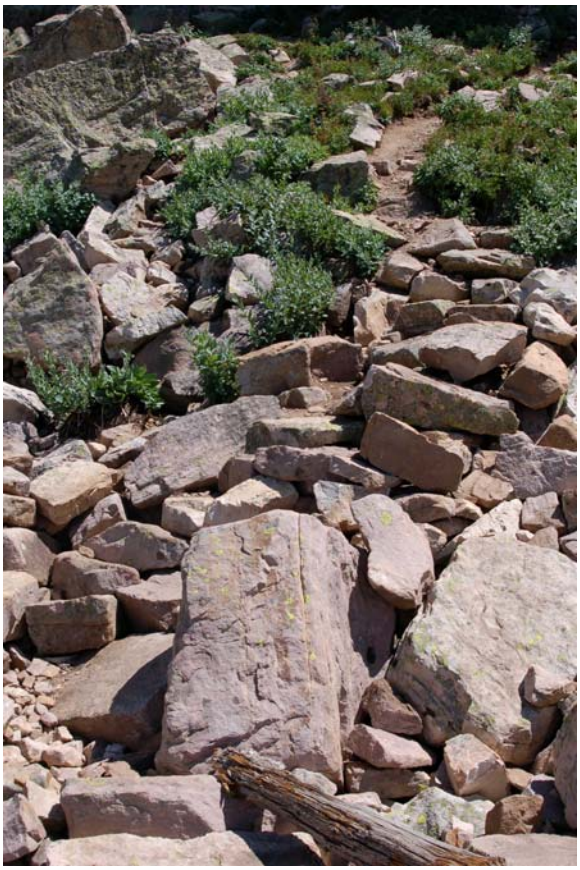

Figure 8. An example of overlapping rock steps that was constructed through a talus field. This type of maintenance structure requires expertise, time, and a good supply of local material.

Provide facility development and site design. Managers can implement facility and site design measures to decrease trail impacts. Some examples include improving and formally designating parking areas and trailheads for bouldering areas. This can be as simple as leaving the current parking configuration and providing a sign marking the beginning of the trail. Signage can be minimal and constructed out of various material including wood, metal, or fiberglass marker

posts. Properly placed and constructed cairns are another option to distinguish were the trail begins and is also useful to mark trails that are difficult to differentiate, go through washes, or goes over rocks. Trailheads can also be intensively developed with the addition of new parking, restrooms, and kiosks. Additionally, within a bouldering trail system directional signs and other forms of signage could be placed if it would decrease trail impacts, enhance users' experiences, and is warranted.

Develop an educational component. Similar to the bouldering sites' educational messaging, communicating trail user expectations should be based on rationale management decisions. Messaging for trail use includes staying on established trails, avoid short cutting, prevent the use of closed trails, avoid establishing new trails, and hike in a single file to prevent trail widening.

Dispersed Campsites

This report identified 94 dispersed campsites and provides a general condition class for each campsite, allowing managers a quick overview on the current condition. Additional indicator and impact indicators were provided for in-depth analysis on the acceptability of these campsites and to monitor future conditions. Unlike backcountry campsites where improvements and intense recreation impacts may not be appropriate, managers may have a higher tolerance for impacted dispersed campsites due to vehicle use, accessibility, patterns of use, and management prescriptions. However, even with a potentially high tolerance of recreation impacts at these campsites, managers still need to account for unacceptable impacts. Acceptability on the amount and extent of impacts occurring at dispersed campsites should be based on management objectives, environmental considerations, user implications, and safety concerns. An example of an environmental issue would include campsites directly adjacent to water sources may be unacceptable if water quality was diminished due to improper sanitation. Additionally, a campsite with a large fire site filled with ash and litter, along with additional satellite fire sites, would be considered unacceptable opposed to having just one maintained fire site. Users' experiences include the acceptability of campsites that are close and visible to other campsites which may increase the sense of crowding. Finally, safety concerns include campsites that have power lines directly overhead and have flash flood potential.

The following are management techniques that can be implemented by land mangers to address recreation impacts at dispersed campsites.

Provide campsite maintenance. General campsite maintenance is an important tactic that can be used to address unacceptable impacts at campsites. Fire sites should be dismantled, ash and litter removed, and a manageable sized fire site should be reconstructed in an appropriate location. Satellite fire sites should be completely dismantled and cleaned with an effort to camouflage the fire site scar. All forms of litter should be collected and removed from the area along with safely disposing exposed human waste sites. Preferably, at highly used dispersed campsites maintenance should be accomplished on a schedule, especially fire sites which are difficult for users to maintain.

Provide facility development and site design. Simple site design strategies at dispersed campsites can be accomplished such as preventing site expansion or limiting the area for vehicle use by defining the boundary with rocks and logs. While small rocks lined up can define the boundary, additional measures to reduce vehicle encroachment may need to be implemented, such as the placement of large rocks which may require mechanical assistance, or fencing (e.g., buck and rail). Additional site design tactics that can be utilized on current dispersed campsite areas includes identifying campsites with assigned areas and designing and constructing information kiosks that are targeted to specific user groups (see Figure 9).

Facility development may be warranted at dispersed campsite areas with multiple campsites. A noticeable seasonal facility that has been provided for the past few years are portable toilets located in Left Fork (Angler Access Camp) and Right Fork (Mansize Camp) during the spring and fall climbing seasons which has been funded through the Salt Lake Climbers Alliance (see Figure 9). The placement of these facilities has noticeably mitigated human waste issues (no human waste sites were identified at either area). However, human waste sites were still present at other well-used dispersed campsite areas (e.g., Porta Pot Camp and Rock Camp). The presence of these facilities at these locations should continue at a minimum, but for long-term waste management solutions, managers should consider permanently located vault toilets at all three regions of Joe's Valley. Finally, managers could address impacts at dispersed campsites by providing major facility development such as constructing formalized campgrounds. Necessity, location, design, functionality, amenities, user experiences, recreational opportunities, and associated cost and fees should be thoroughly analyzed if managers implement this management strategy.

Figure 9. A simple kiosk provides a focal point to disseminate information and educational material while the portable toilet is a temporary solution to manage human waste in heavily-used dispersed campsite areas (Access Fund).

Close and relocate campsites. Managers may consider dispersed campsites that are deemed unacceptable due to environmental, social, or safety concerns be permanently closed with relocation to more appropriate areas. These areas could be new formalized campsites, less-used low expansion potential campsites, or newly established dispersed campsites that are appropriately located. Managers should be aware of the implications that might occur with this tactic such as reducing the number of available sites in a location, displacement of user patterns, an increase of use and impact at less visited campsites, and the establishment of new visitor created campsites. Managers should also be aware that motivating visitors to refrain from using closed campsites may be difficult due to place attachment that users may have for a specific site. Rationale for any closures, appropriate measures to control use in the closed area, and appropriate alternative camping options should be planned and implemented if this tactic is used.

Develop an educational component. Many recreation impacts can be addressed with proper educational messaging for dispersed camping such as campsite expansion and development of new campsites. Since fire sites are one of the most noticeable impacts, clear messaging needs to motivate individuals not to build new fire sites, expand current fire sites, build large uncontrollable fires, burn trash, cut branches from trees, and collect firewood if it is scarce. Lastly, disposal of human waste needs to be addressed with an emphasis on using provided facilities, packing it out with a waste bag system especially in high-use campsites, or properly burying the waste and packing out all toilet paper.

