**United States Department of Agriculture**
Forest Service

# Shasta Agness Landscape Restoration Project

## Hydrology Report

**Gold Beach Ranger District, Rogue River-Siskiyou National Forest, Curry County, Oregon**

/s/ *Lizeth A. Ochoa* **Date: December 30, 2018**
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**Shasta Costa Creek within the Shasta Agness Planning Area. Potential candidate for floodplain restoration for aquatic and riparian habitat improvements.**

# Table of Contents


I. Introduction ..... 1
II. Management Direction ..... 6
Project Design Criteria and Mitigation Measures for Riparian Reserves ..... 7
*1. Overall Project Design Criteria for Riparian Reserve Treatments* ..... 9
*2. Design Criteria for Perennial Streams* ..... 10
*3. Design Criteria for Non Fish-bearing Intermittent/Ephemeral Streams, and Wetlands* ..... 12
*4. Project Design Criteria for Road Reconstruction, Temporary roads, Decommissioning and Landings within Riparian Reserves* ..... 13
E. III. Current Conditions- Channel Condition and Morphology ..... 16
Existing 2018 Klondike Fire Conditions ..... 19
B. Lawson Creek Watershed Analysis (1997) ..... 22
Lower Illinois River Watershed Analysis, below Silver Creek (2000) ..... 25
D. Shasta Costa Creek Watershed Analysis (1996) ..... 27
A. 1. Shasta Costa Creek Level II Stream Survey, July 2014 ..... 27
C. Rogue River Watershed Analysis, Marial to Agness (1999) ..... 30
Other Streams ..... 38
Springs and Wetlands ..... 38
E. III. Current Condition- Water Quality ..... 38
F. G. Sedimentation/Turbidity and Stream Temperature ..... 41
Water Quality- Dissolved Oxygen and Fecal Coliform ..... 41
A. Hazardous Materials ..... 42
B. C. pH ..... 42
D. Biological Criteria ..... 42
E. Habitat Modification ..... 43
F. IV. Hydrologic Effects and Mechanisms & Analysis Framework ..... 46
A. Channel Morphology and Large Wood ..... 47
B. Sediment Delivery ..... 48
C. Water Yield (Peak Flows) ..... 52
D. Stream Temperature ..... 53
A. V. Hydrologic Effects of Alternatives ..... 54
Alternative 1, 2, and 3- Direct and Indirect Effects of Sustainable Roads (Haul Routes, Road Maintenance, Road Decommissioning, Road Storage, Road Improvements, and Temporary Roads) ..... 54
1. Haul Routes and Road Maintenance ..... 54
B. 2. Temporary Roads ..... 54
3. Road Decommissioning, Road Storage, and Existing Road Openings ..... 56
C. Alternatives 1, 2, and 3- Direct and Indirect Effects of Silvicultural and Activity Fuel Treatments ..... 60
1. Direct and Indirect Effects of Logging Systems ..... 63
2. Direct and Indirect Effects of Silviculture and Activity Fuels within Riparian Reserves ..... 66
D. Alternative 1, 2 and 3- Direct and Indirect Effects of Riparian and Aquatic Restoration ..... 67
1. Large Instream Wood Placement ..... 67
2. Aquatic Organism Passage (AOP) Barrier Removal ..... 68
3. Beaver reintroduction and/or installation of Beaver Dam Analogues ..... 69
Alternative 1- Direct and Indirect Effects of Recreation Improvements ..... 70
1. Water Quality- Fecal Coliform ..... 72
2. Billings Creek Dispersed Campground ..... 72
3. Foster Bar Facility and Foster Bar Boat Launch Improvements ..... 72
4. Illahee Campground ..... 73
5. Oak Flat Campground Host and Facility Maintenance ..... 73
6. Shasta Costa Improvements ..... 73
7. Upper Rogue and Big Bend/ Rogue River Trailhead Improvements ..... 74
8. Motorized Trail Conversion ..... 74
9. Nancy Creek Trail Decommissioning ..... 75
E. Alternative 2- Direct and Indirect Effects of Recreation Improvements ..... 75
1. Water Quality- Fecal Coliform ..... 77
2. Billings Creek Dispersed Campground ..... 77

3. Foster Bar Facility and Foster Bar Boat Launch Improvements ..... 78
4. Illahee Campground ..... 78
5. Illinois TH Horse Camp (new) ..... 78
6. Oak Flat Campground Boat Ramp and Water Recreation Improvements ..... 79
7. Shasta Costa Campground ..... 79
8. Upper Rogue and Big Bend/ Rogue River Trailhead Improvements ..... 80
9. Motorized Trail Reconstruction ..... 80
10. Shasta Agness Trail Construction and Maintenance (Big Bend/Rogue River Trail, Nancy Creek Trail, Shasta Costa Creek Trail, Shasta Costa Overlook A, and Shasta Costa Overlook B) ..... 80
F. Alternative 3- Direct and Indirect Effects of Recreation Improvements ..... 81
1. Water Quality- Fecal Coliform ..... 83
2. Billings Creek Dispersed Campground ..... 83
3. Foster Bar Facility and Foster Bar Boat Launch Improvements ..... 83
4. Illahee Campground ..... 83
5. Upper Rogue and Big Bend/ Rogue River Trailhead Improvements ..... 83
6. Oak Flat Campground Host ..... 83
7. Shasta Costa Improvements ..... 83
8. Big Bend/ Rogue River Trailhead Improvements ..... 83
9. Motorized Trail Reconstruction ..... 84
10. Nancy Creek Trail Decommissioning ..... 84
G. Alternative 4- No Action ..... 84
H. Cumulative Watershed Effects of Alternatives 1, 2, and 3 ..... 85
1. Past Activities ..... 86
2. Present & Future Activities ..... 87
3. Conclusion ..... 88
VI. Aquatic Resource Conservation Strategy Objectives ..... 89
VII. References ..... 97
VIII. Appendix 1: Prescribe Burn in Riparian Reserves ..... 101

## List of Tables

Table 1. The Shasta Agness Planning Area by watershed and ownership. ..... 1
Table 2. Estimated silvicultural treatment acres within Shasta Agness Planning Area. ..... 1
Table 3. Candidate stand acres by 5th field watersheds for Alternative 1. ..... 2
Table 4. Estimated road mileage of proposed treatments within Shasta Agness Planning Area. ..... 2
Table 5. Estimated footprint for aquatic and riparian habitat treatments within Shasta Agness Planning Area. ..... 3
Table 6. Estimated acreage of sustainable recreation improvements within Shasta Agness Planning Area. ..... 3
Table 7. Trails proposed for each alternative within the Shasta Agness Planning Area. ..... 4
Table 8. Silvicultural and Fuels Treatment Unit Acres intersecting Riparian Reserve for each action alternative. ..... 8
Table 9. Harvest (Logging) systems acres intersecting Riparian Reserves for each action alternative. ..... 8
Table 10. Primary Shade Zone Width, Based on Adjacent Hill Slope and Average Tree Height within Perennial Streams. 11
Table 11. Overall Design Criteria for Timber Felling and Yarding within Riparian Reserves. ..... 13
Table 12. Summarizes watershed conditions within Shasta Agness Planning Area. ..... 16
Table 13. Water Quality Limited Streams within Shasta Agness Planning Area. ..... 39
Table 14. Range of stream temperatures for water quality limited streams exceeding ODEQ temperature standards. Records are from the most recent stream survey. ..... 40
Table 15. Road density by 6th field watersheds within project area for Forest Service system roads. ..... 49
Table 16. Road density by 6th field watersheds within project area for *all* roads. ..... 50
Table 17. Potential considerations for peak flow increases. ..... 52
Table 18. Factors that Influence Stream Surface Shade. ..... 53
Table 19. Watershed, road bed template, and total miles for proposed temporary roads for each Action Alternative. ..... 56
Table 20. Proposed sustainable road treatments for all action alternatives in the Shasta Agness Planning Area. ..... 59
Table 21. Silvicultural and Activity Fuel Treatments by Watershed. ..... 62
Table 22. Project Acreages by Logging System for Action Alternatives. ..... 65
Table 23. Percent of Subwatershed Affected by Ground Based Equipment. ..... 66
Table 24. Project-wide Riparian Logging System Comparison by Action Alternative ..... 67

Table 25. Proposed recreation improvements for alternative 1 within the Shasta Agness planning area. ..... 70
Table 26. Proposed recreation improvements for alternative 2 within the Shasta Agness planning area. ..... 75
Table 27. Proposed recreation improvements for alternative 3 within the Shasta Agness planning area. ..... 81
Table 28. Ownership by 5th field watershed. ..... 86

## List of Figures

Figure 1. Shasta Agness Planning Area 5th and 6th Field Watersheds. ..... 5
Figure 2. Riparian Reserve Design Elements – Perennial Fish & Non-Fish Bearing Streams ..... 11
Figure 3. Riparian Reserve Design Elements – *Ephemeral/Intermittent Stream Channels, and Wetlands.* ..... 12
Figure 4. Soil Burn Severity Map. ..... 20
Figure 5. Lawson Creek- Illinois River 5th Field watershed within Shasta Agness planning area..... 25
Figure 6. Stair Creek- Rogue River 5th Field watershed within Shasta Agness planning area. ..... 36
Figure 7. Shasta Costa Creek-Rogue River 5th Field Watershed within Shasta Agness planning area..... 37
Figure 8. Existing Stream Shade for Planning Area in Shasta Costa Creek-Rogue River Watershed..... 44
Figure 9. Existing Shade for the Planning Area in Lawson Creek- Illinois River Watershed. The boundary of the Shasta Agness planning area extends from Lawson Creek downstream to the mouth of the Illinois River. The Shasta Agness planning area also does not include above the confluence of Horse Sign Creek and the Illinois River. ..... 45
Figure 10. Existing Shade for Planning Area in Stair Creek-Rogue River Watershed. ..... 46
Figure 11. Road density for 6th field watersheds within the Shasta Agness planning area. ..... 51

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[1] an updated EEO statement (as of 2016).

# I. Introduction

The project planning area for the Shasta Agness Landscape Restoration Project is approximately 92, 207 acres (see Table 1). The Planning Area falls within the Lawson Creek-Illinois River, Shasta Costa Creek-Rogue River, and the Stair Creek- Rogue 5th-Field[2] watersheds (see Figure 1). Four watershed analyses have been completed that cover the Planning Area and contain a synthesis of scientific knowledge about watershed trends and conditions at watershed scales as well as by smaller sub-watersheds.

**Table 1. The Shasta Agness Planning Area by watershed and ownership.**

| Watershed Name | 5th -field HUC-10 Number | Acres in Watershed | Acres (%) of Watershed in Planning Area | Acres (%) In Federal[1] Ownership |
|---|---|---|---|---|
| Lawson Creek – Illinois River | HUC-10 #1710031111 | 41,179 | 10,638 (26%) | 9,308 (87%) |
| Shasta Costa Creek – Rogue River | HUC-10 #1710031006 | 45,026 | 45,026 (100%) | 43,650 (97%) |
| Stair Creek – Rogue River | HUC-10 #1710031005 | 36,544 | 36,544 (100%) | 35,933[1] (98%) |
| Totals | | | 92,207 | 88,891 (96%)[1] |

1. Total of acres managed by Forest Service or BLM (895 acres).

The proposed action for this project (DEIS Alternative 1) would enact multiple actions across the Shasta Agness landscape. These actions would: A) restore unique ecosystems through vegetation treatment and management, and promote late seral habitat development; B) restore and protect aquatic and riparian habitat conditions; and C) provide recreational user opportunity.

The following tables summarize the estimated footprint of each proposed action and alternative:

**Table 2. Estimated silvicultural treatment acres within Shasta Agness Planning Area.**

| Unique Landscape Restoration[3] | Alternative 1 | Alternative 2 | Alternative 3 |
|---|---|---|---|
| Oak Habitat Restoration (acres) | 2199 | 2199 | 1147 |
| Serpentine Pine Restoration (acres) | 484 | 0 | 484 |
| Sugar pine Habitat Restoration (acres) | 549 | 0 | 531 |
| Candidate Plantation Thinning Treatments (acres) | 1635 | 1635 | 1635 |
| Port Orford Cedar Sanitation (acres) | 241 | 0 | 241 |
| Burn Between[4] (acres) | 1859 | 851 | 0 |

[2] A 5th field watershed is a hydrologic classification of stream basins applied to watersheds of 20 to 200 square miles. A 6th field subwatershed is typically one of several subwatersheds within the larger 5th field watershed. Hydrologic Unit Code (HUC).
[3] Riparian Thinning and native species planting is a subset of the total acreage calculated in Unique and Candidate Plantation treatment units.
[4] Additional burn outside and between identified candidate stand treatment units.

| | | | |
|---|---|---|---|
| **Adaptive Fire Re-entry (acres)** | **6726** | **4685** | **3797** |
| **Total Vegetation Treatment (acres)** | **6967** | **4685** | **4038** |
| **Difference in Vegetation Treatments Relative to Alternative 1 (acres)** | **0** | **2282** | **2929** |

**Table 3. Candidate stand acres by 5th field watersheds for Alternative 1.**

| 5th Field Watershed | Stand Type | Estimated Acres |
|---|---|---|
| **Lawson Creek-Illinois River** | **Burn Between**<br>**Oak**<br>**Plantation**<br>**Serpentine Pine** | **329**<br>**790**<br>**139**<br>**87** |
| **Total** | | **1344** |
| **Shasta Costa Creek – Rogue River** | **Burn Between**<br>**Oak**<br>**Plantation**<br>**Serpentine Pine**<br>**Sugar Pine** | **1530**<br>**1410**<br>**377**<br>**397**<br>**549** |
| **Total** | | **4263** |
| **Stair Creek – Rogue River** | **Plantation** | **1119** |
| **Total** | | **1119** |

**Table 4. Estimated road mileage of proposed treatments within Shasta Agness Planning Area.**

| Sustainable Roads | Alternative 1 | Alternative 2 | Alternative 3 |
|---|---|---|---|
| **Existing Road Openings (ML1 to ML2) (miles)** | **1** | **1** | **0** |
| **Road Storage (ML2 to ML1) (miles)** | **9** | **4** | **8** |
| **Road Decommissioning (miles)** | **6** | **6** | **10** |
| **Haul Routes (miles)** | **193** | **151** | **192** |
| **Non-System Road Template Re-used (miles)** | **12** | **10** | **12** |
| **New Temporary Roads (miles)** | **5** | **4** | **0** |

**Table 5. Estimated footprint for aquatic and riparian habitat treatments within Shasta Agness Planning Area.**

| Aquatic and Riparian Habitat Treatments | Alternative 1 | Alternative 2 | Alternative 3 |
|---|---|---|---|
| Instream Large Wood Placement (miles) | 29 | 29 | 29 |
| Removal of Aquatic Organism Passage Barriers (Quantity) | 8 | 8 | 0 |
| Beaver Reintroduction and/or Beaver Dam Analogues (Sites) | 5 | 0 | 0 |

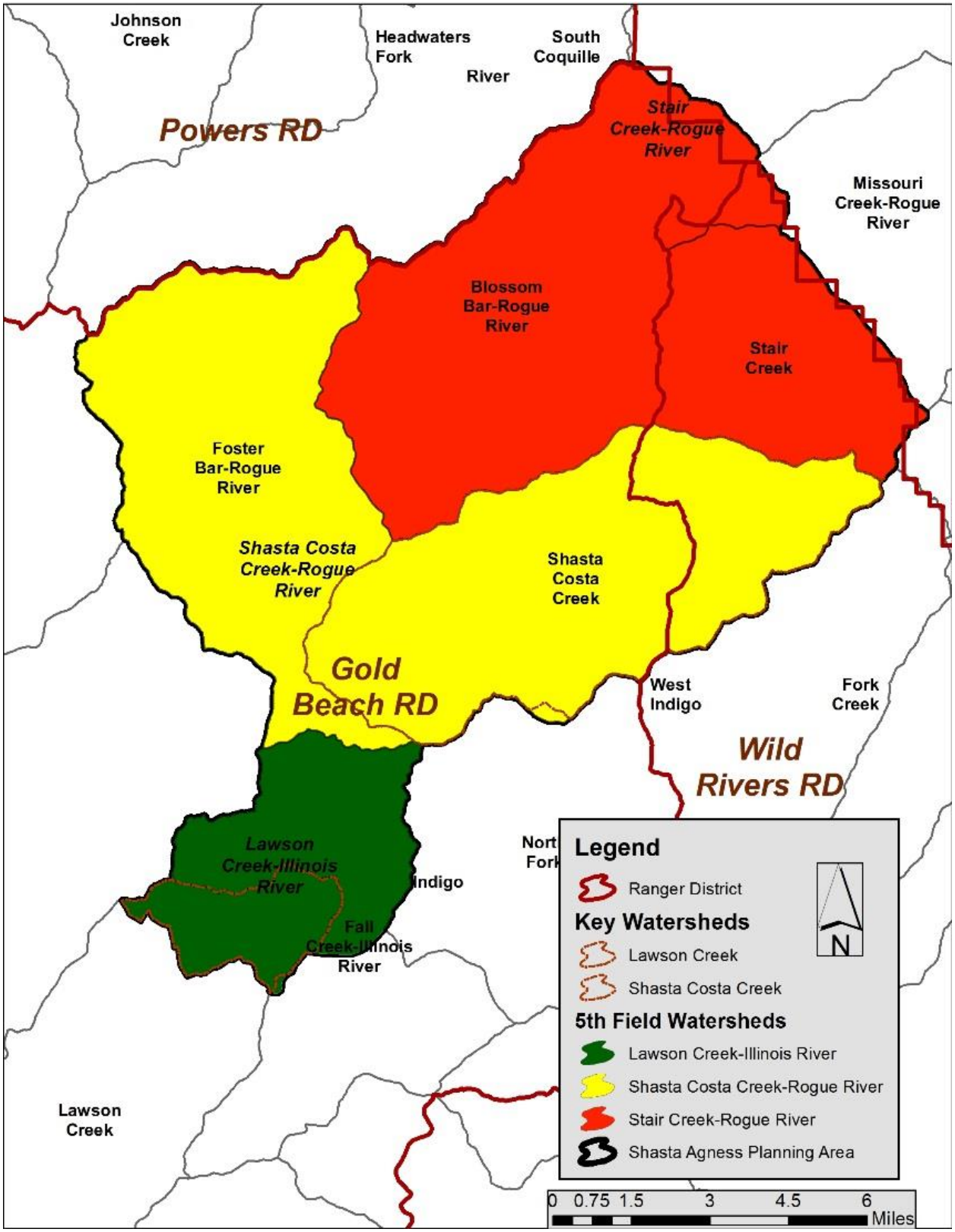
**Table 6. Estimated acreage of sustainable recreation improvements within Shasta Agness Planning Area.**

| Sustainable Recreation Improvements | Alternative 1 (acres) | Alternative 2 (acres) | Alternative 3 (acres) |
|---|---|---|---|
| Billings Cr Dispersed Campground Decommissioned | 0.2 | 0 | 0.2 |
| Foster Bar Facility Maintained | 2.8 | 2.8 | 2.8 |
| Foster Bar Launch Improved | 0.4 | 0.4 | 0 |
| Illahee CG Decommission | 9.9 | 0 | 9.9 |
| Illahee CG Reopened | 0 | 15.7 | 0 |
| Illinois TH Horse Camp (new) | 0 | 1.1 | 0 |
| Oak Flat CG Host | 0.3 | 0.3 | 0.3 |
| Oak Flat CG Boat Ramp/Water | 0 | 21.8 | 0 |
| Shasta Costa Maintenance | 1.2 | 1.2 | 1.2 |
| Shasta Costa Campground (new) | 0 | 8.1 | 0 |
| Upper Rogue TH Improvements | 0.1 | 0.1 | 0 |
| Totals Acres | 14.9 | 51.5 | 14.4 |

**Table 7. Trails proposed for each alternative within the Shasta Agness Planning Area.**

| Trail Name | Trail Type | Alt. 1 (mi.) | Alt. 2 (mi.) | Alt. 3 (mi.) |
|---|---|---|---|---|
| Big Bend Battlefield trail | New trail | 0 | 1.4 | 0 |
| Foster Cr to Brewery Hole trail | New trail | 0 | 0.8 | 0 |
| Foster/Brewery tie-in w/Up. Rogue trail | New trail | 0 | 0.1 | 0 |
| FSR 2308330 to OHV trail | Motorized trail | 0.7 | 0.7 | 0 |
| FSR 3577350 to OHV trail | Motorized trail | 3.9 | 3.9 | 0 |
| Nancy Cr trail 1181 decommissioned | Decomm. trail | 1.9 | 0 | 1.9 |
| Shasta Costa Creek trail | New trail | 0 | 4.3 | 0 |
| Shasta Costa Overlook A | New trail | 0 | 2.8 | 0 |
| Shasta Costa Overlook B | New trail | 0 | 1.9 | 0 |
| **Total miles** | | **6.5** | **15.9** | **1.9** |

**Figure 1. Shasta Agness Planning Area 5th and 6th Field Watersheds.**



# II. Management Direction

The Northwest Forest Plan's (NWFP) Aquatic Conservation Strategy (ACS) has four components: Riparian Reserves, Key Watersheds, Watershed Analysis, and Watershed Restoration. It is guided by nine objectives which are meant to focus agency actions to protect ecological processes at the 5th-field hydrologic scale, or watershed, at the 6th and or 7th fields (subwatershed and or drainage), and at the site level.

Standards and Guidelines for Riparian Reserves are located on pages C-30 through C-38 in the Northwest Forest Plan (NWFP). Timber harvest is prohibited in Riparian Reserves except where needed to attain Aquatic Conservation Strategy objectives (refer to NWFP, page B-11).

The Siskiyou National Forest Land and Resource Plan (LRMP) provides standards and guidelines for soil and water resources on pages IV-44 through VI-48. Management prescriptions for Riparian areas are provided on pages IV-124 through IV-128. LRMP riparian areas extend at least 100 feet to either side of perennial channels; 150 feet is recommended for Class I and II streams. This would be less than the buffer widths provided by the Northwest Forest Plan of one to two site potential tree heights (175 feet and 350 feet, respectively) and its additional buffer of one site potential tree height for intermittent and ephemeral channels.

The Siskiyou National Forest typically utilizes a standard site potential tree height of 175 feet for analysis purposes. For the project area, a stream network was generated from a digital elevation model. A mapped perennial channel is initiated when a collection area reaches 25 acres. Field work verifying the presence of ephemeral or perennial channels was used to confirm the model was accurate. Mapping used for analysis of the alternatives displays the following riparian buffers:

| | |
|---|---|
| **Class I Streams: perennial, fish habitat** | **350 feet** |
| **Class II Streams: perennial, non-fish bearing** | **175 feet** |
| **Class III Streams: ephemeral or intermittent** | **175 feet** |

Under Northwest Forest Plan direction, Key Watersheds are not a designated area or matrix, but overlay all allocations. Portions of the Planning Area are within two Key Watersheds (Lawson Creek and Shasta Costa Creek). Lawson Creek and Shasta Costa Creek are Tier 1 Key Watersheds[5] designated as critical for the management and recovery of salmonid species of fish under the Northwest Forest Plan. Timber harvest cannot occur in Key Watersheds or Riparian Reserves unless watershed analysis is performed to characterize the aquatic, riparian, and terrestrial features within a watershed and to guide activities toward meeting Aquatic Conservation Strategy goals (ROD, page B-20, USFS, 1994). The watershed analyses being used for this document are the following: The Lawson Creek Watershed Analysis Iteration 2.0 (1997), The Shasta Costa Creek Watershed Analysis (1996), and Rogue River Watershed Analysis, Marial to Agness (1999). Outside of Inventoried Roadless Areas (RARE II) management direction is to reduce existing system and non-system road mileage. Under the Northwest Forest Plan, Basis for Standards and Guidelines (NWFP page B-19), there is to be no net increase in the amount of roads; "The amount of existing system and nonsystem roads within Key Watersheds should be reduced through decommissioning of roads."

[5] Tier 2 Key Watersheds are important sources of high quality of water. There are no Tier 2 Key Watersheds within the Shasta Agness planning area.

The basis for this Standard and Guidelines is "amount of existing system and non-system roads." This Standard and Guideline is applicable at the fifth-field scale.

Inside the planning area the Rogue River and Illinois River are designated as Wild and Scenic Rivers. Approximately 16 miles of the wild section of the Rogue River lie in the Shasta Agness planning area. The Illinois River is classified as recreational from its mouth to Nancy Creek, approximately 3.8 miles; and wild from Nancy Creek to the project area boundary, approximately 1.6 miles. Management objectives for Rogue River wild section include to: preserve its essentially primitive character and outstanding scenic attractions, maintain or improve the quality of the water which it enters the river, improve the fish and wildlife habitat, and provide opportunities for river-orientated recreation which is dependent on the free-flowing condition of the river and consistent with the primitive character of the surroundings (USDA 1969). In general, management objectives for the Illinois River are similar, however the Illinois Wild and Scenic River Management Plan (USDA 1985), emphasize the focus on the maintenance of white water boating experience in one of the most primitive settings in the U.S.

Water quality in Oregon is managed in part by compliance with Section 303(d) of the 1972 Federal Clean Water Act with water quality standards set by the Oregon Department of Environmental Quality (DEQ) and the U.S. Environmental Protection Agency (EPA). DEQ is responsible for designating streams and water bodies that require effluent limitations, and, for developing Total Maximum Daily Load (TMDL) allocations that will ensure water quality standards are met. The most recent listing of impaired waters is available on a DEQ website as "Oregon's 2012 Integrated Report" (http://www.deq.state.or.us/wq/assessment/assessment.htm).

## E. Project Design Criteria and Mitigation Measures for Riparian Reserves

This section discusses elements related to the design of treatments and actions (i.e., Project Design Criteria), applicable to Riparian Reserves, under the Action Alternatives for silvicultural treatments. These elements were utilized to develop proposals and/or are to be employed during on-the ground project designation/implementation and are designed to address overall objectives (attain the Purpose and Need) and resource objectives to manage consequences (obtain compliance with Standards and Guidelines). These and other elements that manage consequences during actual operations can also be termed "Mitigation Measures, Best Management Practices, Project Design Features, or Conservation Measures" and are discussed in Appendix B of the DEIS.

Project Design Criteria are employed concurrent with the various silvicultural and aquatic restoration treatment elements, as well as proposed sustainable recreation activities. Many specific Riparian Reserve design elements would require site-specific recommendations for application from Forest Service resource professionals during implementation (adaptive management). These are overall design elements/mitigation measures applicable to all treatments.

Density management and/or commercial extraction within Riparian Reserve shall only be considered to maintain, enhance or restore Aquatic Conservation Strategy (ACS) objectives. Timber harvest in Riparian Reserves is prohibited unless treatments promote desired vegetation characteristics needed to attain ACS objectives or to mitigate damaging effects from catastrophic events such as fire, flooding, volcanic, wind, or insect damage (NWFP Standards and Guidelines, Timber Management, TM-1).

Though commercial harvest and density management are usually prohibited in Riparian Reserves, there are situations in which timber harvest may be needed to maintain or restore (improve) ACS Objectives include thinning in forested Riparian Reserves to improve root strength, and other characteristics having to do with overall health and vigor of the stand. A young, healthy stand has greater potential to restore the timing, volume, rate, and character of sediment input and storage (water quality and aquatic habitat). A young healthy stand also has greater potential to grow into a late seral forest, eventually providing late-successional habitat and large wood recruitment for streams.

Riparian Reserve and its appurtenant Standards and Guidelines apply where these reserves overlap other land allocations (i.e., within LSR). Consequently, field identification of Riparian Reserves and validation of fish-bearing status and stream classification would be required before implementation of treatments. An estimate of Riparian Reserve acreage within proposed units associated with each Action Alternative has been made and is described in Table 8. In addition, Table 9 describes an estimate of the harvesting system acreage for each action alternative.

**Table 8. Silvicultural and Fuels Treatment Unit Acres intersecting Riparian Reserve for each action alternative.**

| Treatment Type | Alternative 1-Preferred | Alternative 2- Modified Collaborative | Alternative 3-Minimum Scope |
|---|---|---|---|
| Burn Between(acres) | 529 | 234 | 0 |
| Oak (acres) | 477 | 477 | 247 |
| Serpentine Pine (acres) | 69 | 0 | 69 |
| Sugar pine (acres) | 44 | 0 | 44 |
| Plantation (acres) | 384 | 337 | 309 |
| POC Sanitation (Acres) | 79 | 0 | 79 |
| Legacy Roads (Existing) (Miles) | 0.7 | 0.7 | 0.7 |

**Table 9. Harvest (Logging) systems acres intersecting Riparian Reserves for each action alternative.**

| Harvest (Logging) Systems | Alternative 1-Preferred | Alternative 2-Modified Collaborative | Alternative 3-Minimum Scope |
|---|---|---|---|
| Ground Based Systems (tractor, rubber-tired skidder, harvester-forwarder) (acres) | 274 | 271 | 187 |
| Skyline-Cable Systems (acres) | 169 | 149 | 119 |
| Aerial (Helicopter) Systems (acres) | 197 | 195 | 112 |
| Non-Commercial[6] (acres) | 941 | 432 | 331 |

Thinning within Riparian Reserves associated with perennial streams within some candidate stands and natural stands is proposed, based on field reconnaissance. Further investigation during implementation may identify Riparian Reserves that are currently fully functioning and not in need of thinning treatments. There are likely to be intermittent or perennial streams not yet identified. These areas would need to be identified through additional field reconnaissance and mapped in GIS. Some, all, or none of these Riparian Reserves may need vegetative treatment to maintain or improve their function in accordance with the ACS.

Specifically for the Shasta Agness Project, proposed Riparian Reserve treatments and connected actions are to be designed to *avoid or minimize conditions* that would increase hydrologic connectivity, increase drainage from roads into streams (especially higher order streams),

[6] Non-commercial total acreage includes POC sanitation total acreage as well as areas included for prescribed fire that are between vegetation treatment units.

increase interception and concentration of subsurface slope flow by road cuts, concentrate runoff into centralized drainage conduits (especially near higher order streams), increase runoff from impervious surfaces or concentrated areas of compaction (landings, skyline pads, roads), and increase activity generated sediment, especially in high-risk areas. This would be accomplished by implementing project design criteria (PDCs), best management practices (BMPs), and other mitigation measures to avoid, minimize, reduce, or rectify any potential negative impacts.

High-risk areas for increased runoff, erosion and hydrologic connectivity as classified for the Shasta Agness Project include steep slopes, high water table areas, proximity to previously disturbed areas (e.g., regeneration harvest along FS/private land boundaries, and proximity to high order streams (mid- and low- slope positions in watersheds).

### *1. Overall Project Design Criteria for Riparian Reserve Treatments*

This sub-section discusses criteria for proposed silvicultural treatments and connected actions associated with timber yarding and felling within Riparian Reserves. Access and haul are discussed in the next sub-section on roads.

Riparian Reserve widths are based on one site-potential tree height[7] each side of stream course (assumed to be 175 feet for all areas within Shasta Agness Planning Area). The Riparian Reserve width for fish-bearing streams is two site potential tree heights on each side (350 ft.). All Riparian Reserves would be identified during implementation and prior to treatments (including currently unmapped Riparian Reserves within treatment areas).

Riparian Reserve treatments and project design elements fall into three categories; **fish-bearing perennial streams**, **non-fish-bearing perennial streams**, and **intermittent/ephemeral streams, and wetlands** (see next sub-sections). Further explanation of categories and terms used in these criteria are contained below.

Silvicultural treatments within Riparian Reserves would include density management thinning via removal of intermediate and suppressed trees. Treatments would be designed to produce a variable thin and create an uneven canopy closure across the stand. For the Shasta Agness Project, Riparian Reserve treatments would typically occur within the outer edges of Riparian Reserves (upland, farthest from stream course, typically with no actual riparian vegetation).

- No density management treatment would reduce the existing overstory canopy closure within the Riparian Reserve treatment zone to less than 50%.
- For *perennial* streams all overstory canopy will be maintained in the primary shade zone[8].
- Commercial extraction of trees would occur outside of variable, no-treatment stream course buffers, according to stream category (45 to 75-ft. depending on slope and fish-bearing status) (see next sections and Table 10).
- To reduce the risk of sediment delivery, soil compaction or the loss of soil infiltration capacity in the riparian area of the streams, yarding activities **within 100 feet of all stream courses, pre and post activity would not result in a loss**

[7] A site potential tree height is the average maximum height of the tallest dominant trees (200 years or older) for a given site class

[8] The Primary Shade Zone is an area where no commercial extraction would occur, however some enhancement treatments could occur. Distance from active stream channel varies according to height of existing overstory trees and hill slope in immediate area.

**of more than 10% of the soil infiltration capacity** which reduces concerns for sediment reaching the stream. This activity would include existing skid trails, which could be re-utilized as necessary and then be ripped (as feasible) to re-establish soil infiltration capacity. Use of long-lining (winch line) to remove material from treatment areas is allowed where it is determined to be of benefit to Riparian Reserve conditions such as reducing the amount of skid trails needed.

