Sawmill Vegetation Management Project

Environmental Assessment

HYDROLOGY/SOILS SPECIALIST TECHNICAL REPORT

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For:
Lost River Ranger District
Salmon-Challis National Forest

Signature: /s/ David Deschaine

Date: 01/30/2015
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II. Introduction

A. Project Overview

The Lost River Ranger district is proposing to conduct a vegetation management project in the Upper Sawmill subwatershed (170402170201). This project implements the Forest Service 2011 Regional and Washington Office goal of restoring and sustaining the Nation’s forests and grasslands by: 1) reducing the risk to communities and resources to wildfire, 2) reducing the adverse impacts from invasive and native species, pests, and diseases, and 3) restoring and maintaining healthy watersheds and diverse habitats. Collaboration with Custer County has identified Sawmill Canyon as an area of concern and has identified the need for projects in the Custer County, Idaho Wildland/Urban Interface Fire Mitigation Plan.

The project area is composed of several mixed conifers and aspen stands broken by areas of sagebrush/grass and is currently experiencing and hosting epidemic outbreaks of Mountain Pine Beetle (MPB) and Spruce Budworm (SBW). MPB outbreaks have resulted in high levels of mortality in lodgepole, whitebark and limber pine and will continue until available food reserves are diminished (trees smaller than 5” dbh). SBW defoliation of Douglas-fir, Engleman spruce, and subalpine fir started approximately four years ago in the Sawmill Canyon area and is continuing to present day. Annual flights by FHP have monitored the progressive infestation and defoliation with aerial detection surveys in Sawmill Canyon. From those surveys, they anticipate that forest insect and disease in this area will continue for many more years. As a result of high levels of repeated defoliation, other concerns have come to light, as mature Douglas-fir in their weaken state are succumbing to a secondary infestation agent, the Douglas-fir beetle (DFB).

The Upper Sawmill Creek subwatershed has been identified by the SCNF as a Class II (functioning at risk) subwatershed using the Forest Service Watershed Condition Classification. Upper Sawmill was chosen as the priority for watershed restoration work in 2012 and 2013 on the South Zone of the Forest. Sawmill Creek is a listed 303(d) stream. This area receives a large amount of visitation during the summer months into the fall from the recreating public, principally from the eastern Idaho Area. Sawmill Canyon provides opportunities for dispersed and non-dispersed camping, fishing, hunting, prospecting, fuelwood gathering, and miles of ATV trails for the recreating public to enjoy. Sawmill Canyon also has two private in-holdings and three administrative sites (Timber and Mill Creek Campground and Fairview Guard Station) with numerous trailheads located in the drainage. Access in and out of Sawmill Canyon is limited for passenger vehicles to Forest Service Road #4010. The area has been designated for full fire suppression by the Fire staff of the Salmon-Challis National Forest. Large stand replacing fires have occurred in the past, including the 6,246 acre Little Lost Fire in 1988 and the Warm Creek Fire that burned 6,393 acres of which half was in the Little Lost River watershed.

This report was prepared to provide an analysis of available baseline data and evaluate effects on soils, hydrology and water quality from the proposed action and alternatives within the Sawmill Vegetation Management Project Hydrology Analysis Area which includes the Upper Sawmill (170402170201) subwatershed. The purpose of this report is to provide detailed data and analysis to support the NEPA
decision making process for this project. Section IV A of this report describes current conditions and Section IV B analyzes potential impacts that would be associated with the proposed activities.

B. Description of Alternatives
The following hazardous fuels treatments and associated opportunities have been preliminarily identified by the Forest Service for this project through extensive discussions, field surveys, fuel and vegetation modeling, focused site visits.

1. Alternative 1- No Action
Under HFRA, Title 1, Section 102(4), for Threats to Ecosystem, a No-Action alternative is required. The No Action alternative, as HFRA states, “.... should evaluate the effects of failing to implement the project.” This evaluation should allow an assessment of the short and long-term effects of failing to implement the project in the event the court is asked to consider requests for an injunction”. In this context changes in forest structure in the project area have significantly increased the potential for uncharacteristic fire behavior. A landscape scale (stand-replacing wildland fire during summer drought and extreme weather conditions with lethal fire severity to 50 percent of forested and riparian ecosystems) is a plausible event as a consequence of not implementing hazardous fuels reduction activities. This is the context for which “No Action with Wildfire” needs to be evaluated for the Sawmill Canyon Vegetation Management HFRA project.

2. Alternative 2- Proposed Action

a) Mechanical Treatments
The proposed action is expected to change current stand structure to make those stands more resilient to current insect epidemic by changing density, structure, and potential ladder fuels, and surface fuels while also reestablishing aspen in the drainage on 420 acres. Activities include pre-commercial and commercial thinning of stands addressing large scale mortality as a result of insect and disease activity using sanitation and salvage harvest activities. Tractor based logging systems using timber sale contract(s) on over 326 acres would be used to thin live trees and to remove dead and dying trees from the stands of mixed conifers. Tree density after thinning in the treatments units would be 15 feet to 25 feet between stems (150-175 trees/acre) with volume removals roughly estimated to be 3,500 hundred cubic feet (CCF). When aspen is present all encroaching conifers within 100 feet of live aspens will be removed to promote regeneration. After harvest, timber stand improvement (TSI) treatments would be applied to pockets of thick understory and remaining trees that act as ladder fuels. Of the 450 acres to be treated, 94 acres are lodgepole pine plantations that will be thinned to 15 feet by 15 feet spacing and pruned to 6 feet above ground surface which will decrease potential for crown fire and the transition of ground fire to a crown fire. No tree cutting, sale or removal would occur in Idaho Roadless Areas (Lemhi Range IRA #06-093). INFISH guidelines will be followed for all mechanical harvest units. No treatments are planned in Intermountain Region defined “Old Growth” stands. A detailed summary of proposed vegetation treatment by silviculture treatment is described in Table 1 - Description of Vegetation Treatments.
Table 1 - Description of Vegetation Treatments in the Proposed Action.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Number of Units (Acres) Unit Designation</th>
<th>Treatment Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Commercial Thinning</td>
<td>18 (94 acres) Units A-R</td>
<td>Reduce tree stocking to allow selected residual trees to grow more vigorously. Residual stand will be spaced 15 feet by 15 feet leaving approximately 200 trees per acre. Remove lower limbs of residual trees to 6’ from ground surface or if tree is less than 12 feet tall only half the limbs will be removed (example 11 foot tree, only remove bottom 5 feet). Lop and scatter dropped trees. Retain 7 to 13 tons of slash/acre for long-term site productivity. If activity exceeds 13 tons/acre a follow up treatment will be implemented to address excess. No activities would occur within the RHCA’s as defined by INFISH which are 300 feet for fish bearing streams, 150 feet for non-fish bearing streams, or within 100 feet of spring, lakes, or wet areas. Implement recreation specialist’s no cut tree buffer recommendations along travel corridors. Treatment will be limited to chainsaw only. All whitebark/limber pine saplings or mature trees will be left if discovered during thinning activity.</td>
</tr>
<tr>
<td>Commercial Thinning with Aspen Release</td>
<td>2 (77 acres) Units 1AR and 2AR</td>
<td>Reduce tree stocking to allow selected residual trees to grow vigorously which will improve tree resistance to disturbance agents. Where live aspen cohorts exist, all conifers within 100 feet will be removed. Between the live aspen stands residual leave trees will be marked with variable tree spacing. Trees will be left in “clumps’ of 2 to 7 trees with 15 feet bole spacing or 5 to 10 feet crown spacing. Distance between clumps will be variable from 30 to 50 feet with an objective to retain approximately 150 to 175 trees per acre across the treatment units. Post-harvest weeding and release of residual stand may be implemented where needed. All large non-marketable, “wolfy” Douglas-fir trees (large diameter trees with crowns that are fading and flattening, and have visible evidence of interior heart rot) will be left as well as any Douglas-fir greater than or equal to 18” dbh excluding the aspen daylight areas. Harvest will be limited to Lodgepole pine and Douglas-fir tree species. If other species are present exclude them from harvest activities. All snags that do not pose a safety hazard during logging operations would be</td>
</tr>
</tbody>
</table>
retained in the stand. Place landings where practical adjacent to aspen clones to promote disturbance and regeneration. During harvest operations place landings, skid trails, and temporary roads to avoid areas that contain large trees. Location of routes will consider visual concerns, minimize disturbance to the largest trees present, and minimize soil stability/sedimentation. Implement whole tree yarding to minimize visuals impacts. Angle temporary roads away from main road to reduce visual impacts. Layout of unit boundaries will meet all INFISH guidelines and employ no cut buffers along travel corridors as recommended by recreation specialists. The treatment will require the following construction activities:

- The construction of 1,100’ of temporary roads into interior landings
- The opening of 1,200’ of currently closed road
- The construction of 20,125’ of skid trails
- The construction of five 100’ by 100’ clearings for landings
- The construction of 17,500’ of jack pole fence to deter livestock use of aspen regeneration in Unit 1AR and 2AR
- Placement of educational interpretive sign across from Timber Creek campground explaining what treatment methods are being employed to address insect agents in Sawmill Canyon.

The following post-harvest activities will occur:

- Post-harvest treatments for noxious weeds for a period of up to five years after sale closure
- Post-harvest treatments to cut damaged and diseased Douglas-fir and lodgepole pine

Once activities are completed all landings, roads, and skid trails will be ripped and seeded.

| Commercial Thinning | 2 (29 acres) 1CT and 2CT | Reduce tree stocking to allow selected residual trees to grow vigorously which will improve tree resistance to disturbance agents. Residual trees will be left in “clumps” of 2 to 7 trees with 15 feet bole spacing or 5 to 10 feet crown spacing. Distance between clumps will be variable from 30 to 50 feet with an objective to retain approximately 150 to 175 trees per acre across the treatment units. All large non-marketable, “wolffy” Douglas-fir trees will |
be left as well as any Douglas-fir greater than or equal to 18” dbh. Only remove Lodgepole pine and Douglas-fir tree species. If other species are present exclude from harvest activities. All snags that do not pose a safety hazard during logging operation would be retained in the stand. During harvest operations place landings, skid trails, and temporary roads to avoid areas that contain large trees. Location of routes will consider visual concerns, minimize disturbance to the largest trees present, and minimize soil stability/sedimentation. This treatment will create a single story stand of the healthiest and largest diameter trees. Layout of unit boundaries will meet all INFISH guidelines. The treatment will require the following construction activities:

- The opening of 2,275’ of currently closed road
- The construction of 7,700’ of skid trails
- The construction of two 100’ by 100’ clearings for landings

The following post-harvest activities will occur:

- Post-harvest treatments for noxious weeds for a period of up to five years after sale closure
- Post-harvest treatments to cut damaged and diseased Douglas-fir and lodgepole pine.

Once activities are completed all landings, roads, and skid trails will be ripped and seeded.

<table>
<thead>
<tr>
<th>Overstory Removal</th>
<th>1 (106 acres) 1 OSR</th>
</tr>
</thead>
</table>
| Remove the large mature overstory trees and release the understory. All large non-marketable, “wolffy” Douglas-fir trees will be left as well as any Douglas-fir greater than equal to 16” dbh and subalpine fir greater than or equal to 8” dbh. Only remove Lodgepole pine and Douglas-fir tree species. If other species are present exclude from harvest activities. All snags that do not pose a safety hazard during logging operation would be retained in the stand. During harvest operations place landings, skid trails, and temporary roads to avoid areas that contain large trees. Location of routes will consider visual concerns, minimize disturbance to the largest trees present, and minimize soil stability/sedimentation. Following harvest, the residual conifer stand would have a 15’ by 15’ spacing resulting in leaving 150 to 175 trees per
acre. Layout of unit boundaries will meet all INFISH guidelines. The treatment will require the following construction activities:

- The opening of 1,800’ of currently closed road
- The construction of 36,000’ of skid trails
- The construction of six 100’ by 100’ clearings for landings

The following post-harvest activities will occur:

- Post-harvest treatments for noxious weeds for a period of up to five years after sale closure
- *Post-harvest treatments to cut damaged and diseased subalpine fir less than 8” dbh, Douglas-fir and lodgepole pine*

Once activities are completed all landings, roads, and skid trails will be ripped and seeded.

| Sanitation/Salvage | 5 (81 acres) | Remove trees killed by bark beetles (Douglas-fir beetle and mountain pine beetle) or trees infected with mistletoe or other diseases agents. Remaining trees will be spaced on a 15 to 25 feet stem spacing leaving approximately 150 to 175 trees per acre. Preferential leave trees would be healthiest and largest in diameter to provide future seed. All large diameter nonmarketable “wolffy” Douglas-fir trees will be retained as well as any Douglas-fir or subalpine fir greater than or equal to 18” dbh excluding daylight thinning areas if aspen is present. Only remove subalpine fire, Lodgepole pine and Douglas-fir tree species. Exclude Engelmann spruce, whitebark and limber pine from harvest if present. All snags that do not pose a safety hazard during logging operation would be retained in the stand. During harvest operations place landings, skid trails, and temporary roads to avoid areas that contain large trees. Location of routes will consider visual concerns, minimize disturbance to the largest trees present, and minimize soil stability/sedimentation. Layout of unit boundaries will meet all INFISH guidelines. The treatment will require the following construction activities:
- The re-opening and subsequent closing of the closed un-numbered road off the Red Rock Road for 300’ and the construction of 2,500’ of temporary road in place of Trail 4337
- The construction of 2,250’ of temporary | 1S, 2S, 3S, and 7S | trails. Location of routes will consider visual concerns, minimize disturbance to the largest trees present, and minimize soil stability/sedimentation. Layout of unit boundaries will meet all INFISH guidelines. The treatment will require the following construction activities:
- The re-opening and subsequent closing of the closed un-numbered road off the Red Rock Road for 300’ and the construction of 2,500’ of temporary road in place of Trail 4337
- The construction of 2,250’ of temporary |
The construction of 18,800’ of skid trail
- The construction of eight 100’ by 100’ clearings for landings
- The re-contouring of 100’ of existing constructed temporary road in place of Trail 4337 and the re-contouring of 600’ of an un-numbered road off of road #40458 leading to Unit 7S once the logging is completed
- The re-contouring of 2,250’ of temporary road once logging is completed

The following post-harvest activities will occur:
- Post-harvest treatments for noxious weeds for a period of up to five years after sale closure
- Post-harvest treatments to cut damaged and diseased subalpine fir, Douglas-fir and lodgepole pine

Once activities are completed all landings, roads, and skid trails will be ripped and seeded.

Group Selection  | 2 (33 acres) 1GS and 3P
--- | ---
Remove all live/dead post and pole material and all dead lodgepole pine trees while retaining live non post and pole size trees. End results would be clumps of mature trees intermixed with saplings that do not meet post and pole standards. Designated material for removal will be strictly lodgepole pine; all other tree species will be retained. For 1GS this unit will be offered for personal use post and pole gathering until all the easily retrieved material is removed, lasting approximately 5 years maximum. After this time period the timber staff will evaluate remaining material, and if needed, offer up remaining material to commercial purchaser to finish up. For 3P this unit will be offered as a commercial sale. Layout of unit boundaries will meet all INFISH guidelines and employ no cut buffers along travel corridors as recommended by recreation specialists. The treatment will require the following construction activities:
- The construction of 5,700’ of temporary road (3,300’ of temporary road over Trail #4109 and 2,400’ over the un-numbered road that exits road #40458 leading into Unit (1GS)
- The construction of 7,200’ of skid trail
• The construction of two 100’ by 100’ clearings for landings
• The re-closing of Trail #4109 back to the original trailhead once logging is completed
• The ripping and seeding of non-slope portions of the un-numbered road leading into 1GS and 7S post-harvest

The following post-harvest activities will occur:
• Post-harvest treatments for noxious weeds for a period of up to five years after sale closure
• Post-harvest treatments to cut damaged and diseased conifers

Once activities are completed all landings, roads, and skid trails will be ripped and seeded.

