



Bumpass Hell Trail Visitor Use Improvements Environmental Assessment

March 2018



Bumpass Hell Basin from Eastern Overlook

Lassen Volcanic National Park
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Table of Contents

Table of Figures	i
List of Tables	ii
Chapter 1: Purpose of and Need for Action	1
A. Purpose.....	1
B. Need	1
C. Background	2
D. Issues and Impact Topics from NPS, Tribal and Public Scoping	3
E. Issues and Impact Topics Considered but Dismissed.....	3
F. Decision to be Made.....	3
G. Summary of Public and Tribal Scoping	4
H. Federal, State, Local Permits and Consultation Requirements	5
Chapter 2: Alternatives, Including the Proposed Action	6
Description of the Alternatives	6
Alternative 1: No Action (Continue Current Management)	6
Alternative 2: Expand Opportunities for Visitor Use (Preferred Alternative)	10
Alternative 3: Improve Visitor Use	13
List of Alternatives and Actions Considered but Eliminated from Detailed Study	15
Chapter 3: Affected Environment and Environmental Consequences	20
Environmental Impact Analysis.....	21
Soils and Geology (including Hydrothermal Resources)	21
Water Resources (Water Quality).....	25
Water Resources (Wetlands)	26
Vegetation.....	28
Archeological and Historic Resources.....	29
Visitor Experience	32
Human Health and Safety.....	35
Chapter 4: Consultation and Coordination	42
A. Internal Scoping	42
B. Native American Indian Tribes Consulted	42
C. Public Involvement	42
D. Agencies Consulted.....	42
E. List of Preparers, Persons, Agencies Contacted	43
F. List of Agencies, Organizations, and Persons to Whom Copies of the EA were Sent (Double check)	43
Chapter 5: References.....	44

Table of Figures

FIGURE 1: PROJECT AREA ALTERNATIVE 1	7
FIGURE 2 BROKEOFF VOLCANO OVERLOOK	8
FIGURE 3: BUMPASS HELL OVERLOOK.....	8
FIGURE 4: LOWER BASIN OVERLOOK.....	8
FIGURE 5: SPLINTERS FROM TREATED WOOD.....	9
FIGURE 6 ALTERNATIVES 2 AND 3	11
FIGURE 7: BIG BOILER OVERLOOK	12
FIGURE 8: OUTER BASIN OVERLOOK	13
FIGURE 9: INNER BASIN OVERLOOK	14
FIGURE 10: TRAIL THROUGH SILVERY LUPINE MEADOW	15
FIGURE 11: HYDROTHERMAL AND VOLCANIC FEATURES IN THE PARK AND VICINITY	22
FIGURE 12: BUMPASS HELL CONTAINS MANY FUMARoles, MUD POTS, AND ACID HOT SPRINGS. BIG BOILER IS A SUPERHEATED FUMAROLE WITH TEMPERATURES AS HIGH AS 161° F.	23
FIGURE 13: DENUDED "TRAILSIDE ROCKS" AREA	24
FIGURE 14: ABANDONED ACCESS TRAIL THROUGH WETLAND	27
FIGURE 15: DETERIORATED BRIDGE ON ABANDONED ACCESS TRAIL	28
FIGURE 16: PROPOSED BUMPASS HELL TRAIL ALIGNMENT	30
FIGURE 17: BUMPASS HELL TRAIL CONSTRUCTION.....	31
FIGURE 18: DETERIORATED ROCK WALLS TRAIL SECTION.....	32
FIGURE 19: EARLY HAZARD WARNING SIGN	36

List of Tables

TABLE 1: ALTERNATIVE COMPARISON CHART	16
TABLE 2: IMPACT COMPARISON CHART	39

Chapter 1: Purpose of and Need for Action

A. Purpose

Improve the trail surface and ease of maintenance on the Bumpass Hell Trail to facilitate safe visitor access to and within the Bumpass Hell Basin while preserving natural and historic resources and wilderness values, improving interpretive opportunities, accessibility, and accommodating high use.

B. Need

- Designated trails to and within the Bumpass Hell Basin are important to provide safe visitor access and resource protection. Because of the risk of serious injury or death, off-trail travel is both extremely dangerous and prohibited in the hydrothermal area.
- Trails to and within the Bumpass Hell Basin are some of the most heavily visited in the park. The area is often crowded, especially on weekends and when school groups are present.
- Accommodating groups is important to prevent the increased potential for off-trail travel.
- The Bumpass Hell Basin presents safety hazards to visitors and employees because of frequent changes in hydrothermal features, including the location and distribution of boiling pools, mudpots, steam vents and other thermal features.
- The existing boardwalk requires frequent maintenance, including rebuilding sections damaged by the heavy annual snow load which often causes portions of the boardwalk to shift and collapse.
- Encroachment of thermal features and the dynamic, ever-changing environment threatens safety and creates a constant need for maintenance and management of trails and the boardwalk within the basin.
- Repairs are difficult and expensive. Relocating the boardwalk is not always possible because of nearby hydrothermal features and/or unstable soils. Recently, a large hydrothermal feature, the pyrite pool, undermined the eastern end of the boardwalk, which had to be removed. The proximity of hydrothermal features in this area prevented relocation of this section of the boardwalk.
- Where trails in the basin are not well-delineated, they may encourage off-trail travel.
- Boardwalk construction materials may be affecting area resources. There are concerns about the impacts of wood splinters, which litter the area, and the leaching of copper or other toxins from treated wood.
- The trail that descends into the basin presents safety hazards (from the potential for slips and falls) during early season use.
- Reopening the abandoned access trail into the basin could provide improved early season ingress and egress, and opportunities to see wetlands and frypans, diversifying the visitor experience.
- The closest restroom is at the trailhead parking area, approximately 1.5 miles from the basin and some visitors have expressed a desire for one located further in on the trail.
- Wayside exhibits have exceeded their useful lives, requiring reconstruction and new information.
- Expansion of overlooks would accommodate increased visitation, including for school groups.
- Views from within and outside the Bumpass Hell Basin are obscured by vegetation.
- A flexible boardwalk that can be moved to coincide with future changes in the locations of hydrothermal features would have fewer resource impacts.
- Proposed modifications to the Bumpass Hell boardwalk resulted in a range of visitor comments that call for improving accessibility and maintaining an “up-close” and intimate full sensory visitor experience in the Bumpass Hell Basin.

This range of needs is important to address to preserve park resources, improve visitor experience and prevent safety problems for both visitors and staff using the area, especially on the boardwalk (which is stable at the present time, but is anticipated to become unstable and unusable), and off-trail travel (which can lead to exposure to high temperature and/or acidic water and gases).

C. Background

Park Guidelines for Access to Hydrothermal Sites

Entering into or upon any hydrothermal area other than by using the trails and boardwalks provided is prohibited.

Hotpotting, hottubbing or any other form of bathing in hydrothermal areas or waters issuing from hydrothermal sources is prohibited.

Throwing, kicking, or otherwise placing any object into hydrothermal areas is prohibited. . .

The Bumpass Hell Trail is closed to all visitors between the Bumpass Hell parking area and the Bumpass Hell caldera at such times when the trail is unsafe and/or when undue damage to resources may occur. This closure will be posted at the Bumpass Hell parking area trailhead, the Lake Helen trailhead, the western end of Bumpass Hell Trail leaving the hydrothermal area, the Kings Creek Trail and the Kings Creek Picnic Area.

. . . Boardwalks provide protection from geological hazards due to thin-crust ground, hot water and mud. Walking off designated walkways exposes travelers to hazards such as breaking through apparently firm ground potentially causing injury and death. Hydrothermal areas also present inherent hazards to visitors and employees. These sites are fragile geological and biological resources susceptible to irreversible degradation and damage.

Visiting the Bumpass Hell Basin is one of the most popular visitor activities in Lassen Volcanic National Park, making trails to and within the basin some of the most heavily used in the park. Bumpass Hell has the largest concentration of hydrothermal features in the park. Like the Lassen Peak Trail, visiting this area is one of the premiere park activities and is tied directly to the creation of the park, which was established to recognize this active volcanic landscape after Lassen Peak erupted. The park receives an average of 450,000 visitors per year.

“The Lassen Volcanic Center hosts far and away the most extensive hydrothermal system in the Cascade arc . . . The surface manifestations of the hydrothermal system include steam vents and hot springs, and alteration of the surface rocks by acidic water and gases creates unstable hazardous ground.” (Clynne *et al.* 2012:19). The hydrothermal area is related to the area’s abundant groundwater, permeable rock and a heat source at depth (Clynne *et al.* 2012:19). USGS monitoring has noted that the movement of hydrothermal features (pools, fumaroles and mudpots) is inevitable, but unpredictable (NPS USGS 2014).

Trails are developed to provide improved safety for visitor access, enhance visitor experience, and to protect park resources. In the Bumpass Hell Basin, designated trails, including the current boardwalk, provide safe visitor access to and opportunities for close observation within the park’s largest hydrothermal area. Currently, visitors travel by foot along the main trail from the Bumpass Hell parking area into the basin where they can traverse a boardwalk that takes them into the dynamic hydrothermal landscape. The Bumpass Hell Trail also connects to the Kings Creek Trail, which traverses the southern ridgeline of the basin offering interior views of the area. The trail continues past Bumpass Hell basin to Cold Boiling Lake and Kings Creek Picnic Area.

The park’s General Management Plan (2003) described the need for physical improvements to protect resources and improve information for visitors in this heavily used area. Physical improvements will be undertaken for resource protection purposes such as redesigning Bumpass Hell Trail in locations where resource damage is occurring, and realignment of portions of Lassen Peak Trail to bypass late season snow

fields (NPS LAVO 2003:22). Recent assessment and maintenance requirements confirm the need for a comprehensive plan to address visitor safety needs and resource protection.

The original trail was constructed in 1935 by the Civilian Conservation Corps (CCC) and did not include a boardwalk, instead it used an on-ground trail to navigate the basin. Initial designs for a boardwalk were developed in 1957; however, it is unlikely one was constructed at that time. Later, in 1973, an environmental assessment to construct a partial boardwalk through the area was completed. Since boardwalk construction, numerous sections have been replaced or reconstructed. The most recent reconstruction was in 2002. When completed it was approximately six-feet wide and 1,135 feet long (including a new section approximately 390 feet long). Some

sections included cable railing (1,050 linear feet) and some sections included wood railing (665 linear feet). Other areas were stabilized, some overlooks were enlarged, and interpretive features modified. The boardwalk was most recently comprised of a combination of pressure-treated wood, recycled plastic lumber and fiberglass decking.

In 2005, a large section of the boardwalk was pushed off its supports during heavy snowloads and had to be rebuilt. More recently, in 2015, a section of the boardwalk that was in danger of falling into the pyrite pool was removed. Dynamic and moving hydrothermal features continue to make it difficult to maintain the boardwalk. Other ongoing issues associated with maintenance of the boardwalk include the need to repeatedly tighten screws, splintering of treated wood from weathering and frequent snow damage. Concerns have also been raised about the potential for copper leaching from the treated wood used in some parts of the boardwalk because of its propensity to splinter in the harsh conditions.

D. Issues and Impact Topics from NPS, Tribal and Public Scoping

The following impact topics are considered in this EA: soils and geology (hydrothermal resources), water resources (water quality and wetlands), vegetation, archeological and historic resources, visitor experience (including visitor use opportunities, and interpretation and education), and human health and safety. These are the resources of concern that may be affected by the range of alternatives considered in this Environmental Assessment (EA).

E. Issues and Impact Topics Considered but Dismissed

Issues and impact topics were dismissed from further evaluation if:

- they do not exist in the analysis area, or
- they would not be affected by the proposal, or the likelihood of impacts are not reasonably expected, or
- through the application of mitigation measures, there would be no measurable effects from the proposal.

The following topics were eliminated from detailed study because there would be minimal or no potential impacts: air quality, water resources (hydrology and water quantity), fish and wildlife, socioeconomics, wilderness, wild and scenic rivers, Indian trust resources, and environmental justice.

In accordance with the Endangered Species Act, the National Park Service contacted the U.S. Fish and Wildlife Service database on February 2, 2018 to confirm that no federally listed species or habitat occurs in the park. Because there are no federally listed species that occur in the park, there would be no effect on the listed species or their habitat. Therefore, there is no requirement for additional consultation with the Endangered Species Act. U.S. Department of the Interior (USDOI) policy requires either an analysis or specific dismissal of Indian trust resources (Executive Order 13007).

No Indian trust resources are in the park; therefore, Indian trust resources were dismissed as an impact topic in this EA.

USDOI policy requires either an analysis or specific dismissal of environmental justice (Executive Order 12898). Mineral, Shingletown, Chester and other communities surrounding the park contain both minority and low-income populations; however, environmental justice was dismissed as an impact topic for the following reasons:

- The impacts associated with implementation of the preferred alternative would not disproportionately affect any minority or low-income population or community.
- Implementation of the preferred alternative would not result in any identified effects, including human health effects, specific to any minority or low-income community.

No measureable impacts on the socioeconomic environment would occur as a result of implementation of the alternatives. Impacts on the socioeconomic environment would not affect the physical or social structure of nearby communities.

F. Decision to be Made

This EA evaluates impacts on park resources and will be used by the NPS Pacific West Regional Director to make a decision, based on a recommendation from the Superintendent of Lassen Volcanic National Park, about whether and how to rehabilitate the Bumpass Hell Trail. This decision will be documented in the proposed Finding of No

Significant Impact (FONSI) for this EA. If the EA reveals significant impacts on park resources from the project, an Environmental Impact Statement and Record of Decision would be prepared.

G. Summary of Public and Tribal Scoping

Public Scoping Summer 2015

The general public, federal, state, local agencies and organizations were provided an opportunity to identify issues and concerns regarding the potential effects of constructing a new trail or boardwalk. Internal scoping for the proposal began in summer 2014 with field site visits and internal meetings held to gather comments from park and other NPS staff with expertise in trails, vegetation, wildlife, water resources and planning. During this initial public scoping, visitors were presented with several potential ideas, including removing the boardwalk and constructing a new trail in potential wilderness.

In summer 2015, the options presented for consideration by the public included:

Option 1: The portion of the boardwalk currently being overtaken by the pyrite pool would be removed. To remediate anticipated future maintenance and safety concerns associated with the remaining boardwalk, the entire boardwalk would be removed and access to the basin would occur via a loop trail that would be constructed by creating a trail on the north slope of the basin that would tie into existing trails surrounding the basin.

Option 2: The portion of the boardwalk currently being overtaken by the pyrite pool would be removed. The remaining boardwalk would stay in place and would be stabilized. Existing overlooks and the terminuses of the remaining boardwalk sections would be enlarged to accommodate larger groups of people.

Option 3: Same as Option 2 plus: an additional loop trail would be constructed around the basin by building a new trail along the northern slope of the basin that would tie into existing trails surrounding the basin and allow a different view of the hydrothermal features (NPS LAVO 2015).

