# Bald Fire Salvage and Restoration Project

## Hydrology Report

**Hat Creek Ranger District**

**Lassen National Forest**

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# INTRODUCTION

This hydrology report for the Bald Fire Salvage and Restoration Project (Bald Project) includes a description of the area, a review of pertinent regulations and beneficial uses, existing conditions, and an analysis of possible effects of the Project.

## REGULATORY FRAMEWORK FOR ANALYSIS

The standards under which this project is analyzed come from the 1992 Lassen National Forest Land and Resource Management Plan (LRMP) and the 1993 Record of Decision (ROD) as amended by the Sierra Nevada Forest Plan Amendment (SNFPA) FEIS (2001), FSEIS (2004) and ROD (2004). Further direction is provided by Region 5 Soil Quality Standards (USDA FS, 1995), Region 5 Best Management Practices (USDA FS, 2011), the 1972 Clean Water Act, as amended, and Executive Order 119900 – Protection of Wetlands (1977).

The State and Regional Water Quality Control Boards entered into agreements with the U.S. Forest Service to control non-point source discharges by implementing control actions certified by the State Water Quality Control Board and the Environmental Protection Agency as Best Management Practices (BMPs) (Central Valley Regional Water Quality Control Board, 1998). BMPs are designed to protect and maintain water quality and prevent adverse effects to beneficial uses both on-site and downstream. Additional mitigations called Integrated Design Features (IDFs) have been placed in the Environmental Assessment to prevent actions, which could have adverse impacts on the watersheds. These are detailed in the Environmental Assessment.

## TIMBER HARVEST ACTIVITIES WAIVER

In December 2014, the California Regional Water Quality Control Board, Central Valley Region (Water Board) adopted Board Order No. R5-2014-0144, a conditional waiver of waste discharge requirements for discharges related to timber harvest activities in the Central Valley Region (2014, Conditional Waiver of Waste Discharge Requirements for Discharges Related to Timber Harvest Activities).

Upon signing of the Decision Notice, the Forest Service would apply to enroll the Bald Project in the Timber Harvest Activities Waiver program before project implementation begins. The Forest Service would meet all conditions of the waiver and would certify to the Water Board conformance and compliance with monitoring and reporting requirements of the waiver following project completion. The Water Board may inspect the project area at any time prior to, during, and following project implementation to ensure that waiver terms and Basin Plan1 objectives are being met.

[1] A set of overarching, desired conditions which are established for each hydrologic basin.

## BENEFICIAL USES

The Bald project is in the HUC-8 Lower Pit Watershed. The Central Valley Regional Water Quality Control Board (CVRWQCB) has jurisdiction over this area. CVRWQCB lists the following as existing beneficial uses for the Pit River system.

- Agricultural Supply (stock watering and irrigation)
- Freshwater Habitat
- Industrial Service Supply (dust abatement for roads and hydropower)
- Municipal and Domestic supply (fire protection)
- Freshwater Replenishment
- Groundwater Recharge
- Recreation (water contact and non-water contact)
- Water Quality Enhancement (e.g. riparian vegetation and stream bank configuration)
- Wildlife Habitat
- Spawning

## IMPAIRED WATERBODIES

Beaver Creek meets state and federal requirements for water quality. Once Beaver Creek leaves the Project area, it is approximately 13 miles until its confluence with the Pit River. From this confluence it is approximately 15 miles until the impoundment, which forms Lake Britton. Lake Britton is 303(d)[2] listed by the US EPA and California Water Resources Control Board as having mercury contamination (Board, 2010).

While it is a tributary to the Pit River upstream of Lake Britton, Beaver Creek and its respective tributaries are not 303(d) listed. The only surficial hydrologic connection between the Project area and the Pit River is through Beaver Creek.

## DESIRED CONDITIONS FOR HYDROLOGY AND RIPARIAN AREAS

Desired conditions are guided by the Riparian Conservation Objectives (RCOs), as set forth in the Sierra Nevada Forest Plan Amendment (2004) and the Lassen Resource Management Plan (LRMP, 1992.

**Hydrology:**

- Restrict operations in floodplains and wetlands in compliance with Executive Orders (LRMP, 4-53).
- Limit individual project impacts as needed to avoid significant cumulative effects on water quality and fisheries (LRMP, 4-5 and 4-32).

[2] Section 303(d) of the Clean Water Act (1972), as amended, requires the US EPA to maintain a list of "impaired" water bodies – those whose waters do not meet the standards mandated in the act.

- Maintain or improve riparian-dependent resources in and around wetlands, stream corridors (including ephemeral and intermittent streams), lakes, seeps, springs, and wet meadows (LRMP, 4-5 and 4-32).
- The connections of floodplains, channels, and water tables distribute flood flows and sustain diverse habitats (SNFPA, p. 42, 2004).
- Meadows are hydrologically functional (SNFPA, p. 42, 2004).
- Sites of accelerated erosion, such as gullies and headcuts are stabilized or recovering. Vegetation roots occur throughout the available soil profile (SNFPA, p. 42, 2004).
- Meadows with perennial and intermittent streams have the following characteristics: (1) stream energy from high flows is dissipated, reducing erosion and improving water quality, (2) streams filter sediment and capture bedload, aiding floodplain development, (3) meadow conditions enhance floodwater retention and groundwater recharge, and (4) root masses stabilize stream banks against cutting action (SNFPA, p. 42, 2004).

**Roads:**

- Keep skid trails and roads away from lakeshores and out of stream corridors, except for stream crossings (LRMP, 4-52).

**Water Quality:**

- Water quality meets the goals of the Clean Water Act and Safe Drinking Water Act, is fishable, swimmable, and suitable for drinking after normal treatment (SNFPA, p.43, 2004).

**Riparian Condition:**

- At either the landscape or project-scale, determine if the age class, structural diversity, composition, and cover of riparian vegetation are within the range of natural variability for the vegetative community. If conditions are outside the range of natural variability, consider implementing mitigation and/or restoration actions that will result in an upward trend. Actions could include restoration of aspen or other riparian vegetation where conifer encroachment is identified as a problem. (ROD Appendix A, Part D, #105)

# AFFECTED ENVIRONMENT

## PHYSIOGRAPHY

The Hat Creek Ranger District (HCRD) lies within a transition zone between the southern Cascade mountain range, the northern Sierra Nevada mountain range of northeast California, and the Modoc Plateau. Within and surrounding the project area, the terrain is broken into a series of meadows, bitterbrush / sagebrush flats, and upland forests. Topography varies from broad and flat to sloping terrain with elevations from approximately 3,600 feet to 5,700 feet. Most slopes *within proposed treatment areas* are less than 35 percent, with some short pitches that exceed 35 percent.

## GEOLOGIC SETTING

Field reconnaissance by LNF personnel in the Project area mostly agrees with the coarse-scale mapping which has been done, although there are many small areas in which materials have been re-worked in the Late Pleistocene and Holocene, and are not shown on the 1:250,000 scale geological maps available from the California Department of Natural Resources and USGS. These aberrations are most often alluvial deposits from high-energy ephemeral flows secondary to spring runoff.

## EVALUATION FOR NATURALLY OCCURRING ASBESTOS

Region 5 has directed that every environmental analysis should evaluate the potential for naturally occurring asbestos, the potential hazard to people working in the area, and plan accordingly. Given the geology of the project area, it is extremely unlikely that any naturally occurring asbestos would be found in the Project area.

## RELEVANT SOIL PROPERTIES

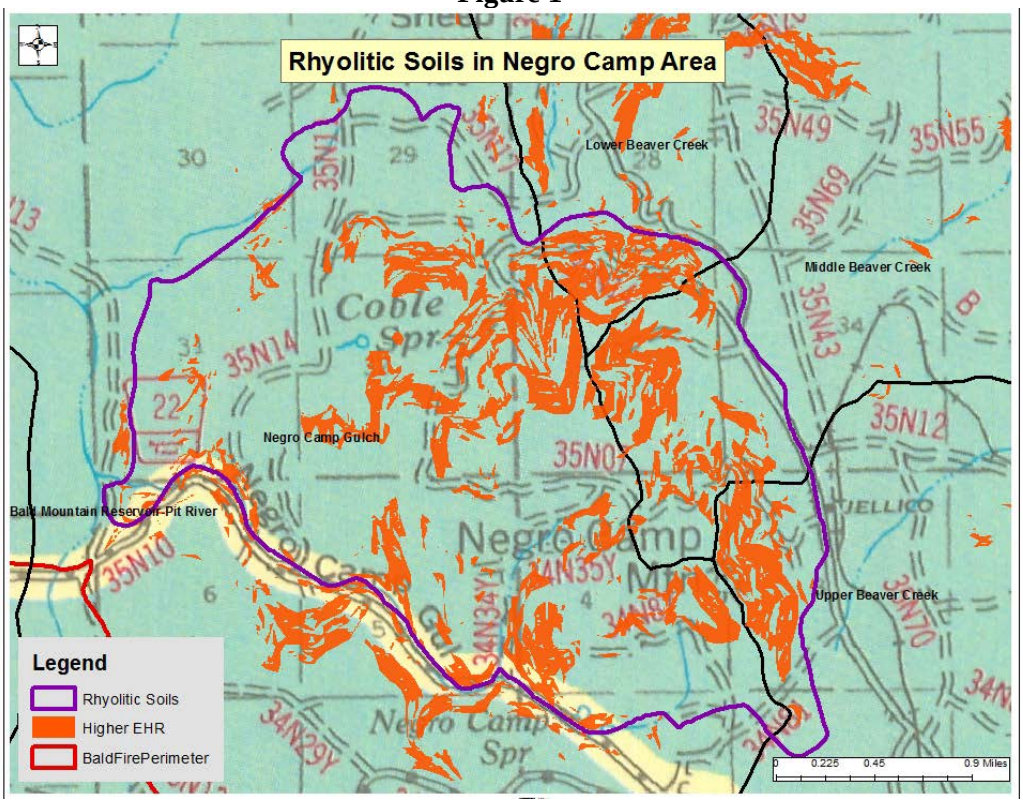
The impacts to hydrologic resources are governed by soil properties and vegetative cover. Hydrologic soil groups (HSGs) are used to estimate runoff from precipitation. Soils are assigned to one of four groups ranging from low to high runoff potential. Almost all of the Bald Fire area soils are categorized as having "moderately low runoff potential". The Burned Area Emergency Response (BAER) team, which responded to the Bald Fire, found heterogeneous hydrophobicity in the soils with moderate to very high burn severities. Hydrophobicity can render even the most permeable soils with low runoff potential impervious to water, thereby increasing the flashiness of runoff after rain events.