### b) Roads

Under the Proposed Action alternative harvest activities will require re-opening four closed road prisms and building 0.7 miles of temporary road for access. Following harvest activities, the four reopened roads will reclosed to their be returned to their original state as well as the temporary roads that are needed for access. In addition, ten segments of roads representing approximately five miles that are no longer needed for future harvest activities will be decommissioned as well as the removal of two culverts on Red Rock Creek as shown in Table 2 - Proposed road decommissioning in Sawmill Canyon for Proposed Action Alternative. Haul travel routes would occur over the Red Rock Road #40460, Camp Creek Road #40104, Timber Creek Road #40105, and Sawmill Canyon Road #40101. Pre-haul, haul and post-haul maintenance on routes would be conducted, including surface blading, slough removal, tree limbing, as well as culvert and ditch cleaning.

**Table 2 - Proposed road decommissioning in Sawmill Canyon**

<table>
<thead>
<tr>
<th>Route Name</th>
<th>Decommissioning Technique</th>
<th>Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>40455</td>
<td>Rip and Seed</td>
<td>.31</td>
</tr>
<tr>
<td>40456</td>
<td>Rip and Seed</td>
<td>.16</td>
</tr>
<tr>
<td>40457</td>
<td>Block Entrance</td>
<td>.26</td>
</tr>
<tr>
<td>40458</td>
<td>Full Bench Obliteration</td>
<td>.82</td>
</tr>
<tr>
<td>40459-A</td>
<td>Remove culvert, obliterate first section of road</td>
<td>.19</td>
</tr>
<tr>
<td>40459-A</td>
<td>Rip and Seed</td>
<td>.10</td>
</tr>
<tr>
<td>40460</td>
<td>Remove culvert, obliterate first section of road</td>
<td>.48</td>
</tr>
<tr>
<td>40460-B</td>
<td>Rip and Seed (North Section that connects to 40460)</td>
<td>.39</td>
</tr>
<tr>
<td>40460-B</td>
<td>Full Bench Obliteration first 200 feet (South Section connecting to 40104)</td>
<td>.04</td>
</tr>
<tr>
<td>40470</td>
<td>Located in Unit 1OSR, rip and seed</td>
<td>.15</td>
</tr>
</tbody>
</table>
c) Slash Treatments

Approximately 7 to 13 tons per acre of slash would be retained within the timber sale treatment units in order to maintain soil organic material and long-term site productivity as recommend for Douglas-fir and lodgepole forest types (USDA Forest Service, Intermountain Research Station, September, 1994). The slash created during mechanical thinning in excess of these amounts would be treated either by piling and burning at the landing or at other locations where machine or hand piles were created within the units. Approximately 7 to 13 tons per acre of slash will be retained within the pre-commercial thinning units as well to provide additional soil organic material by limbing and scattering felled trees. No additional treatment to dispose of excess slash is required on the pre-commercial units because of current existing fuel loading.

3. Alternative 3- Helicopter Logging

This second action alternative also addresses changing current stand structure, making stands more resilient to current insect epidemic. It would change density, structure, potential ladder fuels, and surface fuels while also reestablishing aspen in the drainage on 401 acres. Harvesting using helicopter would be used on treatment where removal of material is required to meet objectives. Pre-commercial thinning and road closure would occur as proposed in Alternative 2 with some adjustments to closing those roads associated with actual harvest. Larger landing and fueling locations would be designated as near as possible to treatment units, though less in number than ground based systems. The need for skid trails and reopening of closed forest roads or construction of temporary roads to access units would not be required. Table X describes the helicopter logging treatments.

Table 3- Description of Proposed Activities in the Helicopter Logging Alternative.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Number of Units (Acres)</th>
<th>Method</th>
<th>Treatment Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Commercial Thinning</td>
<td>18 (94 acres)</td>
<td>Force Account or Contract (Ground base using chainsaws)</td>
<td>Reduce tree stocking to allow selected residual trees to grow more vigorously. Residual stands will be spaced 15 feet by 15 feet leaving approximately 200 trees per acre. Remove lower limbs of residual trees to 6′ from ground surface or if tree is less than 12 feet tall only half the limbs</td>
</tr>
</tbody>
</table>
will be removed (example 11 feet tree, only remove bottom 5 feet). Lop and scatter dropped trees. Retain 7 to 13 tons of slash/acre for long-term site productivity. If activity exceeds 13 tons/acre a follow up treatment will be implemented to address excess. No activities would occur within the RHCA’s as defined by INFISH which are 300 feet for fish bearing streams, 150 feet for non-fish bearing streams, or within 100 feet of spring, lakes, or wet areas. Implement recreation specialist’s no cut tree buffer recommendations along travel corridors. Treatment will be limited to chainsaw only. All whitebark/limber pine saplings or mature trees will be left if discovered during thinning activity.

<table>
<thead>
<tr>
<th>Commercial Thinning with Aspen Release</th>
<th>2 (77 acres) Units 1AR and 2AR</th>
<th>Helicopter Log</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reduce tree stocking to allow selected residual trees to grow vigorously which will improve tree resistance to disturbance agents. Where live aspen cohorts exist, all conifers within 100 feet will be removed. Between the live aspen stands residual leave trees will be marked with variable tree spacing. Trees will be left in “clumps’ of 2 to 7 trees with 15 feet bole spacing or 5 to 10 feet crown spacing. Distance between clumps will be variable from 30 to 50 feet with an objective to retain approximately 150 to 175 trees per acre across the treatment units. Post-harvest weeding and release of residual stand may be implemented where needed. All large non-marketable, “wolfy” Douglas-fir trees (large diameter trees with crowns that are fading and flattening, and have visible evidence of interior heart rot) will be left as well as any Douglas-fir greater than or equal to 18” dbh excluding the aspen daylight areas. Harvest will be limited to lodgepole pine and Douglas-fir tree species. If other species are present exclude them from harvest activities. All snags that do not pose a safety hazard during logging operations would be</td>
<td></td>
</tr>
</tbody>
</table>
retained in the stand. Layout of unit boundaries will meet all INFISH guidelines and employ no cut buffers along travel corridors as recommended by recreation specialists. The following post-harvest activities will occur:

- The construction of 17,500’ of jack pole fence to deter livestock use of aspen regeneration in Unit 1AR and 2AR
- Placement of educational interpretive sign across from Timber Creek campground explaining what treatment methods is being employed to address insect agents in Sawmill Canyon.
- Post-harvest treatments to cut damaged and diseased Douglas-fir and lodgepole pine

| Commercial Thinning | 2 (29 acres) 1CT and 2CT | Helicopter Log | Reduce tree stocking to allow selected residual trees to grow vigorously which will improve tree resistance to disturbance agents. Residual trees will be left in “clumps’ of 2 to 7 trees with 15 feet bole spacing or 5 to 10 feet crown spacing. Distance between clumps will be variable from 30 to 50 feet with an objective to retain approximately 150 to 175 trees per acre across the treatment units. All large non-marketable, “wolfy” Douglas-fir trees will be left as well as any Douglas-fir greater than or equal to 18” dbh. Only remove lodgepole pine and Douglas-fir tree species. If other species are present exclude from harvest activities. All snags that do not pose a safety hazard during logging operation would be retained in the stand. This treatment will create a single story stand of the healthiest and largest diameter trees. Layout of unit boundaries will meet all INFISH guidelines. The following post-harvest activities will occur:
- Post-harvest treatments to cut damaged and diseased Douglas-
Overstory Removal  | 1 (106 acres)  1 OSR | Helicopter Log  | Remove the large mature overstory trees and release the understory. All large non-marketable, “wolfy” Douglas-fir trees will be left as well as any Douglas-fir greater than or equal to 16” dbh and subalpine fir greater than or equal to 8” dbh. Limit harvest to lodgepole pine and Douglas-fir tree species. If other species are present exclude from harvest activities. All snags that do not pose a safety hazard during logging operation would be retained in the stand. Following harvest; the residual conifer stand would have a 15’ by 15’ spacing resulting in leaving 150 to 175 trees per acre. Layout of unit boundaries will meet all INFISH guidelines. The following post-harvest activities will occur:
- Post-harvest treatments to cut damaged and diseased subalpine fir less than 8” dbh, Douglas-fir and lodgepole pine.

Sanitation/Salvage  | 5 (81 acres) 1S, 2S, 3S, and 7S | Helicopter Log  | Remove trees killed by bark beetles (Douglas-fir beetle and mountain pine beetle) or trees infected with mistletoe or other diseases agents. Remaining trees will be spaced on a 15 to 25 feet stem spacing leaving approximately 150 to 175 trees per acre. Preferential leave trees would be healthiest and largest in diameter to provide future seed. All large diameter nonmarketable “wolfy” Douglas-fir trees will be retained as well as any Douglas-fir or subalpine fir greater than or equal to 18” dbh excluding daylight thinning areas if aspen is present. Only remove subalpine fir, lodgepole pine and Douglas-fir tree species. Exclude Engelmann spruce, whitebark and limber pine from harvest if present. All snags that do not pose a safety hazard during logging operation would be retained in the stand. Layout of unit boundaries will meet all INFISH guidelines. The following post-harvest activities will occur:
| Group Selection | 1 (14 acres) 3P | Tractor log | Remove all live/dead post and pole material and all dead lodgepole pine trees while retaining live non post and pole size trees. End results would be clumps of mature trees intermixed with saplings that do not meet post and pole standards. Designated material for removal will be strictly lodgepole pine; all other tree species will be retained. For 1GS this unit will be offered for personal use post and pole gathering until all the easily retrieved material is removed, lasting approximately 5 years maximum. After this time period the timber staff will evaluate remaining material, and if needed, offer up remaining material to commercial purchaser to finish up. For 3P this unit will be offered as a commercial sale. Layout of unit boundaries will meet all INFISH guidelines and employ no cut buffers along travel corridors as recommended by recreation specialists. The treatment will require the following construction activities:

- The reopening of 3,300 of temporary road over Trail #4109.
- The construction of 2,250’ of skid trail
- The construction of one 100’ by 100’ clearings for landings
- The re-closing of Trail #4109 back to the original trail once logging is completed

The following post-harvest activities will occur:

- Post-harvest treatments for noxious weeds for a period of up to five years after sale closure
- Post-harvest treatments to cut damaged and diseased conifers

- Post-harvest treatments to cut damaged and diseased *subalpine fir, Douglas-fir* and *lodgepole pine*
a) Roads

No new construction of permanent roads would occur for this alternative. Harvest activities using a helicopter will not require the construction of temporary roads, reopening of closed roads or require skid trails. Reopening of routes as listed in Proposed Action Alternative 2 would not be required other than trail number 4109, and road 40465 which would provide access to a helicopter landing. All other roads would be left in their current status on the ground and undisturbed. Eight segments of road totaling 2.75 miles would be decommissioned as along with the removal of two culverts on Red Rock Creek as shown in Table X. Haul travel routes would occur over the Timber Creek Road #40105 and Sawmill Canyon Road #40101 from helicopter landings and the fueling location. Pre-haul, haul and post haul maintenance on routes would be conducted, including surface blading, slough removal, tree limbing, culvert and ditch cleaning.

Table 4 - Proposed road decommissioning for Alternative 3 Helicopter Logging

<table>
<thead>
<tr>
<th>Route Name</th>
<th>Decommissioning Technique</th>
<th>Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>40455</td>
<td>Rip and Seed</td>
<td>.31</td>
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<tr>
<td>40458</td>
<td>Full Bench Obliteration</td>
<td>.82</td>
</tr>
<tr>
<td>40459-A</td>
<td>Remove culvert, obliterate first section of road</td>
<td>.19</td>
</tr>
<tr>
<td>40459-A</td>
<td>Rip and Seed</td>
<td>.10</td>
</tr>
<tr>
<td>40460</td>
<td>Remove culvert, obliterate first section of road</td>
<td>.48</td>
</tr>
<tr>
<td>40460-B</td>
<td>Rip and Seed (North Section that connects to 40460)</td>
<td>.39</td>
</tr>
<tr>
<td>40460-B</td>
<td>Full Bench Obliteration first 200 feet (South Section connecting to 40104)</td>
<td>.04</td>
</tr>
</tbody>
</table>

b) Landings

At least two helicopter landings would be required with one of them providing a fueling and service staging zone. Landing locations identified by the ID Team will be straight across from the 1AR and 2AR off Forest Road #40844. Second location will be up on the flat in the old timber sale off of Forest Road #40465. Any yarding over major travel routes including Timber Creek Road and Sawmill Canyon Road would require flaggers to stop traffic as the helicopter crosses the road. Flight paths would avoid flying over any private land and Timber Creek Campground. Minimum landing sizes if just processing and yarding would have to be approximately two acres. If service area and staging is included this area should be at least two plus acres in size, but no more than three acres total (Dave Morris Pers. Comm.).

c) Slash Treatments

Approximately 7 to 13 tons per acre of slash would be retained within the timber sale treatment units in order to maintain soil organic material and long-term site productivity as recommend for Douglas-fir and lodgepole forest types (Graham, Harvey, Jurgensen, Jain, Tonn, & Page-Dumroese, September, 1994). Approximately 7 to 13 tons per acre of slash will be retained within the pre-commercial thinning units to
provide additional soil organic material by limbing and scattering fell trees. No additional treatment to dispose of slash more than 13 tons is anticipated on the pre-commercial units because of current existing fuel loading.

**Table 5- Comparison of Alternatives.**

<table>
<thead>
<tr>
<th>Differences between alternatives</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units</td>
<td>420 acres – original proposed Units</td>
<td>401 acres dropping 1GS</td>
</tr>
<tr>
<td>Roads</td>
<td>Reopening closed roads, using them, then decommissioning and closing those same roads</td>
<td>Reopening only trail 4109 back to open road for harvest then closing it when done</td>
</tr>
<tr>
<td>Roads</td>
<td>Plans for decommissioning some of the reopen roads that were needed to harvest several units were part of the alternative. Decommission the other plan routes as displayed in table above</td>
<td>Decommissioning will still take place on some routes, but the decommissioning of those reopened roads that were needed to harvest in some of the units will not happen</td>
</tr>
<tr>
<td>Decommissioning of roads</td>
<td>Units 1 and 2AR required whole tree yarding.</td>
<td>Whole tree yarding will not be implemented in Units 1 and 2AR. Not practical if helicopter logging</td>
</tr>
<tr>
<td>Harvest Operations – slash and visuals</td>
<td>Multiple landings required</td>
<td>Limited to three landings Two will be associated with the Helicopter operations and one for logging of 3P</td>
</tr>
<tr>
<td>Landings</td>
<td>Multiples required</td>
<td>None except for unit 3P</td>
</tr>
<tr>
<td>Skid Trails</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**C. Design Features**

Early concerns related to soil and water resources that have been identified though scoping include: Equivalent clearcut area, road decommissioning, stream crossings, treatments in RHCAs, landslide prone areas, detrimental soil disturbance, total soil resource commitments, and coarse woody debris.

The following design criteria are recommended in order to ensure that water and soil resources are protected during implementation of the proposed action. These criteria are derived from Forest Plan standards and guidelines (USDA Forest Service, 1989) the National Best Management Practices for Water Quality Management on National Forest System Lands (USDA Forest Service, 2012), the Idaho Forest Practices Act (Idaho Department of Lands, 2005) and the Little Lost Subbasin TMDL (IDEQ, 2000b).
Mechanical Treatment Design Features:

- As determined by the sale administrator, skid trails would be rehabilitated by redistributing the berms or ripping and placing slash back on the area of disturbance.
- Timber sale design would ensure that all riparian habitat conservation areas (RHCA) would be protected in accordance with INFISH regulations.