Public Comment Summary

- Nine comments were received. Of these six did not support removal of the boardwalk.
- Two of the nine commenters supported removal of the boardwalk.
- Those who did not support removal of the boardwalk cited the unique experience of being within the midst of the volcanic hydrothermal features instead of overlooking them from a distance:
- One commenter also mentioned the historic nature of the experience as a reason for retaining it.
- Another commenter noted that the observation areas should not be expanded to reduce overall resource/viewshed impacts.
- Several commenters also identified the need to provide safe visitor access to this area,
- Another commenter suggested a potential guided visitor experience (formal bus-assisted tour) to improve safety in visiting the basin in lieu of a reestablishing the boardwalk.
- One commenter encouraged the placement of warning signs for visitors because of the presence of hydrogen sulfide gases.
- Place signage at the entrance to the Bumpass Hell trail spelling out the potential for sensitive people to experience respiratory distress when breathing the volcanic emissions in the basin.

Impact topics and issues for this plan were also identified based on federal laws, regulations and executive orders, Management Policies (NPS 2006) and NPS and USGS knowledge of resources in the park.

Alternatives Scoping Spring 2017

Additional alternatives scoping was held in spring 2017. A preliminary range of five alternatives were presented to the public and comments sought. Twenty-seven comments were submitted via the NPS Planning, Environment and Public Comment (PEPC) website. Commenters came from five nearby communities, 11 states, and one foreign country (Australia). No comments were received from public entities (agencies or local governments).

Among the suggestions for the alternatives included:

- Considering options for access from the eastern overlook to the pyrite pool;
- Locating a backcountry toilet closer to the Bumpass Hell Basin;
- Adding interpretive information to the eastern overlook;
- Adding benches along the trail
- Providing for accessibility to the Bumpass Hell Basin overlook;
- Adding benches and more interpretive information at the Bumpass Hell Basin overlook;
- Concerns about potential wilderness impacts from locating a new trail around the basin; and
- Concerns about increasing safety hazards and the loss of the immersion in the hydrothermal area should the boardwalk be removed.

There was little support for removing the boardwalk or for alternatives that dramatically reduced its length. Most people favored flexibility regarding the existing boardwalk and improvements to the visitor experience. There was quite a bit of support for making the trail as accessible as possible up to the Bumpass Hell Overlook; however, many commenters noted that they would be satisfied with any one of the boardwalk alternatives. Approximately one-third of commenters made a specific comment about the unique experience/benefits of being within the basin on the boardwalk.

A few commenters were enthusiastic about the webcam, questioned the feasibility of a backcountry toilet, and/or voiced disapproval of potential impacts from adding another new trail around the basin.

H. Federal, State, Local Permits and Consultation Requirements

Proposed rehabilitation of the abandoned section of trail into the basin could require consultation with the U.S. Army Corps of Engineers under a nationwide wetlands permit. A small area of wetlands is traversed by deteriorated historic sections of trail and bridges.

Chapter 2: Alternatives, Including the Proposed Action

This chapter describes the alternatives. An *Alternative Comparison Chart* (Table 1) simplifies the differences among the alternatives and an *Impact Comparison Chart* (Table 2) compares their environmental effects.

Three alternatives are described. The no action (continue current management) alternative is intended to describe the existing state of the Bumpass Hell area management and its impacts on resources. The action alternatives are intended to achieve improved management conditions, such as improved visitor use opportunities, trail conditions and interpretation. The alternatives were generated using interdisciplinary team analysis, public scoping and consultation with applicable agencies and organizations, and are consistent with NPS Management Policies (NPS 2006).

Description of the Alternatives

Alternative 1: No Action (Continue Current Management)

Under Alternative 1, management of the Bumpass Hell Trail would include ongoing maintenance, existing plans and currently approved actions and seasonal repairs to the trail and boardwalk.

The trail to the Bumpass Hell Basin begins from the Bumpass Hell parking area and continues to an overlook above the basin. From there, the main trail descends to the lower basin. An abandoned trail forks off the main trail partway down. For much of the past 42 years, a boardwalk to provide closer access hydrothermal features has been provided. Eventually the trail ascends toward Cold Boiling Lake and on to the Kings Creek Picnic Area. It is the trail to and within the basin that is the subject of this plan.

The Brokeoff Overlook includes a large wayside with a stone base and three panels identifying views of the surrounding terrain (Figure 2 center). The disturbed area is fairly extensive (approximately 2,586 square feet) and includes a way trail to a lower overlook (Figure 2 left and right). Trails lead to and from the overlook on the main trail.



Figure 2 Brokeoff Volcano Overlook

The Bumpass Hell Basin Overlook (Figure 3) is smaller than the Brokeoff Volcano Overlook at approximately 1,124 square feet. It contains a wayside and adjacent bench. It is often a waiting area for visitors who do not descend to the lower basin. It is also used for gathering groups prior to the descent. In the 1930s and beyond, it contained a pit toilet concealed in nearby trees.

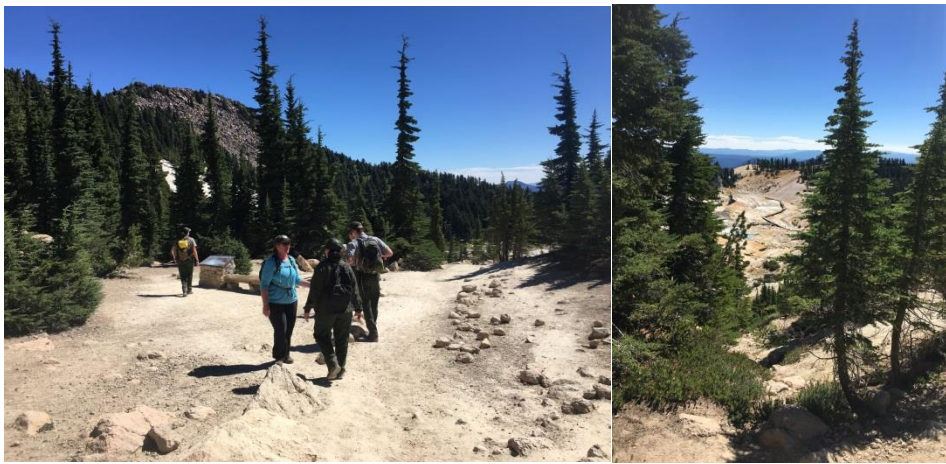


Figure 3: Bumpass Hell Overlook

The Lower Basin Overlook (Figure 4) is the first one reached upon descending into the Bumpass Hell Basin. It offers a distant view of the Big Boiler fumarole and includes a recently constructed split rail fence and a few large boulders.



Figure 4: Lower Basin Overlook

The Outer Basin Overlook is an informal turnout on the trail as it ascends out of the basin toward Cold Boiling Lake. This relatively open area does not contain interpretive signs.

The Eastern Overlook offers a classic view of the Bumpass Hell Basin and boardwalk looking west toward the Bumpass Hell overlook (see front cover), and is sparsely covered with vegetation and scattered rocks.

Boardwalk

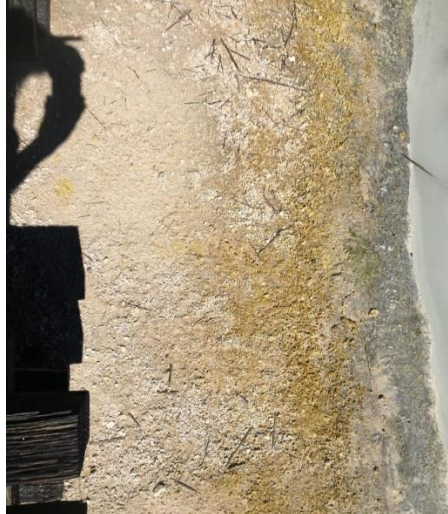


Figure 5: Splinters from Treated Wood

The Bumpass Hell Basin boardwalk would be retained/reconstructed in its former configuration and width, with its terminus as close to the Pyrite Pool as possible. As necessary, the boardwalk would be repaired and materials, such as the kickrail and handrail, replaced as needed. Depending on the movement of hydrothermal features, sections could be rerouted or removed. Treated wood could continue to be replaced with plastic lumber. Treated wood has adverse effects on the surrounding terrain, littering the ground beneath the boardwalk as the wood deteriorates in the harsh environment (Figure 5).

Elements Common to Alternatives (2 and 3) (ECA)

Several ideas that emerged from internal and public scoping would be included in the action alternatives. These include opportunities to:

- Delineate the Bumpass Hell Basin and Brokeoff overlooks to improve opportunities for group use.
- Improve overlooks by adding seating made from natural materials and updating or rehabilitating interpretive information, including interpretive panels.
- Improve safety on the Bumpass Hell Trail by removing obstacles (e.g. fill trail where large angular rocks protrude or remove the rocks); widening pinch points; stabilizing slopes near pinch points; and improving opportunities for shoulder season use.
- Improve accessibility on the Bumpass Hell Trail by restoring the trail to its original width and accessible grade where possible, and improve tread by decreasing roughness. Although the trail cannot meet the Section 1017 standards set for in the Architectural Barriers Act guidelines (obstacles of two inches or less), many sections can meet the standards for an accessible grade and width.¹
- Improve the consistency of seating (rocks, benches, or low rock walls) and barrier (railing, fencing, or post and cable) designs.
- Revegetate disturbed areas.

A variety of safety improvements would be made. Included would be development of a safety operations plan for Bumpass Hell and other hydrothermal areas to address visitor use, routine and cyclic maintenance and construction, and emergency operations. Safety signage and barriers would be added and/or modified (as appropriate to the alternative) to address being in the presence of steam/fumes.

To improve access, the Bumpass Hell Trail would be restored to its original width (approximately 4'). The trail tread would be evened, improving travel on the trail surface. Grade would be restored to 6% where feasible.

The current trail descending into the basin would be improved, retaining and adding wider steps to minimize the potential for slips and falls during early spring descents.

¹ Section 1019 Exceptions: Two conditions do not permit full compliance with Section 1017: terrain and compliance with NHPA. Section 1017.1, Exception 1: When an entity determines that a condition in 1019 does not permit full compliance on a portion of a trail, the portion of the trail shall comply with the provision to the extent practicable. 2. After applying Exception 1, when an entity determines that it is impracticable for the entire trail to comply with 1017, the trail shall not be required to comply with 1017.

Wayside exhibits along the Bumpass Hell trail are from numerous time periods. Some contain misleading or inaccurate information, based on today's knowledge about park resources. Outdated waysides would be rehabilitated or replaced with a consistent form, structure and content. New waysides would be added or removed as needed.

Areas near the Bumpass Hell Trail have deteriorated from user-created social trails (unofficial trails with no destination) and way trails (unofficial trails with a destination). These trails were created from accessing nearby points of interest as well as from unconfined use in overlooks and in some other areas along the trail. Under the action alternatives, these areas would be restored, with revegetation projects planned over time to reduce the incidence of unnatural denuded areas adjacent to the trail. Among the areas that would be restored would be areas beyond the proposed improvements at the Bumpass Hell and Brokeoff Volcano overlooks, the relict gravel-filled trail through the meadow that accessed a former pit toilet, and the area with large flat rocks along the trail, which appears to be a popular rest stop. This area contains quite a few social trails, many emanating from alongside the mostly flat rocks; however these trails do not access viewpoints or other points of interest and are therefore in need of restoration to limit impacts to vegetation, soil and scenic resources.

In addition, the splinters littering the ground from current boardwalk's treated wood would be removed from the Bumpass Hell Basin.

Alternative 2: Expand Opportunities for Visitor Use (Preferred Alternative/Proposed Action)

In addition to the actions identified in the Elements Common to Alternatives 2 and 3 (ECA) Alternative 2 would include a variety of changes to expand opportunities for visitor use, while continuing to protect park resources.

Bumpass Hell Trail

Main Trail: There would be a range of existing and new opportunities for visitors, such as continued access to the Bumpass Hell Basin and an improved trail tread to Bumpass Hell Overlook. All alternatives would improve passage at the pinch points via trail widening. This would be accomplished by restoring stone retaining walls, removing slough, and rehabilitating trail tread to historic levels. Importantly, the modifications would be such that the trail would retain the same alignment and preserve character-defining features noted in the Determination of Eligibility (the analysis that states that the Bumpass Hell Trail is eligible for listing in the National Register of Historic Places).

Beginning with the connection of the trail to the Bumpass Hell parking area, the trail would be restored to its original width (approximately 4-feet) and mild (approximately 6 percent) grade, improving the surface, where possible, to provide for visitors with mobility impairments to use on their own or with assistance. In several short sections, for instance, where the trail exceeds grades of 15 percent, although the trail would be ramped, outside retaining walls constructed, and the trail filled to reduce the grade as much as possible, it would likely be steeper than 6 percent.

The Bumpass Hell Trail, improved by the Civilian Conservation Corps (CCC) in the 1930s, is important for its alignment, constructed features, and the ability of visitors to traverse the Bumpass Hell Basin. Some of its historic components, such as dry-stack rock retaining walls, have collapsed, although evidence of their construction is clear. Under Alternative 2, these features would be reconstructed or rehabilitated, according to the Secretary of the Interior's Standards, pulling up material that has sloughed off and adding adjacent compatible rock. Other features, such as rock lining of some parts of the trail would be retained and/or rehabilitated where needed.

Abandoned Access Trail: An historic trail to the Bumpass Hell Basin that has been abandoned since the early 1990s would also be rehabilitated, improving tread and drainage by replacing water crossings, including a bridge (approximately 3 x 6 feet) (Figure 15) and constructing a short section of boardwalk (approximately 3 x 20 feet) through area wetlands (Figure 14). This trail was the primary access to the Bumpass Hell Basin before it was abandoned and the trail that traverses the west slope was constructed. It provides better shoulder season access since it is less steep and melts out before the existing trail. It also includes some features not accessed by the other trail, including a close-up look at frypans and area native vegetation, such as the wetlands comprised of rushes and sedges. The trail is approximately 0.2 mile (880 feet) long and four feet wide and extends east from a curve in the current access trail down into the basin.

