Trails Assessment - Rough Fire South Zone BAER
Sequoia National Forest
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I. Potential Values At Risk

Burned-Area Emergency Response (BAER) Assessments are rapid evaluations to determine values at risk due to imminent post-fire threats and to develop appropriate actions to manage unacceptable risks (FSM 2523.1). This report summarizes the assessment of trail resources on National Forest System (NFS) lands within and adjacent the Rough fire perimeter. The following critical values were considered during assessment:

CRITICAL VALUES (FSM 2523.1, Exhibit 1)
HUMAN LIFE AND SAFETY
Human life and safety on National Forest System (NFS) lands.
PROPERTY
Buildings, water systems, utility systems, road and trail prisms, dams, wells or other significant investments on NFS lands.
NATURAL RESOURCES
Water used for municipal, domestic, hydropower, or agricultural supply or waters with special Federal or State designations on NFS lands.
Soil productivity and hydrologic function on NFS lands.
Critical habitat or suitable occupied habitat for federally listed threatened or endangered terrestrial, aquatic animal, or plant species on NFS lands.
Native or naturalized communities on NFS lands where invasive species or noxious weeds are absent or present in only minor amounts.
CULTURAL AND HERITAGE RESOURCES
Cultural resources which are listed on or potentially eligible for the National Register of Historic Places, Traditional Cultural Properties, or Indian Sacred Sites on NFS lands.

NFS trails within the Rough Fire burned area may pose risks to all of these critical values. Risks to life and safety may be posed by hazard trees, flooding, debris flows, and falling rocks on trails within or downslope from burned areas. These threats can also affect property by damaging trail infrastructure,

which can pose an additional risk to life and safety. Additional risks to property can be posed by burning of trail infrastructure and erosion of trail tread caused by accelerated overland flows concentrating on trails downslope from burned areas. Erosion from the tread can adversely affect natural resources through sediment delivery to streams and critical habitat. Natural resources may also be affected through the burning of natural or constructed barriers, which can lead to off-site natural or cultural resource damage from off-trail travel. Down trees along a trail may also encourage off-trail travel, which could affect natural resources.

II. Resource Condition Assessment

A. Resource Setting

The Rough Fire began as a lightning caused wildfire on July 1, 2015, and spread to over 151,000 acres with 89% containment by October of 2015. The Rough Fire BAER assessment was split into two zones- the North Zone and the South Zone. The focus of the North Zone assessment was on over 58,500 acres burned on the Sierra National Forest. The South Zone consists of over 82,500 acres burned on the Sequoia National Forest, and will be the focus of this assessment (Appendix D, Map 1). 21 trails totaling approximately 50 miles in length were identified as potentially affected by the Rough Fire. All of these were prioritized and assessed using the Burned Area Reflectance Classification (BARC) data, and GIS and/or through field observations to determine potential threats to BAER values. The BARC data uses reflected infrared light to determine post-fire vegetation condition, which is correlated with soil burn severity. The BARC data and soil burn severity field assessments were used to create a final soil burn severity map. The final soil burn severity map was one of the resources used to determine the level of risk to critical values.

Trails within or downslope of areas burned at moderate to high severity are more likely to have values at risk. The following trails were identified as high priority for assessment either because they have known critical values at risk or have 10% or more of their length within high and moderate burn severity:

- *Boole Tree Trail (28E02)*
- *Boole Tree Trail Spur (28E02A)*
- *Boulder Trail (29E04)*
- *Boyden Cavern Pathway (11141-6)*
- *Camp 4 Trail (26E04)*
- *Choke Creek Trail (30E03)*
- *Deer Cove Trail (30E01)*
- *Evans Grove Loop (30E04A)*
- *Happy Gap Trail (30E02)*
- *Kanawyer Trail (30E04)*
- *Verplank Trail (27E03)*
- *Yucca Point Trail (28E01)*

These trails are Class 2 or 3 non-motorized National Forest system trails and total approximately 30 miles in length. The Boole Tree Trail is a moderate 2.5-loop to the sixth largest tree in the world- a giant sequoia from which the trail gets its name. The Boulder Trail parallels Big Meadows Creek and the Camp 4 Trail connects the White Deer Road (13S94) to the Davis Road (12S01). Both are unmaintained trails that receive little to no use. The Boyden Caverns pathway is a short, steep, paved path to the entrance of the Boyden Caverns, which is a site operated in cooperation with the Forest Service under a special use permit. The Deer Cove trail is a difficult 6.8 mile climb from Highway 180 to Grizzly Lake in the Monarch wilderness, and is an important connector to trails within the Kings Canyon National Park. The Choke Creek and Happy Gap trails are both seldom maintained trails that begin at the Deer Cove trail and head east through the wilderness. The Kanawyer trail, also known as the Kennedy Meadow Trail, begins at Kennedy Grove Road (13S25) and heads through Kennedy Grove into the Monarch Wilderness and ends at Highway 180 less than a mile east of the Wilderness boundary. The Verplank Trail connects the Chicago Stump Road (13S03A) to the River Trail (27E01), and is an unmaintained trail that receives little to no use and is mostly nonexistent. It is likely that the Verplank Trail will be permanently closed in the future. The Yucca Point Trail begins at Highway 180 and ends at the Middle Fork of the Kings Wild and Scenic River.

B. Summary of Analysis

Boole Tree Trail (28E02): The Boole Tree Trail had 13% of its length within moderate burn severity, and is downslope of approximately 23 acres of land burned at moderate and high severity (Appendix B, Table 1). Numerous log waterbars used to divert water from the trail and a log retaining structure stabilizing approximately 40 feet of the tread were burned in the fire (Appendix A, Photo 1 and 2). The loss of waterbars will increase flow down the trail, and result in erosion of the tread. If uncorrected, rills or gullies may form which will further concentrate flow and exacerbate erosion. The loss of the log retainer has resulted in undercutting and destabilization of the outside edge of the tread. A large tree stump on the inside edge of a switchback burned out, resulting in destabilization of the tread which could lead to tread collapse and threaten the safety of administrative or public trail users (Photo 3). Off-trail resource damage could occur if trail users choose to shortcut the switchback in order to avoid the destabilized tread. This trail has the capacity to capture flow from a couple ephemeral drainages. Expected accelerated flow at these drainages from moderate and high burn severity above will result in increased erosion of the trail tread and sediment delivery to the drainages. It is recommended that the burned waterbars and log retainer be replaced, burned-out stump holes be filled with adjacent material, and that drainage function be maintained and restored along the length of the trail in order to reduce the risk to property, safety, and natural resources posed by the fire (Treatment 1). Observations not warranting treatments due to low risk to BAER critical values include potential hazardous waste from burned Forest Service electrical equipment adjacent the trail and reduced functionality of a grazing allotment fence due to numerous burned wooden posts. It is recommended that the burned electrical materials be removed and that the grazing allotment permittee be notified of the damage to the fence.

Boole Tree Trail Spur (28E02A): This trail was subject to either unburned/very low or low burn severity, and is downslope from a relatively large amount of land burned at moderate and high severity (Table 1).

There is a buffer of unburned vegetation between the higher burn severity land and the trail, but higher flows may still occur in drainages. Tread is at risk of eroding due to more flow at an ephemeral drainage crossing, although the risk is likely low due to a relatively small amount of contributing area. A hose lay for fire suppression work heads from the interpretative sign down to the Boole Tree may encourage off-trail foot travel. It is recommended that fire suppression repair work include disguising the hose lay with leaf litter and woody debris. No unacceptable risks to critical values posed by the fire were identified along this trail.

Boulder Trail (29E04): The Boulder Trail had 11% of its length within moderate burn severity (Table 1). The trail receives little to no use and is difficult to distinguish from the surrounding landscape. Approximately 200 feet of the trail from the junction of the Burton Road (14S02K) was used in fire suppression, and was rehabilitated by scattering of woody debris on the bare soil. It is likely that the trail was encroached by vegetation before the suppression work. Due to the primitive trail infrastructure, lack of maintenance, and relatively small amount of trail length within high or moderate burn severity, it is expected that there are no unacceptable risks to critical values posed by the fire along this trail.

Boyden Cavern Pathway (11141-6): The Boyden Caverns pathway was subject to low severity burn (Table 1). Potential risks to natural resources and human life and safety exist along this path. Burned equipment alongside the pathway may leach hazardous materials. A burned tree damaged the paved pathway on the outside edge of the tread when it fell. The decking and railing of two walking bridges was burned, making the bridges unsafe for pathway users (Photo 4). There is also potential for small rocks and debris to fall from slopes above the trail. It is recommended that the permittee keep the pathway closed to public use until the bridges are repaired and the hazardous materials are removed.

Camp 4 Trail (26E04): The Camp Four Trail had 16% of its length within moderate burn severity (Table 1). Knowledge from local resources indicated that this trail is not used and has very little value to the trail system. Due to the low use and primitive trail infrastructure, it is expected that no unacceptable risks to critical values posed by the fire exist along this trail.

Choke Creek Trail (30E03): The Choke Creek Trail had 58% of its length subject to moderate burn severity, with approximately 2,355 acres of land subject to moderate to high burn severity upslope (Table 1, Map 2). The time-constraint due to the rapid nature of the assessment and knowledge from local resources caused this trail to be low priority for field analysis due to its low use and primitive infrastructure. It is likely that accelerated flow from burned areas upslope will cause erosion of the trail at drainage crossings and result in sediment delivery to the drainages, and that an increase in erosion will occur along lengths of trail that capture flow. It is recommended that drainage function be maintained or restored along this trail in order to protect the trail tread and reduce sediment delivery from the trail to stream courses (Treatment 1).

Deer Cove Trail (30E01): The Deer Cove Trail had 7% of its length subject to moderate burn severity, and has a relatively small amount of contributing area with moderate and high burn severity due to being mostly located along ridge tops or spurs or having a wide unburned buffer when located below land

with higher burn severity (Table 1, Map 2). Due to this, the risk to trail infrastructure posed by accelerated runoff is expected to be low. It is likely that burned-out stump and root holes exist that could destabilize trail tread and pose a risk to the safety of trail users. A potential hazard tree and a down oak were observed near the Highway 180 trailhead, and there may be more hazard trees and numerous down trees across the trail due to the fire. Hazard trees pose a risk to life and safety, and both hazard trees and down trees pose a risk to natural resources if user trails are created to bypass the obstacles. Due to the moderate use level and importance of this trail to provide access to other trails and points of interest within the Monarch Wilderness and the Kings Canyon National Park, it is recommended that drainage function be maintained or restored along burned areas to prevent erosion caused by flow down trail in areas with moderate burn severity, and that tread be stabilized where damaged by burned-out stump and root holes to reduce risk of injury to trail users (Treatment 1). Completion of this work would require hazard tree removal and logging out to protect the safety of workers and to reduce risk to natural resources. The Deer Cove Trail provides access to the two trails most at risk of tread damage (Choke Creek and Happy Gap). It is recommended that the implementation leader seek approval to operate chainsaws within the Monarch Wilderness in order to speed implementation and prevent damage to critical values that may be caused by the first damaging storm.

Evans Grove Loop (13E04A): The Evans Grove Loop had 7% of its length subject to moderate burn severity (Table 1). Burned stump holes within low burn severity areas pose a threat to the stability of trail tread and historic trail infrastructure. It is recommended that stump holes be filled with adjacent material to prevent further damage, and that drainage function be maintained and restored to prevent flow down the trail tread (Treatment 1).

Happy Gap Trail (30E02): The Happy Gap Trail had 40% of its length subject to moderate burn severity, and 12% subject to high burn severity with approximately 373 acres of land subject to moderate to high burn severity upslope (Table 1, Map 2). The time-constraint due to the rapid nature of the assessment and knowledge from local resources caused this trail to be low priority for field analysis due to its low use and primitive infrastructure. It is likely that accelerated flow from burned areas upslope will cause erosion of the trail at drainage crossings and result in sediment delivery to the drainages, and that an increase in erosion will occur along lengths of trail that capture flow. It is recommended that drainage function be maintained or restored along this trail in order to protect the trail tread and reduce sediment delivery from the trail to stream courses (Treatment 1).