Slash Treatment Design Features:

- Timber sale contract provisions would require the purchaser to lop and scatter slash and/or mechanically pile slash in all treatment areas or at landings.
- Following Timber Stand Improvement (TSI) activities, residual slash would be evaluated. Where necessary, a method would be prescribed and implemented for reducing the slash loading to a desired level. Slash disposal methods would include options such as piling or jackpot burning.
- Jackpot and pile burning would be limited to be within the Regional Soil Quality direction for detrimental disturbance. Piles would be limited to the smallest size possible to limit the extent of soil heating, but big enough to provide complete combustion.
- Idaho/Montana Air-shed Group operational plan would guide smoke management.
- Water source use during pile burning would follow mitigation measures stated in the Programmatic Biological Assessment for Fire Suppression and Prescribed Natural Fire Activities in the Upper Salmon River Sub-basin (USDA Forest Service, 2002a).

Road Design Features:

- Temporary roads would be closed prior to unit acceptance. Closure would entail obliterating the first 50 feet of the road; activities include berms redistribution, ripping, seeding, and scattering of slash on disturbed ground.
- Re-opened closed roads will be returned to original state post-harvest, with the placement of same kind of barriers when closed and revegetated through seeding or planting.

Weed Management Design Features:

- Utilize USDA Forest Service Guide to Noxious Weed Prevention Practices for all fuels reduction and project associated activities, for instance: prior to entry onto National Forest lands the undercarriage and tires/tracks/skits of harvesting and logging equipment would be power-washed such that they are free of dirt and/or caked-mud that may contain weeds or weed seeds. A visual inspection will be scheduled and completed by the Forest Service Timber Sale Administrator prior to being allowed on the forest.

Additional Project Design Features and Best Management Practices

1. Select for each harvesting operation the logging method and type of equipment adapted to the given slope, landscape and soil properties in order to minimize soil erosion. (IDAPA 20.02.01.030.03)
2. Ground based skidding shall not be conducted if it will cause rutting, deep soil disturbance, or accelerated erosion. On slopes exceeding forty-five percent (45%) gradient, ground based skidding shall not be conducted except with an approved variance. (IDAPA 20.02.01.30.03a)

3. Limit the grade of constructed skid trails on geologically unstable, saturated, or highly erodible or easily compacted soils to a maximum of thirty percent (30%). (IDAPA 20.02.01.30.03b)

4. In accordance with appropriate silvicultural prescriptions, skid trails shall be kept to the minimum feasible width and number. Tractors used for skidding shall be limited to the size appropriate for the job. (IDAPA 20.02.01.30.03c)

5. Uphill cable yarding is preferred. Where downhill yarding is used, reasonable care shall be taken to lift the leading end of the log to minimize downhill movement of slash and soils. (IDAPA 20.02.01.30.03d)

6. Locate landings, skid trails on stable areas to prevent the risk of material entering streams. (IDAPA 20.02.01.30.04)

7. All new or reconstructed landings, skid trails shall be located on stable areas outside the appropriate INFISH buffers. Locate fire and skid trails where sidecasting is held to a minimum. (IDAPA 20.02.01.30.04a)

8. To prevent landslides, fill material used in landing construction shall be free of loose stumps and excessive accumulations of slash. On slopes where sidecasting is necessary, landings shall be stabilized by use of seeding, compaction, riprapping, benching, mulching or other suitable means. (IDAPA 20.02.01.30.04c)

9. For each landing, skid trail or fire lines a drainage system shall be provided and maintained that will control the dispersal of surface water to minimize erosion. (IDAPA 20.02.01.30.05c)

10. Stabilize skid trails and fire lines whenever they are subject to erosion, by water barring, cross draining, outsloping, scarifying, seeding or other suitable means. This work shall be kept current to prevent erosion prior to fall and spring runoff. (IDAPA 20.02.01.30.05a)

11. Reshape landings as needed to facilitate drainage prior to fall and spring runoff. Stabilize all landings by establishing ground cover or by some other means within one (1) year after harvesting is completed. (IDAPA 20.02.01.30.05b)

12. Recommended spacing distances for water bars on tractor skid trails are:

**Table 6. Water bar spacing.**

<table>
<thead>
<tr>
<th>Skid Trail Water Bar Spacing (In Feet)</th>
<th>Sediments &amp; Quartzite</th>
<th>Volcanics</th>
<th>Granitics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradient (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-10</td>
<td>200</td>
<td>80</td>
<td>75</td>
</tr>
<tr>
<td>10-20</td>
<td>160</td>
<td>70</td>
<td>65</td>
</tr>
<tr>
<td>20-30</td>
<td>110</td>
<td>55</td>
<td>50</td>
</tr>
<tr>
<td>30-40</td>
<td>80</td>
<td>40</td>
<td>35</td>
</tr>
<tr>
<td>40-50</td>
<td>60</td>
<td>35</td>
<td>20</td>
</tr>
</tbody>
</table>
13. Deposit waste material from construction or maintenance of landings and skid and fire trails in geologically stable locations outside of the appropriate INFISH buffers. (IDAPA 20.02.01.30.06c)

14. During and after forest practice operations, stream beds and streamside vegetation shall be protected to leave them in the most natural condition as possible to maintain water quality and aquatic habitat. (IDAPA 20.02.01.30.07)

15. Avoid conducting operations along bogs, swamps, wet meadows, springs, seeps, wet draws or other sources where the presence of water is indicated, protect soil and vegetation from disturbance which would cause adverse effects on water quality, quantity and wildlife and aquatic habitat. (IDAPA 20.02.01.30.07c)

16. No commercial harvest within INFISH or modified INFISH Riparian Habitat Conservation Areas (RHCA). (UDSA Forest Service, 1995)

17. All construction actions will meet INFISH Standards and Guidelines.

18. Materials to be used (equipment, erosion control materials, vegetation) will be approved by the Contracting Officer’s Representative (COR) or inspector.

19. All equipment used on the site will be inspected prior to its arrival on the site. The equipment must be 1) free of all noxious weeds and aquatic invasives and 2) free of oil, fuel, or toxic leaks that would wash off into water.

D. Regulatory Requirements

1. Forest Land and Resource Management Plan Direction

The following goals, standards and guidelines and objectives are applicable to the proposed project and are taken from the Salmon and Challis Land and Resource Management Plans (LRMPs). Goals are broad statements of direction describing how Forest lands will be administered to assure long term protection and utilization of resources. Standards and Guidelines are quantifications of the acceptable limits within which general direction is implemented. Objectives are statements of specific program accomplishments that can be achieved during LRMP implementation, and are budget dependent. Forest-wide Direction defines management requirements that set the baseline conditions that must be maintained throughout the Forest, as part of LRMP implementation.

Forest management goals provide general management direction to be achieved during Forest Plan implementation. Associated with the goals are objectives which are concise, time specific statements of measurable planned results that respond to the goals. The goals and objectives listed below are applicable to the Upper North Fork HFRA Ecosystem Restoration Project.

Challis Land and Resource Management Plan
Goals: Provide soil and water guidance to other resource activities to protect or improve water quality and soil productivity, complete necessary inventories, surveys, and monitoring, and improve watershed condition on the Forest.

Standards and Guidelines: a) Ensure that all management-induced activities meet State water quality standards, and Forest water quality goals, including sediment constraints. Conduct nonpoint source activities in accordance with applicable Best Management Practices as referenced in “Idaho Water Quality Standards and Wastewater Treatment Requirements”; and in accordance with the Forest Service soil and water conservation practices. f) Impacts of activities may not increase fine sediment by depth (within critical reaches) of perennial streams by more than 2 percent over existing levels. Where existing levels are 30% or above new activities that would create additional stream sedimentation would not be allowed. If these levels are reached or exceeded, activities that are contributing sediment will be evaluated and appropriate action will be taken to bring fine sediment within threshold levels. o) Develop management options relevant to soil and water related improvement and/or problems. All soil and water planning will be coordinated with other resource element plans.

Management Area Direction: The Forest is divided into 25 Management Areas that provide additional prescriptions, management direction, and standards and guidelines specific to each area. This additional direction complements the Forest Goals and Objectives, Standards and Guidelines, and Desired Future Conditions by providing clear and concise area management direction.

The Sawmill Vegetation Management Project is within management area 22. Specific direction for management area 22 states that management will emphasize dispersed recreation opportunities, enhancement of wildlife habitat, timber production, and minerals activities. Specific soil and water direction is to protect or improve soil productivity and water quality and to provide needed input to resource-disturbing activities within the Mill Creek C&H, future timber sales and mineral activities.

2. Laws, Executive Orders, and Memorandums of Understanding (MOU’s)

Clean Water Act

The Federal Water Pollution Control Act of 1972 (Public Law 92-500) as amended in 1977 (Public Law 95-217) and 1987 (Public Law 100-4) is also known as the federal Clean Water Act.

This Act provides the structure for regulating pollutant discharges to waters of the United States. As stated in Section 101 of the Act, the objective of the Act is “…to restore and maintain the chemical, physical, and biological integrity of the Nation’s waters”. Control of point and nonpoint sources of pollution are among the means to achieve the stated objective. The U.S. Environmental Protection Agency (EPA) administers the Act, but many permitting, administrative, and enforcement functions are delegated to state governments. In Idaho, the designated agency is the Idaho Department of Environmental Quality (IDEQ).

Certain sections of the Act have special importance in management of nonpoint source pollution. Sections 208 and 319 of the Act recognize the need for control strategies for nonpoint source pollution.

Section 305(b) of the Act requires states to assess the condition of their waters and produce a biennial report summarizing the findings. Water bodies that have water quality determined to be either impaired (not fully meeting water quality standards) or threatened (likely to violate standards in the near future) are compiled by the State of Idaho Department of Environmental Quality (IDEQ) in a separate list under Section 303(d) of the Act. This list must be submitted to EPA every two years. Water bodies on
the 303(d) list (known as Water Quality Limited—or WQL—waters) are to be targeted, and scheduled, for development of water quality improvement strategies on a priority basis.

These strategies are in the form of Total Maximum Daily Loads, or TMDLs, which technically consist of the quantity of pollutants that may be delivered to a water body without violating water quality standards. In practice they are plans to improve water quality in a listed water body until water quality standards are met (i.e., until designated uses are fully supported).

Section 404 of the Act outlines the permitting process for discharging dredged or fills material into waters of the United States, including wetlands. The U.S. Army Corps of Engineers administers the 404 program. Under Section 401 of the Act, states and tribes may review and approve, set conditions on, or deny Federal permits (such as 404 permits) that may result in a discharge to State or Tribal waters, including wetlands.

The Forest and Rangeland Renewable Resources Planning Act (RPA) of 1974


States that the development and administration of the renewable resources of the National Forest System are to be in full accord with the concepts for multiple use and sustained yield of products and services as set forth in the Multiple-Use Sustained Yield Act of 1960. The Act requires the maintenance of productivity of the land and the protection of soil and water resources. It requires the Secretary of Agriculture to ensure, through research and monitoring, that forest management practices will not produce substantial and permanent impairment of the productivity of the land.

Forest Service Manual, Water Resources Management, sections 2532.02, 2532.03

Sections 2532.02 and 2532.03 of the Manual describe the objectives and policies relevant to protection (and, where needed, improvement) of water quality on National Forest System Lands so that designated beneficial uses are protected. Guidelines for data collection activities (inventory and monitoring) are also described.


The objective of this handbook is to present a process to develop site specific conservation practices for use on national Forest System lands to minimize effects of management activities on soil and water resources, and to protect water-related beneficial uses. It describes the application, monitoring, evaluation, and adjustment of these conservation practices.

Executive Order 11988, Floodplain Management

This Executive Order requires that agencies avoid, to the extent possible, adverse impacts associated with occupancy and modification of floodplains. It applies to all floodplain locations, as a minimum to areas in the 100-year, or base, floodplain.

Executive Order 11990, Protection of Wetlands

This Executive Order states that agencies shall minimize destruction, loss, or degradation of wetlands and shall preserve and enhance their natural and beneficial values. Agencies are to avoid construction in wetlands unless it is determined that there is no practicable alternative and that all practicable measures are taken to minimize harm to wetlands.
Idaho Water Quality Standards-IDAPA 58, Title 01, Chapter 2

This state law defines the State’s obligations to enforce water quality standards. A copy of the standards is in the project file.

INFISH Guidance

In 1994 the INFISH Environmental Assessment determine that Salmon- Challis LRMPs requirements be superseded by instituting Riparian Management Objectives, (RMO’s) in order to “maintain or restore” watersheds (USDA Forest Service, 1995). The INFISH guidance contains Goals, RMO’s, Riparian Habitat Conservation Area’s (RHCA’s), and Standards and Guidelines for riparian areas.

III. Methods of Analysis

A. Best Available Science

The techniques and methodologies used in this analysis consider the best available science. The analysis includes a summary of credible scientific evidence which is relevant to evaluating reasonably foreseeable impacts. The analysis also identifies methods used and references the scientific sources relied on. The conclusions are based on a scientific analysis that shows a thorough review of relevant scientific information. For this analysis there was not any incomplete or unavailable information that would be necessary for this determination.

The relevant science considered for this analysis consists of several key elements. For water resources the elements of science used are:

- **On site data and history.** The project area was surveyed and the following data was collected in July 2011) collection of WEPP model inputs that included ground cover transects, slope profile measurements, and stream buffering potential. 2.) Soil condition assessment that included, hydrologic and physical soil condition ratings, biological soil condition ratings, fine organic matter, coarse woody debris, photo monitoring, aerial extent and recovery of past activities. 3) Depth fines (stream sedimentation) were measured using a McNeil core sampler and sieve analysis from 1993 to 2011 in Smithie Creek, Timber Creek, Iron Creek, Mill Creek, Squaw Creek and The Little Lost River bank stability and composition measurements, photo monitoring and an aquatic zone analysis rating were also measured.

- **Scientific literature.** Fire effects analysis papers on soil resource (Stednick, 2010, Neary et al., 2005) and watershed hydrology (Stednick, 2010, Troendle and Olsen, 1994; Stednick, 1996; Neary et al., 2005) include a summary of impacts on the soil resource and watershed hydrology. Relevant literature for the basic understanding of effects on these resources relating to timber harvest and fire is also included. The use of design criteria and BMP’s to ensure water quality is protected is addressed in Rules Pertaining to the Idaho Forest Practices Act (IDAPA 20.02.01), Soil and Water Conservation Practices Handbook (FSH 2509.22), the Clean Water Act and is also supported by the Environmental Protection Agency (EPA).

- **Modeling using currently accepted analysis.** The probability of erosion and sediment delivery for each alternative was analyzed using the Disturbed WEPP model (Elliot et al., 2000). Stream flow
statistics were analyzed using the USGS Idaho StreamStats program. StreamStats rely on regression equations developed in the Water-Resources Investigations Reports 01-4093 and 02-4170 (Hortness and Barenbrock, 2001; Barenbrock, 2002).

- **The collective knowledge of the project by ID Team members through integration of science with local conditions.** Experience gained from implementation of the Hughes Creek Fuels Reduction Project, White Knob Fuels Reduction Project, Breaks 1 Ecosystem Restoration Project, Gibbonsville Fuels Reduction Project, North East Stanley Interface Project, Ransack Fuels Reduction Project, Garden Creek HFRA Project and Indian Prescribed Burn Project has been incorporated into the analysis.

- **Comparative analysis considering other local similar projects and past monitoring data.** The affects to water resources in other similar projects in the area have been considered in the analysis. The following effects analysis indicates that design criteria and BMP’s are effective in protecting water quality and long-term soil productivity.