- Yarding activities should achieve full suspension over the active channel[9] (all streams). To facilitate log suspension with skyline operations, corridors for cable rigging would be allowed to pass through Riparian Reserves. A maximum clearing width of 12 feet is required and logs may be yarded through this corridor if necessary. Perennial stream corridors must be spaced at a minimum of 200 feet apart if they pass through Riparian Reserves. Corridor "rub trees" within the Riparian Reserve, even if damaged, would either be left standing or felled and left in place.
- Hand piles and burning should be no closer than 25 ft. from all stream channels to maintain ground vegetation.
- No new temporary roads or landings, gap treatments, or heavy thinning is proposed nor allowed within Riparian Reserves. Legacy roads or landings found within riparian reserves are to be examined in the field by a Soil Scientist, Hydrologist, or Geologist to prescribe site specific mitigation to improve conditions post-harvest, and would allow for short-term use.
- During all treatment actions (including Rx fire), protect existing infrastructure used to collect, impound, store, transmit, and distribute water for uses on and off National Forest System (NFS) lands. A hydrologist will assist in field identification and delineation of water use infrastructure required before implementation of treatments."

### *2. Design Criteria for Perennial Streams*

This category includes permanently flowing perennial fish-bearing and non-fish-bearing streams. The primary concern regarding yarding Riparian Reserves with fish bearing streams is prevention of sediment delivery to streams, prevention of concentrated overland flow, wood recruitment, and maintenance of stream temperatures. Project design features would follow direction provided in NWFP Temperature TMDL Implementation Strategies of 2011[10]. This involves protection, maintenance and enhancement of existing stream shade, and maintenance of the existing micro-climate, ambient air temperature, and air movement.

The primary difference between fish-bearing and non-fish-bearing stream is the width of the entire Riparian Reserve (which is differentiated by fish-bearing status) as shown below:

**Fish-bearing Riparian Reserve widths are two site potential tree heights each side of stream course (175 ft. X 2 = 350 ft. each side; total width 700 ft.).**

[9] Active channel is the bank full width of flowing perennial or intermittent streams.

[10] Northwest Forest Plan Temperature TMDL Implementation strategies were updated in 2011 (Evaluation of the Northwest Forest Plan Aquatic Conservation Strategy and Associated Tools to achieve and maintain stream temperature water quality standards- USFS and BLM). Recommended Primary Shade Zone widths were increased over the September 9, 2005 version.

**<u>Nonfish-bearing</u> Riparian Reserve widths are one site potential tree height each side of stream course (175 ft. each side; total width 350 ft.).**

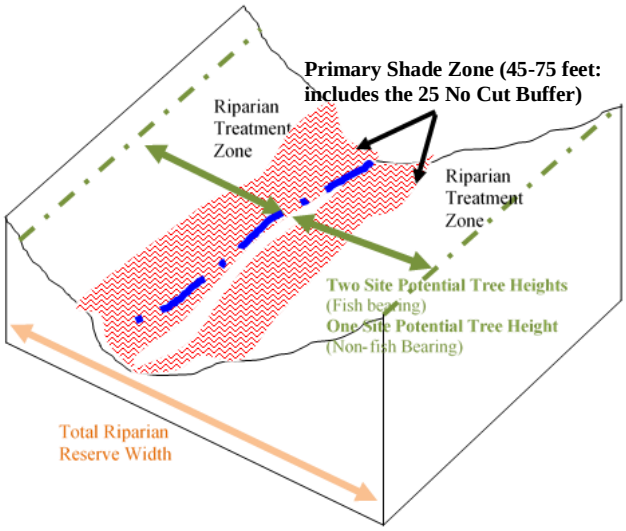
The **Primary Shade Zone** buffer is 45 to 75 feet from the edge of stream course based on the tree height and hill slope, Table 10. This zone is an area where no commercial extraction would occur (larger trees felled for skyline corridor clearing would be left), however some enhancement treatments could occur such as pre-commercial thinning. Distance from active stream channel varies according to height of existing overstory trees and hill slope in immediate area. Regardless of fish presence, slope, or flow seasonality, there also is always a minimum 25-ft no-cut buffer. The 25-ft minimum no-cut buffer is defined as an exclusion zone for vegetation management treatment activities, except for felling of danger trees, understory treatments to protect overstory canopy during prescribed burning activities, and corridor or anchor trees (for skyline cable yarding) would be felled and left at site. There would be no commercial removal. The following table establishes the width of the Primary Shade Zone.

**Table 10. Primary Shade Zone Width, Based on Adjacent Hill Slope and Average Tree Height within Perennial Streams.**

| | Hill Slope < 30% | Hill Slope 30% to 60% | Hill Slope >60% |
|---|---|---|---|
| **Average Tree Height > 60-100 ft** | 45 ft | 50 ft | 55 ft |
| **Average Tree Height > 100-120 ft** | 65 ft | 70 ft | 75 ft |

The **Riparian Treatment Zone** is an area where density management (commercial extraction), fuels reduction (prescribed burning or pile burning), or other enhancement treatments could occur, outside of the Primary shade zone (45 to 75 feet), in accordance with design criteria. This includes criteria such as: maintain at least 50% canopy cover and within 100 feet of all stream courses, pre and post activity would not result in a loss of more than 10% of the soil infiltration capacity.

**Figure 2. Riparian Reserve Design Elements – Perennial Fish & Non-Fish Bearing Streams**

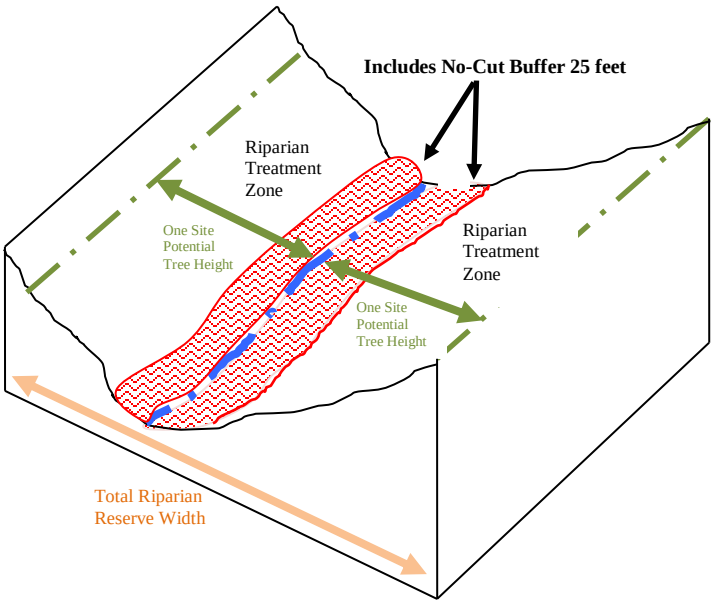


### *3.* *Design Criteria for Non Fish-bearing Intermittent/Ephemeral Streams, and Wetlands*

Seasonally flowing intermittent and ephemeral non-fish-bearing streams and wetlands have buffers established for the prevention of sediment delivery to waterbodies, prevention of concentrated overland flow, and maintenance of micro-climates, ambient air temperature and humidity. There are no known fish-bearing ephemeral or intermittent stream channels in the Shasta Agness planning area. If fish-bearing ephemeral or intermittent streams were discovered during implementation, they would follow the standards for fish-bearing perennial streams indicated above.

The primary difference between perennial and intermittent/ephemeral streams is the buffers for canopy removal and commercial extraction activities. In other words, there is no slope-dependent primary shade zone prohibiting any canopy removal for intermittent/ephemeral streams. However, for the entire riparian treatment zones regardless of stream type, the canopy would not be treated to fall below 50% canopy cover. The intermittent/ephemeral Riparian Reserves and non-fish bearing Riparian Reserves are the same, one site potential tree heights on each side of stream course (175 feet on each side; total 350 feet).

**Figure 3. Riparian Reserve Design Elements – *Ephemeral/Intermittent Stream Channels, and Wetlands.***




The following table presents and summarizes the overall Project Design Criteria developed for Riparian Reserves (PDCRR), for Shasta Agness project area.

**Table 11. Overall Design Criteria for Timber Felling and Yarding within Riparian Reserves.**

| Stream Channel | Project Activities | Buffer | Riparian Reserve | PDCRR Name |
|---|---|---|---|---|
| **Ephemeral/ Intermittent; Wetlands**<br><br>***Non-fish* Bearing Streams** | *No-cut buffer* except for hazard trees, understory treatments to protect overstory canopy during prescribed burning activities, corridor or anchor trees (for skyline cable yarding) may be felled and left at site, no commercial removal. | Stream side to 25 feet along both sides of channel. | One site potential tree height each side of stream (175 feet each side; total width 350 feet) | **Stream Channel Protection Zone** |
| | *Density management and commercial extraction* allowed with constraints. (Maintain 50% canopy; max 10% soil infiltration impact; full suspension yarding; no gaps; no new roads within 175-ft; no new landings within 100ft). | 25 feet from stream side to edge of Riparian Reserve, along both sides of channel, based on one site potential tree height. | | **Riparian Treatment Zone** |
| **Perennial**<br><br>***Non-fish* Bearing Stream** | *No-cut buffer* (same as above). | Stream side to 25 feet along both sides of channel. | One site potential tree height each side of stream (175 feet each side; total width 350 feet) | **Stream Channel Protection Zone** |
| | *Primary Shade Zone* (No overstory canopy removal, no commercial extraction). | Stream side to45-75 feet along both sides of channel depending on % slope and average tree height (Table 10). | | **Primary Shade Zone** (includes Stream Channel Protection Zone) |
| | *Density management and commercial extraction* allowed with constraints (same as above). | From edge of the PSZ to edge (45 feet to 75 feet) of Riparian Reserve, along both sides of channel, based on *one site potential tree height*. | | **Riparian Treatment Zone** |
| **Perennial**<br><br>***Fish* Bearing Streams** | *No-cut buffer* (same as above). | Same as Perennial ***Non-fish*** Bearing Stream. | Two site potential tree height each side of stream (350 feet each side; total width 700 feet) | Same as Perennial ***Non-fish*** Bearing Stream |
| | *Primary Shade Zone* (No overstory canopy removal, no commercial extraction). | Same as Perennial ***Non-fish*** Bearing Stream. | | |
| | *Density management and commercial extraction* allowed with constraints (same as above). | Same as Perennial ***Non-fish*** Bearing Stream, except Riparian Treatment Zone extends from 45-75' buffer limit to edge of *two site-potential tree buffer (350 feet)*. | | |

## *4. Project Design Criteria for Road Reconstruction, Temporary roads, Decommissioning and Landings within Riparian Reserves*

Most of the existing roads or existing legacy templates (non-system roads) evolved from early timber harvesting in the 1960s. Since this time various types of natural and human caused disturbances have impacted the suitability to use these roads adequately and efficiently to access

the planning area for today's management systems. Roads proposed for decommissioning would be completed to prevent failed culverts and perched side cast material, thereby eleiminating the risk that this material would enter the streams, which results in sediment production and potential delivery during treatment activities. Temporary road construction within the Shasta Agness planning area would be completed in order to implement operation activites. Road reconstruction would cross drainages designated as Riparian Reserve, however, these areas have already been impacted by previous road construction. All road related and landing construction would be managed in accordance with water quality Best Management Practices[11].

### a. Temporary Road Construction and Decommissioning Project Design Criteria

Temporary road construction and decommissioning would be managed in accordance with water quality Best Management Practices (BMPs) and can be found in Appendix B. In order to prevent continued low level casual use, and to minimize resource impacts, such roads would be obliterated at the completion of their intended use. Using these existing roads to harvest timber reduces the need to build new temporary roads, limits soil disturbance and compaction to areas previously disturbed and compacted, and allows the opportunity to repair roads that were not built to current standards and design criteria. Effective obliteration is generally achieved through a combination of the following measures implemented to varying degrees as practicable:

- Temporary culverts are removed and natural drainage configuration is re-established;
- Road surfaces are ripped;
- Sideslopes are reshaped and stabilized; road is effectively drained; and
- Road is blocked to further use, and road is returned to vegetation production through revegetation (seeding, planting browse species, or hardwood/conifer trees).
- Remove those elements of a road that reroute hillslope drainage and present slope stability hazards. Another term for this is "hydrologic obliteration."

Temporary roads constructed would be closed after the season of use, and if kept open over winter, would be winterized. Drainage work to winterize temporary roads would include water bars at suitable intervals and out sloping.

### b. Legacy Landing Design Criteria

All legacy landings, designated skid trails, staging or decking areas within Riparian Reserves would:

- Be of minimum size as possible to only allow harvest operations;
- Be located above the break in slope above the stream channel;
- Landing slopes would be armored with logs or other woody material capable of protecting the slope surface;
- Landing surfaces would drain away from the stream channel during use, and, would be revegetated/mulched after use;
- Landing site restoration would consist of :
  - -Loose soil material on the downslope side would be pulled back
  - -Placement of slash on bare soils located on the downhill slope; and
- All new landings will be at least 100 feet away from stream channels.

[11] National Best Management Practices for Water Quality Management on National Forest System Lands, Volume 1: National Core BMP Technical Guide. FS-990a. April 2012. 165 pg.

### c. Aquatic and Riparian Habitat Improvements and Recreation Project Design Criteria

Project design criteria and mitigation measures that would be required of Action Alternatives to manage consequences during actual operations of aquatic and riparian habitat improvements, as well as, recreation project activities would be carried forth in accordance with the National Core BMP Technical Guide (USDA FS, 2012). Best Management Practices are described below, but are further discussed in the Appendix B of the EIS.

- Minimize the number and length of access points through riparian areas for operations in aquatic ecosystems.
- Heavy equipment will be cleaned free of potential aquatic invasive species.
- Develop and implement an approved spill containment plan that includes having a spill containment kit on-site.
- Construct log complexes built with ground based equipment during dry conditions whenever possible; however some of the work by nature would have to occur instream.
- All in-channel stream work would occur during the Oregon Department of Fish and Wildlife (ODFW) instream construction timing window: Rogue River tributaries- July 15th to September 30 and the Illinois River tributaries June 15th to September 15th, unless an instream extension waiver is obtained from ODFW.
- All trails would be constructed to minimize erosion, avoid natural water courses, and avoid sensitive riparian areas and plants to the extent possible.
- All trails would be designed to minimize sustained steep pitches, grade reversals, and to reduce the chance for water to gain enough speed to recruit and encourage erosion. Rock needed for trail stabilization, sediment traps, and erosion control would be from on-site or other approved sources.
- Any constructed trail bridge would have a free span of 1.5 times bankfull width and pass a 100-year flood event.
- Intermittent waters would be crossed by hard fords as necessary on trails.
- Stream crossing approaches on both new and reconstructed trails would be designed to minimize sedimentation by reducing diversion potential; avoiding deeply incised streams with steep side slopes; using native rock sources to armor approaches on soils with a high erosion rating; and avoiding long approaches that allow water to concentrate, erode trail tread and deliver fine sediment.
- All trail stream crossings would meet the following to the extent practicable: (1) contain little to no fine fill material; (2) provide for unrestricted stream flows; and (2) avoid stream capture. Stream crossings that must use conveyance structures, such as culverts, would be inspected yearly and maintained when needed.
- Legacy sediment sources, such as gullies, head cuts, and fill material in stream crossings, which are associated with existing historic or unauthorized trails in the action area would have stabilization techniques applied during trail reconstruction or decommissioning. If trails are re-routed to avoid these areas, stabilization techniques would be applied during the decommissioning process. Example of stabilization techniques include water bars, check dams, waddles, fill and culvert removal, and planting and seeding.
- Existing historic and unapproved trail segments proposed for decommissioning would be recontoured where needed to eliminate erosion. All fill would be removed from channels and stream banks would be recontoured to mimic the upstream and downstream banks to the extent possible. Adjacent duff or litter would be moved to cover trail tread and the trail would be obscured by placing branches and small diameter course wood.

- During trail maintenance, reconstruction, and decommissioning, all displaced soil or fill materials would be placed in locations where they are unlikely to be discharged to streams, to the extent practicable, and be decommissioned or reconstructed during dry periods.
- Signs would be installed at appropriate trailheads or facilities providing guidance to trail and recreational users on the proper disposal of pet and human waste. The signs would indicate that all waste must either be removed using a disposal waste bag, or buried. In all cases, buried waste must be located at least 100 feet from any waterbody and buried at least 6 inches deep.
- Use proper field investigations to locate, design, or remove sanitation systems such as vault and pit toilets.

# III. Current Conditions- Channel Condition and Morphology

This section of this report presents existing condition information, summarized from existing Watershed Analyses and Assessments within the planning area. Table 12 summarizes the information for watersheds containing the proposed activities. Stream surveys were also conducted for several of the drainages with dates ranging from 1990 to 2014. Further information relevant to the current condition in the Planning Area has been extracted and/or paraphrased from these documents and presented below in descriptions of existing condition.

**Table 12. Summarizes watershed conditions within Shasta Agness Planning Area.**

| 5th and 6th field watershed names | Riparian Reserve Land Allocation | Annual Precipitation | Ownership | % of watershed harvested | Hydrologic Recovery of 6th field watershed | **Road Density of 6th field mi./ $mi^2$ | Geologic Setting |
|---|---|---|---|---|---|---|---|
| ***Lawson Creek-Illinois River** Lawson Creek | 7% | 90-130"; 46% of w.s. in rain dominated zone; 53% in TSZ***; 1% in snowpack zone. rainfall intensities double those for other west side Siskiyou NF sites. | 99% NFS | 15% of Lawson Ck w.s.since 1955. | Any increases in peak flows from harvest units is expected to decrease as the trees continue to mature in size. As roads are decommissioned and revegetate, peak flows may decrease in tributary streams. | 1.9 (low risk) | West half- primarily colebrooke schist; east half- ultramafic rocks with large areas of Dothan formation with some Colebrooke schist and volcanic rocks. |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lower Illinois watershed** Fall Creek-Illinois River | 3% | 70-140"; 62% of w.s. in the rain dominated zone: 37% in TSZ; 1% in snowpack zone. Lower storm intensities lie along the Illinois River, with higher intensities along the ridge bordering the southeast edge of the Lawson Creek drainage. | 94% NFS | Seventh field w.s-zero percent harvested before 1970; 15% harvested after 1970 of Fall Ck w.s. | None of the subwatersheds are >80% level usually considered to be the natural condition, even those that had no harvest. Most riparian harvest was more than 20 years ago, and some riparian areas are now well shaded by hardwoods and small conifers. | Seventh field w.s.-3.27 (moderate risk) | Quaternary unconsolidated alluvial sediments; Tertiary marine sedimentary rocks-lookingglass formation; cretaceous marine sedimentary rocks- Humbug Mountain Formation; Jurassic metasedimentary rocks- Dothan formation; gneissic metagabbro; ultramafic rocks- serpentinite and peridotite; metavolcanic rocks-Rogue formation |
| **Stair Creek-Rogue River** Stair Creek | NA in the watershed analysis summary | 72-190"; 65% of w.s. in rain dominated zone; 30% in TSZ; 5% in snowpack zone. Lower storm intensities lie along the Rogue River, with higher intensities along the ridge bordering the southeast edge of Shasta Costa Creek drainage. | 96% NFS | Sixth field w.s.-4% harvested before 1970; 9% harvested after 1970 | The percent of mature and old growth riparian vegetation within the individual WAAs**** range from 35% to 75%. All <80% considered to be the natural condition, even though some WAAs had little to no harvest. Some riparian areas are now well shaded by hardwoods and small conifers. | 2.44 (low risk) | Dothan: sandstone, conglomerate, siltstone |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Stair Creek-Rogue River** Blossom Bar-Rogue River | 5% plus the additi-on of RR in Wilde-rness | See above | 96% NFS | Sixth field w.s.-5% harvested before 1970; 4% harvested after 1970 | See above | 0.81 (low risk) | Metagabbro, dorite, and metavolcanics; peridotite, serpentine, ultramafics; galice-metamorphosed volcanic rocks; myrtle- conglomerate, sandstone, siltstone; recent alluvium, terrace, landslide deposits; marine siltstone, sandstone, siltstone; tertiary marine sandstone, siltstone; tyee- bedded micaceous siltstone, sandstone |
| ***Shasta Costa Creek-Rogue River** Foster Bar-Rogue River | NA in watershed analysis summary | 85-145"; 36% in TSZ; 13% in snowpack zone; The hydrology network may be flashier in Shasta Costa than in neighboring watersheds. | 99.9 % NFS | Sixth field w.s.-5% harvested before 1970; 16% harvested after 1970 | The percent of mature and old growth riparian vegetation within the individual WAAs range from 35% to 75%. All <80% considered to be the natural condition, even though some WAAs had little to no harvest. Some riparian areas are now well shaded by hardwoods and small conifers. | 5.54 (high risk) | Metagabbro, dorite, and metavolcanics; galice-metamorphosed sedimentary rock; peridotite, serpentine, ultramafics; galice-metamorphosed volcanic rocks; Dothan-sandstone, conglomerate, siltstone; recent alluvium, terrace, landslide deposits; marine siltstone, sandstone, siltstone; tyee- bedded micaceous siltstone, sandstone |
| ***Shasta Costa Creek-Rogue River** Shasta Costa Creek | 7% | See above for Shasta-Costa Creek-Rogue River w.s. annual precipitation | 99.9 % NFS | fifth field w.s.-5% harvest before and after 1970 | Streamside vegetation has since grown back along harvested tributaries, and it is estimated that temperatures in these streams have returned to pre-harvest levels. | 1.53 (low risk) | Upper section: Dothan formation-sandstones, siltstones, and mudstones, and minor amoutns of chert. Middle section: narrow band of diorites and metavolcanics (erosion resitant; steep slopes and cliffs). Lower section: Fluornoy and lookingglass formations; umpqua group- tertiary in age; mudstones, siltstones, sandstones, and conglomerates; exposures of serpentinite, diabase, and andesites. |

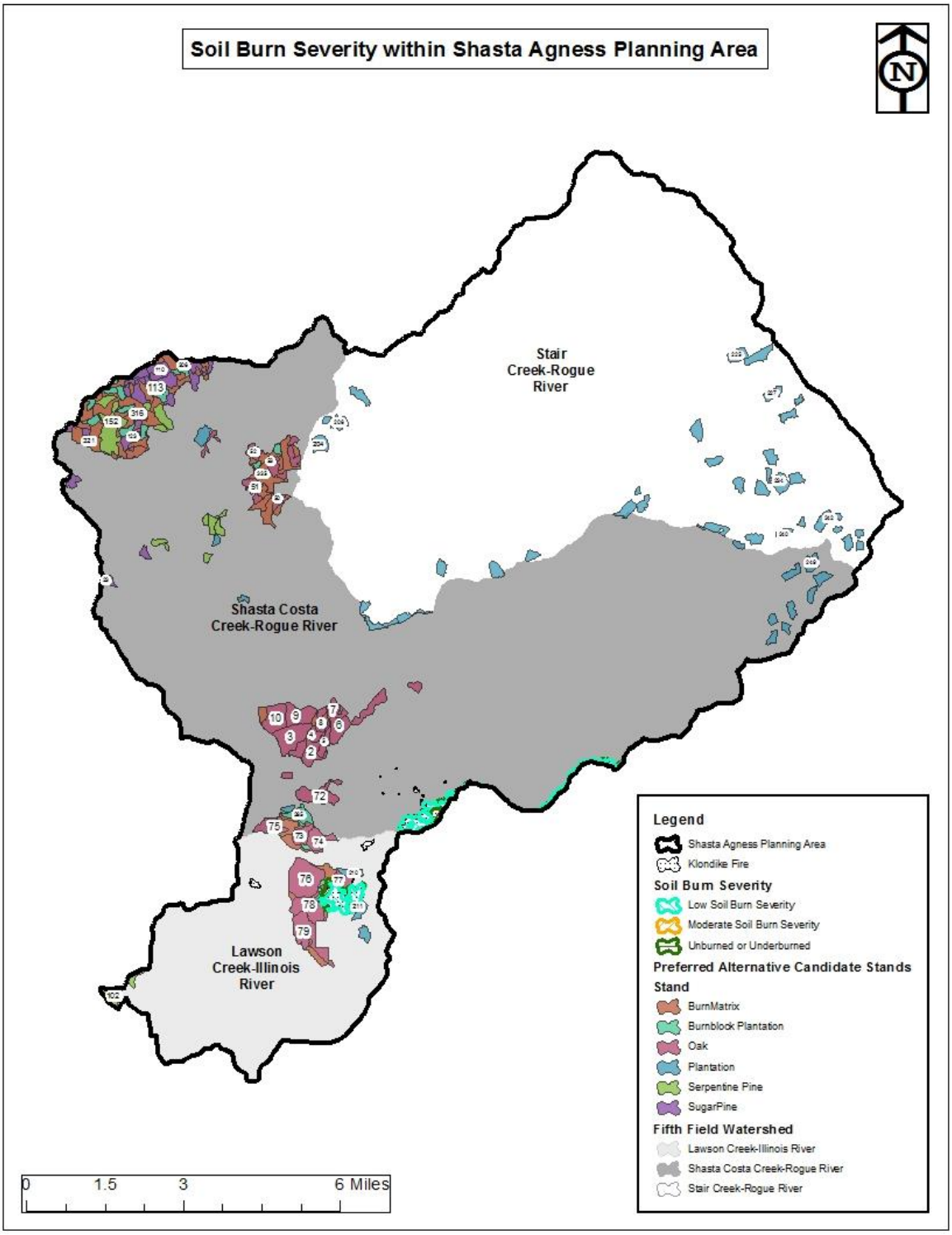
**Key Watershed: Serve as refugia that are crucial for maintaining and recovering habitat for at risk species and stocks (ROD, B-12, B-18)*
***Road density less than 3.0 miles per square mile is considered low risk for channel network expansion sufficient to increase peak flows; 3.0 to 5.0 miles per square mile is considered moderate risk; over 5.0 miles per square mile is considered high risk for contribution to increased peak flows.*
****TSZ: Transient snow zone (2500-4000').*
*****Watershed Analysis Area*
*Lawson Creek Watershed Analysis, Iteration 2.0, 1997*
*Lower Illinois River Watershed Analysis, 2000*
*Rogue River Watershed Analysis, Marial to Agness, 1999*
*Shasta Costa Creek Watershed Analysis, 1996*

## A. Existing 2018 Klondike Fire Conditions

The intent of this summary is to determine if there are fire effects leading to changed conditions for the hydrology resource within the project area of the Shasta Agness project that would change the determinations of the environmental consequences of the project. Refer to the 2018 Geology and Soils resource report for more detail on the methodology, slope stability, and soil productivity.

For the hydrology review the BAER report was assessed, field site visits were conducted, use of best professional judgement, and historical monitoring data from the 1987 Silver and 2002 Biscuit Fires were used to inform the review. The project planning area is comprised of three fifth field watersheds (See Figure 4), however not all were impacted by the 2018 Klondike Fire. Those affected by the fire were Shasta Costa Creek (1710031006) and Lawson Creek (1710031111) 5th field watersheds. The Klondike Fire impacted less than one percent of the entire Shasta Costa Creek 5th field watershed; additionally the area burned at low or very low/unburned SBS, which would not change the current conditions of the watershed. Furthermore, the fire did not impact any proposed treatment activities within Shasta Costa Creek watershed, therefore there would be no increase in impacts to water quality or peak flows from proposed treatment activities. Therefore, Shasta Costa Creek will no longer be discussed further in this analysis. Lawson Creek is an important tributary and contributor for maintaining and recovering habitat for at-risk species and stocks to the lower Illinois River (USDA 1997). No other main tributaries in the project boundary were impacted by the fire.

**Figure 4. Soil Burn Severity Map.**



## Water Quality

The Klondike Fire perimeter overlaps with an estimated 4, 912 acres within the Lawson Creek watershed. There are no changes to the Lawson Creek watershed analysis for the Shasta Agness project due to the Klondike Fire since the high and moderate SBSs was limited to less than 1% or approximately 147 acres of the watershed. Of the estimated 4, 912 acres within the fire perimeter that intersects Lawson Creek watershed, approximately 1, 874 acres or 4.6% had low soil burn severity. Moderate soil burn severity occurred in 146 acres or less than 1%. High soil burn severity occurred in 1 acre or less than 1%. Last, 2, 891 acres or 7.0 % of the fire perimeter overlaying with the watershed was unburned. Therefore within the Lawson Creek watershed 95% is unburned from the Klondike Fire. Within the planning area about 246 acres burned and 109 acres overlap with proposed treatment activities under the preferred alternative. Similarly, to the watershed the planning area only exhibited low or very low/unburned SBS. No high or moderate SBS was observed in the planning area.

A total of 1,582 riparian treatment acres is proposed in the Shasta Agness project area under the Preferred Alternative. Approximately 98.5% (1,559 acres) of the riparian treatment acres were unburned, and 23 acres or 1.5% were burned. Drainages where riparian treatments are proposed experienced low soil burn severity. Therefore, a large sediment response from a high probability precipitation event would not be expected. By implementing the Project Design Criteria there would be no increase in fine sediment delivery to a stream or associated increase in turbidity from treatment activities.

### Peak Flow

Soil water storage, interception, and evapotranspiration are reduced when vegetation is removed or killed by fire and when organic matter on the soil surface is consumed by fire (DeBano et al. 1998; Neary et al 2005). The Klondike Fire has impacted approximately 4, 912 acres within the Lawson Creek 5th field watershed. Of those acres, approximately 246 acres are within the planning area. There are an estimated 108 acres from the preferred alternative, and roughly 23 acres in riparian areas that intersect with the burned area. However, based on the low acreage and soil burn severity impacted by the fire there are no changes to the effects analyzed in the hydrology report. In addition, the project design criteria and mitigation measures identified in Appendix B of the Shasta Agness Landscape Restoration EIS are still expected to be effective for maintaining water yield (peak flows), and would prevent increasing peak flows from proposed thinning activities.

## Cumulative Effects

There will be no change in direct or indirect effects to peak flows or on the sediment regime as a result of the Klondike Fire, therefore there will be no change to the cumulative effects analyzed in the hydrology report.

## Aquatic Conservation Analysis

The Aquatic Conservation Strategy (ACS) is an essential part of the NWFP that “was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands” (USFS 1994, B9). Therefore the Northwest Forest Plan requires consistency with the Aquatic Conservation Strategy (ACS) with specific reference to nine ACS

Objectives. The action alternatives within the Shasta Agness project have been evaluated to determine how consistent they are with the nine aquatic conservation strategy objectives. However, the intent of this summary is to determine if there are fire impacts leading to changed conditions that would alter the ACS consistency review determinations within the project area. The Shasta Agness Landscape Restoration project (The Project) and the Watershed Analyses (WA) provided the context for the responses to the Aquatic Conservation Strategy objectives within the EIS (See EIS for full ACS consistency review). .Other specific rationale may be found in other analysis documented under other resources in the EIS, e.g., Soils, Fisheries, Wildlife, Botany, etc.

Levels of down wood within the project area would be maintained since within the fire affected areas fire-killed trees would not be removed from Riparian Reserves. The project would continue to contribute toward maintaining and restoring the sediment regime of the project area through application of project design criteria, such as placing protective buffers adjacent to streams within Riparian Reserves. The fire affected areas would maintain water quality necessary to support healthy riparian, aquatic, and wetland ecosystems because project design criteria would be employed and the fire would not prevent attainment of this objective since the majority of the area had a low severity burn. The wildfire may have contributed, in part, to ACS objectives for enhancing the distribution, diversity, and complexity of landscape-scale features to maintain or protect aquatic systems where the fire had a low-severity burn, however, since wildfires do not result in targeted treatment where always needed, the strategic and active management of the Shasta Agness project is still necessary to reach the desired conditions described in the EIS for within and outside Riparian Reserves. For example, the proposed activities of the Shasta Agness project would more successfully decrease stand densities, shift tree species and seral stages, and provide growing space and access to light and nutrients for residual tree development toward late successional conditions.

## B. Lawson Creek Watershed Analysis (1997)

Lawson Creek is designated as a Key Watershed as defined by the Northwest Forest Plan (1994), and is approximately 25, 241 acres in size. It is an important tributary to the lower Illinois River, and flows into the Illinois River 3.5 miles above the confluence of the Rogue and Illinois Rivers at the community of Agness. According to the watershed analysis the entire watershed is managed by the Forest Service except for 250 acres of Private Land.

The Lawson Creek Watershed contains approximately 4 percent of the watershed area of the Illinois River. Recorded rainfall amounts are significantly higher than any other Remote Access Weather Station (RAWS) in the Planning Area, and may receive in excess of 115 inches of precipitation a year. According to the watershed analysis for the Lawson Creek watershed, a streamflow gage is not present. However, summer flows were recorded in September, 1993 and were said to be average for Siskiyou coastal stream low flows. The transient snow zone (TSZ) can receive moisture as either rain or snow, and is located above 2500 feet. The TSZ is approximately 53 percent of the watershed.

The geology of the watershed is reflected by an east and west division. The west half is primarily Colebrooke schist. The east half of the watershed is from the southern edge of the basin to Sevenmile Peak. Other rock types are also interspersed within the west half. The east side is made up of ultramafics, Dothan Formation, and some Colebrooke schist and volcanic rocks. Further geologic descriptions are described in the soils report.

Lawson Creek consists of low to moderate gradients, and boulders/cobble dominated cascades, rapids, riffles, and non-turbulent riffles and gravel/ boulder dominated mid-channel pools, lateral scour pools, trench pools, landslide dam pools, and plunge pools. Pools are often deep. According to the watershed analysis Lawson Creek provides fish habitat for a variety of fish species, such as: fall Chinook salmon, Coho salmon, winter steelhead, Coastal cutthroat trout, etc. However, the most recent Lawson Creek stream survey (2003) presented no observations of Chinook salmon or Coho salmon.