Although most of the soils in the eastern portion of the Hat Creek Ranger District are derived from basalts and other extrusive mafic materials, in the Project area several areas are primarily composed of rhyolite (an extrusive silicic/felsic material). Rhyolitis soils are of particular importance on steeper slopes because they tend to have lower cohesion than the other soils in the Project area. The risk of soil erosion is higher in these areas.

The greatest concentration of high erosion hazard ratings (EHRs) are on the rhyolitic soils in the Negro Camp Mountain area (Figure 1). There are high EHRs on the steeper areas when modeled with 5 percent cover. When modeled with 50 percent vegetation cover, the rating drops to moderate.

The infiltration rate of the soil directly influences the migration of water and suspended soil downslope. When infiltration rates are higher, peak flows in creeks are lower, and base flows are higher, which helps protects the stability of channels. One of the primary ways to protect water quality is to minimize the quantity and speed of runoff.

**Figure 1**




## HYDROLOGIC SETTING

The setting being described is that which exists on the ground at the present time, post-Bald Fire and pre-Bald Project. All analyses for direct, indirect, and cumulative effects are based on HUC-12[3] watersheds, as defined in the USGS's 2012 National Hydrologic Database (NHD). Figure 2 shows the Bald Project perimeter in relation to the relevant HUC-10 and HUC-12 watersheds. Table 1 displays HUC-10, and HUC-12 watersheds relevant to the Bald Project area, in tabular form.

[3] HUC = "Hydrologic Unit Code", with lower numbers corresponding to larger watersheds. This is a USGS system, with HUC units often being different both in name and spatial extent from California State Water Resources Control Board hydrological units of similar scale.

**Figure 2**

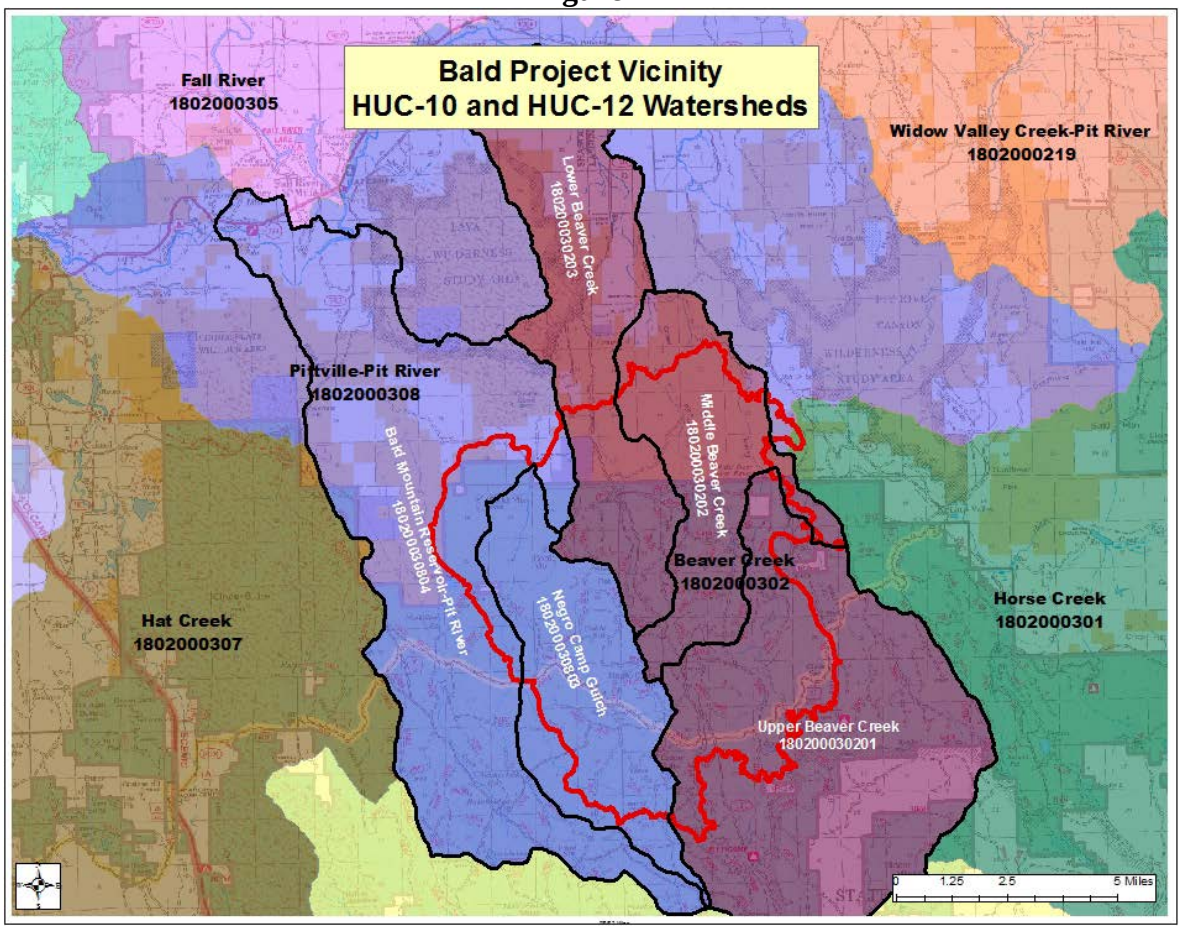



**Table 1 - Local Watershed Arrangement**

| Watershed Organization<br>Partial Contents of Lower Pit HUC-8 Watershed |
|---|
| |
| **Pitville – Pit River HUC-10 Watershed** |
| **Bald Mountain Reservoir – Pit River HUC-12** |
| **Negro Camp Gulch HUC-12** |
| |
| **Beaver Creek HUC-10 Watershed** |
| **Lower Beaver Creek HUC-12** |
| **Middle Beaver Creek HUC-12** |
| **Upper Beaver Creek HUC-12** |

**Note:** There are other HUC-10 watersheds in the Lower Pit watershed not hydrologically connected to the Project area.

**Bald Mountain Reservoir –Pit River HUC-12 Watershed** (Bald Mountain)**:** North of Bald Mountain, most surface water joins the Pit River. The southern portion of the watershed, however, is internally drained, with the majority ponding near Bald Mountain Reservoir (see Figure 3). These waters infiltrate, evaporate or are transpired locally. The Bald Fire burned 11 percent of this watershed.

**Negro Camp Gulch HUC-12 Watershed** (Negro Camp)**:** This watershed has the highest concentration within the Project area of rhyolitic soils, which are very erodible. The majority of timber, soils with high EHRs, and steep slopes occur within the southern portion of this watershed. Waters in this area drain internally. They are mapped as predominately infiltrating near Peterson Ranch, on the northeast side of Bald Mountain. Field reconnaissance suggests that a portion of these waters travel to Bald Mountain Reservoir. There is no mapped surface water connection between it and the Pit River or Beaver Creek. In the Negro Camp Mountain area, many of the roads were constructed in, or directly next to, drainages. The Bald Fire burned 81 percent of this watershed, with much of it at high to very high severity

**Lower Beaver Creek HUC-12 Watershed** (Lower Beaver)**:** Similar to the Bald Mountain watershed, waters in the southern portion of this watershed are not surficially connected with those in the northern portion. The northern portion, on BLM managed lands, has channels, which join Beaver Creek, while the southern, in the burned area, does not (Figure 3). The section of this watershed on NFS lands has a fair slope in a mountainous area with rhyolitic soils on its west side, which gradually flattens as it approaches Beaver Creek to the north and east. The Bald Fire burned 33 percent of this watershed.

**Middle Beaver Creek HUC-12 Watershed** (Middle Beaver)**:** The drainages in this entire watershed are mapped as having surficial connectivity with Beaver Creek, with tributaries, which directly join Beaver Creek on BLM land. The southern portion of this watershed abuts the Negro Camp watershed, and shares the same issues, erodible soils and high burn severity. Away from Negro Camp Mountain, the rest of the terrain in this watershed is relatively flat. The Bald Fire burned 75 percent of this watershed.

**Upper Beaver Creek HUC-12 Watershed** (Upper Beaver)**:** Both the headwaters of Beaver Creek and its main stem on NFS land are in this watershed. Beaver Creek passes into Middle Beaver just after it reaches BLM lands. Beaver Creek is the only perennial stream in the five HUC-12 watersheds in the analysis area. While it is mostly perennial, some reaches are intermittent, especially during dry years. This is the only HUC-12 watershed being analyzed that has private timber sales occurring. These are on the slopes of Blacks Mountain. The Bald Fire burned 30 percent of this watershed.

### Channels within the Project Area

The miles of channel, which are present in each HUC-12 watershed that touches the Bald Project, are summarized in Table 2 and shown in Figure 3. Ephemeral and intermittent streams are grouped together as "seasonal" since it is difficult to draw a firm distinction between them in this terrain[4].

[6] An intermittent stream interacts with groundwater, while an ephemeral one does not.

**Table 2 - Miles of Channels in Each Watershed**

| | Perennial Streams | Seasonal Streams |
|---|---|---|
| ***HUC- 12 Watershed*** | *(miles)* | *(miles)* |
| **Bald Mountain Reservoir** | 0 | 35 |
| **Lower Beaver Creek** | 3 | 38 |
| **Middle Beaver Creek** | 5 | 23 |
| **Negro Camp Gulch** | 0 | 30 |
| **Upper Beaver Creek** | 7 | 40 |

The headwaters of Beaver Creek are south of the Project area, beginning jointly in Beaver Creek Spring and the Beaver Creek Wetlands. Only a portion of the Beaver Creek Wetland resides within the Project area. There are no proposed treatments within the Beaver Creek Wetland, with the exception of a few hazard tree units on its periphery.