The determinations reached in the specialist’s report are based upon ground reconnaissance of the proposed project area, previous monitoring of similar types of activities on NFS lands, and a review of literature that is cited in the specialist report. Finally, the potential effect of the Sawmill Vegetation Management Project on water resources is predictable and well documented. In my professional opinion, there are no significant scientific uncertainties of risks associated with this proposal. On the basis of the foregoing, it is my determination that I have considered the best available science relevant to the effect of this project on water resources of the Salmon-Challis National Forest.

### B. Methodologies

**WEPP Fuels Management Erosion Analysis and Disturbed WEPP**

WEPP is a physically-based soil erosion model that can provide estimates of soil erosion and sediment delivery, considering the specific soil, climate, ground cover, and topographic conditions. The accuracy of the projected rates is, at best, plus or minus 50 percent. Any predicted runoff or erosion value, by a model, will be within only plus or minus 50 percent of the true value (Elliot et al., 2000). Erosion and sediment delivery values are used to compare relative differences between alternatives.

Soil properties are based on research findings from Forest Service research and USDA Agriculture Research Service (ARS) (Elliot et al. 2000). The soil file database includes four textural categories. Within each of these categories, there is a separate set of erodibility values for each of the eight types of vegetation or disturbance. Thus, the database has a total of 32 soil/vegetation conditions.

Disturbed WEPP describes vegetation for the WEPP model in a cropland format because that format provides greater flexibility. Because WEPP does not allow mixing cropland and rangeland format vegetation scenarios on a hillslope, all vegetation was described in the cropland format.

Disturbed WEPP gives both an average annual erosion, as predicted by most USLE-based erosion technologies, and the probability of a given annual erosion rate following a disturbance. The average
annual erosion is more appropriate for application to rangelands, whereas the probabilities of annual erosion are more applicable to disturbed forest conditions, where a forest quickly revegetates following a disturbance.

To estimate an average annual erosion, Disturbed WEPP generates a stochastic climate for the climate selected, for the number of years specified. The WEPP model then runs a daily simulation for the specified period of time, and calculates the average annual runoff, erosion, and sediment yield values.

To determine the probability values, Disturbed WEPP is run for the number of years requested, and the annual values of runoff, erosion, and sediment yield are generated by WEPP. Disturbed WEPP then sorts the annual values by magnitude.

For a 50-year run, the largest values estimate a 50-year return period (or 0.02 probability of occurring) value; the second largest, a 25-year return period; the fifth largest a ten-year return; and the 20th largest a 2.5-year return period. The average value is the same as a 2-year return period regardless of the number of years of simulation selected.

For forest conditions, there are two levels of forest age: 5-year-old and 20-year-old. By the time a forest reaches 20 years of age, the impact of the canopy and residue accumulation is sufficient to provide as much erosion protection as can be achieved from vegetation.

The 5-year-old forest is considered a reasonable condition to describe a forest that has been heavily logged, leaving some side trees and considerable groundcover, or to describe a forest one to two years after a prescribed fire, or two to three years after a wild fire (Elliot et al. 2000). The skid trail condition describes a compacted, bladed skid trail with very little cover (Elliot et al. 2000). The prescribed burn and wildfire conditions contain soil properties similar to those observed in research (Elliot et al. 2000).

Three plant communities are provided for rangeland conditions: short grass, tall grass, and shrubs. Typical heights and spacings for each of these communities are described in the WEPP management file.

Stream flow Information

Mean Annual Flow (QA) has been calculated based on the procedure outlined in the Water-Resources Investigations Report 01-4093, “Estimating Monthly and Annual Streamflow Statistics at Ungaged Sites in Idaho” by Jon E. Hortness and Charles Berenbrock (Hortness and Barenbrock 2001). Peak Flows have been calculated based on the procedures outlined in the Water-Resources Investigations Report 02-4170, “Estimating the Magnitude of Peak Flows at Selected Recurrence Intervals for Streams in Idaho” by Charles Berenbrock (Berenbrock 2002). In these reports hydrologic regions are identified for different geographic areas of the State of Idaho. The hydrologic region encompassing the project area is identified and the appropriate regression equations are selected to calculate QA and peak flows.

Cumulative Effects and Watershed Risk Assessment
The existing condition, watershed sensitivity and degree of management within a watershed or subwatershed affect the potential to experience adverse effects to watershed and aquatic resources. As a general rule, the probability of experiencing adverse effects increases as the percentage of the watershed or subwatershed affected by management actions or natural disturbances increases. Based upon a watershed risk assessment presented in the document *Determining the Risk of Cumulative Watershed Effects Resulting from Multiple Activities* (USDA Forest Service 1993), road density and percent of the subwatershed covered with "hydrologically immature" vegetation are used as indicators of potential effects on water yield and timing as well as erosion and sediment potential.

Roads can affect hydrologic functions and resultant water quality by altering groundwater interception, runoff distribution over time and space, and the potential for sediment production and delivery to streams. The risks of a road affecting water yield and/or quality are largely determined by location, maintenance level, dimensions, and surfacing. Road density expressed as miles per square mile provides an index of the overall potential for roads to affect watershed function. In general, watersheds (or subwatersheds) with less than 30 percent watershed relief and road density of three miles per square mile or less are considered to have a low risk for the overall potential for roads to affect watershed function. Watershed relief is the average watershed slope determined as the difference between the lowest and highest points in the watershed divided by the length of a straight line projected along the main axis of the watershed and roughly parallel to the main drainage (USDA Forest Service, 1993). Watershed relief was calculated for all subwatersheds in the project area and all had watershed relief less than 30 percent.

**Water Yield Analysis**

Young stands, resulting from harvest or natural ecosystem components such as fire or disease, are indicative of the potential effects on the magnitude and timing of runoff from the watershed. The term "hydrologic immaturity" is used to indicate forested stands in which root structure and canopy density have not reached the level of water use and influence created by mature stands. A process and model is presented in the report *Software for Calculating Vegetation Disturbance and Recovery by Using the Equivalent Clearcut Area Model* (Ager and Clifton, 2005). The ECA model uses on set of coefficients to describe the proportion of the total basal area removed for different disturbance types, including harvest prescriptions, wildfire, prescribed fire, roads, and insect mortality. A second set determines how fast the treated acres recover to 100 percent of potential leaf area or canopy closure, at which point the acre is assumed to have hydrologic function the same as an untreated acre. The physical model behind ECA as a cumulative-effects measure is that vegetation removal changes water yield characteristics (peak flow, timing, total yield) in rough proportion of leaf area or basal area removed from the site. Several studies have shown that timber harvest affects water yield by reducing water associated with interception and evapotranspiration, or by changing snow distribution and melt rates (Stednick, 1996). The hydrologic changes may lead to destabilized stream channels and other adverse ecological effects (Reid, 1993). The ECA statistic (percentage of area in equivalent clearcut condition) is typically used in conjunction with climactic data to evaluate the cumulative effects of vegetative removal on water yields and peak flows. The ECA statistic may also be used as a general guide to overall watershed condition when coupled with site-specific evaluations.
C. Measurement Indicators

- Compliance with State Water Quality Standards and Maintenance of Beneficial Uses (yes, no)
- Probability of erosion and sediment delivery to streams. (% probability)
- Potential for changes in timing and magnitude of water yield (yes, no)
- Detrimental soil disturbance (% detrimental disturbance)
- Cumulative effects watershed risk rating combining existing condition, watershed sensitivity and degree of management as a comparison of the potential to experience adverse effects to water resources (low, moderate, high)

D. Desired Conditions

“Watershed conditions will improve. There will be a slight increase in delivered sediment as a result of management activities, but an increased improvement emphasis will reduce the impacts of existing sources. Best management practices will be implemented and monitored for representative activities on the Forest.” (FLRMP IV-43)(USDA Forest Service, 1989)

IV. Results of the Analysis

A. Affected Environment

1. Analysis Area

The Sawmill Vegetation Management Project direct, indirect and cumulative effects analysis area for hydrology and soil resources is approximately 25,816 acre (40.3 square miles) in size and includes the Upper Sawmill Creek (170402170201) subwatershed.

2. General Description

Sawmill canyon is located on the west flank of the Lemhi mountain range and forms the headwaters of the Little Lost River. Elevations range from 6,800 feet to over 10,800 feet. The watershed is characterized by a dendritic drainage pattern. Major tributaries include the Smithie Fork, the Main Fork, Iron Creek and Timber Creek all converging to form the Little Lost River which flows through Sawmill canyon. The physiography of the watershed includes high and moderate relief mountains, fan remnants and floodplains. Prominent peaks in the southwestern portion of Sawmill Canyon and define the east side along the crest of the Lemhi Mountain range were formed through cryoturbation processes on metamorphic and sedimentary rocks (quartzite and limestone). Mountains with moderate relief are the dominant landtype throughout Sawmill Canyon. They formed through fluvial and mass wasting processes on igneous rocks (Challis Volcanics) in the west side of the watershed and fluvial or cryoturbation processes on metamorphic in the east side of the watershed. The high country is typical of alpine glaciated country. Glacial cirque basins and lakes are found in the surrounding ridges, giving way to gentle timbered or sagebrush and grass slopes adjacent to the River. Predominant vegetation includes sagebrush and grass communities, lodgepole pine, Douglas-fir, and subalpine, and mountain mahogany. The area is classified as sagebrush steppe and western spruce/fir ecosystem. Current uses include livestock grazing, timber harvest, big game hunting, OHV use, camping, fishing and backpacking.
The watershed is considered functioning at risk. The three main conditions contributing to the functioning at risk classification include; loss of ecosystem health caused by a wide spread beetle epidemic, introduced non-native fish species threatening native bull trout populations, and heavy recreation pressure including need for trail maintenance and OHV use management.

The Sawmill area is currently experiencing a Douglas-fir bark beetle and spruce budworm epidemic. The watershed has experienced a large buildup of forest fuels and change in vegetation composition and structure. Exceptionally dense stands are undergoing intense completion for limited amounts of water, nutrients, and sunlight. These conditions, in combination with recent long-term drought, have led to recent and ongoing insect epidemics and high intensity wildfires around the project area. The development of mid to late-seral stand structures and species composition favors conifer species over aspen. As a result, aspen stands are declining reducing the diversity and overall resiliency of the ecosystem.

Introduced brook trout appear to be a major threat to bull trout (Endangered Species Act Threatened species) populations in the Little Lost River basin. Brook trout, which are native to eastern North America, have been introduced throughout the western United States and wild populations are now established in many areas outside their native range. Brooke trout were stocked throughout the Little Lost River drainage in the 1900’s and the species is now widely distributed in the basin. Managers have recognized the potential impact of introduced brook trout on bull trout populations in this area. The Sawmill Canyon sub-watershed upstream from, and including, Iron Creek contains approximately 22 miles of occupied bull trout habitat and approximately 95% of the bull trout found in the Little Lost River basin. Additional assessments have concluded that brook trout will completely replace bull trout within the next 50 years if management action is not taken.

The Sawmill Canyon area is heavily used by recreationists. OHV use in particular requires management attention. Many new routes and loops between and around campground are created each year. These user created routes do not have adequate drainage and are often near streams contributing sediment to and breaking down stream banks.

Rangeland riparian health is not at desired condition. The resource objective for sediment is to have less than 20% fines (< 0.25 inches in diameter). Sediment levels exceed the resource objective in many areas on the Mill creek allotment. The elevated sediment levels found in streams on this allotment have likely been caused by road construction, poorly located trails, timber harvest, dispersed recreation, and livestock grazing. The western portion of the allotment is particularly sensitive to disturbance from grazing and other activities because it is composed primarily of volcanic rock. The analysis of streambank condition focuses on streambank stability. The resource objective for bank stability on this allotment is to have bank stabilities of 90% or greater. Bank stabilities are below the resource objectives in some areas. Livestock grazing has likely partially contributed to bank stabilities not meeting the resource objective. The analysis of riparian conservation areas focuses on greenline ecological status and woody species recruitment. The resource objective for greenline ecological status is to have a greenline ecological status of 61 or greater. In 2009, the Forest Service evaluated greenline ecological status at
several locations on this allotment using the MIM protocol. Greenline ecological status exceeded 61 at all but one location.

3. Hydrology

The climate of the analysis area is characteristic of intermontane basins in the northwest; warm and dry in the summer and cold and moist in the winter. Snowfall accounts for about 55 to 60 percent of the precipitation. Rainfall is greatest during May and June. Precipitation within the analysis area is about 25 inches annually. Significant runoff events can be triggered by rain on snow conditions. Severe thunderstorms can occur but are relatively infrequent.

The Upper Sawmill Creek subwatershed has a branched or dendritic pattern of streams. Surface hydrologic features are composed of an ephemeral, intermittent and perennial stream network, many small seeps and wetlands, and a few small ponds primarily in the headwaters. The subwatershed has a snowmelt dominated streamflow pattern. Peak flow occurs in May and June and the lowest flow period occurs in late fall and winter (Figure 1). Snowfall accounts for 50 to 60 percent of the precipitation.

Streamflow regime is the amount and timing of streamflow. Peak flows from snowmelt occur in late May or June, while base flows occur from late summer through winter. On the North Fork Salmon River mean annual discharge at mouth of the stream is approximately 19 cubic feet per second (cfs) with average minimum flows of 5 cfs in January and February and average high flows in the range of 100 cfs occurring in late May or early June.

![Typical Hydrograph for the Little Lost River in the Upper Sawmill Creek subwatershed](image)

*Figure 1. Typical hydrograph for the Little Lost River in the Upper Sawmill Creek subwatershed.*

Flows are regulated by the amount of snowpack, the rate of snowmelt, the amount of early spring rain, the movement of water through the watershed to the valley bottom and the condition of the riparian area and stream channel.
Streams in the analysis area can be grouped into three types: 1) source reached high in the drainage, 2) transport reaches at mid-elevation connecting the upper reaches with lower ones, and 3) response reaches along the valley bottom that adjust to the variety of flows and sediment loads. All of the channel types have inclusion within the general reach type.

Source channels are classified as Rosgen A channel types. These are high relief channels entrenched in steep mountain terrain. Most have a low width to depth ratio and are relatively straight, with a vertical step pool morphology and high mud and rock flow potential. These channels have high bank erosion rates and can produce large amounts of bedload during peak flows. Many of these streams are intermittent and often do not support riparian vegetation. The upper reaches of Slide, Timber, Jackson and Redrock creeks are high gradient source reaches.

Transport Channels are most often B type channels when classified according to the Rosgen channel type system. These are the most common channel types found in the project area. These channels have a moderate gradient, sinuosity, width to depth ratio and entrenchment. They are riffle dominated with occasional pools and occur in narrow, gently sloping valleys. The middle section of Sawmill Creek is an example of a transport channel. The banks of these channels are comprised of relatively fine grained material. The transport channels start below the source channels and have large stable channel material. As the channels flow downstream they become more dependent on large woody debris for stabilization until they flow down the alluvial deposits when they become dependent on vegetation for stability. Transport channels can cut both downward and laterally if they become unstable. There are inclusions of low gradient wet meadows in the transport reaches.

Response channels are the low gradient reaches along valleys with terraces and floodplains. They are meandering and slightly entrenched. Their width to depth ratio varies from moderate to high. They can be confined by a high bank (terrace) on one side and not confined on the other. These reaches are C type channels when classified according to the Rosgen channel type system. There are inclusions of B and D type channels within the response reaches. B channels are higher gradient and less sinuous than C channels. The response channels are higher gradient and less sinuous than C channels. The Little Lost River below the project area would be an example of a response reach.