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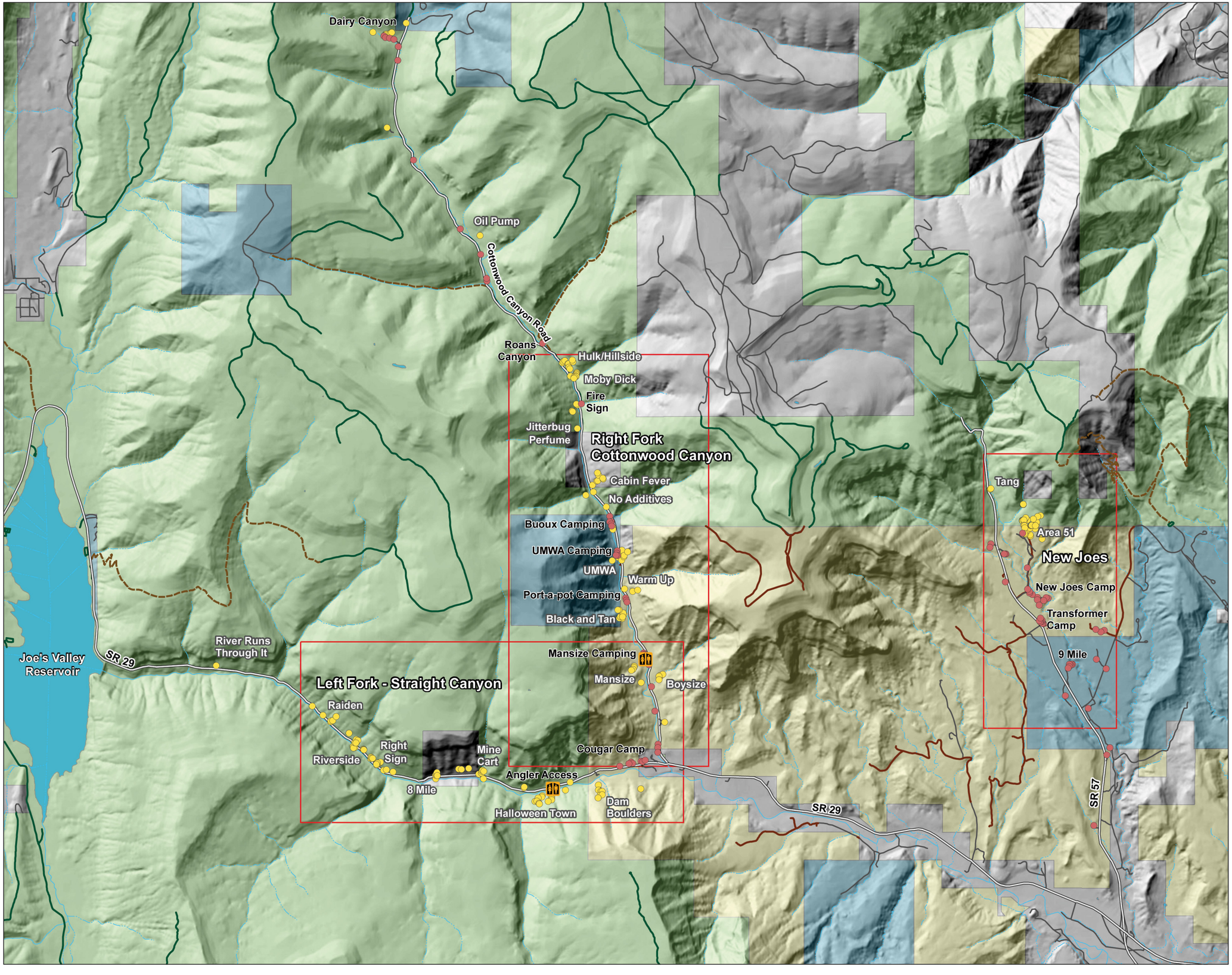
APPENDIX A: MAPS

Joe's Valley Bouldering Recreation Impact Assessment

Figure 1
Project Overview



Legend

- Dispersed Campsite
- Boulder Site
- Toilet Location 2014
- Major Road
- USFS Road
- Road
- USFS Trail
- BLM Designated Route
- Perennial Stream
- Intermitent Stream
- Survey Results Map Index

Land Ownership

- BLM
- Private
- SITLA
- USFS

This recreation impact assessment made possible by:

SLCA Salt Lake Climbers Alliance · the American Alpine club · BCC boulder climbing community · Access Fund Protect America's Climbing

Sources:
Bureau of Land Management (BLM);
United States Forest Service (USFS);
State of Utah, Automated Geographic Reference Center;
Salt Lake Climbers Alliance
Service Layer: Source: ESRI, Microsoft (8/12/2011)
Credit: Jonathan Knight and Jeff Porucznik

1:54,000 September 2014

0 0.375 0.75 1.5 Miles

0 0.25 0.5 1 Miles

1:14,000

This recreation impact assessment made possible by:

SLCA Salt Lake Climbers Alliance
the American Alpine club
BCC boulder climbing community
Access Fund Protect America's Climbing

Sources:
Bureau of Land Management (BLM); United States Forest Service (USFS);
State of Utah, Automated Geographic Reference Center;
Salt Lake Climbers Alliance

Service Layer/Imagery: Source: ESRI, Microsoft (8/12/2011)

Legend

Dispersed Campsite
Condition Class
- 0
- 1
- 2
- 3
- 4
- Camping Delineation

Boulder Site
Condition Class
- -1
- 0
- 1
- 2
- 3
- 4
- 5

Informal Trail
Condition Class
- 0
- 1
- 2
- 3
- 4
- 5

- Parking
- Major Road
- USFS Road
- Road
- BLM Designated Route
- Intermitent Stream
- Perennial Stream

Land Ownership
- BLM
- Private
- SITLA
- USFS

Joe's Valley Bouldering Recreation Impact Assessment

Survey Results
Left Fork - Straight Canyon

Figure 2

September 2014

Credit: Jonathan Knight and Jeff Porucznik

Joe's Valley Bouldering Recreation Impact Assessment

Survey Results
Right Fork - Cottonwood Creek

Figure 3

Hulk/Hillside
Moby Dick
Fire Sign
Minute Man
Smile
Jitterbug
Perfume
Cabin Fever
No Additives
Maxipad
All
Buoux Camping
Buoux
UMWA Camping
UMWA
Warm Up
Port-a-pot Camping
Black and Tan
Cottonwood Canyon Road
Mansize Camping
Mansize
Boysize
Gunshot
Cottonwood Creek
Thighmaster
Cougar Camp 2
Cougar Camp

Legend

Dispersed Campsite

Condition Class

- 0
- 1
- 2
- 3
- 4
- Camping Delineation

Boulder Site

Condition Class

- -1
- 0
- 1
- 2
- 3
- 4
- 5

Informal Trail

Condition Class

- 0
- 1
- 2
- 3
- 4
- 5
- Parking
- Major Road
- USFS Road
- Road
- BLM Designated Route
- Intermitent Stream

Land Ownership

- BLM
- Private
- SITLA
- USFS

September 2014

Credit: Jonathan Knight and Jeff Porucznik

This recreation impact assessment made possible by:

SLCA Salt Lake Climbers Alliance
the American Alpine Club
BCC boulder climbing community
Access Fund Protect America's Climbing