Kanawyer Trail (30E04): The Kanawyer Trail had 11% of its length subject to moderate burn severity, and 1% subject to high burn severity (Table 1). The segment of the trail between Boulder Creek and Monarch Grove has approximately 224 acres of mostly moderate burn severity land upslope (Map 3). The trail was assessed in the field from the Kennedy Grove Road trailhead to an overlook that allowed viewing of the burned trail segment east of Boulder Creek. Approximately 6 trees were observed and determined to be imminent hazards to trail users along the 2 miles of trail surveyed (Photo 5-7). It is very likely that more hazard trees exist that would pose a risk to life and safety of administrative or public trail users. Several burned stumps along the edge of the trail corridor have destabilized the tread, and pose a safety risk to trail users and natural resources. Off-trail resource damage could occur if trail users choose to

travel off-trail to avoid the destabilized tread. A burned directional sign at the western junction with Evan's Grove Loop may lead to user confusion. The trail has the capacity to capture flow due to the presence of berm and the lack of adequate water diversion structures, and will lead to increased erosion of the trail tread in areas of moderate burn severity if not addressed. The trail crosses multiple steep draws having the potential to carry accelerated flow from land subject to moderate burn severity upslope, and is at risk of washing out at these crossings in periods of high runoff (Photo 8). It some cases, flow from these draws would be captured by the trail tread for short distances, which can lead to complete loss of the tread. It is likely that there are similar risks at most of the drainage crossings along the burned sections of trail. Local knowledge and field observations indicate the area of moderate burn severity above the trail segment east of Boulder Creek appeared to have been mostly grasses pre-fire. This hillslope was left bare after the fire, and the trail below may be subject to increased flow from the bare hillslope and ephemeral drainages feeding into rattlesnake creek. The seldom maintained trail tread likely has the potential to capture flow which would increase erosion of the tread and the potential for sediment delivery from the tread to Rattlesnake Creek or Boulder Creek. In order to address the unacceptable risk to life and safety along the Kanawyer Trail, it is recommended that a forest order be obtained to close the trail from the Deer Meadow Trail junction to the 13S25 Road for up to a year or until the hazard trees are mitigated, and that hazard warning and closure signs be posted at trail access points adjacent the fire perimeter (Treatment 2). To protect property and natural resources it is recommended that stump holes are filled, berm is removed, the tread is outsloped, rock waterbars are maintained, additional rock waterbars and/or rolling dips are installed where necessary to deflect flow from the trail tread, and armored drainage dips are installed at the identified at-risk draws and where necessary to prevent wash-outs at drainage crossings (Treatment 1). Completion of this work would require hazard tree removal to protect the safety of workers. It is recommended that the implementation leader seek approval to operate chainsaws within the Monarch Wilderness in order to speed implementation and prevent damage to critical values that may be caused by the first damaging storm.

Verplank Trail (27E03): The Verplank Trail had 22% of its length subject to moderate burn severity, and has little chance of receiving accelerated runoff from burned land upslope, due to being located on the ridgetop through most of the adjacent area with moderate and high burn severity (Table 1). The vegetative barriers to OHV traffic were not affected by the fire on the southern, and the north end was unburned. These factors and the low visitor use make it likely that there are no unacceptable risks to critical values posed by the fire along this trail.

Yucca Point Trail (28E01): The Yucca Point Trail had 60% of its length subject to moderate burn severity and has a relatively small amount of contributing area with moderate burn severity (Table 1). Trailhead signage at the Highway 180 junction was burned which may lead to user confusion (Photo 9). The trail has the capacity to capture flow due to the presence of berm and the lack of adequate water diversion structures, especially where a culvert directs flow from a large roadside catchment into the trail tread (Photo 10). Accelerated flow from land burned at moderate severity adjacent the trail and land draining into the road culvert is likely to erode the trail tread. Removal of vegetative cover and burning of the soil structure has destabilized the slopes above the trail, and caused the slopes to be subject to dry ravel

(Photo 11). Loose lock material has sloughed onto the trail tread and has likely loosened boulders on the steep slopes. The instability of the dry ravel-covered trail tread and the potential for rock fall poses a risk to life and safety of trail users. It is recommended that a forest order be obtained to close this trail to public use for up to a year or until there is no longer an unacceptable risk from rock fall, and that hazard warning and closure signs be posted at both ends of the trail (Treatment 2). To protect property and natural resources it is recommended that dry ravel is periodically removed from trail tread, berm is removed and the tread is outsloped, where feasible, rock waterbars are maintained, additional rock waterbars and/or rolling dips are installed where necessary to deflect flow from the trail tread, and an armored rolling grade dip is installed to deflect water entering the trail from the road culvert (Treatment 1).

III. Assessment of Values at Risk

Emergency conditions were determined to exist for specific trails and sections of trail within the burned area. These emergency conditions were determined to exist using the BAER Risk Assessment Matrix (FSH 2323.1, Exhibit 2) and are based on threats associated with anticipated post-wildfire impacts to trail infrastructure and trail users.

Threats to trail infrastructure includes excessive erosion of the trail tread caused by interception of accelerated runoff and capture of streamflow from steep hill slopes and drainages subject to moderate and high burn severity. Table 1 in Appendix B outlines the Soil Burn Severity Class for each affected trail. The cumulative risk to property is high along the following NFS trails: Boole Tree Trail (28E02), Deer Cove Trail (30E01), Kanawyer Trail (30E04), and Yucca Point Trail (28E01).

Threats to trail users exist from hazard trees, rock fall, and tread destabilization due to dry ravel, burned stump and root holes, and burned retainers. The cumulative risk to life and safety of National Forest visitors and agency personnel is high along the following NFS trails: Boole Tree Trail (28E02), Deer Cove Trail (30E01), Kanawyer Trail (30E04), and Yucca Point Trail (28E01). The potential for intermediate risk from hazard trees and tread destabilization exists along all other trails that were burned.

Table 2 in Appendix B summarizes the risk assessment for each trail.

IV. Treatments to Mitigate the Emergency

A. Treatment Type

1. Road and Trail Treatments- *Trail Storm Proofing*

Storm proofing should occur prior to the first damaging rain events and within the first year following the fire. Treatments would be implemented with hand tools and would include outsloping, berm removal, replacement of burned water bars, maintenance and construction of drainage dips and water bars, and installation of armored drain dips where necessary to prevent erosion of the trail infrastructure. Treatment would also include filling of stump holes, replacement of burned log retainers, and removal of dry ravel to prevent destabilization of the tread. All treatment locations and borrow pits

would receive archeological clearance prior to implementation. If necessary, an Archeologist would make field visits to determine appropriate locations to borrow soil and rocks needed for filling of stump holes, construction of rock water bars, or armoring of trail tread (Map 4-7, Table 3).

2. Protection and Safety Treatments- *Trail Closure and Hazard Warning Signs:*

Hazard warning signs should be posted to inform the public of the increased risk to safety in burned areas posed by hazard trees and rock fall. Warning signs should be installed at access points to all trail segments that have been burned and should remain in place for up to 3 years or until potential hazards are mitigated (Map 8-10, Table 4). Locations of hazard sign installations would be approved by an Archeologist prior to implementation.

This treatment would include administrative closure by forest order of the Kanawyer and Yucca Point trails for up to one year or until hazards are mitigated. Closure signs would be installed and removed after the forest order is terminated.

All treatments are consistent with the Burned Area Emergency Response Treatments Catalog.

B. Treatment Description

1. Trail Storm Proofing

Outsloping: Establishing a downward grade from the inside edge (uphill side) of the tread to the outside edge (downhill side) of the tread. Downward sloping of ½" to 1" per foot of trailbed width is normally sufficient (FSH 2309.18). Outsloping by itself is normally not sufficient unless trail grades are slight. Soil may be loosened with a Pulaski and removed using a McLeod, and can be used to fill holes in the tread. This treatment would occur on all trails that require storm proofing.

Berm Removal: Removal of soil build-up on the outside edge of the trailbed that prevents water from exiting the trail. Soil may be removed using a McLeod and used to fill holes in the tread. Berm should be removed where feasible. This treatment would occur on all trails that require storm proofing.

Maintenance of existing water bars: Use a shovel to dig material from directly upslope of the waterbar, being sure to maintain the outslope, and use the removed material to fill below the waterbar. If drains are eroded they would be armored with rock collected from adjacent the trail (Appendix E, Exhibit 1).

Replacement and installation of log water bars: This treatment would occur on the Boole Tree Trail. Burned log water bars would be replaced and log waterbars would be installed where necessary to restore drainage function so that they match existing log water bars in order to keep the character of the trail and reestablish drainage function. Waterbars should be up to 12" diameter peeler core or treated lodgepoles, anchored 12" into the cutslope and extending at least 6" into the fillslope at a 45° angle (Exhibit X). Log water bars must be maintained regularly to function properly. If maintenance cannot be guaranteed, consider installing knicks instead (Exhibit 2).

Installation of rock waterbars: This treatment would occur on the Kanawyer trail. Rock waterbars would be installed to match the existing rock waterbars where necessary to restore drainage function. Rock would be gathered from adjacent the trail and should be installed so that there is an overlapping line of rock skewed 45°on the downhill side of the trail, 2/3 of each rock buried in the soil surface with at least 4" showing on the downhill side (Exhibit 3). Rock water bars must be maintained regularly to function properly. If maintenance cannot be guaranteed, consider installing rolling grade dips instead (Exhibit 4).

Installation of armored grade dips: This treatment would occur at a culvert outlet on the Yucca Point trail, and ephemeral drainage crossings and steep draws identified on the Kanawyer Trail, Boole Tree trail, Yucca Point Trail, and potentially existing on the Choke Creek and Happy Gap trails where tread erosion from accelerated post-fire flows is likely. Rock would be gathered from adjacent the trail after obtaining archeological clearance. Tread would be reshaped to create a gradual dip where water can exit the tread followed by a rise at an angle to the outslope to divert water off the trail. The drainage structure would include a riprap tray where the water exits the trail followed by a rock waterbar to divert flow, a section of fill and a retainer bar to retain the fill (Exhibit 5).

Filling of Stump and Root Holes: This treatment would occur where identified on the Boole Tree Trail and anywhere stump and root holes may destabilize trail tread on the other trails that will receive storm proofing treatment. Fill material would be removed from adjacent the trail tread after receiving archeological clearance, and would be packed into the stump of root hole then compacted with the back of a McLeod or a tamping bar.

Burned Log Retainer Replacement: This treatment would occur on the Boole Tree Trail. Treated 6-8" lodgepole or peeler core would be placed where the logs burned out and would be anchored using lengths of rebar. Fill material would be used to fill the tread on the inside edge of the log retainer (Exhibit 6).

Hazard Tree Removal: Hazard trees along the trails receiving treatment would be identified by a C-faller and removed before implementation. Blazed trees would be retained, if possible.

Logging Out: Logs across the trails receiving treatment would be removed where necessary to provide for ease of passage and safety of trail workers, and to prevent resource damage that may occur if trail users choose to bypass obstacles and travel off-trail.

Dry Ravel Removal: Dry ravel would be removed from the Yucca Trail tread in order to provide for ease of passage and safety of trail workers. It is expected that the material will need to be removed a few times during the course of implementation or if the trail opens to the public before the slopes stabilize.

2. Trail Closure and Hazard Warning Signs

Hazard Sign Installation: Treated posts would be sized to allow for a 2 foot burial depth, 5 feet of length before the bottom of the sign, and 2 inches of post above the top of the sign slanted at a 45 degree angle away from the sign face. Pre-drilled post-fire warning signs would be ordered and mounted on the treated wooden posts with vandal-resistant hardware (Exhibit 7).

Administrative Closure: A Forest Order would be obtained to temporary close the Kanawyer Trail and Yucca Point Trail to public use for up to one-year or until hazards from rock fall and/or hazard trees are mitigated. The order would be posted in the Ranger District offices, the Forest Supervisor's Office, at display boards where trail users may receive information, and on the hazard warning sign posts at the Kanawyer and Yucca Point trailheads and trail junctions. Terminate the order when no longer necessary and remove closure signs after termination.

3. Treatment Best Management Practices

All structure installation locations would be identified by an experienced trail technician, who would also supervise construction. Construction would meet Forest Service specifications as outlined in the Trail Construction and Maintenance Notebook (0723-2806-MTDC) and the Trails Management Handbook (FSH 2308.18) All soil and rock used for structure construction or filling of burned-out stump holes would be gathered from locations adjacent the trail and approved by an Archeologist before implementation. The organic material from the surface of borrow pits would be retained and the pits would be rehabilitated by recontouring to a natural grade and replacement of the organic material.

All sign installation would occur according to the Forest Service Sign and Poster Guidelines for the Forest Service (EM 7100-15). Installation locations would receive archeological clearance before implementation.

All implementation work would be consistent with safety guidelines outlined in the Health and Safety Code Handbook (FSH 6709.11)

C. Treatment Cost

1. Trail Storm Proofing: It is recommended that a California Conservation Corps (CCC) Backcountry trail crew be used to implement these treatments. Costs were calculated using this crew and using only Forest Service staff. See Appendix C for Treatment Cost Details.

2. Trail Closure and Hazard Warning Signs: See Appendix C for Treatment Cost Details.

V. Discussion/Summary/Recommendations

High risks to property due to the fire exist along the Boole Tree Trail (28E02), Deer Cove Trail (30E01), Kanawyer Trail (30E04), and Yucca Point Trail (28E01). High risks to cultural resources exist along the Evans Grove Loop (30E04A). Storm proofing treatments would reduce these risks to an acceptable level. High risks to human life and safety exist along the Boole Tree Trail (28E02), Deer Cove Trail (30E01), Kanawyer Trail (30E04), and Yucca Point Trail (28E01). Intermediate risks to human life and safety may exist along all other burned trails. Temporary closure of the Kanawyer Trail and Yucca Point Trail, and installation of post-fire hazard warning signs at the access points of all burned trails will reduce this risk to an acceptable level.