Riparian areas are a form of wetland transition between permanently saturated wetlands and upland areas. These areas exhibit vegetation or physical characteristics reflective of permanent surface water of subsurface water influence. Riparian wetland areas are grouped into two major categories; 1) lentic, which are standing water habitats such as lakes, ponds, seeps, bogs, and meadows, and 2) lotic, which are running water habitats such as rivers; streams, and springs. Both riparian types have been identified in the Upper North Fork HFRA Ecosystem Restoration analysis area. The functioning condition of riparian wetland areas is a result of the interaction among geology, soil, water and vegetation. Riparian wetland areas are functioning properly when adequate vegetation, landform, or large woody debris is present to dissipate stream energy associated with high waterflows, thereby reducing erosion and improving water quality; filter sediment, capture bedload, and aid floodplain development; improve flood water retention and ground-water recharge; develop root masses that stabilize streambanks against cutting action; develop diverse ponding and channel characteristics to provide the habitat and the water depth,
duration, and temperature necessary for fish production, waterfowl breeding, and other uses; and support greater biodiversity.

4. Water Quality
The Idaho Department of Environmental Quality (DEQ) has designated the following beneficial water uses for the Little Lost River; primary contact recreation, industrial water supply, wildlife habitat and aesthetics. Existing beneficial uses include cold water biota and salmonid spawning.

Sediment in the analysis area ranges from small suspended material to cobble size bedload. Fine sediment is produced in the source reaches and transported to the response reaches during all flows except the lowest ones. The transport reaches are also adding sediment through bank erosion. Fine sediment should be transported through the response reaches at bankfull flows and deposited in the response reaches with low flows. Bedload is transported mainly during peak flows and is deposited at a bankfull or low flow.

Instream core sampling is used to monitor trend and to determine the amount (percent) fine sediment in the stream’s substrate. Streams that support of have the potential to support anadromous fish are cored to a depth of 6 inches (the amount of substrate material an anadromous fish could move when preparing a red) and resident fish streams are cored to a depth of 4 inches using a McNeil core sampler. The percent fines at depth are used in determining the stream’s biotic potential (Stowell, et al. 1983). Biotic potential is the condition of spawning substrate quality which maximizes survival and emergence of fish embryos.

Percent fine sediment in the substrate for selected streams, collected by the McNeil core sampling method, is displayed below (Table 7, Figure 2-3).

**Table 7.** Percent Depth Fines measurements of major tributaries in the Project Area.
<table>
<thead>
<tr>
<th>Year</th>
<th>Percent</th>
<th>Depth Fines</th>
<th>6.35mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>15.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>9.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>20.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>19.9</td>
<td>34.3</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>22.6</td>
<td>23</td>
<td>29.7</td>
</tr>
<tr>
<td>2011</td>
<td>29.5</td>
<td>21.3</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>27.7</td>
<td>28.4</td>
<td>32.7</td>
</tr>
</tbody>
</table>

**Figure 2.** Depth fines trend for the Little Lost 1R monitoring site.
Most streams in the analysis area have some amount of bank erosion. Following are bank stability ratings for selected streams in the analysis area from 1993 to present (Table 8).

**Table 8.** Bank Stability of major tributaries in the Project Area.

<table>
<thead>
<tr>
<th>Year</th>
<th>Smithe Fk 1R</th>
<th>Timber Creek 1R</th>
<th>Iron Creek 1R</th>
<th>Little Lost 1R</th>
<th>Mill Creek 1R</th>
<th>Squaw Creek 1R</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>88.5</td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>1998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>98</td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>79</td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>57</td>
<td>54</td>
<td>44.5</td>
<td>45</td>
<td>95</td>
<td>100</td>
</tr>
</tbody>
</table>

**Figure 3.** Little Lost 1R sediment monitoring site.
303(d) Streams

The Clean Water Act (CWA) requires that the states and tribes restore and maintain the chemical, physical and biological integrity of the nation's waters. As mandated by the CWA the State of Idaho is required to conduct a comprehensive analysis of Idaho’s water bodies to determine whether they meet state water quality standards and support beneficial uses or if additional pollution control measures are needed.

The 2010 Integrated Water Quality Monitoring and Assessment Report (IDEQ, 2011) guides the current direction for water quality management for the project area. The integrated Report serves as a guide for developing and implementing water quality improvement plans to protect water quality and achieve federal and state water quality standards. Assessment units are groups of similar streams within a subbasin that have similar land use practices, ownership, or land management. Representative streams or reaches were monitored within each assessment unit to determine whether or not the streams within the assessment unit are fully supporting their designated beneficial uses. Table 4 identifies the assessment units and streams within the analysis area that are listed on the 2010 Integrated Report.

Table 9. Assessment Units and 303(d) Listed Streams

<table>
<thead>
<tr>
<th>Assessment Unit</th>
<th>Streams Not Supporting Beneficial Uses</th>
<th>Support Status/ Causes</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID17040217SK014_02</td>
<td>Sawmill Creek – confluence of Timber Fork and Main Fork to Squaw Creek</td>
<td>Not supporting: Salmonid Spawning Causes: Combined Biota/Habitat Bioassessments, temperature, water</td>
<td>SMI, SHI and SFI for 2007 BURP site all indicate full support. EPA indicates temperature exceedances in this Bull trout Watershed. Bacterial data for all present and past sites have no exceedances.</td>
</tr>
<tr>
<td>ID17040217SK014_04</td>
<td>Sawmill Creek – confluence of Timber Fork and Main Fork</td>
<td>Not Supporting: Cold Water Aquatic Life</td>
<td>Pass with SMI scores of 3. Brook, bull and rainbow trout found in multiple year classes adequate to</td>
</tr>
</tbody>
</table>
Assessment Units and 303(d) Listed Streams Within the Sawmill Vegetation Management Analysis Area in the 2010 Integrated Report For Idaho.

<table>
<thead>
<tr>
<th>Assessment Unit</th>
<th>Streams Not Supporting Beneficial Uses</th>
<th>Support Status/ Causes</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>to Squaw Creek</td>
<td></td>
<td></td>
<td>show full support. Bull trout present in 4 year classes, brook in 3, rainbow in 5. Data from FS documented in Little Lost River SBA/TMDL.</td>
</tr>
</tbody>
</table>
| ID17040217SK017_02 | Main Fork- source to mouth | **Not Supporting:** Cold Water Aquatic Life and Salmonid Spawning  
*Causes:* Sediment/Siltation | Although BURP scores from several sites in 2007 and previous years indicate full support, there is an approved TMDL for sediment, therefore this AU will remain in category 4a. Bull and rainbow trout found in multiple year classes adequate to show full support. However, ALUS is not supporting although BURP scores indicate full support for both ALUS and SS because there is an approved TMDL for this AU for sediment. According to WBAGII, if ALUS is not supporting, SS is also not supporting. |
| ID17040217SK017_03 | Main Fork- source to mouth | **Not Supporting:** Cold Water Aquatic Life and Salmonid Spawning  
*Causes:* Sediment/Siltation | 2007 as well as previous years BURP data indicates full support for ALUS, however an approved sediment TMDL is in place so ALUS must remain not supporting. Bull and rainbow trout found in multiple year classes adequate to show full support. However ALUS is not full support because of an approved TMDL for sediment. According to WBAGII, if ALUS is not supporting, SS is also not supporting. |
| ID17040217SK018_03 | Timber Creek- source to mouth | **Not Supporting:** Salmonid Spawning  
*Causes:* Temperature, water | No Notes |
The primary water quality concern in Sawmill Creek is elevated water temperature and subsurface fine sediment deposited within the stream substrate preferred by salmonids for spawning (IDEQ, 2000b). Fine sediment is likely impacting the success of salmonids spawning and the abundance of quality of fish habitat (IDEQ, 2000b). The primary source of sediment appears to be streambank erosion. The primary cause of streambank erosion is related to two large wildfires that burned in 1966 and 1988 (IDEQ, 2000b). The combined result of accelerated spring runoff from fires and poor riparian conditions prior to the fires were channel blowouts that widened the stream channel beyond the ability of riparian vegetation to quickly revegetate and stabilize streambanks (IDEQ, 2000b).

Through the TMDL process DEQ has developed recommendations for the reduction of streambank erosion that would ultimately result in beneficial use support through improving streambank stability and subsequently riparian vegetation to reduce temperature. Sediment load reductions are quantified through streambank erosion inventories that estimate streambank erosion based in streambank conditions documented along several reaches of each stream. Instream sediment targets have been identified from literature values that are supportive of salmonid spawning and coldwater biota. These target values will be used to track the progress of streambank recovery and determine the need for additional management practices to improve water quality.

Streambank erosion must be reduced by an average of 80% on Sawmill Creek (IDEQ, 2000b). This reduction of streambank erosion should result in a reduction of streambed fine sediment smaller than 6.35 mmm (0.25 in) to the target level of 28% in areas suitable for salmonid spawning (IDEQ, 2000b). These reductions incorporate an implicit margin of safety to assure restoration of beneficial uses and equate to streambank erosion and rates expected at 80% streambank stability, which is considered natural background erosion within the TMDL (IDEQ, 2000b). To improve the quality of coldwater biota in Sawmill Creek, it will be necessary to maintain the instantaneous maximum temperature below 13 deg. C and the maximum daily average temperature below 9 deg. C as prescribed in State of Idaho Water Quality and Wastewater Treatment administrative Rules IDAPA 58.01.02.250.02.b for salmonid spawning (IDEQ, 2000b).

5. **Soils**

Landforms within the analysis area include mountains foothills, fan remnants, alluvial fans, plateaus, valleys, and floodplains. The dominant parent materials are Challis volcanics, Kinnikinick quartzite and members of the Saturday Mountain Formation., and lesser amounts of limestone and sandstone. Mixed alluvium derived from these sources is found on alluvial fans, fan remnants, and floodplains.

Twenty two ecological units have been mapped in the Sawmill watershed. An ecological unit is the mapped delineation of one or more ecological types as they are found in a repeating pattern across the landscape. An ecological type is a category of land defined for a unique combination of vegetation, soil, topography, geology and climate. The proposed treatment activities fall within two ecological units, the ALBA/ARCO9 Worock-PSME/SYOR2 Parkay association, 30 to 60 percent slopes (EU 6) and the PSME/ARCO9, ARCO9 Lemco- PSME/ATRV Zeebar- Tall Forb Nearl association, 4 to 15 percent slopes (EU 24).
The EU 6 ecological unit is on unstable mountains in the forested zone. The topography is characterized by steep mountain sideslopes that are weakly to strongly dissected by spur ridges and draws in dendritic and trellis patterns. A mosaic of cool, north-facing and warm, south-facing sideslopes is common. The north-facing sideslopes support closed canopy forests of mixed conifers. The south-facing sideslopes support open canopy forests of conifers over a diverse layer of mountain shrubs with variable cover. Slump-earth flows with benches and basins are common.

The EU 24 ecological unit is on unstable footslopes and basins of mountains in the forested zone. The landscape is characterized by short scarp slopes, small benches and basins that support a mosaic of forested, shrub steppe, subalpine forb and riparian communities. These positions occupy the body or toe of earth flows.

Soils formed in quartzites (EU 6) are light colored, loamy or sandy soils that have abundant rock fragments and are well or somewhat excessively drained. These soils are stable and are not prone to slumping or mass failure. Infiltration of water into these soils is rapid and they are not easily compacted.

Soils on floodplains (EU 24) formed in mixed alluvium are poorly or somewhat poorly drained and dark colored. Loamy soils are dominant on the broader floodplains supporting willow and grass communities. Very poorly drained, organic soils are identified on narrow floodplains where conifers are supported and in wet meadows supporting sedges, rushes and grasses. Both of these soil types have a high water table and a high water holding capacity. They are cold and wet during the growing season. These soil types are very fragile and are easily compacted. They are susceptible to damage by the hooves of cattle and elk, by recreation trails and off-road vehicle use.

In addition to the land forming processes of cryoturbation and glacial action that have shaped the landscape over time, and processes of mass wasting and fluvial action that continue to occur, hillslope processes also affect the way the watershed functions. Hillslope processes include surface erosion overland flow, infiltration of precipitation and movement of water downslope. Surface erosion includes soil creep, sheet, rill, and gully erosion. The rate of surface erosion is dependent on the inherent erodibility of the soil, slope, the amount, rate and timing of precipitation, and the type and amount of vegetative cover and litter on the soil surface. Infiltration is dependent on soil texture, slope, and vegetative cover and litter. The amount of water that infiltrates the soil surface and percolates through the soil profile influences the kind and amount of vegetation and the contributions to surface flow. Subsurface flow, in turn affects groundwater recharge and surface flows. Changes in vegetation type and density can also affect the interception of precipitation and the amount of subsurface water that is used in transpiration.

Natural disturbances such as drought, insects, disease and fire also affect hillslope processes. Approximately 6,246 acres in the Smithie Fork drainage burned in 1988 and 3,560 acres of the Warm Springs drainage within the watershed burned in 1966. These fires increased the amount of surface runoff and erosion and decreased the amount of infiltration during the first few years after the fires occurred, especially in areas that burned at high intensity on steep slopes. The vegetative cover was drastically altered which decreased the amount of precipitation that was intercepted by plants and
increased the amount of rain and snow that reached the soil surface. Evaporation rates at the soil surface would have increased and soil temperatures would have been warmer during the summer and colder during the winter. The effects of drought, insects and disease on hillslope processes were not as obvious as the effects of the fires.

Land use activities have also affected hillslope processes in the analysis area. Timber harvesting, livestock grazing, recreational activities, and road construction and maintenance have altered hillslope processes to some degree in specific areas of the watershed. Soil compaction from timber harvesting and dispersed recreation have had the most obvious effect on hillslope processes. Soil compaction was also observed in both developed and dispersed campsites. Compaction on level terrain, increases soil puddling and reduces site productivity. Roads, particularly cut and fill roads, intercept the downslope movement of water.

**B. Environmental Consequences**

Proposed activities that could potentially affect water resources included timber harvest and yarding, hauling and road management, road decommissioning. Potential effects include direct, indirect and cumulative. Each alternative will be analyzed for the impacts of associated treatments in addition to past, present and reasonably foreseeable future actions. Each alternative considers the projected loss of vegetation due to insect, disease and catastrophic fire.

Indices of measurement to compare alternatives and analyze the relative risk of cumulative watershed effects are: compliance with State water quality standards and maintenance of beneficial uses, potential for changes in timing and magnitude of water yield, probability of erosion and sediment delivery to streams, percent detrimental soil disturbance, and cumulative effects watershed risk rating combining existing condition, watershed sensitivity and degree of management as a comparison of the potential to experience adverse effects to water resources.

Direct effects are caused by the action occurring at the same time and place. Tractor yarding across a stream would constitute a direct effect if sediment were introduced at the time of the action. Indirect effects are caused by the action and occur at a later time or farther removed in distance. An example would be increased erosion rates on a harvest unit before vegetation has fully recovered. Cumulative effects result from the incremental effects of the proposed action when added to the other past, present, and reasonably foreseeable future actions.

1. **Alternative 1- No Action**

   a) **Direct and Indirect Effects**

   There would be no direct effects associated with Alternative 1 because the consequences of not treating fuels would likely occur at a later time.
Indirect effects of the No Action Alternative relate to the unnatural build-up of fuels in the project area. The probable long-term consequence of not treating fuels is a large scale, high intensity wildfire. Predicting actual long-term effects from a major fire is difficult due to variability in location of fire and fuel types. The worst case scenario would concentrate a major wildfire in the Upper Sawmill subwatershed, in heavy timber, and remove the majority of vegetation which would create hydrophobic soil conditions in areas with heavy fuel accumulation. Appreciable changes in slope stability, runoff, and sediment delivery are likely to occur following a large scale, high intensity wildfire.