Beaver Creek is actively incising, and has formed a gorge in the northern part of the Project area and BLM lands. It emerges from this gorge after transecting the Beaver Creek Rim. Approximately 95 percent of the Beaver Creek RCA burned at moderate to very high severity. There are portions where most to all of the woody debris was consumed. Field observations done directly following the fire by a BAER team revealed that ash was already moving down gradient.

### Springs, Small Reservoirs, and Wetlands

There are a small number of springs, wet meadows, potential wetlands[5], seasonal pools, and small reservoirs within the project area (both named and un-named).

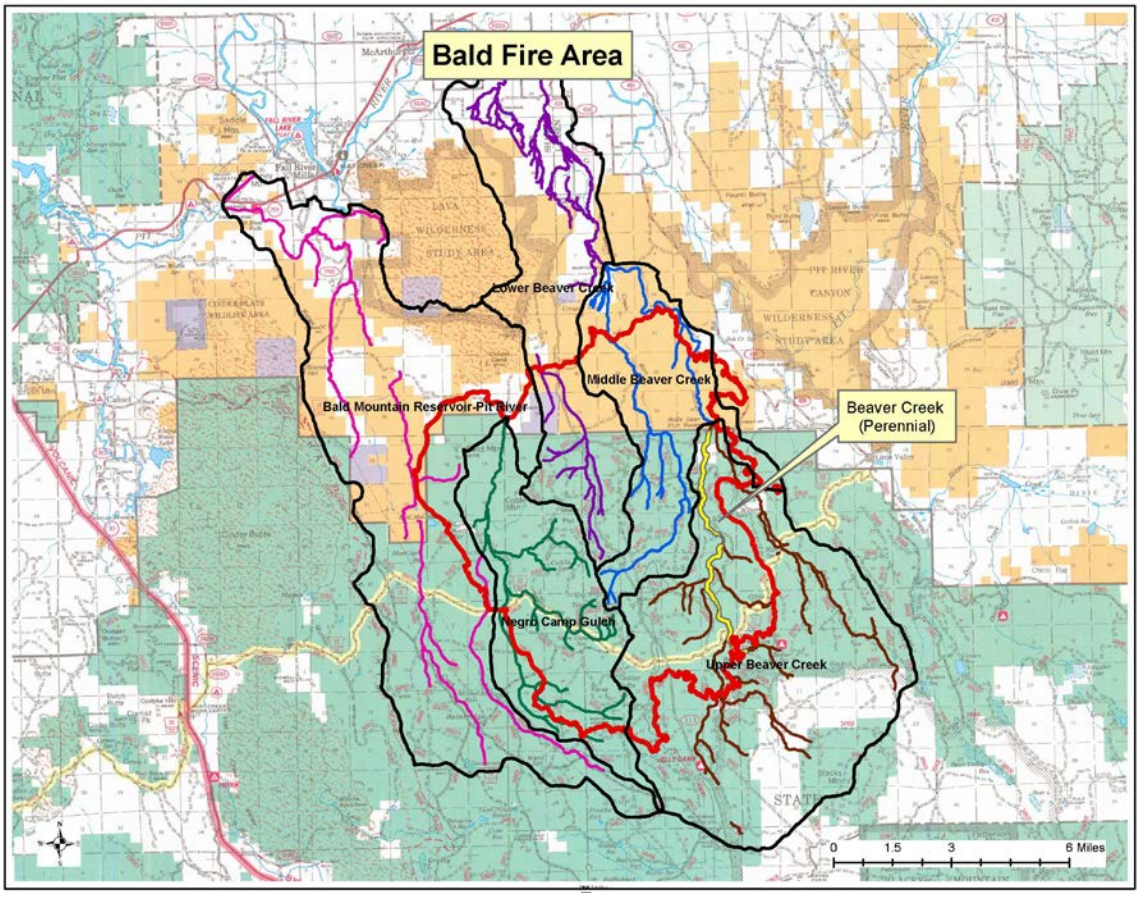
### Riparian Conservation Areas (RCA)

RCAs are a land management designation, which exists in order to protect the sensitive resources in and around most waterbodies. These regulations are fashioned in order to address concerns in many different fields, including aquatic and wildlife biology, botany, ecology, geology, hydrology, and soil science, and then balancing these against fuels reduction and fire prevention concerns.

RCAs are not “no entry” zones. An analysis of Riparian Conservation Objectives (RCOs) is done to determine what activities could occur without causing detrimental effects to the riparian resources. Table 3 shows the widths of the RCAs for the Bald Project, as designated by the Sierra Nevada Forest Plan Amendment (2004) (SNFPA).

[5] For a feature to be legally considered a wetland, it must be evaluated under criteria promulgated by the US Army Corps of Engineers.

**Figure 3**




**Note The Project perimeter is in red. The channels in each watershed are shown in a distinctive color.**
**Source: Channel data are from the National Hydrologic Database (NHD), distributed by the USGS.**

**Table 3- RCA Widths**

| RCA Type | RCA Width | Example Project Feature |
|---|---|---|
| Perennial Streams | 300 feet (each side of stream), measured from bank- full edge of | Beaver Creek |
| Streams in Inner Gorge (slopes > 70% gradient) | The top of the inner gorge | Beaver Creek Gorge |
| Seasonally Flowing Streams (includes ephemerals with defined stream channel and evidence of scour) | 150 feet (each side of stream), measured from bank- full edge of stream | Scattered throughout the project area |
| Special Aquatic Features (includes wet meadows, wetlands, and springs) | 300 feet from edge of feature or riparian vegetation, whichever width is greater | Scattered in the project area including Sheep Flat, Beaver Creek Wetlands, Gibbs Spring, Negro Camp Spring, Coble Spring, etc. |

Table 4 provides the vegetation burn severity of the Project, based on satellite imagery of the vegetation.

**Table 4 – The Percentage of Watershed by Vegetation Burn Severity**

| | Very High | High | Moderate | Low | Total |
|---|---|---|---|---|---|
| **Bald Mountain Reservoir** | 5% | 3% | 2% | 1% | 11% |
| **Lower Beaver Creek** | 17% | 7% | 7% | 2% | 33% |
| **Middle Beaver Creek** | 36% | 15% | 14% | 10% | 75% |
| **Negro Camp Gulch** | 59% | 15% | 6% | 1% | 81% |
| **Upper Beaver Creek** | 16% | 6% | 6% | 2% | 30% |

Sediment levels in channels increase following fires due to increased runoff, surface erosion, channel incision, road failures, hydrophobicity, and mass wasting. These elevated sediment levels typically peak within the first few years following the fire and begin to decrease towards pre-fire levels within a decade (Robichaud and Brown, 2000; DeBano and others, 1996; Berg and Azuma, 2010; and Robichaud and others, 2009).

Present impacts on water quality include removal of vegetation by the fire, and road damage, both of which contribute sediment to streams. This sediment has a negative impact on the quality of the aquatic habitat as well as causing water quality concerns.

The temperature of a stream is generally expected to increase where the fire removes trees providing shading, especially along perennial streams. Beaver Creek has some springs that should regulate temperature despite removal of vegetation shading the stream.

**Watershed Improvements**

The Bald BAER Team determined that approximately 36 miles of FS roads within the Bald Fire boundary were at risk of increased erosion and potential failure. The road work started soon after the fire was controlled to reduce road related sediment production from post-fire runoff. Road work included replacing undersized culverts with larger culverts, adding rolling dips to remove water from the road more quickly and disconnect some of the stream channel road connectivity. It also reduces chronic sediment production and delivery related to these at risk roads. Most of the work occurred in the fall of 2014, some areas would have additional work in the spring of 2015.

# ENVIRONMENTAL CONSEQUENCES

## METHODOLOGY

Field reconnaissance of the treatment areas began immediately after the Bald fire, and continued through the fall and winter of 2014-2015. Stream channels and other aquatic features were visually assessed. Literature reviews, Forest monitoring reports, Geographical Information System (GIS) data, and professional judgment were used to support report conclusions. Cumulative watershed effects were modeled using Equivalent Roaded Acres (ERA) method. (More information on the method and its limitations may be found in Appendix B). Cumulative effects were looked at for the previous 30 years and 10 years in the future.

## INTEGRATED DESIGN FEATURES (IDF)

IDFs are resource protection measures that are incorporated as part of the Action Alternatives for the Project. The following IDFs would be in addition to standards and guidelines from the Forest Plan, as amended. California Best Management Practices (BMP) would be implemented for the entire project. California BMPs are described in Water Quality Management for Forest System Lands in California, Best Management Practices (2011). They are implementation parameters that would be incorporated into treatments, contracts, or used to guide Forest Service personnel in conducting implementation.

As additional, small, non-mapped aquatic features are found during implementation, the district Hydrologist would assesses the site-specific mitigations required for protection.

## ALTERNATIVE 1 (PROPOSED ACTION)

Treatments proposed under Alternative 1 include hazard tree removal, area salvage, area fuels treatments, and planting only treatments (Table 5). Treatments would use a combination of mechanical and hand work, in addition to prescribed fire. All acres proposed for treatment were analyzed for planting.

**Table 5 – Alternative 1 Treatment by Watershed**

| HUC12 | Salvage[6] (acres) | % of WS | Fuels[7] (acres) | % of WS | Replant (acres) | % of WS | Hazard Tree (acres) | % of WS | Total Acres | % of WS |
|---|---|---|---|---|---|---|---|---|---|---|
| **Bald Mountain** | 67 | 0% | 112 | 0% | 1 | 0% | 63 | 0% | 243 | **1%** |
| **Negro Gulch** | 1557 | 9% | 1753 | 10% | 143 | 1% | 536 | 1% | 3989 | **20%** |
| **Lower Beaver** | 509 | 4% | 1639 | 13% | 395 | 3% | 297 | 2% | 2840 | **23%** |
| **Middle Beaver** | 965 | 7% | 1553 | 11% | 0 | 0% | 434 | 2% | 2952 | **21%** |
| **Upper Beaver** | 1650 | 5% | 2019 | 6% | 0 | 0% | 807 | 1% | 4476 | **13%** |

*WS' is short for 'watershed'.

[6] Salvage units are also treated for fuels and are reforested.
[7] Fuels units are also reforested.

Roadside hazards would be treated along all Maintenance Level 2 (ML2) and higher roads within the Project area.