The majority of the riparian overstory in the surveyed section of Lawson creek is in the small tree successional class. However, approximately 4.34 miles upstream from the confluence of the Lawson Creek and the Illinois River, larger trees dominate the overstory.

Large woody material is not an immediate, lasting contributor to habitat complexity in Lawson Creek. Canyon magnitude, frequent flushing flows, and past flood events are likely reasons for this condition. Wood inputs and their effects may be more transient in this portion of the system and move downstream before stabilizing long enough to establish more lasting habitat features. The number and size of instream wood pieces also was noted as lacking.

### 1. Lawson Creek Level II Stream Survey, July 2003

This summary includes findings and observations from the Lawson Creek Level II Stream Survey of July 2003. Prior stream surveys were conducted the year of 1990, 1991, 1992, and 1993. Approximately 11.46 miles of Lawson Creek were surveyed. Five reaches were delineated.

Riparian provided stream shade is variable and dependent on vegetation density, parent geology, hillslope processes, topography, and canyon aspect.

Lawson Creek flows through a variety of rock types including Cretaceous marine sedimentary rock, Jurassic ultramafic sedimentary, and volcanic rock, and Jurassic metamorphic rock (Ramp, Schlicker, and Gray, 1977). Fault movements and natural erosion processes are responsible for the different landforms observed within the watershed. Geomorphology of Lawson Creek ranges from a colluvial /alluviated canyon containing a narrow flat-floored valley to a colluvial canyon containing a moderate V-shaped valley within the survey reaches of the stream. Also commonly observed were sub-linear streamcourses, terraces, and steep areas often associated with exposure of bedrock or landslide deposits fanned out onto terraces or ending inside streams. Channel gradient percent ranged from 1 to 25. In all reaches, observations indicated a scarcity or lack of wood across all size classes. Larger potential recruitment trees were only noted in Reach 5.

The following are individual attribute summaries of the five reaches surveyed:

**Reach 1:**

- Rosgen channel type F4; narrow flat floored alluvial valley; gravel dominated; cobble sub-dominant substrate
- No evidence of bank instability
- Average stream gradient 1%
- Medium and large class wood material lacking
- Instream small class wood scarce (3.5 pieces per mile)

- Upper canopy dominated by small tree successional class Port Orford cedar, Douglas fir, and ponderosa pine.

**Reach 2:**

- Rosgen channel type B2; narrow flat floored alluvial valley; gravel dominated; boulder sub-dominant substrate
- Bank sloughing and the active toe of an old inner canyon landslide were the only types of bank instability observed. Outer canyon instability is more common in this reach than in reach 1.
- Average stream gradient 2%
- Medium and large class wood lacking
- Instream small class wood scarce (7.3 pieces per mile)
- Upper canopy dominated by small tree successional class Port Orford cedar, Douglas fir, and ponderosa pine; yew was also noted, and overall density was lower than reach 1.

**Reach 3:**

- Rosgen channel type A2; moderate v-shaped colluvial canyon; boulder dominated; gravel sub-dominate substrate
- One instance of bank instability, bank slough, was noted. Outer canyon instability is less apparent in reach 3 than in previous reaches.
- Moderate average stream gradient 8%
- Medium and large class wood lacking
- Instream small class wood scarce (19.7 pieces per mile)
- Upper canopy dominated by small tree hardwoods such as alders, big leaf maples, myrtle, and vine maple

**Reach 4:**

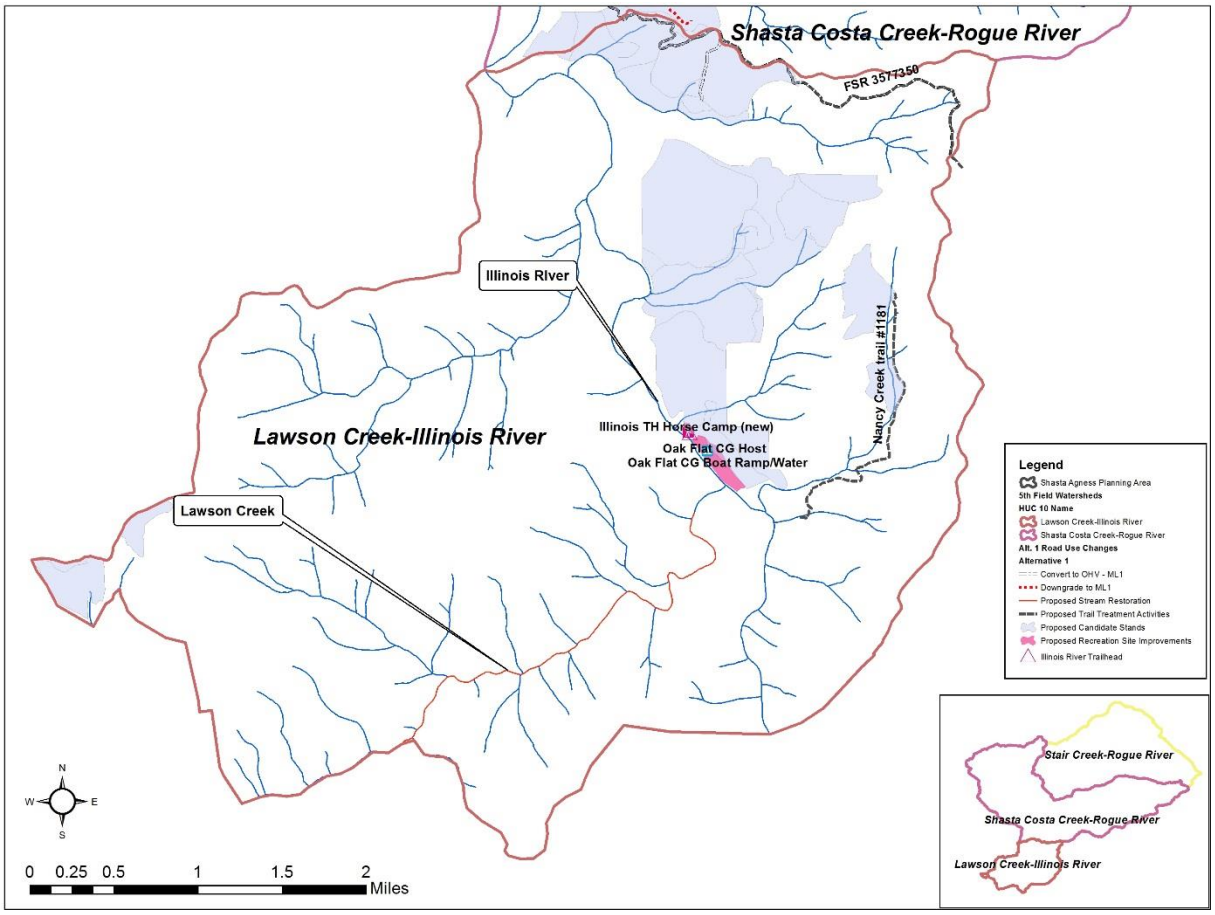
- Rosgen channel type B4; narrow flat floored alluvial valley; gravel dominated; boulder sub-dominate substrate
- Sixteen instances of bank instability were noted, about 9.8% of total reach length. Most of the bank instability observed was in the form of landslides and sloughs. Outer canyon instability appears to be at its highest level in this reach.
- Average stream gradient 3%
- Medium and large class wood lacking
- Instream small class wood scarce (12.2 pieces per mile)
- Upper canopy dominated by small tree successional class Port Orford cedar, Douglas fir, and ponderosa pine. However, segment reaches contain hardwoods as dominate overstory canopy similar to reach 3.

**Reach 5:**

- Rosgen channel type B4a; moderate v-shaped colluvial canyon; gravel dominated; boulder sub-dominated substrate
- Overall, the inner canyon of reach 5 appears stable. However, three rather large instances of bank instability (landslides) were noted. Approximately 4.9% of reach length. Outer canyon instability was not noted.
- Average stream gradient 5%

- Medium and large class wood lacking
- Instream small class wood scarce (22.5 pieces per mile)
- Large woody material is at its highest density in reach 5. Given the proximity of large trees to the stream, the potential for LWM recruitment appears good.
- Large conifers (Douglas fir and Port Orford cedar) dominate the overstory and hardwoods drop out as an overstory component. Other species assemblage are similar to previous reaches.

**Figure 5. Lawson Creek- Illinois River 5th Field watershed within Shasta Agness planning area.**




C.

## Lower Illinois River Watershed Analysis, below Silver Creek (2000)

The Illinois River is a major tributary to the Rogue River in southwestern Oregon. This portion of the Illinois River watershed includes the Illinois River from the mouth of Silver Creek, but not including Silver Creek, to the mouth of the Illinois River at its confluence with the Rogue River near the town of Agness, Oregon. Land Ownership is made up of approximately 94 percent USDA Forest Service, 5 percent private, and less than 2 percent divided between the State of Oregon and Josephine County. This watershed analysis also includes the Lawson Creek watershed, however this drainage is analyzed in detail above, and will not evaluated in this section.

The approximate size of the watershed is 41,154 acres. There are no other Key Watersheds within the Lower Illinois River watershed besides Lawson Creek watershed described above. The Lower

Illinois Watershed contains various management areas for National Forest lands, however management areas within the portion that lies in the Shasta Agness planning area include: Wild River, Backcountry Recreation, Late Successional Reserves, Special Wildlife Site, Scenic/ Recreation River, and Riparian Reserves.

The Lower Illinois watershed lies entirely within the Klamath Geologic Province, a very old accretion of volcanic and sedimentary rocks that have undergone tectonic deformation and alteration. Major formations found in the watershed consist of: Quaternary unconsolidated alluvial sediments, Tertiary marine sedimentary rocks- Lookingglass Formation, Createaceous marine sedimentary rocks- Humbug Mountain Formation, Jurassic metasedimentary rocks- Dothan Formation, and ultramafic rocks- serpentinite and peridotite. Underlying geologic structure strongly controls the direction of stream channels and influences the type and location of erosional processes. Near highly fractured, tightly folded, and sheared zones landslides are active. In addition, ancient landslides are common throughout the subwatersheds, and generally mark the contacts between different rock types. For further detailed descriptions of lithologies refer to the Geology and Soils Report.

The climate of the Illinois River watershed varies because of its steep topography and interception of moisture from the Pacific Ocean. Annual precipitation ranges from 70 inches near the mouths of the Lawson and Indigo Creeks to 140 inches near Fairview Mountain, on the southern border of the Lawson Creek watershed. The portion of the Lower Illinois watershed that lies in the Shasta Agness planning lies entirely in the rain- dominated zone, below 2,500 feet.

Stream flow patterns typically show moderate to heavy runoff throughout the winter and early spring with low flows during the summer and fall. The only USGS gaging station left on the Illinois River being maintained is 47 miles upstream of the watershed at Kerby, Oregon in the Illinois Valley (USDA 2000). Stream flow measurements have been recorded since 1926 to the present. Approximate peak flows were measured for the flood events of 1955, 1964, and 1997.

The primary human influences on hydrologic processes have consisted of water withdrawal permits, road construction, and timber harvest. Data analyzed for the Lower Illinois River watershed analysis (USDA 2000) indicated timber harvest may have affected water yield at the seventh field scale for: between Lawson and mouth, Fall Creek, Fox Creek, and Nancy Creek. Road densities considered moderate risk (3.0 to 5.0 miles per square mile) for channel network expansion sufficient to increase peak flows for seventh field watersheds are located between Lawson and mouth and Fall Creek. Furthermore, a total of 23 water withdrawal permits, equal to 1.06 cubic feet per second are used for domestic, irrigation, and livestock use . However, the amount withdrawn is unknown.

According to the watershed analysis (USDA 2000), basic morphological characteristics of the Illinois River describe this drainage in two sections. From the mouth of Silver Creek to the mouth of Nancy Creek the river continues to flow through the canyon. Long confined reaches transport sediment through during high flows, with deposition occurring along the outside curves in the channel. From the mouth of Nancy Creek to the confluence of the Illinois with the Rogue River, the stream flows into a wide valley. The channel is characterized by large depositional bars changing according to peak flow events. Above the channel, alluvial terraces are formed, such as Oak Flat. Tributaries to the Illinois River are primarily steep transport streams with gradients from 4 percent to over 50 percent.

Five species of Pacific salmon and trout use the Lower Illinois River, these include: Coho, chinook, steelhead, rainbow trout, and cutthroat trout. This important fish migration route is key for allowing access between the sea and important spawning tributaries. However, peak stream temperatures in the Illinois River and Lawson creek are warmer than optimum for cool water fish.

Riparian zones in the lower Illinois River can be differentiated into four vegetative categories. These are conifer forest, hardwood forest, meadows, and riparian areas developed in ultramafic soils. The most abundant type is the conifer forest riparian, which stands and streambanks are generally stable due to the high to moderate soil productivity, water supply is not limited, root strength, and dense undergrowth. Due to the high value wood production and abundance in these areas more human management activities have disturbed this category. Additional key finding of these riparian zones indicated conifer encroachment on meadows due to fire suppression in the early 1940s, the meadows and open oak savannas have been increasingly overgrown with conifer tree species.

## D. Shasta Costa Creek Watershed Analysis (1996)

The Shasta Costa Creek watershed was designated as a Key Watershed by the ROD (NWFP 1994). Tier I Key Watersheds serve as refuge for maintaining and recovering habitats for at-risk anadromous fish species (USDA, 1996). Shasta Costa Creek flows into the Rogue River near the community of Agness, approximately 30 miles east of the Pacific Ocean. The approximate size of the watershed is 23, 400 acres. Elevations within the Shasta Costa Creek drainage range from 115 feet at the mouth of Shasta Costa Creek to 5,298 feet atop Brandy Peak. The Shasta Costa Creek drainage is located in the rain-dominated zone (0 – 2,500 feet), the transient snow zone (2,500 feet – 4,000 feet), and a small portion is located in the snow-dominated zone (Shasta Costa Creek Level II Stream Survey, July 2014). The total national forest land within the watershed is 99.9%.

Streamflow measurements in August and September have found lower flows in Shasta Costa Creek than in neighboring watersheds, which may be due to a higher number of ephemeral streams. Primary natural processes are inner gorge landslides, debris flows, slump-earthflows, and deep-seated rotational movements. Shasta Costa Creek flows over the Dothan formation, diorites, metavolcanics, Flournoy Formation, Lookingglass Formations, and the Umpqua Group. Rocks of these formations are dominated by sandstones, siltstones, mudstones, conglomerates, and small amounts of chert. Exposures of serpentinite, diabase, and andesites can also be observed along the mainstem. The lithologies of the watershed have influenced slope steepness. The steepest slopes are formed by volcanic rocks (diabases, metavolcanics, andesites), because they are more resistant to erosion. Low to moderate slopes are formed by the remaining rock types.

The 1955 flood had the greatest impact to the channel prior to timber harvest and road construction human activities (USDA Forest Service 1996). Channel widening and a decrease in depth at low gradient habitats are examples of the effects from the 1955 flood. The lower reaches are depositional and have evidence of fine sediment deposits. According to the Shasta Costa Creek watershed analysis(USDA Forest Service 1996), the primary beneficial use of the channel is the anadromous fishery. High width to depth ratios also can result in effects to the water quality parameters for temperature, which are important for maintaining such beneficial uses.

### 1. Shasta Costa Creek Level II Stream Survey, July 2014

This summary includes findings and observations from the Shasta Costa Creek Level II Stream Survey of July 2014. Prior stream surveys were conducted the year of 1994 and 2000. Approximately 11.2 miles of Shasta Costa Creek were surveyed. Five reaches were delineated.

Tributary streams flow through three distinctive canyon morphologies. These include: moderately wide, flat-floored alluviated canyons; moderately wide to narrow, V-shaped colluvial, alluviated, and bedrock canyons; and moderately narrow, V-shaped colluvial canyons. Valley widths were

estimated from 115 feet in Reach 5 to 176 feet in Reach 1. Channel sinuosity was low (1.02 to 1.04). Channel gradients ranged from 0.64 percent in Reach 1 to 9.8 percent in Reach 5. Through all reaches, observations indicated there was a scarcity or lack of instream wood across all size classes.

The following are individual attribute summaries of the five reaches surveyed:

**Reach 1:**

- Rosgen channel type B; wide, flat-floored, alluviated canyon; cobble dominated; gravel subdominant substrate
- Bank instability occurred in seven aquatic habitats, about 5.3% of the total reach length. Erosion was exhibited in the form of cutbank erosion and a large inner canyon landslide
- Average stream gradient of 0.64%
- Average mapped valley width was estimated to be 176 feet, but ranged from 100 feet to greater than 500 feet
- Medium and large class wood material lacking; reach frequency of 21 pieces/ mile
- Instream small class wood scarce (18 pieces per mile)
- Canopy closure and shading consists of small diameter hardwood vegetation such as: alder, tanoak, myrtle, bigleaf maple, canyon live oak, and scattered large tree class Douglas-Fir.

**Reach 2:**

- Rosgen channel type B3; moderately narrow, confined, V-shaped colluvial canyon with few terraces; cobble and boulder dominated with substantial amount of gravel
- Stream banks were stable; one occurrence of erosion affecting 31 feet or 0.3% of the total reach length
- Average stream gradient 2.13%
- Average mapped valley width of 100 feet, but ranged from 70 feet to 150 feet
- Medium and large class wood material lacking
- Instream small class wood scarce (9 pieces per mile)
- Riparian vegetation providing canopy closure and shading consists of small diameter hardwood vegetation and scattered large conifers. Harwood species included: alder, tanoak, myrtle, bigleaf maple, canyon live oak. Conifers included: Douglas-Fir and Port-Orford-cedar in the areas containing serpentine geology. Stream shade was variable from well shaded by hardwood vegetation species to open to solar exposure.

**Reach 3:**

- Rosgen channel type B; moderately wide, low gradient, flat-floored alluviated canyon; gravel and cobble dominated with a moderate amount of sand found in pool habitat
- Areas of erosion were noted in the form of small inner canyon landslides and cutbanks; thirteen areas of streambank erosion were documented, or 6.4 percent of the total reach length
- Average stream gradient 1.6%
- Average mapped valley width of 120 feet, but ranged from 100 feet to greater than 300 feet
- Medium and large class wood material lacking
- Instream small class wood scarce (10 pieces per mile)

- Riparian vegetation consisted of an inner zone of small tree class alder, bigleaf maple, dogwood, myrtle, canyon live oak, Port-Orford-cedar, and Douglas-fir, and outer zone of small and large tree class Douglas-fir, tanoak, canyon live oak, and bigleaf maple. Inner zone is defined as extending 25 feet from the stream bank, and outer zone from 25 to 100 feet from stream bank.

**Reach 4:**

- Rosgen channel type B3; moderately wide, moderate gradient, V-shaped alluviated and colluvial canyon with sections of narrow bedrock canyon; nearly an equal mix of gravel, cobble, and boulder substrate; bedrock was noted as substrate through bedrock controlled canyon sections
- Bank instability was observed in the form of small inner canyon landslides, and documented in six different locations, or 0.9 percent of the reach length.
- Average stream gradient 3.68%
- Average mapped valley width 150 feet, but ranged from 60 feet to 200 feet.
- Medium and large class wood material lacking, but more than observed in previous reaches; reach frequency of 23 pieces/ mile
- Instream small class wood scarce (18 pieces per mile)
- Riparian vegetation consisted of an inner zone of small and large tree class alder, bigleaf maple, canyon live oak, and scattered large and mature tree size-class Douglas-fir. . The outer riparian zone contained an overstory of scattered large and mature tree size-class Douglas-fir, and an understory of small and large tree size-class tanoak, canyon live oak, and bigleaf maple.

**Reach 5:**

- Rosgen channel type B3 and A2; moderately steep gradient, narrow, V-shaped, alluviated and colluvial canyon; cobble and boulder dominated channel with a substantial amount of gravel

- Stream banks were generally stable, however two large landslide occurrences were documented. The length affecting the channel totaled 4.4 percent of the total reach length.
- Average stream gradient 9.8%
- Average mapped valley width 115 feet; estimated range of 100 feet to 150 feet.
- Medium and large class wood material lacking.
- Instream small class wood scarce (33 pieces per mile)
- Inner zone: a dense, even aged, small diameter stand of alder with an overstory of scattered large and mature tree size-class Douglas-fir, bigleaf maple, and western red cedar. Outer Zone: overstory of mature tree size-class Douglas-fir and an understory of tanoak, canyon live oak, madrone, Douglas-fir, and western red cedar.

E.

## Rogue River Watershed Analysis, Marial to Agness (1999)

The Rogue River watershed analysis, Marial to Agness includes river mile 48.5 to river mile 27. This section of the Rogue River begins from the mouth of Mule Creek to the mouth of the Illinois River, which covers an area of 81, 424 acres (this includes the area within the Shasta Costa Creek Watershed, approximately 23, 500 acres). Other watershed analyses covering portions of this

analysis area are the Shasta Costa Creek Watershed analysis completed in 1996 (included in the prior section), therefore it will not be discussed in further detail in this section. Additionally, Stair Creek watershed analysis was completed in 1999.

The Rogue River Watershed, Marial to Agness traverses the Klamath Geologic Province, which includes a mixture of igneous, metamorphic, and sedimentary formations. Geologic rock types or formations found within the analysis are: recent alluvium, terrace, landslide deposits; Tyee Formation-bedded micaceous siltstone, sandstones; marine siltstone, sandstone, conglomerate; tertiary marine sandstone, siltstone; Dothan Formation- sandstone, conglomerate, siltstone; Myrtle Formation- conglomerate, sandstone, siltstone; Galice- metamorphosed sedimentary rocks; Galice- metamorphosed volcanic rocks; peridotite, serpentine, ultramafics; and metagabbro, diorite and metavolcanics. For further information on the geology of this analysis area refer to the Geology and Soils Shasta Agness Report.

Key findings of this analysis attribute the complex geologic relationships, forming the lithologies and faults, directly related to the topography and erosional processes observed during investigation. Natural, large slump-earthflows are often associated with sediment delivery and occur more frequently over the Lookingglass Formation. These features also dominate the sediment transport and deposition processes in Billings, Foster, Twomile, Waters, Shasta Costa, and Snout Creeks. The Rogue River corridor between Marial to Agness is a major migration corridor for anadromous fish, and according to the Rogue River, Marial to Agness watershed analysis, stream temperatures are warmer than optimum for fish in many of these streams.

Further information describing the subwatersheds within this analysis area will be described below. The use of stream survey reports will likewise aid in describing the current channel condition and morphology.

### 1. Billings Creek (Rogue River Watershed Analysis, 1999)

Major formations found within the Billings Creek subwatershed are the Tyee Formation and the Lookingglass Formation. The Tyee Formation forms high, exposed bluffs of greenish-gray, clay-rich sandstones with interbeds of mudstone and siltstone. The Lookingglass Formation is characterized by layered mudstones and siltstones. Large slump-earthflows commonly contribute fine-grained sediments to Billings Creek, and have dominated the landform developments within the watershed. The upper half has long, sloping benches with low, gentle stream banks. The lower half has a deep inner gorge with a steep channel. The stream gradient is what divides the upper and lower half. About one mile of fish habitat is available in Billings Creek due to the steep gradients and cascades forming fish barriers.

Aerial photography were reviewed in 1940, 1957, 1969, and 1997. The watershed analysis indicates that the channel instability may be natural, although the channel stability of smaller streams may have been affected by tractor harvest that occurred in half of section 7, and most of section 8 near road 3353060 crossing Billing Creeks.

#### a. Billings Creek Stream Survey, (July 2012)

This summary includes findings and observations from the Billings Creek Level II Stream Survey of July 2012. The survey began at the confluence of Billings Creek with the lower Rogue River, and ended 1.55 miles upstream. No prior stream surveys were conducted. One reach was delineated.

Billings Creek flows south from Bald Knob before joining the Rogue River approximately 34.60 river miles upstream of Rogue River's confluence with the Pacific Ocean. Elevations range from 200 feet at the mouth of Billings Creek to 3,615 feet atop Bald Knob. The watershed drains an area of approximately 2,235 acres of steep mountainous terrain, narrow canyons, steep gradient incised drainages, and a moderate gradient, V-shaped actively eroding colluvial canyon.

The geomorphology of the long and narrow Billings Creek watershed is dominated by large slump-earthflows and debris slides, which have created a deep inner gorge with a steep gradient channel. Further information, according to field analysis completed in the Rogue River watershed analysis, describe the geology found in the Billings Creek watershed. Inner canyon instability and streambank erosion is extreme in the surveyed section and riparian vegetation is absent or in a pioneer seral stage in many areas associated with these erosional features. Observations indicated there was a scarcity or lack of instream wood across all size classes.

The following are individual attribute summaries of reach one:

- Rosgen channel type B5a/B1a; narrow, V-shaped, actively eroding colluvial canyon; a large quantity of sand/silt and boulders and bedrock and a small amount of gravel and cobble were the dominant and subdominant substrate
- Areas of erosion were noted in the form of large slump-earthflows in the form of exposed mudstone and siltstone canyon walls, landslides, and cutbanks; 80% of the reach length showed stream bank erosion
- Average stream gradient 10.7%
- Low channel sinuosity (1.09)
- Average mapped valley width of 50 feet, but ranged from greater than 500 feet in lower Reach 1 to 20 feet in upper Reach 1
- Medium and large class wood material lacking
- Instream small class wood scarce (13 pieces per mile)
- The riparian vegetation consisted of an inner riparian zone of sapling/pole, small tree, and shrub class alder, Himalayan blackberry, and Douglas fir, and an outer riparian zone of sapling/pole and small tree class alder, Oregon myrtle, Douglas-fir, bigleaf maple, and canyon liveoak. Inner zone is defined as extending 25 feet from the stream bank, and outer zone from 25 to 100 feet from stream bank.

**2. Foster Creek (Rogue River Watershed Analysis, 1999)**

The Foster Creek watershed contains 7, 735 acres. Within that area 93% is managed as Late Successional Reserve, 5% is privately owned, 1% is Unique Interest Area, and 1% is Supplemental Resource. Land uses within the Foster Creek watershed have included: timber harvest and road construction, travel corridor, hunting, recreation, private residences, mining, and harvest of forest products such as firewood, wild mushrooms, greenery, etc.

The Foster Creek watershed receives 80 to 110 inches of precipitation per year, with 70% of the area in the rainfall dominated zone, and 30% in the transient snow zone. According to the Rogue River watershed analysis, in July of 1989 streamflow was measured as 8.8 cubic feet per second (cfs) and 9.1 cfs in September of 1993 and July of 1999. At the time of the watershed analysis there were five permitted water rights for Foster Creek, totaling 0.52 cfs.

The geology of the Foster Creek drainage is characterized by the numerous faults and folds that are influenced by the major fault contact, known as the Coquille River Fault. Due to the highly

sheared topography, several dissimilar rock types are adjacent to one another; the Dothan Formation, Lookingglass Formation, and serpentine rocks are examples of the lithologies common in this drainage.

The streams flowing into Foster Creek are generally characterized by steep, transport gradients over 10%. However, the mainstem has a depositional gradient of one or two percent in the first two miles upstream from its mouth. Though, depending on the rain event stream discharge can have enough energy to carry sediment loads through this reach.

Sediment delivery in Foster Creek is dominated by a landslide which is known as Foster Creek Slide. As the stream cuts into the toe of the slide fine grained sediment enters, and consequently turbidity is observed in Foster Creek.

Large ancient landslide deposits deliver large wood to the unstable drainages along the riparian corridor. In addition, the contribution of Port-Orford-cedar (POC) to root strength is declining along streams which are infected with *Phytophthora lateralis*. The abundance of dead and dying POC may also have accelerated the rate of supply of large wood to the stream channels.

**a. Foster Creek Stream Survey, (2012)**

This summary includes findings and observations from the Foster Creek Level II Stream Survey of July 2012. No prior stream surveys were conducted. Approximately 4.32 miles of Foster Creek were surveyed. Three reaches were delineated.

Foster Creek flows east-southeast from Ophir Mountain before joining the Rogue River approximately 33.75 river miles upstream of Rogue River's confluence with the Pacific Ocean. Elevations range from 310 feet at the mouth of Foster Creek to 3, 966 feet atop Ophir Mountain. The watershed drains steep mountainous terrain, narrow canyons, steep gradient incised drainages, and moderately wide, low gradient, flat-floored alluviated canyons.

The geomorphology of Foster Creek consisted of moderately wide, flat-floored and low gradient alluviated canyons with small terraces and floodplains (Reach 1 and lower Reach 2) and a narrow, steeply sloped colluvial canyon (Reach 3). Stream banks and the inner canyons exhibited areas of erosion in the form of active slump/earthflow, exposed and eroding canyon walls of mudstone and siltstone, and cutbank bank erosion from channel downcutting. Generally, bank instability (streambank erosion) affected between 8% and 20% of the reach lengths. Through all reaches, observations indicated there was a scarcity or lack of instream wood across all size classes. Trees with instream recruitment potential were indicated as primarily small or mid seral age class.

The following are individual attribute summaries of the three reaches surveyed:

**<u>Reach 1:</u>**

- Rosgen channel type type B4/B1; moderately wide, flat-floored, low gradient alluviated canyon with small floodplains and elevated terraces; bedrock dominated channel in pools and a gravel/cobble bedded channel in riffles and rapids
- Areas of erosion were noted in the form of large exposed mudstone and siltstone canyon walls and cutbanks; eleven areas of streambank erosion were documented, or 7.8 percent of the total reach length
- Average stream gradient 1.8%
- Low channel sinuosity (1.06)

- Average mapped valley width of 80 feet, but ranged from 60 feet to greater than 500 feet
- Medium and large class wood material lacking
- Instream small class wood scarce (4 pieces per mile)
- Riparian vegetation consisted of an inner zone of small tree class alder, bigleaf maple, Oregon myrtle, willow, and Douglas-fir; Outer riparian zone consisted of small tree Douglas-fir, alder, bigleaf maple, Oregon myrtle, tanoak, and canyon live oak. Inner zone is defined as extending 25 feet from the stream bank, and outer zone from 25 to 100 feet from stream bank.

**Reach 2:**

- Rosgen channel type type B2a/B3; moderately narrow, flat-floored, alluviated canyon, and upper reach, a V-shaped, moderately steep gradient, boulder dominated colluvial canyon; substrate material dominated by boulders
- Areas of erosion were noted in the form of large exposed mudstone and siltstone canyon walls, cutbanks, and inner canyon landslides; eight areas of streambank erosion were documented, or 9.7 percent of the total reach length
- Average stream gradient 5%
- Low channel sinuosity (1.07)
- Average mapped valley width of 50 feet
- Medium and large class wood material lacking
- Instream small class wood scarce (15 pieces per mile)
- Riparian habitat consisted of mid seral vegetation of small tree class alder, bigleaf maple, canyon live oak, tanoak, Oregon myrtle, and Douglas fir, and scattered large and mature tree class Douglas-fir.

**Reach 3:**

- Rosgen channel type type A2a; narrow V-shaped, steeply sloped, steep gradient colluvial canyon.; boulder dominated colluvial canyon; substrate material dominated by boulders
- Large earthflow resulting in a large contributing percentage of the sediment input budget was recorded. Approximately 19.8 percent of the total reach length
- Average stream gradient 26%; however some sections exceeded 40%
- Low channel sinuosity (1.07)
- Average mapped valley width of 60 feet
- Medium and large class wood material lacking; however reach 3 showed the greatest amounts of large and medium class of wood, but still remains lower than what would be expected in a boulder dominated channel.
- Instream small class wood average 49 pieces per mile
- Riparian habitat consisted of sparse sapling/pole class alder and willow due to the impacts from the large slump/earthflow; outside of slump/earthflow feature, the riparian vegetation consisted of small tree class alder, canyon live oak, bigleaf maple, Oregon myrtle, Port-Orford-cedar, and scattered large tree and mature tree class Douglas-fir and Port-Orford-cedar.

**i. North Fork Foster Creek, (July 2012)**

The survey of North Fork Foster Creek began at the confluence with Foster Creek and ended 1.45 miles upstream at the confluence with a dry tributary channel. As with the

mainstem Foster Cr., observations indicated there was a scarcity or lack of instream wood across all size classes.

**Reach 1:**

- Rosgen channel type type B3a/B1a; narrow, V-shaped, steeply sloped colluvial canyon containing small terraces within the inner canyon; bedrock dominated pool habitat and cobble dominated rapid habitat
- Canyon and stream banks have experienced erosion in the form of small cutbanks and small inner canyon landslides; approximately 3.4% of the reach length
- Average stream gradient 11.5%
- Low channel sinuosity (1.05)
- Average mapped valley width of 50 feet
- Medium and large class wood lacking
- Instream small class wood scarce (25 pieces per mile)
- Riparian habitat consisted of a mature forest containing an overstory of scattered large and mature tree class Oregon myrtle, Douglas-fir, alder, and Port-Orford-cedar, and an understory of sapling/pole and small tree class alder, bigleaf maple, Oregon myrtle, Port-Orford-cedar, Douglas-fir, and vine maple.

### 3. Stair Creek

The Stair Creek watershed contains the second largest tributary to allow consistent salmon spawning and/or trout rearing within the Rogue River, Marial to Agness watershed. The watershed lies mainly within the rainfall dominated zone, 2500 feet and below. However, south of the headwaters of Stair Creek, a portion of the watershed lies in the transient snow zone, 2500 feet to 4000 feet. The watershed is managed as Wilderness, Late Successional Reserve, and Riparian Reserves.