**Compliance with State Water Quality Standards and Maintenance of Beneficial Uses.**

The direct water quality effects of wildfire are usually associated with burned material or air dropped retardant entering a waterbody and potentially elevating water temperature and/or nutrient levels. The indirect effects include possible decreases in interception and infiltration, with possible increases in surface and mass erosion, nutrient loading, and sedimentation. Fire that includes significant amounts of high burn severity can greatly increase erosion rates. Elevated turbidity (suspended sediment) could also degrade water quality. Erosion and sedimentation rates due to wildfire typically recover to normal levels in 3 years for low severity fires, and 7 to 14 years for moderate and high severity fires, respectively (Robichaud et al. 2000).

In watersheds where fire suppression and succession have allowed forests to reach mature stages, water yields may approach a minimum level and decrease the amount of water available for irrigation. However, continued fire suppression may result in fuel buildups that could result in catastrophic fires that could ultimately impact channels through post-fire flood flows (Farnes et al. 2000).

Post-fire changes in streamflow regime could result due to changes in snow accumulation/melt patterns and evapotranspiration. Increased streamflow could result in short-term increases in the amount of water available for irrigation.

**Modeled Probability of Erosion and Sediment Delivery**

Wildfires burn indiscriminately without regards to mitigation normally associated with prescribed burning including buffer strips, fuel loadings and burn severity. Wildfires usually burn late in the summer when relative humidity is low and fuel moistures is low even in the riparian areas. Because the buffer strips burn under these extreme conditions there will be a greater chance for the eroded materials to enter stream courses.

The potential for adverse impacts to soil and water resources is greatest on landforms that have high inherent erosion hazard in combination with a high fire risk. In the event of a large scale fire, effects would not be confined to the treatment units or the project area, and the magnitude of effects could result in detrimental impacts to the Little Lost River.

Changes in streamflow regime due to changes in snow accumulation/melt patterns and evapotranspiration can also result. The significance of effects may vary as a function of parameters including but not limited to fire intensity/duration, soil characteristics, precipitation patterns, vegetative cover types, slope, and aspect. Any discussion addressing the effects of fire will relate to changes in slope and/or channel stability. In watersheds where fire suppression and succession has allowed forests to reach mature stages, water yields may approach a minimum level. However continued fire suppression may result in fuel buildups that could result in catastrophic fires that could ultimately impact channels through post-fire flood flows (Farnes, et al. 2000).
Observations from the Clear Creek Fire of 2000 show that stream substrate sediment levels greatly increased over pre-fire conditions. Pre-fire data consisted of eight years of McNeil core sampling information, which identifies levels of fine materials (less than 0.64 cm in diameter) within spawning gravels. Pre-fire monitoring identified an average of 19 percent fines at depth. During the summer following the fire, a high intensity storm event carried fines from the burned hillslopes into Clear Creek, elevating levels of fines to 83 percent. Follow up monitoring during July of 2002 indicated that substrate sediment levels at depth had recovered to 24 percent. A second high intensity storm event later that year once again increased depth fines to 83 percent. In 2003 the site became immeasurable due to a much larger event that inundated the site with sediment and rerouted the channel.

Potential for changes in timing and magnitude of water yield

If the No Action alternative is selected, the project area ECA would continue to decrease as stands mature to 30-years of age and older. In the subwatersheds where fire suppression and vegetative succession have allowed forests to reach mature stages, water yields (baseflows and peakflows) may approach a minimum level. Continued fire suppression may result in fuel buildups that could result in catastrophic fires and ultimately impact channels due to post-fire flood flows and sediment delivery (Farnes et al. 2000).

There is potential for a large increase in ECA in the event of large scale, stand-replacing fire in the project area. Post-wildfire increases in ECA could result in changes in the magnitude and timing of spring-early summer peakflows, and late summer-fall baseflows. Increases in the magnitude and duration of peakflows could result in channel morphology changes and streambank erosion. Decreased baseflows could result in low flow fish migration barriers and increased water temperatures.

In the wildfire scenario described in the No-Action alternative it is expected that 50% of the forested ecosystems would incur a lethal fire severity and increase the ECA from less than 5% to over half of the subwatershed.

High severity fires are of particular concern because of the loss of protective cover and fire-induced soil water repellency can induce severe flooding and erosion even after moderate rain events. In most cases, the decline in soil water repellency and vegetative regrowth means that these large increases in runoff and erosion diminish quite rapidly. Most long-term studies show no detectable increase in erosion by about the fourth year after burning.

Analysis of Haul Routes

There would be no direct effects because no hauling will occur. In the event of a wildfire some routes would be opened with bulldozers and receive moderate to heavy traffic during fire suppression activities. Fire suppression activities have the potential to increase the road and drainage density and contribute to stream sedimentation. It is not possible to quantify these effects without knowledge of the fires location, size, and suppression tactics.

Detrimental Disturbance

With no ground disturbing activities proposed in the No Action alternative any detrimental disturbances that have occurred as a result of past forest management activities are expected to recover through natural processes. Disturbed sites will return to pre disturbance conditions by means of freeze thaw cycles, translocation, organic matter accumulation and vegetation establishment.
**b) Cumulative Effects**

Cumulative effects are those direct and indirect effects that result from the proposed action or alternatives when added to other past, present, and reasonably foreseeable actions of the agency and others. Many multiple use management activities occur on lands within the Sawmill analysis area. These include things such as livestock grazing, recreational developments such as campgrounds, trails for hiking ATV’s and horses, fire control, wildlife fisheries and watershed habitat improvement projects, timber sales, insects and disease, special uses, mining, firewood cutting, and noxious weed treatments.

All multiple use projects implemented on the Salmon-Challis N.F go through NFMA/NEPA analysis. Any project that has the potential for ground disturbance has the appropriate best management practices prescribed to minimize soil disturbance erosion and sedimentation.

A watershed risk rating based on watershed relief, road density, channel stability, and ECA was used to calculate the current cumulative effects for hydrologic and aquatic resources in each project subwatershed (Table 10).

The No Action Alternative proposes no treatment and would not cumulatively impact watershed function. Under the No Alternate scenario considering a large wildfire event the risk of cumulative impacts becomes much higher. When the effects of the No Action Wildfire scenario are combined with the past and foreseeable future effects of insects and disease there is potential for increased impacts to soil and water resources. The loss of vegetation from insects and disease can reduce evapotranspiration and interception, which lessens detention and storage of rainfall and changes snow distribution, accumulation, and melt rates. The risk of effects from wildfire can be amplified by the high rates of mortality resulting from mountain pine beetle epidemic. Heat pulse to the soil would likely be greater due to the greater accumulation of fuels. With the increased tree mortality there would be a higher risk of crown fire making a greater burn area extent more likely amplifying the hydrologic effects.

<table>
<thead>
<tr>
<th>Subwatershed</th>
<th>Alternative 1 No Action Current Condition</th>
<th>Alternative 1 No Action Wildfire</th>
<th>Alternative 2 Proposed Action</th>
<th>Alternative 3 Helicopter Logging</th>
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<td>High (basin relief &lt;30%, road density 1.6 mi/mi², ECA &gt;50%)</td>
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<td>Low (basin relief &lt;30%, road density 1.5 mi/mi², ECA &lt;5%)</td>
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2. Alternative 2- Proposed Action

a) Direct and Indirect Effects

Compliance with State Water Quality Standards and Maintenance of Beneficial Uses

The IDEQ Designated Beneficial Uses for Sawmill Creek include: Primary Contact Recreation, Industrial Water Supply, Wildlife Habitat and Aesthetics. Existing Beneficial uses include Cold Water Biota and salmonid Spawning. The subsurface fine sediment target for this TMDL is set at 28% or less fine particles <6.35 mm (0.25 in) not including substrate larger than 63.5 mm (2.5 in). Attainment will be expected in habitat capable of supporting salmonid spawning after implementation of BMPs identified to reduce subsurface fine sediment. IDEQ states that beneficial uses were or would be fully supported at natural background sediment loading rates that are assumed to equate to 80% bank stability, and temperature regimes that would meet state water quality standards.

The proposed action for this project includes ground disturbing activities such as commercial harvesting and road reclamation. There is a small chance (3% see analysis in following section) that a storm large enough to generate sediment from a proposed harvest unit before ground cover is fully reestablished. This small chance of sediment delivery to streams is mitigated by the BMPs required by INFISH. INFISH RHCA buffers (300 ft) along stream channels would capture any sediment leaving a harvest unit before it reached a stream channel. Additionally the RCHA buffers insure riparian trees and shrubs are protected providing shade for streams maintaining cool stream temperatures. The proposed activities are not expected to affect streambank stability. In addition to protecting 303(d) streams from project activities. This project allows for an opportunity to further the goals established in the Little Lost Subbasin TMDL by eliminating roads from the system. Thirteen segments of roads representing 4.21 miles will be decommissioned. The decommissioned sections will have natural drainage restored, soil compaction relieved and native vegetation reestablished effectively eliminating these segments as contributing sediment sources.

Through project BMPs including INFISH guidance and proposed road decommissioning this project would be in compliance with section 303(d) of the Clean Water Act protecting Beneficial Uses and implementing in part the goals and recommendations of the Little Lost River Subbasin TMDL.

Modeled Probability of Erosion and Sediment Delivery

The proposed activities have the potential to increase the probability of erosion and sediment delivery to streams. In order to estimate to the potential effects and evaluate differences between alternatives the WEPP model was used to estimate erosion and sediment delivery from treatment units. WEPP is a physically-based soil erosion model that can provide estimates of soil erosion and sediment delivery, considering the specific soil, climate, ground cover, and topographic conditions and treatment.

BMP reviews of past projects have shown that filterstrips provide effective buffers (undisturbed soil and vegetation) to capture sediment before it reaches a stream in the event that there is erosion and transport from the treatment unit. INFISH (USDA Forest Service, 1995) was amended to the Forest Plan and requires buffers along all water bodies with differing widths dependent on the type of feature and
presence of fish. The RHCA buffers provide sediment filtering as well as other ecological functions (e.g. large woody debris recruitment, riparian habitat, floodplain function, insect production, and instream detritus).

In the Proposed Alternative harvest units were designed so that the standard INFISH buffers were excluded from the treatment units.

Activities within the delineated RHCA such as road decommissioning and culvert removal would maintain INFISH Riparian Management Objectives (RMOs) for pool frequency, water temperature (i.e. no measurable increase in maximum water temperature), large woody debris (i.e. >20 pieces/mi, >12 inches diameter, >35 feet long), bank stability (>80% stable), lower bank angle (>75% with <90° angle), and channel width to depth ratios (<10). The INFISH RMOs were designed to protect aquatic habitat and channel morphology, and promote desired channel, riparian, and floodplain characteristics.

The WEPP model uses the buffer, soil type, average slope, percent ground cover, and climate data to predict the probabilities of erosion and sediment yield occurring within the first year following treatment when the units would be most vulnerable to the effects of high intensity storms. The objective of the unit buffers was to minimize the percent probability that there would be sediment delivery in the first year following harvest.

Mean annual averages, probabilities of occurrence in the first year following disturbance, and buffer effectiveness during large storm events were estimated for a representative hillslope profile for each treatment unit (Figure 4, Table 6).

Results of the analysis predict that average probability of sediment leaving a harvest unit the first year following a disturbance would be less than 3% (Table 11), values ranged from 0-6% probability. With the unit layout and design criteria of the proposed activities any sediment leaving the proposed units will be retained in the 300 ft. INFISH RHCA buffer before it can enter adjacent streams.

Table 11. Disturbed WEPP Modeling results summary.

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### Hillslope Descriptions

#### Probabilities of Occurrence in First Year Following Disturbance

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## Hillslope Descriptions

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<td>28.3</td>
<td>711</td>
<td>38</td>
<td>TEU 6 Volcanic</td>
<td>sandy loam</td>
<td>2</td>
<td>0</td>
<td>8</td>
<td>0</td>
<td>4</td>
<td>6</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Figure 4. Hillslope profiles modeled with Disturbed WEPP.
Potential for changes in timing and magnitude of water yield

The proposed action includes the removal of forest cover and has the potential to decrease interception and transpiration, and increase annual water yields. The potential for changes in timing of increases in runoff due to the proposed activities is important because of the potential impact on water supplies, sediment transport capacity, bank erosion, and aquatic ecosystems. In snow-dominated environments like Upper Sawmill, nearly all of the increases in runoff would occur in early spring. Forest harvest reduces summer evapotranspiration and increases the amount of soil moisture carryover. Less snowmelt is needed for soil moisture recharge, so more of the early season melt is converted into runoff. The reduction in forest canopy also increases the amount of solar radiation that reaches the surface of the snowpack and the transfer of advective heat, and these changes increase the amount of solar radiation that reaches the surface of the snowpack and the transfer of advective heat, and these changes increase the rate of snowmelt and may slightly accelerate the timing of peak runoff. Some change in timing is expected from both the beetle epidemic and proposed activities, however effects will be minimal based on the silviculture prescription and design of this project. The increases in annual water yield following forest harvest are usually assumed to be proportional to the amount of forest cover removed, but at least 10 to 20 percent of the trees must be removed to produce a statistically detectible effect. In areas where the annual precipitation is less than 18 to 20 in, removal of the forest canopy is unlikely to significantly increase water yields. In drier areas, the decrease in interception and transpiration is generally offset by the increase in soil evaporation, and there is no net change in runoff as long as there is no change in the underlying runoff process. No measurable increase in runoff can be expected from thinning operations that remove less than 15 percent of the forest cover or in areas with less than 18 in of annual precipitation. Since evapotranspiration rapidly recovers with vegetative regrowth in partially thinned areas, any increase in runoff due to thinning operations is likely to persist for no more than 5 to 10 years. The Sawmill HFRA Project area has an average annual precipitation of 19 inches and will treat less than 5 percent of the forested area in the subwatershed. There is not expected to be any detectable change streamflow in the Upper Sawmill subwatershed as a result of the proposed activities.

Figure 5 displays the pre-project and post-project ECAs as a percentage of the Upper Sawmill subwatershed. The ECA in Upper Sawmill peaked in 1987 with about 18% of the subwatershed in a hydrologically immature condition. Currently more than 95% of the subwatersheds encompassing the project area are in a mature condition. The ECA in Upper Sawmill would remain below 5 percent if the proposed action is implemented.
Figure 5. Percent of forested area in equivalent clearcut acres in the Upper Sawmill subwatershed over time.

Analysis of Haul Routes

Roads can affect hydrologic functions and resultant water quality by altering groundwater interception, runoff distribution over time and space, and the potential for sediment production and delivery to streams. The risks of a road affecting water yield and/or quality are largely determined by location, maintenance level, dimensions, and surfacing. Road density, expressed as miles per square mile, provides an index of the overall potential for roads to affect watershed function. In general, watersheds or subwatersheds with less than 30 percent watershed relief (30 percent average drainage slope from upper end to lower end) and road density of three miles per square mile or less are considered to have low risk for the overall potential for roads to affect watershed function (USDA Forest Service, 1993). The road density within the Upper Sawmill project area is 1.7 mi/mi.

Forest roads are needed to conduct the thinning, and timber harvest operations proposed in this alternative. Figure 6 displays road management associated with this project. These compacted road surfaces typically have very low infiltration rates and, as a result generate surface runoff. Road surfaces are subjected to rain splash, and the combination of rain splash with surface runoff results in surface erosion rates that are higher than the adjacent undisturbed forest. Research has consistently shown that roads have the greatest effect on erosion of all practices associated with forest management.
Figure 6. Proposed road management for the Sawmill Canyon HFRA project.
Runoff can detach and transport the fine material available on native material road surfaces, without vehicle traffic, the sediment concentration in the road decreases over time. However, vehicle traffic, especially heavy trucks, can crush surface aggregate material and this generates more fine particles that are available for transport by runoff. In addition, the pressure of vehicular tires on saturated road aggregate can force fine particles from below the surface to move to the surface. Higher use also is associated with more frequent maintenance operations, and grating increases the amount of available sediment and road erosion rates.