Under Alternative 1, approximately 2.2 miles of existing roads would be designated and added to the LNF transportation system. While forest roads are one the biggest causes of water quality issues in western forests, these road are already on the ground, and are already affecting the landscape. These roads are already included in the cumulative effects modeling. The breakdown of these additional road segments by watershed is shown in Table 6.

**Table 6 – Miles of Roads to be added to the LNF Transportation System by Watershed**

| | Miles of Road Added |
|---|---|
| **Bald Mountain Reservoir** | 0.0 |
| **Lower Beaver Creek** | 0.9 |
| **Middle Beaver Creek** | 0.0 |
| **Negro Camp Gulch** | 1.0 |
| **Upper Beaver Creek** | 0.2 |

To facilitate Project implementation, several short segments of temporary road may be needed. The total length would not exceed one mile.

## DIRECT AND INDIRECT EFFECTS

The criteria discussed in detail, are:

- Stream Flows
- Streambank Stability
- Water Quality
- Down Woody Debris
- Aquatic Features

Together, these cover the major hydrologic resources and potential for adverse effects. The analysis is confined to potential disturbance *beyond that which would occur in the existing (post Bald Fire) condition*.

## STREAM FLOWS

Potential concerns:

1. The removal of remaining live vegetation: transpiration would decrease in the watershed, therefore increasing base flow and peak runoff in area streams.
2. Compaction by heavy equipment: could reduce soil infiltration rates, and thereby cause an increase in peak flows and a decrease in base flows.

Transpiration rates would not change from the post-fire condition as a result of the salvage and fuel reduction activities proposed in Alternative 1. The trees to be removed are already dead or dying so treatments would not immediately change transpiration in the project area. Over time as vegetation

reestablishes and the plantations develop, transpiration rates would return to the pre-fire levels. Stream flow would be expected to increase in the short-term and return to pre-fire levels in the long term. Replanting would help to quickly reestablish vegetation and lower peak flows over time.

Hydrophobicity as a result of the fire in the moderate to high severity burned soils has the potential to increase surface flow and decreased infiltration, leading to increased peak runoff. The ground disturbing activities in Alternative 1 would help break up these hydrophobic soils thereby reducing these negative effects from the fire.

Compaction resulting from the use of heavy equipment could increase runoff and raise peak flows. The potential one mile of temporary road would not cross stream channels or be within the RCA and therefore would have negligible effect to flows. The implementation of BMPs and adherence to Wet Weather soil moisture requirements would minimize project related compaction. An IDF requires remediation of unit soils if the LRMP standard of 15 percent areal extent detrimental porosity loss is exceeded. Taken together, negligible effects to flows are anticipated.

## STREAMBANK STABILITY

There would be minimal direct or indirect effects to streambank stability from Alternative 1 as there is no mechanical treatment within the RCA for Beaver Creek, the only perennial stream, and there is a minimum of 25 feet no mechanical equipment buffer along all other channels. With hand treatments, no trees providing bank stability would be removed and no live trees would be removed. This would all protect streambank stability. In addition, 90 percent groundcover would be required for skid trails in the RCA, lowering the potential for erosion.

Pile burning post salvage would not occur within 25 feet of a channel or of riparian vegetation to protect bank stability.

Beaver Creek, the only perennial channel within the project area, would be buffered from project activities with a 300 foot no treatment zone with the exception of minor (approx. 14 acres) hand treatment.

The tributaries to Beaver Creek, in the Upper and Middle Beaver Creek Watersheds, would have site-specific IDFs, as well as BMPs, to protect them from bank degradation, including a 25 foot no mechanical equipment buffer adjacent to the channel. Most of these channels are ephemeral, with a couple of intermittent ones.

The channels in the Bald Mountain, Lower Beaver, and Negro Camp watersheds are predominately ephemeral. In the Project area, these channels are internally drained. They drain to nearby areas and physically cannot surfically affect Beaver Creek, the Pit River, or any downstream beneficial uses.

Field monitoring, to-date, following major precipitation events has not shown any major erosion or bank undercutting within these drainages.

## WATER QUALITY

Potential concerns:

- Sedimentation
- Temperature
- Chemical

Risks of water quality degradation driven by increases in sediment delivery from Alternative 1, beyond that which would already occur because of the Bald Fire, are negligible. No mechanical treatments are planned within the RCA of Beaver Creek, the only perennial stream within the project area. A small number of acres (approximately 15) could have fuels treated by hand but this minor treatment is unlikely to impact water quality.

Up to one mile of temporary road could be constructed. Temporary roads would not be placed in RCAs and therefore would have no impact to stream channels. These roads would be decommissioned after use.

In the Middle and Upper Beaver Watersheds, where water quality problems could affect impaired bodies downstream and their beneficial uses, there are only a few areas where RCAs are being treated. The existing slope gradients adjacent to stream channels are moderate to low. Furthermore, with implementation of IDFs and BMPs for the soil moisture and groundcover, effects from the project on sediment delivery are expected to be negligible. The portion of the Project area in the Bald Mountain, Lower Beaver, and Negro Camp watersheds are not surficially connected to any waterbodies in other watersheds, but are instead internally drained and could not transport sediment downstream.

Temperature rates would not change from the post-fire condition as a result of the salvage and fuel reduction activities proposed in Alternative 1. All channels within treatment units except the 14 acres of hand treatment along Beaver Creek are seasonal in nature. Stream channel shading in seasonal channels has little influence on water temperature further downstream in late summer and fall, when elevated water temperatures are most likely to occur. By the time water temperature is of greater importance, such as late summer, the seasonal streams are no longer carrying water. Additionally, tree removal is limited to dead or dying trees that would provide little shade in the future.

Piling and burning of material near stream courses could contribute ash to streams. Ash can change the pH and other chemical properties of water if contributed in sufficient quantity. Treatments within RCAs are expected to result in a large amount of breakage and a corresponding increase in groundcover. IDFs restrict piling within 25 feet of aquatic features and limit the timing of pile burning within the RCA. Together, these would reduce the risks of ash from pile burning moving into channels. The increased groundcover produced by the project activities would aid in filtering out potential sediment from both the Bald Fire and Project activities before it reaches stream channels.

Borate compounds that would be applied to cut stumps of conifers greater than 24 inches in diameter to reduce the risk of root diseases would not be applied within 25 feet of live stream courses, meadows/wetlands, or sensitive plant locations, reducing risk to water quality from use of the compound. The timing of borate compound application would also be during dry season conditions when there is little likelihood of runoff events.

BMP Practice 2-12 requires that servicing and refueling activities that may be needed by mechanical equipment during project implementation would be located away from RCAs. Suitable locations for such activities are to be designated and agreed to prior to project implementation. A Riparian Conservation Objective Consistency Analysis for this alternative is located in the project record.

### DOWN WOODY DEBRIS

Alternative 1 with the incorporation of IDFs and wildlife retention areas would meet the RCO for large woody debris within RCAs. RCOs call for large woody debris to be "within the range of natural variability" (SNFPA, RCO #3). Large woody debris is important for:

- Providing roughness in the landscape to slow down water, thereby reducing both sedimentation and damage to the banks
- Providing current and future habitat
- In channel wood is necessary to form log jams and other grade-controlling features.
- Providing material from which new soil can be formed

Eight to ten of the largest snags per 100 linear feet would be left in the RCAs. These would also provide a reservoir of future down woody debris that would add to future channel complexity and sediment regulation.

Alternative 1 would reduce the fuel loading in RCAs, thereby decreasing the fire hazard.

Down woody debris also holds moisture in place, thereby limiting evaporation, increasing infiltration, and keeping some moisture on the ground later into the year.

### SPRINGS, SMALL RESERVOIRS, AND WETLANDS

Adverse effects to the Aquatic Features, as listed in Table 7 are expected to be negligible because there is a minimum of 25 foot mechanical buffer on these features within units. In addition, IDFs require 8 to10 large logs be left on site where they exist and that planting of conifers would not occur within 20 feet of riparian plant communities. If riparian vegetation does not naturally regenerate, riparian species may be planted. These IDFs are expected to protect and if necessary improve riparian conditions in these areas.

**Table 7 - Burn Severity of Aquatic Features within Alternative 1 Treatment Units**

| Watersheds and Aquatic Features[8] | RCA Burn Severity | RCA acres w/in Treatment Unit |
|---|---|---|
| **Bald Mountain Reservoir – Pit River HUC-12** | | |
| • Moon Spring | Low-Very High | 0 |
| **Negro Camp Gulch HUC-12** | | |
| • Coble Spring | Moderate-Very High | <1 |
| • Negro Camp Reservoir | None-Very High | 3 |
| • Negro Camp Springs | None-Very High | 9 |
| • Negro Camp Wetlands | Moderate-Very High | 25 |
| • Sheep Flat | Moderate- High | 5 |
| **Middle Beaver Creek HUC-12** | | |
| • Willow Spring | Moderate-Very High | 0 |
| **Upper Beaver Creek HUC-12** | | |
| • Beaver Creek | None-Very High | ~15 |
| • Beaver Creek Wetland | Low-Very High | 0 |
| • Gibbs Spring | None-Very High | 0 |

Source: Burn severity based upon data received from the Remote Sensing Applications Center (RSAC) at Salt Lake City, Utah as mapped by satellite.

## ALTERNATIVE 2 (NO ACTION)

Under the No Action alternative, none of the activities proposed under Alternative 1 would be implemented. The No Action alternative would not preclude activities already approved in this area or activities planned as separate projects. Danger trees could be cut and left on site under road maintenance. No fuels treatments, site preparation, or reforestation would occur. Current management practices such as road maintenance and fire suppression would continue.

### DIRECT AND INDIRECT EFFECTS

There would be no direct effects from Alternative 2, as no actions would be authorized under it

An indirect effect would be a more continuous increased fuel load within the Project area, without the areas of lowered fuel loading provided under Alternative 1. If another fire started in the area, the more continuous untreated fuel load would lead to higher potential for a large fire, as well as increased potential for higher intensity burning likely to remove groundcover, adversely affecting soils, remove shading from streams, and increasing sediment load of the streams.

[8] Note that there are other minor waterbodies present, but these are not being specifically detailed in this document because they are not in treatment units, or are too small to be treated individually.