It is recommended that the Forest notify the grazing allotment permittee of the burned fence posts along the Boole Tree trail, and the Boyden Caverns permittee of the of risk to life and safety due to the

burned walking bridges on the Boyden Cave pathway. It is also recommended that the private landowners be notified where the Crabtree Trail meets the 12S01 road, and at the south end of the Camp 4 Trail before installation of a warning hazard signs at these locations.

VI. Consultations

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VII. References

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VIII. Appendices

A. Referenced Photographs
B. Referenced Tables
C. Treatment Cost Details
D. Maps
E. Exhibits

Appendix A: Referenced Photographs

Photo 1: Burned Waterbar on Boole Tree Trail

Photo 3: Burned-Out Stump Hole on Boole Tree Trail

Photo 2: Burned Log Retainer on Boole Tree Trail

Photo 4: Burned Bridge Decking and Railings on Boyden Cave Pathway

Photo 5: Hazard Tree on Kanawyer Trail

Photo 6: Hazard Tree on Kanawyer Trail

Photo 7: Hazard Tree on Kanawyer Trail

Photo 8: Kanawyer Trail Tread Captures Flow

Photo 9: Burned Signs at Yucca Point Trailhead

Photo 10: Yucca Point Trail Captures Flow from Road Culvert

Photo 11. Dry Ravel Sloughing onto Yucca Point Trail

Appendix B: Referenced Tables

Table 1: Soil Burn Severity Class by Trail.

Trails segments with 'no data' are outside of the fire perimeter and unburned.

Soil Burn Severity (SBS) Class by Trail	Length in SBS Class	Percent in SBS Class
BOOLE TREE (28E02)		
Unburned/Very Low	1,977.10	16.21%
Low	8,626.13	70.74%
Moderate	1,590.13	13.04%
BOOLE TREE SPUR (28E02A)		
Unburned/Very Low	153.59	51.39%
Low	145.30	48.61%
BOULDER TRAIL (29E04)		
No Data	567.76	5.53%
Unburned/Very Low	3,969.21	38.63%
Low	4,578.76	44.56%
Moderate	1,159.03	11.28%
CAMP 4 1/2 TRAIL (26E02)		
No Data	6,624.05	52.18%
Unburned/Very Low	2,610.40	20.56%
Low	3,461.09	27.26%
CAMP 4 TRAIL (26E04)		
Unburned/Very Low	2,345.27	13.58%
Low	12,115.61	70.14%
Moderate	2,813.18	16.29%
CHICAGO STUMP TRAIL (20E07)		
Unburned/Very Low	446.39	30.86%
Low	1,000.02	69.14%
CHOKE CREEK TRAIL (30E03)		
Unburned/Very Low	55.76	0.68%
Low	3,447.36	41.77%
Moderate	4,750.22	57.56%
CRABTREE TRAIL (27E05)		
Unburned/Very Low	1,222.56	9.66%
Low	11,432.91	90.34%
DAVIS FLAT TRAIL (27E04)		
Unburned/Very Low	3,597.91	29.24%
Low	8,053.15	65.45%
Moderate	653.47	5.31%
DEER COVE TRAIL (30E01)		
No Data	12,897.43	27.21%
Unburned/Very Low	12,887.20	27.19%
Low	18,182.37	38.36%

Moderate	3,429.16	7.24%
DEER MEADOW TRAIL (30E05)		
No Data	12,384.79	74.99%
Unburned/Very Low	3,613.07	21.88%
Low	518.35	3.14%
EVANS GROVE LOOP TRAIL (30E04A)		
Unburned/Very Low	3,700.16	64.50%
Low	1,618.41	28.21%
Moderate	418.37	7.29%
HAPPY GAP TRAIL (30E02)		
No Data	4,641.67	23.09%
Unburned/Very Low	3,195.18	15.90%
Low	1,725.33	8.58%
Moderate	8,144.78	40.52%
High	2,393.96	11.91%
HUME LAKE TRAIL (28E05)		
No Data	13,695.53	97.73%
Unburned/Very Low	279.47	1.99%
Low	38.72	0.28%
KANAWYER TRAIL (30E04)		
No Data	35,523.68	59.18%
Unburned/Very Low	5,374.70	8.95%
Low	12,220.38	20.36%
Moderate	6,566.46	10.94%
High	344.42	0.57%
LITTLE BOULDER GROVE TRAIL (29E09)		
Unburned/Very Low	6,387.95	70.62%
Low	2,657.16	29.38%
RIVER TRAIL (27E01)		
Unburned/Very Low	12,104.80	52.84%
Low	10,805.04	47.16%
SAMPSON TRAIL (27E06)		
Unburned/Very Low	8,622.06	28.45%
Low	20,808.32	68.67%
Moderate	870.79	2.87%
VERPLANK TRAIL (27E03)		
Unburned/Very Low	3,242.89	11.82%
Low	17,977.09	65.51%
Moderate	6,161.72	22.45%
High	60.99	0.22%
YUCCA POINT TRAIL (28E01)		
Low	3,622.75	40.48%
Moderate	5,326.11	59.52%
Grand Total	**735,744.08**	**100.00%**

Table 2: Risk Assessment of BAER Critical Values

Value Category	Value-at-Risk (VAR)	Description of Threat	Location	Probability	Magnitude	Risk	Overall Risk to Critical Value
Human Life & Safety (HLS)	National Forest visitors & agency personnel on trails.	Human life and safety is at risk from burned hazard trees along trails, tread destabilization from burned-out stump holes and sloughing of dry ravel from slopes with fire-removed vegetation, and rock fall potential from burned slopes above the trail.	Boole Tree (28E02)	Possible	Moderate	Intermediate	High
			Deer Cove (30E01)	Possible	Major	High	
			Kanawyer (30E04)	Possible	Major	High	
			Yucca Point (28E01)	Possible	Major	High	
			All Other Burned Trails	Unlikely	Major	Intermediate	
Property (P)	NFS Trails	Trail infrastructure is at risk due to erosion and destabilization caused by burned-out stump holes, rock fall, dry ravel, and accelerated overland flow within and downslope from areas burned at moderate to high severity. This can indirectly affect natural resources through sediment delivery to ephemeral drainages from the trail, and human life and safety by creating unsafe trail conditions.	Boole Tree (28E02)	Likely	Moderate	High	High
			Choke Creek Trail (30E03):	Likely	Major	Very High	
			Deer Cove Trail (30E01):	Possible	Moderate	Intermediate	
			Evans Grove Loop (13E04A)	Likely	Moderate	Intermediate	
			Happy Gap Trail (30E02)	Likely	Major	Very High	
			Kanawyer Trail (30E04)	Possible	Major	High	
			Yucca Point Trail (28E01)	Likely	Moderate	High	
Natural Resources	Water and Soil Quality	Risk to water quality of streams caused by increased sediment delivery from trail tread due to accelerated overland flows concentrating on routes downslope from area burned at moderate to high severity. Risk to soil quality caused by increased off-trail erosion caused by creation of user-trails to bypass obstacles such as destabilized tread, down trees, and burned stump holes.	Boole Tree (28E02)	Possible	Minor	Low	Low
			Choke Creek Trail (30E03):	Possible	Minor	Low	
			Deer Cove Trail (30E01):	Possible	Minor	Low	
			Happy Gap Trail (30E02)	Possible	Minor	Low	
			Kanawyer Trail (30E04)	Possible	Minor	Low	
			Yucca Point Trail (28E01)	Possible	Minor	Low	
Cultural Resources	Historic Trail Infrastructure	Risk to historic trail infrastructure posed by destabilization due to burned stump and root holes.	Evans Grove Loop (13E04A)	Likely	Moderate	High	High

Table 3: Storm Proofing Treatment Details

Storm Proofing	
Trail	Treatment Description
Boole Tree	Replace burned waterbars and log retainer Fill burned-out stump holes Maintain drainage structures Construct log waterbars or knicks where necessary Install armored drainage dips where identified Remove hazard trees where necessary
Choke Creek	Maintain and restore drainage function Remove down and hazard trees where necessary
Deer Cove	Fill burned-out stump holes Maintain and restore drainage function Remove down and hazard trees where necessary
Evans Grove	Fill burned-out stump holes Maintain and restore drainage function
Happy Gap	Maintain and restore drainage function Remove down and hazard trees where necessary
Kanawyer	Fill burned-out stump holes Maintain drainage structures Outslope and remove berm Install rock water bars or rolling grade dips where necessary Install armored drainage dips where identified and as necessary Remove hazard trees where necessary
Yucca Point	Maintain drainage structures Outslope and remove berm Remove dry ravel as necessary Install rock water bars or rolling grade dips where necessary Install armored drainage dip where identified Remove hazard trees where necessary

Table 4: Trail Closure and Hazard Warning Sign Installation Details

HAZARD WARNING SIGN INSTALLATION	
Trail	**Location Details**
Boole Tree Trail	Boole Tree Trailhead at the 13S55 Road
Boulder Trail	Boulder Trail at the 29E04 Road
	Boulder Trail at the 14S11 Road
Camp 4 Trail	Camp 4 Trail at the 12S01 junction
Crabtree Trail	Crabtree Trail at the 12S01 junction
	Crabtree Trail at the junction with 12S02A
Davis Flat Trail	Davis Flat Trail at the 12S01 Junction
	Davis Flat Trail at the 12S02 junction
Deer Cove Trail	Deer Cove Trail just north of the Monarch Wilderness boundary on the east Side of the fire Perimeter
	Deer Cove Trail at the eastern edge of the fire perimeter just north of the Monarch Wilderness boundary.
	Deer Cove Trail at the 13S39 Road junction
	Deer Cove Trail at the junction with the NPS connector trail from Lewis Creek Trail (NPS) just south of Fry Pan Meadow to Deer Cove.
	Deer Cove Trail at the Kennedy Canyon Trail (NPS) junction
Evans Grove Loop	Evans Grove Trailhead at the 13S05 Road junction
Kanawyer Trail	Kanawyer Trailhead at the 13S25 Road Junction
	Kanawyer Trail in Agnew Grove on the east side of the fire perimeter
	Kanawyer Trail at the north Evans Grove Loop junction
	Kanawyer Trail at the south Evans Grove Loop Junction
Kings River NRT	Kings River NRT at the 12S001 Road junction
Little Boulder Grove Trail	Little Boulder Grove Trail at the 13S53 Road junction
	Little Boulder Grove Trail at the 13S23 Road junction
River Trail	River Trail Trailhead at the 12S01 Road junction near Mill Flat Campground
Sampson	Sampson Trail at the 12S01 junction
Verplank	Verplank Trail at the 13S03 Junction
Yucca Point Trail	Yucca Point Trailhead at the HWY 180 junction
TRAIL CLOSURE SIGN INSTALLATION	
Kanawyer Trail	Kanawyer Trailhead at the 13S25 Road junction
	Kanawyer trail in Agnew Grove on the east side of the fire perimeter
	Kanawyer Trail at the north Evans Grove Loop junction
	Kanawyer trail at the south Evans Grove Loop junction
Yucca Point Trail	Yucca Point Trailhead at the HWY 180 junction