The Stair Creek watershed lies in the Dothan Formation which is characterized by sandstones, siltstones, and conglomerates. Further information describing the geology of the watershed can be found in the Shasta Agness Geology and Soils Report. The mainstem of Stair Creek flows through a series of waterfalls at its mouth, and transitions to lower gradient reaches upstream, until reach 5 at mile 3.4, where it continues the same stair-like pattern as the confluence.

Approximately, 7 percent of the watershed has been harvested, mostly occurring after the 1970s. Aerial photography taken in the year of 1969 did show evidence of channel scour, however in the west fork of Stair Creek, which had not seen road construction or timber harvest channel scour was also observed. Therefore channel scour may be due to underlying geologic traits of the watershed. Passive restoration has restored some of these areas, which have mostly revegetated the zones of the channel scour.

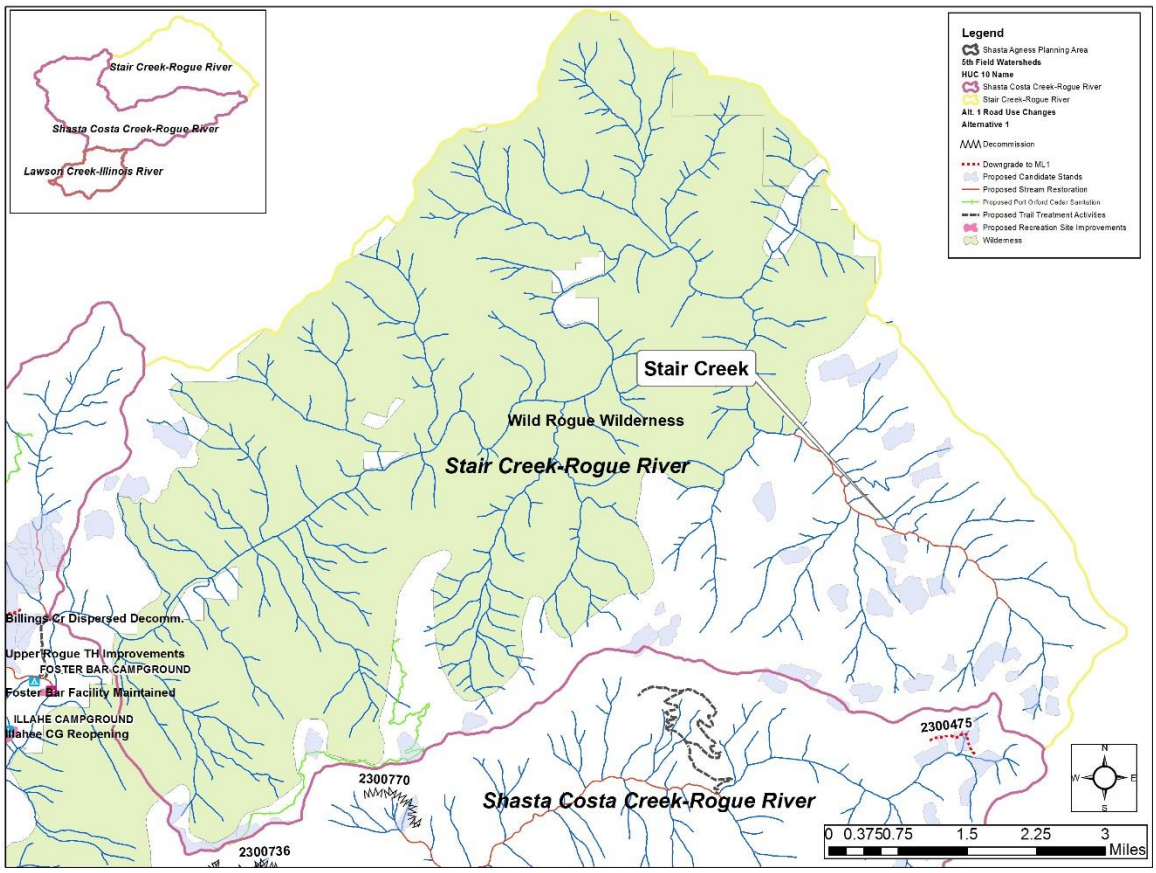
#### a. Stair Creek Stream Survey, (1993)

Marginal information was provided in the 1993 stream survey for Stair Creek and no stream surveys have been completed to date to compare to past records. Records indicate 4.8 miles divided by six reaches were surveyed. Broad morphological characteristics were noted and special features classified included: falls, chutes, and culverts. Streambed substrate were

characterized by cobbles as the dominant material. Sand, gravel, and bedrock made up the subdominant streambed substrate throughout the reaches. Stream gradients ranged from 4% to 20%.

## 4. Twomile Creek

**Figure 6. Stair Creek- Rogue River 5th Field watershed within Shasta Agness planning area.**




The Twomile watershed contains 3,489 acres. Ninety eight percent of this is managed as Late Successional Reserve, one percent near the mouth as Supplemental Resource, and one percent is privately owned (USDA, 1999).

The lithology found within the subwatershed are from tertiary to Jurassic aged rocks. The underlying provinces that formed the geology of the subwatershed are the Coast Range Geologic Province to the east and the Klamath Mountain Geologic Province to the west. The division is formed by the South Fork Coquille River Fault. Due to the underlying geologic processes natural landslide activity is common throughout the watershed. Most observed according to the watershed analysis are along the divisions of faults and contacts in the form of debris slides. Debris flows are also seen when landslides have occurred at the headwalls of tributaries.

The watershed receives 85 to 100 inches of precipitation per year as rainfall. Nearly the entire watershed, approximately 85%, is within the rainfall dominated zone, 2500 feet and below. The remaining percent is within the transient snow zone, 2500 feet to 4,000 feet. The Twomile Creek basin contains approximately 17 miles of perennial and intermittent streams. The channel morphology of Twomile Creek is a cascade with many step pools. Based on thermometer reading

taken in 1993 a recording thermometer placed near the mouth documented a 7-day average maximum of 61.7 degrees F.

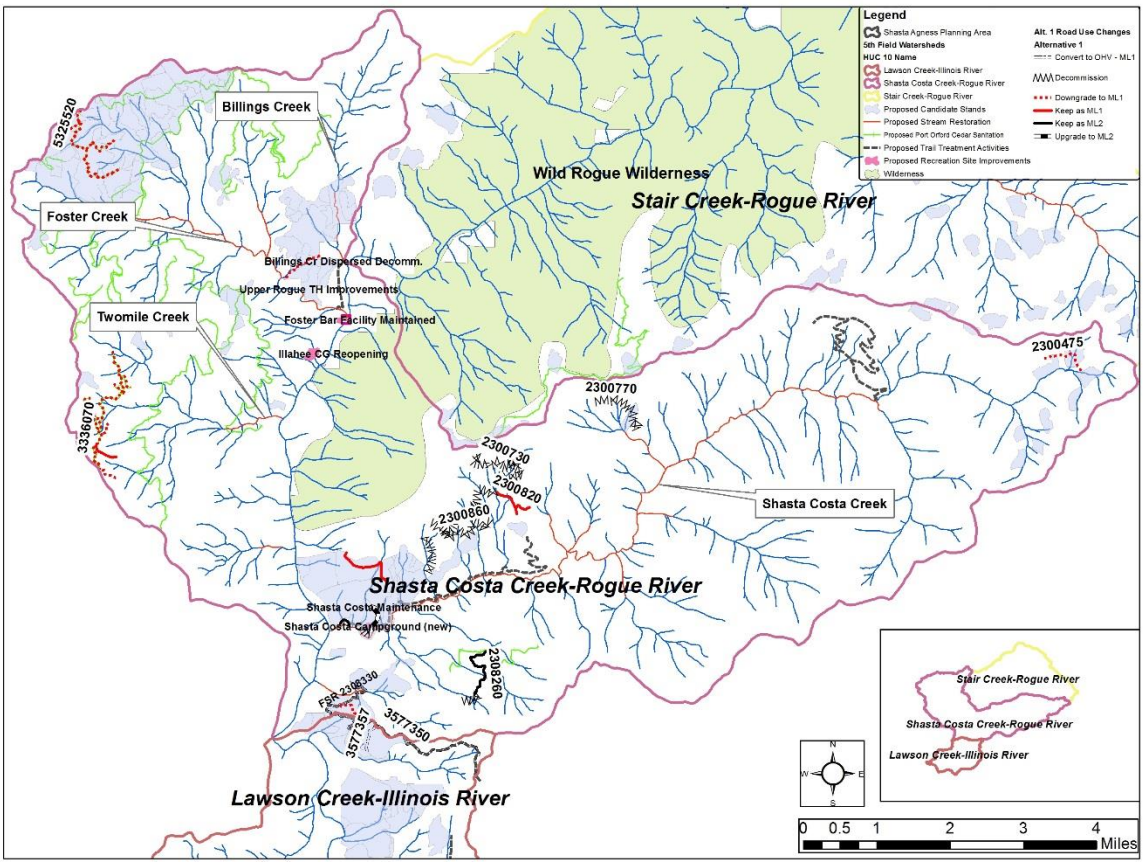
The watershed has been managed previously through timber harvesting and road building activities. Approximately 20% of the area was harvested according to the watershed analysis, and furthermore the subwatershed analysis (USDA1999, Appendix A) identified to have the potential to have resulted in flow alterations on the south side of Upper Twomile Creek.

In addition, the watershed has been infected with *Phytophthora lateralis*, decreasing stream shade due to tree mortality of Port-Orford-cedar, and increasing stream temperature.

### a. Twomile Creek Stream Survey (1990)

Marginal information was provided in the 1990 stream survey for Twomile Creek and no stream surveys have been completed to date to compare to past data. Records indicate 0.9 miles for one reach were surveyed. Morphological characteristics noted were steep cascades and small, plunge pools. Streambed substrate were characterized by boulders as the dominant material. Sand and bedrock made up the subdominant streambed substrate throughout the reaches. Stream gradient measured was approximately 4 percent as well as sinuosity for the stream.

**Figure 7. Shasta Costa Creek-Rogue River 5th Field Watershed within Shasta Agness planning area.**



### Other Streams

Information for the remaining streams within the project area is limited. Neither Level 2 Stream Surveys nor Rosgen Level II surveys have been conducted. In addition, the watershed analyses that included these streams did not have any specific information on physical characteristics for these streams.

F.

### Springs and Wetlands

Several springs and wetland-type areas are present throughout the Shasta Agness project planning area. There is limited information on the springs, and many of them have not been officially documented in GIS or on District maps. More springs may be located as project layout and additional field visits take place.

G.

Wetland-type areas were also observed during site visits to the project planning area. Observations included evidence of a shallow water table, such as the presence of water above or at the ground surface, saturated soils, and wetland-type vegetation. The sizes of these sites varied, but most were small patches, approximately one acre or less in size. One of the wetland-type areas observed in the field was larger than one acre. This site is located in a candidate plantation in the eastern portion of the project planning area within Township 34 south, Range 12 west, and section 13 and in unit 201. None of these areas have been officially mapped or delineated as a "wetland" based on some formal evaluation process (e.g., U.S. Army Corps of Engineers Wetlands Delineation). More wetland-type areas may be located as project layout and additional field visits take place. Riparian Reserves for wetland areas would be delineated as they are located based on requirements described in the ROD and Standards and Guidelines for the NWFP (USDA Forest Service and USDI Bureau of Land Management 1994).

# III. Current Condition- Water Quality

Water quality standards are established to protect beneficial uses of the State's waters. Beneficial uses are assigned by basin in the Oregon Administrative Rules for water quality. The Planning Area occurs in the South Oregon Coastal Basin which has beneficial uses listed below (Oregon Administrative Rule 340-041-0300; adopted by the Oregon Environmental Quality Commission, 2003).

- Public Domestic Water Supply
- Private Domestic Water Supply
- Industrial Water Supply
- Irrigation
- Livestock Watering
- Fish and Aquatic Life
- Wildlife and Hunting
- Fishing
- Boating
- Water Contact Recreation
- Aesthetic Quality
- Hydro Power
- Commercial Navigation & Transportation
- Salmonid Fish Spawning
- Salmonid Fish Rearing
- Resident Fish and Aquatic Life
- Anadromous Fish Passage

- Estuarine Water
- Shellfish Growing
- Cold-water Aquatic Life
- Salmon and Trout Rearing and Migration
- Human Health
- Steelhead Spawning

The state adopted new stream temperature standards in 2004 (OAR 340-041-0028). For stream temperature, the state has defined the following categories:

**•Core cold water habitat: streams where temperatures are maintained within the range considered optimal for salmon and steelhead rearing. Temperature in these waters should maintain a seven-day average maximum no higher than 16°C (60.8°F).**

**•Salmon and trout rearing and migration: These waters are expected to maintain a seven-day average maximum no higher than 18°C (64.8°F), except during times and places of salmonid spawning.**

**•Migration corridors: Some major rivers in Oregon are designated as being migration corridors only, and the seven-day average maximum temperature should be no higher than 20°C (68°F).**

**•Spawning: During places and times of spawning, the seven day average maximum temperatures are expected to be no greater than 13 degrees Celsius (55.4 degrees Fahrenheit).Table 3 identifies the basin and subbasin, streams, the parameters for which they were listed, and the section of stream listed (river mile).**

Several streams in the Shasta Agness project area were considered water quality limited by the Oregon Department of Environmental Quality (ODEQ) and were placed on the Oregon's 2012 Integrated Report- Assessment Database and 303(d) list. This information is available to the public on DEQ's website. Table 13 identifies the basin, subbasin, streams, the parameters for which they were listed by the state, and the section of stream listed (river mile).

**Table 13. Water Quality Limited Streams within Shasta Agness Planning Area.**

| Stream | Parameter | River Mile | Basin; Subbasin; 4th field HUC |
|---|---|---|---|
| **Lawson Creek-Illinois River Watershed** | | | |
| Lawson Creek | Temperature | 0 to 11.1 | Southern Oregon Coastal; Illinois 17100311 |
| Illinois River | Temperature | 0 to 56.1 | Southern Oregon Coastal; Illinois 17100311 |
| **Shasta Costa Creek- Rogue River Watershed** | | | |
| Billings Creek | Sedimentation | 0 to 3.5 | Southern Oregon Coastal; Lower Rogue; 17100310 |
| Foster Creek | Habitat Modification | 0 to 4.9 | Southern Oregon Coastal; Upper Rogue 17100307 |
| Foster Creek | Temperature | 0 to 5.2 | Southern Oregon Coastal; Lower Rogue; 17100310 |

| | | | |
|---|---|---|---|
| Shasta Costa Creek | Temperature, Biological Criteria, pH | 0 to 13.4 | Southern Oregon Coastal; Lower Rogue 17100310 |
| Squirrel Camp Creek | Biological Criteria | 0 to 2.7 | Southern Oregon Coastal; Lower Rogue 17100310 |
| **Stair Creek- Rogue River Watershed** | | | |
| Dans Creek | Toxic Substances (Alkalinity, Ammonia, Chloride) | 0 to 1.3 | Southern Oregon Coastal; Lower Rogue; 17100310 |
| Dans Creek | pH | 0 to 1.3 | Southern Oregon Coastal; Lower Rogue; 17100310 |
| Flora Dell Creek | Biological Criteria | 0 to 1.6 | Southern Oregon Coastal; Lower Rogue; 17100310 |
| Stair Creek | Sedimentation | 0 to 6.5 | Southern Oregon Coastal; Lower Rogue; 17100310 |
| **Rogue River Watershed, Marial to Agness (River Mile 48.5 to River Mile 27)** | | | |
| Twomile Creek | Alkalinity, Ammonia, Biological Criteria, Chloride, Dissolved Oxygen, Iron, Manganese, pH, Phosphate, Phosphorus, Temperature | 0 to 2.8 | Southern Oregon Coastal; Lower Rogue; 17100310 |
| Rogue River | Dissolved Oxygen | 33.8 to 131.8 | Southern Oregon Coastal; Middle Rogue; Lower Rogue 17100308; 17100310 |
| Rogue River | Fecal Coliform | 0 to 27.2 | Southern Oregon Coastal; Lower Rogue 17100310 |
| Rogue River | Mercury | 0 to 216.8 | Southern Oregon Coastal; Upper Rogue; Middle Rogue; Lower Rogue 17100307; 17100308; 17100310 |
| Rogue River | Sedimentation | 0 to 27.2, and 68.3 to 94.9 | Southern Oregon Coastal; Lower Rogue; 17100310 |

Table 14 indicates that stream temperatures in Foster Creek, Lawson Creek, and Shasta Costa Creek exceed state standards within the planning area. In addition, the Illinois River and Twomile Creek also exceed state temperatures within the planning area. Table 14 indicates the range of stream temperatures recorded by the most recent stream surveys completed in various years in July.

**Table 14. Range of stream temperatures for water quality limited streams exceeding ODEQ temperature standards. Records are from the most recent stream survey.**

| Stream Survey (SS) | Month/Year SS Completed | Range of Stream Temperatures (°C;°F) |
|---|---|---|
| Foster Creek | July 2012 | 11-18; 52-64 |
| Lawson Creek | July 2003 | 15-24; 59-75 |
| Shasta Costa Creek | July 2014 | 9-18; 48-64 |

A stream survey for the Illinois River has not been completed. However, according to the Lower Illinois River Watershed Analysis (USDA 2000) the section (river mile 0 to 56.1) of the river was listed for the parameter temperature in 1996. Recording thermometers at Oak Flat from 1992 to 1998 recorded seven day average maximum temperatures from 71.7 to 76.3 degrees Fahrenheit. This exceeds the temperature standards for Core cold water habitat (60.8°F); Salmon and trout rearing and migration (64.8°F); Migration corridors (68°F); and Spawning (55.4).

Many factors can affect water temperature, and it is difficult to relate forest management activities directly to water temperature changes. It has become standard practice in the Pacific Northwest to utilize stream shading as a surrogate measure and predictor of long term water temperature changes. Effective shade from the forest canopy screens the water's surface from direct rays of the sun. Highly shaded streams typically have cooler stream temperatures due to reduced input of solar energy (Brown 1972; Beschta et al., 1987). DEQ has assigned limits to solar radiation reaching streams by utilizing effective shade as a surrogate target for solar loading.

RAPID is a shade model that runs in ArcGIS that was developed to complete a shade assessment at the 5th field level and identify potential restoration sites. Figure 8, Figure 9, and Figure 10 were generated by using the RAPID model to assess existing stream shade condition within the Shasta Agness Planning Area. Stream shade provided by forest canopy is generally sufficient on small streams on NFS land within the Planning Area. Mainstem channels can often have low stream shade values because these channels are too wide (exceeding 100 feet in active channel width) for riparian area trees to shade. This is the case on the Rogue River, Illinois River, and the mouth of Lawson Creek as shown on Figures 8, 9, and 10. The RAPID model identified these channels current shade value as 0 to 44%. However, the tributaries to the mainstems generally exhibited existing shade values of 65 to 100%, except in areas of past timber harvest or meadows where open canopy systems are present. On wide mainstem channels there is little or no opportunity to improve vegetative stream shading. Opportunities for shade improvement occur mainly along tributaries to mainstem channels.

A.

## Sedimentation/Turbidity and Stream Temperature

Sedimentation, turbidity and stream temperature are further discussed below in *Hydrologic Effects and Mechanisms & Analysis Framework* as well as the Alternatives discussions in *Hydrologic Effects for Alternatives,* and will not be discussed in this section.

B.

## Water Quality- Dissolved Oxygen and Fecal Coliform

Water chemistry and biological constituents are important factors for maintaining the water quality necessary for the health of humans and aquatic organisms and for the breakdown of organic material. Dissolved oxygen concentration refers to the amount of oxygen dissolved in water. Dissolved oxygen concentrations are related to water temperature, such that when water temperatures increase, oxygen concentrations decrease (USDI 1998). High concentrations are needed to benefit aquatic species. Low dissolved oxygen can stress aquatic species and lower resistance to environmental variables. Low concentrations can also lead to changes in water and sediment chemistry. Currently, Twomile Creek and the Rogue River are listed on the 303(d) list for dissolved oxygen or Fecal Coliform (See Table 13). Review of watershed analyses for the area show that there is a lack of dissolved oxygen and Fecal Coliform data. At this time, there is no known dissolved oxygen or Fecal Coliform data on the remaining streams within the project area. Treatments proposed for vegetation management, sustainable road treatments, aquatic and riparian habitat improvements are not expected to change concentrations in fecal coliform and

will not be further discussed under those treatment types. Sustainable recreation treatments that have the potential to increase concentrations are discussed below. The only potential effects on reducing dissolved oxygen from the proposed activities would be a reduction in stream shade or mass wasting of sediment into a stream resulting in changes to channel morphology. There would be no loss of stream shade (See Temperature and Hydrologic Effects of Alternatives section) or increase in sediment delivery (See Sedimentation and Hydrological Effects of Alternatives sections.) No changes in dissolved oxygen associated with the proposed activities would occur, and therefore will not be discussed further in the analysis.

## C. Hazardous Materials

Based on review of watershed analyses, there are no records of sites where hazardous materials would be entering streams within the project area. On lands managed by the Forest Service, Best Management Practices are required which minimize risk of chemical spills during equipment use. With the exception of Aquatic and Riparian Habitat Improvements, Sustainable Road Treatments, and Sustainable Recreation Improvements this project does not place equipment near stream channels where it would be possible for chemicals to spill. A spill plan and having a spill containment kit on-site will be in place prior to any activity which would encompass appropriate BMPs (see Appendix B) for minimizing any risk of spills associated with equipment use, and therefore will not be further discussed in the analysis.

## D. pH

Twomile Creek, Dan's Creek, and Shasta Costa Creek have been listed on the 303(d) list for pH. It is expected that impacts to pH would be associated to prescribed burning from the treatment activities proposed under the Shasta Agness project. However, Dan's Creek is within the Wild Rogue Wilderness, and no treatment activities are proposed in this area, and therefore pH concentrations would not change. Likewise, Twomile Creek is not within any of the proposed burn blocks, and therefore pH concentrations would not change due to proposed prescribed burning activities. It is expected that impacts to pH from prescribed burning would likely be immeasurable at the reach scale, such as in Shasta Costa Creek, due to the low intensity burns, and PDCs that are associated with prescribed burning (see Appendix B). Therefore, effects to pH will not be discussed further in the analysis.

## E. Biological Criteria

This listing is the result of habitat limitations created by an excess of fine sediments and excessive summertime temperatures. Within the Shasta Agness Planning Area, Twomile Creek, Flora Dell Creek, Shasta Costa Creek, and Squirrel Camp Creek have been listed on the 303(d) list for biological criteria. Listing is most likely due to impairment from historical logging and roads, however no data is present within the watershed analyses to confirm this. Flora Dell Creek is within the Wild Rogue Wilderness where no treatments are proposed, therefore concentrations of biological criteria would not change. However, for the remaining streams since there would be no increase in stream temperature or sediment (See Stream Temperature, Sedimentation, and Hydrologic Effects of Alternatives sections) from the proposed action, no negative effects to biological criteria would be expected. In the long term it is expected there would be a reduction in sediment from proposed sustainable road treatments (i.e. road decommissioning and road closures), road maintenance and reconstruction for associated roads proposed for log haul, and aquatic and riparian habitat improvements. As a result, biological criteria will no longer be further discussed in the analysis.

## Habitat Modification

Foster Creek is listed on the 303(d) list for habitat modification. Habitat modification includes physical alterations to a stream channel from increased: erosion/sedimentation and stream temperature. Potential causes that could further degrade and influence habitat modification are vegetation management treatments. However, there would be no loss of stream shade (See Temperature and Hydrologic Effects of Alternatives section) or increase in sediment delivery (See Sedimentation and Hydrological Effects of Alternatives sections.). No changes in habitat modification would be associated with the proposed vegetation management, and is not discussed further for these specific treatments. In contrast, aquatic and riparian improvements, such as instream large wood placement and aquatic organism passage barrier removal/replacement could occur on FSR 33 and 3730 as well as sustainable road treatments to minimize the effects of chronic sources of fine sediments by improving or removing road prisms. Beaver dam analogs also would improve habitat complexity and function within these streams. Recreation Improvements that would be adjacent to Foster Creek would be the proposed Foster Bar Facility/ Foster Bar Launch Improvements as well as Big Bend/Rogue River trailhead that is accessible from Foster Bar Campground to Brewery Hole. Effects discussions are below in Hydrologic Effects of Alternatives.

**Figure 8. Existing Stream Shade for Planning Area in Shasta Costa Creek-Rogue River Watershed.**

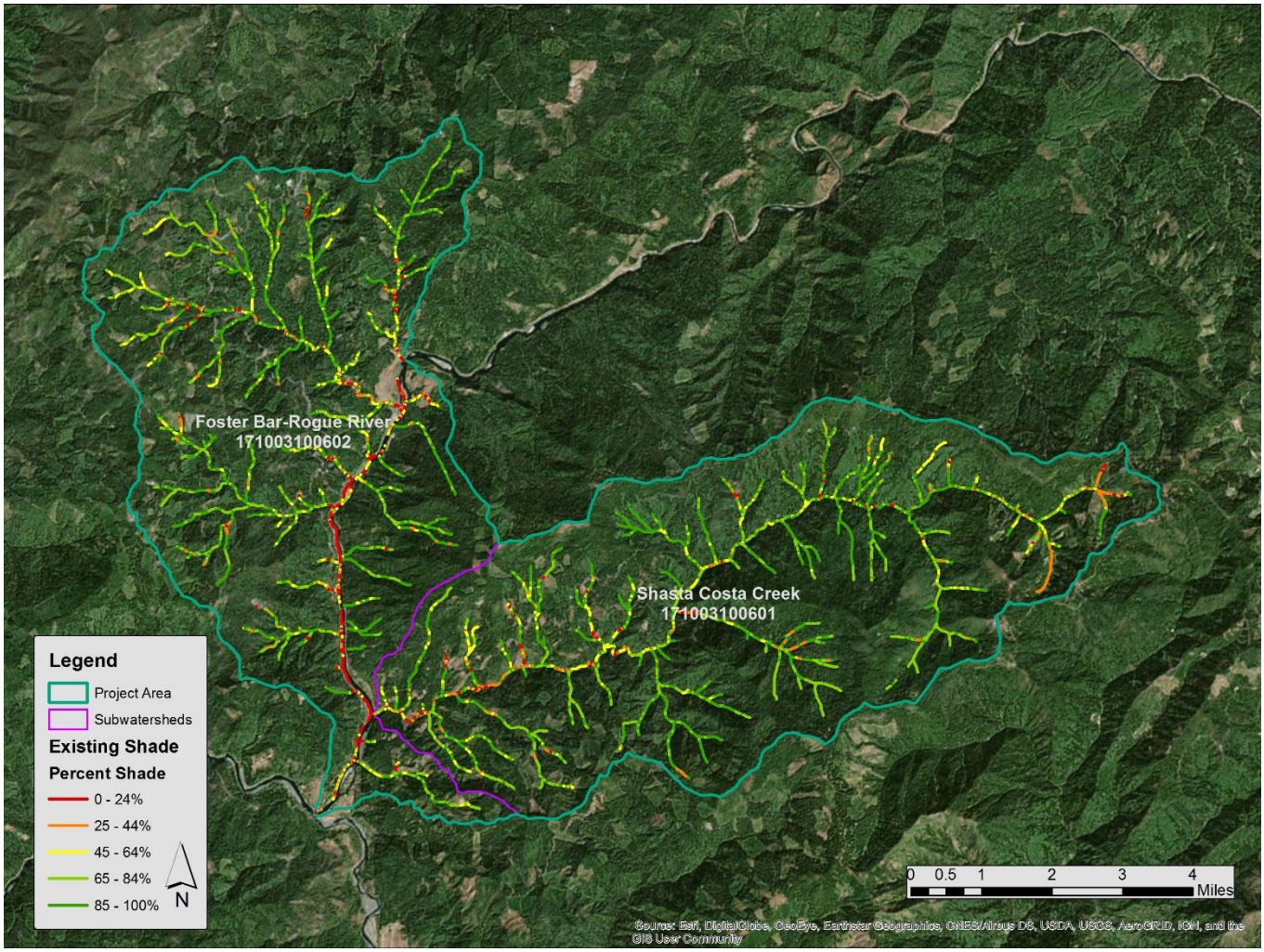


**Figure 9. Existing Shade for the Planning Area in Lawson Creek- Illinois River Watershed. The boundary of the Shasta Agness planning area extends from Lawson Creek downstream to the mouth of the Illinois River. The Shasta Agness planning area also does not include above the confluence of Horse Sign Creek and the Illinois River.**

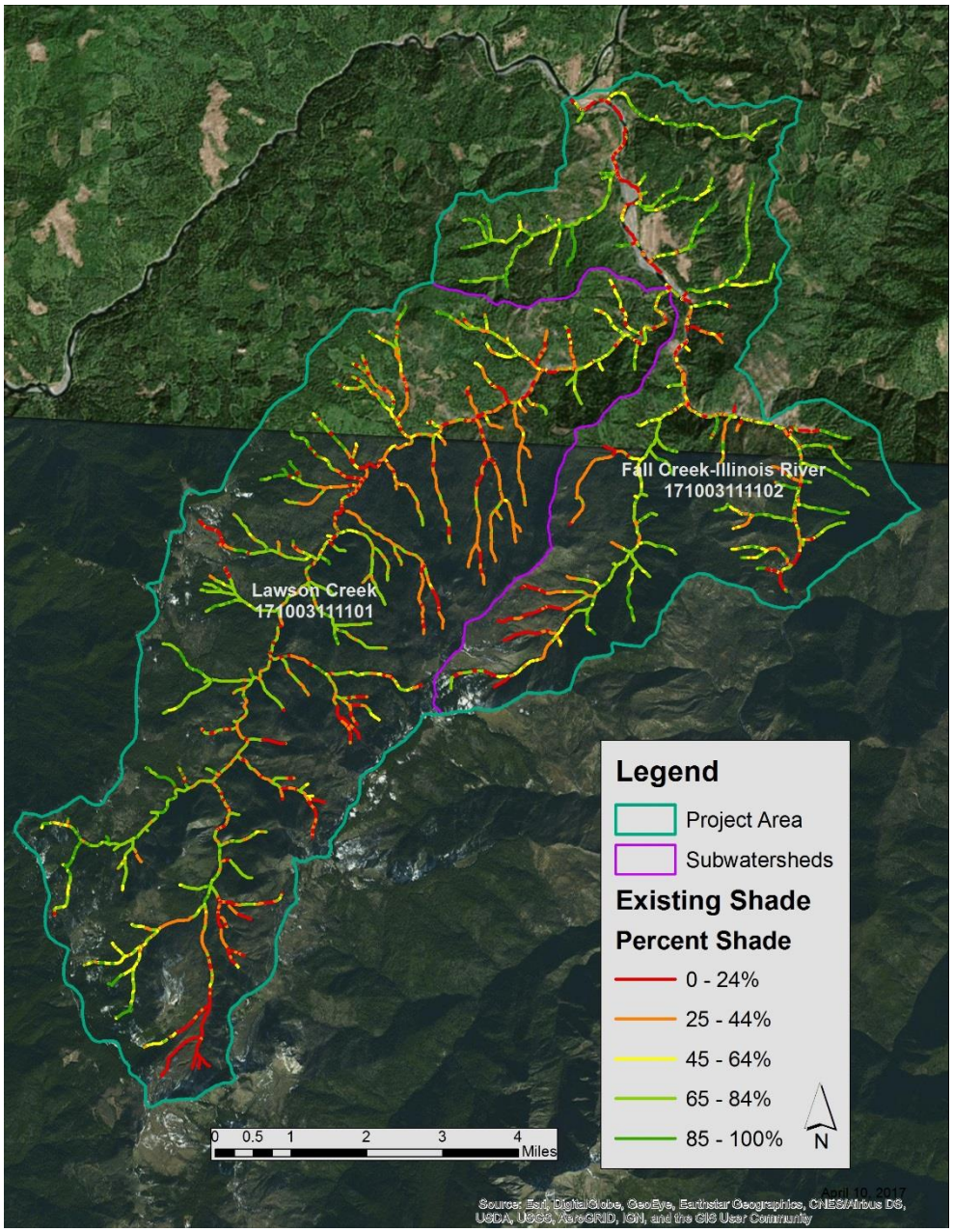
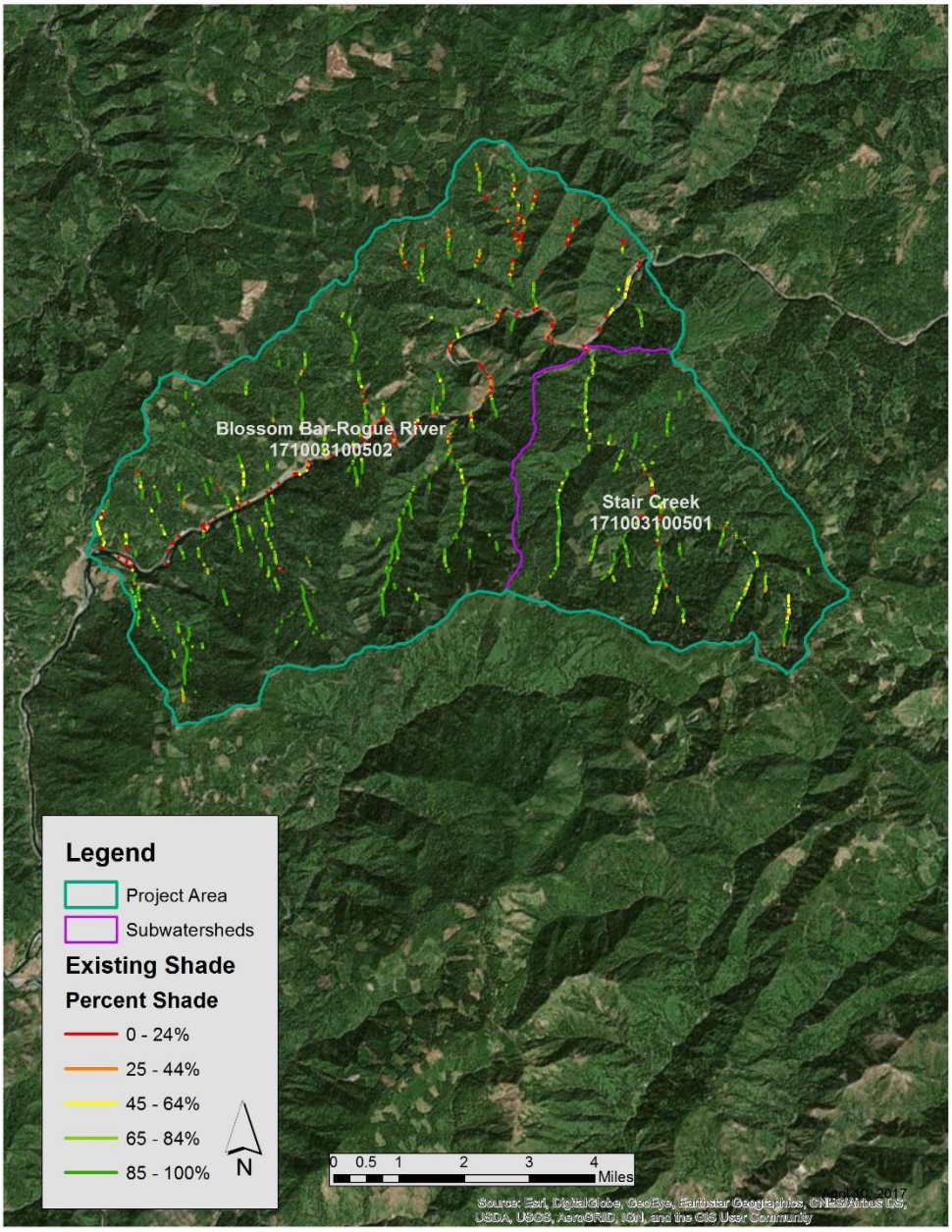


**Figure 10. Existing Shade for Planning Area in Stair Creek-Rogue River Watershed.**




# IV. Hydrologic Effects and Mechanisms & Analysis Framework

Effect mechanisms present existing condition information on hydrologic processes including channel morphology, water yield, stream temperature, sediment delivery, water quality and 303(d) listed waterbodies, and Northwest Forest Plan Riparian Reserves and KeyWatersheds.