## STREAM FLOWS

Hydrophobicity as a result of the fire in the moderately to highly burned soils would cause minor increases in surface flow and decreased infiltration. However, this is a short term effect, as the hydrophobicity is expected to disappear in approximately 2 years.

As the quantity of down wood increases from falling snags, the hydrologic connection between the burnt areas and hydrologic features would decrease. The speed and quantity of runoff would decrease in time, which would decrease peak flows and increase base flow. The effect of the hydrophobicity would decrease in time, as the effects from the increasing number of down snags would increase.

Changes in flows would be the same as seen under the post-fire existing conditions due to the high degree of vegetation mortality from the fire. Over time as vegetation reestablishes the transpiration rates would return to the pre-fire levels. Stream flow would be expected to increase in the short-term and return to pre-fire levels in the long term.

## STREAMBANK STABILITY

There would be minimal direct or indirect effects to streambank stability from Alternative 2.

Without the removal of any snags, channel stability could be compromised in isolated areas, due to high concentrations of woody debris.

## WATER QUALITY

The primary water quality concerns after a fire are mobilized sediment and increases in pH from ash being flushed into the waterbody. Initially the risk of sediment and ash flushing into waterbodies is high due to the lack of ground cover. Overtime, vegetation regrowth and increased down woody material would aid in filtering out sediment before it reaches stream channels.

Temperature rates would not change from the post-fire condition. All channels with the exception of Beaver Creek are seasonal in nature. Stream channel shading in seasonal channels has little influence on water temperature further downstream in late summer and fall, when elevated water temperatures are most likely to occur. By the time water temperature is of greater importance, such as late summer, the seasonal streams are no longer carrying water.

## DOWN WOODY DEBRIS

The positive and negative effects of down woody debris are the same as discussed under Alternative 1.

## SPRINGS, SMALL RESERVOIRS, AND WETLANDS

Since no actions would be taken under this alternative, the aquatic features in the Project area would not be damaged or helped by management actions.

## ALTERNATIVE 3 (ROAD HAZARD ONLY)

In Alternative 3, approximately 4,700 acres of hazard tree removal, adjacent to LNF roads, would be treated. Where hazard trees are being removed within RCAs, ground-based mechanical equipment would be restricted to the road prism. Hazard trees that cannot be removed would be felled parallel to the contour of the slope and left in place. The breakdown of these treatment units by watershed are shown in Table 8, a map of these units can be found in the EA.

**Table 8 – Alternative 3 Treatments by Watersheds**

| HUC12 | Hazard Tree Units (acres) | Percent of Watershed |
|---|---|---|
| **Bald Mountain** | 79 | <1% |
| **Negro Gulch** | 1147 | 9% |
| **Lower Beaver** | 905 | 5% |
| **Middle Beaver** | 1042 | 8% |
| **Upper Beaver** | 1562 | 4% |
| **Total** | **4736** | |

### DIRECT AND INDIRECT EFFECTS

#### STREAM FLOW, STREAMBANK STABILITY, WATER QUALITY, DOWN WOODY DEBRIS, SPRINGS, SMALL RESERVOIRS, AND WETLANDS

Direct and indirect effects to hydrologic resources from Alternative 3 would be minimal

- Treatments in RCAs would occur from the road prism, therefore effects to stream channels or any aquatic features would be minimal.
- Trees to be removed are dead or dying, no measureable effects to streamflow are expected.
- With the IDFs, which restrict equipment operations near streams, no direct or indirect effects to channel stability are expected to occur.
- Ground disturbance from roadside hazard removal would be relatively minimal since most roads proposed for hazard removal are not near stream channels and treatments in RCAs would occur from the road prism. No measureable effects to water quality would be expected from this alternative.
- The positive effects of down woody debris are the same as discussed under Alternative 1.

Outside the road hazard units, no other actions would occur in the fire perimeter. Therefore, the effects in these areas for Alternative 3 are the same as those discussed under Alternative 2

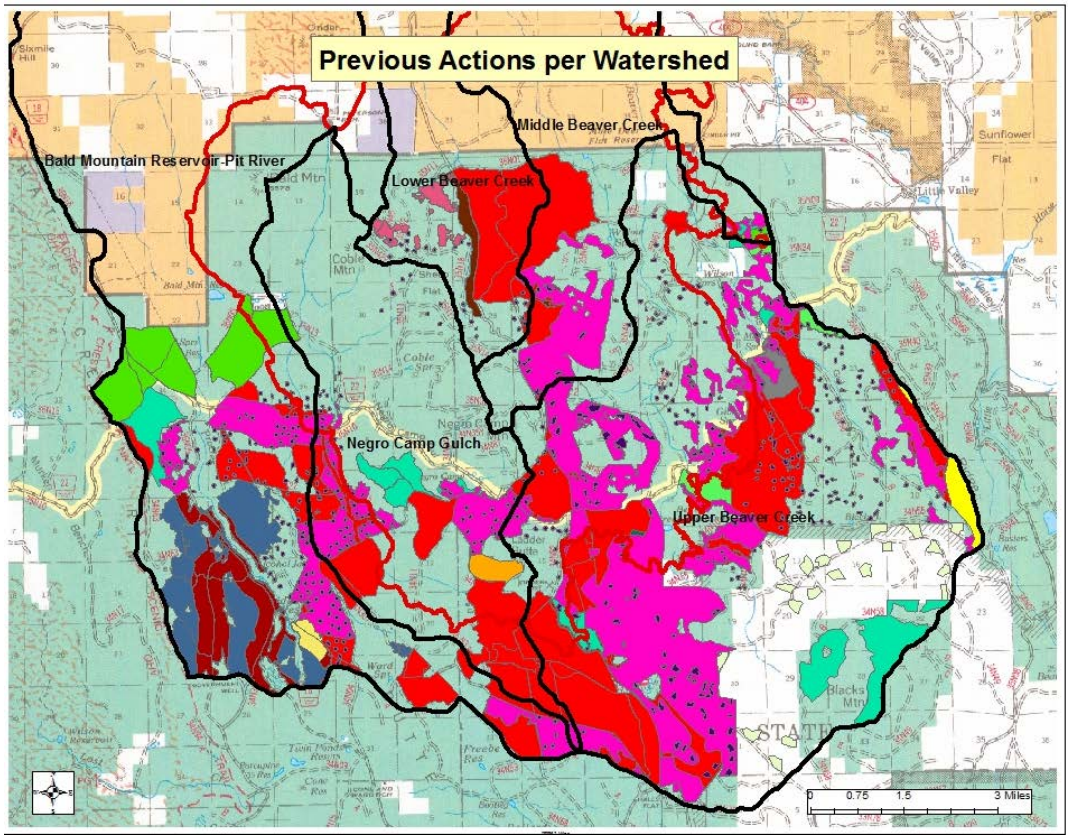
## CUMULATIVE EFFECTS – ALL ALTERNATIVES

Cumulative watershed effects (CWE) include past, present and reasonably foreseeable future ground disturbing activities within the analysis area. Cumulative watershed effects can occur on site or

downstream of land disturbing activities. These effects may be either beneficial or adverse, and result from additive changes in watershed structures and processes caused by multiple land management activities or natural events (such as wildfire) within a watershed. The key steps in a cumulative effects analysis are to identify the beneficial uses of concern, determine the cause-effect relationships of an Alternative on the beneficial uses, and determine the magnitude and significance of the environmental consequences resulting from the alternative in relation to other past, present, and future actions. The significance of effects should be determined based on context and intensity. Factors that would be used to define context and intensity of effects include their magnitude, geographic extent, duration, and frequency. Changes in flow regimes, especially peak flows, and sediment introduced to streams can combine to upset the dynamic sediment transport/stream flow equilibrium conditions.

Wildfires as well as management practices can alter soil condition. This may affect infiltration rates and increase the amount of disturbed soils within a watershed. Modification of ground cover can also change run-off rates and erosion processes. All of these factors have the ability to create CWEs. The BMPs and IDFs are tools to minimize adverse CWEs, and to ensure that beneficial uses of waterbodies are maintained.

**Figure 4**




**Note: Lime green = broadcast burning, cyan = burning of piled material, pink = commercial thin, dark purple = group selection cut, bluish gray = stand clearcut, red = underburn, orange = wildfire/ natural ignition, brown = compacting / crushing fuels, yellow = insect prevention. In the private land surrounding Black's Mountain, the light yellow polygons are clearcuts that were performed by SPI.**

Past activities within the Project area include wildfire activity as well as resource management on both Forest and adjacent lands. Figure 4, shows the location of past actions from the past 30 years within the project area by watershed. The only ongoing projects in the project area is the Eastside Underburn, which is an ongoing fuels project, and BAER road work which started in the fall of 2014 and would continue this spring. The BAER roadwork does not affect the ERA model, but does help lower the risk of adverse CWEs by decreasing road/stream connectivity within the Project area, reducing chronic sedimentation, and potentially lowering peak flows. In addition, undersized culverts have been replaced to accommodate the larger flows that could potentially occur until the area is revegetated.

## EQUIVALENT ROADED ACRES

The Pacific Southwest Region (Region 5) of the Forest Service has adopted the Equivalent Roaded Acres (ERA) model as a method of assessing the risk of adverse CWEs. Under this method, the watershed is rated by soils, streams, roads, fire history, past activities, and given a number showing susceptibility to adverse CWEs from both natural events and management activities. This model is designed as a preliminary indicator for managers to determine whether past and present land management disturbances in a given watershed approach or exceed a threshold of concern (TOC), which is given as a percent of the watershed area. The TOC is set for each watershed based of how sensitive the watershed is to impacts. For this analysis, a threshold of concern (TOC) of 18 percent is used to identify potential risks for adverse impacts to the watershed. When ERAs approach or exceed a given watershed's TOC, further field work would be necessary to ascertain the risk of land management activities adversely adding to those effects and resulting in detrimental impacts to beneficial uses. This fieldwork occurred periodically after storm events in the winter of 2014-2015 and in April 2015.

The ERA methodology has both strengths and weaknesses. The modeling is readily duplicated, computationally simple, and easily understood. It also incorporates rates of management disturbance and recovery times associated with those disturbances, an attribute which is missing in many other CWE models.