1:15,000

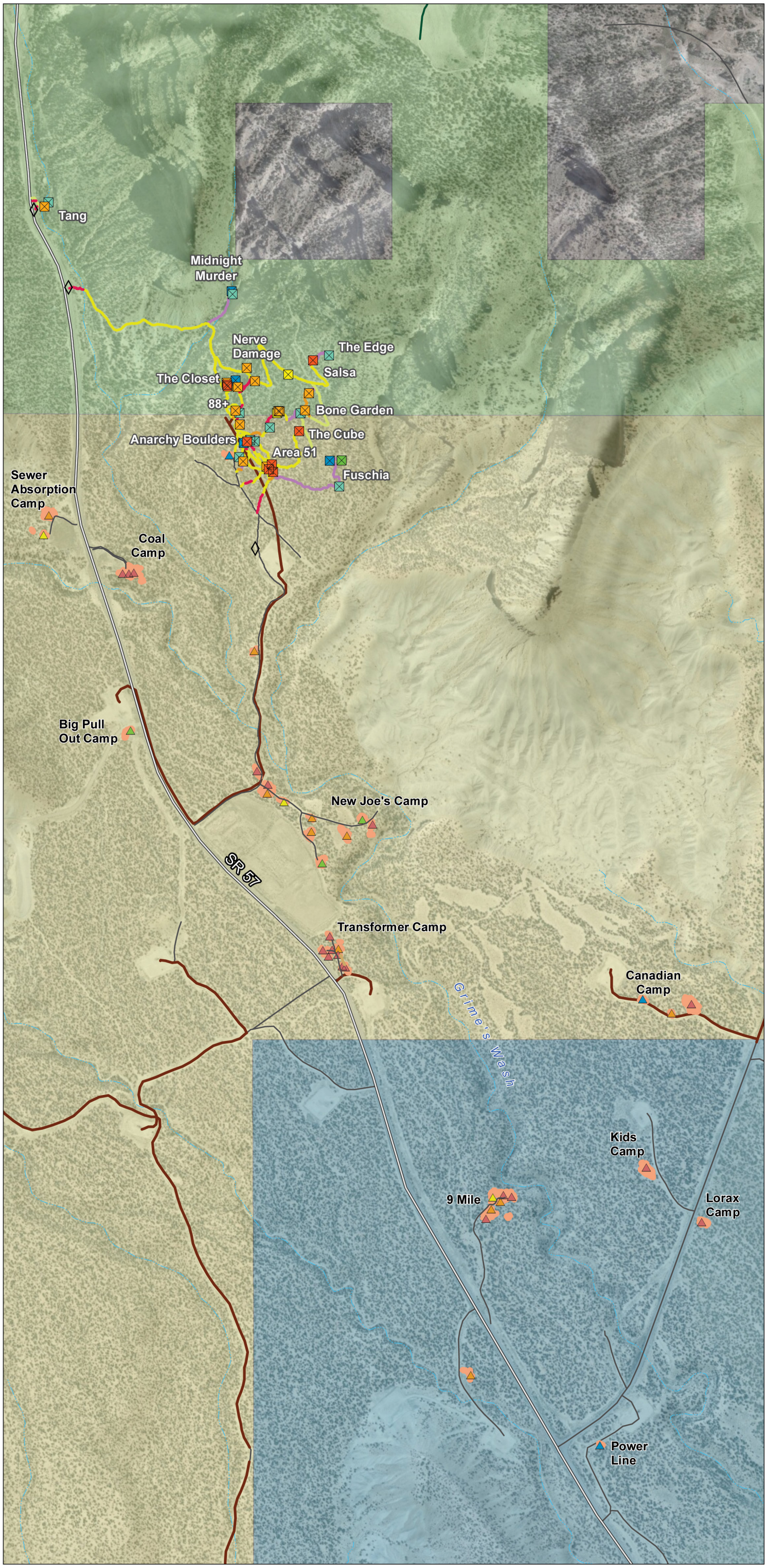
Sources:
Bureau of Land Management (BLM);
United States Forest Service (USFS);
State of Utah, Automated Geographic Reference Center;
Salt Lake Climbers Alliance
Service Layer: Source: ESRI, Microsoft (8/12/2011)

0 0.125 0.25 0.5 Miles

Joe's Valley Bouldering Recreation Impact Assessment

Survey Results New Joes

Figure 4



Legend

Dispersed Campsite

Condition Class

- 0
- 1
- 2
- 3
- 4
- Camping Delineation

Boulder Site

Condition Class

- -1
- 0
- 1
- 2
- 3
- 4
- 5

Informal Trail

Condition Class

- 0
- 1
- 2
- 3
- 4
- 5
- Parking
- Major Road
- USFS Road
- Road
- BLM Designated Route
- Intermitent Stream

Land Ownership

- BLM
- Private
- SITLA
- USFS

September 2014

Credit: Jonathan Knight and Jeff Porucznik

This recreation impact assessment made possible by:

SLCA Salt Lake Climbers Alliance

the American Alpine club

BCC boulder climbing community

Access Fund Protect America's Climbing

1:10,000

Sources:
Bureau of Land Management (BLM);
United States Forest Service (USFS);
State of Utah, Automated Geographic Reference Center;
Salt Lake Climbers Alliance
Service Layer: Source: ESRI, Microsoft (8/12/2011)

0 0.075 0.15 0.3 Miles

APPENDIX B: BOULDERING RECREATION SITE ASSESSMENT MANUAL

Bouldering Recreation Site Assessment Manual
Joe's Valley, Utah

(version 9/2014)

This manual describes procedures for conducting current resource condition assessments for bouldering recreation sites. It was developed for quickly assessing conditions at bouldering sites within Joe's Valley, Utah. Two general approaches are used for assessing boulder site conditions: 1) a condition class assessment determined by visual comparison with six described levels of boulder site impacts, and 2) rapid multi-indicator assessment of fire sites and litter. In addition, photographs are used for sites assessed as highly impacted.

For the purpose of this manual, bouldering sites are defined as areas of disturbed vegetation, surface litter, or soils caused by human use at staging and climbing areas at the base or in the vicinity of boulders, excluding associated trails.

Assessment measurements should be taken near the middle or end of the visitor use season but before leaf fall. Site conditions generally recover during the periods of lower visitation and reflect rapid impact during early season use. Site conditions are more stable during the mid- to late-use season and reflect the resource impacts of that year's visitation.

Materials
(Check before leaving for the field)

- □ Joe's Valley guidebooks [3] [4]
- □ Maps
- □ Compass (corrected for declination)
- □ Clinometer
- □ Blank field forms, pencils
- □ Digital camera with extra batteries and memory card
- □ Mapping-grade GPS unit
- □ Clipboard
- □ Monitoring manual

[1] These procedures and manual are adapted from Marion, J. L., and Carr, C., (2007). *An assessment of recreation impacts to cliff and rock outcrop environments in Shenandoah National Park*. Blacksburg, VA: USDI, US Geological Survey, Patuxent Wildlife Research Center, Virginia Tech Field Station and Porucznik, J. (2009). *Recreation site and trail impact assessment methods and procedures for bouldering areas in Little Cottonwood Canyon.* Unpublished master's thesis, The University of Utah.

[2] Photographs illustrating campsite boundaries, boundary flag placement, vegetative ground cover classes, soil exposure, and root exposure may be found in: Marion, J. L. (1991). *Developing a natural resource inventory and monitoring program for visitor impacts on recreation sites: A procedural manual*. (Report No. NPS/NRVT/NRR-91/06). Denver, CO: USDI, National Park Service, Natural Resources Publication Office.

[3] Baldwin, J., Beck, M., & Russo, M. (2003). *A bouldering guide to Utah*. Glen Falls, NY: Springhill Press.

[4] Caldiero, I. (2011). *An insightful guide to Joe's Valley bouldering.* Orem, UT: Shibidaang Publishing.

General Site Information

1) **Date**: Month, day, and year the sites were evaluated (e.g., May 1, 2014 = 05/01/14).

2) **Surveyors**: Identify the field personnel(s) responsible for assessing the sites.

Location Description: Location names are based on a hierarchy derived from guidebooks, previous surveys, web based information, and local knowledge.

3) **Region**: The area where groups or individual boulders are located.
LF = Left Fork
RF = Right Fork
NJ = New Joe's

4) **Cluster**: The name given to group of boulders within the region.

5) **Boulder**: Develop predefined codes or general system for boulders.

6) **Boulder Name**: The specific documented name of a boulder(s) within the cluster or if the cluster name is the obvious boulder. If the boulder does not have a name, record 0.

Note: In clusters with multiple sites or impacted areas, there may not always be undisturbed areas separating sites, and an arbitrary decision may be necessary to define separate sites or to inventory as one site.

7) **Ownership (OW)**: Record if the location is located on US Forest Service land, Bureau of Land Management land, Utah State land, or on private property. This can also be determined in post-processing.

FS = US Forest Service
BLM = Bureau of Land Management
SITLA = State of Utah School and Institutional Trust Lands Administration
PR = Private

8) **GPS Coordinates**: Record the location of the boulder using a resource-grade GPS unit. Try to select a reference spot that is preferably as close as possible to the boulder while maintaining GPS accuracy and precision settings. If necessary, record an offset point, referencing distance and bearing to the target location.

Note: Some bouldering sites will be assessed separately, but may be close enough that only one GPS coordinate is necessary to document both areas.

Inventory Indicators

9) **Site Slope (SS)**: Use a clinometer and record the site slope category. Choose the highest percentage category when there are multiple sites around a boulder.

F = <5%
M = 5–10%
S = >10%

10) **Use Level (UL)**: Record the amount of use at the boulder based on occurrence and amount of chalk.

L = Low (none or very little chalk)
M = Moderate (chalk is present, can be easily cleaned off)
H = Heavy (large concentration of chalk, can be thick at times, not easily cleaned off; polished holds)

Impact Indicators

Identify Site Boundaries: Identify site boundaries by pronounced changes in vegetation cover, vegetation height/disturbance, vegetation composition, surface organic litter, soil, and topography (refer to photographs following these procedures). Project site boundaries straight across areas where trails enter the site. Many sites will have very little vegetation and it will be necessary to identify boundaries by examining soil (i.e., compacted soil compared to non-compacted soil) and organic litter (i.e., leaves and needles which are untrampled and intact compared to leaves and needles which are pulverized or absent). In defining the site boundaries include only those areas that appear to have been disturbed from human trampling. Natural factors such as dense shade can create areas lacking vegetative cover and boulders located in natural drainages may appear impacted due to natural erosion. Do not assess a higher condition class to these areas if they appear "natural" to you. When in doubt speculate on which areas typical visitors might use based on factors such as where the boulder problems are located, slope, or rockiness.