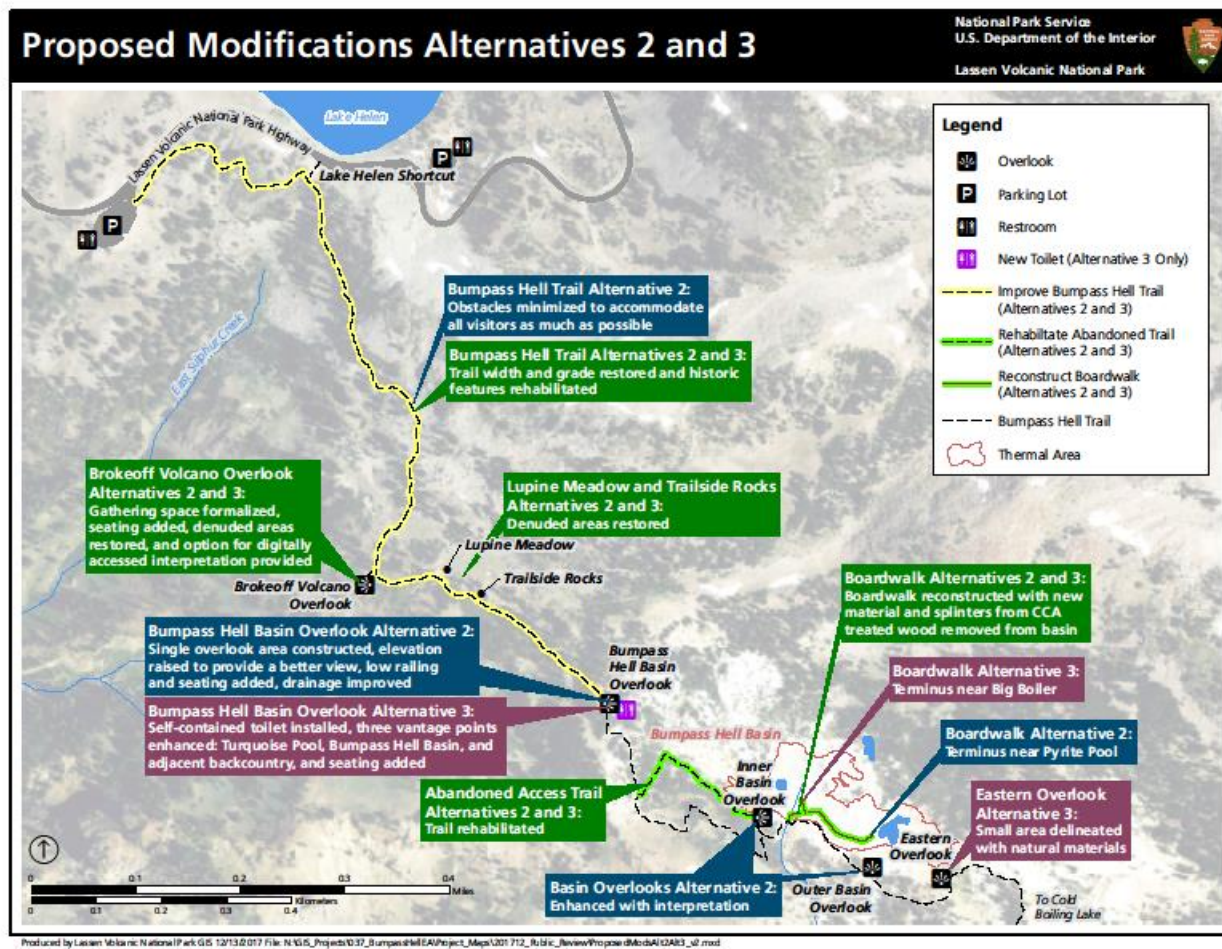


Figure 6: Alternatives 2 and 3

Trail Overlooks (4 Formal)

- *Brokeoff Volcano Overlook*

The Brokeoff Volcano Overlook (Figure 2) would be improved by reconfiguring the current open gathering space to accommodate school and other groups stopping in the area to take advantage of opportunities for extended education/interpretation. Seating would be added and barriers and/or revegetation would be used to reduce the disturbance area within the site. As under ECA, interpretive exhibits would be rehabilitated. In addition, because this area has good cell phone coverage, this alternative would include providing an option for an audio tour or other digitally accessible information about the area and Bumpass Hell Trail features.



Figure 7: Big Boiler Overlook

- *Bumpass Hell Overlook*

Enhancing the Bumpass Hell Overlook would consist of raising and leveling the area to provide a better view, while reconfiguring the gathering space to better accommodate visitors in the designated area. Additional seating would be added to accommodate groups and to provide for those who do not descend into the basin. Limited vista clearing would improve already good views by removing a few small trees not present historically. As in ECA, the area wayside would be updated and safety signage would also be added. Near the edge of the viewpoint, where drainage is poor and the slope adjoining the lower basin unstable, drainage improvements would be made and the area may be delineated with a fence or rail to prevent further deterioration of the unstable slope.

Winter-removable spotting scopes would also be added to the site to provide close-up views of area features for those visitors who do not descend into the basin and also to provide views of sites not accessed by the trail/boardwalk below.

- *Inner Basin Overlook (at the base of the abandoned access trail)*

This overlook (Figure 9) is a spur off the current main trail and is also at the base of the abandoned trail. The split rail fence added a few years ago has worked well to prevent people from leaving the overlook to traverse what appears to be open ground toward the boardwalk, but which is, in fact, quite hazardous. The Inner Basin Overlook would be enhanced by placement of low profile, minimally visible interpretive signs. Site seating (rocks) may also be added.

- *Outer Basin Overlook*

This informal overlook would be enhanced with interpretation.

Boardwalk

Initially, the boardwalk would be reconstructed in its current alignment, with its terminus as close to Pyrite Pool as possible. As described in ECA, it would be rebuilt with untreated wood, plastic lumber and plastic reinforced lumber (embedded with fiberglass rods, or similar material designed to be structurally sound, to blend into the environment, and to not deteriorate under harsh environmental conditions, where needed). It would continue to have a kickrail and handrail where needed and its existing width (approximately 6 feet) would also be maintained. Depending on hydrothermal features, the boardwalk would continue to access the Pyrite Pool and would also be designed to be more moveable. Because the boardwalk sits on the surface and would continue to be within a dynamic landscape, the alignment would be realigned when hydrothermal features move. Removing, adding and adjusting sections would occur minimally as needed to provide a similar safe visitor experience.

Where possible, the boardwalk would be lower in profile, minimizing opportunities for it to tip over in winter, and increasing its ability to withstand snow loading. The park would also explore opportunities for creating a winter-removable railing to improve its stability and ability to withstand winter conditions.

Boardwalk Overlooks (Termini)

Existing overlooks, including the Big Boiler and Pyrite Pool, would be retained if possible. If these or other features moved, undermining the boardwalk or making access to them otherwise dangerous and/or impossible, other alignments would be used in the future, when warranted.

- *Enhance Big Boiler Boardwalk Terminus*

The elevated boardwalk terminus at Big Boiler (Figure 7) would be enlarged by approximately 1-2 feet on each side, if this could be done without affecting surrounding hydrothermal features. Although there is a group size limit, this would provide some additional space when school groups and other visitors congregate in this area. In addition, the wide steps leading up to the overlook would be replaced with a ramp to minimize tripping hazards on the boardwalk. Interpretive signs would be updated and/or added. If the boardwalk is unable to be reconstructed near the Big Boiler because of steaming voids that have recently formed where the feet would be placed, there would continue to be viewing opportunities from the rehabilitation of the abandoned section of trail.



Figure 8: Outer Basin Overlook

- *Pyrite Pool Boardwalk Terminus*

The Pyrite Pool Boardwalk terminus would also be retained if possible, including continuing to move the terminus as the Pyrite Pool configuration changes. This would include expanding the terminus, such as with small “T” landing. Care would be taken to undertake the expansion within the confines of adjacent thermal features.

Facilities

No additional facilities would be constructed on the Bumpass Hell Trail.

Restoration

In addition to areas identified in ECA, the Eastern Overlook would also be delineated.

Interpretation

In addition to actions in ECA (improved interpretive exhibits) and noted above under the Bumpass Hell Overlook (spotting scopes), the park would also develop signage to delineate natural features along the Bumpass Hell Trail, creating a nature trail by identifying numbered stops via an electronic and/or paper trail brochure, including accommodations for universal design (accessibility).

Safety

Actions would be the same as in ECA.

Alternative 3: Improve Visitor Use

Bumpass Hell Trail

Main Trail: In addition to rehabilitation of the trail tread and other actions identified in ECA, the park would reconstruct the historic retaining walls, using the same means as in Alternative 2.

- *Abandoned Access Trail*

As described in Alternative 2, the abandoned access trail to Bumpass Hell Basin would also be rehabilitated.

Trail Overlooks (3 Formal)

- *Brokeoff Volcano Overlook*

Actions to enhance the Brokeoff Volcano Overlook would be the same as in Alternative 2.

- *Bumpass Hell Overlook*

Actions to improve the Bumpass Hell Overlook would be similar to Alternative 2; however, instead of creating a single elevated overlook, three smaller vantage points would be created. The three vantage points would provide views of the Turquoise Pool, which is no longer accessible from the basin, the Bumpass Hell Basin, and the surrounding backcountry. As in Alternative 2, the gathering space would accommodate groups by adding more seating for those who remain at the top; improve views by limited vista clearing; improve safety messaging; and provide some additional reinforcement to the unstable slope below the area by improving drainage and keeping visitors back from the edge.

In addition, a webcam may be installed in a non-visible area near the overlook to provide internet-accessible views of the area for remote visitors. A single pole would be used to support equipment needed, including a small solar panel, a power storage case, a cellular wireless hotspot and antenna, and the webcam plus outdoor enclosure. The camera will upload photos through a wireless connection. The color of the equipment will blend with the surrounding area. The proposed south aspect provides a clear view of the basin and maximizes solar efficiency. A set of hemlock trees provides an enclosure on the west side, nearly eliminating the visibility from the Bumpass Hell Trail.

Other equipment would be stored in a metal box at the base of the pole. The location is accessible in the winter via a northeastern route and in the summer from the Bumpass Hell Trail. The exact location would be selected based on cellular service reception, efficacy of the solar panel, and visibility from the trail and boardwalk.

- *Eastern Overlook*

This currently informal overlook would be enhanced to reduce resource damage currently occurring by delineating a small area, using natural features such as rocks, to confine disturbance.

Boardwalk

Actions to reconstruct the boardwalk would be the same as in Alternative 2. The boardwalk; however, would be truncated close to the Big Boiler. Because the boardwalk would not extend to the Pyrite Pool, another overlook (Eastern Overlook) would be enhanced along the Bumpass Hell Trail above the basin toward Cold Boiling Lake, which would provide views looking down on the Pyrite Pool.

This new overlook would be delineated with an edge treatment, such as a split rail fence and enhanced with interpretation to replace those lost along the removed sections of boardwalk. The barrier would be intended to minimize disturbance of the adjacent slope and adjoining creek.

Facilities

An enclosed self-contained (accessible) toilet would be installed at, but concealed visually from, the Bumpass Hell Basin Overlook. This would replace a pit toilet, constructed in the 1930s, formerly located in the area. The facility would be either a composting toilet or a dehydration system with small solar panels. To minimize visual intrusion, it would be sited on the hillside in the trees near the overlook to facilitate waste removal and maintenance. The building would be prefabricated and similar to CXT construction in order to withstand heavy snow loads at this high elevation site. The facility would improve the experience for those visitors ending their journey at the overlook as well as for those wanting to spend more time in the basin. Depending on the type of toilet constructed, the need to remove human waste would be minimized. To minimize or avoid the use of air support for this operation, which could affect nearby wilderness, human waste would be removed using a trail vehicle.

Restoration

Actions would be the same as in ECA.



Figure 9: Inner Basin Overlook

Interpretation

Actions would be the same as in Alternative 2.

Safety

Actions would be the same as in ECA.

List of Alternatives and Actions Considered but Eliminated from Detailed Study

Remove boardwalk and construct a trail on the north side of the basin.

This alternative was dismissed because it would have more impacts than other alternatives considered in this EA. Building a new (0.6 mile) trail would have adverse effects on a range of park resources. Constructing a new trail, without enhancing access to the Bumpass Hell Basin, would likely also encourage off-trail travel into the basin to get a closer look at dangerous hydrothermal features, adversely affecting visitor safety. A trail around the basin would not provide the up-close experience desired by most visitors commenting during public scoping. Although views from the west side would be good, they would not necessarily be much better or different than views from the east side. A loop trail around the basin would provide more visitor use opportunities within the area, but it would not achieve the objective of allowing visitors to experience hydrothermal features at close range. As noted in the Superintendent's Compendium, going off-trail in a hydrothermal area is prohibited.

Remove only the unsafe portion of the boardwalk.

This alternative would provide access into the basin for the close up visitor experience on the remaining boardwalk, but the smaller area is likely to become very crowded and off-trail travel may become a problem.

Figure 10: Trail Through Silvery Lupine Meadow



Construct a self-contained restroom across the meadow, approximately 0.8 mile from the trailhead.

At this location, a trail across the nearby often lupine-filled meadow (Figure 10) formerly accessed a pit toilet in the 1960s and 70s. Since then, no rehabilitation has occurred to repair the damage caused by the gravel-filled trail across the meadow and it remains an attractive nuisance for visitors passing by on the Bumpass Hell Trail, encouraging access, but not providing a destination. Although reusing the existing trail would minimize additional damage, the area has become a popular vista for viewing the lupines, when they are in bloom. Because constructing a new access trail through the meadow would disturb resources in recovery, this option was considered but dismissed. The restroom would likely be a self-composting toilet due to the location.

Table 1: Alternative Comparison Chart

Action	Alternative 1: No Action	Elements Common to Alternatives 2 and 3 (ECA)	Alternative 2 (Preferred Alternative)	Alternative 3
Actions	Continue Current Management		Expand Visitor Use Opportunities: Pyrite Pool Terminus	Improve Visitor Use Opportunities: Big Boiler Terminus
Bumpass Hell Trail	Minor tread repair, as needed.	<p>Improve trail tread by removing obstacles (e.g. fill trail where large angular rocks protrude)</p> <p>Widen trail to its original width (4') and lessen grade to 6% where possible</p> <p>Improve consistency of barrier designs (railing, fencing, post, and cable)</p>	<p>Same as ECA plus:</p> <p>Reconstruct deteriorated retaining walls.</p>	Same as Alternative 2
Overlooks	Retain 3 formal, 2 informal	Improve consistency of seating designs (rocks, benches, low rock walls)	4 formal	3 formal
1) Brokeoff Volcano	Retain in current configuration.	<p>Formalize a gathering space to accommodate groups and to confine visitors within a designated area</p> <p>Add seating</p> <p>Add barriers/ revegetation to reduce disturbed area</p> <p>Provide option for digitally accessed interpretation</p>	Same as ECA	Same as ECA

Action	Alternative 1: No Action	Elements Common to Alternatives 2 and 3 (ECA)	Alternative 2 (Preferred Alternative)	Alternative 3
2) Bumpass Hell Overlook	Retain in current configuration.	<p>Formalize a gathering space to accommodate groups and to confine visitors within a designated area.</p> <p>Add seating to provide for those who do not descend with their party on the trail into Bumpass Hell Thermal Basin.</p> <p>Improve views by limited vista clearing.</p> <p>Add a safety message about the gases in the basin.</p>	<p>Construct single overlook area.</p> <p>Raise the elevation of the overlook to provide a better view.</p> <p>Add a low railing and improve drainage near the edge to delineate the area and to keep visitors back from the unstable slope.</p>	Enhance three vantage points (Turquoise Pool, Bumpass Hell Basin, and adjacent backcountry), instead of single overlook.
3) Inner Basin (Fry Pan) Overlook	Retain in current configuration.	n/a	Enhance with interpretation.	Same as Alternative 1
4) Outer Basin Overlook	Informal	n/a	Enhance with interpretation.	Same as Alternative 1
5) Eastern Overlook	Informal	n/a	Same as Alternative 1	Delineate small area with natural materials to minimize disturbance.
Boardwalk Terminuses	Retain 2	n/a	Improve 2	Improve 1
1) Big Boiler Terminus	Retain in current configuration.	<p>Enlarge approximately one-foot on all sides.</p> <p>Replace steps with ramp.</p>	Same as ECA.	Same as ECA. Enhance with additional interpretation.
2) Pyrite Pool Terminus	Retain in current configuration.	n/a	Delineate by adding a small “T” landing with edge treatment.	n/a
Facilities	n/a	n/a	n/a	Install self-contained restroom near Bumpass Hell overlook.
Abandoned Access Trail	n/a	Rehabilitate abandoned access trail to provide close-up views of adjacent hydrothermal features and to improve conditions for descent	Same as ECA.	Same as Alternative 2