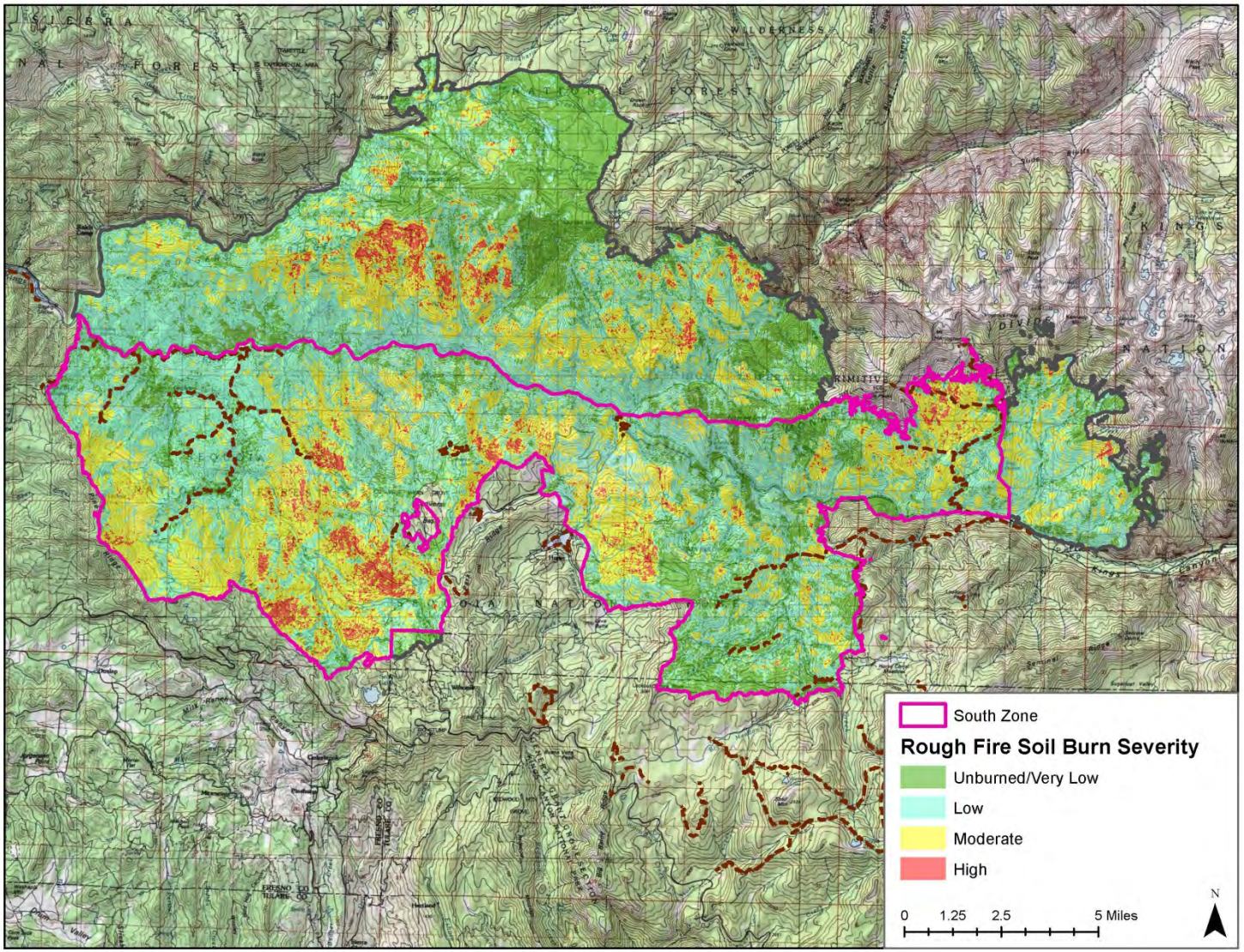
Appendix C: Treatment Cost Details

Treatment 1: Trail Storm Proofing

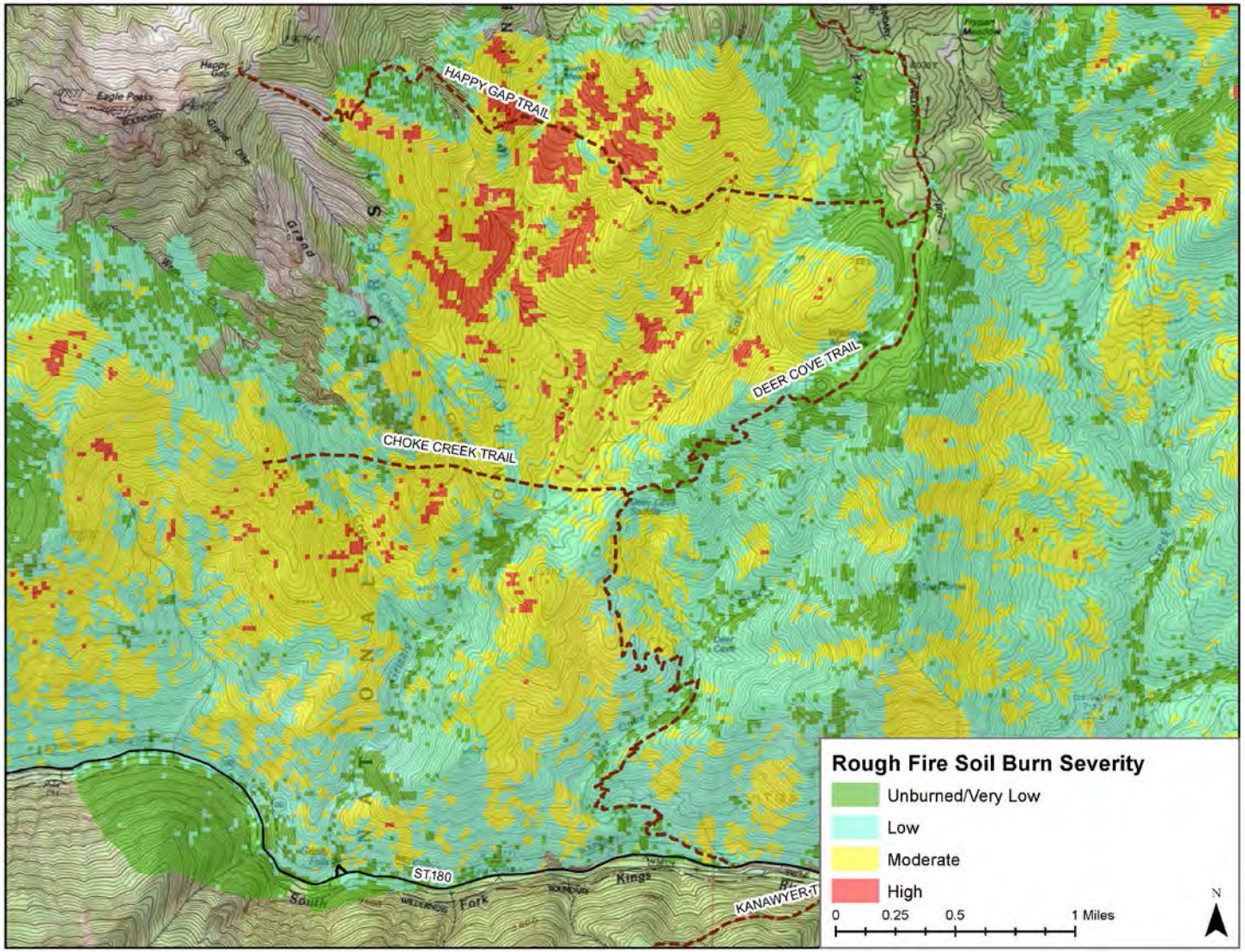
STORM PROOFING COST COMPARISON

Appendix D: Maps

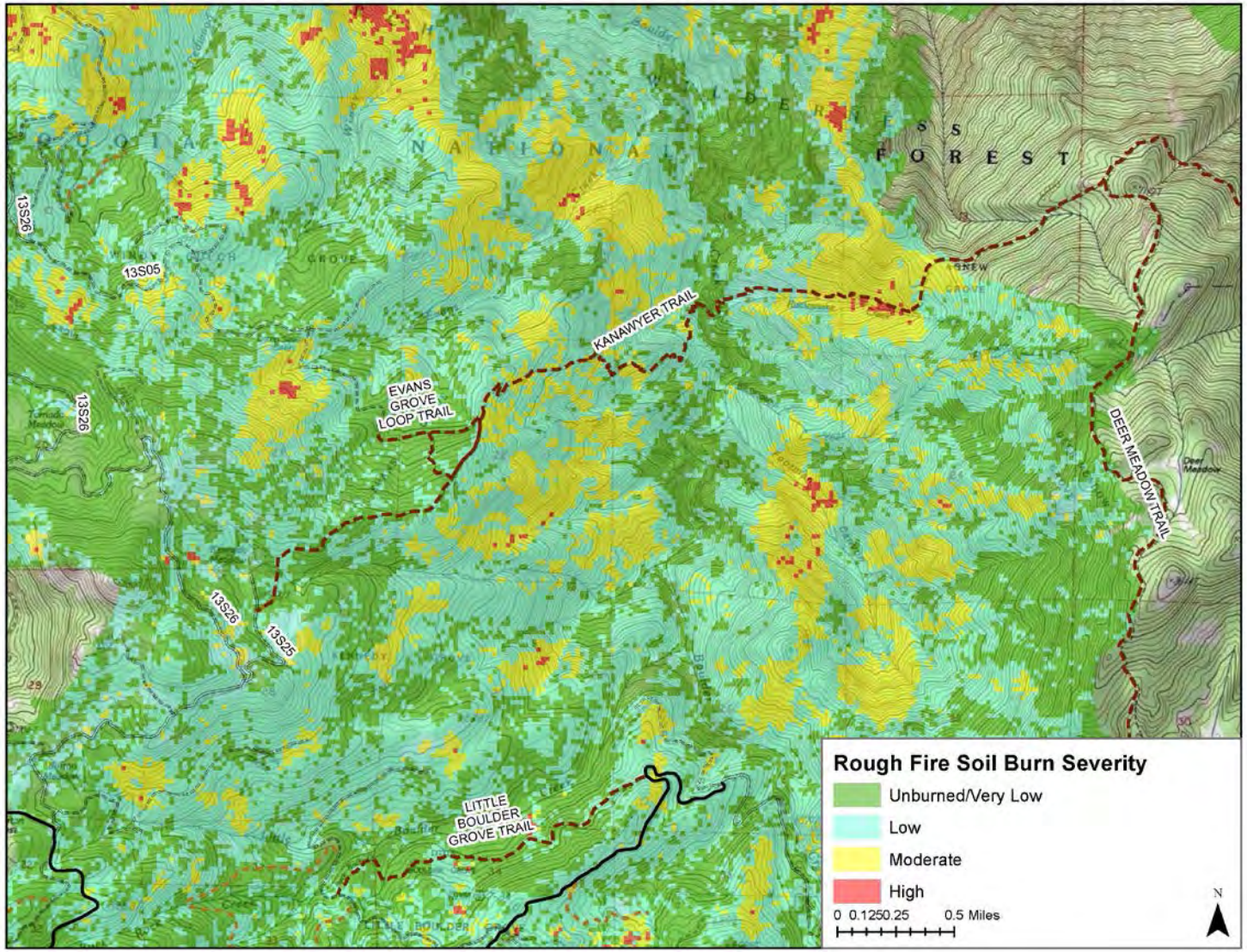
Map 1: South Zone Soil Burn Severity Map



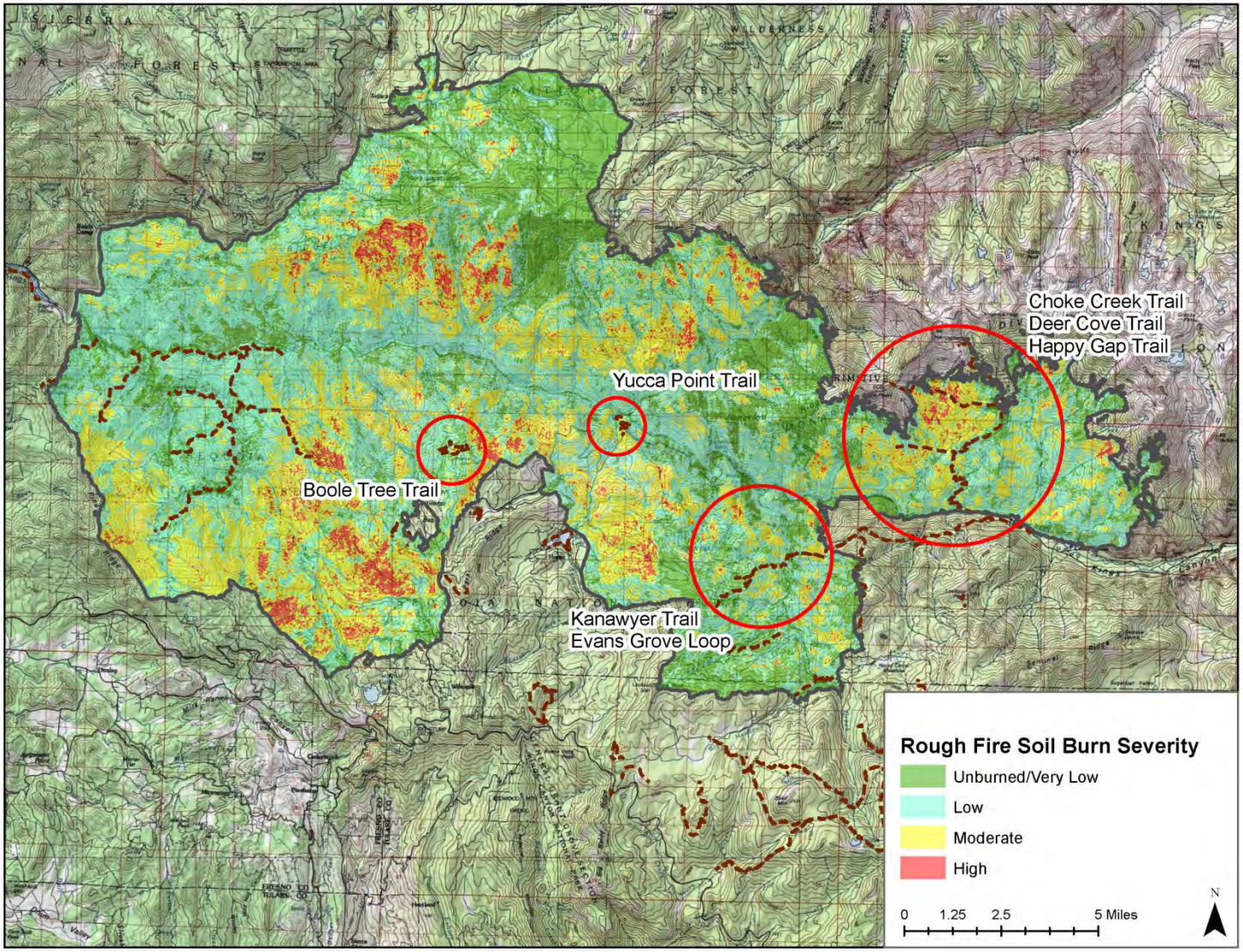
Map 2: Soil Burn Severity Map for Deer Cove Trail, Choke Creek Trail, and Happy Gap Trail.