Note: Remember that all impact zones under known boulder problems should be assessed as a recreational impact. Some of these impacted spots might also be part of a social trail. Be sure to comment on this.

11) **Condition Class (CC)**: Record a site condition class using the descriptions below. If a site is underlain entirely by bedrock record "-1" for this item. Include an explanation on the field form under Comments. Record highest condition class when there are multiple impacts around one boulder.

Class 0: Site barely distinguishable; no or minimal disturbance of vegetation and/or organic litter. No soil compaction. Often an old bouldering site that has not seen recent use.
Class 1: Site barely distinguishable; slight loss of vegetation cover and/or minimal disturbance of organic litter.
Class 2: Site obvious; vegetation cover lost and/or organic litter pulverized in primary use areas.
Class 3: Vegetation cover lost and/or organic litter pulverized on much of the site, some bare compacted soil exposed in primary use areas (i.e., under boulder problems).
Class 4: Nearly complete or total loss of vegetation cover and organic litter, bare compacted soil widespread. Very minor erosion localized under bouldering problems may be present.
Class 5: Soil erosion obvious, as indicated by exposed tree roots and rocks and/or gullying.

22) **Number of Fire Sites (FS)**: A count of the number of campfires or fire scars within or on the site boundaries. Look for fire pits, charred rocks, ash, and blackened vegetation/soil.

23) **Litter (L)**: Litter in the impact zone is recorded along with trash visible when standing in the zone. Mentally extend the zone boundaries out into the adjacent area to decide which zone to record any trash in. Include human waste, toilet paper, off-site lumber, and trash found in fire rings. Use comment section to note on the presence of human waste, toilet paper, or pet waste.

None……..No litter/trash present
Small…….Micro trash (tape, cigarette butts, candy wrappers, etc.)
Medium…....Obvious, not wide spread. Include foil and glass in fire rings
Large…….Excessive, wide spread

Site Photographs: If the boulder site has a condition class of 5 a photograph should be taken at each area. Select a vantage point that provides the best view of the site. Try to select a location that clearly shows the impact zone. Set the camera lens at a consistent, preferably wide angle and focal length. Take photos with the camera pointed down to include as much of the site groundcover as possible. If more than one photograph is needed document each image.

24) **Photo ID Number**: Record the photo file number.

Note: If possible GPS coordinates can be taken at the camera site. Use the Photo ID Number to document in GPS data dictionary. Record waypoint in Photo Notes.

25) **Photo Direction**: Record the direction the photo being taken. Use standard codes (e.g., N = North, SW = Southwest).

26) **Photo Notes**: Comment on photo if needed.

27) **Comments**: Describe location of boulder if needed. Also, an informal list of comments concerning the impact zone: Record if the zone is a trail; if the zone is near or contains heritage/archeological resources; if non-native vegetation is present within or beyond the zone boundaries, species, and amount (quantify if possible); if any structures have been built (e.g., cribbing and retaining walls) or any other modifications (e.g., leveling of the landing zone, moved rocks, and tree removal); and any clarifications on the condition class assigned to the boulder.

SITE BOUNDARIES

Identified by pronounced changes in vegetation, organic litter, or topography.

Vegetation Cover

Vegetation Composition

Vegetation Height/Disturbance

Topography

Organic Litter

Organic Litter

(Marion, 1991, p. 46).

Site Boundary

Identified by pronounced change in soil (i.e., compacted compared to non-compacted).

(Photo by J. Porucznik).

SITE BOUNDARIES

Yellow triangles indicate flagged pin locations which delineate site boundaries.

Site boundaries determined by pronounced changes in vegetation cover.

Site boundaries determined by pronounced changes in vegetation height/disturbance.

(Marion, 1991, p. 47).

SOIL EXPOSURE

Areas of predominantly bare soil; very little or no organic litter or vegetation cover.

Organic litter on left is pulverized but still covers underlying organic and mineral soil. Dark organic soil on right, which covers lighter colored mineral soil, should be assessed as bare soil.

As organic litter is pulverized and eroded from sites the remaining materials often clump together, resulting in a patchwork of organic litter and bare soil which is difficult to evaluate. If patches of organic material are relatively thin and few in number, as illustrated in the photo above, the entire area should be assessed as bare soil. Otherwise, the patches of organic litter should be mentally combined and excluded from assessments.

(Marion, 1991, p. 49).

Bouldering Site Impact Form

Date: **Surveyors:**

Region	Cluster	Boulder	Boulder Name	OW	SS	UL	CC	FS	L	Photo ID Number	Photo Dir.	Photo Notes	Comments

OW=Ownership CC=Condition Class

SS=Site Slope FS=Fire Sites

UL=Use Level L=Litter

APPENDIX C: INFORMAL TRAILS ASSESSMENT MANUAL

Informal Trails Assessment Manual
Joe's Valley, Utah

(version 9/2014)

Introduction

A common occurrence at bouldering areas is the proliferation of informal (also known as social or visitor-created) trails and their associated impacts. These paths are created as climbers pioneer a trail to a new bouldering area that may not be accessible by a formal trail. These trails usually develop along the fastest route to the bouldering site from the parking area and between different boulders within a site. Once these social trails are established and frequency of use increases, it is highly probable that soil erosion, vegetation trampling, and multiple trails, along with other trail impacts will occur. These unplanned informal trail networks generally receive no environmental reviews and resource degradation is often severe due to their lack of professional design, construction, and maintenance. While some degree of visitor impact is unavoidable, excessive trail impacts threaten natural resource values, visitor safety, and the quality of recreational experiences.

Objectives

The main objective of this assessment is to document the number, lineal extent, spatial distribution, area of trampling disturbance, and resource condition of all informal trails accessing bouldering areas in Joe's Valley, Utah. Assessment procedures are efficiently applied through walking surveys that employ resource-grade, Global Positioning System (GPS) units providing field staff a paperless accurate method for collecting trail inventory and resource condition data. When periodically collected over time, these data assist with the monitoring of onsite resource conditions and provide long-term documentation of the existence, location, and condition of informal trails. The data also provide supporting information for management decisions, such as to evaluate which informal trails should be closed or left open, and later to evaluate the success of management efforts to close selected trails, prevent the creation of new trails, or prevent further deterioration of existing trails.

Guidance

This collection protocol should be performed at the end of peak season visitation when evidence of visitor use is most pronounced and to minimize seasonal variations in trail conditions. Collection should be done at multi-annual intervals (e.g., every three to five years). This schedule assists in locating trails that may emerge or change conditions later in the season. It is important to perform the collection consistently in time across each year to provide management with comparable data.

[1] These procedures and manual are adapted from Wimpey, J., Marion, J., and Park, L. (2011). Informal Trail Monitoring Manual. In Wimpey, J. & Marion, J. L. (2011). *Formal and informal trail monitoring protocols and baseline conditions: Great Falls Park and Potomac Gorge*. Final Research Report. U.S. Geological Survey, Distributed by the Virginia Tech College of Natural Resources & Environment, Blacksburg, VA.

Materials

- Trimble 6000 Series GeoXH GPS
    - Loaded with: 1) Informal Trail (IT) Data Dictionary, and 2) formal trail layer
    - Stylus
    - Hurricane antenna and connecting lead
    - Trimble backpack and spare external battery
- Tape measure (6ft auto-retracting)
- Paper maps showing roads and formal trail system
- Flagging tape and pin flags
- Pens and notebook

Methods

Survey staff should be familiar with study area and its visitor use patterns, particularly where visitors are most likely to depart roads, formal trails, and potential off-trail destinations (i.e., bouldering sites). Scheduling field surveys during times of optimal GPS satellite geometry may be necessary for some areas. Begin work by selecting an area (sub region of the study area) on the paper map to search. Use features such as trails, roads, and streams, along with prior survey data and personal knowledge, to divide the area into manageable units. Prior data should be used as a guide but not as an authoritative catalog of where informal trails will be found and mapped. To ensure that all informal trails are located, walk roadsides and formal trails and search the areas adjacent to each of these for informal trails.