Action	Alternative 1: No Action	Elements Common to Alternatives 2 and 3 (ECA)	Alternative 2 (Preferred Alternative)	Alternative 3
		during shoulder seasons.		
Boardwalk	Terminus: Pyrite Pool	n/a	Terminus: Pyrite Pool	Terminus: Big Boiler
Boardwalk modifications	Retain (reconstruct, reroute, replace in kind with upgraded materials).	<p>Reconstruct new boardwalk with new materials, such as untreated wood, plastic lumber, and plastic lumber reinforced with fiberglass rods.</p> <p>Construct boardwalk in sections to readily move with changing hydrothermal features.</p> <p>Maintain existing width, kick rail and handrail where needed.</p> <p>Reduce the height of the boardwalk.</p> <p>Determine need for railing (with regard to safety and visual intrusion).</p>	Same as ECA.	Same as Alternative 2
Interpretation	Retain existing wayside exhibits, rehabilitating or replacing them as needed.	<p>Update wayside exhibits (rehabilitate and/or replace).</p> <p>Improve consistency of waysides (form, structure, and content).</p>	<p>Same as ECA plus:</p> <ul style="list-style-type: none"> • Provide numbered stops for electronic and/or paper guide. • Add winter-removable spotting scopes at Bumpass Hell Overlook. 	Same as ECA plus: Install webcam at Bumpass Hell Overlook.
Safety	Retain existing signs and prevention measures	<p>Develop park safety operations plan (address visitors, employees, emergency use).</p> <p>Safety signage and barriers (as appropriate to alternative, address going into stream, fumes), including adding a safety message about the possibility of an inversion trapping gases.</p> <p>Widen pinch points to improve trail for litter carry-out.</p>	Same as ECA	Same as ECA

Action	Alternative 1: No Action	Elements Common to Alternatives 2 and 3 (ECA)	Alternative 2 (Preferred Alternative)	Alternative 3
		<p>Remove obstacles in trail tread.</p> <p>Trail descending into Bumpass Hell: Retain check steps, add more wide wooden steps to improve trail for descent.</p>		
Restoration	No additional rehabilitation	Restore heavily used / denuded areas adjacent to the trail.	Rehabilitate 4 areas	Rehabilitate 5 areas
Restoration Actions	n/a	<ul style="list-style-type: none"> • Brokeoff Volcano • Trailside rocks • Lupine Meadow • Bumpass Hell Overlook <p>Remove splinters from CCA treated wood boardwalk in Bumpass Hell Basin.</p>	Same as ECA	<p>Same as ECA plus:</p> <ul style="list-style-type: none"> • Eastern Overlook

Chapter 3: Affected Environment and Environmental Consequences

Introduction

This section describes the existing setting or baseline conditions and analyzes the potential environmental consequences (impacts or effects) that would occur as a result of implementing the no action and action alternatives. Cumulative effects are also analyzed for each resource topic.

Cumulative Impacts

Cumulative impacts are defined as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions” (40 CFR 1508.7). Because the scope of this project is relatively small, the geographic and temporal scope of the cumulative analysis is similarly small. The temporal scope includes future projects within a range of approximately 10 years.

Past projects

- *Lassen Peak Highway Rehabilitation*

The roadway in Lassen Volcanic National Park underwent rehabilitation in 2002 and 2005. The first part consisted of the repair of 7.9 miles (12.7 kilometers) of the main park road, beginning at the south entrance, and 0.6 miles (0.96 kilometers) of the road beginning at the north entrance. The second part included the remainder of the main park road, a distance of about 21.7 miles (34.9 kilometers). Project work included repair and rehabilitation of the campground loop roads at Manzanita Lake, Craggs Campground, Lost Creek Campground and North and South Summit Lake campgrounds. Rehabilitation began at the end of the previous rehabilitation project, just north of the Bumpass Hell Parking Area, and extended northward to the Manzanita Lake Campground Entrance Road. It included repaving and rehabilitation of numerous areas along the route, including spur roads to campgrounds and picnic areas, and pullouts.

- *Lassen Peak Trail Rehabilitation*

The Lassen Peak Trail was rehabilitated to a consistent four-foot width (including narrowing of existing wider sections) to replicate its historic condition. Social / way trails continue to be the primary means of access in the crater and true summit areas. The trail improvement project included: rehabilitation or reconstruction of the trail tread, including rock walls and steps; shoulder season way finding / access improvements; relocation of the radio repeater structure; use of rock from within and outside the park for trail rehabilitation; helicopter transport of materials; ongoing trail maintenance; and increased trail monitoring. Existing interpretive exhibits were rehabilitated and staff presence occasionally allows for interpretive programming.

- *Removal of a portion of the Bumpass Hell Boardwalk*

In 2015, a portion of the Bumpass Hell Boardwalk which was close to being undermined by movement of the Pyrite Pool was removed. The boardwalk was then truncated and a small overlook created on it near the Pyrite Pool.

Current projects

- *Resource Stewardship Strategy (RSS)*

A RSS is a long-range dynamic planning tool for a national park unit to set specific goals and track progress in achieving its desired natural and cultural resource conditions. As part of a park’s planning portfolio, the resource stewardship strategy serves as a bridge between the park’s foundation document, other plans, and everyday management of its natural and cultural resources.

A RSS provides a basis for making informed resource management decisions for developing specific park project proposals, and for developing and revising annual work plans. It also is intended to help determine a park unit’s short- and long-term funding needs for resource management.

Future projects

- *Rehabilitation of the Manzanita Lake Campground*

This project is proposed for 2018. It would include developing a comprehensive site plan for the Manzanita Lake area to alleviate safety and environmental impact concerns, while focusing on providing a quality visitor experience. A comprehensive site plan will improve circulation due to congestion, and pedestrian and bike trails will be planned to provide access between the lake, museum, store, campground and amphitheater. Facilities in the area will be evaluated and, where possible, guidance provided for future implementation projects to meet health and safety code. Many of the area's historic structures will be assessed and, where possible, guidance provided for future rehabilitation projects to improve educational opportunities and other visitor uses.

Environmental Impact Analysis

Some information about park resources can be found within the analysis below. More detailed information is available in the Lassen Volcanic National Park General Management Plan (NPS 2003) as well as on the park's website (www.nps.gov/lavo).

Soils and Geology (including Hydrothermal Resources)

Thermal features in the park are the result of boiling and steam separation in an associated reservoir. "The hottest and most vigorous features are at Bumpass Hell and Boiling Springs Lake, which mark the principal areas of upflow and steam discharge from the Lassen hydrothermal system" (Janik and McLaren 2010 in Clynne *et al.* 2012). Steam-dominated features also occur at five other areas in the park: Sulphur Works, Pilot Pinnacle, Little Hot Springs Valley, Devils Kitchen, and Terminal Geyser. Bumpass Hell, Sulphur Works and Devils Kitchen display hydrothermal (sulfuric acid) alteration. Elsewhere, travertine (calcium carbonate) springs occur on the edges of some of the steam-dominated thermal areas in Little Hot Springs Valley (Clynne *et al.* 2012:19).

Boiling of the 240°C [464 °F] hot water in the deep reservoir provides the steam that feeds the surface hydrothermal features of LVNP. This steam contains hydrogen sulfide (H₂S), which oxidizes in the near-surface environment to produce sulfuric acid that in turn reacts with the near-surface volcanic rocks, altering them to soft, light-gray to white slopes . . . composed primarily of opal (SiO₂) and kaolinite (a clay mineral). The major thermal areas . . . display numerous thermal vents, ranging from superheated fumaroles with temperatures as high as 161° C at Bumpass Hell and 147° C at Little Hot Springs Valley (Janik and Bergfeld, 2010), steam vents at the boiling point for this altitude (~92°C), mud pots ranging in temperature from boiling to near ambient, and warm to hot ground commonly covered with orange and yellow sulfates. Native sulfur (S) is common on the walls of steam vents, and gray to black pyrite (FeS₂) is common as linings of the vents and discharge channels, as scum floating on the surface of pools, and as dispersions in mud pots.

The vigor of the surface hydrothermal features varies both seasonally and from year to year. To potentially provide early warning of impending volcanic activity, the thermal features in LVNP are chemically and physically monitored by the USGS and the National Park Service (Sorey, 1986) to detect changes that may be caused by renewed influx of magma into the LVC [Lassen Volcanic Center] (Clynne *et al.* 2012:19-20).

Because of the dynamic nature of subsurface heating, the movement of hydrothermal features, i.e. pools, fumaroles, and mudpots, is inevitable within the active hydrothermal area. Unlike most active areas at Yellowstone, steam erosion from sulfur mixed with hot water vapor to form sulfuric oxide is also present in the basin.

Impacts from Alternative 1

There would be no additional impacts from implementation of Alternative 1. Existing impacts, both beneficial and adverse, would continue. The trail from the parking area to the Bumpass Hell Overlook has eroded in numerous places. A combination of fill and soil loss along the trail tread has occurred from both human use and from natural forces, such as rain, snowmelt, and unstable slopes. Under Alternative 1, erosion would continue and would likely continue to worsen; contributing to an already unstable trail tread with potholes, protruding rocks, and roots.

Rocks used in some areas to line the edges of the trail when it was constructed have fallen downslope or been dislodged. Rock walls constructed along the trail to widen it in some areas have deteriorated to such a degree that they are no longer apparent to the casual observer and the trail has narrowed in these areas, forcing hikers to go around protruding boulders from the hillside above the trail. Many of the rocks used to construct the dry stack rock

walls that widened the trail in these areas have slid downslope. While some of these rocks are evident, others may no longer be in the vicinity. Due to materials sloughing off downslope onto the trail, the trail has also narrowed considerably in some places. The trail has also widened in some areas and some areas have lost vegetation cover.

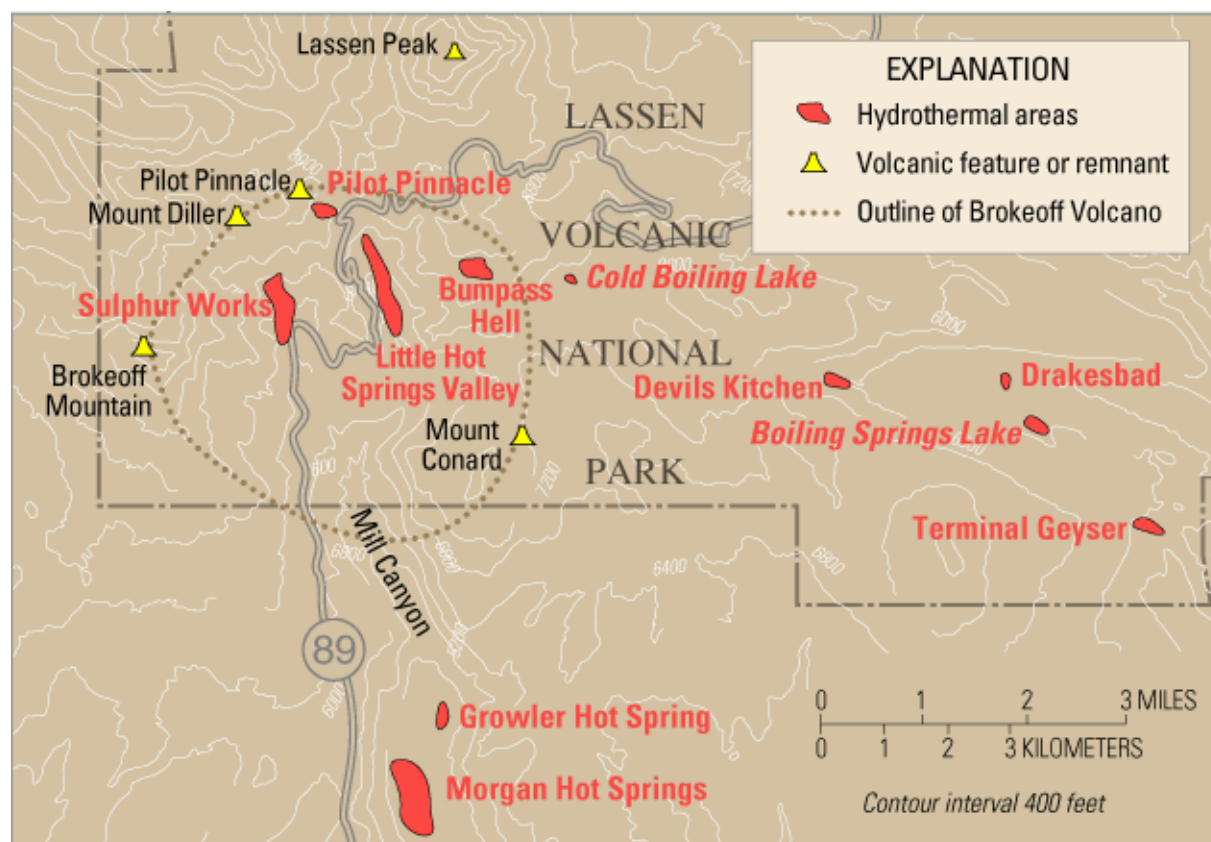


Figure 11: Hydrothermal and Volcanic Features in the Park and Vicinity

Overlooks and rest stops along the trail have large bare areas of soil. While some erosion is natural in this high elevation environment, some is from heavy visitor use, first causing damage to, then loss of vegetation and soil. In addition, there are numerous areas, where paths now devoid of vegetation (social trails) lead out from the edges of the trail or overlooks. In these areas soil is continuing to erode, making it more difficult for vegetation to reestablish in the short growing season.

The abandoned access trail into the Bumpass Hell Basin is still evident, though overgrown in some areas and deteriorated in others. A trail bridge at the base of the trail, near where it connects with the current access trail has broken apart, with stringers and decking separated, though the pieces are still present in the vicinity (Figure 15).

In the Bumpass Hell Basin, retaining a boardwalk continues to protect both soils and geology from damage caused by people walking through sensitive areas and breaking through the thin crust. Without the boardwalk, footprints would damage fragile volcanic features that cannot be repaired. Without the boardwalk, visitors could inadvertently step into a boiling hot spot, causing serious burns or death. Although the boardwalk protects nearby features, the portions of the boardwalk made from treated wood break down in the hot, gaseous atmosphere of the basin. Currently, splinters from the boardwalk litter the ground in some areas, potentially contributing an unknown degree of toxins, such as the chromium copper arsenate (CCA) that was used to treat the wood.



Figure 12: Bumpass Hell contains many fumaroles, mud pots, and acid hot springs. Big Boiler is a superheated fumarole with temperatures as high as 161° F.

Impacts from Alternative 2

Under Alternative 2, the systematic rehabilitation of the trail and overlooks, as well as restoration of damaged areas would occur. Under this alternative, soils would be affected over the length of the trail rehabilitation project, wherever excavation and fill are called for, as well as in the following specific areas: Brokeoff and Bumpass Hell overlooks, abandoned access trail, Bumpass Hell Basin, and restoration areas. During excavation and grading, soils would be mixed, moved, and replaced, causing small, localized but long-term, adverse effects to the area's soil profiles. This would be particularly evident where it is necessary to restore trail tread and/or reconstruct the boardwalk. Disturbed areas would be within the trail prism (area previously disturbed by the trail construction). Moving, covering, trampling, and compaction of soils by equipment and workers within the construction work zone would also occur, however, because most soils have been previously disturbed, these effects would be small. Localized soil compaction would temporarily decrease soil permeability, change soil moisture content, and lessen its water storage capacity. Scarifying (aerating/breaking up) soil during restoration would improve the ability of plants to reestablish in disturbed areas.