Adverse changes in sediment delivery processes can be related to existing turbidity, water temperature, and channel morphologic conditions. Existing changed conditions in runoff timing and water yield from historical timber harvest and fire are evaluated so that the proposed actions' effects on runoff timing and water yield can be related to existing conditions. Furthermore, the following discussion summarizes the possible concerns related to the hydrologic conditions and processes, and then specifies whether or not these would arise as a result of proposed action alternative components.

## A. Channel Morphology and Large Wood

Most of the streams where unique habitat landscape restoration and sustainable road treatments are proposed under the Shasta Agness Landscape Restoration project are located on upland valleys constrained by hillslopes rather than valley bottoms. However, aquatic and riparian habitat improvements as well as some recreation improvements will be located along the mainstem and tributaries of the Rogue and Illinois River. Streams are steep (usually greater than 3% in gradient) and channel substrate is usually a combination of bedrock, boulder, cobbles and some areas of sand and gravel. These streams tend to transport sediment, rather than deposit it and are considered stable and quick to recover from disturbance. Proposed areas described as candidate plantations have been harvested in the past, which has reduced large wood available for recruitment in streams. Watershed Analyses and stream surveys conducted throughout these watersheds confirms these findings.

The Planning Area contains numerous small streams (only a few feet wide) that are first and second order channels, are intermittent or ephemeral, and may include wetland areas and springs. Stream valleys are often V-shaped and the active channel less than ten feet wide. Small wood and vegetation are sufficient to provide channel and slope stability. Wood falling into the channel cannot travel downstream due to the lack of streamflow and topographic confinement. Sediment transport in these small channels is moderated by the presence of heavy vegetation in the form of both trees and shrubs, and by wood present in the channel and on adjacent steep slopes. Wood falling directly into small channels contributes to their sediment capture and holding capacity.

Over the longer term, timber harvest in riparian areas can have a beneficial or detrimental impact to channel stability by increasing or decreasing the availability of large woody material for recruitment to streams. Instream large wood aids in the trapping, storage, and sorting of sediment, and provides channel roughness that dissipates stream energy. Removal of trees from Riparian Reserves can affect source, number, size and mechanisms of delivery of large woody material to streams. In-channel large woody material in region 6 is defined as a minimum of 50 feet long with a diameter of 36 inches at the small end. Currently, few of the trees within Riparian Reserves meet this criterion. However, large instream wood placement treatment activities would assist in adding structure complexity to streams lacking large wood.

In addition, in riparian areas over-stocked with small diameter trees, thinning or partial timber harvest can be used to allow more rapid growth of the remaining trees, which over the longer term contributes to a more stable, functional channel, large wood recruitment, and stream shading.

Changes in water quality and quantity and channel morphology (channel form and structure) are potential issues because these changes can affect the beneficial uses of water. Changes in water quality can make water more or less beneficial for aquatic life, wildlife, and human use. Changes in (1) hillslope vegetation, (2) hillslope soil properties, (3) condition, type, and amount of roads

and, (4) riparian vegetation are the primary factors affecting water quality and quantity and channel morphology.

Changes in channel morphology are most likely to be caused by changes in sediment delivery processes (primarily changes in hillslope delivery processes and changes in the condition, type, and amount of roads). Though much less likely to be significant under current forest practices, changes in runoff timing and water yield due to timber harvest can also adversely affect turbidity and channel morphology. With current forest practices, changes in riparian vegetation could be expected to have beneficial effects on turbidity and channel morphology by increasing root strength, the future potential for large wood recruitment, and, thereby, bank stability.

## B. Sediment Delivery

Sediment is fine and coarse geologic material that is naturally delivered to streams through natural processes such as mass wasting, surface soil erosion, and stream bank erosion. Due to the size and number of watersheds in this project, it was not feasible to perform a field review of all the channels (perennial, intermittent, and ephemeral) in the watersheds. Land management activities, such as silviculture and sustainable road treatments (i.e. road decommissioning, road storage, or road improvements), log hauling, culvert removal or replacement, instream projects such as large wood additions to tributaries, and development of recreation sites (i.e. trail construction, boat ramp modifications or construction, facility improvements, etc.) can alter natural sediment production and delivery processes.

Reduced canopy cover following project activities can allow more direct raindrop impact on the soil surface, increase the amount of rain reaching the soil, and change the accumulation and melting pattern of snow. Disturbance activities by heavy machinery can induce changes in soil properties that can accelerate natural rates of erosion and sediment delivery to streams.

A reduced canopy cover could contribute to quicker runoff, which could increase sheet and rill and gully erosion as well as increase the erosive power of receiving streams. However, overland flow that can cause erosion is uncommon because of the high infiltration capacity of the soils on the Siskiyou side of the Forest. Compacted soils resulting from road/trail construction and the use of heavy equipment also contribute to increased runoff. Rapid re-growth of the understory after thinning typically balances removal of the canopy except where soil compaction discourages moisture infiltration and new growth. Harvest operations may trigger accelerated erosion in unstable areas if the combination of canopy removal during silviculture treatment activities and road reconstruction generates enough cumulative impact to result in increased or concentrated runoff. High risk areas include steep slopes associated with Riparian Reserves of higher order channels (3rd order and higher) within the transient snow zone.

Turbidity, or the loss of water clarity, is due to the presence of suspended particles of silt and clay. Other materials, such as finely divided organic matter can also contribute to the loss of water clarity. Water quality is thereby effected by the fine sediments-- especially clays that remain suspended except in very still water.

In addition, coarser sediment may bury stream gravels and pools or, change channel shape and flow in cases of high sediment input such as debris flows. Sediment delivery to streams is a concern since several channels are critical habitat for coho salmon.

Roads intercept runoff from upslope areas, so an existing high road density is a concern. The intercepted runoff and rain falling directly on the surface of the road is collected in a drainage

ditch on the uphill side of the road. Roads also intercept near-surface groundwater flowing through the slope. The flow in the drainage ditch is periodically discharged underneath the road through a culvert to prevent excessive road erosion and flooding. This effectively concentrates flow on the hillside at the point the flow discharges from underneath the road. This concentrated flow often causes a channel to form which, during storm events, transports flow to streams more rapidly than prior to road construction. This has the effect of increasing the drainage network, thereby increasing peak flow and runoff speed. Roads, by increasing the drainage network, have the potential to increase peak flows through concentration of runoff and more rapid routing to stream channels (Wemple 1996). Roads create unprotected ditches, cut slopes and fills that can contribute sediment to streams. Elevated sediment is either stored or transported downstream and may contribute to morphological changes (filling of pools, channel widening) and/or degraded water quality.

There are approximately 193 miles of roads across all ownerships within the project area. The road density for all roads and for Forest Service roads for the 6$^{th}$ field watersheds in the planning area are listed in Table 15and Table 16. Densities under 2 miles per square mile are considered low; over 3 miles per square mile suggest a concern for sediment. Within the planning area there are no subwatersheds that are over 3 miles per square mile. Though road density is low for subwatersheds, it should be stated that it is common knowledge within the Forest Service that due to lack of road maintenance funds, 85 to 90 percent of forest service roads are not maintained and are an additional source of sediment delivery to streams. Figure 11 shows the road density within the subwatersheds contained in the Planning Area.

However, slope distance of roads and road culvert discharge points from surface channels may be more important for impacts than road density. For example, a road near the top of a slope and far from a natural channel will likely not intercept very much water and the water it does intercept is likely to re-infiltrate the soil rather than forming a surface channel that quickly routes the flow to the natural channel at the bottom of the slope. By contrast, a road near a natural channel and near the bottom of a slope will intercept a relatively large amount of water, but the water discharging from the road culvert will route flows faster to the natural channel for only a short distance and, thus, have more of an effect on runoff timing.

Existing roads can have long term adverse effects on water and sediment transport that must be considered and mitigated during treatment activities. Roads can also increase sedimentation through structural failure. Road structural failure is most commonly caused by culvert embankment failure and slope failure. The probability of the flow capacity of the culvert being exceeded can be minimized through adequate sizing during design and good maintenance practices.

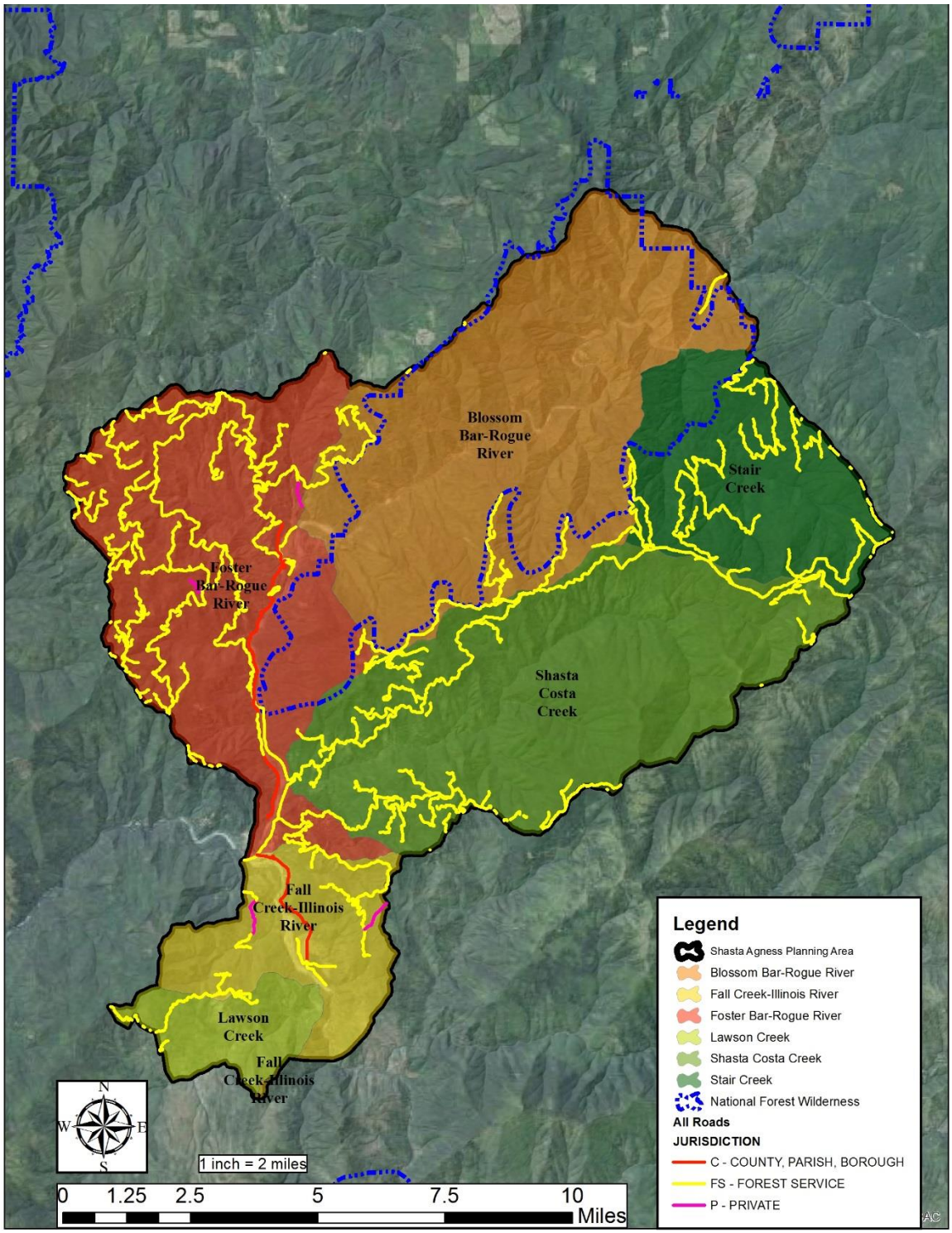
**Table 15. Road density by 6$^{th}$ field watersheds within project area for Forest Service system roads.**

| Subwatershed Name | Miles of Road | Area of Watershed (Sq. Miles) | Road Density (miles per sq. mile) |
|---|---|---|---|
| Blossom Bar- Rogue River | 18.67 | 40.52 | 0.46 |
| Fall Creek-Illinois River | 11.97 | 11.25 | 1.06 |
| Foster Bar- Rogue River | 70.84 | 33.51 | 2.11 |
| Lawson Creek | 3.30 | 5.36 | 0.61 |
| Shasta Costa Creek | 47.51 | 36.80 | 1.29 |
| Stair Creek | 31.50 | 16.55 | 1.90 |

**Table 16. Road density by 6th field watersheds within project area for *all* roads.**

| Watershed Name | Miles of Road | Area of Watershed (Sq. Miles) | Road Density (miles per sq. mile) |
|---|---|---|---|
| Blossom Bar- Rogue River | 18.67 | 40.52 | 0.46 |
| Fall Creek-Illinois River | 16.46 | 11.25 | 1.46 |
| Foster Bar- Rogue River | 77.81 | 33.51 | 2.32 |
| Lawson Creek | 3.30 | 5.36 | 0.61 |
| Shasta Costa Creek | 47.51 | 36.80 | 1.29 |
| Stair Creek | 31.50 | 16.55 | 1.90 |

**Figure 11. Road density for 6th field watersheds within the Shasta Agness planning area.**



## C. Water Yield (Peak Flows)

Increases in water yield (low and peak flows) are associated with forest management activity. Road surfaces and cut slopes intercept water, and road ditches act as intermittent streams, transporting water more rapidly than natural processes. These properties of roads combine to change the timing and increase the size of peak flows. The potential for effects from increased peak flows are the greatest in areas where road density is highest and when they are located in riparian areas.

Many studies have shown that the removal of vegetation by logging results in increased annual water yield. Most studies agree that the increase in water yield is most evident during summer low flows (Rothacher 1971, Harr et. al. 1975, Ziemer 1981, and Wright et. al. 1990). An increase in low summer flows can benefit salmonid habitat by lowering summer temperatures and increasing the amount of rearing habitat.

An increase in annual flows can also indicate an increase in winter flows. Increases in peak or storm flows, can change channel morphology by flushing smaller substrate, causing the channel to down cut, and increase stream bank failures. This produces a negative effect on salmonid habitat. Studies on increased peak flows are varied in their findings on how much increase in flow will results from a given amount of timber harvest. Most studies do agree that percentage treatment effects decrease as flow event size increase and is non-detectable for flows with a 2 year return interval or greater (Harr et. al. 1979, Ziemer 1981, Wright et. al. 1990, Megahan 1998).

Recent literature from Grant addresses the effects of forest practices on peak flows and the consequent channel response in western Oregon (Grant et. al. 2008). Grant et al. synthesizes the findings of an extensive array of existing literature linking forest practices in the Pacific Northwest with changes to peak flow.

(Grant et. al. 2008) provides a general guideline for assessing harvest peak flow effects in the table reproduced below. Roads may play a role in the generation of increased peak flows at the small basin scale. This is due to their ability to intercept and concentrate subsurface and surface water. Road networks combine with stream networks to accelerate water drainage from the land. Note also that thinning would be expected to generate a low risk of increased peak flows as compared to equivalent timber removal in large patches.

**Table 17. Potential considerations for peak flow increases.**

| Likelyhood of peak flow increase (High ← → Low) | | | Potential considerations |
|---|---|---|---|
| High | Moderate | Low | Road density |
| All or most | Some | Few or none | Road connectivity |
| Fast | Moderate | Slow | Drainage efficiency |
| Large | Small | Thinned | Patch size |
| Absent | Narrow | Wide | Riparian buffers |

Rain is the dominate process for water yield in the Shasta Agness planning area. Rainfall varies from 80 inches annually in lower elevations to 140 inches in higher elevations. In the dry summer in areas where fog persists, interception of moisture from vegetation can result in fog drip that increase soil moisture. Studies in these areas has shown temporary reduction in summer yield was offset by renewed fog drip (Ingwersen, 1985 and Dawson, 1998). In the summer fog is common on the coast in Gold Beach. Because of the coastal mountains and wind patterns, coastal fog dissipates approximately 10 miles inland, or at the confluence of the Rogue River and Lobster Creek. Fog dip is not a factor of increase summer soil moisture in the Shasta Agness planning area. Furthermore, because of the varied landscape position of restoration stands, the limited nature of canopy removal, and the relatively small spatial extent of the overall treatment units, the suite of actions proposed here, if fog drip did occur, it is anticipated to have no measurable impacts to levels of fog interception.

## D. Stream Temperature

Changes in water temperature are most likely to be caused by changes in riparian vegetation and sediment delivery processes. Though impacts are much less likely to be measureable under current forest practices are applied, also known as Project Design Criteria (PDCs). Changes in runoff timing and water yield can also affect water temperature.

Stream temperature is affected by many variables. Energy exchange may involve solar radiation, long wave radiation, evaporative heat transfer, convective heat transfer, conduction, and advection (Lee 1980; Beschta 1984). With the exception of solar radiation, which only delivers heat energy, these processes are capable of both introducing and removing heat from a stream. Solar radiation is the most important radiant energy source for the stream heating during the daytime (Brown, 1984; Beschta, 1997). Reduced riparian vegetation can increase solar radiation, and stream temperature.

**Table 18. Factors that Influence Stream Surface Shade.**

| Description | Measure |
|---|---|
| Season | Date |
| Stream characteristics | Aspect, Bankfull Width |
| Geographic Position | Latitude, Longitude |
| Vegetative Characteristics | Buffer Height, Buffer width, buffer Density |
| Solar Position | Solar Altitude, Solar Azimuth |

As described in Table 13 above, several waterbodies associated with candidate stands proposed for thinning have streams listed by the Department of Environmental Quality 303(d) report as water quality limited with regard to water temperature or other listing parameters. Past timber harvest may have exacerbated these conditions by removing trees on candidate plantation stands that would have provided stream shade. Natural disturbance, roads, mining and water withdrawal can also cause increased stream temperatures.

Further potential causes for water temperature increases would be associated with canopy removal at temporary and permanent stream crossings (existing road maintenance on Forest system roads and upgrades for AOP) for both roads and skyline corridors. Canopy removal elsewhere on roads and for thinning outside the primary shade zone would not affect stream temperature since there is no surface water present.

# V. Hydrologic Effects of Alternatives

The **project specific plan amendment** for this project which would allow cutting of trees over 80 years of age within the LSR allocation, was not driven by hydrologic conditions. It also would not measurably affect water quality and hydrologic conditions. Land management activities shall be planned and conducted to limit impacts on streams and water quality (USDA Forest Service 1989). Application of broad-scale conservation objectives, coupled with the implementation of site-level design and protection measures is intended to minimize or avoid impacts to water quality and streams. PDCs previously indicated to avoid these impacts would be implemented, including but not limited to those described for maintaining no cut zones, primary shade zones, etc. Together these are the principle means for protecting and conserving riparian resources and meeting the Standards and Guidelines associated with Riparian Reserves (NWFP C-33 & 34). Furthermore, complying with the Aquatic Conservation Strategy objectives means that an agency must manage the riparian-dependent resources to maintain the existing condition or implement actions to restore conditions. Restoration actions to improve the growth, size, and vigor of riparian vegetation would eventually improve its function, including increased wood size and inputs. To analyze these effects to hydrologic resources, a summation of the environmental analysis regarding consistency with the elements and components of the objectives was completed, and can be found in Section VII of the Hydrology Report.

## A. Alternative 1, 2, and 3- Direct and Indirect Effects of Sustainable Roads (Haul Routes, Road Maintenance, Road Decommissioning, Road Storage, Road Improvements, and Temporary Roads)

### 1. Haul Routes and Road Maintenance

Road maintenance, such as blading and ditch cleaning, and haul traffic are activities that affect sediment production from forest roads. During the wet season, roads become saturated and fines from the road sub-surface can pumped to the road surface from log haul. These fines move into the road ditch and at stream crossings can be delivered to the stream system causing turbidity. For the Shasta Agness Project there would be no wet weather haul permitted *unless* consultation was performed with specialists and PDCs were followed for all activities. Thus, for any of the action alternatives, there would be no or immeasurable impacts from road sediments as a result of wet weather log haul. Alternatives 1 and 3 have the largest mileage of proposed haul route (~193 miles); alternate 2 has the least (~151).

### 2. Temporary Roads

There would be no new permanent road construction proposed in any action alternative for this project. Temporary roads would be created for the purpose of transporting logs and would be built, utilized, and decommissioned (rehabilitated) over the course of the treatment. Rehabilitation of these roads would occur after the completion of their intended use.

Under the action alternatives, there would be a maximum of 5 miles of new temporary road construction and 12 miles of temporary road construction on existing non-system road templates (Alternative 1 has the most mileage). Under Alternative 2 there would be approximately 4 miles of new temporary road constructions, and 10 miles of temporary road construction on existing non-system road templates. Under Alternative 3 there would be no new temporary road

construction, and an estimated 12 miles of temporary road construction on non-system road templates. Table 19 indicates the watershed, road bed template, and miles of temporary road needed per Action Alternative.

**Table 19. Watershed, road bed template, and total miles for proposed temporary roads for each Action Alternative.**

| | Watershed | Road bed Template | Miles |
|---|---|---|---|
| **Alternative 1** | Lawson Creek-Illinois River | Existing | 2.5 |
| | | New | 1.5 |
| | Shasta Costa Creek-Rogue River | Existing | 6.2 |
| | | New | 2.6 |
| | Stair Creek-Rogue River | Existing | 3.1 |
| | | New | 1.1 |
| **Alternative 2** | Lawson Creek-Illinois River | Existing | 1.7 |
| | | New | 1.5 |
| | Shasta Costa Creek-Rogue River | Existing | 5.0 |
| | | New | 1.1 |
| | Stair Creek-Rogue River | Existing | 3.1 |
| | | New | 1.1 |
| **Alternative 3** | Lawson Creek-Illinois River | Existing | 2.5 |
| | Shasta Costa Creek-Rogue River | Existing | 6.2 |
| | Stair Creek-Rogue River | Existing | 3.1 |

None of the action alternatives currently propose new temporary road segments within riparian reserves. However, new temporary roads could be considered if needed to better meet resource objectives that would attain the purpose and need of the Project. No new temporary roads would be within 100 feet of streams, and all standards and guidelines within the Siskiyou LRMP and NWFP would be reviewed to maintain consistency with management direction, such as the Aquatic Conservation Strategy. Building new temporary roads would be generally on stable ridge systems, where there are no stream channels to intersect. It is likely that sediment would not be delivered to streams because road locations are sufficiently far from streams to preclude sediment delivery.

Temporarily reopening old, existing timber harvest roads has the potential for increasing sediment production and delivery through exposure of mineral soil and increased soil compaction. In addition, reuse of legacy templates would create a loss of vegetation from passive restoration that previously occurred over time. Though, this loss of vegetation would be understory vegetation and would not reduce stream shading. These effects would be addressed by project design criteria (Appendix B), until vegetation becomes reestablished in road prisms. Using these existing roads to harvest timber reduces the need to build new temporary roads, limits soil disturbance and compaction to areas previously disturbed and compacted, and allows the opportunity to repair roads that were not built to current standards and design criteria. Decommissioning of temporary roads will restore the soils infiltration capacity on the old road templates resulting in an improved condition. Project design criteria and best management practices are expected to prevent or minimize the potential for these roads to become chronic sources of fine sediment.

## 3. Road Decommissioning, Road Storage, and Existing Road Openings

Aquatic systems are primarily affected by roads through the associated increase in peak stream flows, interception of overland flow, and addition of sediment from road surfaces. Increases in flow as a result of roads can cause stream bank cutting and channel destabilization. Too much sediment can embed fish spawning gravels and suffocate developing fish eggs that are laid there. The primary mechanism for the transfer of sediment is from culverts plugging at stream crossing. Fill failures at stream crossings, and the subsequent landslide associated with it, can contribute substantial amounts of sediment to streams. It can take decades for this material to be flushed out of the channel through normal stream flows.

Road decommissioning activities have been in the forefront for watershed restoration projects over the last decade. Monitoring has shown it to be effective at reducing surface erosion and mass failure risk while increasing water infiltration rates and vegetative ground cover. The effects of decommissioning create conditions which improve water quality and hydrologic function of aquatic ecosystems.

*Road Improvements*

Road improvement activities are a part of road maintenance and consist of improving road drainage to protect the road surface and upgrading stream crossings to reduce the risk of sediment delivery to stream channels during storm events.

***Road improvement work may entail any or all of the following treatments:***

- ♦ Apply rock aggregate or paving to the road surface where necessary
- ♦ Add rolling dips where feasible
- ♦ Upgrade stream crossing culverts to withstand 100-year peak flows and/or debris flows
- ♦ Construct dips at stream crossing that have a diversion potential
- ♦ Install downspouts
- ♦ Add ditch relief culverts
- ♦ Improve ditch line
- ♦ Fill in road ditch and outslope roads where feasible
- ♦ Where the ditch is hydrologic connect to a stream install a cross-drain to prevent ditch water from entering a stream channel
- ♦ Provide fish passage

*Road Decommissioning*

Road decommissioning is the physical treatment of a roadbed to restore the integrity of associated hillslopes, channels, and flood plains and their related hydrologic, geomorphic, and ecological processes and properties. The road would be closed to motor vehicles either using barricades or recontouring. Waterbar installation and ditch drainage culvert removal would also occur.

The primary goals of road decommissioning are to restore natural drainage patterns and infiltration capacity. Decommissioning a road involves one or more of the following restorative actions, dependent upon site-specific evaluations and recommendations of resource specialists.

- ♦ Removing drainage structures including culverts and bridges
- ♦ Pulling back stream banks to natural channel slope
- ♦ Restoring out-slopes for drainage by placing waste on sub-grade to reestablish original ground lines
- ♦ Outsloping roads by pulling sub-grade material back toward the hillslope
- ♦ Constructing cross-drains and waterbars
- ♦ Scattering woody debris on road travel ways
- ♦ Subsoiling and/or ripping compacted road travel ways
- ♦ Seeding and/or planting road travel ways with native seed and vegetation (conifers, hardwoods, shrubs)
- ♦ Blocking road entrances with barriers

Decommissioned roads are removed from the Forest transportation system once restorative actions have been implemented and closing barriers installed. The objectives of road decommissioning include:

♦ Reducing the risk of mass failures and subsequent impact on streams
♦ Protecting fish and fish habitat
♦ Restoring natural surface and subsurface drainage patterns
♦ Restoring vegetation and site productivity
♦ Restoring stream channels at road crossings
♦ Increasing road maintenance cost-effectiveness by concentrating available funds on roads needed for long-term access
♦ Restoring terrestrial habitat that has been invaded by vehicles and other human activities

*Storage*

Roads that were identified as needed for reasonably foreseeable future resource management activities would be closed to vehicular traffic until needed, and changed in the Forest Service transportation system to custodial maintenance "level 1." These roads would be closed for periods of 1 year or more.

Objectives for Level 1 closed roads are to eliminate traffic and minimize resource impacts. Road surface deterioration may occur at this level. Management emphasis for these roads is on maintaining drainage facilities and runoff patterns. The treatment on these roads would include the removal of high risk road stream crossings with the culverts stored on-site for easy installation if the road is reopened, construction of cross drains, and blocking the road entrance with a barrier.

Closing roads under Level 1 custodial maintenance involves one or more of the following actions, dependent upon site specific evaluations and recommendations of resource specialists:

♦ Construct a dip in the fill at road stream crossings
♦ Fills and culverts would be removed and stored at the site for culvert stream crossing identified as having a high potential to fail and impact anadromous fish habitat and water quality
♦ Sub-soiling or ripping a portion of the compacted road travel way
♦ Constructing a series of cross-drains and or waterbars

The proposed action alternatives for sustainable road treatments are shown in Table 20. Under Alternative 1 and 2, the failed drainage structure on Snout Creek at the beginning of the 2308330 road would be replaced by a structure suitable for use by OHVs and designed to provide for Aquatic Organism Passage (AOP). Therefore, Alternatives 1 and 2 propose that the 2308330, 3577350 and 3577357 roads be closed to highway vehicles but open to off-highway vehicles (OHVs).There are seven additional structures that would need to be assessed in the field to verify if the current drainage structure need to be replaced with AOP suitable structures. Operationally, the designs would be prepared by engineering staff following applicable Best Management Practices (BMPs) and consultation with other specialists as necessary. Future opening of these roads for both highway vehicles and OHV use would require that decision to be advised by documented engineering analysis conducted by a qualified engineer (FSM 7715.77). In addition, under Alternative 1, part of the currently closed 2300990 road would be open but would have a seasonal closure.

Channel morphology would be improved at the proposed AOP stream crossing replacement locations. Stream crossings that are replaced would have stream channels rebuilt to mimic the upstream and downstream morphology allowing for a connection in flow through these sites

which once were unnaturally impacted often through narrowing of the stream channel by undersized culverts. Future impacts to channel morphology would be reduced by decreasing sediment input and the risk of pool filling, and channel widening and instability. However, there would be small amounts of sediment during the replacement of the AOP structures and would cause some localized, short-term and very small increases in turbidity through the disturbance of stream-channel beds.

**Table 20. Proposed sustainable road treatments for all action alternatives in the Shasta Agness Planning Area.**

| | Alternative 1 | Alternative 2 | Alternative 3 |
|---|---|---|---|
| Existing Road Openings (ML1 to ML2) (miles) | 1 | 1 | 0 |
| Road Storage (ML2 to ML1) (miles) | 10 | 4 | 9 |
| Road Decommissioning (miles) | 6 | 6 | 10 |

As part of this project, there would be between 6 to 10 miles of road decommissioning; 4 to 9 miles of road storage; and 1 mile of existing road openings. The action alternatives all propose to stabilize the road drainage system through stormproofing, road closure and decommissioning in varying degrees; these treatments would improve the existing road drainage system. Improved road drainage is expected to reduce the negative impacts to the aquatic ecosystem from road-induced changes in sediment delivery, water yield, morphology, and temperature. The potential for roads to deliver sediment to streams varies with the road features. Risk to aquatic resources increases with road stream crossings, high erosion potential of the hillslope, the proximity of the road to streams and fish habitat.

Design criteria for road treatments, such as placement of waterbars and erosion control measures are expected to prevent sediment from entering streams. In addition, due to the small area of disturbance and the implementation of BMPs, the amount of sediment from these activities is not expected to effect the stream system. The indirect, long term effects of these operations would reduce sediment production and delivery to stream systems within the watershed. Removal of culverts may produce some short term, direct sediment, but in the long term, there would be a reduced risk from culvert failure or diversion and hence, a reduction in sediment production within the watershed. Thus, there would a beneficial effect from preventing potential road failures and associated fine sediment inputs at 14 decommissioned stream crossings in Alternative 1 and 2, and 23 stream crossings in Alternative 3 within the project planning area for the proposed road decommissioning treatments. Heavy equipment used for road treatments would use fuel, need to be fueled and potentially could spill hydraulic fluid. Best Management Practices (USDA, 2012) and contract specs/administration include mandatory setbacks for staging and fueling areas, which would mitigate any potential spill from entering a live stream channel.