Where possible, do not assess trails created and/or used predominantly by wildlife (e.g., deer). Such trails are generally narrow and go under low-hanging branches that would obstruct human traffic. Be spatially aware and thoroughly search along/near formal trails and features for areas that are likely to draw visitors off the formal trail network (e.g., boulders, vistas, water bodies, geographic features of interest, historic structures). In particular, beware of informal trails that depart a road or formal trail on resistance surfaces (e.g., rock, gravel, bare soil, grass) that may hide the beginning of in informal trail. Some random searching and walking transects across off-trail areas, particularly near any features of interest, are necessary to locate and map all informal trails.

When an informal trail is located and the GPS unit has a satellite fix, open and begin recording an informal trail segment feature using the IT data dictionary. Use the Condition Class descriptors below to determine and record the appropriate condition class. Do not begin walking the trail segment until the GPS has successfully recorded its first position. Walk the trail while collecting the feature until it reaches a junction or changes condition class. Assess and record the segment's average trail width (see below) and then close the segment in the GPS.

Trail width is defined as the most visually obvious outer boundary of trampling-related disturbance that receives the majority (>95%) of traffic. These boundaries are defined by pronounced changes in ground vegetation height (trampled vs. untrampled), cover, and composition; when vegetation cover is reduced or absent; by disturbance to organic litter (intact vs. pulverized); or trampling of cryptobiotic crust and/or soils. Include any secondary parallel

treads within this assessment only when they are not differentiated from the main tread by strips of less disturbed vegetation or organic matter. See Figure 1 and Figure 2 for photographs illustrating these trail boundary definitions.

When in areas or during times with poor GPS accuracy, stop at trail junctions to record an averaged IT trail junction point feature. These points will improve the accuracy of GIS data editing. After thoroughly collecting all informal trails within your sub region, make a notation on your paper map to indicate it has been collected and move on to another sub region.

Decision Rules for Collecting Informal Trail Segments

A condition class change that occurs for less 12 feet can be ignored (i.e., collect it as one segment and assign the dominant condition class to the segment). Be careful to try to avoid collecting animal trails. These trails will be narrow and have low hanging branches/ vegetation. Use your judgment and look for signs of human and animal use (footprints, litter, deer browse, etc.).

Condition Class Structure

Class 0: Trail slightly distinguishable; faint access route; trail follows drainage/wash; or trail is underlain by bedrock.
Class 1: Trail distinguishable; slight loss of vegetation cover and /or minimal disturbance of organic litter.
Class 2: Trail obvious; vegetation cover lost and/or organic litter pulverized in primary use areas.
Class 3: Vegetation cover lost and/or organic litter pulverized within the center of the tread, some bare compacted soil exposed.
Class 4: Nearly complete or total loss of vegetation cover and organic litter within the tread, bare compacted soil widespread.
Class 5: Soil erosion obvious, as indicated by exposed roots and rocks and/or gullying.

Condition Class rating descriptions applied to informal trails.

IT Photographs

Take representative photos of typical views of trails, sections that require urgent repair, maintenance features, safety concerns, or any other pertinent issues as follows: turn camera to take a vertical format photo and compose picture to get a closer view of trail tread in bottom foreground with a more distant view of trail corridor in background. Where possible, try to take these latter photos when the sun is behind clouds—the lighting will be much more even. For each photo collect a photo point feature in the data dictionary, recording the photo ID number and photo direction.

Surveying Tips

- Use the pause and resume (log) capabilities of the GPS to prevent collecting extraneous points at the beginning and end of a segment. Pause the data logger when not moving; restart it as you resume movement.

- Working in pairs or using flagging tape and or pin flags will help when the IT network is very dense. Flag sub regions on the ground and work through them individually.
    - When working a dense network work small sub areas and utilize flags and landmarks to delineate them; when collection has been completed within one flagged sub area, establish an adjacent sub area and collect it (e.g., 50-100 m long on one side of a formal trail).

- Collect IT anchor points when needed to aid in tying trail junctions to a specific location. Use the nested point feature to record trail junction, anchor, or photo point features as needed while segment logging is paused.

- Use the formal trail layer, roads layer, and paper maps as a reference.

- Keep a written field notebook record of all fieldwork, including field staff names, search areas, dates/times, and computer filenames.

Figure 1. Trail width is defined as the most visually obvious outer boundary of trampling-related disturbance that receives the majority (>95%) of traffic. These boundaries are defined by pronounced changes in ground vegetation height (trampled vs. untrampled), cover, composition, or, when vegetation cover is reduced or absent, by disturbance to organic litter (intact vs. pulverized) or lichen.

Figure 2. Trail width outer boundary defined by trampling of cryptobiotic soils (Photo by J. Porucznik).

APPENDIX D: DISPERSED CAMPSITE IMPACT ASSESSMENT MANUAL

Dispersed Campsite Impact Assessment Manual
Joe's Valley, Utah

(version 9/2014)

This manual describes procedures for conducting current resource condition assessments for dispersed campsites. It was developed for assessing conditions at dispersed campsites within Joe's Valley, Utah. Two general approaches are used for assessing campsite conditions: 1) a condition class assessment determined by visual comparison with six described levels of campsite impact, and 2) predominantly measurement-based assessments of several impact indicators. In addition, photographs are used, but without the installation of permanent reference points.

For the purposes of this manual, dispersed campsites are defined as areas of disturbed vegetation, surface litter, or soils caused by human use by overnight camping activities that are adjacent to roadways and accessible with vehicles. In areas with multiple sites or use areas, there may not always be undisturbed areas separating sites and an arbitrary decision may be necessary to define separate sites.

Assessment measurements should be taken near the middle or end of the visitor use season but before leaf fall. Site conditions generally recover during the periods of lower visitation and reflect rapid impact during early season use. Site conditions are more stable during the mid- to late-use season and reflect the resource impacts of that year's visitation.

Materials
(Check before leaving for the field)

- □ Maps
- □ Compass (corrected for declination)
- □ Reel tape (100 ft)
- □ Clinometer
- □ Blank field forms, pencils
- □ Digital camera with extra batteries and memory card
- □ Mapping-grade GPS unit
- □ Clipboard
- □ Monitoring manual

[1] These procedures and manual are adapted from Marion, J. L. & Hockett, K. (2008). *Trail and campsite monitoring protocols: Zion National Park*. Blacksburg, VA: USDI, US Geological Survey, Patuxent Wildlife Research Center, Virginia Tech Field Station.

[2] Photographs illustrating campsite boundaries, boundary flag placement, vegetative ground cover classes, soil exposure, and root exposure may be found in: Marion, J. L. (1991). *Developing a natural resource inventory and monitoring program for visitor impacts on recreation sites: A procedural manual*. (Report No. NPS/NRVT/NRR-91/06). Denver, CO: USDI, National Park Service, Natural Resources Publication Office.

General Campsite Information

1) **Date**: Month, day, and year the sites were evaluated (e.g., May 1, 2014 = 05/01/14).

2) **Surveyors**: Identify the field personnel(s) responsible for assessing the sites.

Location Description

3) **Dispersed Campsite Tag Number**: Develop predefined code/name for each dispersed campsite.

4) **Region**: The area where the dispersed campsites are located.
LF = Left Fork
RF = Right Fork
NJ = New Joe's

5) **Location**: Record the general name for the dispersed campsite if known. If a name is not known leave blank.

6) **Ownership**: Record if the location is located on US Forest Service land, Bureau of Land Management land, Utah State land, or on private property.
FS = US Forest Service
BLM = Bureau of Land Management
SITLA = State of Utah School and Institutional Trust Lands Administration
PR = Private

7) **GPS Coordinates**: Record the location of the impacted site using a resource-grade GPS unit. Try to select a reference spot that is preferably as close as possible to the middle of the largest impacted area while maintaining GPS accuracy and precision settings. If necessary, record an offset point, referencing distance and bearing to the target location.

Inventory Indicators

8) **Distance to Nearest Other Campsite**: Record the appropriate category for campsite distance (campsite boundary to campsite boundary) to the nearest other campsite**.**
(1 = <10 yds 2 = 11–20 yds 3 = 21–40 yds 4 = 41–60 yds 5 = >60 yds.)