Haul routes (Table 12) and their proximity to streams are variable throughout the project area. Airborne delivery of fine sediment to streams would vary depending on many factors including the proximity to a stream, slope, vegetative cover, prevailing wind and season. Research by Randy Foltz, USDA Forest Service, Rocky Mountain Research Station, Forestry sciences Laboratory, Moscow, ID, and others has shown that if road blading is reduced, sediment that reaches streams is reduced.

Table 12. Proposed Haul Routes in Upper Sawmill (decommissioned)

<table>
<thead>
<tr>
<th>Forest ID</th>
<th>Route Name</th>
<th>Maintenance Level</th>
<th>Open Period</th>
<th>Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>40459</td>
<td>NORTH REDROCK</td>
<td>1 - BASIC CUSTODIAL CARE (CLOSED)</td>
<td></td>
<td>1.82</td>
</tr>
<tr>
<td>40460</td>
<td>REDROCK SPUR</td>
<td>2 - HIGH CLEARANCE VEHICLES</td>
<td>01/01-12/31</td>
<td>0.73</td>
</tr>
<tr>
<td>40459</td>
<td>NORTH REDROCK</td>
<td>2 - HIGH CLEARANCE VEHICLES</td>
<td>01/01-12/31</td>
<td>0.47</td>
</tr>
<tr>
<td>40459-A</td>
<td>NORTH REDROCK SPUR A</td>
<td>1 - BASIC CUSTODIAL CARE (CLOSED)</td>
<td></td>
<td>0.32</td>
</tr>
<tr>
<td>40469</td>
<td>SOUTH REDROCK</td>
<td>1 - BASIC CUSTODIAL CARE (CLOSED)</td>
<td></td>
<td>1.06</td>
</tr>
<tr>
<td>40460-B</td>
<td>REDROCK SPUR</td>
<td>1 - BASIC CUSTODIAL CARE (CLOSED)</td>
<td></td>
<td>1.05</td>
</tr>
<tr>
<td>40104</td>
<td>REDROCK LOOP</td>
<td>2 - HIGH CLEARANCE VEHICLES</td>
<td>01/01-12/31</td>
<td>1.26</td>
</tr>
<tr>
<td>40104</td>
<td>REDROCK LOOP</td>
<td>1 - BASIC CUSTODIAL CARE (CLOSED)</td>
<td></td>
<td>2.05</td>
</tr>
<tr>
<td>40455</td>
<td>CAMP CR. SPUR #2</td>
<td>1 - BASIC CUSTODIAL CARE (CLOSED)</td>
<td></td>
<td>0.31</td>
</tr>
<tr>
<td>40456</td>
<td>CAMP CR. SPUR #3</td>
<td>1 - BASIC CUSTODIAL CARE (CLOSED)</td>
<td></td>
<td>0.29</td>
</tr>
<tr>
<td>40105</td>
<td>TIMBER CREEK</td>
<td>2 - HIGH CLEARANCE VEHICLES</td>
<td>01/01-12/31</td>
<td>2.13</td>
</tr>
<tr>
<td>40470</td>
<td>BULL PINE T. S. ROAD</td>
<td>1 - BASIC CUSTODIAL CARE (CLOSED)</td>
<td></td>
<td>1.36</td>
</tr>
<tr>
<td>40379</td>
<td>QUIGLEY SPUR 5</td>
<td>1 - BASIC CUSTODIAL CARE (CLOSED)</td>
<td></td>
<td>0.26</td>
</tr>
<tr>
<td>40375</td>
<td>QUIGLEY SPUR 7</td>
<td>1 - BASIC CUSTODIAL CARE (CLOSED)</td>
<td></td>
<td>0.24</td>
</tr>
<tr>
<td>40347</td>
<td>QUIGLEY SPUR 4</td>
<td>1 - BASIC CUSTODIAL CARE (CLOSED)</td>
<td></td>
<td>0.40</td>
</tr>
<tr>
<td>40101</td>
<td>SAWMILL CANYON</td>
<td>3 - SUITABLE FOR PASSENGER CARS</td>
<td>01/01-12/31</td>
<td>9.62</td>
</tr>
</tbody>
</table>
Fines generated from increased road activity are generally airborne and fall out adjacent to the road and accumulate on the leaves of nearby vegetation. Typically dust settles quickly and is not transported far from the road. Dust and fine sediment are transported from the vegetation and incorporated into the forest floor during precipitation events. Typically airborne particles will only reach streams if they settle directly on the water surface. Sediment generated from hauling and road maintenance are not expected to measurably increase turbidity or levels of fine sediment in the Upper Sawmill Project area or negatively impact downstream beneficial uses.

On low-use forest roads, vegetation is allowed to grow on the running surface to reducing road-generated sediment. These “brushed-in” roads generally have sediment production rates that are a tenth of the rates for bare roads with traffic. Access for timber management activities will likely require that these brushed-in roads be reopened by scraping the vegetation off the running surface and to some degree, the cut and fill slopes. The opening and use of these roads have the potential to increase erosion and sediment delivery during the time they are open for the project. Any increases will quickly diminish after use is discontinued and the road is restored to a closed condition. Similar to road closure activities road obliteration has the potential for a spike in sediment production that decreases rapidly after the activity ends and vegetation becomes established.

For roads immediately adjacent to a stream, much of the road-generated sediment is delivered directly to streams. However, when a sufficient forest buffer is located between the road and the stream, much of the sediment may be captured and deposited on the forest floor. In addition to road location, road-stream connectivity can be increased because the concentrated runoff from roads can increase the drainage density. The proposed activities would decommission and revegetate 4.59 miles of road eliminating them as sources of sediment and removing the potential for flow capture and alteration of the drainage density.

In addition to roads used for the proposed action unauthorized routes that are not needed for public access or administrative use would be decommissioned to improve watershed conditions (Table 7). Surveys were conducted on these unauthorized routes to identify problem areas, develop closure prescriptions, and prioritize routes for closure (Table 2). Generally speaking, decommissioning roads by re-contouring to establish original drainage would be the preferential treatment, however, in most cases, the roads identified for decommissioning are well vegetated and closed to traffic. In these cases, a less disturbing method of decommissioning by treating only the entrance may be preferred.

**Detrimental Soil Disturbance**

Detrimental disturbance effects depend on a combination of factors such as existing ground cover, soil texture, timing of operations, equipment used, skill of the equipment operator, the amount of wood to be removed, and sale administration. Forest Plan disturbance guidelines are evaluated after the completion of all management activities including mitigation measures, such as, ripping skid trails and landings, redistributing berm and slash onto roads and skid trails, redistributing soil and slash on firelines, and installing waterbars. Harvest intensity also affects the amount of soil disturbance. Even though 15 percent of a stand may be impacted by skid trails and landings not all areas that are impacted are detrimentally disturbed. Thinning within proposed vegetation treatment units is designed to avoid detrimental soil impacts. This goal is achieved by implementing mitigation and design features as Best Management Practices and Soil and Water Conservation Practices. The design features and management practices would minimize the extent of compaction, rutting, puddling, and displacement.

**Tractor Harvest**
Soil compaction and displacement at landing sites and on main skid trails are expected due to equipment operations. The total area with potential for detrimental disturbance is 8.5 percent (Table 8). This assumes that all areas where the soil is contacted by equipment would be detrimentally disturbed. In reality the number is likely to be less than predicted. Only a small portion of the skid trails and landing are expected to be detrimentally disturbed and will be rehabilitated following completion of harvest activities. Soil monitoring was conducted to determine if there were lingering detrimental effects from past activities. Soil health ratings were satisfactory with a stable trend. No detrimentally disturbed areas were observed in any units including those that had been. Detrimental disturbance in proposed units would remain below 15%. Soil displacement is expected to be small and localized and may occur where logs are lifted from the forest floor or at landings. The impacts of compaction depend largely on site conditions affecting air and water balance in the rooting zone (Powers et al., 2004; Page-Dumroese et al., 2006). Compaction is not expected to be an issue in these units due to the high rock fragment content and sandy loam soil texture. In addition, areas that do become compacted or displaced would be rehabilitated by scarifying or ripping the soil to restore proper water infiltration, redistributing displaced topsoil, seeding with native species, and constructing waterbars. Plant root expansion, freeze/thaw cycles, and rodent activities will continue to rework the soil to improve soil structure.

Small, localized areas may have reduced soil productivity in the first 10 years following harvest as vegetation becomes re-established and organic layers rebuild. Areas of reduced productivity include skid trails, landings, and firelines. However, rehabilitation is prescribed to limit the severity of soil damage or its aerial extent.

Loss of groundcover and organic matter at landing sites and on main skid trails is expected due to equipment operations (Table 8). However, the Proposed Action is designed to leave a variety of organic matter on site. Vegetation and organic matter protects the soil surface from raindrop impact, dissipates energy of overland flow, binds soil particles together, and dampens soil temperature extremes and daily fluxes. Studies have found that 60% effective ground cover reduced sediment movement substantially and 30% ground cover reduced erosion by ½ compared to bare soil (Robichaud et al., 2000). Logging slash will add to effective ground cover until fine logging slash decomposes over several decades (Clayton, 1981). Any increase in groundcover and/or fine logging slash through harvest may be offset by fuel treatments. Fuel treatments may reduce the amount of organic matter and groundcover in the short term (0-5 years after treatment) through the use of fire and slash pile burning. In the long-term (greater than 5 years) re-growth of vegetation and needle drop would provide groundcover and leaf and litter material for conversion into soil organic matter.

Table 13. Detrimental soil disturbance estimates for Alternative 2 proposed harvest units.

<table>
<thead>
<tr>
<th>Unit</th>
<th>GIS Acres</th>
<th># of Trails</th>
<th>Trail Distance (ft)</th>
<th>Total Trail Distance (ft)</th>
<th>Area in Square Feet</th>
<th>Skid Trail acres</th>
<th># Landings Required</th>
<th>Acres of Landings</th>
<th>Disturbance Acres</th>
<th>Disturbance %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 GS</td>
<td>19.2</td>
<td>5</td>
<td>1,200</td>
<td>6,000</td>
<td>48,000</td>
<td>1.10</td>
<td>1</td>
<td>0.5</td>
<td>1.6</td>
<td>8.3</td>
</tr>
<tr>
<td>7S</td>
<td>16.6</td>
<td>7</td>
<td>500</td>
<td>3,500</td>
<td>28,000</td>
<td>0.64</td>
<td>2</td>
<td>1.0</td>
<td>1.6</td>
<td>9.9</td>
</tr>
<tr>
<td>3P</td>
<td>14.4</td>
<td>5</td>
<td>450</td>
<td>2,250</td>
<td>18,000</td>
<td>0.41</td>
<td>1</td>
<td>0.5</td>
<td>0.9</td>
<td>6.3</td>
</tr>
<tr>
<td>1S</td>
<td>27.2</td>
<td>8</td>
<td>750</td>
<td>6,000</td>
<td>48,000</td>
<td>1.10</td>
<td>2</td>
<td>1.0</td>
<td>2.1</td>
<td>7.7</td>
</tr>
<tr>
<td>2S</td>
<td>26.5</td>
<td>8</td>
<td>750</td>
<td>6,000</td>
<td>48,000</td>
<td>1.10</td>
<td>2</td>
<td>1.0</td>
<td>2.1</td>
<td>7.9</td>
</tr>
</tbody>
</table>
Pre-Commercial Thinning

Pre-commercial thinning activities would not impact the soil resource. All work would be accomplished with hand tools (chainsaws) so there would be no increases in soil compaction or other detrimental changes in soil physical properties.

Pile Burning

Pile burning would occur where hand or machine piles remain after treatment and biomass utilization. It is not anticipated to have large adverse effects to soil productivity. Burning of large slash piles may sterilize the underlying soil because heat is retained in the pile. This could cause small, localized areas of soil sterilization, reduced water infiltration, and lost groundcover.

Total Soil Resource Commitment

No new permanent road construction, permanent landings, or permanent skid trails that would convert productive sites to a condition of total soil resource commitment are planned as part of the proposed action. With this alternative approximately 4.59 miles of roads would be decommissioned. By decommissioning roads the total amount of total soil resource commitment will be reduced. By Decommissioning 4.59 miles of road approximately 16.7 acres of national forest system land will be returned to production.

b) Cumulative Effects

Cumulative effects are those direct and indirect effects that result from the proposed action or alternatives when added to other past, present, and reasonably foreseeable actions of the agency and others. Many multiple use management activities occur on lands within the Sawmill analysis area. These include things such as livestock grazing, recreational developments such as campgrounds, trails for hiking ATV’s and horses, fire control, wildlife fisheries and watershed habitat improvement projects, timber sales, insects and disease, special uses, mining, firewood cutting, and noxious weed treatments. Figure 16 displays major past disturbances (harvest, roads and wildfires) within the project area considered in this cumulative effects analysis.

All multiple use projects implemented on the Salmon-Challis N.F go through NFMA/NEPA analysis. Any project that has the potential for ground disturbance has the appropriate best management practices prescribed to minimize soil disturbance erosion and sedimentation.
A watershed risk rating based on watershed relief, road density, channel stability, and ECA was used to calculate the current cumulative effects for hydrologic and aquatic resources in each project subwatershed. The Upper Sawmill subwatershed would see a slight increase in ECA over a period of time. The increase would be from 3% to 4% at its peak and would be under the threshold that we would expect to see measurable change in flow. Road densities would be reduced from 1.6 mi/mi² to 1.4 mi/mi² improving watershed condition. The overall cumulative risk rating would remain the same however the resiliency of the watershed would be improved by protecting it from wildfire and reestablishing a more natural fire regime. The net result is a reduced watershed risk rating and an improved condition in the watershed.

Livestock grazing can affect watershed function and productivity of forest soils mainly through the modification of hydrologic properties. The primary means by which this is accomplished are by the reduction of vegetative cover (defoliation) and by trampling of the soil surface (McCalla et al. 1984). Livestock grazing in the Sawmill analysis area occurs primarily on the non-forested lands. Densely forested areas like those proposed for treatments in this project provide only transitory range. Consequently there are few cumulative impacts. The exception is the commercial thin/aspen release unit immediately adjacent to main Sawmill road in the Quigley Creek area. It is likely livestock would congregate here and slow recovery. To mitigate this potential use by livestock a wildlife friendly fence would be constructed to provide protection to the aspen stand to enhance regeneration success and to protect soils from trampling.

The Warm Creek Habitat Improvement Fence Project proposed in the analysis area and would exclude livestock from a portion Warm Creek. This proposed fencing project will be cumulatively beneficial to meeting TMDL goals in the project area by improving bank stability, reducing sediment, and enhancing vegetation and shading along Warm Creek.

When the effects of the Proposed Action Alternative are combined with the past and foreseeable future effects of insects and disease there is potential for an increased risk of hydrological effects of removing large stands of trees form a watershed. The loss of vegetation from insects and disease can reduce evapotranspiration and interception, which lessens detainment and storage of rainfall and changes snow distribution, accumulation, and melt rates.

Roads can alter the drainage density, and the timing and synchrony of stormflow and snowmelt runoff, resulting in an increase in the number and/or magnitude of peakflow events. The Proposed Alternative would reduce current road densities.

The present level of firewood cutting would have no effect on water resources. Public pioneering of roads to gather firewood could affect water resources depending on the extent and location of pioneered roads.