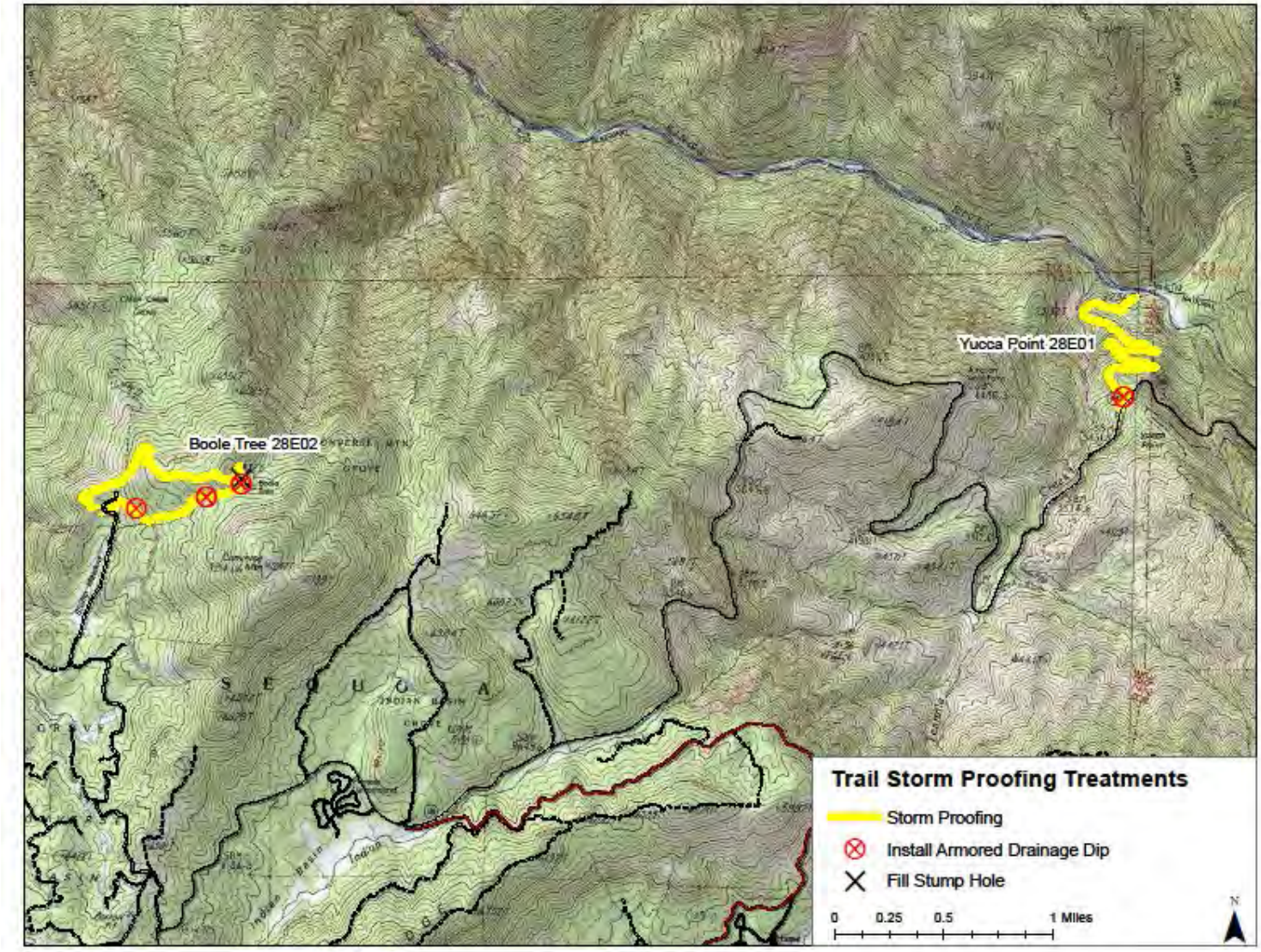
Map 3: Soil Burn Severity Map for Kanawyer Trail and Evans Grove Loop



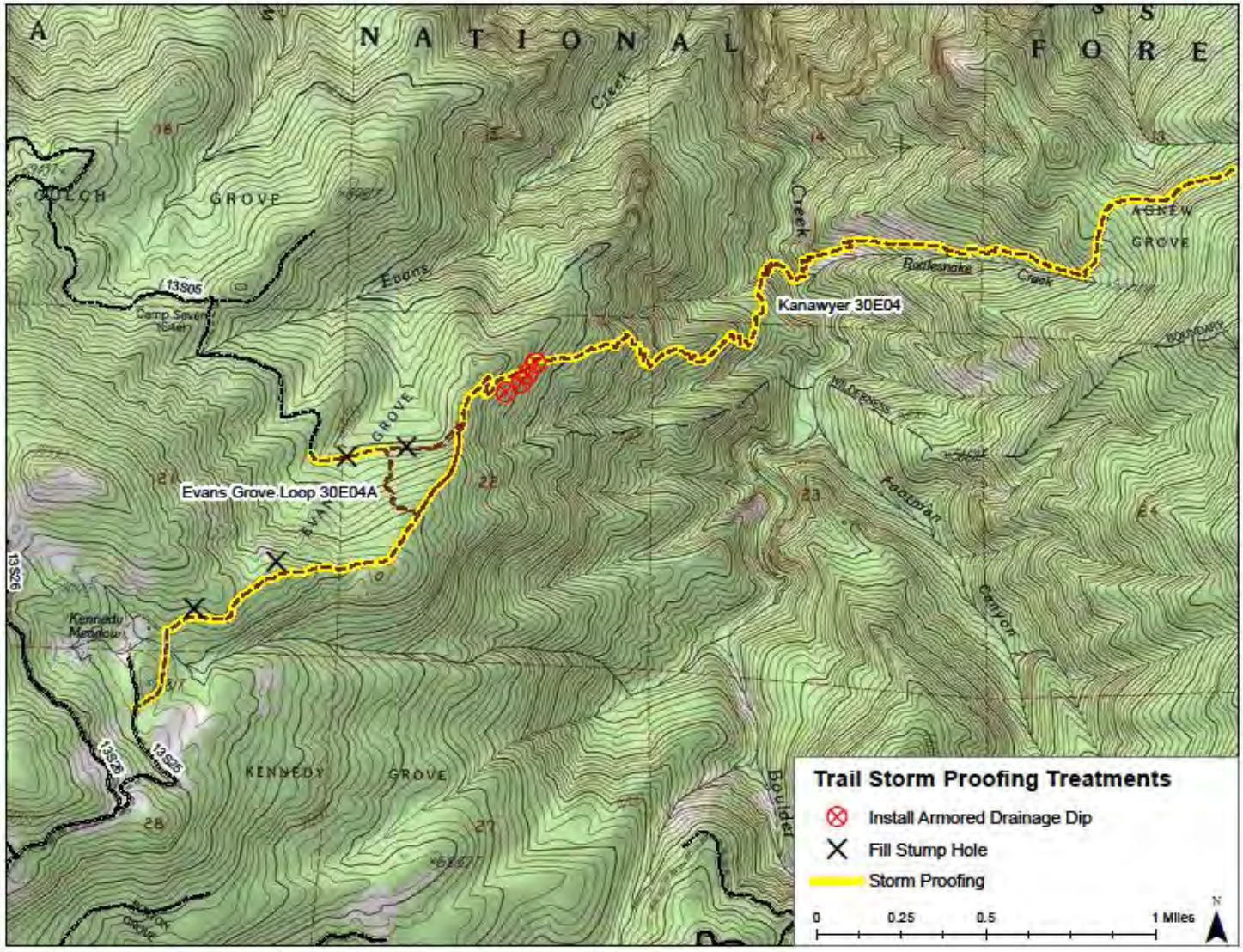
Map 4: Soil Burn Severity Map with Treatment 1 Locations Circled.



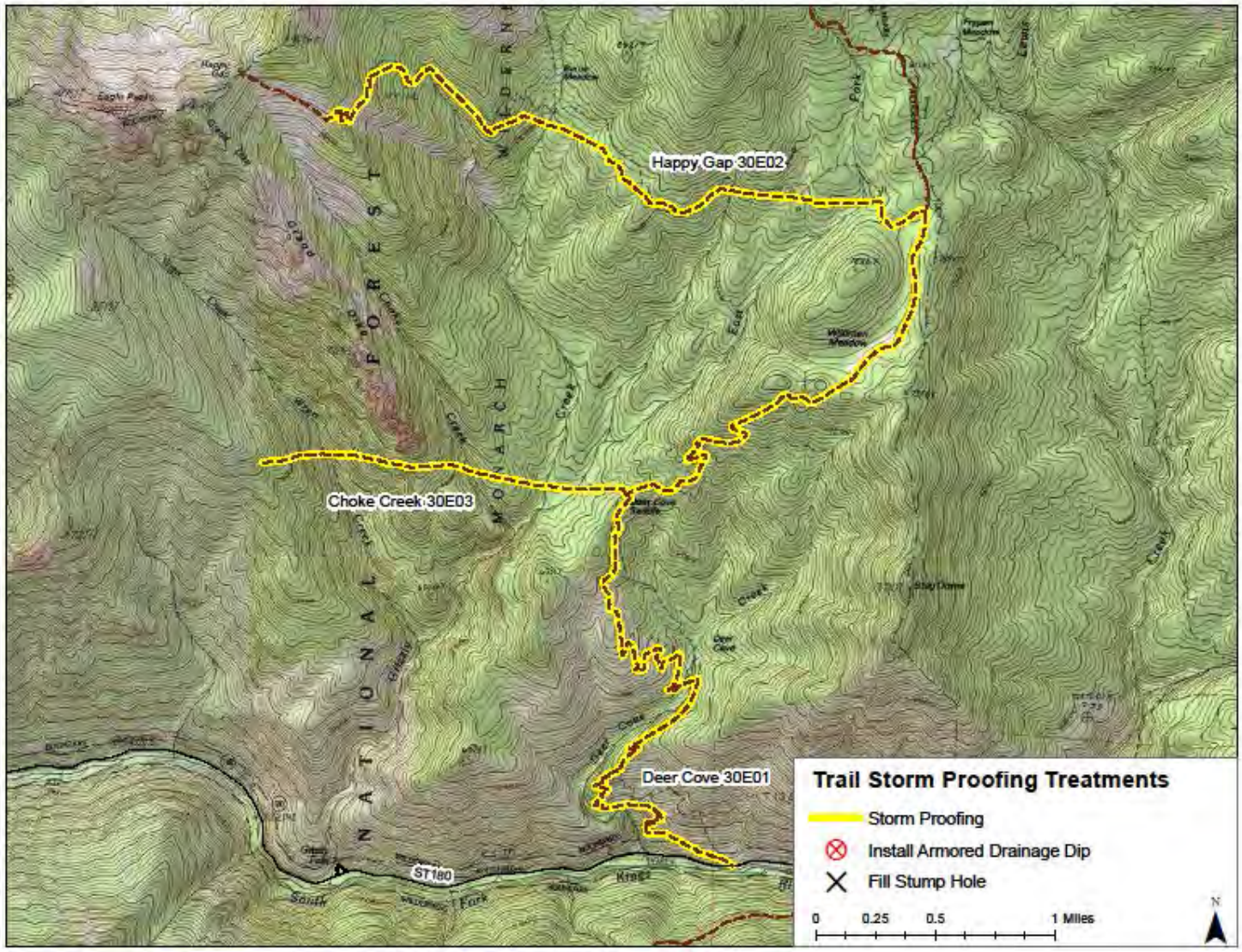
Map 5: Treatment 1 Detail Map for Boole Tree Trail and Yucca Point Trail