9) **Other Campsites Visible**: Record the number of other dispersed campsites, which if occupied, would be visible from the campsite. This is a social variable to assess intervisibility.

10) **Site Visible from Road**: Record whether the campsite, if it were occupied, would be visible from the main road.

11) **Site Expansion Potential**: L= Low expansion potential - off-site areas are completely unsuitable for any expansion due to steep slopes, rockiness, dense vegetation, and/or poor drainage, M = Moderate expansion potential - off-site areas moderately unsuitable for expansion

due to the factors listed above, and H = High expansion potential - off-site areas are suitable for campsite expansion, features listed above provide no effective resistance to campsite expansion.

12) **Maximum Number of Vehicles**: Record the maximum number of vehicles the site can potentially accommodate.

13) **Distance to Water**: Record the appropriate category for campsite distance (nearest campsite boundary to water) to the nearest water source.
(1 = <10 yds 2 = 11–20 yds 3 = 21–40 yds 4 = 41–60 yds 5 = >60 yds.)

14) **Type of Water**: Record the type of water source.
(PC=Perennial Creek, I=Intermittent Creek, S=Spring, L=Lake)

15) **Site Slope**: Record the campsite slope category.
(F = <5% M = 5–10% S = >10%)

16) **Tree Canopy Cover**: Imagine that the sun is directly overhead and estimate the percentage of the campsite that is shaded by the tree canopy cover. Note: use category 5 for nearly full to full tree canopy cover over the site; use category 6 only if the cover is fairly dense or thick.
(1 = 0–5% 2 = 6–25% 3 = 26–50% 4 = 51–75% 5 = 76–95% 6 = 96–100%)

Impact Indicators

Step 1. Identify Site Boundaries. Identify site boundaries by pronounced changes in vegetation cover, vegetation height/disturbance, vegetation composition, surface organic litter, soil, and topography (refer to photographs following these procedures). Project site boundaries straight across areas where roads/trails enter the site. Many sites will have very little vegetation and it will be necessary to identify boundaries by examining soil (i.e., compacted soil compared to non-compacted soil) and organic litter (i.e., leaves and needles which are untrampled and intact compared to leaves and needles which are pulverized or absent). In defining the site boundaries be careful to include only those areas that appear to have been disturbed from human trampling. Natural factors such as dense shade can create areas lacking vegetative cover. Do not include these areas if they appear "natural" to you. When in doubt speculate on which areas typical visitors might use based on factors such as slope or rockiness.

Step 2. **Measure the Site Area.** Once the site boundaries have been identified, use a mapping grade GPS to record the site boundary. Using this data, calculate the total campsite area.

Step 3. Measure Barren Core Area. Use a mapping grade GPS to record barren core areas. These are areas within the site boundary that have no vegetation, little organic litter, and primarily exposed and/or compacted soil. Using this data, calculate the total barren core area.

Step 4. Measure Island Areas. Identify any completely undisturbed "islands" of vegetation (3x3 ft) inside campsite boundaries (often due to clumps of trees or shrubs) and “islands of exposed bedrock within the boundary (3x3 ft.). Use a mapping grade GPS to record these areas if possible. Subtract these areas from the total site dimensions.

Step 5. Measure Satellite Areas. Identify any disturbed "satellite" use areas (3x3 ft) outside campsite boundaries (often due to tent sites or cooking sites). Use campsite boundary definitions for determining the boundaries of these areas. Use a mapping grade GPS to record these areas and add this area to the total site dimensions.

Option: The Geographic Figure Method could also be used to determine the areas of these islands and satellites (refer to the diagrams at the end of the manual). This method involves superimposing one or more imaginary geometric figures (rectangles, circles, or right triangles) on island or satellite boundaries and measuring appropriate dimensions to calculate their areas. Record the types of figures used and their dimensions on the back of the form; the sizes of these areas should be computed in the office with a calculator.

17) **Condition Class**: Record a campsite Condition Class using the descriptions below. If a campsite is underlain entirely by bedrock record "-1" for this item and items 17–19 as they are not applicable for bedrock campsites. Include an explanation in the field form under Comments.

Class 0: Campsite barely distinguishable; no or minimal disturbance of vegetation and/or organic litter. Often an old site that has not seen recent use.
Class 1: Campsite barely distinguishable; slight loss of vegetation cover and/or minimal disturbance of organic litter.
Class 2: Campsite obvious; vegetation cover lost and/or organic litter pulverized in primary use areas.
Class 3: Vegetation cover lost and/or organic litter pulverized on much of the site, some bare soil exposed in primary use areas.
Class 4: Nearly complete or total loss of vegetation cover and organic litter, bare soil widespread.
Class 5: Soil erosion obvious, as indicated by exposed tree roots and rocks and/or gullying.

18) **Vegetative Ground Cover On-Site**: An estimate of the percentage of live non-woody vegetative ground cover (including herbs, grasses, and mosses and excluding tree seedlings, saplings, and shrubs) within the flagged campsite boundaries using the coded categories listed below (refer to photographs following these procedures). Include any disturbed "satellite" use areas and exclude undisturbed "islands" of vegetation. For this and the following two indicators, it is often helpful to narrow your decision to two categories and concentrate on the boundary that separates them. For example, if the vegetation cover is either category 2 (6-25%) or category 3 (26-50%), you can simplify your decision by focusing on whether vegetative cover is greater than 25%.

	1 = 0–5%	**2 = 6–25%**	**3 = 26–50%**	**4 = 51–75%**	**5 = 76–95%**	**6 = 96–100%**
Midpoints:	2.5	15.5	38	63	85.5	98

19) **Vegetative Ground Cover Off-Site**: An estimate of the percentage of live non-woody vegetative ground cover (including herbs, grasses, and mosses and excluding tree seedlings, saplings, and shrubs) in an adjacent but largely undisturbed "control" area. Use the categories listed above. The control site should be similar to the campsite in slope, tree canopy cover (extent of sunlight penetration), and other environmental conditions. The intent is to locate an area which would closely resemble the campsite area had the site never been used. In instances

where you cannot decide between two categories, select the category with less vegetative cover. The rationale for this is simply that the first visitors would have selected a campsite with the least amount of vegetation.

20) **Exposed Soil**: An estimate of the percentage of exposed soil, defined as ground with very little or no organic litter (partially decomposed leaf, needle, or twig litter) or vegetation cover, within the campsite boundaries and satellite use areas (refer to the photographs following these procedures). Dark organic soil, the decomposed product of organic litter, should be assessed as bare soil when its consistency resembles peat moss. Assessments of exposed soil may be difficult when organic litter forms a patchwork with areas of bare soil. If patches of organic material are relatively thin and few in number, the entire area should be assessed as bare soil. Otherwise, the patches of organic litter should be mentally combined and excluded from assessments. Soil covered by a shelter should be counted as exposed soil. Code as for vegetative cover above.

21–23) **Tree Damage**: Tally each live tree (>1 in. diameter at 4.5 ft.) within or on campsite boundaries to one of the tree damage rating classes described below (refer to the photographs following these procedures). **Include** trees within undisturbed "islands" and **exclude** trees in disturbed "satellite" areas. Assessments are restricted to all trees within the flagged campsite boundaries in order to ensure consistency with future measurements. Multiple tree stems from the same species that are joined at or above ground level should be counted as one tree when assessing damage to any of its stems. Assess a cut stem on a multiple-stemmed tree as tree damage, not as a stump. Do not count tree stumps as tree damage. Take into account tree size. For example, damage for a small tree would be considerably less in size than damage for a large tree. Where obvious, assess trees with scars from natural causes (e.g., lightning strikes) as None/Slight.

None/Slight.....No or slight damage such as broken or cut smaller branches, one nail, or a few superficial trunk scars.
Moderate.....Numerous small trunk scars and/or nails or one moderate-sized scar.
Severe.....Trunk scars numerous with many that are large and have penetrated to the inner wood; any complete girdling of tree (cutting through tree bark all the way around tree).

24–26) **Root Exposure**: Tally each live tree (>1 in. diameter at 4.5 ft.) within or on campsite boundaries to one of the root exposure rating classes described below. **Include** trees within undisturbed "islands" and **exclude** trees in disturbed "satellite" areas. Assessments are restricted to all trees within the flagged campsite boundaries in order to ensure consistency with future measurements. Where obvious, assess trees with roots exposed by natural causes (e.g., stream/river flooding) as None/Slight.