Beginning with the connection of the trail to the Bumpass Hell parking area, the trail would be restored where possible to its original width (approximately 4-feet) and mild (approximately 6 percent) grade, improving the surface to provide for visitors with mobility impairments to use on their own or with assistance. In several short sections, for instance, where the trail exceeds grades of 15 percent, although the trail would be ramped, outside retaining walls constructed, and the trail filled to reduce the grade as much as possible, it would likely be steeper than 6 percent.

Overall, improvements would be consistent and would leave a trail with a smooth surface of natural materials in place of the existing trail where numerous rocks and roots protrude and which varies in width, narrowing where the remnant rock walls are located. In improving the trail, soil along the route would be excavated to mineral soil, and replaced back onto the tread, likely with fill added from stockpiles elsewhere in the park or from another clean (weed free) source with the same materials. Depending on the consistency of the tread, a soil binder, colored to

match the surrounding area, could be added to reduce maintenance by retaining soil on the surface. Excavation and top-dressing would improve the trail tread slope to drain properly, further reducing the potential for erosion.

Rocks lining the trail would be reset and replaced where needed, while dry stack rock walls would be reconstructed from surrounding materials and/or from similar imported materials. The entire Bumpass Hell Trail up to and including the new boardwalk in the basin would be rehabilitated (approximately three miles, 4-foot wide) resulting in both adverse and beneficial effects from modifications to the existing tread and from imported materials.

In addition, there would be approximately 1,584 feet of trail rehabilitation associated with improving the abandoned access trail into the basin. This trail would continue to be 4-foot wide, resulting in disturbance of approximately 6,336 square feet (0.15 acres). Included would be 15 cubic feet of excavation for trail bridge footings and up to 35 feet of puncheon or boardwalk construction to minimize adverse impacts to a small seep wetland.

Similarly, overlooks and rest stops would be rehabilitated. The largest two (Brokeoff Volcano and Bumpass Hell) would be redesigned to accommodate the school and other groups that are frequent users of the trail, and would include site furnishings, such as benches or large seating rocks pulled from surrounding areas or imported. Although no paving or hardening of the sites would occur, the wide areas encompassing the overlooks would continue to have compacted soils. At the Bumpass Hell Overlook, modifications would occur to create a single large overlook by correcting erosion along the edges and by removing a few small trees and other vegetation that blocks views of the basin. Each of these actions would affect soils and geology to varying degrees. Soils would be affected slightly by



the small degree of vegetation removal, with more effects from continued compaction. Geology would be affected by importing materials from the surrounding area, other parts of the park, or suitable materials from outside the park, depending on availability of stockpiled materials. This is because no borrow areas are available or can be created. Approximately 10,000 square feet of imported material would be used to cover rocky protuberances in the existing trail tread to eliminate tripping hazards. Rock needed to reconstruct the rock walls and overlooks would consist of approximately eight cubic yards and would be procured locally. Excavation would occur for placement of new or rehabilitation of old wayside exhibit bases.

Figure 13: Denuded "Trailside Rocks" Area

Another 1,000 square feet of imported fill would be needed annually to maintain the trail tread and to withstand mechanical erosion from hikers and water flow during spring snowmelt.

Improvements at the eastern overlook would also reduce social trailing in that area by delineating a small area for the viewpoint. In addition, there would be restoration actions associated with delineation of the Bumpass Hell and Brokeoff Volcano overlooks and the trailside rocks and lupine meadow areas plus the trail through the lupine meadow would be restored, resulting in beneficial effects from improved vegetation coverage of soil and from making the area of disturbance associated with visitor use smaller.

Impacts from Alternative 3

Impacts would be similar to Alternative 2, including for rehabilitation of the main trail, for the abandoned access trail, for the Brokeoff Volcano overlook, for restoration of the trailside rocks and lupine meadow areas, and for work on the boardwalk in the Bumpass Hell Basin.

Instead of creating one large area at the Bumpass Hell Overlook, however, three smaller areas would be improved, offering discrete viewpoints into surrounding backcountry, the basin and of the Turquoise pool. This would result in a need to import fewer materials to the area, with a slight reduction in impacts on area soils and associated with imported rock. In addition, there would be some excavation and fill associated with constructing a hydration or composting toilet unit near the overlook. Other differences, primarily resulting in long-term beneficial effects on

soils and geology would result from rehabilitation of social trails and overlooks. Some small adverse effects would also result from improvement of other overlooks.

Cumulative Effects

Adverse impacts to soils as a result of other past and ongoing actions include compaction, soil mixing, and soil loss from removal and erosion. Similarly geological resources have been disturbed as a result of development and concentrated visitor use. In some areas of disturbance, revegetation has not occurred naturally or been undertaken by the park. Localized but distributed impacts include an overall decrease in soil infiltration, where hardening of surfaces (roads, walkways, buildings) has occurred. In the future, additional restoration and development projects (e.g. addition of new visitor service facilities, restoration of old roads or building sites) could occur within the park and project vicinity. Combined, these projects have contributed to and could increase both beneficial and adverse impacts on soils and geological resources. Because most of the park continues to be undisturbed by human impacts and is designated wilderness, the amount of area affected by past and possible future projects is not substantial, thus overall impacts are small.

When impacts from the no action or action alternatives are combined with impacts from the above actions, there would continue to be cumulative adverse impacts to soils and geology but because most park geological and soils resources are substantially preserved, these would continue to be small in comparison. The action alternatives (2-3) would contribute another small increment to the total cumulative effects on soils and geology, while also having some cumulative beneficial effects. No additional cumulative beneficial effects would be contributed from the no action alternative, however, over time, additional cumulative adverse impacts could occur as areas targeted for rehabilitation continue to deteriorate.

Conclusion

Although there would be a range of short- and long-term localized adverse impacts on soils and geology in both alternatives, restoration of disturbed areas and improvements to minimize future disturbance, such as confining impact areas would also result in long-term beneficial effects. Overall impacts would continue to be more widespread and long-term in Alternative 1, while overall impacts would be more localized and would include some benefits in the action alternatives. Alternative 2 would have impacts over a larger area than Alternative 3 because of more boardwalk retention in the Bumpass Hell Basin.

Water Resources (Water Quality)

Alternative 1: There would be no new impacts to water quality. Existing impacts would continue to be small and adverse from occasional improper disposal of human waste because of the lack of toilets on/near the Bumpass Hell Trail. Because the trail is adjacent to streams in a few areas, erosion would continue to primarily occur during storms and snowmelt, causing small naturally occurring inputs of sediment to water resources. In addition, the deteriorated trail bridge and culverts along the abandoned access trail would continue to result in effects to the wetland and creek channel.

Alternatives 2 and 3: Work in or near water would include installing footbridges at one unnamed intermittent creek and a raised boardwalk in one wetland, near a spring. Trail work would also occur near boiling springs and a hot creek within the Bumpass Hell Basin. Because the creek would be bridged, above the ground surface, avoiding bank impacts there would be no need to redirect flow during installation. Similarly, constructing a structure, such as a boardwalk, that would allow water flow beneath it would have long-term beneficial effects on water quality. Elsewhere, trail work in the basin would not be expected to cause sedimentation. Overall, these actions are small and could result in localized inputs of sediment to their associated water bodies, constituting very small localized short-term adverse effects. Beneficial effects on water resources could occur from removal of the decrepit culvert and bridge (Figures 14 and 15) and from avoiding an on-ground trail through the spring-fed wetland. There would be short-term adverse impacts during construction and beneficial impacts once construction is complete.

Additional small-scale impacts to water quality could occur if unexpected precipitation occurs during the trail rehabilitation project. Other impacts could occur from erosion following the first rains after completion. For the most part, however, it is unlikely that sedimentation would reach most area waterways because of the distance to

these from the trail. Long-term beneficial effects could occur from stabilization of soils within the existing and rehabilitated abandoned access trail tread.

Alternative 3: In addition to the impacts from Alternative 2, there could be a small degree of beneficial and adverse impacts from installation of a hydration or composting toilet. Similar small impacts may occur from improper use or disposal of waste from the toilet, as well as from natural runoff, where the trail crosses drainages. In addition to beneficial effects from trail stabilization (see above), there could be long-term beneficial effects related to a reduction of human waste in the area from the placement of a backcountry toilet in the area.

Impact Avoidance, Minimization and Mitigation Strategies

To avoid, minimize or mitigate water quality impacts, the following strategies would be used during or following construction:

- Using temporary sediment control devices such as filter fabric fences, or sediment traps as needed during work near water.
- Minimizing soil disturbance and re-seeding or revegetating disturbed areas as soon as practicable.
- Adding rocks, soil, or duff to areas without vegetation
- Locating staging areas away from areas where water would runoff to adjacent water bodies.
- Covering stockpiled soil and rock throughout the duration of the project with a breathable, water repellent fabric anchored around the perimeter to minimize sedimentation.
- Minimizing the amount of disturbed earth area and the duration of soil exposure to rainfall.
- Minimizing soil disturbance and reseeding or revegetating disturbed areas as soon as practical.
- Using swales, trenches or drains to divert stormwater runoff away from disturbed areas.
- Outsloping the rehabilitated trail.

Cumulative Effects

Other visitor use and facilities in the park and project area contribute sediment and pollutants, including oil and other contaminants from motor vehicles as well as litter, which can enter drainages and adversely affect water quality. Some restoration and development projects (e.g. addition of new visitor service facilities, restoration of old roads or building sites) could occur within the park and would contribute both beneficial and adverse impacts to water quality. Given the minimal and localized nature of these effects parkwide, overall impacts on park waters would be very small. Non-human factors, such as natural erosion of exposed soils can also affect water quality. Impacts of the above actions and factors, in conjunction with the impacts of the no action alternative (Alternative 1), would continue to result in small adverse cumulative effects on water quality. Alternative 1 would continue to contribute small localized cumulative impacts. Under Alternatives 2 and 3, there would be also be small short-term, localized adverse effects on water resources during construction, but these would be combined with cumulative beneficial effects once construction had been completed.

Conclusion

See Wetlands section

Water Resources (Wetlands)

There is one small sedge (*Carex* sp.) and rush (*Juncus* sp.) dominated wetland (seep) located along the abandoned access trail. Another small stream crossing with a deteriorated footbridge is located slightly downhill. The portion of the abandoned access trail through the wetland is approximately 35 feet long, descending through the wetland en route to the thermal basin. Water is supplied by a surface spring and the nearby stream as well as from surface runoff from snowmelt. Although snow does accumulate in the basin, the warmth of the hot pools and fumaroles greatly reduces its duration in some areas. Elsewhere, where the ground surface is cooler or on the boardwalk, it may be as deep as in those areas surrounding the basin.

Herbaceous wetland communities are scattered throughout the park. They form densely vegetated, wet meadows near seeps, streams and lakes that contain primarily grass and grass-like species including sedges, and perennial grasses, such as Thurber's bentgrass (*Agrostis thuberiana*), tufted hairgrass (*Deschampsia caespitosa*), bluejoint reedgrass (*Calamagrostis canadensis*), and pull-up muhly (*Muhlenbergia filiformis*) (Taylor 1990b). Common flowering plants include monkeyflower (*Mimulus* sp.), bog laurel (*Kalmia* sp.), California corn lily (*Veratrum californicum*), alpine shooting star (*Dodecatheon alpinum*) and lupine.

Impacts from Alternative 1

There would be no additional impacts from implementation of Alternative 1. Existing impacts from the abandoned trail through the wetland, though currently unused would continue, with bare areas revegetating naturally over time, though compaction from previous use of the trail is still evident after more than 13 years of disuse. Similarly, there would continue to be adverse effects from the deteriorated footbridge, because the pieces have not yet been retrieved, nor the banks rehabilitated.

Impacts from Alternative 2 and 3

Approximately 50 feet of the 0.3 mile long trail occurs adjacent to a wetland. Under the action alternatives, the trail through the wetland would be rehabilitated with a short section of boardwalk or puncheon to allow free flow of water beneath the structure and to minimally impact the vegetation.

The trail would also intersect with a small drainage that would be bridged. No obstruction of water movement would occur. Because only a few tens of square feet of wetlands would be affected, much less than one-tenth acre (4,356 square feet), no NPS Wetlands Statement of Findings would be required.

Existing deteriorated culverts and wood decking would be removed. These actions would result in short-term adverse impacts on approximately 15 square feet of vegetation and soils in the wetland area, combined with long-term beneficial effects from removing the on-ground trail and constructing a permeable trail structure through the area. Vegetation would be able to grow adjacent to and beneath the edges of the structure and water would generally flow unimpeded in saturated soils except where boardwalk supports were located. A small degree of excavation would be needed for the boardwalk supports and there would continue to be adverse effects from the potential for off-trail travel in the area.

To reconstruct the trail bridge, it is likely that some shoring up of the edges would be required, prior to resetting the sills and stringers beneath the decking. For small fill areas like this, soils could be procured locally or imported from those used in other areas of the park. Other wetlands (including drainages) would be completely avoided by the proposed rehabilitation project under the action alternatives.

Impact Avoidance, Minimization and Mitigation Strategies

To avoid, minimize or mitigate wetland impacts, the following strategies would be used during or following construction:

- Avoiding wetlands where possible by trail routing.
- Using bridges rather than culverts to cross drainages.
- Avoiding excavation during wet periods.

Cumulative Effects

Wetlands and riparian areas have been lost or disturbed by a number of past and present actions in the park. Heavy sheep and cattle grazing in the late 1800s and early 1900s reduced or eliminated herbaceous cover in meadows and riparian areas. Natural drainage patterns and water flow were altered by development and diversions. The Manzanita Lake dam raised the water level in this natural lake to create a larger water storage area. The Dream Lake Dam also converted natural stretches of creek and riparian habitat into open water. The digging of ditches to drain or redistribute water in Drakesbad Meadow and Warner Valley affected local hydrology and vegetation. Since rehabilitation these impacts from the dam and to the meadows have largely been alleviated. In addition, numerous road and stream crossings have been constructed throughout the park, which have reduced the extent of riparian habitat. Overall, in comparison to the total park area originally containing wetlands, the extent of these cumulative impacts has been



Figure 14: Abandoned Access Trail through Wetland

localized and small, except associated with dam construction. The contribution of the alternatives to these effects would be undetectable, both in terms of beneficial and adverse effects.

Conclusion

There would be a small degree of and potential for impacts on water resources, including water quality and wetlands. These impacts would primarily occur where work is adjacent to water bodies, including in the wetland along the abandoned access trail. There would also be long-term beneficial effects from changing an on-ground trail to a trail structure, such as a boardwalk. Long-term impacts would be greater in Alternative 1, while beneficial impacts would be greater in Alternative 2. Alternatives 2 and 3 would both have a range of short-term adverse impacts, with slightly more potential for adverse impacts because of the hydration or composting toilet in Alternative 3.