Removal and/or replacement of culverts and removal of unstable sidecast during decommissioning or closure road treatments may remove trees that could provide some shade to streams. Shade reductions would be minor because roads are generally less than 20 feet wide; and

short term because residual tree crowns adjacent to roads would respond rapidly to the additional light and continue to grow laterally and vertically, providing additional shade over time.

Any trees lost from road decommissioning, storage and stormproofing activities would not be large enough to affect the overall watershed vegetation composition. Any conifers removed that are greater than 18-inches in diameter could be used for stream restoration projects throughout the Forest. It would be preferable to keep root wads attached to any trees that will be used for stream restoration. Therefore, no measureable change in peak flow is expected with the implementation of any of the sustainable roads components in any of the action alternatives. However, some benefits would be anticipated to varying degrees due to the reduction both sediment delivery and in hydraulic connectivity between the roads and aquatic ecosystem. Alternative 3 would provide the greatest reduction, and Alternative 2 the least.

Under the Action Alternatives road densities would decrease, and there would be a reduction in road segments adjacent to stream systems and a reduction of potential sediment delivery to stream systems in comparison to no reduction in chronic sediment sources under Alternative 4. Qualitatively, under Alternative 3 there would be the most potential to reduce chronic sediment sources, followed by Alternative 1, and lastly Alternative 2.

## B. Alternatives 1, 2, and 3- Direct and Indirect Effects of Silvicultural and Activity Fuel Treatments

Stream response to storms and runoff is generally measured in terms of increased water flow volume and velocity. Precipitation and snowmelt increase stream flow until a peak is reached and stream flow declines toward ground-water supported levels. The speed and duration of stream response is a function of the size and drainage network configuration of the watershed, topographic and vegetative watershed characteristics, and storm/runoff event size and duration. Peak flows are categorized in terms of their return interval, that is, the highest expected flow for a specific time interval. The two year return interval generally determines basic stream morphology since it occurs regularly over the long term and thus distributes the bulk of the long term sediment load (Rosgen 1994).

Effects of Forest Practices on Peak Flows and Consequent Channel Response paper is a state-of-the-art synthesis of effects of forest harvest activities on peak flows and channel morphology in the Pacific Northwest (Grant et al 2008). The study reviewed peak flow data across rain, transient and snow dominated hydrologic zones. The paper provides guidance as to how to evaluate the potential risk of peak flows for specific management treatments employed.

For basins within the transitional snow hydrologic zone, Grant et al. found that the detection threshold for changes in peak flows occurs at 20% of watershed area clear cut or regeneration harvested. Thus, changes in peak flows cannot be detected at harvest levels of less than 20% (Grant et al 2008). Based on the hydroregions developed by Grant et al., the project area would be located in the transitional hydroregion. Based on the detection threshold for changes in peak flows occurring at 20% of watershed area harvested, changes in peak flows cannot be detected at harvest levels of less than 20%. The study examined clear-cuts and shelterwood harvests. These results are relevant to this analysis because they represent an important analog for potential effects to peak flow that would be expected from proposed thinning elements in each of the action alternatives. Based on these related findings, the relatively small areas of restoration thinning proposed in all action alternatives would not reach the 20% threshold (9.9% would be the maximum potential percent of watershed treatment). Therefore, effects to water yields and peak flows across all alternatives would be immeasurable.

Turbidity, or the loss of water clarity (turbidity), is due to the presence of suspended particles of silt and clay, but other materials such as finely divided organic matter can contribute to the loss of water clarity. It is an important component of water quality and indicator for sediment yield. Wildfires remove vegetation whose roots hold the soil together, so after a fire there is the potential that rain can cause erosion. Eroded fine soils carried into a stream can increase turbidity (cloudiness).

Turbidity monitoring was conducted following the Silver Fire of 1987 to determine if water turbidity increased following the fire. Results showed turbidity does not appear to be a significant concern following a wildfire (Kormeier, 1995).

In the Biscuit fire area turbidity monitoring was also conducted over the winter following the fire. Three severely burned tributaries to the Illinois River as well as the Illinois River were measured in 2002 and 2003 to determine whether any changes could be found following the first winter after the Biscuit Fire of 2002. The winter following the Biscuit Fire was normal with one storm of magnitude between a 2 and 5 year event that occurred the last week of December and first week of January. In the three severely burned small watersheds, no high turbidity was noted the winter following the fire. The Illinois on December 16 did show high turbidity but the sediment source was reported to be above or outside the fire area.

Following the 2002 Biscuit Fire and before the first winter, 240 erosion pin plots were installed in the fire area to quantify the effects on soils. After three winters there did not appear to be a significant increase in soils movement due to the fire (Mchugh and Sensenig, 2005). Another soil study, Ecosystem effects and propagation of the Biscuit fire across the large-scale plots of the long-term ecosystem productivity experiment 2003, looked at the effects on soil including erosion pins. The erosion pins demonstrated fluctuating soil surface heights (relative to the top of rebar grid-point posts). The study failed to see significant movement at the base of hotly burned units. Little soil accumulated in ditches along the road (Bormann et. al. 2003)

Turbidity monitoring following both the Silver and Biscuit fires supports field observations of hillslopes and erosion pin studies that wildfire on the Siskiyou National Forest does not accelerate surface erosion enough to cause soil movement that can increase stream turbidity. These results are relevant to this analysis because they represent a worst-case analog for possible effects to sediment delivery and water quality from burning proposals in the action alternatives. However, prescribed fire would be akin to much lower and less extensive burn conditions relative to these wildfires. Based on these related studies, the proposed PDCs that would facilitate a low-intensity burn scenario, and the limited extent of the prescribe burn area relative to the planning area, none of the prescribed fire components in any of the action alternatives would be anticipated to have measureable impacts to sediment delivery or turbidity.

A cross-section study was done on two small tributaries to the Illinois River in 2002 and 2003 to determine whether any stream channel changes could be found following the first winter in a Biscuit Fire high burn intensity area from: Spring Creek, and an unnamed stream referred to as Annsylinn Creek in this study. The results indicate that there was very little change in any of the measured cross-sections. These results are relevant to this analysis because they represent a worst-case analog for possible effects to channel morphology from burning. However, prescribed fire proposals in the action alternatives would be of lower intensity and lesser extent relative to conditions in these study findings. Therefore, no negative effects to channel morphology are expected from fire components of the action alternatives.

Similar prescribed burning treatments proposed for Shasta Agness were implemented on the Forest for the 1995 Waters Thin Hazardous Fuels Reduction Project (Waters Thin Project). For this project, monitoring sites were established to determine if there were any changes in the stream channel or shade as a result of the thinning and fuels treatment. The monitoring sites were established to validate the findings in the 1995 Waters Thin Hydrology Cumulative Effects Analysis that concluded there would not be a significant risk to the integrity of the aquatic system if the treatments occurred. Sites were monitored just after thinning and fuels treatments. Monitoring included measuring stream shade using a solar pathfinder and tracking channel changes from sediment delivery using photo points. This baseline data collected in 1997 was then compared to data collected in 2005, years after treatment and the occurrence of several winter storms, including the 1997 storm that was a 50-year event. No changes were detected (Park and Jubas 2005). These results are relevant to this analysis because they represent an analog for possible effects to shade and channel morphology from prescribed burning and riparian thinning proposals in the action alternatives.

Low intensity prescribed burning activities are less disturbing than wildfires. Water Quality monitoring data from both the Silver and Biscuits fires did not show any impacts to water quality following winter storms. Monitoring following prescribed fire from the 1995 Waters Fuels Treatment project did not detect any changes in the stream channel from increases in sediment delivery. Given that in these representative studies no water quality issues were detected following two wildfires, and given the relative low intensity of prescribed fire, there would be no measureable effect to water quality anticipated from any of the prescribed fire or other thinning activities proposed in any of the action alternatives.

**Table 21. Silvicultural and Activity Fuel Treatments by Watershed.**

| Watershed | Watershed Acreage | Acres of Proposed Commercial Thin Harvest and Activity Fuels Treatments | | | % of Watershed Affected by Proposed Commercial Thinning and Activity Fuels treatments | | |
|---|---|---|---|---|---|---|---|
| | | Alt. 1 | Alt. 2 | Alt. 3 | Alt. 1 | Alt. 2 | Alt. 3 |
| Lawson Creek – Illinois River | 41,179 | 1,344 | 1,258 | 512 | 3.3 | 3.1 | 1.2 |
| Shasta Costa Creek – Rogue River | 45,026 | 4,479 | 2,309 | 2,382 | 9.9 | 5.1 | 5.3 |
| Stair Creek – Rogue River | 36,544 | 1,144 | 1,119 | 1,144 | 3.1 | 3.1 | 3.1 |

The effects of silvicultural and activity fuels for alternative 2 and 3 are the same as those disclosed above for the preferred alternative. However, there is a difference in treatment acreage of harvested area within Riparian Reserves. There are less treatment acres in alternative 2 and 3 than the preferred alternative. The estimated total riparian reserve harvest treatment is 1, 044 acres. This is a difference of 455 acres between treatment alternatives. Another difference is the total harvest in vegetation treatments proposed for alternative 2. The difference relative to alternative 1 is 2, 282 acres. This is due to not planning restoration treatments of pine stands and Port Orford cedar sanitation along high risk areas. Table 2 and Table 24 compare the estimated footprint and logging systems proposed for treatments between action alternatives within the Shasta Agness planning area. The PDCs and BMPs incorporated into alternative 2 and 3 are the same as those for the preferred alternative. The incorporated PDCs/BMPs have been shown to be

effective; and findings from similar projects all indicate that prescribed fire and silviculture activities like the thinning proposed here would not impact water quality, turbidity, or water yield.

In addition, the other difference between the preferred alternative and action alternative 2 is the miles of temporary road proposed. The preferred alternative would have 5 miles of new harvest-related temporary road construction and 12 miles of temporary road construction on existing non-system road template. Alternative 2 would have 4 miles of new temporary road construction and 10 miles temporary road construction on existing non-system road template. Table 4 shows the change in mileage under all action alternatives.

In addition haul routes are minimized from 193 miles to 151 miles, therefore reducing reconstruction mileage needed to implement treatments. Most of the reductions are to roads located in areas with low hydrologic impact sensitivity: upland areas near the watershed divide and along ridgelines. Excluding these roads would further eliminate any potential, short-term risk of sediment generated from reconstruction activities.

The effects of silvicultural and activity fuels for alternative 3 are the same as those disclosed above for the preferred alternative. The difference in treatment acreage of harvest area within Riparian Reserves is an estimated 670 acres. This is a difference of 829 acres between alternative 1 and 374 acres between alternative 2. The difference in total harvest in vegetation treatments proposed for alternative 3 relative to alternative 1 is 2, 929 acres. This is due to not including unroaded areas, burn between, and burn block plantations within treatment areas. Table 2 and Table 22 compare the estimated footprint and logging systems proposed for treatments between action alternatives within the Shasta Agness planning area. The PDCs and BMPs incorporated into alternative 3 are the same as those for the preferred alternative. The incorporated PDCs/BMPs have been shown to be effective; and findings from similar projects all indicate that prescribed fire and silviculture activities like the thinning proposed here would not impact water quality, turbidity, or water yield.

There is a difference between the preferred alternative and action alternative 3 of miles of temporary road proposed. The preferred alternative would have 5 miles of new temporary road construction and 12 miles of temporary road construction on existing non-system road template. Alternative 3 would have zero miles of new temporary road construction and 12 miles temporary road construction on existing non-system road template. Table 4 shows the change in mileage under all action alternatives.

In addition haul routes are minimized from 193 miles to 192 miles between alternative 1 and alternative 3. The relatively small reduction in road mileage would not have a meaningful change in effects compared to the preferred alternative. However, the road reconstruction proposed would eliminate potential, short-term sediment generated from reconstruction activities associated with the one mile of road eliminated from this proposal. The change occurs in Shasta Costa Creek subwatershed (0.6 miles) and Fall Creek-Illinois River subwatershed (0.5 miles). While alternatives 1 and 3 have the greatest potential exposure lengths for sedimentation, due to effective implementation of PDCs and findings in related research studies, no measureable effects would be expected from any of the alternatives.

## 1. Direct and Indirect Effects of Logging Systems

Proposed yarding activities include those conducted by ground based heavy equipment (“tractors”), helicopter, and those conducted by skyline cable equipment operating from a

landing. Surface disturbance resulting from ground-based equipment utilizing limited skid trails would be limited to a maximum of approximately 15% of the area. Skyline yarding typically disturbs approximately 5% of the surface area; helicopter operations are estimated at 2%[12]. Direct surface impacts are discussed in the soil report for this project. Surface impacts could result in decreased hydrologic infiltration (soil compaction), increased erosion potential/sediment delivery (vegetation removal), and increased peak flows (compaction and vegetation removal). However, under the action alternatives, disturbance areas from logging systems would be limited in extent spatially. Hydrologic impacts resulting from tractor use would be low due to the design constraints of the project

Tractor units are limited to areas where slopes are 35% or less, unless steep slope logging is approved; and post activity would not result in a loss of more than 10 % of the soils infiltration rate within 100-ft to any stream channel. This effectively limits heavy equipment use to upland areas, distant from streams. In addition to being located away from streams, design criteria—such as limiting yarding to the dry season, limiting yarding to slopes less than 35 percent, with exception of steep slope logging where safety conditions allow and following specialists review and approval of resources, and designating skid-road locations—are expected to prevent delivery of sediment to streams. By implementation of the project PDC's, there will be no sediment delivery to streams. Under the Preferred Alternative, tractor and shovel logging units account for approximately 1, 353 acres (20%) of the total harvest acreage. Under LRMP standards and guidelines, a maximum of 15% of the unit, or 203 acres of the proposed ground-based-harvested acres could incur direct surface disturbance from heavy equipment use. This number includes past disturbances within an activity area.

Skyline units have the same 15% LRMP soil disturbance limitation. Skyline yarding is capable of accomplishing harvest with surface disturbance of 5% of the activity area; equivalent to approximately 74 acres out of the 1, 473 acres of skyline units.

Helicopter logging eliminates the ground disturbance associated with tractor logging and eliminates yarding corridors resulting from skyline yarding. Helicopter landings require larger areas (one to two acres) than log decks to accommodate landing clearances, fueling, and support vehicle parking. Helicopter logging is capable of accomplishing harvest with surface disturbance of 2% of the activity area; equivalent to approximately 19 acres out of the 944 acres of helicopter units.

These limited disturbance acreages in alternative 1 would be even less under the remaining alternatives. Given the small extent of the possible logging system impacts to infiltration, and given the buffer requirements to avoid stream proximity, any hydrologic effects from these logging systems would be immeasurable.

Non-commercial thinning in uplands or riparian areas would have minimal effects on sediment production and delivery. This is because there would be little or no ground disturbance or use of heavy equipment for such operations within 25 feet of streams. Since no material would be yarded from the site, soil disturbance associated with yarding would not occur. There may be minor, local effects to stream channels if trees fall into them. However, increasing wood in stream channels is a desired outcome. Non-commercial thinning in riparian areas would speed the development of residual trees into large wood that could enter streams in the future. Large wood

[12] Percentages derived from the Geology and Soils Report.

benefits stream hydrology by dispersing energy during high flows, connecting streams to their floodplains, storing and sorting in-stream sediment, and regulating stream temperatures.

**Table 22. Project Acreages by Logging System for Action Alternatives.** [13]

| Logging System | Preferred Alternative 1 | Alternative 2 | Alternative 3 |
|---|---|---|---|
| Ground Based | 1,353 | 1,211 | 1,041 |
| Skyline | 1,473 | 1,177 | 929 |
| Helicopter | 944 | 840 | 738 |
| Noncommercial | 2,956 | 1,457 | 1,088 |
| Total Acres | 6,726 | 4,685 | 3, 796 |

[13] Does not include Port Orford cedar sanitation acreage.

**Table 23. Percent of Subwatershed Affected by Ground Based Equipment.**

| Subwatershed | Subwatershed Acreage | Acres of Proposed Ground Based Commercial Thin Harvest | | | % of Subwatershed Affected By Ground Based Commercial Thinning | | |
|---|---|---|---|---|---|---|---|
| | | Alt.1 | Alt.2 | Alt.3 | Alt.1 | Alt.2 | Alt.3 |
| Blossom Bar- Rogue River | 25,931 | 324 | 111 | 98 | 1.25% | 0.43% | 0.38% |
| Fall Creek-Illinois River | 7, 198 | 146 | 347 | 126 | 2.02% | 4.82% | 1.75% |
| Foster Bar- Rogue River | 21, 448 | 972 | 361 | 295 | 4.53% | 1.68% | 1.38% |
| Lawson Creek | 3, 433 | 11 | 0 | 29 | 0.32% | 0 | 0.84% |
| Shasta Costa Creek | 25, 549 | 588 | 458 | 213 | 2.3% | 1.79% | 0.83% |
| Stair Creek | 10, 589 | 215 | 281 | 235 | 2.03% | 2.65% | 2.22% |

## 2. Direct and Indirect Effects of Silviculture and Activity Fuels within Riparian Reserves

While the mechanisms and effects of the different silviculture, logging systems, and fuels components within action alternatives were described, their context within the riparian reserves would also be an important consideration given the sensitivity of and constraints for protecting this land allocation. Acreages of riparian reserve restoration, including the acreage breakdowns for possible logging systems were described in Chapter 2. They range from a maximum riparian reserve area of approximately 1,582 acres in alternative 1, to the least amount of approximately 748 acres in alternative 3 (commercial, non-commercial, and prescribed fire treatments). The preferred alternative proposes 274 acres of tractor, 169 acres of skyline, 197 acres of helicopter, and 941 acres of noncommercial treatments within Riparian Reserve. Proposed activity fuels contains 1,581 acres of Riparian Reserve. Harvest would occur within the Riparian Treatment Zone which is approximately 2/3 of the total defined Riparian Reserve (one or two site potential tree heights from the stream channel, each side), excluding the Primary Shade Zone. Fuels treatment in Riparian Reserves would be accomplished by manual thinning and backing prescribed fire into the riparian area. This would occur mainly along first and second order channels. However, the Billings Creek, Shasta Costa Creek, and Fall Creek burn blocks border or run through the main channels of Billings, Shasta Costa Creek, and Fall Creek. Corresponding units within these burn blocks include: 1, 2, 5, 6, 53, 54, 55, 72, 74, 75, 78, 79, 80, 209, and 285. These units are located in a hydrologically sensitive area due to their proximity to class 1 streams, fish-bearing, perennial streams.

Project design ensures that infiltration capacity would not be reduced by more than 10 percent from any activity near Riparian Reserves. Skyline corridors that cross Riparian Reserves are required to be 12 feet or less in width, and no less than 150’ apart, and be utilized with full log suspension. This would eliminate potential ground disturbances that have a higher risk of leading to reduced infiltration or increased sediment delivery. Commercial thinning near perennial streams would stop at the Primary Shade Zone. Outside of the primary shade zone, the existing canopy would not be reduced below 50%. This would avoid any changes in canopy cover or ground cover that could lead to changes in stream temperature or sediment delivery. Hydrologic impacts from skyline yarding are expected to be low since the overwhelming majority of the activity occurs in the uplands where stream widths are narrow, thus reducing or eliminating ground disturbance in riparian areas. No measureable water temperature increases are anticipated from disturbance or changes in vegetative cover due to thinning or logging systems. In addition, prescribed fire ignition points would not occur closer than 100 feet from perennial streams or as

determined at the site to meet burn objectives and protect ground vegetation within 25 feet of the stream. No hand piles would be burned within 25 feet of a stream. Therefore, this would avoid any prescribed fire impacts to sediment delivery or water yield related to changes in ground cover or soil conditions.

**Table 24. Project-wide Riparian Logging System Comparison by Action Alternative**

| Alternative | Ground Based Yarding | | Skyline Yarding | | Helicopter Yarding | | Non-commercial | | Total Riparian Harvest Acres |
|---|---|---|---|---|---|---|---|---|---|
| | Total Acres | Riparian Acres | Total Acres | Riparian Acres | Total Acres | Riparian Acres | Total Acres | Riparian Acres | |
| **Preferred Alt. 1** | 1,353 | 274 | 1, 473 | 169 | 944 | 197 | 2, 956 | 941 | 1, 581 |
| **Alt. 2** | 1,211 | 271 | 1, 177 | 149 | 840 | 195 | 1, 457 | 432 | 1, 047 |
| **Alt. 3** | 1,041 | 187 | 929 | 119 | 738 | 112 | 1, 088 | 331 | 749 |

Under the preferred action (alternative 1), the proposed restoration units listed above that are in riparian reserves are located in areas that have a greater potential for hydrologic impacts compared to the amount of similar acreage in other alternatives. Concern for resource damage is due to the proximity to streams and the steep slopes adjacent to major tributaries. Their combined acreage is relatively small; however these units would present more potential risk of measurable impact than the rest of the project. Even under these conditions, this hydrologic risk is sufficiently mitigated given the combination of the BMPs, PDCs, and relatively small scale of riparian restoration (a maximum of about 6% of the entire riparian reserves acreage in the planning area). Therefore, there are no anticipated negative effects to water yield or water quality hydrologic conditions from silviculture, fire, or logging system components of the action alternative.

## C. Alternative 1, 2 and 3- Direct and Indirect Effects of Riparian and Aquatic Restoration

### 1. Large Instream Wood Placement

Under the proposed action alternatives 29 miles of large wood placement may occur in the following streams: Billings Creek, Foster Creek, Lawson Creek, Shasta Costa Creek, Snout Creek, Squirrel Camp Creek, Stair Creek, Twomile Creek, and Waters Creek.

The anticipated effects of these actions would be primarily focused on beneficial changes to channel morphology. Construction and reconstruction of large wood structures in the streams would allow for the retention of spawning gravels and woody debris within the channel. The addition of large wood would also increase channel complexity, protect streambanks, and aid in the regulation of sediment in the system. Large wood structures would provide roughness elements that would help regulate bed load movement of the stream channel and fine sediment deposition in the floodplain through time. The structures would assist in the regulation of water velocity and volume in the newly accessible side channels. Therefore, large wood structures would have a beneficial effect on channel morphology.

Although there are risks associated with construction of the large wood structures (e.g. erosion of the opposite bank associated with the structures) , assessments completed during the design phase of this project would measurably reduce the potential risk. Actions considered to reduce the risk of log displacement include interconnecting multiple logs, burying logs into the streambanks,

placing structures so that they anchor to extend above the 100-year flood elevation, and weaving structures into existing vegetation when using helicopter placement.

Placement of large wood structures would remove some stream side vegetative cover as trenches for large wood pieces are dug into the streambank. Locations of structures would be determined to minimize the loss of trees and shrubs. Any shrubs or small trees removed would be used on-site for slash in structures or as cover for newly disturbed areas. No vegetation that is providing shade to the mainstem would be removed. Areas disturbed during construction would be planted with a mix of trees and shrubs following construction, and would follow guidelines outlined in the project design criteria. Although there would be some effects to vegetation in the riparian area, adverse impacts would be short term and are expected to be minimal.

Placement of large wood structures would not have any direct negative effects on stream temperature, as there would be no measureable reduction in canopy cover. Large wood structures could provide some level of reduced temperatures at the microsite scale, but this effect would not be measurable throughout the project reach.

However, short-term temporary impacts to sediment delivery could occur from the limited extent of ground disturbance that would occur during implementation. All in-water work would follow the appropriate state water quality standards, and acquire the appropriate permits fill and removal permits authorized by US Army Corps of Engineers and Department of State Lands. Short-term small pulses of turbidity would occur when large wood structures are constructed in the stream channel using ground-based equipment. Any short-term pulses of turbidity will be in compliance with what is allowed in the fill and removal permit. Since structures would be buried into the streambanks there would be some sediment inputs to the stream channel. Turbidity pulses caused by these activities would quickly decrease to background levels after equipment work stops. In addition, large wood structures would be placed during low flow to minimize effects to water quality from sediment and turbidity. As any impacted vegetation becomes re-established or increases in the riparian reserve, bank stability would be provided, aiding in the prevention of excessive erosion and associated fine sediment inputs to the stream. Large wood structures placed using helicopters would not have any measurable effect on water clarity since these structures would be woven into existing trees and would not be buried into the streambank.

Over time watershed condition would be maintained and improved by increasing channel complexity through the addition of large wood structures and off-channel habitat, and improving riparian plant diversity though riparian planting. Watershed condition in the Shasta Agness planning area is currently functioning properly, however the Foster Bar-Rogue River subwatershed is functioning at risk and would move toward and possibly attain proper functioning condition.

## 2. Aquatic Organism Passage (AOP) Barrier Removal

Proposed removal of the AOP barrier is proposed under Alternative 1 and 2 for the failed drainage structure on Snout Creek at the beginning of the 2308330 road. Similar effects as those described in ***Direct and Indirect Effects of Sustainable Roads- Subsection 3*** would occur under this project activity. There are seven additional streams besides Snout Creek that will also need site verification to identify if fish passage restoration is needed. A GIS analysis intersecting roads and streams identified with fish habitat estimated approximately 8 total stream crossings (i.e. potential aquatic passage barriers) along FSR 3300000, 3700000, and 3730010.

The range of AOP treatments includes: total removal of culverts or bridges, or replacing culverts or bridges with properly sized culverts and bridges, replacing a damaged culvert or bridge, and resetting an existing culvert that was improperly installed or damaged; stabilizing and providing. Such projects will take place where fish passage has been partially or completely eliminated through road construction or stream degradation. Equipment such as excavators, bull dozers, dump trucks, front-end loaders, and similar equipment may be used to implement projects. Compliance reviews to evaluate if the objectives, project design criteria, and mitigation measures for the soil and geology resources defined in the Shasta Agness project are adhered too will be completed prior to implementation. Recent 2016 storms further impacted a second stream crossing along the 2308330 road that would be addressed, but not as AOP because there are no fish in the tributary.

Minor, short-term sediment delivery would likely occur at sites where AOP structures are replaced. These disturbances would likely result in temporary localized increases in turbidity during construction. Minor sediment delivery is expected to continue at these sites until exposed side-slopes re-vegetate, which often occurs within two years of implementation. These disturbances are not expected to increase turbidity to levels that would produce substantial adverse effects. Replacing or removing these culverts would reduce the risk of culvert failure and stream-channel diversion, thereby reducing the volume of sediment that could be delivered to stream channels due to mass wasting in the long term.

Effects related to stream temperature would have similar effects to those described in ***Road Decommissioning, Road Storage, and Existing Road Openings*** related to culvert removals/replacement. Alternative 3 would not remove the Snout Creek and other AOP barriers identified, and continued resource damage would continue to occur as described in alternative 4-No Action.

## 3. Beaver reintroduction and/or installation of Beaver Dam Analogues

Under the proposed action alternative 1 identification of up to five sites would be selected for beaver reintroduction and/or installation of beaver dam analogues to recruit local pairs or accept transplants. Alternative 2 and 3 would not propose beaver reintroduction or construction of beaver dam analogues.

Beavers can strongly influence large wood recruitment because beavers actively create and maintain dams that are primarily composed of wood pieces of varying size (Wohl 2016). Beavers recruit wood to the channel and floodplain by cutting down living trees and woody shrubs, and beaver dams typically include wood pieces of a size that would otherwise likely be mobile within the channel (Wohl 2017). In addition to large wood retention, beavers have an effect on water retention and base flows, peak flows, channel morphology, sediment delivery, and stream temperature.

According to the Beaver Restoration Guidebook: Working with Beaver to Restore Streams, Wetlands, and Floodplains (Polluck et. al 2015), beaver impoundments change the spatial distribution of water as well as the timing of its release and residence time in the watershed. By holding the water in pools formed by the dams or analogues the flow in the stream slow, therefore increasing the amount of time water remains within the channel and base flows. An increase in water storage is also seen in areas where beaver is reintroduced. Particularly during low flows during reduced hydrologic inputs and given that climate change is expected to increase drought and reduce snow pack, water storage from beaver impoundments may be an effective tool to help mitigate the associated reductions in water resources (Polluck et. al. 2015)

Beaver activity within the watersheds would not increase peak flows. Generally, beavers decrease peak flows by dissipating the energy flowing downstream. The roughness created by the construction of the beaver dam or analogue allows the single channel to transform into multiple small channels and continue downstream (Polluck et. al 2015).

Additionally, water quality is improved by removing suspended sediments within the water column and moderating stream temperatures. The creation of deep pools behind the structures, reduce flow velocities, and the decrease in energy moving downstream allow sediment deposition to occur and raise the gradient of the stream through aggradation. If the structure were to be breached by high flows or removed sediment could remobilize through the stream, however the effects would be minimal in small streams. Stream temperature is often a concern when introducing beavers to the area due to the increase solar radiation reaching the surface of the pond, warming the stream (Polluck et. al 2015). Although, warming of the surface does occur, large ponds generally stratify, with cool water pooled under the warm surface, separated by a sharp thermocline (Hoffman and Recht 2013). This cooler deep water provides refuge for fish during the warm parts of the day, and the fish can feed in the more productive upper waters during the nights and mornings, before midday heating (Hoffman and Recht 2013). Small beaver ponds generally do not increase surface area enough to have major temperature effects (Hoffman and Recht 2013).

Additional benefits would improve conditions favorable to coho salmon, cutthroat trout and other animals; increase the diversity of riparian vegetation species and wetland habitat available to aquatic organisms.

## D. Alternative 1- Direct and Indirect Effects of Recreation Improvements

Under the preferred alternative the recreation improvements proposed include: trail decommissioning, motorized trail reconstruction, campground decommissioning, structural improvements to facilities, and boat launch improvements. The estimated total footprint affected for each of these activities is described in Table 6 and 7. Furthermore, Table 25 describes the recreation facility, and the proposed recreation improvements for Alternative 1.

**Table 25.[14] Proposed recreation improvements for alternative 1 within the Shasta Agness planning area.**

| Preferred Alternative- Alternative 1 | |
|---|---|
| **Name of Recreation Improvements** | **Proposed Recreation Improvements** |
| Billings Cr Dispersed Campground | This action will include removal of one existing pit toilet, barrier installation, soil de-compaction, and replanting of impacted areas with native species. This contains approximately 0.2 acres. |
| Foster Bar Facility/ Foster Bar Launch Improved | Proposed improvements to Foster Bar Boat Ramp involve the installation of a pre-cast concrete ramp to improve access to the existing concrete pads. The improved ramp will connect the existing pads to the asphalt ramp access road, which will be |

[14] Cr= Creek; CG= Campground; TH= Trailhead; FSR= Forest Service Road; OHV= Off Highway Vehicles; RRS= Rogue River-Siskiyou

| | |
|---|---|
| | repaved to FSR 33. That area is within the footprint of the existing boat-ramp, connecting two pieces of existing infrastructure; the existing concrete pad and the asphalt approach road. |
| Illahee CG | Illahee Campground, approximately 9.9 acres, is currently closed. Under this alternative, all remaining facilities, structures, and small-scale features at the site would be removed, and roads to/through the site would be decommissioned. |
| Illinois TH Horse Camp (new) | No Action |
| Oak Flat CG Host | Addition of host site with septic holding tank, fee tube installation, repair of OHV resource damage, invasive plant removal, native plantings, and barrier installation. |
| Oak Flat CG Boat Ramp/Water | No Action |
| Shasta Costa Improvements | Improvements at Shasta Costa would include a new road terminus with turnaround and parking area, and road repair/improvement. Existing resource damage would be repaired, damaged areas would be replanted with native vegetation, and mitigation measures to include signage and native material barriers would be installed to prevent future resource damage. |
| Upper Rogue TH Improvements | An interpretive kiosk will be installed within the existing footprint of the trailhead and parking area to educate visitors of the resources found within the area. |
| Big Bend/ Rogue River Trailhead | An interpretive kiosk will be installed within the existing footprint of the trailhead and parking area to educate visitors of the historic and cultural significance of the Big Bend area. The existing pit toilet will be decommissioned and replaced by a vault toilet in a suitable location within the existing facility footprint. |
| FSR 2308330 to OHV trail | Convert FSR 2308330 to Class I OHV trail. This conversion will add 0.7 miles of dedicated OHV trail to the RRS trail systems. |
| FSR 3577350 to OHV trail | Convert FSR 3577350 to Class I OHV trail. This conversion will add 3.9 miles of dedicated OHV trail to the RRS trail systems. |
| Nancy Cr trail 1181 | Barriers will be installed at all trail access points, and visible portions of the trail from those points will be obliterated. Any remaining culverts will be removed, and the rest of the trail will |

| | |
|---|---|
| | be allowed to decompose. Approximately 1.9 miles would be restored. |
| Shasta Costa Creek trail | No Action |
| Shasta Costa Overlook A | No Action |
| Shasta Costa Overlook B | No Action |

## 1. Water Quality- Fecal Coliform

The Rogue River is listed on the 303(d) list for fecal coliform. Projects proposed under Alternative 1 that would have the potential to change coliform bacteria levels include: Oak Flat Campground Host and Big Bend/ Rogue River Trailhead improvements due to the additions of the septic holding tank and pit toilet replacement with a vault toilet. In addition, vault toilet and septic systems would meet DEQ standards. Therefore actions are not expected to affect the levels of coliform bacteria.