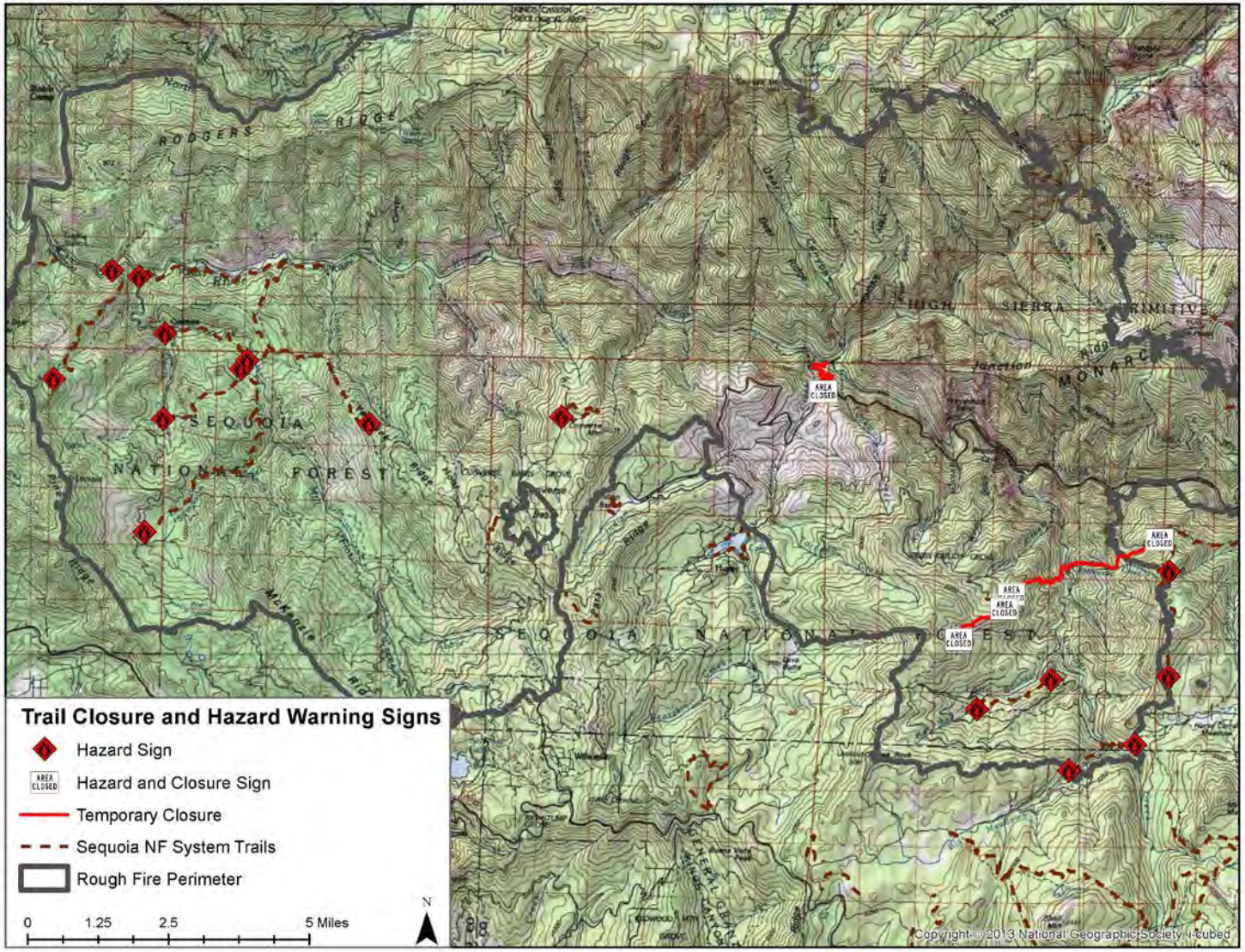
Map 6: Treatment 1 Detail Map for Evans Grove Loop and Kanawyer Trail



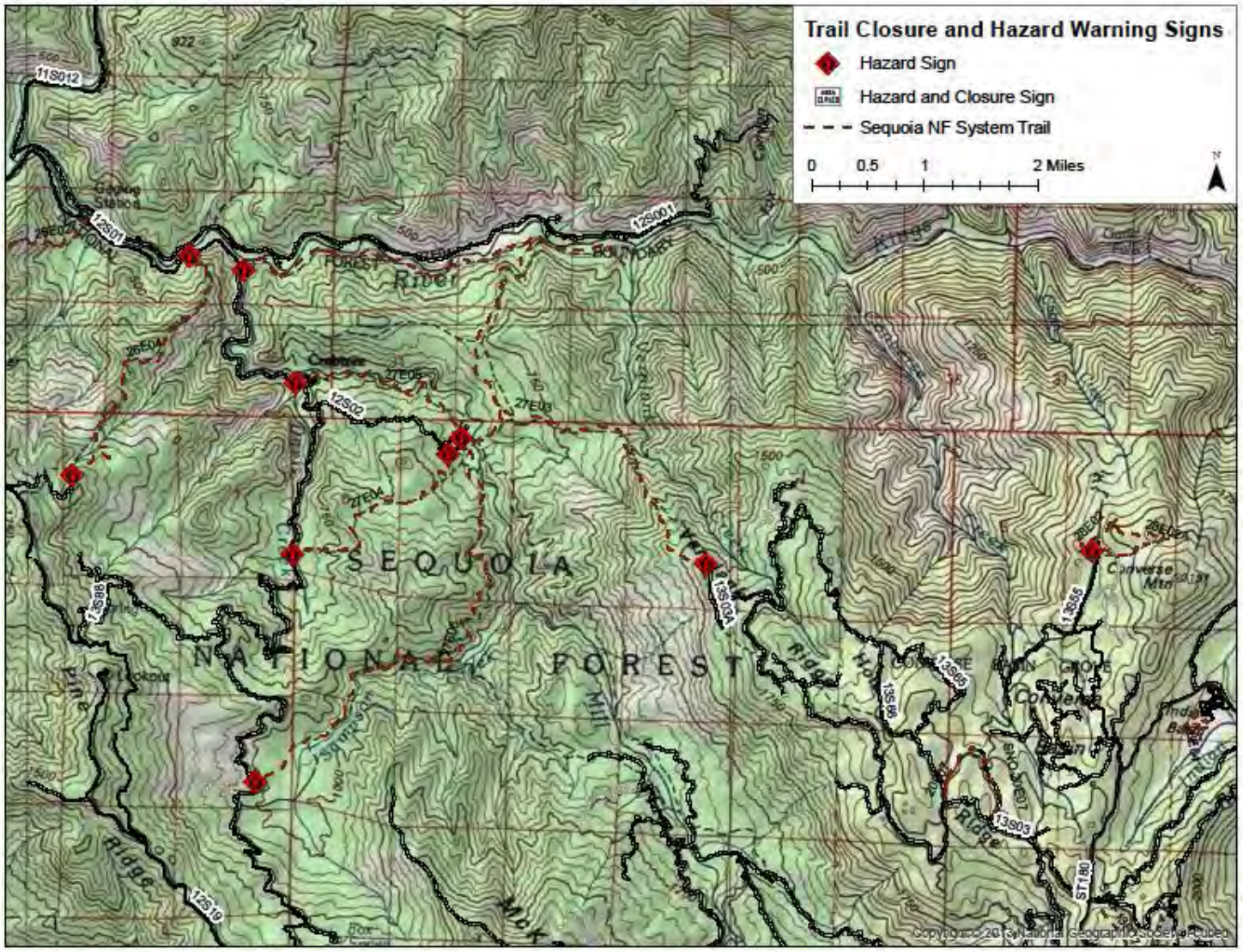
Map 7: Treatment 1 Detail Map for Choke Creek Trail, Deer Cover Trail, and Happy Gap Trail