Conversely, it is an empirical model that has no basis in physical or biological processes. It cannot consider the location of features, soil types and conditions, or the distribution and types of vegetation. It does not address physical or biological processes in stream channels, nor does it account for the time lag associated with moving sediment delivered from a given activity downstream. Recovery times in the ERA model apply only to onsite impacts.

As this project is proposed to address the effects of the Bald Fire, the largest number of treatments are proposed in the watersheds, which experienced the most effects from the fire. While the ERA from the Project is modeled with all activities occurring in 2015, in reality, some salvage could occur in 2016 lowering the effects for 2015. Other activities such as fuel reduction and planting would occur over the next five to ten years.

## ALTERNATIVE 1

The watersheds are discussed below based on whether the watersheds are internally or externally drained. The first group is internally drained watersheds consisting of Bald Mountain Reservoir, Lower Beaver Creek, and Negro Camp Gulch. Bald Mountain Reservoir and Lower Beaver Creek have some externally drained stream channels but these are north of the project area. Within the Project area, the three watersheds listed above are internally drained and lack connectivity to channels downstream. The second group is externally drained watersheds and consists of Middle Beaver Creek and Upper Beaver Creek.

**Table 9 - Prefire ERA, the ERA from the Bald fire, addition of Alternative 1 and the total ERA**

| HUC-12 Watershed | ERA Threshold | ERA Before Fire | Fire ERA | Alternative 1 ERA | Cumulative ERA |
|---|---|---|---|---|---|
| **Bald Mountain Reservoir** | 18 | 3 | 3 | <1 | 6 |
| **Lower Beaver Creek** | 18 | 5 | 8 | 4 | 17 |
| **Middle Beaver Creek** | 18 | 2 | 18 | 5 | 26 |
| **Negro Camp Gulch** | 18 | 5 | 23 | 6 | 35 |
| **Upper Beaver Creek** | 18 | 6 | 8 | 5 | 18 |

## INTERNALLY DRAINED WATERSHEDS

Bald Mountain Reservoir is considered low risk for adverse CWEs. Negro Camp Gulch is considered to be at very high risk of adverse CWEs, primarily from the fire. With the combined ERA numbers, Lower Beaver Creek Watershed is below the 18 percent TOC, but still is considered to be at high risk for adverse CWEs under Alternative 1 (Table 10 below). As discussed under direct and indirect effects above, IDFs are in place to minimize effects from the project. These include a 25-foot no mechanical equipment buffer along channels, a prohibition on equipment on slopes over 20 percent within RCAs, and a requirement to leave 90 percent groundcover along skid trails in RCAs. All of these help to disconnect treatments from the stream channels, to minimize impacts from the Project. In addition, eight to ten of the larger snags would be left along channels for future large wood recruitment. These and other IDFs would decrease onsite effects from the project as discussed above in the direct and indirect effects section. Following preliminary analysis, it was decided that in the steeper areas with rhyolitic soils (highly erosive) of Negro Camp Gulch and Lower Beaver Creek Watersheds, fuel treatments would be limited to mastication, grapple piling and other less ground disturbing techniques.

In the winter of 2014-2015, fieldwork after large precipitation events showed minor rilling on hill slopes and few impacts from higher flows in the channels. Little sediment transport or erosion was observed in the channels; they remained stable and largely unaffected.

Due to the lack of connectivity with channels downstream, Project activities can have no effect on downstream beneficial uses.

Over the next ten years, as the area revegetates (both naturally and by planting), the effects from both the fire and project are modeled as decreasing, along with the risk of adverse CWEs. Within ten years, all the watersheds are modeled to be below the TOC, except for Negro Camp Gulch, which would be at a moderate risk. In reality, it would be expected that the true risk would be low within a few years as the area is revegetated and groundcover is in place to protect the soils.

## EXTERNALLY DRAINED WATERSHEDS

The Middle Beaver Creek and Upper Beaver Creek Watersheds are externally drained, with waters flowing through Beaver Creek and into the Pit River. Both are modeled to be at very high risk of adverse CWEs (Table 10). After preliminary analysis, as with Negro Camp Gulch, as discussed above, treatments were dropped or modified on the steeper, more sensitive slopes and the permitted fuels treatments in these areas were reduced to allow only low impact methods, such as grapple piling, mastication, etc. In addition, the 25 foot no mechanical entry buffer around the seasonal channels and the 300 foot no mechanical entry buffer around Beaver Creek (planned treatments are approximately 15 acres of hand treatments) would help disconnect the mechanical treatments from the channels. During the winter of 2014/2015, one channel in the Upper Beaver Creek Watershed was impacted by higher flows and eroded around a culvert. This area will be stabilized with further roadwork in the summer of 2015.

Further fieldwork occurred after preliminary analysis to examine the channels downstream of the proposed treatment areas, particularly in the Middle Beaver Creek Watershed. Downstream of the proposed treatments, the topography becomes less steep and many of the seasonal channels tend to be low gradient and poorly defined. As of April 2015, few impacts from the flows of the previous winter were seen. The channels are predominately stable. Where they go through meadows, the grasses are growing back, further adding to bank stability. Given BMPs, IDFs for the treatments and the low gradient of the channels downstream of the Project area, it is unlikely that the Project would impact downstream beneficial uses.

**Table 10 - ERA changes and modeled recovery risk from adverse CWEs over time for Alternative 1**

| HUC-12 Watershed | 2015 ERA | 2020 ERA | 2025 ERA |
|---|---|---|---|
| **Bald Mountain Reservoir** (Risk of CWE) | **6** (Low) | **4** (Low) | **2** (Low) |
| **Lower Beaver Creek** (Risk of CWE) | **17** (High) | **11** (Moderate) | **5** (Low) |
| **Middle Beaver Creek** (Risk of CWE) | **26** (Very High) | **19** (Very High) | **7** (Low) |
| **Negro Camp Gulch** (Risk of CWE) | **35** (Very High) | **26** (Very High) | **10** (Moderate) |
| **Upper Beaver Creek** (Risk of CWE) | **18** (Very High) | **14** (Moderate) | **7** (Low) |

Over the next ten years, as the area revegetates, the effects of both the fire and Projects would go down, as does the modeled risk of adverse CWEs. Within ten years, both Middle Beaver Creek and Upper Beaver Creek Watersheds are modeled to be at low risk of adverse CWEs.

## ALTERNATIVE 2

Alternative 2 is the present existing condition. There are no additional adverse CWEs from the Project, as seen in Table 11. Trees would be dropped under road maintenance agreements already in effect and left in place. Some of the watersheds are modeled to be at high to very high risk of adverse CWEs in 2015 due to effects of the fire, as shown in Table 12 below.

As vegetation grows, the effects from the fire would decrease and within ten years the modeled risk of adverse CWEs are low for all watersheds (Table 12). As with Alternative 1, it would be expected that the true risk would be low within a few years, as the area is revegetated and groundcover is in place to protect the soils.

**Table 11 - Prefire ERA, the ERA from the Bald Fire, the Addition of Alternative 2, and the total ERA**

| HUC-12 Watershed | ERA Threshold | ERA Before Fire | Fire ERA | Alternative 2 ERA | Combined ERA after Alternative 2 |
|---|---|---|---|---|---|
| **Bald Mountain Reservoir** | 18 | 3 | 3 | 0 | 6 |
| **Lower Beaver Creek** | 18 | 5 | 8 | 0 | 13 |
| **Middle Beaver Creek** | 18 | 2 | 18 | 0 | 20 |
| **Negro Camp Gulch** | 18 | 5 | 23 | 0 | 28 |
| **Upper Beaver Creek** | 18 | 6 | 8 | 0 | 13 |

**Table 12 - ERA changes and recovery risk from adverse CWEs over time for Alternative 2**

| HUC-12 Watershed | 2015 ERA | 2020 ERA | 2025 ERA |
|---|---|---|---|
| **Bald Mountain Reservoir** (Risk of CWE) | **6** (Low) | **4** (Low) | **2** (Low) |
| **Lower Beaver Creek** (Risk of CWE) | **13** (Moderate) | **8** (Moderate | **3** (Low) |
| **Middle Beaver Creek** (Risk of CWE) | **20** (Very High) | **14** (High) | **4** (Low) |
| **Negro Camp Gulch** (Risk of CWE) | **28** (Very High) | **21** (Very High) | **7** (Low) |
| **Upper Beaver Creek** (Risk of CWE) | **13** (Moderate) | **9** (Moderate) | **4** (Low) |

## ALTERNATIVE 3

This alternative has risk ratings between those of Alternative 1 and Alternative 2 because there are fewer treatment acres than Alternative 1. The treatments are along the roads and railroad grades. This alternative has minimal impact on channels as all mechanical treatments in RCAs occur from road prism.

**Table 13 - Prefire ERA, the ERA from the Bald fire, the addition of Alternative 3, and the total ERA**

| HUC-12 Watershed | ERA Threshold | ERA Before Fire | Fire ERA | Alternative 3 ERA | Cumulative ERA |
|---|---|---|---|---|---|
| **Bald Mountain Reservoir** | 18 | 3 | 3 | <1 | 6 |
| **Lower Beaver Creek** | 18 | 5 | 8 | 3 | 16 |
| **Middle Beaver Creek** | 18 | 2 | 18 | 5 | 25 |
| **Negro Camp Gulch** | 18 | 5 | 23 | 5 | 33 |
| **Upper Beaver Creek** | 18 | 6 | 8 | 2 | 15 |

**Table 14 - ERA changes and recovery risk from CWE over time for Alternative 3**

| HUC-12 Watershed | 2015 ERA | 2020 ERA | 2025 ERA |
|---|---|---|---|
| **Bald Mountain Reservoir** (Risk of CWE) | **6** (Low) | **4** (Low) | **2** (Low) |
| **Lower Beaver Creek** (Risk of CWE) | **16** (High) | **10** (Moderate) | **4** (Low) |
| **Middle Beaver Creek** (Risk of CWE) | **25** (Very High) | **18** (Very High) | **6** (Low) |
| **Negro Camp Gulch** (Risk of CWE) | **33** (Very High) | **25** (Very High) | **10** (Moderate) |
| **Upper Beaver Creek** (Risk of CWE) | **13** (High) | **11** (Moderate) | **5** (Low) |

## INTERNALLY DRAINED WATERSHEDS

While the ERA numbers are lower for Alternative 3 than for Alternative 1 (Table 13), as far as modeled risk ratings are concerned, there are no differences (Table 14). As with Alternative 1, the watersheds modeled to be at high risk are the ones that had the most acres burn in the fire. Within ten years, the Middle Beaver Creek Watershed's modeled risk of adverse CWEs drops to low and the Negro Camp Gulch's drops to moderate As with the other alternatives, within ten years, Negro Camp Gulch would be revegetated and despite the modeled risk of moderate, would in reality likely be at low risk of CWE.