Vegetation

Beginning at an elevation of approximately 8,000 feet, the trail passes through subalpine communities, including plants such as white bark pine, mountain hemlock, silverleaf lupine, pink heather and bog kalmia. Grass-like rushes and other water-dependent plants are found in wetter areas. The following plants were among those observed in areas that would be affected by the proposed project— trees (white bark pine, mountain hemlock); shrubs (mountain heather, currants, rabbitbrush, pinemat manzanita, chinquapin); forbs (silvery lupine, pine drops, knotweed, pussy toes [*Antennaria*], and corn lily); as well as a variety of grasses and grass-like plants (western needlegrass and sedges).

Impacts from Alternative 1

There would be no additional impacts to vegetation from implementation of Alternative 1. Existing impacts, such as ongoing bare ground and compaction from visitor use, would continue in some areas along the Bumpass Hell Trail. Other areas would continue to recover slowly from disuse, including the seep along the abandoned access trail, the trail within the silvery lupine meadow, and at overlooks. Although restoration of some areas could occur, there are currently no specific plans for restoration of existing disturbed areas along the Bumpass Hell Trail.

Impacts from Alternative 2

There would be a small range of impacts from trimming and removing soil, rock and vegetation along the edges of the trail to restore it to its original historic width (4-feet), widening the trail at pinch points where rock has fallen onto it or soil has eroded from it. Cutting or removal of protruding roots on the trail could have adverse effects, while adding soil could benefit the vigor of some trees and shrubs. There would also be slight adverse effects from trimming or removal of a small number of young trees that are adversely affecting the view from the Bumpass Hell Overlook. Enlarging the area by placement of rocks and logs and building up the elevation slightly would also require importation of soil and the rocks/logs for seating, with potential adverse effects from adding these elements and from the disturbance to potentially result in nonnative invasive plant communities. Improving drainage may also result in minimal loss of vegetation. Although numerous areas along this high elevation trail have little vegetation, some, such as the trailside rocks area (Figure 13) have been denuded from visitor use, such as rest stops and social trailering in the vicinity. In these areas, some rehabilitation, such as placement of brush combined with replanting or seeding would be undertaken, improving the area by distinguishing resting and restoration areas.

Elsewhere, there would be specific plans developed to revegetate areas surrounding overlooks as well as areas that are no longer used, such as the trail through the lupine meadow. These restoration areas could comprise approximately 3,000 square feet (0.07 acre).



Figure 15: Deteriorated Bridge on Abandoned Access Trail

Impacts from Alternative 3

Impacts would be similar to Alternative 2. In addition, there may be a small amount of additional vegetation disturbance to construct a backcountry toilet and to install a webcam near the Bumpass Hell Overlook, depending on whether disturbed areas can be located nearby that can accommodate these additions. In either case, it is likely that some vegetation disturbance would be a consequence of constructing a public access trail to the toilet and from periodic administrative checks of the webcam. Constructing three small vantage points instead of one large one may result in less open area at the overlook, but a similar amount of vegetation disturbance.

Impact Avoidance, Minimization and Mitigation Strategies

To avoid, minimize or mitigate vegetation impacts, the following strategies would be used during or following construction:

- Narrow limits of construction would be established to avoid impacting sensitive, slow-growing subalpine and alpine plants.
- Rock imported from outside the park would be from approved sources and would be inspected and/or approved by NPS staff prior to importation into the park to avoid inadvertent importation of invasive species.
- Materials used in project work would be transported and stored so as not to acquire noxious weed seeds from adjacent areas.
- The project area would be monitored for undesirable plant species (exotics) and control strategies implemented if such species occur.
- Although most restoration would include only replacement of rocks, if seeding or planting occurs, only native species, appropriate to the site would be used.
- Where possible, removed native plants would be salvaged and transplanted.

Cumulative Effects

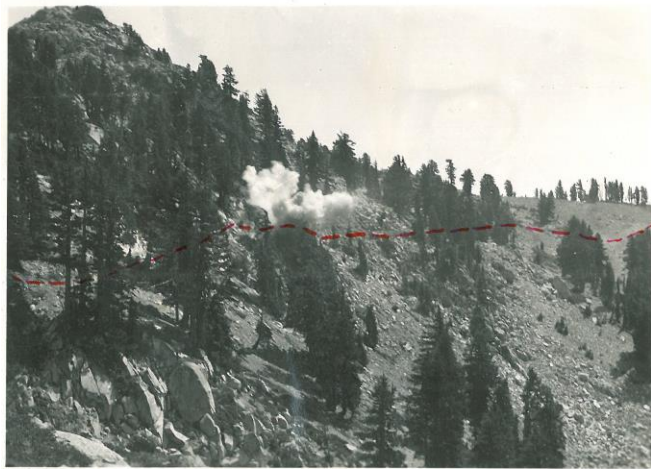
Much of the area that the trail traverses is open and vegetation is sparse. Volcanic eruptions of Lassen Peak in 1914 and 1915 destroyed over three square miles (640 acres) of forest cover in the park. Some areas continue to be affected by hydrothermally altered rocks with coarse rocky soils. Human activities, particularly fire suppression, have also altered the structure and composition of forest and other area vegetation. In contrast to these broad changes, relatively small patches and corridors of habitat have been disturbed or lost from areas developed for roads, visitor and administrative facilities. Impacts from past development, in combination with the impacts of any one of the alternatives, would continue to result in small cumulative adverse effects on vegetation.

Conclusion

Overall effects on vegetation would be small and would continue to primarily affect plants on the edges of the trail under all alternatives. Additional effects from trimming/removal of small trees at overlooks would also occur in the action alternatives. There would be both short-term adverse and long-term beneficial vegetation impacts from rehabilitation of the historic trail alignment. Other beneficial effects would arise from restoration of impacts from past trail development. Though the range of impacts among alternatives would be small, Alternative 3 would be likely to have slightly more short- and long-term adverse impacts than Alternative 2, from slightly more trail construction and provision for a backcountry toilet.

Archeological and Historic Resources

The area of potential effects for prehistoric and historic archeological resources, ethnographic resources, historic structures and cultural landscapes for the Bumpass Hell Trail Repair project consists of approximately 10 acres within and adjacent to the Bumpass Hell caldera basin in Lassen Volcanic National Park, Shasta County, California (Township 30 North, Range 4 East, Sec 14). This area includes the trail for Bumpass Hell, beginning at the Bumpass Hell Parking Area, continuing to the access trail from the turnout across from Lake Helen, and the trail to Bumpass Hell, including the area comprised by the boardwalk in Bumpass Hell Basin and the trail to the Eastern Overlook (before the trail descends as it continues toward Cold Boiling Lake). Although the section of trail from the Eastern Overlook to the Kings Creek Picnic Area was constructed at the same time by the CCC that section of trail is not part of the rehabilitation project in this environmental assessment.



Construction on Bumpas Hell Trail in 1935 showing rocky terrain through which trail must pass in order to eliminate steep gradients. This section of the trail is between the highway and the Bumpas Hell Area. Note the smoke from a blast that had just been set off. The dotted line follows the location of the trail.

The trail up the east side of the Bumpass Hell Basin was planned to start at Cold Boiling Lake and travel up the mountain on a 15 percent grade (1.8 miles). The trail up the west side was planned to start at the Lassen Peak Highway near Lake Helen and hold a fairly level grade on the rocky headwall of upper Mill Creek Canyon and then to maintain a grade of approximately 6 percent to the rim of Bumpass Hell (1.3 miles). The trails were to be properly brushed out, constructed on a four foot standard width, and properly drained by water breaks, with the surface of the trails constructed smooth for easy foot travel (NPS [Swartzlow] 1936:2).

The Lake Helen (west) part of the trail was constructed during the summer of 1935. Heavy construction work included use of a compressor and air hammer to drill holes for blasting. Further along the trail, trees made clearing and grubbing of timber and brush necessary. Excavation, rock and common borrow were necessary because the trail was located on the steep hillside, and cuts and shoulder fills were common. This part of the trail was very rough and rocky and to provide fairly smooth footing crushed rock was hauled and spread to make a suitable surfacing (NPS [Swartzlow] 1936:2, 3).

Figure 16: Proposed Bumpass Hell Trail Alignment

from the parking lot is at an easy grade with an average trail width of 4 feet. The trail briefly parallels the road, offering a view of Lake Helen before it curves south and begins a gentle ascent through subalpine biotic communities of white bark pine and mountain hemlock. Several benches and established lookouts provide places for hikers to stop and rest, enjoy the view, or read interpretive panels. A final lookout, approximately one mile from the trailhead, provides a sneak peek to the steaming basin below. From here, the trail descends rapidly towards Bumpass Hell. A timber bridge provides access across the a creek and onto the boardwalk that winds through the basin, as well as a single track trail that continues onto Cold Boiling Lake and King's Creek Campground.

Impacts from Alternative 1

There would be no additional impacts to cultural resources from implementation of Alternative 1. Although there are no known impacts to archeological resources from continued use of the Bumpass Hell Trail, ongoing deterioration of the abandoned access trail would continue to have adverse effects on the contribution of this section to the overall eligibility of the Bumpass Hell Trail for the National Register of Historic Places. Similarly, without rehabilitation, other sections of the trail are deteriorating and furthering that deterioration (benign neglect) would have increasing adverse effects on the trail as an historic resource.

Impacts from Alternatives 2 and 3

Ground disturbing activities, (e.g. excavation, grading, vegetation removal, and scarification for trail repair), rock wall reconstruction, improving overlooks, rehabilitating the historic trail, and rehabilitation/restoration of denuded areas could affect previously unknown prehistoric and historic archeological resources. To the extent that these activities occur on the historic portions of the Bumpass Hell Trail, including work on the trail and rock wall reconstruction, would also affect historic resources. A small portion of the current trail, from the Bumpass Hell Overlook to the basin, was constructed in the 1970s and is not part of the historic trail.

Because activities on the historic portions of the Bumpass Hell Trail, including reopening of the abandoned access trail into the basin, would be conducted in accordance with the Secretary of the Interior's Standards for Rehabilitation, actions would be intended to have no adverse effect on historic resources. Character-defining

features, including conforming to the original width, grade, and alignment of the Bumpass Hell Trail and its small-scale features, such as rock lining, would be retained. Although there would be changes to improve tread in Alternative 2, these changes would be primarily related to reconstructing the trail to meet its original grade and width, in keeping with its construction by the CCC.

The current trail has two sections of stone steps, which were originally constructed by the CCC. One section is located on the uphill section adjacent to the historic dry-stack rock retaining walls which have deteriorated; the other is located on the descent to the Brokeoff Volcano Overlook. Other currently impassable features, such as protruding rocks and roots, are artifacts of the trail's deterioration since its construction. In many locations, the width of the trail has narrowed from 48-inches to 24 inches, due to deposition on the trail from above and from erosion of fines and other materials from the trail tread.

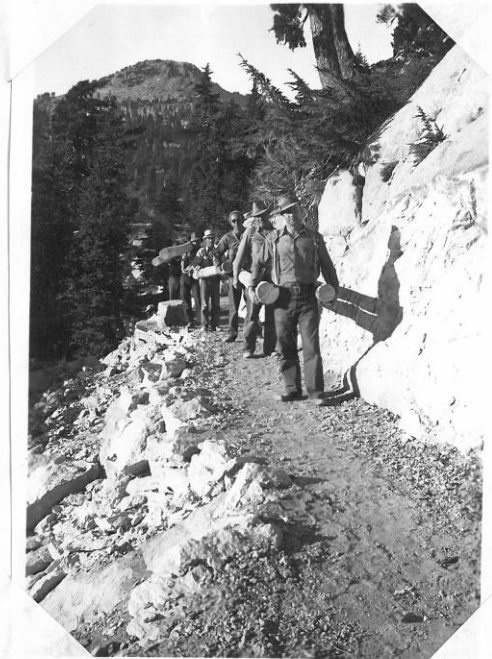
Rehabilitation of the trail would include reconstruction of dry-stack rock retaining walls along approximately 0.5 miles of the trail. These walls would source materials from the local area, including rocks that have fallen downslope as well as material removed from above the trail tread and would use traditional methods to reconstruct them. Slope retention may also be necessary in other areas, such as in the area downhill from the parking area, depending on the need to widen areas that have lost width from deposition or erosion or where the need to flatten the grade in steep sections exists. In these areas additional fill would also be added to the trail tread. Because the alignment and small scale character-defining features, such as rock-lining would not be affected, rehabilitation actions would meet the Secretary of the Interior's standards and would have no adverse effect on the eligibility of the trail for the National Register.

Rehabilitation of the abandoned access trail would also have some long-term beneficial effects on historic resources from restoration and reuse of the original trail alignment. Adverse effects from its deterioration would be alleviated with the restoration of trail features, including restoration of its width and trail structures (bridge and culverts). Replacement of the on-ground trail through a section of wetland vegetation with a structure, such as a boardwalk or puncheon, instead of a culvert would have slight adverse effects on this section of trail combined with long-term beneficial effects on the wetlands. Similarly, ongoing use of the alternative alignment that has been used over more than 13 years, would have small, indirect ongoing adverse effects.

The potential for affecting previously unidentified archeological resources would be reduced somewhat by the completed and ongoing survey of the project area for archeological resources and from the need to add fill, rather than excavate in most areas. During surveys conducted to date, no resources have been found. Especially detailed surveys have been conducted in the vicinity of the overlooks and trails to be rehabilitated. Except for the trail itself, and features formerly associated with it, no prehistoric archeological resources, eligible for or listed on the National Register, have been located in the project area. One historic archeological resource in the vicinity (the former location of the CCC pit toilet) would be unaffected by proposed project work.

Additional Impacts from Alternative 3

Additional impacts from Alternative 3 would include slightly more potential for uncovering buried archeological resources, from the excavation associated with placement of the webcam and from placement of a backcountry toilet; however surveys and testing would be used to avoid areas with high potential for archeological resources so



Scene showing crew of men packing in logs for guard rails for the construction of the Inner Bumpas Hell Trail. The trail over which the men are walking is the recently completed approach trail to the area.

Figure 17: Bumpass Hell Trail Construction

additional impacts would not be anticipated. Similarly, although there would be a slightly different configuration of the Bumpass Hell Overlook, actions would be unlikely to adversely affect cultural resources.

Impact Avoidance, Minimization and Mitigation Strategies

To avoid, minimize or mitigate impacts to cultural resources, the following strategies would be used during or following construction:

- Should unknown archeological resources be uncovered during construction, work would be halted in the discovery area, the park Cultural Resources Program Manager contacted, the site secured, and the park would consult according to 36 CFR 800.11 and, as appropriate, provisions of the Native American Graves Protection and Repatriation Act of 1990. In compliance with this act, the National Park Service would also notify and consult concerned tribal representatives for the proper treatment of human remains, funerary, and sacred objects should these be discovered during the course of the project.
- If necessary or possible, relocation of the work to a non-sensitive area would occur to enable more site testing and documentation. Every effort would be made to avoid further disturbance to the site. If relocation could not occur, then mitigation would include exhaustive documentation of the site to appropriate standards based on consultation with the State Historic Preservation Officer and other experts as applicable.

Cumulative Effects

Archeological resources in Lassen Volcanic National Park have been adversely impacted to varying degrees from past construction-related disturbances (prior to the advent of archeological resources protection laws); visitor impacts and vandalism; and erosion and other natural processes. Historic resources, including other CCC-constructed trails have been affected to varying degrees by deterioration and loss during rehabilitation efforts, prior to an understanding of their significance and also during recent rehabilitation of the Lassen Peak Trail. There would be no project-related contributions to cumulative impacts from the Alternative 1. Similarly, because of mitigation measures, the action alternatives would also not be expected to measurably contribute to cumulative adverse effects on archeological or historic resources. Cumulative beneficial effects on archeological and historic resources would be contributed from the rehabilitation of the main trail and from the reopening of the abandoned access trail.