None/Slight.....No or slight root exposure such as is typical in adjacent offsite areas.
Moderate.....Top half of many major roots exposed more than one foot from base of tree.
Severe.....Three-quarters or more of major roots exposed more than one foot from base of tree; soil erosion obvious.

27) **Number of Tree Stumps**: A count of the number of tree stumps (> 1 in. diameter at ground and less than 4.5 feet tall) within or on campsite boundaries. **Include** trees within undisturbed

"islands" and **exclude** trees in disturbed "satellite" areas. Do not include windthrown trees with their trunks still attached or cut stems from a multiple-stemmed tree.

28) **Number of Fire Sites**: A count of each fire site within campsite boundaries, including satellite areas. Include old inactive fire sites as exhibited by blackened rocks, charcoal, or ashes. Do not include locations where charcoal or ashes have been dumped. However, if it is not clear whether a fire was built on the site, always count questionable sites that are within site boundaries and exclude those that are outside site boundaries.

29) **Access Trails**: A count of all trails leading away from the outer campsite boundaries. For trails that branch apart or merge together just beyond campsite boundaries, count the number of separate trails at a distance of 10 ft. from campsite boundaries. Do not count extremely faint trails that have untrampled tall herbs in their tread.

30) **Human Waste**: Follow all trails connected to the campsite to conduct a quick search of likely "toilet" areas, typically areas just out of sight of the campsite. Count and record the number of individual human waste sites, defined as separate locations with human feces present. The intent is to identify the extent to which improperly disposed human feces is a problem.

31) **Litter**: Litter in the impact zone is recorded along with trash visible when standing in the zone. Mentally extend the zone boundaries out into the adjacent area to decide which zone to record any trash in. Include off-site lumber and trash found in fire rings. Use comment section to note on the presence of pet waste.

None……..No litter/trash present
Small…….Micro trash (tape, cigarette butts, candy wrappers, etc.)
Medium…...Obvious, not wide spread. Include foil and glass in fire rings
Large……Excessive, wide spread

32) **Comments**: An informal list of comments concerning the campsite: note any assessments that you felt were particularly difficult or subjective, problems with monitoring procedures or their application to this particular campsite, potential hazards (e.g., traffic, flooding, power lines), descriptions of particularly significant impacts beyond campsite boundaries (quantify if possible), excessive litter, human waste, or any other comments you feel may be useful.

Site Photographs: Select a vantage point that provides the best view of the site. Try to select a location that clearly shows the impact zone. Set the camera lens at a consistent, preferably wide angle and focal length. Take photos with the camera pointed down to include as much of the campsite groundcover as possible. If more than one photograph is needed document each image.

33) **Photo ID Number**: Record the photo file number.

34) **Photo Direction**: Record the direction the photo being taken. Use standard codes (e.g., N = North, SW = Southwest).

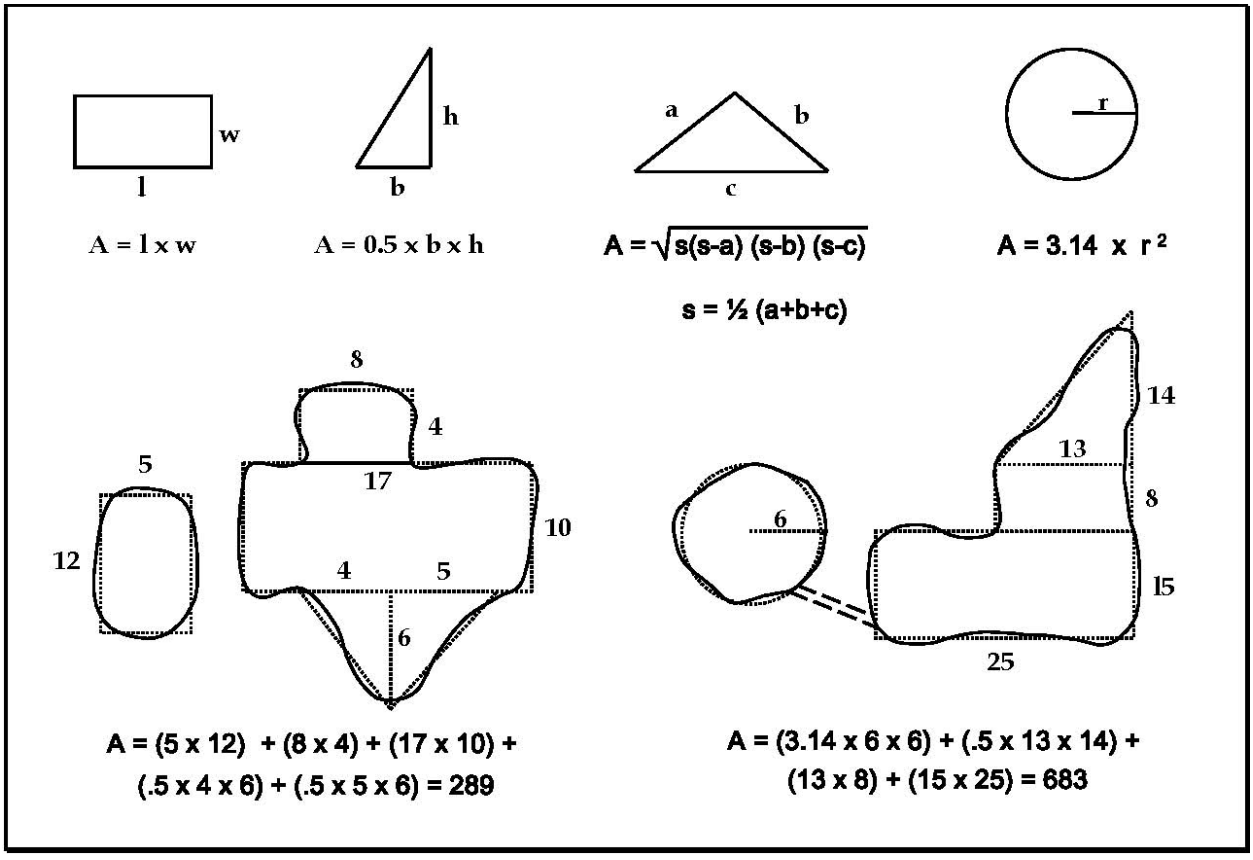
35) **Camera Site Waypoint**: If possible GPS coordinates should be taken at the camera site. Use the Photo ID Number to document in GPS data dictionary and record waypoint on the form.

36) **Photo Notes**: Comment on photo if needed.