See Alternative 1 for further discussion of CWEs.

## EXTERNALLY DRAINED WATERSHEDS

The only watershed with a different risk rating than Alternative 1 is Upper Beaver Creek, which is rated as very high risk under Alternative 1 and rated high under Alternative 3. As the activities within RCAs require that equipment stay on roads, the project is unlikely to contribute to CWE in any measurable way. As with the other alternatives, within 10 years, the area would revegetate and risks of effects would be low for these watersheds.

## FOREST PLAN AMENDMENT

The Lassen Land and Resource Management Plan (LRMP) directs the Forest to adjust project impacts and/or timing to keep disturbance below the appropriate threshold of concern (TOC) in all affected subbasins and watersheds (LNF LRMP, pg 4-32 (22 b (4)). With implementation of either of the action alternatives, some watersheds would be over the TOC. A non-significant site-specific Forest plan amendment would be necessary to meet management direction. Alternative 1 and Alternative 3 are consistent with all other management direction concerning soils, fisheries, and hydrology.

## SUMMARY OF EFFECTS

While the ERA model shows a high risk of negative cumulative effects in some watersheds, implementation of the Bald Project would not be expected to adversely affect hydrologic function because of the reasons listed below

- IDFs are in place along all channels to buffer the channel from project activities.
- Beaver Creek, the only perennial stream in the project area, would have no mechanical treatments and less than 20 acres of hand treatments within 300 feet of the channel.
- Three of the five watersheds do not have a surficial connection with channels downstream but are internally drained and can have no effect to beneficial uses downstream
- Additional groundcover would be left on bare soils within RCAs where project activities occur, to help stabilize soils and reduce erosion,
- Within units, additional groundcover is left following activities that lowers erosion rates for the soils within units

Items not accounted for within the ERA model include:

- BAER work to stormproofing roads post-fire and replaced undersized culverts.
- Under Alternative 1, road maintenance to improve roads and to meet BMPs would occur

# MONITORING RECOMMENDATIONS

Annual monitoring is done on projects throughout the Forest at randomly selected sites to determine if BMPs have been effective. Because the Negro Gulch and Middle Beaver Creek subwatersheds are over threshold, additional monitoring beyond effectiveness monitoring would be required by the Central Valley Regional Water Quality Control Board. These forensic monitoring inspections would be conducted during the winter period and are designed to detect potentially significant sources of pollution such as failed management measures. The goal of winter forensic monitoring is to locate sources of sediment production in a timely manner so that rapid corrective action may be taken where feasible and appropriate (CVRWQCB, 2014).

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# APPENDICIES

## APPENDIX A: APPLICABLE BEST MANAGEMENT PRACTICES

USDA Forest Service. 2011. Water Quality Management Handbook: Best Management Practices. R5 FSH 2509.22 Chapter 10, Southwest Region, 261p.

**BMP 1.1 Timber Sale Planning Process**

*Objective*: To incorporate water quality and hydrologic considerations into the timber sale planning process.

*Implementation*: Maintenance of RCA areas and a 10-foot "no mechanical equipment" buffer zone for protection of water quality and riparian ecosystems.

**BMP 1.2 Timber Harvest Unit Design**

*Objective*: To ensure that timber harvest unit design will secure favorable conditions of water quality and quantity while maintaining desirable stream channel characteristics and watershed conditions. The design should consider the size and distribution of natural structures (snag and down logs) as a means of preventing erosion and sedimentation.

*Implementation*: No entry into Lassen LRMP buffers by equipment unless specified for RCA improvement. Group thinning/timber units will minimize landings.

**BMP 1.3 Determining Surface Erosion Hazard for Timber Harvest Unit Design**

*Objective*: To identify high erosion hazard areas in order to adjust treatment measures to prevent downstream water quality degradation.

*Implementation*: Review of soil input has identified most areas to be of low to moderate erosion hazard. Operation of mechanical treatments will be limited to slopes less than 35 percent and follow guidelines for maintaining ground cover.

**BMP 1.4 Using Sale Area Maps (SAM) and/or Project Maps for Designating Water Quality Protection Needs.**

*Objective*: To ensure recognition and protection of areas related to water quality protection delineated on a SAM or Project Map.

*Implementation*: The IDT will identify and delineate streams, RCAs and other features on maps, as part of the environmental documentation process. They will be included on the SAM at the time of contract preparation. The SA and the purchaser will review these areas on the ground prior to the commencement of harvesting.

**BMP 1.5 Limiting the Operating Period of Timber Sale Activities.**

*Objective*: To ensure that the purchasers conduct their operations, including erosion control work, road maintenance, and so forth, in a timely manner, within the time specified in the timber sale contract.

*Implementation*: The IDT will identify and recommend limited operating periods such as operating when soils are dry to a depth of 12 inches in RCAs that are within the Lahontan WQCB region, and 10 inches in the Central Valley WQCB region.

**BMP 1.8 Streamside Management Zone Designation**

*Objective*: To designate a zone along riparian areas, streams and wetlands that will minimize potential for adverse effects from adjacent management activities. Management activities within these zones are designed to improve riparian values.

*Implementation*: Identification of buffers (indicated in BMP 1.4) and identification of RCAs for the project area with the interdisciplinary team.

**BMP 1.10 Tractor Skidding Design**

*Objective*: By designing skidding patterns to best fit the terrain, the volume, velocity, concentration and direction of runoff, water can be controlled in a manner that will minimize erosion and sedimentation.

*Implementation*: The SA may work with the operator to minimize skid trail density.

**BMP 1.12 Log Landing Location**

*Objective*: To locate new landings or reuse old landings in such a way as to avoid watershed impacts and associated water quality degradation.

*Implementation*: No new landing within the RCA or in meadows will be created. Existing landings will not be utilized if they are within RCAs.

**BMP 1.13 Erosion Prevention and Control Measures During Timber Sale Operations**

*Objectives*: To ensure that the purchasers operations will be conducted reasonably to minimize soil erosion.

*Implementation*: Equipment will not be operated when ground conditions are such that excessive damage will result. Erosion control measures will be maintained.

**BMP 1.16 Log Landing Erosion Control**

*Objective*: To reduce the impacts of erosion and subsequent sedimentation associated with log landings by use of mitigating measures.

*Implementation*: Include proper drainage on landings.

**BMP 1.17 Erosion Control on Skid Trails**

*Objective*: To protect water quality by minimizing erosion and sediment derived from skid trails.

*Implementation*: Ensure that no more than 15% of the activity area has compacted skid trails.

**BMP 1.18 Meadow Protection During Timber Harvesting**

*Objective*: To avoid damage to the ground cover, soil and the hydrologic function of meadows.

*Implementation*: Maintain RCA buffer widths as identified under Lassen LRMP guidelines. Consult with Forest Soil Scientist/Hydrologist for any areas that appear ambiguous. Ensure that Riparian conservation objectives are followed.

**BMP 1.19 Stream course and Aquatic Protection**

*Objectives*:

1. To conduct management actions within these areas in a manner that maintains or improves riparian and aquatic values.
2. To provide unobstructed passage of storm flows
3. To control sediment and other pollutants from entering stream courses.
4. To restore the natural course of any stream as soon as practicable, where diversion of the stream has resulted from timber management activities.

*Implementation*: RCA widths are to be established and equipment/operations are to be excluded from the area unless authorized for RCA improvement. In unforeseen areas where skid trails, landings, or roads intersect and/or divert any natural drainage feature, the natural course of that drainage should be restored.

**BMP 1.20 Erosion Control Structure Maintenance**

*Objective*: To ensure that constructed erosion control structures are stabilized and working.

*Implementation*: Field review of necessary erosion control structures immediately after construction. Follow-up visits are to occur to ensure that the structures are functional over time.

**BMP 1.21 Acceptance of Timber Sale Erosion Control Measures Before Sale Closure**

*Objective*: To ensure the adequacy of required erosion control work on timber sale.

*Implementation*: The SA will inspect erosion control measures prior to accepting the unit. Coordination for routine inspections should be carried out in association with the Forest Soil Scientist.

**BMP 2.3 Road Construction and Reconstruction**

*Objective*: Minimize erosion and sediment delivery from roads during road construction or reconstruction, and their related activities.

*Implementation*: An approved Erosion Control Plan will be implemented for all disturbed areas including the rock quarry and road management activities. The Forest's wet weather operations standards will be included in the Erosion Control Plan.

**BMP 2.4 Road Maintenance and Operations**

*Objective*: To ensure water quality protection by providing adequate and appropriate maintenance and by controlling road use and operations.

*Implementation*: Work with the Transportation Planner to ensure roadwork is done in a manner to minimize hydrologic connectivity and protect water quality. To ensure proper drainage maintenance will utilize armoring sections of roads with aggregate, outsloping where possible, upgrading culverts, removing unneeded crossings, and constructing and armoring low-water crossings.

**BMP 2.5 Water Source Development and Utilization**

*Objective*: To supply water for road construction, maintenance, dust abatement, fire protection, and other management activities, while protecting and maintaining water quality.

*Implementation*: Measures to protect water source use will be included in the Erosion Control Plan and will include following the Forest's wet weather operations standards and guidelines, and treating road approaches and drafting pads to prevent sediment production and delivery to the waterholes.

**BMP 2.11 Servicing and Refueling of Equipment**

*Objective*: To prevent pollutants such as fuels, lubricants, bitumen and other harmful materials from being discharged into or near rivers, streams and impoundments, or into natural or man-made channels.

*Implementation*: Operators are required to remove all service residues, waste oil and other materials from National Forest land.