## 2. Billings Creek Dispersed Campground

Decommissioning of the Billings Creek dispersed campsite would restore the hydrologic processes and conditions for approximately 0.2 acres within the Foster Bar- Rogue River subwatershed. Subsoiling or scarification would improve soil productivity in the affected area in the long term because vegetation would be encouraged to grow in the former dispersed campsite. Short term effects include: soil disturbance, vegetation removal, and localized erosion, however activities would be completed during the dry season, which would minimize the extent of sediment delivery and detrimental effects to hydrologic processes. Campground activities, including scarification and replanting of native species, would have no effects to the watershed since the area is too small to have any detectable effect on the stream flow of Billings Creek, and the site would meet state water quality requirements for waste disposal for facilities. Furthermore, replanting native species will improve habitat conditions for areas riparian as invasive plants can provide less stream-shading than native hardwoods and conifers.

## 3. Foster Bar Facility and Foster Bar Boat Launch Improvements

The installation of a pre-cast concrete will connect the existing pads to the asphalt ramp access road, which will be repaved to FSR 33. That area is within the footprint of the existing boat-ramp, connecting two pieces of existing infrastructure; the existing concrete pad and the asphalt approach road. Improvements to this recreation infrastructure would help more effectively constrain ramp use to the existing footprint and would better manage any current ramp use impacts to the Rogue River. Activities will not affect the stream flow of the Rogue River from current levels since the area, 0.41 acres, is too small to have an impact. During construction activities, there may be plumes of turbid water, however these would be localized and short term. All in-water work would follow the appropriate state guidelines, and acquire the Joint Fill Removal Permit authorized by US Army Corps of Engineers and Department of State Lands to the Forest Service. Implementation of the asphalt approach road would include the proposed engineering site plans to avoid potential erosion during wet seasons. This plan would encompass appropriate PDCs (Appendix B) and BMPs (USDA Forest Service 2012) for minimizing any risk of potential effects to water quality.

## 4. Illahee Campground

Current conditions during field reconnaissance exhibited gullies, rills, headcuts, and multiple foot trails from unauthorized use leading to the Rogue River at Illahee Campground. As such, the preferred alternative proposed to decommission the campground and rehabilitate existing conditions. Similar effects from decommissioning Billings Creek dispersed campground would occur at Illahee Campground, however since the area is approximately 9.9 acres the disturbance would have potential to have a greater short-term effect on hydrologic processes and conditions. These could include: short-term erosion and sedimentation from decommissioning activities using heavy equipment, slight alterations to stream banks bisecting the campground, however channel morphology would be improved, especially for these streams in time from bank stabilization and vegetation regrowth. During decommissioning activities, such as removing old drainage structures, would rehabilitate stream channels to mimic the upstream and downstream morphology, which may have been unnaturally impacted through recreation actions. Future impacts to channel morphology would be reduced by decreasing user-created sediment input and the risk of pool filling, and channel widening and bank instability. In the long-term the overall condition of the watershed would be improved by allowing vegetation to recover and help stabilize soils, decreasing sediment delivery inputs by improving infiltration rates in compacted areas, increasing shade from the growth of conifers and hardwoods, and removing the potential of hazardous materials entering streams from degrading infrastructure such as pit toilets. This would be expected to improve beneficial effects to water quality and reduced sediment delivery to downstream salmon-bearing streams.

## 5. Oak Flat Campground Host and Facility Maintenance

The addition of a host site with a septic disposal and maintenance activities at the Oak Flat Campground would not have any measureable effects to water quality nor the hydrologic processes that occur in this area. This area is already disturbed from illegal OHV activity, which has created ruts and an uneven surface. Therefore any improvements made by subsoiling/scarification, invasive plant removal, native planting, and barrier installation would decrease current levels of resource damage. In addition, the preferred alternative would occur on level ground covered by very well drained sandy/silty soils. Potential runoff from the existing roads and facilities is easily absorbed by surrounding undisturbed areas without visible erosion or sedimentation. The placement of the septic disposal would meet state water quality requirements for waste disposal for public facilities. These activities would encompass appropriate PDCs (Appendix B) and BMPs (USDA Forest Service 2012) for minimizing any risk of potential effects to water quality.

## 6. Shasta Costa Improvements

The Shasta Costa improvements would include a new road terminus with a turnaround and parking area, road maintenance and repair, rehabilitation of disturbed areas from vehicle use, planting of native plant species, and placement of signs and barriers to prevent potential resource damage in the future. These activities would not have a negative long term effect on water quality or the hydrological conditions and processes based on project design associated with the activities, such as erosion control measures (i.e. use of straw wattles, silt fences, and mulch), and proper recreation maintenance that would be required. However, short term impacts would have the potential to create erosion/sediment delivery, and reduce soil infiltration for a short period through the duration of implementation activities. Activities including, decommissioning a portion of this road would improve soil productivity affecting infiltration rates and surface runoff by decompacting affected areas and encouraging vegetation growth in the former road prism that leads to the floodplain of Shasta Costa Creek. Short-term disturbances from heavy equipment use

include: localized erosion/sediment delivery, localized soil compaction, modification of existing soil structure, and vegetation removal (i.e. exposure of bare mineral soil). Road maintenance and repair would reduce the potential for mass wasting and erosion by reducing the risk of water diversion that currently is causing gullying to occur on the road from storm flow on Bear Camp, FSR 23. In addition, road repair and improvement plans including site drainage would include adequate engineering design. Manual treatments of revegetation would result in minimal, short-term localized soil displacement that is not expected to be measureable. Detrimental direct and indirect soil disturbance effects that could impact water quality from road use, maintenance, repair, and decommissioning activities are expected to be minor at the subwatershed scale because most actions would occur on road prisms, and project design criteria (Appendix B) and best management practices would be applied to actions.

## 7. Upper Rogue and Big Bend/ Rogue River Trailhead Improvements

These actions would have no detrimental effect to water quality and hydrologic conditions. The proposed restroom facilities include removing the existing pit toilet and replacing with a vault toilet. No on-site disposal or treatment of waste is proposed. The site would meet state water quality requirements for waste disposal for public facilities, and the addition of the interpretive kiosk to educate visitors of the historic and cultural significance of the Big Bend area may deter resource damage to the area from unauthorized recreational use. Potential short term, localized soil disturbance may occur with installation. However project design criteria and best management practices as well as the far proximity of the treatment activities from streams would avoid any risk of potential sediment delivery.

## 8. Motorized Trail Conversion

Proposed activities to convert FSR 2308330 and 3577350 and spur to Class 1 OHV trail would designate approximately 4.6 miles of closed ML1 roads to off-highway vehicles (OHVs) only.

Current FSR system has these roads designated as maintenance level 1 closed status, therefore there may be a slight increase in erosion and sedimentation risk, however since these road prisms are currently on the landscape, no new disturbance would be created impacting channel morphology, large wood, peak flows, and water quality. In addition, the proposed action is located in relatively stable areas, along existing roads positioned on upper slope and ridge areas. Reconstruction actions would be implemented using design criteria, for example: working in dry soil conditions, identifying locations where heavy equipment can operate, and implementing erosion control measures such as installing sediment barriers, which ensures best management practices for soil and water quality, especially in instances of high risk areas such as in road-stream crossings minimizing erosion and sediment delivery. Proposed design features include replacing the failed drainage structure on Snout Creek at the beginning of the 2308330 road, which would be replaced by a structure suitable for use by OHVs and designed to provide for Aquatic Organism Passage (AOP). Operationally, the design would be prepared by engineering staff following applicable Best Management Practices (BMPs) and consultation with other specialists as necessary.

In addition, the designated motorized access changes included in the preferred alternative would provide a remedy for some of the resource damage impacts occurring in some roads and campgrounds currently unsuited for use, while providing for legal and sustainable public access on the trails that can support it. This alternative may result in minor erosion and sedimentation while trail reconstruction is implemented, however effects are expected to be minor in scope due to the application of best management practices.

Furthermore, the integrity of the water and riparian features where treatment activities are proposed would be maintained as a result of the application of general Soil and Water Forest Plan standards and guidelines (pages IV-44 to IV-48), as well as site-specific project design criteria created for the Shasta Agness planning area. It is expected that the reconstruction activities associated with preferred alternative would benefit watershed health (through reduced resource damage from illegal OHV activity and through on-going trail maintenance reducing potential rutting, erosion, and sedimentation). Therefore, the Clean Water Act and State Water Quality Standards would be met.

### 9. Nancy Creek Trail Decommissioning

Decommissioning of the Nancy Creek trail would restore the hydrologic processes and conditions along 1.9 miles of trail. Proposed decommissioning would remove existing culverts, obliterate visible access points to recreational users, and place barriers at trail access points. The methods to decommission the trail would ensure adequate drainage and help stabilize soils. In addition, there is a potential reduction in fine sediment at stream crossings because there is no longer a potential for failures during storm events. Short term effects may cause erosion due to soil disturbance during heavy equipment use to obliterate the visual portions of the trail, however mitigation measures such as placing a slash mat would prevent water quality impairment from fine sediment delivery. Furthermore, vegetation would be encouraged to grow and compaction would be reduced by roots; increasing infiltration rates and development of large wood. No effects to channel morphology, large wood, peak flows, and water quality are expected to occur.

## E. Alternative 2- Direct and Indirect Effects of Recreation Improvements

Under alternative 2 the recreation improvements proposed include: new trail construction, motorized trail reconstruction, campground reconstruction and new construction, structural improvements to facilities, and boat launch construction and improvements. The estimated total footprint affected for each of these activities is described in Table 6 and Table 7. Furthermore, Table 26 describes the recreation facility, and the proposed recreation improvements for Alternative 2.

**Table 26. Proposed recreation improvements for alternative 2 within the Shasta Agness planning area.**

| Alternative 2 | |
|---|---|
| **Name of Recreation Improvements** | **Proposed Recreation Improvements** |
| Billings Cr Dispersed Campground | Billings Creek, approximately 0.2 acres of dispersed campground will remain open. |
| Foster Bar Facility/ Foster Bar Launch Improved | Proposed improvements to Foster Bar Boat Ramp involve the installation of a pre-cast concrete ramp to improve access to the existing concrete pads. The improved ramp will connect the existing pads to the asphalt ramp access road, which will be repaved to FSR 33. That area is within the footprint of the existing boat-ramp, connecting two pieces of existing infrastructure; the existing concrete pad and the asphalt approach road |

| | |
|---|---|
| Illahee CG | Illahee Campground will be rehabilitated and re-opened; either as a 75 persons-at-one-time (PAOT) group campground or as a 23 site (138 PAOT) family campground. |
| Illinois TH Horse Camp (new) | The trailhead area will be redesigned to accommodate horse-trailer parking, three campsites with fire rings and picnic tables, a new vault toilet, and a new manure bunker. The estimated total acreage is 1.1 acres. |
| Oak Flat CG Host | Addition of host site with septic holding tank, fee tube installation, repair of OHV resource damage, invasive plant removal, native plantings, and barrier installation. |
| Oak Flat CG Boat Ramp/Water | A gravel boat ramp and a potable water system would be installed. |
| Shasta Costa Campground and hiking trail | A five-site, semi-primitive family campground and vault toilet building would be constructed/installed at the terminus of FSR 23-990 on flat ground near Shasta Costa Creek. A new, four-mile hiking trail would extend eastward along Shasta Costa Creek from this location along an old road bed; it would connect to FSR 23 via FSR 23-842. |
| Upper Rogue TH Improvements | An interpretive kiosk would be installed within the existing footprint of the trailhead and parking area to educate visitors of the resources found within the area. |
| Big Bend/Rogue River trailhead | An interpretive kiosk would be installed within the existing footprint of the trailhead and parking area to educate visitors of the historic and cultural significance of the Big Bend area. The existing pit toilet would be decommissioned and replaced by a vault toilet in a suitable location within the existing facility footprint. An accessible, Big Bend Battlefield interpretive and Foster Creek access trail would be constructed. The trail would begin and end at the Rogue River Trailhead and also provide access from Foster Bar Campground to Brewery Hole; a total trail distance of approximately 2.3 miles. |
| FSR 2308330 to OHV trail | Convert FSR 2308330 to Class I OHV trail. This conversion would add 0.7 miles of dedicated OHV trail to the RRS trail systems. |
| FSR 3577350 to OHV trail | Convert FSR 3577350 to Class I OHV trail. This conversion would add 3.9 miles of dedicated OHV trail to the RRS trail systems. |
| Nancy Cr trail 1181 | Nancy Creek Trail, approximately 1.9 miles, would remain open, and creek crossings would be repaired/improved as necessary to reduce sediment introduction. |

| | |
|---|---|
| Shasta Costa Creek trail | A new, 4.3-mile trail would be constructed along Shasta Costa Creek from FSR 2300995. |
| Shasta Costa Overlook A | A new, 2.8-mile trail would be constructed from the Shasta Costa Overlook on FSR 23. |
| Shasta Costa Overlook B | A new, 1.9-mile loop trail would be constructed from the Shasta Costa Overlook on FSR 23. |

## 1. Water Quality- Fecal Coliform

The Rogue River is listed on the 303(d) list for fecal coliform. Projects proposed under Alternative 2 that would have the potential to change coliform bacteria levels include: Billings Creek Dispersed Campground, Illahee Campground Reopening, Illinois TH Horse Camp, Oak Flat Campground Host, Shasta Costa Campground, Big Bend/ Rogue River Trailhead improvements, and new trails. Campgrounds/camps would include the additions of a septic holding tank or vault toilet additions or replacements, and would follow and meet DEQ standards; therefore levels of coliform bacteria are not expected to change. However, Billings Creek Dispersed campground and the continued use of the site after the pit toilet is removed could lead to improper human waste disposal and increased waste/pollutant discharges that would have the potential to degrade the water quality of Billings Creek and the Rogue River. Trails proposed for construction are generally located away from the Rogue River; this provides a natural buffering system for waste generate from humans and domestic animals such as dogs and horses. Therefore actions are not expected to affect the levels of coliform bacteria.

## 2. Billings Creek Dispersed Campground

Proposed activities would continue to allow dispersed camping near the Big Bend Meadow, approximately 0.2 acres. Activities would not involve new ground disturbance, however the constant use for this area includes: vehicles, tents, and trailers which would continue to expose soil material and compaction levels that would temporarily increase the potential for erosion and sediment delivery.

Since the existing dispersed campsite affects up to 0.2 acres, no detectable effect on stream flow would be expected to be observed because this is too small to impact the Rogue River. However, sediment delivery could increase locally and since disturbances to riparian vegetation would continue to impact their growth bare soil would continue to be exposed. Conifers and hardwoods would also not have the ability for growth and recovery as time passes, which would decrease the potential for large wood in the future to Billings Creek.

Furthermore, the continued use of the site after the pit toilet is removed could lead to improper human waste disposal and increased waste/pollutant discharges that would degrade water quality. In addition, according to the *Recreation Report* (Sheehan 2017), the increased draw and increased access of other proposed facilities in the immediate vicinity, could encourage further dispersed use. This could lead to user-created expansion of the existing site or lead to the creation of other user-created dispersed campsites at Big Bend that could lead to resource damage such as soil compaction, reducing soil infiltration capacity and increasing runoff from precipitation events, vegetation disturbance and further erosion and sedimentation. As such, natural sediment transport and storage regimes would be altered, and degradation of aquatic life within these reaches over time would occur.

## 3. Foster Bar Facility and Foster Bar Boat Launch Improvements

No change in effects from preferred alternative.

## 4. Illahee Campground

Proposed activities at Illahee Campground include reopening the site and allowing a 75 persons-at-one-time (PAOT) group campground or as a 23 site (138 PAOT) family campground. Associated treatments with reopening the campground consist of: removing hazard trees, understory thinning to remove overgrown vegetation, road improvements, excavation, grading, ground clearing, subsoiling/scarification, and drainage improvements. Although, treatment activities would not create a new disturbance footprint, reopening of the campground would have the potential to increase compaction and change the natural soil structure decreasing the soil infiltration capacity through foot/traffic use, and increase potential erosion/sedimentation through ground disturbing activities (i.e. ground clearing of vegetation, excavation, grading, and road improvements) causing bare soil exposure and detachment of soil aggregates. Additionally, removing hazard trees could reduce some stream shade on two small unnamed streams that bisect the campground. Both streams are dry in the summer so an increase in summer stream temperature is not a concern.

Proposed drainage improvements would better collect stormwater runoff in the campground and route it to the Rogue River. Drainage improvements and subsoiling/scarification would reduce the potential for erosion, sediment transport and deposition, and compaction in the campground and downstream in the long term, though in the short term would locally increase these effects. However, current conditions during field reconnaissance exhibited gullies, rills, headcuts, and multiple foot trails from unauthorized use leading to the Rogue River, which if not properly maintained after opening could continue to occur and degrade water quality and hydrologic processes

## 5. Illinois TH Horse Camp (new)

Proposed activities to develop an equestrian campground with the additional structure amenities would create approximately 1.1 acres of new disturbance changing the long-term hydrologic conditions and processes. Treatment activities would be similar to Illahee Campground, however no subsoiling or scarification would occur due to the primitive state of the area. The site is located on a flat, alluvial terrace with loam and clay loam soils. The erosion hazard of these soils are slight/moderate. This means the area would be at some risk for increased sediment delivery, which would degrade water quality resulting from modifications of the sediment transport and storage regime. The increase in recreational use could also increase the amount of foot/OHV trails in areas adjacent to the Rogue River corridor, allowing these pathways to become water diversion routes, creating gullies and rills if not properly maintained.

Implementation of the proposed action would also cause short term soil disturbance from the use of heavy equipment. Project design criteria and mitigation measures would minimize erosion and sediment delivery to the degree that would not result in changing the status and channel morphology of any water body near the site. Stream temperature would not be affected as the Illinois River is too wide for trees that are removed for construction to provide adequate shade.

Activities that compact soil would increase bulk density and decrease hydraulic conductivity in the soil by collapsing soil pore spaces. This has the potential to reduce soil infiltration rates and increase surface overland flow during precipitation events, potentially increasing stream flows.

## 6. Oak Flat Campground Boat Ramp and Water Recreation Improvements

In addition to the improvements recommended for the preferred alternative, construction of a gravel boat ramp and a potable water system would be installed.

There are two watershed issues related to the addition of the gravel boat ramp and potable water system: sediment generated and erosion (i.e. turbidity, deposition and scour) and water quality. The stream flows of the Rogue River are too great to be meaningfully affected by the proposed activities. The inputs of potable water would be miniscule relative to the lowest discharge levels on the Rogue River, therefore there would be no effect to peak flows. In addition, the site where the recreation structures would be constructed would not affect the stream shade values because trees would not be removed from the gravel bars of river.

During the construction of the gravel boat ramp there would be plumes of sediment, increasing temporarily the turbidity of the river, however these would be localized and water quality would return to normal levels once construction activities are completed. All in-water work would follow the appropriate state guidelines, and acquire the appropriate permits if they fall outside the current general permits authorized by US Army Corps of Engineers and Department of State Lands to the Forest Service. In addition, the boat ramp could receive maintenance each year clearing gravel and sand deposits from past winter flows. However, according to the Recreation Report (Sheehan 2017) states: “maintenance, monitoring, regulation would likely exceed current FS recreation management capacity.” Further, constructing the ramp would slightly alter the current morphology of the bed and banks in the structure’s immediate vicinity. Given the relatively small spatial extent of the ramp and the natural dynamism of the bar, this alteration would not be expected to create channel instability or measurable changes in morphology to the larger system. Additionally, creating a ramp at this site has the potential to add or concentrate boat and vehicle traffic into a location where access was previously limited. With this additional use comes a higher risk of inadvertent discharge of motor-related petroleum products or other pollutants onto the bar or directly into the river where it could create water quality concerns for listed species and recreational values. Therefore, relative to alternatives 1 and 3, alternative 2 poses the greatest risk of generating some hydrological impacts in a salmon-bearing and wild and scenic river.

## 7. Shasta Costa Campground

Alternative 2 proposes to construct a five-site, semi-primitive family campground and a vault toilet building at the terminus of FSR 23-990 on flat ground near Shasta Costa Creek.

The construction of the campground would create approximately 8.1 acres of new disturbance to allow increased access to the Shasta Costa area. Since this is new disturbance, campground design would need to account for a drainage system to reduce the long term potential for erosion, sediment transport and deposition in the campground and downstream to Shasta Costa Creek, which is a stream with endangered Coho and chinook fish populations. Designing the campground adequately with the appropriate FS standards and guidelines, in combination with project design criteria as well as mitigation measures for treatment activities would reduce and prevent potential short term effects; though the appropriate maintenance and regulation would still need to be met in order to ensure no resource damage or impacts from campground construction would have long-term effects to the hydrologic conditions and processes in this area. Although with current funding and staffing levels, there could be potential to result in shortfalls in recreation maintenance and regulation that possibly could lead to impacts in the future. Such impacts could entail excessive erosion/sediment delivery and compaction from camper traffic on

the adjacent river terrace and banks, reducing soil infiltration capacity. Additionally, garbage from future users or pollutants from traffic use could enter the waterway, or reductions in vegetation cover from unauthorized firewood or OHV uses.

## 8. Upper Rogue and Big Bend/ Rogue River Trailhead Improvements

No change in effects from preferred alternative.

## 9. Motorized Trail Reconstruction

No change in effects from preferred alternative.

## 10. Shasta Agness Trail Construction and Maintenance (Big Bend/Rogue River Trail, Nancy Creek Trail, Shasta Costa Creek Trail, Shasta Costa Overlook A, and Shasta Costa Overlook B)

Alternative 2 proposes to construct approximately 11.3 miles of new non-motorized trails within the Shasta Agness planning area. Nancy Cr trail already exists and would remain open in this alternative. Without proper design and maintenance, hydrologic effects from trails generally result from: sediment delivery coming off of the trails, increased hydraulic connectivity, infiltration reduction from foot traffic compaction, trail expansion from user-generated trails, vegetation removal, greater potential user-generated pollutant waste, and stream crossings. However, trails proposed here would implement appropriate PDCs to avoid or minimize such effects. Trails proposed for construction are proposed at various locations ranging from high on slopes or ridges such as motorized trail reconstruction, to low on slopes, adjacent to stream channels such as Shasta Costa Trail, crossing multiple stream courses. Generally, trails run along gentle slopes (< 30 percent), but there are sections of trails proposed on moderate to steep slopes (i.e. > 30 percent), such as the Nancy Creek Trail. The majority of trail construction would be outside the primary shade zone within riparian reserves, with the exception of the Foster Creek to Brewery Hole Trail, which contains approximately 135 feet (0.03 miles) of trail within the primary shade zone. However, this portion of trail is perpendicular to the stream, and therefore would adequately disperse water to adjacent areas with undisturbed vegetation, and prevent sediment delivery to waterways in comparison to a trail that would run parallel along the entire stream channel.

Streams within the watersheds affected by the trail proposals generally exhibit good water temperatures. However, Foster Creek and Shasta Costa Creek are listed as a section 303(d) Water Quality Limited water body for temperature. High summer temperatures within these drainages are related to past human management activities such as timber harvest and road construction, as well as continuous inner gorge slides that prevent growth of shading vegetation. However as stated above, the trails are outside the primary shade zone, considered to be the distance where incoming solar radiation is intercepted by trees. No impacts to stream temperature would be expected from trail construction because there would be minimal or no tree removal or canopy impacts and existing stream shade would be maintained.

Additionally, Billings Creek is Section 303(d) listed for sedimentation, and is adjacent to 0.06 miles of the proposed Big Bend/Rogue River Trail. Sedimentation is largely due to the large slump-earthflows that dominate the landform developments within the watershed; and due to the major formations found within the subwatershed- the Tyee Formation and the Lookingglass Formation. These soils are mainly characterized by clay-rich sandstones, mudstones, and siltstones. Machine work to construct trails and complete maintenance work would create raw disturbed areas, however all removed vegetation will be used to cover off-trail disturbed areas that will mitigate erosion and sedimentation until vegetation is reestablished. The amount of

sediment from these activities is expected to be small in quantity and insignificant in effects to the stream system.

Channel maintenance and peak flows with short return intervals are not expected to change as a result of implementing the trails management proposal. Peak flows are largely influenced by increases in hydrologically immature vegetation (i.e. low percent of crown closure (>10%) and/or crown is made up of hardwoods and shrubs), road construction, and soil compaction. The Shasta Agness Project does not propose any trail construction activities with any of the alternatives considered that would increase the proportion of the watersheds in hydrologically immature vegetation or road density. Activities leading to compaction over current levels, such as increased foot traffic, would be minor with the implementation of this project. Also, a fair amount, approximately 4 miles (35%), of the new trail construction on the Shasta Costa Trail would be developed on an old road bed, relieving impacts on previously undisturbed area.

Trail stream crossings could also cause potential hydrologic effects due to increased sediment delivery, localized erosion of bed and banks, potential pollutant/waste discharge, and increased hydraulic connectivity between the trail and the stream. This alternative would increase the number of trail crossings by approximately 20. The following trails would have stream crossings associated with construction and maintenance: Shasta Costa Trail (9), Nancy Creek Trail (4), Shasta Costa Overlook (3), FSR 2308330 to OHV trail (3), and Big Bend/Rogue River Trail (1). Negative effects of stream crossings would be avoided or minimized by PDCs such as: any constructed trail bridge will have a free span of 1.5 times bankfull flow and pass a 100 year flood event; installing appropriately spaced water bars to frequently divert water off of the trails and reduce hydraulic connectivity and rilling; and providing adequate switchbacks and sloping on steeper trail sections.

Because of the very minor and spatially limited change in area disturbed by this project, there would be *no* measurable change in peak flows, or in the timing and magnitude of flood events as a result of implementation of alternative 2 considered.

In addition, during the construction of the trail systems all activities would encompass appropriate PDCs (Appendix B) and BMPs (USDA 2012) to minimize any risk of impacts that would affect water quality and the hydrologic conditions and processes.

## F. Alternative 3- Direct and Indirect Effects of Recreation Improvements

Under alternative 3 the recreation improvements proposed include: trail and campground decommissioning, and facility and structural maintenance improvements. The estimated total footprint affected for each of these activities is described in Table 6 and Table 7. Furthermore, Table 27 describes the recreation facility, and the proposed recreation improvements for Alternative 3.

**Table 27. Proposed recreation improvements for alternative 3 within the Shasta Agness planning area.**

| Alternative 3 | |
|---|---|
| **Name of Recreation Improvements** | **Proposed Recreation Improvements** |

| | |
|---|---|
| Billings Cr Dispersed Campground | This action will include, barrier installation, soil de-compaction, and replanting of impacted areas with native species. This contains approximately 0.2 acres. |
| Foster Bar Facility Recreation Improvements | Facility maintenance improvements similar to Alternative 1 would be implemented, however no action would be implemented to the Foster Bar boat ramp access. |
| Illahee CG | Illahee Campground, approximately 9.9 acres, is currently closed. Under this alternative, all remaining facilities, structures, and small-scale features at the site would be removed, and roads to/through the site would be decommissioned. |
| Illinois TH Horse Camp (new) | No action |
| Oak Flat CG Host | Improvements will consist of host site installation (without septic holding tank), fee tube and signage, OHV mitigation, invasive removal, and resource damage repair. The only change from the preferred alternative is that the host site will not have a septic holding tank. Changes from Alternative 2 are: no gravel boat ramp, no host septic, and no potable water. |
| Oak Flat CG Boat Ramp/Water | No action |
| Shasta Costa Improvements | Shasta Costa Campground will not be improved. FSR 23-990 will be decommissioned, OHV damage will be repaired, and measures will be taken to prevent/mitigate unauthorized motorized access to the area. |
| Upper Rogue TH Improvements | No action |
| Big Bend/ Rogue River Trailhead | An interpretive kiosk will be installed within the existing footprint of the trailhead and parking area to educate visitors of the historic and cultural significance of the Big Bend area. The existing pit toilet will be decommissioned and replaced by a vault toilet in a suitable location within the existing facility footprint. |
| FSR 2308330 to OHV trail | No conversion change. |
| FSR 3577350 to OHV trail | No conversion change. |
| Nancy Cr trail 1181 | Barriers will be installed at all trail access points, and visible portions of the trail from those points will be obliterated. Any remaining culverts will be removed, and the rest of the trail will be allowed to decompose. Approximately 1.9 miles would be decommissioned. |
| Shasta Costa Creek trail | No action |

| | |
|---|---|
| Shasta Costa Overlook A | No action |
| Shasta Costa Overlook B | No action |

## 1. Water Quality- Fecal Coliform

The Rogue River is listed on the 303(d) list for fecal coliform. Projects proposed under Alternative 3 that would have the potential to change coliform bacteria levels include: Oak Flat Campground Host and Big Bend/ Rogue River. Similar effects from Alternative 1 for proposed activities would occur under Alternative 3, with the exception of not installing a septic holding tank for the Oak Flat Campground host. This could cause potential increases in human waste. However signage, and the adjacent Oak Flat Campground would minimize the human and dog waste from recreationalists. Therefore actions are not expected to affect the levels of coliform bacteria. Billings Creek Dispersed Campground

## 2. Billings Creek Dispersed Campground

No change in effects from preferred alternative.

## 3. Foster Bar Facility and Foster Bar Boat Launch Improvements

There would be minimal differences in effects from the preferred alternative. There would be no improvements made to the access or to the boat launch at Foster Bar, this would prevent the short-term resource impacts from turbidity during the implementation of proposed actions.

## 4. Illahee Campground

No change in effects from the preferred alternative.

## 5. Upper Rogue and Big Bend/ Rogue River Trailhead Improvements

No change in effects from preferred alternative.

## 6. Oak Flat Campground Host

The change in effects from this compared to the preferred alternative would be undetectable because no septic holding tank would be installed for the host, there would be nominally less total disturbance between the preferred alternative and alternative 3. Effects from this reduced disturbance would be immeasurable.

## 7. Shasta Costa Improvements

This alternative would decommission the associated dispersed campsite access, rather than implementing a seasonal closure. This would further reduce any long-term potential hydrologic effects from sediment delivery, infiltration reduction, or temperature changes. There would be some short-term disturbance from site restoration and decommissioning of unauthorized OHV trails. However, the longer-term effects would be anticipated to be beneficial because they would reduce the existing site problems.

## 8. Big Bend/ Rogue River Trailhead Improvements

No change in effects from the preferred alternative.

### 9. Motorized Trail Reconstruction

Alternative 3 proposes no conversion change of FSRs 2308330 and 3577350 and spur to Class I OHV trail. There would be fewer direct effects to hydrologic processes relative to other alternatives. This would eliminate the crossing at Snout Creek such that there would be no hydraulic controls or culverts at the existing crossing. Compared to the other alternatives, there would be relatively less authorized OHV use along these trails, which would reduce potential ongoing soil compaction and potential for vegetation removal, sediment delivery, or waste generation. However, it is likely that illegal OHV resource damage will continue to occur, degrading watershed health within the Shasta Agness planning area.

### 10. Nancy Creek Trail Decommissioning

No change in effects from the preferred alternative.

## G. Alternative 4- No Action

Under this alternative, no direct effects from treatment activities would occur on National Forest System lands in the Planning Area. There would be no potential for project-induced changes to channel morphology, large woody material, sediment delivery, stream temperature, and peak flows as a result of NFS land management activities in the Planning Area.

There would be no direct effects on channel morphology if no-action is taken. Existing channel processes would persist, since there would be no treatment and no short-term erosion through soil disturbance. Natural recovery and processes would continue to occur, in some cases at a more delayed rate. In addition, under no-action, there would be no roads decommissioned, closed, stormproofed, or reopened. Existing problems with increased hydraulic connectivity, sediment delivery, slope and drainage failures, and AOP barriers would not be addressed. Hydrologic effects from these conditions, such as impacts to water yield, channel morphology, chronic excessive sediment delivery, risk of culvert failure or stream channel diversion, mass wasting hazards, and exceeding temperature standards would persist. No undersized or misaligned culverts would be replaced or repaired. These culverts would continue to function as barriers to aquatic life, organic material, and coarse sediment. Also, the potential for stream crossing failure would increase over time (i.e., the potential for culverts to plug and fail due to lack of maintenance and deterioration increases with time), thereby increasing the risk of sedimentation of streams from mass wasting of soils. No timber harvesting would be conducted. As a result, no temporary roads (new or existing), log landings, haul roads, and natural stands or plantations would be disturbed by heavy equipment. As such, no new sources of potential management-related sediment production would be created. As a result, historical legacy templates (i.e. non-system templates) would remain in their current states (i.e, chronic sources of sediment, barriers to natural sediment transport regimes, or risk of stream channel diversion)

If no action is taken there would be no direct effects to riparian vegetation and large wood recruitment in Riparian Reserves. Natural recovery and processes would continue to occur for peak flows, growth of riparian vegetation, and large wood inputs. There would be no direct loss of riparian vegetation through thinning, prescribed burning activities, recreation improvements, or temporary road construction. Without Riparian Reserves treatments, the existing conditions of overstocked stands and smaller diameter trees would persist. Canopy conditions would remain unchanged and shading would persist at its existing levels. However, despite this overstocked state, current riparian conditions indicate an instream wood deficit, including scarcity in large wood and recruitment sources that are important for instream and floodplain habitat complexity (see above and also Wildlife, Silviculture, and Fisheries Reports). This means that density-

dependent competition would continue to delay the development of large wood inputs. Current deficiencies in the amount of large wood mean the risk of channel changes such as pool filling, channel widening, and stream bank failures persist. Channel widening could have subsequent effects on water quality by causing increases in stream temperature. Riparian reserves would remain less resilient and at higher risk of stand replacement due to floods or wildfire. Stands less resilient to disturbance could result in greater stand mortality and detrimental morphological changes such as pool filling, alterations in wood supply to the stream, channel widening, and stream bank failure. Such conditions could affect water quality and increase stream temperatures.