Noxious weed treatments have the potential to affect water quality by killing streamside vegetation and reducing the effectiveness of the filter strips. If procedures found in the Programmatic Biological Assessment: Effects of 2002 Herbicide Treatment of Noxious Weeds on Lands Administered by the Salmon-Challis National Forest (USFS 2002) are followed, no increased adverse effects to water quality are expected under the Proposed Action Alternative.
Figure 7. Disturbance history used to determine cumulative impact.
3. Alternative 3 - Helicopter Logging

a) Direct and Indirect Effects

Compliance with State Water Quality Standards and Maintenance of Beneficial Uses

The IDEQ Designated Beneficial Uses for Sawmill Creek include: Primary Contact Recreation, Industrial Water Supply, Wildlife Habitat and Aesthetics. Existing Beneficial uses include Cold Water Biota and Salmonid Spawning. The subsurface fine sediment target for this TMDL is set at 28% or less fine particles <6.35 mm (0.25 in) not including substrate larger than 63.5 mm (2.5 in). Attainment will be expected in habitat capable of supporting salmonid spawning after implementation of BMPs identified to reduce subsurface fine sediment. IDEQ states that beneficial uses were or would be fully supported at natural background sediment loading rates that are assumed to equate to 80% bank stability, and temperature regimes that would meet state water quality standards.

Alternative 3 includes ground disturbing activities such helicopter logging and road reclamation. There is a small chance (3% see analysis in the Proposed Action Modeled Probability of Erosion and Sediment Delivery section above) that a storm large enough to generate sediment from a proposed harvest unit before ground cover is fully reestablished. This small chance of sediment delivery to streams is mitigated by the BMPs required by INFISH. INFISH RHCA buffers (300 ft.) along stream channels would capture any sediment leaving a harvest unit before it reached a stream channel. Additionally the RCHA buffers insure riparian trees and shrubs are protected providing shade for streams maintaining cool stream temperatures. The proposed activities are not expected to affect streambank stability. In addition to protecting 303(d) streams from project activities. This project allows for an opportunity to further the goals established in the Little Lost Subbasin TMDL by eliminating roads from the system. Nine segments of roads representing 2.75 miles will be decommissioned. The decommissioned sections will have natural drainage restored, soil compaction relieved and native vegetation reestablished effectively eliminating these segments as contributing sediment sources.

Through project BMPs including INFISH guidance and proposed road decommissioning this project would be in compliance with section 303(d) of the Clean Water Act protecting Beneficial Uses and implementing in part the goals and recommendations of the Little Lost River Subbasin TMDL.
Modeled Probability of Erosion and Sediment Delivery

Activities proposed in Alternative 3 have the potential to increase the probability of erosion and sediment delivery to streams. In order to estimate the potential effects and evaluate differences between alternatives the WEPP model was used to estimate erosion and sediment delivery from treatment units. WEPP is a physically-based soil erosion model that can provide estimates of soil erosion and sediment delivery, considering the specific soil, climate, ground cover, and topographic conditions and treatment.

BMP reviews of past projects have shown that filterstrips provide effective buffers (undisturbed soil and vegetation) to capture sediment before it reaches a stream in the event that there is erosion and transport from the treatment unit. INFISH (USDA Forest Service, 1995) was amended to the Forest Plan and requires buffers along all water bodies with differing widths dependent on the type of feature and presence of fish. The RHCA buffers provide sediment filtering as well as other ecological functions (e.g. large woody debris recruitment, riparian habitat, floodplain function, insect production, and instream detritus).

Harvest units proposed in Alternative 3 were designed so that the standard INCFISH buffers were excluded from the treatment units (300 feet for fish bearing streams, 150 feet for non-fish bearing streams, or 100 feet of springs, lakes or wet areas).

The WEPP model uses the buffer, soil type, average slope, percent ground cover, and climate data to predict the probabilities of erosion and sediment yield occurring within the first year following treatment when the units would be most vulnerable to the effects of high intensity storms. The objective of the unit buffers was to minimize the percent probability that there would be sediment delivery in the first year following harvest.

Mean annual averages, probabilities of occurrence in the first year following disturbance, and buffer effectiveness during large storm events were estimated for a representative hillslope profile for each treatment unit (Figure 5, Table 6).

Helicopter logging systems are known to have the least amount of ground disturbance of the major harvest systems in use today. Research conducted by the Rocky Mountain Research Station found that where no post-harvest site preparation was performed using ground-based machines, helicopter harvesting resulted in significantly less detrimental disturbance (0.2%) than units harvested by either skyline (3.8%) or ground based systems (8.2%)(Reeves et al., 2011). With less than one percent ground disturbance and no skid trails needed the modeled probability of erosion and sediment delivery would be similar to the no action alternative. Table 11 compares the predicted probabilities of erosion and sediment delivery for all proposed project alternatives. For Alternative 3 the probability of runoff predicted by the model varied from a 2 to a 30 with no erosion and sediment delivery, similar to the no action alternative.

Potential for changes in timing and magnitude of water yield

Alternative 3 includes the removal of forest cover and has the potential to decreases interception and transpiration, and increase annual water yields. The potential for changes in timing and magnitude of water yield will be the same for Alternative 2 the Proposed Action. Figure 6 displays the pre project and
post project ECAs as a percentage of the Upper Sawmill subwatershed. The ECA in Upper Sawmill peaked in 1987 with about 18% of the subwatershed in a hydrologically immature condition. Currently more than 95% of the subwatersheds encompassing the project area are in a mature condition. The ECA in Upper Sawmill would remain below 5 percent if Alternative 3 is implemented.

There is not expected to be any detectable change in streamflow in the Upper Sawmill subwatershed as a result of the proposed activities.

**Analysis of Haul Routes**

The helicopter logging systems proposed in Alternative 3 will require fewer haul roads and will therefore have less impact related to haul routes. Table 14 identifies the 13 miles of road needed for haul routes under Alternative 3, seven miles fewer than the proposed action alternative. The routes used for this alternative are main routes that are wider and receive regular maintenance.

**Table 14. Proposed Haul Routes in Upper Sawmill Alternative 3**

<table>
<thead>
<tr>
<th>Forest ID</th>
<th>Route Name</th>
<th>Maintenance Level</th>
<th>Open Period</th>
<th>Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>40104</td>
<td>REDROCK LOOP</td>
<td>2 - HIGH CLEARANCE VEHICLES</td>
<td>01/01-12/31</td>
<td>1.26</td>
</tr>
<tr>
<td>40105</td>
<td>TIMBER CREEK</td>
<td>2 - HIGH CLEARANCE VEHICLES</td>
<td>01/01-12/31</td>
<td>2.13</td>
</tr>
<tr>
<td>40101</td>
<td>SAWMILL CANYON</td>
<td>3 - SUITABLE FOR PASSENGER CARS</td>
<td>01/01-12/31</td>
<td>9.62</td>
</tr>
</tbody>
</table>

Fines generated from increased road activity would be less than the proposed action alternative. Sediment generated from hauling and road maintenance are not expected to measurably increase turbidity or levels of fine sediment in the Upper Sawmill Project area or negatively impact downstream beneficial uses. Secondary roads proposed for opening in alternative 2 will not be open with this alternative maintaining the same potential for sediment generation as the no action. Road obliteration would occur on some routes and has the potential for a spike in sediment production that decreases rapidly after the activity ends and vegetation becomes established. The proposed activities would decommission and revegetate 2.75 miles of road eliminating them as sources of sediment and removing the potential for flow capture and alteration of the drainage density. Generally speaking, decommissioning roads by re-contouring to establish original drainage would be the preferential treatment, however, in most cases, the roads identified for decommissioning are well vegetated and closed to traffic. In these cases, a less disturbing method of decommissioning by treating only the entrance may be preferred.
Detrimental Soil Disturbance

With the use of helicopter logging systems the aerial extent of detrimental disturbance to soils within harvest units is minimized. Research based on observations from ten northern region national forests found that helicopter harvesting resulted in significantly less detrimental disturbance (0.2%) than units harvested by either skyline (3.8%) or ground based systems (8.2%) (Figure 8) (Reeves et al., 2011).

Detrimental disturbance effects depend on a combination of factors such as existing ground cover, soil texture, timing of operations, equipment used, skill of the equipment operator, the amount of wood to be removed, and sale administration. Forest Plan disturbance guidelines are evaluated after the completion of all management activities including mitigation measures, such as, ripping skid trails and landings, redistributing berm and slash onto roads and skid trails, redistributing soil and slash on firelines, and installing waterbars. Harvest intensity also affects the amount of soil disturbance. Even though 15 percent of a stand may be impacted by skid trails and landings not all areas that are impacted are detrimentally disturbed. Thinning and harvest within proposed vegetation treatment units is designed to avoid detrimental soil impacts. This goal is achieved by implementing mitigation and design features as Best Management Practices and Soil and Water Conservation Practices. The design features and management practices would minimize the extent of compaction, rutting, puddling, and displacement. Table 15 displays estimates of detrimental disturbance for Alternative 3. Under this alternative there would be two large helicopter landings totaling 6 acres. During the period of operations this area would be disturbed and in a nonproductive state. Post project reclamation including ripping and seeding would return the landing sites to their natural condition and are expected to fully recover in the following 1 to 2 growing seasons when vegetative ground cover is reestablished.

Table 15. Detrimental soil disturbance estimates for Alternative 3 proposed harvest units.

<table>
<thead>
<tr>
<th>Estimated Disturbance Acres – Alternative 3 Helicopter Logging</th>
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<tbody>
<tr>
<td><strong>Unit</strong></td>
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### Tractor Harvest

The effects of tractor harvest are minimized in Alternative 3 with the 14.4 acre unit 3p the only tractor harvested unit. Within this unit the effects would be the same as the proposed action described in the above section.

### Pre-Commercial Thinning

Pre-commercial thinning activities would not impact the soil resource. All work would be accomplished with hand tools (chainsaws) so there would be no increases in soil compaction or other detrimental changes in soil physical properties.

### Pile Burning

Pile burning would occur where machine piles remain after treatment. Burning of large slash piles may sterilize the underlying soil because heat is retained in the pile. This could cause localized areas of soil sterilization, reduced water infiltration, and lost groundcover. In Alternative 3 slash piles would be located at the helicopter landings and would be reclaimed by ripping and seeding after burning and would have no lasting effect to soils.

### Total Soil Resource Commitment

No new permanent road construction, permanent landings, or permanent skid trails that would convert productive sites to a condition of total soil resource commitment are planned as part of the Alternative 3. With this alternative approximately 2.75 miles of roads would be decommissioned. By decommissioning roads the total amount of total soil resource commitment will be reduced. By
Decommissioning 2.75 miles of road approximately 10 acres of national forest system land will be returned to production.

**b) Cumulative Effects**

Cumulative effects are those direct and indirect effects that result from the proposed action or alternatives when added to other past, present, and reasonably foreseeable actions of the agency and others. Many multiple use management activities occur on lands within the Sawmill analysis area. These include things such as livestock grazing, recreational developments such as campgrounds, trails for hiking ATVs and horses, fire control, wildlife fisheries and watershed habitat improvement projects, timber sales, insects and disease, special uses, mining, firewood cutting, and noxious weed treatments. Figure 7 displays major past disturbances (harvest, roads and wildfires) within the project area considered in this cumulative effects analysis.

All multiple use projects implemented on the Salmon-Challis N.F go through NFMA/NEPA analysis. Any project that has the potential for ground disturbance has the appropriate best management practices prescribed to minimize soil disturbance erosion and sedimentation.

A watershed risk rating based on watershed relief, road density, channel stability, and ECA was used to calculate the current cumulative effects for hydrologic and aquatic resources in each project subwatershed. The Upper Sawmill subwatershed would see an slight increase in ECA over a period of time. The increase would be from 3% to 4% at its peak and would be under the threshold that we would expect to see measurable change in flow. Road densities would be reduced from 1.6 mi/mi² to 1.4 mi/mi² improving watershed condition. The overall cumulative risk rating would remain the same however the resiliency of the watershed would be improved by protecting it from wildfire and reestablishing a more natural fire regime. The net result is a reduced watershed risk rating and an improved condition in the watershed.

Livestock grazing can affect watershed function and productivity of forest soils mainly through the modification of hydrologic properties. The primary means by which this is accomplished are by the reduction of vegetative cover (defoliation) and by trampling of the soil surface (McCalla et al. 1984). Livestock grazing in the Sawmill analysis area occurs primarily on the non-forested lands. Densely forested areas like those proposed for treatments in this project provide only transitory range. Consequently there are few cumulative impacts. The exception is the commercial thin/aspen release unit immediately adjacent to main Sawmill road in the Quigley Creek area. It is likely livestock would congregate here and slow recovery. To mitigate this potential use by livestock a wildlife friendly fence would be constructed to provide protection to the aspen stand to enhance regeneration success and to protect soils from trampling.

The Warm Creek Habitat Improvement Fence Project proposed in the analysis area and would exclude livestock from a portion Warm Creek. This proposed fencing project will be cumulatively beneficial to meeting TMDL goals in the project area by improving bank stability, reducing sediment, and enhancing vegetation and shading along Warm Creek.

When the effects of the Proposed Action Alternative are combined with the past and foreseeable future effects of insects and disease there is potential for an increased risk of hydrological effects of removing large stands of trees form a watershed. The loss of vegetation from insects and disease can reduce evapotranspiration and interception, which lessens detainment and storage of rainfall and changes snow distribution, accumulation, and melt rates.
Roads can alter the drainage density, and the timing and synchrony of stormflow and snowmelt runoff, resulting in an increase in the number and/or magnitude of peakflow events. The Proposed Alternative would reduce current road densities.

The present level of firewood cutting would have no effect on water resources. Public pioneering of roads to gather firewood could affect water resources depending on the extent and location of pioneered roads.

Noxious weed treatments have the potential to affect water quality by killing streamside vegetation and reducing the effectiveness of the filter strips. If procedures found in the *Programmatic Biological Assessment: Effects of 2002 Herbicide Treatment of Noxious Weeds on Lands Administered by the Salmon-Challis National Forest* (USDA Forest Service, 2002) are followed, no increased adverse effects to water quality are expected under the Proposed Action Alternative.

V. Implementation and Effectiveness Monitoring

The Forest Service policy for control of nonpoint sources of pollution is to use Best Management Practice’s (BMP’s), monitor the implementation and effectiveness of those BMP’s, and adjust management practices using monitoring results. The Sawmill interdisciplinary team has identified the appropriate BMP’s for this project and has developed site-specific BMP prescriptions based on site conditions, Idaho State BMPS, and other agency guidance and requirements. The deciding official will consider the recommendation of the IDT and make a decision on which site-specific BMP prescriptions will be applied to the project. Staff will monitor project activities and BMP effectiveness and make corrections to management practices if desired results are not obtained.

**Monitoring Tasks**

1. Interdisciplinary BMP review of project activities.
2. Depth fines monitoring of long term trend sites downstream of project activities.

VI. References


Elliot, William J.; Hall, David E.; Scheele, Dayna L.; February 2000. Disturbed WEPP (draft)
http://forest.moscowfsl.wsu.edu/fswepp/docs/fswepping.html


Idaho Department of Environmental Quality (IDEQ), 2000a. Idaho Administrative Code IDIPA 58.01.02, Water Quality Standards and Wastewater Treatment Requirements.
http://www2.state.id.us/adm/adminrules/rules/idapa58/0102.pdf (October 2003).


Idaho Department of Environmental Quality (IDEQ), 2011. 2010 Integrated 303(d)/305(b) Report.
http://www.deq.state.id.us/water/data_reports/surface_water/monitoring/integrated_report.cfm

Idaho Department of Lands, 2005. Rules Pertaining to the Idaho Forest Practices Act,(Title 38, Chapter 13, Idaho Code. [IDAPA 20.02.01000]