Conclusion

There would continue to be adverse effects on historic resources under Alternative 1, potentially resulting in the loss of eligibility for the Bumpass Hell Trail for the National Register of Historic Places, and in continued deterioration on the abandoned access trail, which dates from the same period. There would be no effect on archeological resources under Alternative 1. There would be no effect on archeological resources and no adverse effect on historic resources under Alternatives 2 and 3. Long-term beneficial effects would accrue in Alternatives 2 and 3 from actions to preserve historic resources.

Visitor Experience

Impacts from Alternative 1

There would be no additional impacts on visitor experience from implementation of Alternative 1. Ongoing deterioration of the trail or failure in the slopes above or below the tread could result in unsafe conditions for visitors that would require future delays or closures to repair. Similarly, the boardwalk could deteriorate and change in configuration when hydrothermal features move. There would continue to be unsightly splinters from the treated wood portion of the boardwalk littering the ground beneath it. Further deterioration of either the trail or the inability to reconstruction sections of the boardwalk could result in visitors either not being able to access part of the trail or boardwalk during their visit or in longer term area closures while resources were secured for repairs. This would adversely affect the experience of some visitors wishing to experience the Bumpass Hell Basin during their visit. For



Figure 18: Deteriorated Rock Walls Trail Section

some of those visitors, this could affect their once-in-a-lifetime visit to the park. Although visitors would be directed to other hydrothermal features in the park and/or could access views of the basin from the trail beyond Cold Boiling Lake, the up-close experience many visitors seek would temporarily be unavailable in the Bumpass Hell Basin.

The area would continue to be crowded when school groups are present. The boardwalk is very popular for school groups because it is close to the hydrothermal features. Sometimes three or four classes converge at one time. When this likelihood is known ahead of time, a staff person is sent to help keep too many from being in one place at a time. Although there are group size restrictions on the trail, crowding can still occur when the separate groups meet. Despite no major problems being documented, the basin area gets quite crowded in midsummer and early fall. It is also becoming more popular for school groups to shuttle – starting at the Bumpass Hell Trail, taking in Cold Boiling Lake, and ending with a picnic at the Kings Creek Picnic Area, where buses pick them up.

Trail access to the Turquoise Pool has been cut off since the boardwalk that ascended to it was undermined by the Pyrite Pool. Because this access cannot easily be reestablished through this dynamic hydrothermal area, the loss of the ability to get to the Turquoise Pool would continue to adversely affect the experience of some repeat visitors.

Impacts from Alternative 2

The rehabilitation of the trail would affect visitor access to the Bumpass Hell Trail. Short-term adverse effects would include closure of the trail during one summer (approximately a 4-5 month construction season) for its reconstruction. Although the Bumpass Hell Trail would be closed, access to the basin for viewing (but not for descent) would continue via the trail from the Kings Creek Picnic Area. Often access to the Bumpass Hell Trail via the trail from Kings Creek is the only shoulder season access, and sometimes early to mid-summer season, access because of heavy snow and/or late melt-out from the trail that descends into the basin from the Bumpass Hell parking area. For example, in summer 2017, the trail did not open until the third week of August.

Long-term beneficial effects would also occur from improving the surface and width of the trail tread. Work on the trail would improve its ability to be traversed by visitors of all ages and most abilities. Improved tread would be possible by adhering to the trail's original construction width (4-feet) and grade (6%) where possible. The rehabilitation would preserve features from its CCC construction to the extent possible, while improving the ability for the trail to be traversed by those with movement difficulties. Spotting scopes at the Bumpass Hell Overlook would increase opportunities for visitors who do not descend into the basin.

Rehabilitation of the Brokeoff Volcano and the Bumpass Hell Overlooks would improve opportunities for use by both individuals and groups. Expanded interpretive opportunities in these areas and along the trail itself would improve visitor understanding of park resources. Locating spotting scopes at the Bumpass Hell Overlook would improve not only the experience of visitors descending into the basin, but also those remaining in this area. There would also be improvements in the safety messages at the Bumpass Hell Overlook to further acknowledge the gaseous nature of the basin and the potential for inversions to concentrate gases.

Improvements to the abandoned access trail into the basin would also provide new opportunities for visitors to observe fry pans and bubbling mud pots, hydrothermal features that are either not available from, or not as close to, the current trail alignment.

Reconstructing at least a portion of the boardwalk in the basin would have long-term beneficial effects on visitor experience. Most visitors would continue to enjoy immersion in the hydrothermal area within the Bumpass Hell Basin. This was the key characteristic identified during public scoping by many commenters. Although visitors can no longer access the Turquoise Pool, there would continue to be access to the Pyrite Pool under Alternative 2. This is the same as the current access. As in Alternative 1, access to the Turquoise Pool would not be reopened because there is no safe passageway for a boardwalk between the Pyrite Pool and the Turquoise Pool and this could continue to adversely affect the experience of some repeat visitors. From the Bumpass Hell Overlook, the pool would continue to be visible in the distance.

Boardwalks in Bumpass Hell, Devils Kitchen, and Sulphur Works have been relocated numerous times over the years because the acidic vapors affect both wood and metal. In some cases, wood posts in the ground have served as conduits or “wicks” for steam and acid. Even boardwalks constructed on seemingly cool ground can be affected, because the steam vents and mud pots change in temperature and character and can migrate laterally with time

(Clynne *et al.* 2012:35). This would continue to be the case under Alternative 2, with the boardwalk being constructed in a more moveable fashion so that parts can be moved to easily accommodate the movement of hydrothermal features. Changes in alignment of the boardwalk could also occur for the same reason, resulting in restricted access to some features visitors may want to get closer to, such as the Big Boiler and the Pyrite Pool.

Closing and restoring social trails that emanate from the Bumpass Hell Trail would have a range of effects on visitor experience, with some visitors approving of and staying within the changed access area, while other visitors would express disapproval and of further trail restrictions in the area.

Impacts from Alternative 3

Except for changes in the configuration of the overlook at Bumpass Hell; a different proposed terminus for the boardwalk; some differences in social trail rehabilitation; and installation of additional facilities (webcam and toilet), impacts from Alternative 3 would be similar to Alternative 2. Although the effects from these additional actions would be mostly beneficial, some visitors would find the intrusiveness of the webcam to be inappropriate in this backcountry setting. Similarly, some visitors expressed concern during public scoping about the effects of actions needed to maintain the backcountry toilet and that they would find this accommodation inappropriate in the setting.

Rehabilitation of the Bumpass Hell Overlook would provide three distinct areas for viewing, including of the surrounding backcountry, the Turquoise Pool and the Bumpass Hell Basin. Interpretive signs would be used to highlight these areas and would potentially improve opportunities for visitors to understand the surrounding area.

Social trail rehabilitation would be most extensive in Alternative 3, with existing trails that have long been in use rehabilitated. For the small number of visitors who took advantage of these from the main trail, rehabilitation would not necessarily preclude use of the areas they access since off trail use is not prohibited except in the basin itself, but that access would be made more difficult because of restoration efforts for formerly obvious trails.

Because the boardwalk would continue to access the Big Boiler as long as the ground surface approaching it was a stable enough surface for the boardwalk, most visitors would be satisfied with the new terminus of the boardwalk; however, some visitors would be unhappy with the reduced access to the basin, including loss of access to a close overlook of the Pyrite Pool. Improvements to the closed access trail would not only protect wetland resources, but would provide new opportunities for visitors to experience other hydrothermal features. This new access to frypans and mudpots on the abandoned access trail may partially make-up for loss of access to the Pyrite Pool. Although Alternative 2 would maintain this access, at least for a time, as noted above, continued erosion of the area or movement of this feature could later preclude that access. If eventual loss of close access to the Big Boiler occurred, that would further diminish visitor enjoyment.

The proposed solar panel to power the webcam would be installed, to the degree possible, in an area that is not evident to those in the basin; however, it is likely that it would be visible from some angles because of the need to place it in a relatively open area. Its placement in a grove of hemlocks would conceal it from most views and the upward angle of the solar panel would prevent visible reflection from the panel itself.

Solar panels for the toilet facility would be treated similarly to those for the webcam.

Impact Avoidance, Minimization and Mitigation Strategies

To avoid, minimize or mitigate visitor experience impacts, the following strategies would be used during or following construction:

- Press releases to local media and signs in the park would inform visitors about trail conditions in the park during the projects.
- During construction, signs would inform visitors of the construction activities on the trail and of potential closures or delays. Barriers and barricades, signs and flagging, as necessary or appropriate, would be used to clearly delineate work areas and provide for safe pedestrian travel through the construction area (if appropriate).
- On anticipated busy weekends a roving park ranger would patrol the trail for eims, education, and closure enforcement.

Cumulative Effects

Visitor access and opportunities in the park have largely expanded over the years. The Kohm Yah-mah-nee Visitor Center has resulted in a more obvious and better source of information for park visitors. There would be no contribution to adverse cumulative impacts on visitor experience from the alternatives. Cumulative beneficial impacts could result from Alternatives 2-3 from rehabilitation of the trail, including the abandoned portion into the Bumpass Hell Basin. New interpretive opportunities could also result in a more informed public.

Conclusion

There would be a range of short-term adverse and long-term beneficial impacts from the action alternatives. The greatest improvement to visitor use would occur in Alternative 2, while the reduced access in Alternative 3 would appeal to some visitors. Overall impacts from Alternative 1 would be adverse, with continued deterioration of the trails and boardwalk in Bumpass Hell.

Human Health and Safety

High-temperature fumaroles, mud pots, and other hydrothermal features present potential burn hazards to persons straying from trails and boardwalks in park hydrothermal areas. Thin crusts in the hydrothermal areas are susceptible to collapse from people walking on them. First-, second-, third-degree and sometimes fatal burns from boiling mud or water and steam have affected people in similar thermal areas in the U.S. and elsewhere in the world. Hydrogen sulfide (H₂S) and carbon dioxide (CO₂) gases are part of the steam in thermal areas. Although carbon dioxide is common in the atmosphere and hydrogen sulfide in other areas, hazards from concentration of these gases have the potential to overwhelm visitors to hydrothermal areas during inversions.

Based on Clynné *et al.* 2012, these hazards are discussed extensively in Christiansen *et al.* (2007: 34–36), from which the following information is adapted.

Although CO₂ is ubiquitous in the atmosphere at a concentration of 0.038 percent, both CO₂ and H₂S can be lethal in higher concentrations; 0.5 percent is the threshold limit value for continuous 8-hour exposure to CO₂. Signs of intoxication, however, appear in a 30-minute exposure at 5 percent (Aero Medical Association, 1953), and a few minutes of exposure at 7–10 percent produces unconsciousness (Flury and Zernik, 1931; Hunter, 1975). H₂S at 0.005–0.01 percent causes mild conjunctivitis and respiratory irritation after 1 hour, and 0.07–0.1 percent results in rapid unconsciousness, cessation of respiration, and death (Yant, 1930).

Typically, the gas released from fumaroles contains 95–99 percent CO₂ and 1–5 percent H₂S. Normally, these gases dissipate safely in the surrounding air; concentrations at waist level are rarely above 0.1 percent and 0.0002 percent respectively, even adjacent to fumaroles (Christiansen *et al.* 2007: 34, based on unpublished data of Jacob Lowenstern and Henry Heasler). Both gases, however, are heavier than air and, under calm conditions, can collect in low-lying areas sheltered from the wind. In particular, these gases can collect in pits or caves that can form in deep snow around areas of gas venting. The hazard from CO₂ is exacerbated because CO₂ is odorless and colorless and thus cannot be perceived readily. H₂S has a conspicuous “rotten egg” smell at low concentrations, but at concentrations above 0.015 percent (150 parts per million) the olfactory nerve is overwhelmed and the sense of smell disappears, often together with awareness of danger (Mandavia 2009).

Toxic gases from fumaroles thus pose a potential hazard to park visitors and staff, and thermal areas are especially hazardous when buried by snow after a significant storm. Normally, the gases dissipate quickly into the atmosphere, and only rarely are visitors present where gas concentrations can cause harm. Nevertheless, fatal incidents such as those at Mammoth Mountain in eastern California (Hill 2000; Becerra 2006) and at Lassen in 1995 (Arthur and Packer 1995) are possible. Also, unless safety measures are utilized, incidents similar to the one that caused a worker’s death at Tower Junction in Yellowstone National Park (Whittlesey 1995: 67) could occur (Clynné *et al.* 2012:35).

As noted in the compendium and Figure 20, boardwalks are provided to enhance protection from geological hazards due to thin-crust ground, hot water and mud. Walking off designated walkways exposes travelers to additional hazards (beyond the gases), such as breaking through these crusts into hot or boiling water or mud, including possible injury or death. In addition to presenting inherent hazards to visitors and employees, hydrothermal areas

are fragile geological and biological resources susceptible to irreversible degradation and damage from inappropriate use by visitors.

As early as 1936, NPS staff, such as a regional landscape architect recommended against a trail in the Bumpass Hell Basin, stating that it was dangerous. The park staff responded in a report noting: “As Mr. Meier says, this area is dangerous for unguided visitors.

However, visitors now wander all over the area by themselves and are very apt to get into trouble by breaking through the crusts into hot mud or hot water, or by slipping into the boiling pools.

The purpose of a trail is to provide a definite and safe travelable area, to prevent visitors from getting into trouble” (NPS LAVO 1936). The writer went on to note that there had already been one death from scalding and that each year, there are several serious burns, also noting that at present, there are tracks leading all over the area. A visitor cannot tell which is the official path: the one that is safe to follow (LVNP 1936).

As a result, the park determined that it was more dangerous to not provide a trail than to provide a designated trail from which off-trail travel was prohibited. Later correspondence noted: “As the park administration has pointed out, trails along these treacherous boiling waters are very necessary, indeed if the public is to be safeguarded from the temptation to wander indiscriminately over the brittle crust which covers part of the boiling area” (NPS LAVO 1936).

Because the park biologists objected to peeled logs that had already been carried in and stacked in preparation for construction of a barrier, staff also discussed the type of barrier:

“Instead of an unsightly barrier of this nature [peeled log post railing] we urge that one or more emphatically worded warning signs be set out at strategic locations calling attention to the possibility of serious injuries as a consequence of leaving the trail. Signs of this sort would be worded even more emphatically, if necessary, than the sample shown in Figure 19. They would not be as jarringly conspicuous as a barrier, yet they would discharge the duty of the Service in warning the public. It might be argued that a certain type of irresponsible individual refuses to obey signs but unless a wooden guard rail were to be made “bull-strong, hog-tight, and horse-high” such individuals would hardly respect the guard rail either” (E. Lowell Sumner, Jr. Wildlife Technician 1937).

Impacts from Alternative 1

A range of maintenance activities performed on the trail would continue to minimize overall hazards. Among these include clearing of fallen trees, drainage maintenance (digging out accumulated silt near water bars or drain dips), annual boardwalk inspection and maintenance, including fixing loose guardrails, tightening screws and replacing damaged or warped decking boards.