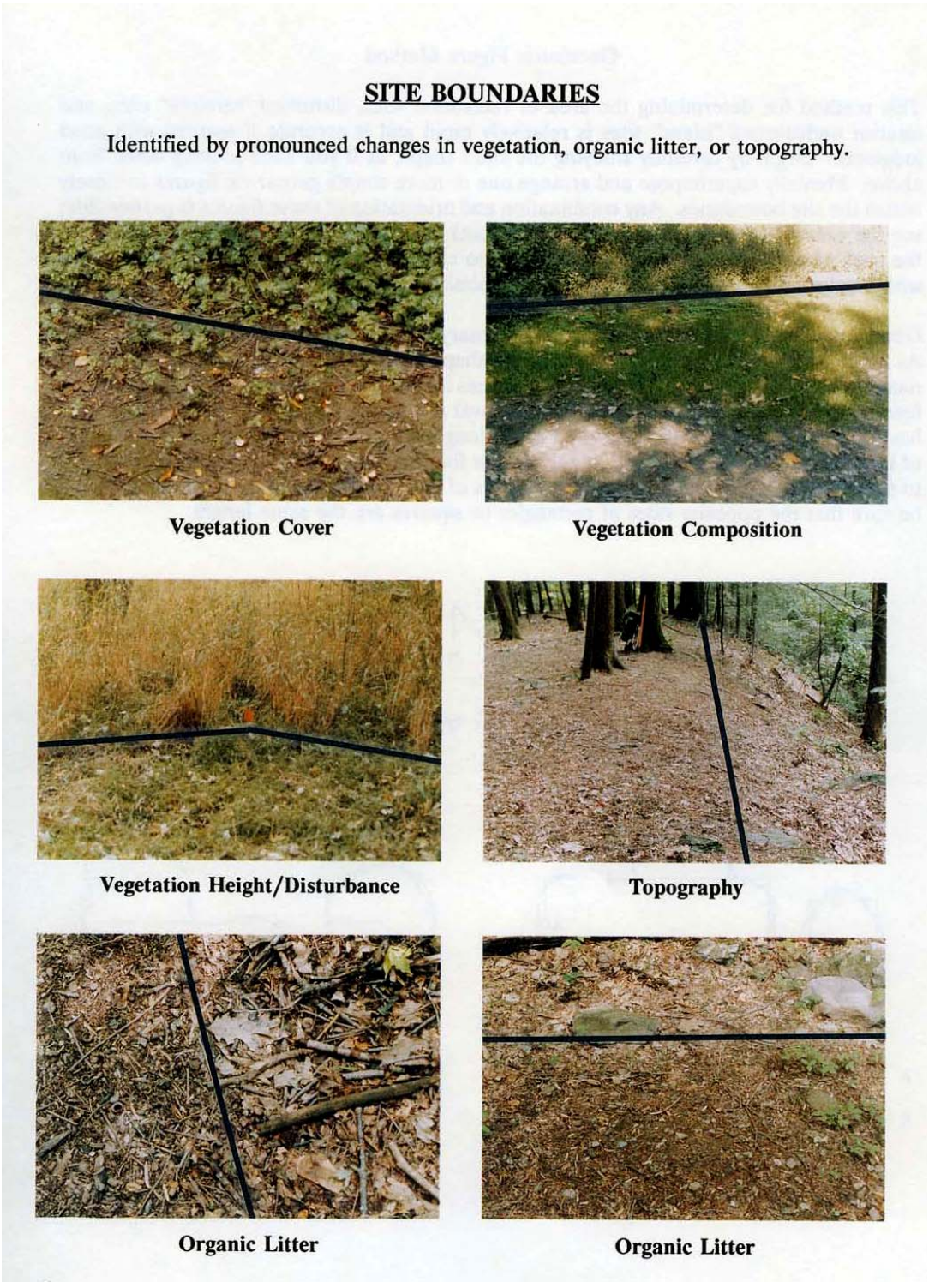
Geometric Figure Method

This method for determining the area of campsites, disturbed "satellite" sites, and interior undisturbed "island" sites is relatively rapid and can be quite accurate if applied with good judgment. Begin by carefully studying the campsite's shape, as if you were looking down from above. Mentally superimpose and arrange one or more simple geometric figures to closely match the campsite boundaries. Any combination and orientation of these figures is permissible, see the examples below. Measure (nearest 1/10th foot) the dimensions necessary for computing the area of each geometric figure. It is best to complete area computations in the office with a calculator to reduce field time and minimize errors.

Good judgment is required in making the necessary measurements of each geometric figure. As boundaries will never perfectly match the shapes of geometric figures, you will have to mentally balance disturbed and undisturbed areas included and excluded from the geometric figures used. For example, in measuring an oval campsite with a rectangular figure, you would have to exclude some of the disturbed area along each side in order to balance out some of the undisturbed area included at each of the four corners. It may help, at least initially, to place plastic tape or wire flags at the corners of each geometric figure used. In addition, be sure that the opposite sides of rectangles or squares are the same length.



(Marion & Hockett, 2008, p. 74).



(Marion, 1991, p. 46).

Site Boundary

Identified by pronounced change in soil (i.e., compacted compared to non-compacted).

(Photo by J. Porucznik).

SITE BOUNDARIES

Yellow triangles indicate flagged pin locations which delineate site boundaries.

Site boundaries determined by pronounced changes in vegetation cover.

Site boundaries determined by pronounced changes in vegetation height/disturbance.

(Marion, 1991, p. 47).

VEGETATIVE GROUND COVER

Live non-woody vegetative ground cover (including herbs, grasses, and mosses).

1=0-5%

2=6-25%

3=26-50%

4=51-75%

5=76-95%

6=96-100%

(Marion, 1991, p. 48).

SOIL EXPOSURE

Areas of predominantly bare soil; very little or no organic litter or vegetation cover.

Organic litter on left is pulverized but still covers underlying organic and mineral soil. Dark organic soil on right, which covers lighter colored mineral soil, should be assessed as bare soil.

As organic litter is pulverized and eroded from sites the remaining materials often clump together, resulting in a patchwork of organic litter and bare soil which is difficult to evaluate. If patches of organic material are relatively thin and few in number, as illustrated in the photo above, the entire area should be assessed as bare soil. Otherwise, the patches of organic litter should be mentally combined and excluded from assessments.

(Marion, 1991, p. 49).

TREE DAMAGE

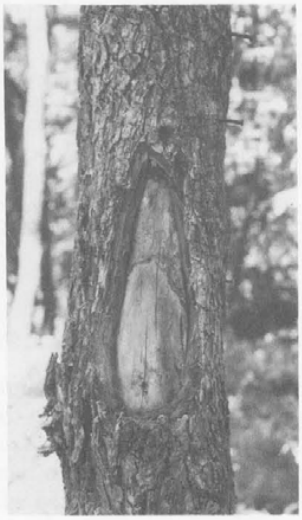
NONE/SLIGHT

MODERATE

NONE/SLIGHT: No or slight damage such as broken or cut smaller branches, 1 nail, or a few superficial trunk scars.

MODERATE: Numerous small trunk scars and nails or 1 moderate sized scar.

SEVERE: Trunk scars numerous with many that are large and have penetrated to the inner wood; any complete girdling of tree.



SEVERE

50

(Marion, 1991, p. 50).

ROOT EXPOSURE

NONE/SLIGHT: No or slight root exposure such as is typical in adjacent offsite areas.

MODERATE: Top half of many major roots exposed more than 1 foot from base of tree.

SEVERE: Three-quarters or more of major roots exposed more than 1 foot from base of tree; soil erosion obvious.

NONE/SLIGHT

MODERATE

SEVERE

(Marion, 1991, p. 51).

Joe's Valley Dispersed Camping Impact Assessment Form

General Site Information

1) Date:_____ 2) Surveyors:_____

3) Dispersed Campsite Tag No:_____

4) Region:_____ 5) Location Name: _____ 6) Ownership:_____

7) Waypoint:_____

Inventory Indicators

8) Distance to Nearest Other Campsite: (Use categories below) _____

(**1** = <10 yds **2** = 11–20 yds **3** = 21–40 yds **4** = 41–60 yds **5** = >60 yds.)

9) Other Campsites Visible: (#) _____

10) Site Visible from Road: (**Y** = Yes, **N** = No) _____

11) Site Expansion Potential: (**L** = Low, **M** = Medium, **H** = High) _____

12) Maximum Number of Vehicles: (#) _____

13) Distance to Water: (Use categories below)

(**1** = <10 yds **2** = 11–20 yds **3** = 21–40 yds **4** = 41–60 yds **5** = >60 yds.) _____

14) Type of Water: (**PC** = Perennial, **I** = Intermittent, **S** = Spring, **L** = Lake) _____

15) Site Slope: (**F** = <5% **M** = 5-10% **S** = >10%) _____

16) Tree Canopy Cover: _____

(**1** = 0–5% **2** = 6–25% **3** = 26–50% **4** = 51–75% **5** = 76–95% **6** = 96–100%)

Impact Indicators

17) Condition Class: (0–5) _____

18) Vegetative Ground Cover On-Site: (Use categories below) _____

(**1** = 0–5% **2** = 6–25% **3** = 26–50% **4** = 51–75% **5** = 76–95% **6** = 96–100%)

Midpoints: 2.5 5.5 38 63 85.5 98

19) Vegetative Ground Cover Off-Site: (Use categories above) _____

20) Exposed Soil: (Use categories above) _____

21–23) Tree Damage: None/Slight _____ Moderate _____ Severe _____

24–26) Root Exposure: None/Slight _____ Moderate _____ Severe _____

27) Tree Stumps: (#) _____

28) Fire Sites: (#) _____

29) Access Trails: (#) _____

30) Human Waste: (#) _____

31) Litter: (**N**=None, **S**=Small, **M**=Medium, **L**=Large) _____

Comments:_____

_____

_____

_____

_____

_____

_____

Site Determination:

Satellite Site Dimensions

Island Site Dimensions

Site Dimensions (office) _____

+ Satellite Area _____

- Island Area _____

= Total Site Area _____ ft²

Total Barren Core (office) _____

Photo Documentation

Photo ID #	Photo Direction	Camera Site Waypoint	Notes