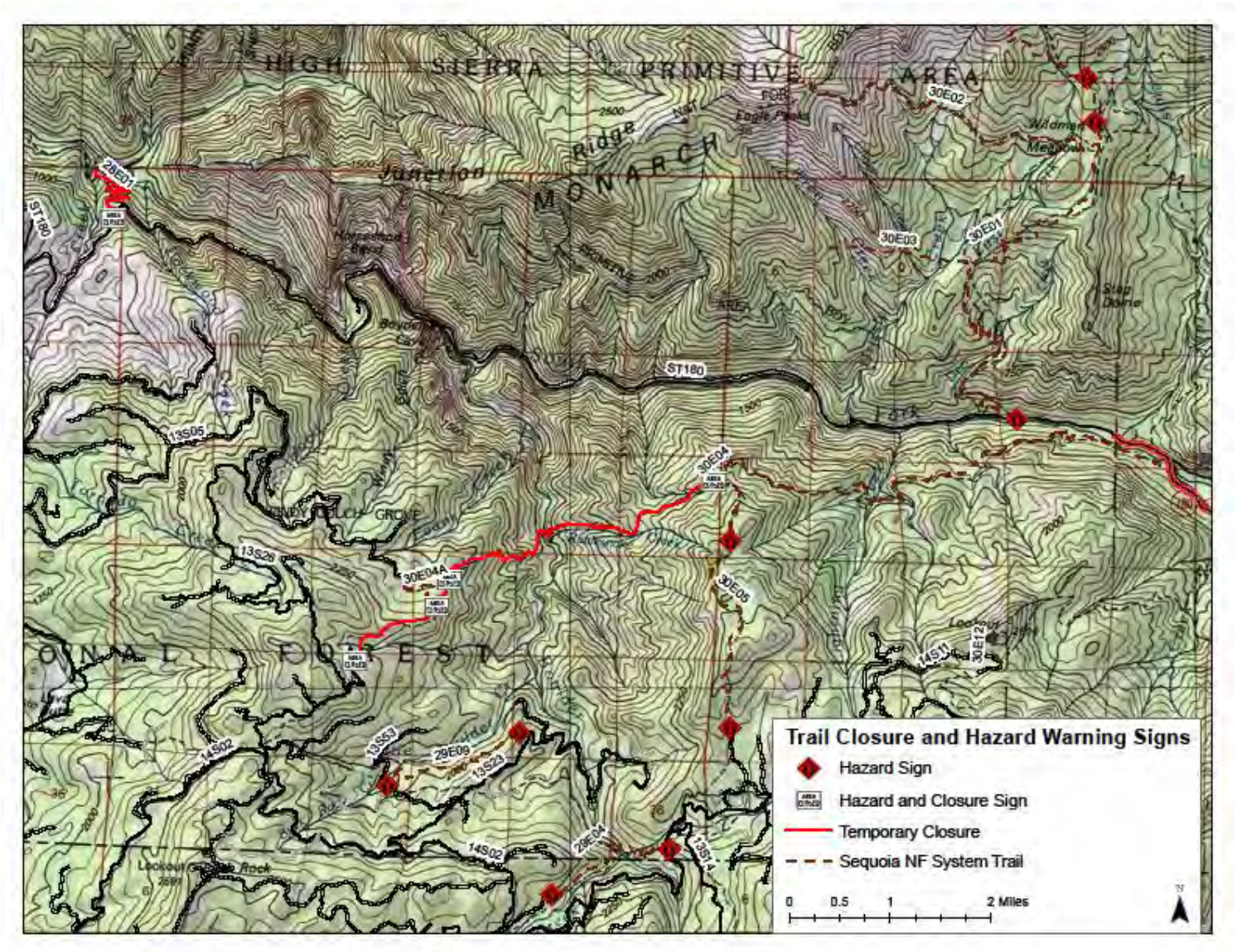
Map 8: Treatment 2 Overview Map



Map 9: Treatment 2 West Detail Map



Map 10: Treatment 2 East Detail Map



Appendix E: Exhibits

Exhibit 1: Log or Treated Timber Waterbar

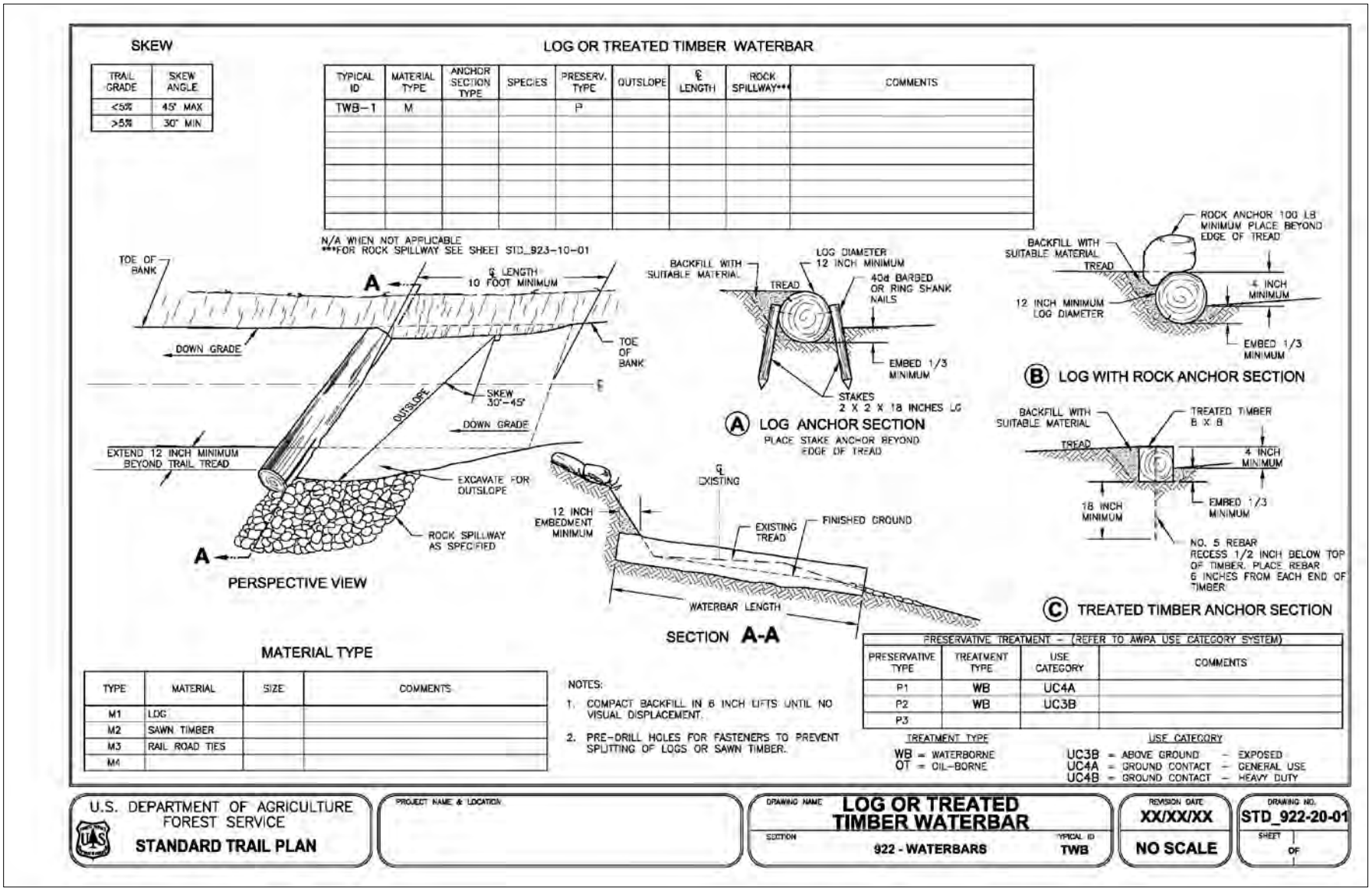


Exhibit 2: Knick

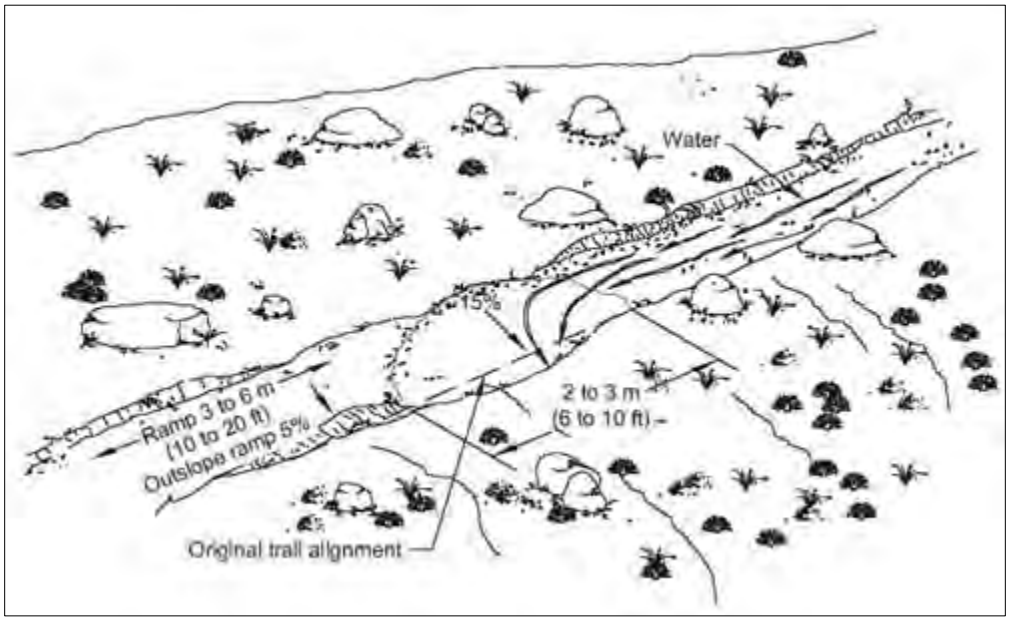


Exhibit 3: Rock Waterbar

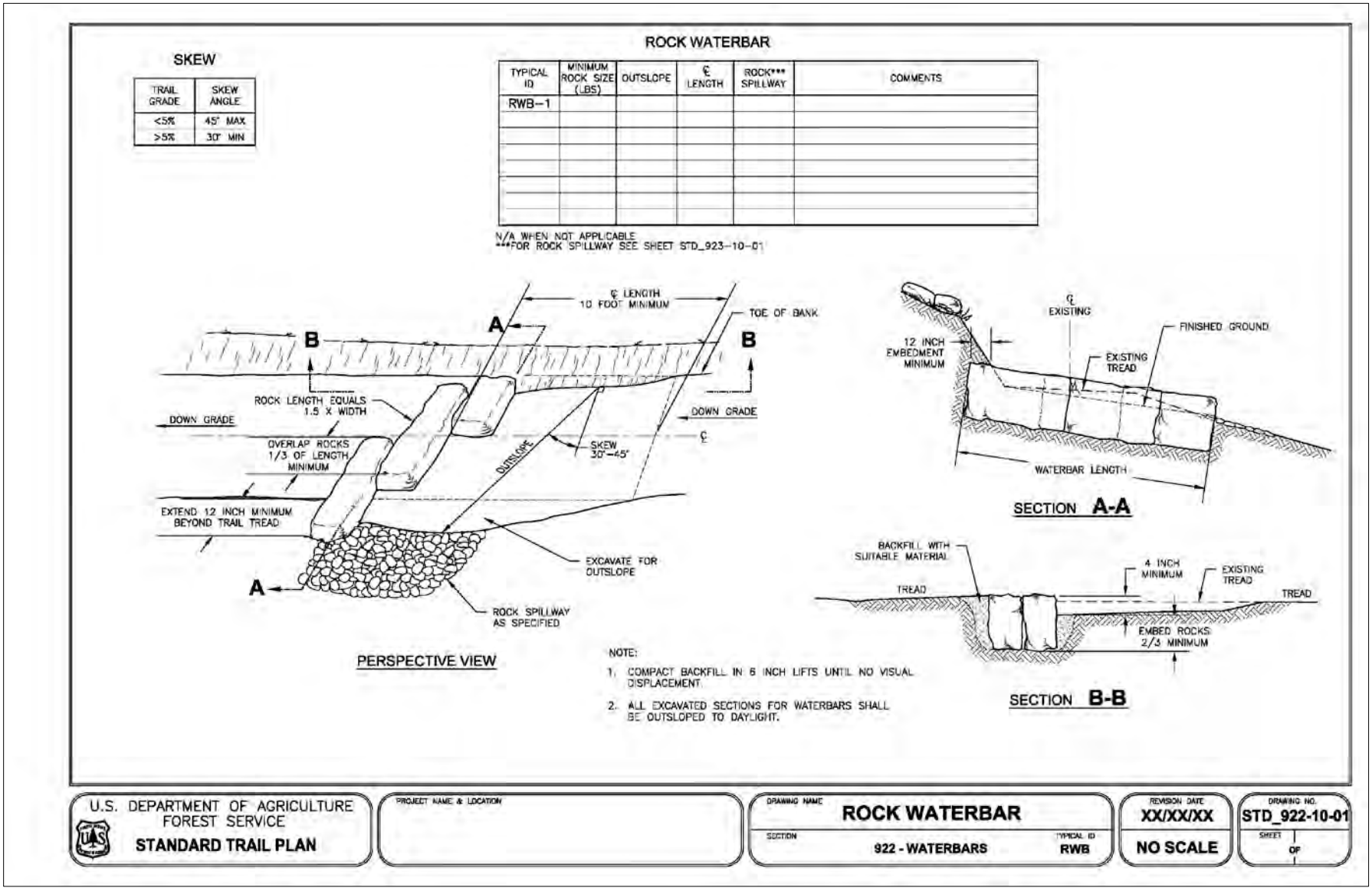


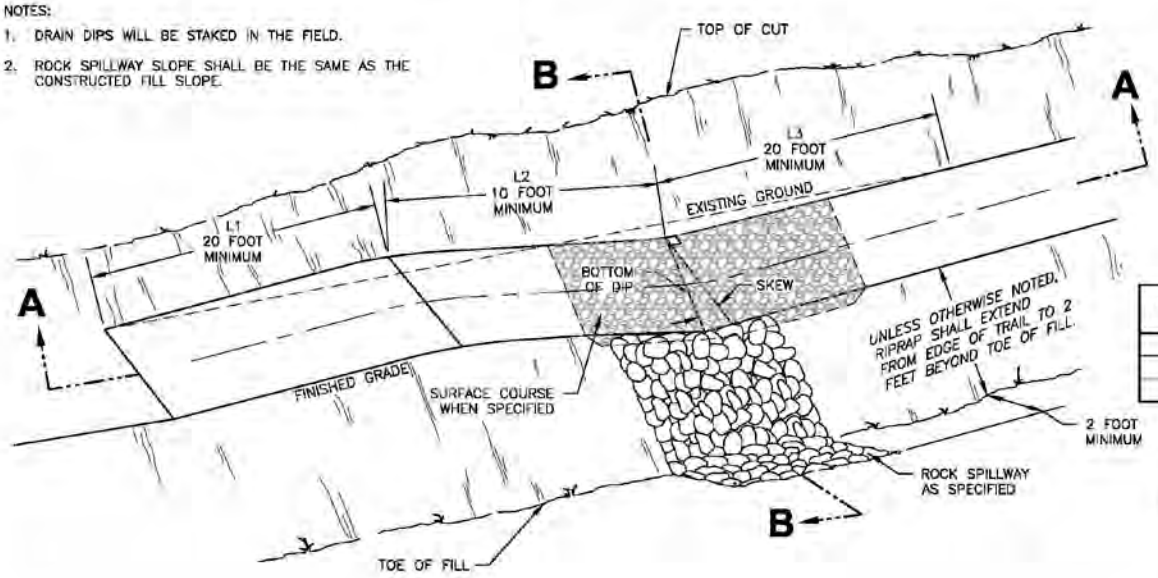
Exhibit 4: Rolling Grade Dip (rock spillway only as necessary)

DRAIN DIP SECTION

TYPICAL ID	DRAIN DIP TYPE	GEOTEXTILE TYPE	SKEW	SURFACE COURSE TYPE	SURFACE COURSE DEPTH	ROCK SPILLWAY***	COMMENTS
DD1–1	DD	G		S			

N/A WHEN NOT APPLICABLE
***FOR ROCK SPILLWAY SEE SHEET STD_923-10-01

NOTES:
1. DRAIN DIPS WILL BE STAKED IN THE FIELD.
2. ROCK SPILLWAY SLOPE SHALL BE THE SAME AS THE CONSTRUCTED FILL SLOPE.