Although there is no specific written protocol for trails work in hydrothermal areas, in consultation with the USGS, park staff have developed a number of work processes to ensure their safety in this unstable environment. Under Alternative 1, Job Safety Analyses (JSAs) would continue to be used at tailgate safety meetings and while working in the basin.



Fig. 4. A warning sign, lettered in red, which appears at the beginning of the descent into the Bumpass Hell area. Signs of this type, but even more emphatically worded, were proposed as a substitute for the much more conspicuous and artificial looking guard rails which have been suggested for the area.

Figure 19: Early Hazard Warning Sign

Without extensive rehabilitation, the trail would continue to be rutted in some areas, with poor drainage and filled with sharp protruding rocks in other areas. Narrow, pinch points in some areas would preclude safe passing for individuals and groups. These areas would continue to contribute tripping and other safety hazards for visitors as they navigate the current trail surface. There are numerous reported and non-reported slips, trips and falls attributed to the poor condition of the trail tread. There are also numerous carry-outs every year, some of which require helicopter transport. Visitors are occasionally injured, some seriously.

Wandering (marking the correct trail over snow with bamboo flags) and benching of the spring snow pack on the tight switchback turns and trail below the Bumpass Hell Overlook would continue to occur before the public opening (typically during July). Other areas that often require snow removal to improve public safety include a section benched along a steep cliff, near the beginning of the trail.

Although it provides safe passage through the hydrothermal area, which requires visitors to stay on the formal trail, the boardwalk would continue to be relocated as necessary following winter damage and to minimize potential safety hazards to visitors from movement of hydrothermal features.

On the trail descending into the basin, wandering and digging out snow berms helps to prevent resource damage that occurs when multiple social trails descending the hillside form because people do not want to hike in snow or because they cannot determine the correct path. These actions would continue to minimize the potential for visitors to get into unsafe areas as they descend into the Bumpass Hell Basin.

Impacts from Alternatives 2 and 3

Some potential impacts to human health and safety would continue to be mitigated by wandering and digging out snowbanks under the action alternatives. Other natural hazards in the Bumpass Hell Basin would continue, with informational signs providing information to visitors about ways to avoid the hazards.

Compared to Alternative 1, there would be improved access to the Bumpass Hell Basin from rehabilitation of the trail by filling the tread, removing obstacles and widening pinch points by reshaping the trail where it has narrowed on steep hillsides. Improved and safer access would also occur from reopening the abandoned access trail because it melts out earlier in the spring than does the current main trail. A range of improvements, including signage and modifications to the boardwalk and overlooks to add seating and wider sections would also address the crowding that sometimes occurs during visits by groups. Overall enhancements would result in a safer trail experience by minimizing in-trail tripping hazards and by increasing its width to its historic constructed dimension (4-feet).

Reconstruction of the boardwalk would follow its existing footprint. To minimize onsite construction, sections of the boardwalk could be built offsite to be more moveable than the current structure and brought in. Lowering the boardwalk profile would increase its stability, not only for visitors, but when it is left during winter. Included in proposed modifications may be a removable railing and additional changes in materials to increase its longevity.

Impact Avoidance, Minimization and Mitigation Strategies

To avoid, minimize or mitigate human health and safety impacts, the following strategies would be used during or following construction:

- Before work on reconstruction of rock walls commenced, area surveys would occur to ensure a stable working environment. As appropriate, the work area would be reinforced to minimize the potential to trigger a rockslide during excavation.
- Personal protective equipment (PPE), such as helmets, would be worn by personnel during rock work.
- Standard Operating Procedures or assessment techniques to determine when the trail is safe to open would be developed.
- Park staff would also develop written protocols for working in the hydrothermal basin, to minimize the inherent risk to employees responsible for conducting the rehabilitation of the trail and boardwalk and would use protocols developed during the Lassen Peak Trail rehabilitation for work around rock walls.

Cumulative Effects

Prior to the installation of the boardwalk in the 1970s, injuries to visitors were more common. A range of inherent safety hazards, as described above, is present. These include burning by immersion in hot or boiling water and/or

steam vents and inhalation of concentrated gaseous carbon dioxide and hydrogen sulfide. Under Alternative 1, there would continue to be a range of short-term adverse impacts that would not contribute to cumulative effects on human health and safety because there are no additive effects on human health and safety. Although this range of potential adverse impacts would be narrowed in the action alternatives, some inherent hazards would remain. Nonetheless, for the same reason as Alternative 1, the action alternatives would not contribute to cumulative adverse impacts.

Conclusion

Although there would be no cumulative adverse effects on human health and safety, there would continue to be a potential for adverse effects under all alternatives. The potential for these to occur would be mitigated more effectively under the action alternatives (2 and 3).

Table 2: Impact Comparison Chart

Impact Topics	Alternative 1 Impacts	Alternative 2 Impacts	Alternative 3 Impacts
Soils and Geology	<p>No additional impacts. Existing extensive erosion of native soil and fill from human and natural forces (rain, snowmelt, unstable slopes) would continue to worsen.</p> <p>Loss of soil and tread retaining walls would continue. Bare areas would grow.</p> <p>Protection of the hydrothermal area would continue from use of boardwalk to prevent breaking through thin crust.</p> <p>Treated wood splinters from deteriorating boardwalk would remain.</p>	<p>Loss of soil and fill from the trail would be reduced by reconstruction of tread retaining structures. Imported and native soil and fill would be compacted with native soil and rock to improve retention of the trail tread.</p> <p>Rehabilitation of the abandoned access trail would re-disturb approximately 0.15 acres, including constructing footings for puncheon and a trail bridge.</p> <p>Soils in bare areas impacted by unauthorized visitor use (social trails, etc.) would be restored by adding back native vegetation.</p> <p>The addition of a soil binder could further reduce erosion and long-term maintenance.</p> <p>Additional seating rocks and fill would be gathered to improve overlooks and rest areas.</p> <p>Boardwalk reconstruction would continue to protect hydrothermal features, including fragile areas from human foot traffic.</p>	<p>Impacts would be the same as Alternative 2 for rehabilitation of the main trail and the abandoned access trail. Impacts would be similar to Alternative 2 for rehabilitation of overlooks and reconstruction of the boardwalk. There would be slightly different impacts (digging, compaction, loss of vegetative cover) from construction of a backcountry toilet and webcam.</p> <p>Differences in overlook use and rehabilitation could result in less use/importation of native soil and rock for rehabilitation.</p> <p>A shorter boardwalk would reduce overall impacts from its reconstruction in the hydrothermal area.</p>
Water Resources: Water Quality	<p>No new impacts. Existing impacts would continue to be small and adverse from improper disposal of human waste and naturally occurring runoff, as well as from continued deterioration of constructed features on the abandoned access trail.</p>	<p>Impacts would continue from improper disposal of human waste. Beneficial and adverse impacts affecting a small wetland and stream channel would occur from rehabilitation of the abandoned access trail.</p>	<p>In addition to impacts from Alternative 2, there would be a small degree of beneficial and adverse impacts from installation and use of a backcountry toilet.</p>
Water Resources: Wetlands	<p>Ongoing impacts from compacted soils and stunted vegetation (less than 0.01 acre) from lack of rehabilitation of sedge-dominated wetland from abandoned access trail.</p>	<p>Short- and long-term adverse impacts on approximately 125 square feet of wetland from construction of boardwalk or puncheon to allow for water movement in the area. Slight additional impacts from construction of bridge stringers and footings downstream from the wetland.</p>	<p>Impacts same as in Alternative 2.</p>

Impact Topics	Alternative 1 Impacts	Alternative 2 Impacts	Alternative 3 Impacts
Vegetation	No additional impacts. Existing impacts, including bare ground near overlooks and from social trails. No specific plans for revegetation or restoration.	Range of small impacts from loss of vegetation during rehabilitation of the trail and overlooks. Some removal of small trees blocking viewpoints. Beneficial effects from rehabilitation/restoration of disturbed areas (0.07 acre), such as social trails and potentially from adding fill to the trail tread.	Impacts similar to Alternative 2, with additional vegetation disturbance from other proposed actions, including webcam and toilet installation and from different array of overlooks.
Archeological and Historic Resources	Continued adverse effects from benign neglect of abandoned access trail into Bumpass Hell Basin. Similar, but fewer adverse effects from continued loss of trail structures and tread from erosion of main trail.	Beneficial and adverse effects from reconstruction of deteriorated rock walls and trail tread, including rock lining and ramping and/or steps present in some areas. Beneficial effects from rehabilitation of abandoned access trail. Potential to affect previously unidentified archeological resources.	Same as Alternative 2, with slight additional potential to affect unidentified archeological resources from excavation in additional areas.
Visitor Experience (including visitor use opportunities, interpretation and education)	No additional impacts. Continued unsafe conditions for visitors from trail tread deterioration, leading to tripping hazards. Without repair the trail and boardwalk would continue to deteriorate, resulting in the potential for longer closures. Little specific interpretation of trail, other than at overlooks. Continued loss of visitor access to some areas, depending on movement of hydrothermal features. Deteriorated conditions on and surrounding the trail (bare, unsightly areas).	Short-term, temporary adverse effects on access to the Bumpass Hell Trail and Basin during construction. Reconstruction of the full width and former 6 percent grade of the trail would result in a smooth trail tread. Reconstruction of the boardwalk would continue to provide the up close and personal access to hydrothermal features that many visitors seek. New closer access to frypans and mudpots would also provide an improved experience. Social trails would be rehabilitated, overlooks improved, and interpretation of features upgraded or added, improving overall visitor experience through knowledge and aesthetics. Improvements would provide better access for groups.	Impacts would be similar to Alternative 2, however there would likely be a shorter reconstructed boardwalk, which may not fulfill some visitors' desire to be fully within the basin. Because of more limited improvements to make the trail as accessible as possible, there might be impediments to some visitors accessing the trail. Beneficial impacts from improved interpretation would be the same as Alternative 2. Some visitors would find new facilities, such as the backcountry toilet and webcam appealing.
Human Health and Safety	Although safety hazards would continue to be minimized by routine and cyclic maintenance activities, the extent of deterioration of the trail tread, including	Although safety hazards would continue to be minimized by maintenance activities, the trail and boardwalk would be reconstructed to good condition,	Same as Alternative 2.

Impact Topics	Alternative 1 Impacts	Alternative 2 Impacts	Alternative 3 Impacts
	<p>from erosion would continue to present numerous obstacles, including protruding rocks and ruts.</p> <p>Reconstructing the boardwalk would continue to provide safe passage through the hydrothermal area.</p>	<p>resulting in a much smoother travel surface with far fewer obstacles. Other modifications would improve opportunities and therefore safety for group use and would make the overall experience easier, potentially resulting in fewer injuries requiring carry-outs.</p>	

Chapter 4: Consultation and Coordination

A. Internal Scoping

Internal scoping began in summer 2014, following the removal of the section of boardwalk near the Pyrite Pool. The first interdisciplinary team meeting was held on January 7, 2014. Afterwards the park solicited additional information from the public to determine how to proceed with planning for the area. The park also worked with the USGS and others during this time.

B. Native American Indian Tribes Consulted

Prior to public scoping, scoping was conducted with Native American Indian tribes affiliated with the park. There are ten federally recognized tribes in the Lassen area. They are: Berry Creek Rancheria, Enterprise Rancheria, Greenville Rancheria, Mechoopda Indian Tribe of the Chico Rancheria, Mooretown Rancheria, Redding Rancheria, Susanville Rancheria, Round Valley Indian Tribe, Pit River Tribe, and United Auburn Indian Community. These tribes were sent letters on March 3, 2017 noting the likely undertaking in the proposed project area. No comments were received.

Enterprise Rancheria
Glenda Nelson, Tribal Chair

Greenville Rancheria
Kyle Self, Tribal Chair

Mooretown Rancheria
Gary Archuleta, Tribal Chair

Pit River Tribe
Morning Star Gali, Tribal Historic Preservation
Officer

Redding Rancheria
James Hayward, Sr., Cultural Resources Program

Shingle Springs Rancheria
Nick Fonseca, Tribal Chair

Susanville Indian Rancheria
Melany Johnson, Tribal Historic Preservation Officer

United Auburn Indian Community
Gene Whitehouse, Tribal Chair

C. Public Involvement

During the public scoping comment period in spring 2017 for the Lassen Volcanic National Park Bumpass Hell Trail Project alternatives, the park received 27 correspondence letters. All of these were received via the National Park Service (NPS) Planning, Environment and Public Comment (PEPC) website ([NPS Park Planning](#)). They included commenters from the local area, 11 states and one foreign country (Australia). No letters were received from other public agencies, representatives of non-profit organizations, or individuals noting affiliation with other organizations. A summary of comments is provided in Chapter 1.

D. Agencies Consulted

California State Historic Preservation Office

In accordance with Section 106 of the National Historic Preservation Act, the National Park Service provided the State Historic Preservation Officer (SHPO) of the California State Department of Archaeology and Historic Preservation an opportunity to comment on the effects of this project.

Proposed actions would have no adverse effect on the eligibility of the Bumpass Hell Trail for listing on the National Register of Historic Places or on other historic or cultural resources in the park. Prior to making a decision as to which alternative or combination of alternatives would be implemented, concurrence with this determination of effect would be sought from the SHPO.

Formal consultation was initiated June 22, 2017. A Concurrence of No Adverse Effect is expected in April 2018.

U.S. Fish and Wildlife Service / National Marine Fisheries Service

In accordance with the Endangered Species Act, the National Park Service contacted the U.S. Fish and Wildlife Service on February 5, 2018 to determine which federally listed special status species should be included in the analysis. No federally listed species exist in the park. Therefore, the park has determined that there would be no effect on species eligible for or listed under the Endangered Species Act.

U.S. Army Corps of Engineers

The rehabilitation of the abandoned access trail includes a small bridge (approximately 3 x 6 feet) and a short section of boardwalk (approximately 3 x 20 feet) through area wetlands. Because only a few tens of square feet of wetlands would be affected, much less than one-tenth acre (4,356 square feet) threshold, no NPS Wetlands Statement of Findings would be required.

E. List of Preparers, Persons, Agencies Contacted

NATIONAL PARK SERVICE Lassen Volcanic National Park

Jim Richardson, Superintendent
Kirk Barrett, Trails & Signs Supervisor
Juanita Bonnifield, former Cultural Resource Program Manager
Gary Mott, Chief of Maintenance
Steve Gibbons, former Superintendent
Elizabeth Hale, GIS Specialist
Karen Haner, Chief of Interpretation & Education
Deirdre Hanners, Compliance Specialist
Mike Magnuson, Wildlife Biologist
Ashley Phillips, Historical Architect/Section 106 Coordinator

Pacific West Regional Office

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909 First Avenue, Seattle, Washington 98104

Rose Rumball-Petre, Environmental Protection Specialist (preparer)
Alan Schmierer, Regional Environmental and Wilderness Coordinator (reviewer)

F. List of Agencies, Organizations, and Persons to Whom Copies of the EA were Sent

This list, which includes individuals and groups that have requested to be kept informed about park activities, as well as conservation organizations and federal, state and local partners and nearby agencies, is available from the park upon request.

Libraries

- Chester Library, Plumas County, Chester, CA

Agencies

- Lassen National Forest
- U.S. Fish and Wildlife Service
- U.S. Geological Survey
- U.S. Geological Survey – Volcano Hazards Team

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