In addition, fire exclusion has also changed the dynamics of current vegetation within units proposed for riparian thinning. If stand replacement wildfire occurred in Riparian Reserves, there could be indirect effects on coarse sediment. Associated erosion triggered by this type of wildfire could cause channel changes, such as pool filling, channel widening, and stream bank failures. Channel widening could have subsequent effects on water quality by causing increases in stream temperature. The risk of stand replacement fire would remain unchanged in overstocked stands which could result in extensive mortality within Riparian Reserves if this type of fire occurred. Although the future supply of large wood to stream channels could be reduced due to extensive mortality from fire, there could be in increase in the amount of large wood in the stream channels in the short term, depending on the severity to which trees are burned. The effect of a broad scale high intensity fire would be potential increases in stream flow in small tributaries, with increased downcutting and bank erosion. This could cause increased turbidity for a few years following an intense fire, until stream banks stabilize. In the long-term there would be an increase in young stands if a stand replacement fire occurred, and the watershed would not be considered hydrologically recovered.

Campgrounds and trails with existing hydrologic effects in need of restoration actions such as revegetation, OHV remediation and barriers, soil de-compaction, erosion control, etc. would not be addressed. Problems with water quality listings for the parameters of temperature and sediment would remain, and existing passage barriers would remain. These issues would continue to affect the existing beneficial uses in the watersheds, and impacts to channel morphology, sediment, water yield, and temperature would remain.

## H. Cumulative Watershed Effects of Alternatives 1, 2, and 3

The Siskiyou National Forest Land and Resource Management Plan of 1989 (Forest Plan) addresses the need for cumulative effects analysis on page IV-48, S&G 7-15: Project planning shall assess the potential for adverse effects beyond the immediate activity site. Cumulative effects for the project area encompass the Lawson Creek-Illinois River, Shasta Costa Creek-Rogue River, and the Stair Creek- Rogue 5th-Field watersheds, including private and other public lands that lie within the Forest boundary.

Past activities are considered part of the existing condition. To understand the contribution of past actions to the cumulative effects of the proposed action, this analysis relies on current environmental conditions as a proxy for the impacts of past actions. This is because existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment, and might contribute to future cumulative effects.

Risk analysis here utilized a process developed for the Pacific Northwest in response to a request from the National Marine Fisheries Service regarding determination of the cumulative effects to fish populations protected under the Endangered Species Act of 1973. The process is documented

as *Determining the Risk of Cumulative Watershed Effects Resulting from Multiple Activities* (McCammon, 1993). This process was developed by Forest Service fish biologists and hydrologists from Regions 1, 4 and 6, and reviewed by forest industry, National Marine Fisheries Service, and tribal representatives.

By assessing the percent of watershed with young stands, or stands less than 30 years old, this can be used as a proxy to represent the relative risks from increases in peakflow in to the watershed from project elements – younger stands are considered at higher risk for increases in snow melt for basins within the transitional zone having not achieved full hydrologic recovery. the relative risks of the watershed can be identified. Hydrologic recovery can be assessed in terms of relative watershed risks. If less than 15% of the watershed is young stands, the watershed risk is considered low. If 15-30% of the watershed is young stands, there is a moderate risk, and there is a high risk if greater than 30% of the watershed is comprised of young stands (USDA 1993).

These watersheds are comprised of several ownerships, including Bureau of Land Management (BLM) (895 acres, less than one percent), Forest Service (87, 996 acres, 95.4 percent), private land (2, 718 acres, 2.95 percent), Oregon Department of Forestry (ODF) - State Lands (599 acres, less than one percent).

**Table 28. Ownership by 5th field watershed.**

| Watershed Name | HUC-10 Number | Acres in Watershed | Ownership (acres) | Total in Planning Area (acres) |
|---|---|---|---|---|
| Lawson Creek – Illinois River | HUC-10 #1710031111 | 41,179 | Private: 956<br>State-ODF: 373<br>FS: 9, 308 | 10, 638 |
| Shasta Costa Creek – Rogue River | HUC-10 #1710031006 | 45,026 | Private: 1,150<br>State-ODF: 225<br>FS: 43, 650 | 45, 026 |
| Stair Creek – Rogue River | HUC-10 #1710031005 | 36,544 | BLM: 895<br>Private: 612<br>FS: 35, 038 | 36, 544 |
| Totals | | | | 92, 207 |

Past, present, and foreseeable future activities include variable density thinning, meadow restoration treatments (commercial timber harvest, slash treatments, and prescribed fire), non-commercial meadow restoration, fuel wood cutting, road maintenance, and invasive weed treatments.

## 1. Past Activities

GIS analysis of stand age on Forest Service-managed lands in the Lawson Creek-Illinois River Watershed showed that there are 647 acres of stands less than 30 years old (1.57 percent of the watershed within the planning area); Shasta Costa Creek- Rogue River Watershed 1,852 acres of stands less than 30 years old (4.11 percent of the watershed); and Stair Creek- Rogue River Watershed showed that there are 910 acres of stands less than 30 years old (2.49 percent of the watershed), not including stand replacement fire activity from the Blossom Fire of 2005.

Within the Lawson Creek-Illinois River 5th field watershed there were 4, 155 acres impacted by the Biscuit Fire in 2002. According to the *Biscuit Fire Recovery Project*, wildfire acres burned in each watershed and the intensity of the fire varied (USDA and USDI 2004). Furthermore, the *Water Quality and Fish Habitat Affected Environment* identified 10 percent was affected by a

high severity burn for the Lawson Creek-Illinois River 5th field watershed, which would equate to 416 acres. The Shelley Fire which burned in 1987 burned nine acres within the watershed as well.

Within the footprint of the Blossom, Huggins, and Solitude Fires, no activities would be implemented, which occurred within Stair Creek- Rogue River 5th Field watershed in 2005. Therefore no effects to the age of stands or their current trajectories of growth affecting hydrologic recovery would occur. Additionally, if worst case-scenario were to be analyzed, and include the total footprint of the Fires (3, 696 acres), the relative watershed risk for hydrologic recovery would still remain below 15%, which is considered low. However, this would grossly overestimate the acres in young stands because the Fires received patchy stand replacement activity, not affecting the total acreage within the planning area.

Even if all private lands were harvested, the percent of private land compared to the forest service land ownership would not increase the percent of watershed of young stands to greater than 15 percent for Shasta- Costa Creek-Rogue River when added to the percent above for stands younger than 30-yrs-old (~4%) in the Shasta Costa – Rogue River. The relative watershed risk for hydrologic recovery would be considered low.

The Stair Creek-Rogue River increased to 17%, when including non-forest land harvest to the worst case- scenario percent of relative risk to watershed hydrologic recovery, and there would be a moderate watershed risk. This may be an overestimation for the reasons stated above – that the stand replacement from the Blossom fire would be less than the actual percentage of younger aged stand acreage.

In addition, within the Lawson Creek-Illinois River drainage, approximately six percent of the watershed is likely young stands. This is considered as a low watershed risk. On private land and other jurisdictions, all stands are assumed to be young (1, 329 acres, 12.5%). This assumption was made because the Forest Service does not have accurate data for stand age on private lands and other jurisdictions.

Based on recent activity levels, it would be reasonable to assume that the risk of adverse watershed effects would remain at low levels for the Shasta Costa Creek- Rogue River watershed, and Lawson Creek-Illinois River, and moderate levels for Stair Creek-Rogue River when averaged over the entire watershed.

## 2. Present & Future Activities

There are six management activities currently occurring or reasonably foreseeable on Forest Service-managed lands in the Shasta Agness planning area. These activities include: Coastal Healthy Forest Treatments (CHFT), livestock grazing, Lower Rogue Vegetative Strategy Fuels (LRVS) Categorical Exclusion (CE) activities, LRVS Meadows CE activities, Plantation Thinning and Fuel Reduction, and road and trail maintenance.

CHFT comprises 716 acres within the planning area. CHFT is a thinning project on overstocked previously managed stands (plantations) between stand ages of 30 and 60 years. The project would maintain 50% canopy cover in Riparian Reserves, and other land allocations with at least a 40 percent canopy closure. Livestock grazing encompasses 296 acres of the planning area. It would not involve canopy removal, but would entail soil compaction and smaller vegetation removal/consumption. It would not change the age of the stands. The LRVS Fuels CE includes 323 acres. This project involves removing ladder fuels, smaller trees in the understory, and thinning of conifer thickets where no overstory exists to reduce fire hazard in surrounding

communities and aid in fire suppression efforts in strategic areas, such as private inholdings and along major egress/ingress routes. LRVS Meadows CE includes 266 acres. Projects implemented on this decision are to eliminate encroaching conifers and unwanted vegetation in meadows. Methods include manual cutting of small conifers, pile and burn of slash material, girdling of larger trees, under-burning of open areas, noxious weed removal, and disking and reseeding native seed in meadows. Trees larger than 6 inches and older than 20 years would not be cut. Plantation Thinning and Fuel Reduction projects consist of thinning overstocked plantations to improve vigor and reduce hazardous fuels resulting from this project as well as from previous management activities. Fuels treatment would consist primarily of pruning, sectioning and scattering, hand piling and burning, chipping and/or yarding. The plantations range from 10 to 40 years old and most are the product of regeneration harvests.

However, none of these projects would increase the amount of young stands within the watershed presently or in the future. Furthermore, as described in the previous sections of this report, activities associated with thinning and prescribed burning would have relatively low impacts and hydrologic effects to morphology, sediment yield, water yield and temperature would be minimal. Harvest on private lands is assumed to be on-going with management occurring on a 60-year rotation, and expected to be maintained at the current intensity and rotation. In general, if private lands are harvested on a 60-year rotation, there would continue to be young stands on private land about half of the time. This worst-case scenario assumption still maintains the percentage of young stands above the risk threshold described above.

The proposed project comprises a small percentage of each watershed (Shasta Costa Creek-Rogue River- 9.5%, Lawson Creek-Illinois River- 3.3%, and Stair Creek-Rogue River- 3.1%). None of the activities would reduce any of the stand ages, and the percentage of under 30-year old stands would not change. Therefore, there would be no increase in negative cumulative effects when combined with activities presently occurring or planned for the foreseeable future. The current watershed risk of moderate would likely decrease over time as no increase in young stands is projected for public lands. Stands are proposed for treatment in order to accelerate their development of late seral stand conditions. Overall the streams within the watershed would be considered hydrologically recovered from past timber harvest.

## 3. Conclusion

The current watershed risk of low and moderate for hydrologic recovery would be expected to improve over time, as the amount of newly created young stands is a relatively small portion of the watershed and as stands harvested and impacted from wildfire in the past continue to recover. When assessing cumulative effects in terms of hydrologic recovery, there would still be less than 15 percent of the watershed in young stands in Shasta Costa Creek- Rogue River and Lawson Creek- Illinois River watersheds, and less than 20 percent for Stair Creek-Rogue River. Overall, the streams within the watershed would be considered hydrologically recovered, or improving from past timber harvest and wildfire. As described previously in the *Hydrologic Effects of Alternatives* section, by implementing PDCs (Appendix B) and BMPs (USDA Forest Service 2012), adverse cumulative effects to streams and Riparian Reserves would be minimized, and no predictable adverse effects are expected to occur to the Illinois or Rogue River within and downstream of the Shasta Agness project planning area from proposed management activities.

# VI. Aquatic Resource Conservation Strategy Objectives

This section focuses on the attainment of the nine Aquatic Conservation Strategy Objectives of the alternatives considered in detail, the response to the specific Standards and Guidelines associated with Riparian Reserves (NWFP C-33 & 34), and the attainment of Standards and Guidelines associated with Key Watersheds (NWFP B-19).

Complying with the Aquatic Conservation Strategy objectives means that an agency must manage the riparian-dependent resources to maintain the existing condition or implement actions to restore conditions. The baseline from which to assess maintaining or restoring the condition is developed through a Watershed Analysis (all three of which were described earlier). Improvement relates to restoring biological and physical processes within their ranges of natural variability.

The Standards and Guidelines are designed to focus the review of proposed and certain existing projects to determine compatibility with the Aquatic Conservation Strategy objectives. The Standards and Guidelines focus on "meeting" and "not preventing attainment" of Aquatic Conservation Strategy objectives. The intent is to ensure that a decision maker must find that the proposed management activity is consistent with the Aquatic Conservation Strategy objectives. The decision maker will use the results of watershed analysis to support the finding.

In order to make the finding that a project or management action "meets" or "does not prevent attainment" of the Aquatic Conservation Strategy objectives, the analysis must include a description of the existing condition, a description of the range of natural variability of the important physical and biological components of a given watershed, and how the proposed project or management action maintains the existing condition or moves it within the range of natural variability.

Below is a summation of the environmental analysis regarding consistency with the elements and components of the objectives. Specific rationale may be found in other analysis documented under other resources, e.g., Soils, Fisheries, Wildlife, Botany, etc.

**ACS Objective 1. Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.**

Actions are designed to restore unique habitats, accelerate development of late-successional forest, increase terrestrial and aquatic bio-complexity, create recreational user opportunities, and increase the diversity of landscape features to maintain or restore upland, riparian, and landscape communities.

Vegetation management and activity fuels actions are expected to increase the rate of development of large conifers and remove encroaching conifers from historic meadow and oak savanna/ woodland habitat in riparian and upslope areas, understory complexity, and species diversity. It would restore low intensity fire to a fire dependent ecosystem. Gap creation is expected to add to the diversity of habitat types and species at the landscape scale.

All action alternatives propose varying degrees of road decommissioning and closure activities. These activities are expected to reduce overall instability on the landscape and reduce the potential for stream crossing failure over time. Replacement of AOP barriers and undersized or

misaligned culverts would be replaced or repaired. These culverts would no longer continue to be barriers to aquatic life, organic material, and coarse sediment.

For the Action Alternatives a connected action will include temporary roads. Best Management Practices pertaining to drainage and location, and field review during implementation will be an effective means for eliminating localized impacts such as site erosion of flow modification.

Understory and riparian planting projects are expected to increase vegetation species diversity and accelerate the development of multiple stand layers; increasing the complexity of these landscape scale features.

Adding wood to streams is expected to increase the diversity and complexity of habitat types in streams.

Removing invasive plants found growing in riparian areas would help maintain the distribution, diversity, and complexity of watershed and landscape-scale features, and serve to protect aquatic habitats.

All treatment activities proposed in all alternatives would employ extensive Project Design Criteria and Mitigation Measures. All of the Action Alternatives would have an undetectable short-term effect with a long-term beneficial effect on the watershed and landscape-scale features.

**ACS Objective 2. Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.**

Spatial and temporal connectivity within and between watersheds would be improved by implementing projects recommended in the proposed actions. Specific activities that would achieve this objective include decommissioning roads and trails (especially removing stream crossings and improving AOP), closure of roads, improving road-stream crossings, large instream wood placement, decommissioning of campgrounds, activity fuel treatments, and riparian thinning. Design criteria described below are intended to maintain or restore connectivity, particularly in riparian areas.

Road, trail, and campground decommissioning activities include removing road-stream crossings, waterbarring, removing facility structures, and closing roads. In some cases, surfaces may be decompacted or re-contoured. Removing road-stream crossings directly reconnects stream channels above and below the road, allowing the natural processes of transport (e.g., water, sediment, and large wood) to naturally occur. Reconnected water ways would provide unobstructed passage for aquatic and riparian-dependent terrestrial species. Decompacting and re-contouring surfaces reconnects altered surface and subsurface flow pathways, such that water and chemicals are routed naturally from headwaters to lowlands.

Thinning would accelerate the rate at which plantations and natural stands become mature stands, increasing the connectivity among existing mature stands within and between watersheds. In addition, removing encroaching conifers restores the nutrient diversity provided by meadows and oak savannas, both upslope and within riparian areas on intermittent streams. No-cut buffers along all streamcourses are designed to protect riparian areas from disturbance and maintain a high level of connectivity along these corridors. There would be no change to floodplains, wetlands, or refugia (see ACSO #6, 7, and 8). There would be short term effects to the

connectivity provided by upslope areas and riparian headwater tributaries created by vegetation removal through conifer harvest and prescribed burning. These would be expected to last until the spring following burning, when meadow vegetation species would begin growing back and grasses and herbs would resprout. There would be no effect on stream network connectivity, but nutrient diversity in fish-bearing streams would be maintained and restored as meadow and oak savanna vegetation increases. Also, temporary road construction would be limited to ridges or generally flat terrain. These criteria serve to minimize the disturbance of intact riparian areas.

Removing invasive vegetation is expected to benefit aquatic and terrestrial communities in the long term by increasing native floodplain vegetation area available for nutrient, sediment and large wood storage, and flood flow refugia.

All action alternatives and their associated components would meet this criteria.

**ACS Objective 3. Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.**

Trees would not be removed from stream banks, steep inner gorges, or unstable areas. Prescribed fire would not be ignited within these areas, but would be allowed to creep in to consume small vegetative material in a manner similar to natural low intensity fire patterns. This could result in small isolated areas of bank erosion, however it would not be large enough to alter channel morphology.

Because peak flows are not expected to change in streams from project activities, there would not be increased downcutting or bank erosion in most streams from that source.

Road decommissioning and large-wood placement actions are intended to restore the physical integrity of shorelines, banks, and stream bottoms. Design criteria would reduce impacts associated with actions that would maintain these features. In the long term, road decommissioning would reduce management-related sediment inputs due to road-stream crossing failures and chronic erosion of the road prism. At project completion, road decommissioning would restore natural functions that deliver sediment and wood, and restore the natural hydrologic process.

Past logging practices have depleted large wood recruitment in many streams. Large-wood additions to stream channels would restore sediment routing and sorting processes that restore naturally functioning bed and bank configurations. The physical integrity of the aquatic system would be maintained by no-cut buffers along all stream channels. Additionally, road construction, reconstruction, and decommissioning activities are designed to minimize impacts at project sites.

The action alternatives require the use of the existing Forest System Road network. This network is dependent on maintained drainage systems (i.e. culverts and ditches) that allow water collection and passage to occur with minimal erosion and deposition. Maintenance of the permanent road system associated with the project contributes to the physical integrity of the stream network. New temporary road construction is limited to stable areas, such as ridges or generally flat terrain. These actions maintain physical integrity of riparian areas by conducting these activities outside of (or away from) riparian areas.

Removal or replacement of culverts in streams and road decommissioning would start the process of streambank and streambed restoration.

There is minimal risk of negatively impacting channel condition and dynamics as a result of treating invasive plants. Action alternatives would help restore the physical integrity of stream banks by reducing impacts from invasive plant communities and encouraging native plant communities. The types of treatments proposed could result in minor stream-bank erosion, but impacts would be localized and short-lived.

The project would have no effect on channel configuration from silviculture actions since post activity would not result in a loss of more than 10 % of the soils infiltration rate, and equipment would not travel closer than 100-ft to any stream channel. Furthermore, runoff/streamflow changes are not anticipated. All treatment activities would employ extensive Project Design Criteria, Best Management Practices, and Mitigation Measures.

All action alternatives and their associated components would meet this criteria.

**ACS Objective 4. Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.**

Water quality parameters of particular concern for the Shasta Agness planning area are stream temperature, sedimentation, habitat modification, biological criteria, toxic substances, pH, dissolved oxygen, fecal coliform, and mercury, due to Clean Water Act Section 303(d) listings for water quality limitations on the Rogue and Illinois Rivers and their tributaries. The activities that could have an effect on these parameters are thinning in stands; prescribed burning, culvert removal and road decommissioning, recreation improvements (i.e. campground construction or decommissioning, new trail construction or decommissioning, boat ramp improvements or construction, etc.), and large-wood placement. However, effects on water quality are based on implementing the project design criteria, and are likely to be immeasurable on the mainstems of the Rogue, Illinois River, and their tributaries in the long term. No new temporary roads would be constructed within Riparian Reserves. Actions are designed to maintain or restore water quality.

The natural patterns of turbidity are not expected to change. If there are small scattered areas of bank erosion resulting from project activities, such as prescribed burning, vegetation management, road decommissioning, large wood placement, trail construction or decommissioning, and other similar project activities the duration would be short term and the spatially would be localized to where the activity is occurring. In addition, past observations of culvert removal and replacement projects have projected a likelihood to create turbidity pulses that last for a few minutes to a few hours before water clarity returns to background levels.

In the long term, vegetation management, decommissioning of roads, trails, and campgrounds, removing culverts, and adding wood to streams are expected to improve water quality sooner than under the no-action alternative. Thinning increases the rate of growth of vegetation within and adjacent to streams, increasing the upper and lower canopy cover and shaded area, thereby decreasing in-stream heating due to incident solar radiation. Adding large wood to streams directly shades the stream and increases retention of in-stream gravels. Water flowing through gravel (subsurface) is subject to decreased exposure to solar radiation, thereby reducing the rate at which water is heated, and potentially reducing water temperature. Also, upon completion of proposed actions, some roads would be decommissioned, reducing the road network within the drainage area, relative to current conditions. These actions would maintain or improve water

quality by reducing the area of exposed, compacted soils, which typically deliver substantial quantities of fine sediments, thus reducing human-caused sources of sediment input.

No overstory canopy providing shade within the primary shade zone (45 to 75 feet from stream edge) would be removed from the Riparian Reserves of perennial streams. Fire would not be ignited within 100 feet of Riparian Reserves, but would be allowed to backburn into the Primary Shade Zone and No Cut Zone (25 feet). There would be no effect on vegetation that shades these streams, and canopy conditions in the treatment areas would be maintained at a 50% minimum. Because there would be no measurable effect on stream temperature in tributaries such as Shasta Costa Creek and Lawson Creek, there would be no effect on stream temperature in the 303 (d) listed Illinois or Rogue River.

Fire has the potential to increase pH in streams that drain the burned area. However, because of the high infiltration capacity of the soils, the increase in surface erosion is less following a wildfire than may be found in other areas. Following the 2002 Biscuit fire, 240 erosion pin plots were established before the first winter following the fire. After three winter seasons there did not appear to be a significant movement in soils due to the fires (McHugh, 2005). No increase in pH is expected in streams from any burning.

Dissolved oxygen and sediment conditions would be maintained by implementing design criteria, such as variable-width, no-harvest buffers adjacent to all stream channels and wetlands in thinned stands. Vault toilets and septic systems would meet DEQ standards, and no mining-related activities are proposed. Under Alternative 2, the pit toilet at Billings Creek is scheduled for decommissioning under a separate project, and could increase human and animal waste if not properly disposed. No other planned actions is expected to affect the level of coliform bacteria or mercury in surface or subsurface water in the planning area.

Instream beaver dam analogues would improve water quality by removing suspended sediments within the water column and moderating stream temperatures.

All action alternatives and their associated components would meet this criteria.

**ACS Objective 5. Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.**

All elements of the sediment regime were considered in the design of the project. Many road-related actions were chosen specifically to restore the sediment regime under which aquatic ecosystems evolved.

Rates of bank erosion and volumes of sediment input are affected by factors, such as vegetative conditions in riparian areas and concentration of flow from roads and landings. Vegetation management in managed and natural stands is intended to improve vegetative conditions in riparian areas.

Felling and yarding trees would disturb soils, but the type of logging system used - helicopter, skyline, or tractor - would be matching to the appropriate soil conditions, minimizing this effect.

Because of the flashy nature of the streams in the planning area and surrounding landscape, any increases in sediment are not likely to be discernible in larger intermittent streams or perennial

streams within already elevated background rates of stream turbidity currently noted after storm events.

Road decommissioning is intended to remove concentration of water flow from roads. It also restores connections between surface and subsurface flow between inter-fluvial and fluvial areas. Road treatments, especially road decommissioning, decrease effects of past actions on the sediment regime.

Road-stream crossings usually change the character of sediment input, storage, and transport. Road decommissioning (especially removal of road-stream crossings) and culvert replacement projects are designed to eliminate or minimize the effects of past actions. These activities would also reduce the rate and volume of sediment delivery due to chronic surface erosion. By locating new temporary roads on ridges or generally flat terrain, and avoiding stream crossings (except where necessary to reduce overall impacts), the risk of sediment delivery from these sources would be greatly reduced.

Addition of wood to stream channels is intended, in part, to increase the storage of coarse sediment in stream channels, which improves conditions for fish that evolved in the aquatic ecosystem found in the Project area.

All action alternatives and their associated components would meet this criteria.

**ACS Objective 6. Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.**

Road treatments, culvert repair/removal/replacement, recreation improvements, and large-wood placement are the actions most likely to affect in-stream flows. There is high natural variability in discharge that is related directly to annual or seasonal precipitation. As such, it is difficult to predict how, when, and where proposed activities would affect the timing, magnitude, duration, and spatial distribution of peak, high, and low flows. However, it is expected that the effects described below are likely to occur, if proposed actions are implemented.

Road-stream crossings can alter the timing, magnitude, duration, and spatial distribution of peak, high, and low flows in a watershed. Road decommissioning and culvert repair/removal/ replacement are designed to restore natural processes of streamflow regulation at both the local and watershed scale.

Vegetation management is not expected to result in measurable changes in streamflow at both the project and the watershed scales. This is due to the amount of remaining vegetation (which results in minor changes in evapo-transpiration rates), low elevation of the Project area (because the area receives minimal snow, and patterns of snow interception and retention would not be altered), and the small portions of the watersheds that would be affected.

Large-wood placement is intended, in part, to reconnect channels to their floodplains. All action alternatives and their associated components would meet this criteria.

**ACS Objective 7. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.**

Bedrock and hillslope confinement limit the extent of floodplain development in the three watersheds. For example, Shasta Costa Creek has a few depositional areas that function as floodplains. These floodplain areas are about 10 to 50 feet wide, and 100 to 200 feet long.

In addition, project design criteria, such as no-cut riparian buffers and full-log suspension requirements over streams would protect floodplains and wetlands.

Large-wood additions on floodplains would restore the timing, variability, and duration of floodplain inundation and water-table elevation. In the long term, riparian thinning would increase the rate of large-conifer development in riparian areas, which would increase the future supply of large wood to floodplains and stream channels, restoring floodplain function.

Instream beaver dam analogues would restore the timing, variability, and duration of floodplain inundation and water-table elevations by aiding in large wood recruitment, and aid in restoring floodplain function.

The removal of invasive plants and the recovery of native plant communities would help restore floodplain habitat and maintain water table elevation in meadows and wetlands.

All action alternatives and their associated components would meet this criteria.

**ACS Objective 8. Maintain and restore the species composition and structural diversity of plant communities in Riparian Reserves and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.**

Plantation and natural stand thinning, port- orford cedar sanitation, snag and coarse woody debris creation, and riparian planting and release are intended to restore species composition and structural diversity of plant communities in riparian areas. Habitat elements such as large standing conifers and downed wood, multi-layered canopies, and species diversity would be improved by these activities.

Harvest would occur within the Riparian Treatment Zone which is approximately 2/3 of the total defined Riparian Reserve (one or two site potential tree heights from the stream channel, each side), excluding the Primary Shade Zone. The trees that would be removed are in the outer edges of the reserve, outside the area of riparian characteristics, and their removal would have little effect on the character of the reserve. Their removal would help to preserve the meadow and savanna diversity and accelerate late-seral characteristics that borders the Riparian Reserve. In several areas, the former diversity provided by the meadows and savannas within the prescribed riparian buffers has been lost.

This would help to protect these areas in the event of a large-scale or high intensity wildfire. Conifer removal is proposed within Riparian Reserves along intermittent and ephemeral streams. These areas would also be allowed to burn with low intensity prescribed burn. These activities would help to maintain and restore the meadow and oak savanna riparian areas that formerly occupied much of the project area, and the diversity they provide both within the project area and throughout the connected stream network. This may be especially important to nutrient diversity in downstream fish-bearing reaches of Shasta Costa Creek.

Silvicultural prescriptions include retention of larger diameter trees and favor less common tree species in stands. Hardwoods would typically retained, except where a few alder would be removed to allow conifer to develop in riparian areas. Variation of species composition would be promoted within stands, with the retention of the hardwood component being emphasized.

Riparian Reserves associated with intermittent streams in the project area have the same warm, dry climate as the surrounding upslope areas, and are equally susceptible to wildfire. Reduction of fuels through conifer removal and prescribed burning would help to protect these areas from high intensity wildfire. The small seasonal wetland described under Affected Environment would be protected from damage during removal of conifers in the nearby area.

Design criteria, such as no-cut riparian buffers and yarding restrictions, are intended to maintain species composition and structural diversity of plant communities.

All action alternatives and their associated components would meet this criteria.

**ACS Objective 9. Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.**

All activities are designed to restore natural processes or accelerate development of habitat for native riparian-dependent species. Design criteria such as no-cut riparian buffers and locating temporary roads on ridges to avoid stream crossings are intended to maintain habitat for riparian-dependent species. Restoring habitat for riparian-dependent species is promoted by speeding the development of late-successional and old-growth forest habitat in plantations and removing conifer encroachment in historic meadow oak savanna's and oak woodlands in and adjacent to riparian areas.

Treating invasive plants would help recover native plant communities, benefiting species dependent on riparian and aquatic habitat.

All action alternatives and their associated components would meet this criteria.

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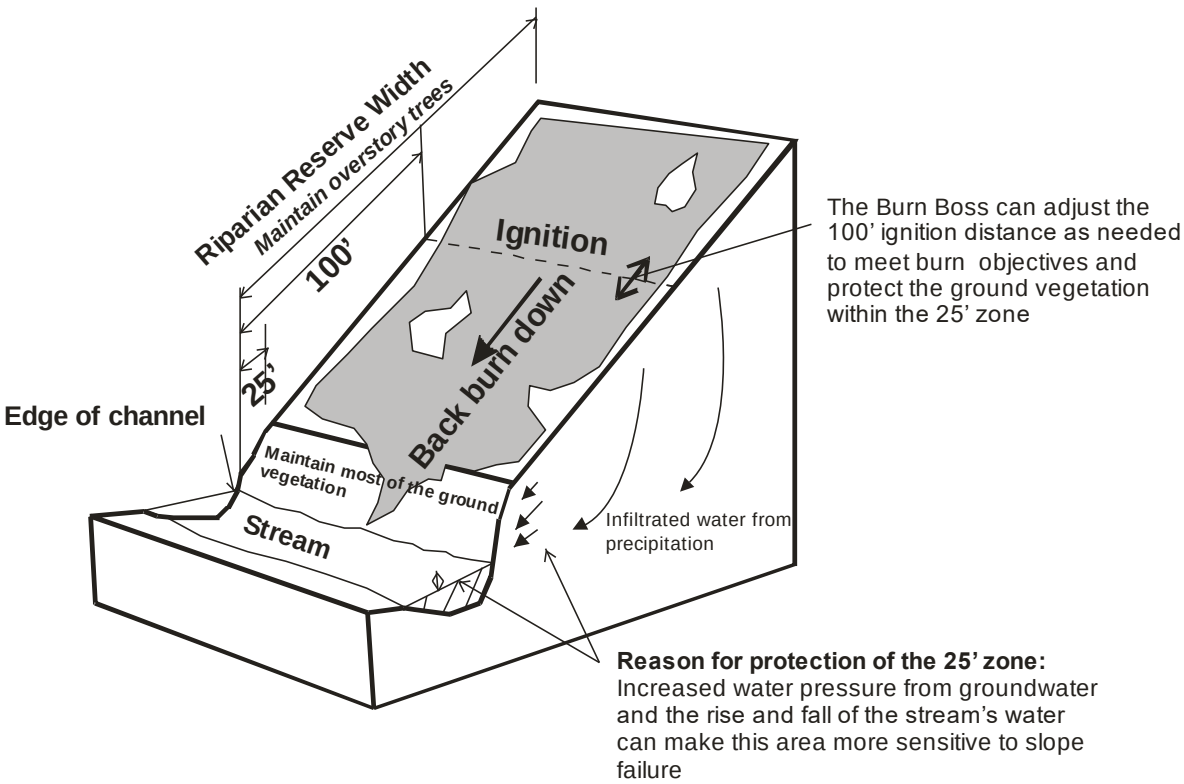
http://www.deq.state.or.us/wq/assessment/assessment.htm

# VIII. Appendix 1: Prescribe Burn in Riparian Reserves

**Roque River Siskiyou N.F**
**August 2008**

## Prescribed Burn in Riparian Reserves

***Project Design Criteria***




**Reducing high fuel Loading** - Use mechanical treatment and pile burning as needed prior to under burning to protect the overstory trees. Pile and burning should be no closer to the stream than 25' to maintain ground vegetation.

**Pump chances** - Fire, engineering and aquatic resource personnel will work together to determine suitable pump chances and the measures needed for the protection of aquatic resources. Refuel 100' feet from a stream or use measures to assure fuel does not reach flowing water. Water withdrawal equipment must have a 3/32 intake screen in order to avoid fish entrapment.

**Literature**

Bormann, B, Homann, P, Cromack, K, Darbyshire, R, Molina, R, and Grant, G, Ecosystem effects and propagation of the Biscuit fire across the large-scale plots of the long-term ecosystem productivity experiment, 2003, Joint Fire Science Program AFP3-2003

Kormeier, E. 1995. Summary of Fish Habitat/Water Quality Since the Silver Fire of 1987. Siskiyou National Forest, Grants Pass, Oregon

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