**BMP 2.13 Erosion Control Plan**

*Objective*: To limit and mitigate erosion and sedimentation through effective planning prior to initiation of construction activities and through effective contract administration during construction.

*Implementation*: Work with Engineering on erosion control plan for site-specific work.

**BMP 5.1 Soil Disturbing Treatments on the Contour**

*Objective*: To decrease sediment production and stream turbidity while mechanically treating slopes.

*Implementation*: During site preparation ensure that factors such as slope, infiltration rate, and water-holding capacity of the soil are evaluated prior to implementation.

**BMP 5.2 Slope Limitations for Mechanical Equipment Operation**

*Objective*: To reduce gully and sheet erosion and associated sediment production by limiting tractor use.

*Implementation*: Ensure soil cover is approximately 50%. Include the soil scientist for questions and soil cover requirements on a site-specific basis.

**BMP 5.3 Tractor Operation Limitation in Wetlands and Meadows**

*Objective*: To limit turbidity and sediment production resulting from compaction, rutting, runoff concentration, and subsequent erosion by excluding the use of mechanical equipment in wetland and meadows except for the purpose of restoring wetland and meadow function.

*Implementation*: The application of this BMP will be mandatory on all vegetation manipulation projects as prescribed in the environmental document. Mitigation includes maintaining RCA buffers and only allowing mechanized equipment in these areas to meet Riparian conservation objectives.

**BMP 5.6 Soil Moisture Limitations for Mechanical Equipment Operations**

*Objective*: The objective of this measure is to prevent compaction, rutting, and gullying, with resultant sediment production and turbidity.

*Implementation*: Ensure soil conditions are evaluated and soils are not saturated prior to the implementation of management activities. LNF visual indicators, Central Valley RWQCB standards, and Lahontan RWQCB standards will be used in the applicable project areas.

**BMP 5.7 Pesticide Use Planning Process**

*Objective:* To introduce water quality and hydrologic considerations into the pesticide use planning process.

*Implementation:* The IDT will evaluate the project in terms of site response, social and environmental impacts and the intensity of monitoring needed. The responsible line officer will prepare environmental documentation, Project Plan, and the Safety Plan. Project plans and safety plans will specify management direction.

Approval or for proposed pesticide projects will proceed according to direction established in region 5 supplement No. 2100-95-1 to 2150.

**BMP 5.8 Pesticide Application According to Label Directions and Applicable Legal Requirements**

*Objective:* To avoid water contamination by complying with all label instructions and restrictions for use.

*Implementation:* Constraints identified on the label and other legal requirements of application must be incorporated into project plans and contracts.

Both contracted and force account projects will follow label directions on packaging and other legal requirements accordingly.

**BMP 5.9 Pesticide Application Monitoring and Evaluation**

*Objective:* To determine whether pesticides have been applied safely, restricted to intended target areas, and have not resulted in unexpected non-target effects.

*Implementation:* The need for a monitoring plan will be identified during the pesticide use planning process as part of the project environmental evaluation and documentation.

The water quality monitoring plan will specify:

1. Who will be involved and their roles and responsibilities;
2. What parameters will be monitored and analyzed;
3. When and where monitoring will take place;
4. What methodologies will be used for sampling and analysis, and the rationale behind each of the preceding specifications.

A water quality specialist and the project leader will evaluate and interpret the water quality monitoring results in terms of compliance with and adequacy of project specifications.

**BMP 6.1 Fire and Fuel Management Activities**

*Objective*: To reduce public and private losses and environmental impacts which result from wildfires and/or subsequent flooding and erosion by reducing or managing the frequency, intensity and extent of wildfire.

*Implementation*: Fuel treatments will be implemented on a project wide basis to reduce public and private losses and environmental impacts.

**BMP 6.2 Consideration of Water Quality in Formulating Fire Prescriptions**

*Objective*: To provide for water quality protection while achieving the management objectives through the use of prescribed fire.

*Implementation*: The fire prescription will include elements such as fire weather, slope, aspect, soil moisture, and fuel conditions. These elements influence the fire intensity and have a direct effect on whether or not a desired ground cover remains after burning, and a water-repellent layer is formed.

**BMP 6.3 Protection of Water Quality from Prescribed Burning Effects**

*Objective*: To maintain soil productivity, minimize erosion, and minimize ash, sediment, nutrients, and debris from entering water bodies.

*Implementation*: Fuel treatments will meet Riparian conservation objectives and minimize disturbance or riparian ground cover and vegetation. No ignition would occur within RCAs unless otherwise prescribed for RCA improvement. Fire would be allowed to back into the RCAs to achieve low intensity burning. Fire lines would be roads, skid trails, natural barriers, hand lines or machine lines (ATV or tractor).

**BMP 7.3 Protection of Wetlands**

*Objective:* To avoid adverse water quality impacts associated with destruction, disturbance, or modification of wetlands.

*Implementation*: The Forest Supervisor must ensure that all mitigating measures are incorporated into project plans and designs and that the actions maintain the hydrologic and biologic function of the wetlands. All potentially impacted wetlands will be identified on maps as part of project development.

# APPENDIX B: THE EQUIVALENT ROADED AREA (ERA) METHOD AND ITS LIMITATIONS

| Summary |
|---|
| The risk of adverse cumulative watershed effects (CWE) is assessed using the Equivalent Roaded Acre method developed by R5 USFS. In this method, an index is calculated for an entire watershed that expresses most land use in terms of the percent of the watershed covered by roads. Based on the ERA and a threshold of concern (TOC), a given watershed is assigned a relative risk – low, moderate, high, or very high - of adverse CWE. The primary cumulative impact of concern is an increase in sediment delivery to streams and degradation of aquatic habitat. This method is not based on any physical process, and as such has copious limitations that must be understood in order to interpret the results accurately. |
| **Important aspects of the ERA method** |
| Roads, which are considered to have the greatest potential to increase runoff and sediment to streams, are given a value of 1.0. The number of acres of roads in a watershed is divided by the size of the entire watershed (in acres) x 100. This gives the percent of the watershed covered by roads. For each land disturbance activity other than roads, the number of acres is multiplied by a number less than 1.0.<br><br>The result (for each land disturbance activity) is then divided by the number of acres of the entire watershed x 100.<br><br>This gives the percent of the "equivalent roaded acres" in the watershed for each type of land disturbance.<br><br>The values for equivalent roaded acres for all of the land disturbance activities are added together. The final number represents the percent of the watershed that is covered by the 'equivalent' of roads.<br><br>The threshold of concern (TOC) is usually between 12 and 18 percent. That is, when 12 to 18 percent of a watershed is covered by the equivalent of roads, there is a "high risk" that increased peak flows of streams and sediment delivery to streams would occur. This does not mean these effects would occur precisely when the ERA reaches the TOC, or that an increase in peak flows and sediment delivery to streams will automatically result in a degradation of fish habitat or diminish the experience of recreationists. It is merely a warning that cumulative effects might occur. |
| **Assumptions and limitations of the ERA method** |
| ERA modeling is an empirical approach. It is not based on physics, geology, hydrology, or any other physical process. It is a set of equations and numbers that are manipulated until they make useful predictions. High and very high ERA values represent a "yellow-flag" warning, meaning that there is a risk of adverse CWEs occurring. They cannot be used to determine the percent or numerical amount of increase of sediment delivery to streams, stream channel eroded, fish habitat degraded or lost, or any other change in watershed condition. Such quantitative assessments require additional analysis.<br><br>There are many limitations to the method. One of the chief of these is that the location of land disturbance activities within a watershed is not considered. For example, roads near streams are treated exactly the same as roads that are far from streams while, in reality, roads located within or next to riparian areas contribute more sediment to streams than roads in upland areas.<br><br>Other Limitations include:<br><br>• Assumption that all roads are equal. The slope and proximity to water bodies is not factored in.<br>• Changes in slope across the watershed are not considered.<br>• For timber harvest activities, hydrologic recovery is assumed to take thirty years (i.e. ERA contribution is zero thirty years after timber harvest.)<br>• It is assumed that effects do not occur when the disturbance occurs, but in the following year.<br>• Landslides and other forms of mass wasting are not taken into account.<br>• Physical and biological processes in stream channels are not considered.<br>• Precipitation type, timing, and changes across the landscape are ignored. Likewise, snowmelt |

dynamics and timing cannot be addressed.

- Roads are assumed to stay on the landscape in a static state.
- Site specific mitigations and IDFs are not considered.
- Slope stability is not part of the analysis.
- Soil compaction is not considered.
- Soil type and properties are ignored.
- The listed recovery times do not differentiate between variations in vegetation types.
- The method is intended for watersheds between 3,000 and 10,000 acres in size.
- The time lag between disturbance and sediment delivery down slope is ignored.
- The type, amount, and health of waterbodies is not taken into account.
- Vegetation and soil do not necessarily recover at the same rate, as the method assumes.
- "Complementary effects are also excluded, because the method requires identifications of a single impact mechanism" (Reid, 1993).
- "… [ERA] has tenuous linkages between activities in upland areas and in-stream effects." (Menning, Erman, Johnson, & Sessions, 1997)
- "… the evaluation of recovery over time is more linked to the causes of effects than to the effects themselves" (Menning, Erman, Johnson, & Sessions, 1997)

Finally, like all models, the quality of the predictions are contingent on the calibration, "Each National Forest is expected to identify focal concerns and mechanisms and calibrate coefficients for characteristic site types… ERAs are not comparable between areas because the method is customized to address issues relevant to each implementation area." (Reid, 1993)

While calibrations have not been done for the Lassen NF specifically, it was done for the QLG Pilot Project, of which the Lassen NF was a part. Even though the Bald Project area is very different from the granite dominated landscapes of the Sierra Nevada, the ERA coefficients developed for QLG are used. While this allows Bald to remain comparable to projects done on the Lassen under QLG, it does represent an additional limitation on the accuracy of the predictions.

| Risk categories |
| --- |
| Low risk of CWE - ERA is less than 50% of TOC |
| Moderate risk of CWE - ERA is between 50% and 80% of TOC |
| High risk of CWE - ERA is between 80% and 100% of TOC |
| Very high risk of CWE - ERA is greater than TOC |