GEOTEXTILE TYPE

TYPE	MATERIAL	COMMENTS
G1	NON-WOVEN	
G2	WOVEN	
G3		

SURFACE COURSE MATERIAL TYPE

TYPE	MATERIAL	GRADATION	COMMENTS
S1	PITRUN		
S2	AGGREGATE		
S3			

DRAIN DIP CONSTRUCTION DIMENSIONS

DRAIN DIP TYPE	% PROFILE GRADE	L1	L2	L3	(H)	(E)
DD1	0 TO 4					
DD2	5 TO 6					
DD3	7 TO 8					
DD4	9 TO 10					
DD5						

OVER 10% NOT RECOMMENDED
H = ℄ OF TREAD

SHEET 1 OF 2

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
STANDARD TRAIL PLAN

PROJECT NAME & LOCATION:

DRAWING NAME: **DRAIN DIP**
SECTION: **927 - DRAIN DIPS**
TYPICAL ID: **DD1**

REVISION DATE: **XX/XX/XX**
NO SCALE

DRAWING NO.: **STD_927-10-01**
SHEET: OF

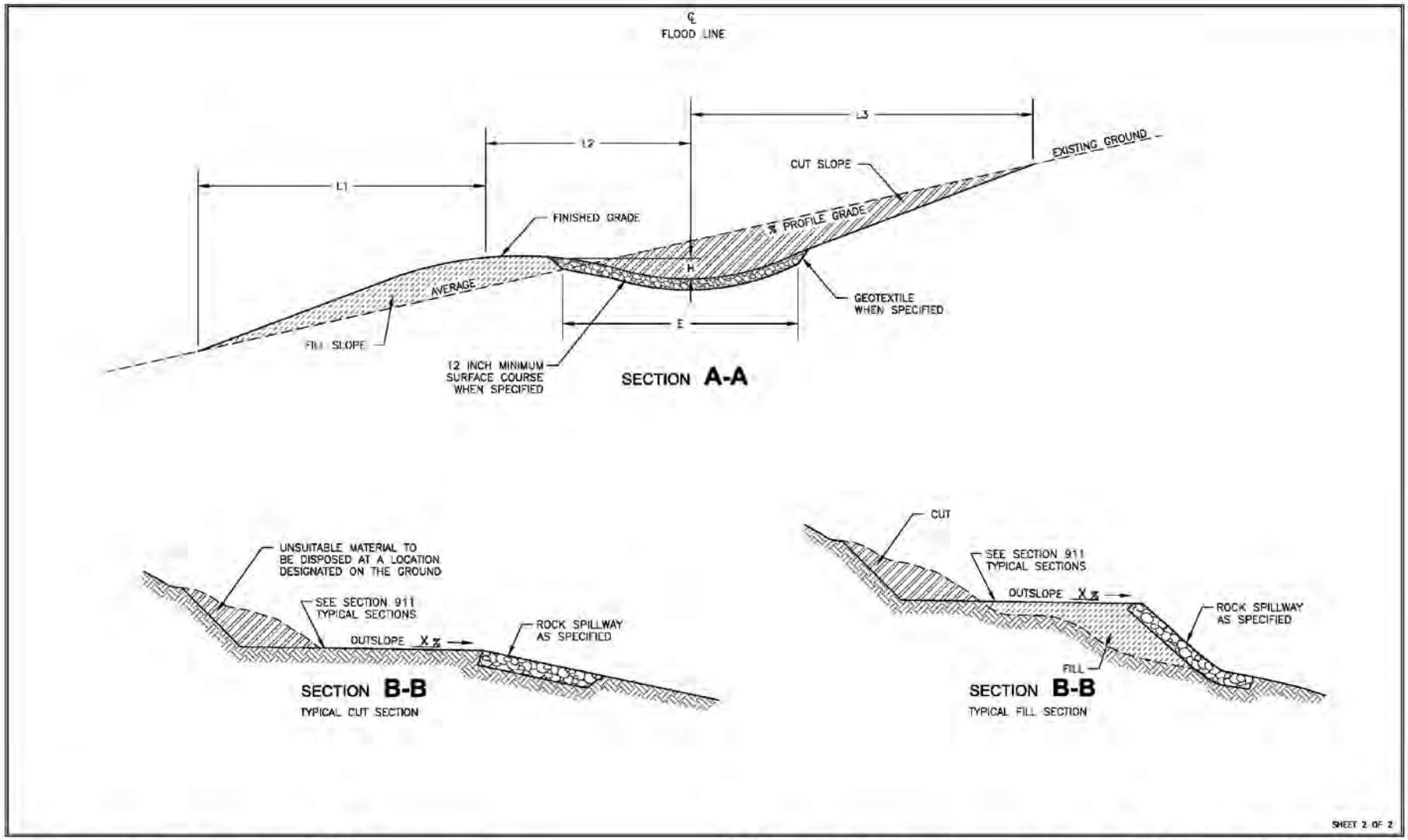

℄
FLOOD LINE
L3
L2
L1
EXISTING GROUND
CUT SLOPE
FINISHED GRADE
PROFILE GRADE
H
AVERAGE
FILL SLOPE
E
GEOTEXTILE
WHEN SPECIFIED
12 INCH MINIMUM
SURFACE COURSE
WHEN SPECIFIED
SECTION A-A
UNSUITABLE MATERIAL TO
BE DISPOSED AT A LOCATION
DESIGNATED ON THE GROUND
SEE SECTION 911
TYPICAL SECTIONS
OUTSLOPE X%
ROCK SPILLWAY
AS SPECIFIED
SECTION B-B
TYPICAL CUT SECTION
CUT
SEE SECTION 911
TYPICAL SECTIONS
OUTSLOPE X%
ROCK SPILLWAY
AS SPECIFIED
FILL
SECTION B-B
TYPICAL FILL SECTION
SHEET 2 OF 2
U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
STANDARD TRAIL PLAN
PROJECT NAME & LOCATION
DRAWING NAME
DRAIN DIP DETAILS
SECTION
927 - DRAIN DIPS
TYPICAL ID
DD2
REVISION DATE
XX/XX/XX
NO SCALE
DRAWING NO.
STD_927-10-02
SHEET
OF

Exhibit 5: Armored Grade Dip

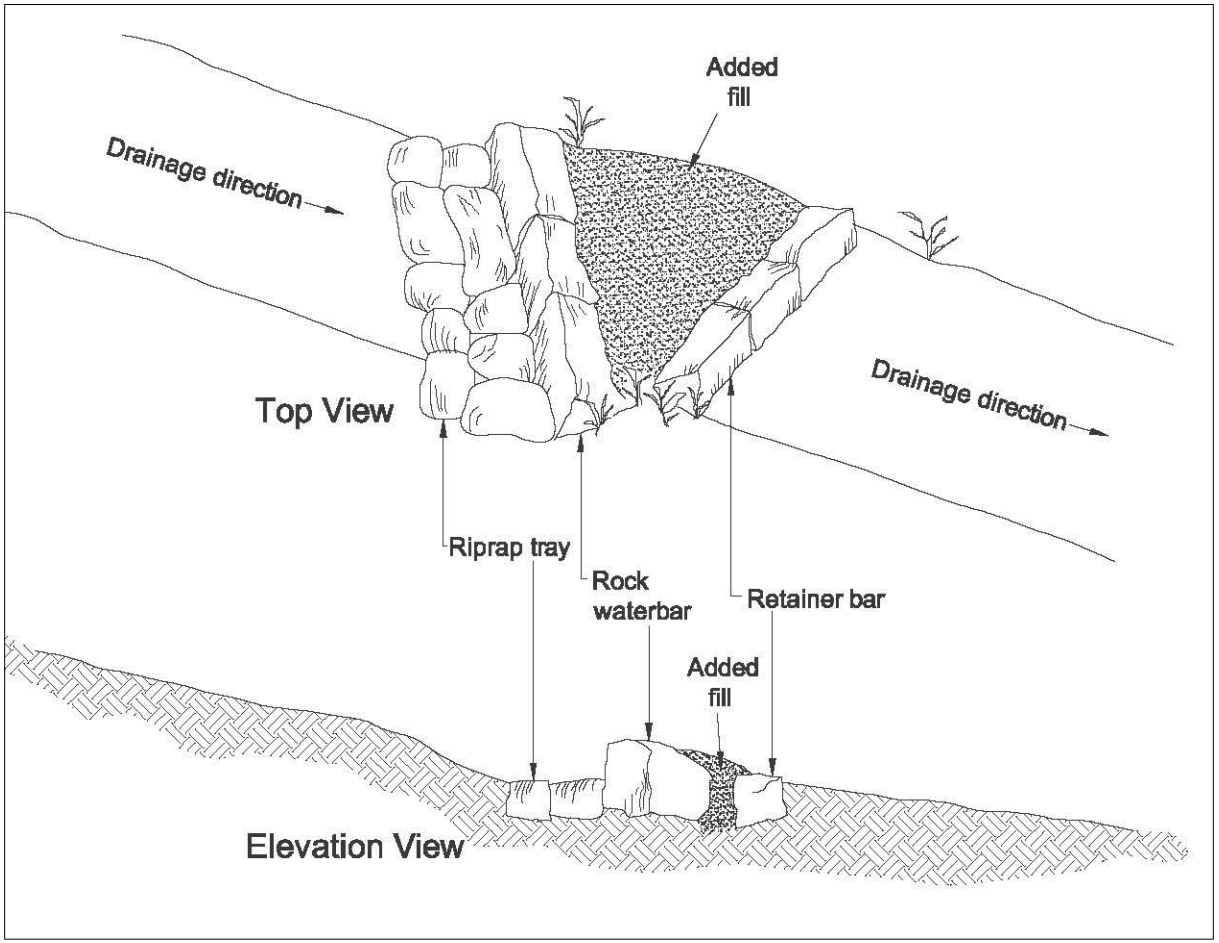
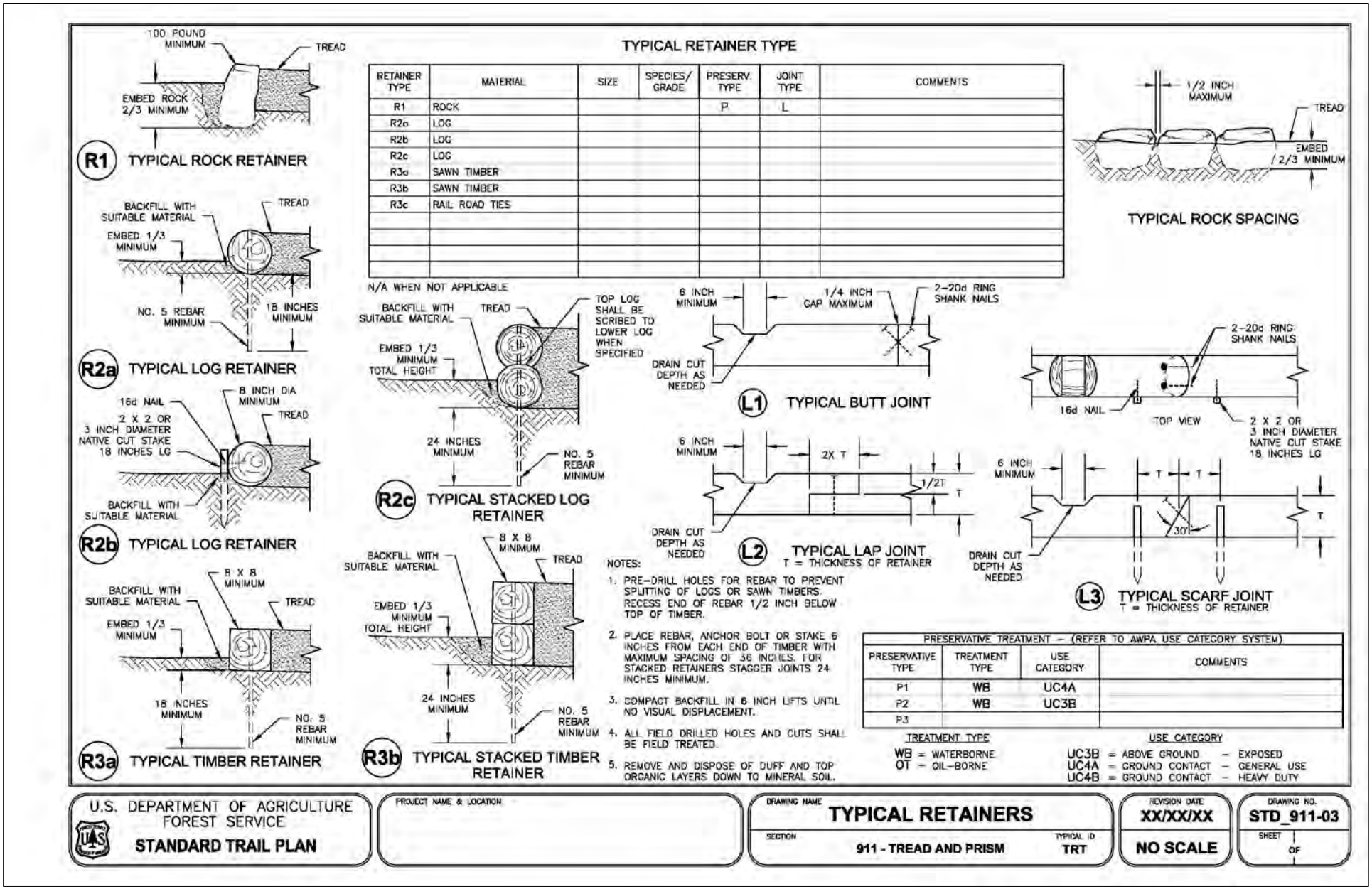


Exhibit 6: Log Retainer



RETAINER TYPE	MATERIAL	SIZE	SPECIES/ GRADE	PRESERV. TYPE	JOINT TYPE	COMMENTS
R1	ROCK			P	L	
R2a	LOG					
R2b	LOG					
R2c	LOG					
R3a	SAWN TIMBER					
R3b	SAWN TIMBER					
R3c	RAIL ROAD TIES					

PRESERVATIVE TYPE	TREATMENT TYPE	USE CATEGORY	COMMENTS
P1	WB	UC4A	
P2	WB	UC3B	
P3			

Exhibit 7: Typical Hazard Warning Sign and Sign Installation Plan