United States Department of Agriculture

Clear Creek Integrated Restoration

Draft Supplemental Environmental Impact Statement

Forest Service
Ranger District

Nez Perce - Clearwater National Forests
September 2018

Moose Creek

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CLEAR CREEK INTEGRATED RESTORATION PROJECT
Draft Supplemental
Environmental Impact Statement
Idaho County, Idaho

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Abstract: The Forest is preparing this SEIS to further review the project alternatives and analysis, to correct and update information that was presented in the Final Environmental Impact Statement (FEIS), and to consider information that has become available since the FEIS was published in September 2015.The project area comprises 43,731 acres of National Forest System lands within the Clear Creek drainage, located approximately 5 air miles southeast of Kooskia, Idaho. This project proposes timber harvest, commercial thinning, precommercial thinning, prescribed fire, reforestation, native grass restoration, and road system improvements to achieve desired age class and species distributions and to improve watershed health.

It is anticipated that a Notice of Availability will be published in the Federal Register on September 28, 2018 initiating a 45-day comment period. It is important that reviewers provide their comments at such times and in such a way that they are useful to the Agency's preparation of the SEIS. Therefore, comments should be provided prior to the close of the comment period and should clearly articulate the reviewer's concerns and contentions. The submission of timely and specific comments can affect a reviewer's ability to participate in subsequent administrative review or judicial review. Comments received in response to this solicitation, including names and addresses of those who comment, will be part of the public record for this proposed action. Comments submitted anonymously will be accepted and considered; however, anonymous comments will not provide the respondent with standing to participate in subsequent administrative or judicial reviews.

Send Comments to: Zoanne Anderson, NEPA Planner
903 3rd Street
Kamiah, ID 83546; *Or*
comments-northern-nezperce-moose-creek@fs.fed.us; *Or*
Provide Comments Online At: https://www.fs.usda.gov/project/?project=38021

**** To establish standing to object under 36 CFR Section 218, comments must be received within 45 days after publication of the Notice of Availability in the Federal Register.***

Summary

The Forest is preparing this Draft SEIS to further review the project analysis, to correct and update information that was presented in the Final Environmental Impact Statement (FEIS), to consider information that has become available since the FEIS was published in September 2015, and to modify Alternative C based on technical reviews.

This draft SEIS incorporates by reference and supplements the original Clear Creek Integrated Restoration Project Final Environmental Impact Statement of September 2015. This project proposes timber harvest, commercial thinning, precommercial thinning, prescribed fire, reforestation, native grass restoration, and road system improvements to achieve desired age class and species distributions and to improve watershed health. This SEIS modifies Alternative C and provides supplemental information for the following resource areas:

- Aquatics,
- Economics,
- Fuels,
- Vegetation
- Visuals
- Watershed, and
- Wildlife

The project area comprises 43,731 acres of National Forest System lands within the Clear Creek drainage, located approximately 5 air miles southeast of Kooskia, Idaho. The Clear Creek watershed lies within the Selway–Middle Fork Clearwater Collaborative Forest Landscape Restoration Program (CFLRP) area.

Purpose and Need for Action

As stated in the 2015 FEIS, the purpose of the Clear Creek Integrated Restoration Project (Project) is to manage forest vegetation to restore natural disturbance patterns; improve long-term resistance and resilience at the landscape level; reduce fuels; improve watershed conditions; improve elk habitat effectiveness; improve habitat for early seral species; and maintain habitat structure, function, and diversity. Timber outputs from the proposed action would be used to offset treatment costs, support the economic structure of local communities, and provide for regional and national needs.

Desired conditions for the Project area were identified after careful consideration of the existing condition of the area; applicable Forest Plan management direction, recommendations in the Selway and Middle Fork Clearwater Rivers Subbasin Assessment (USDA Forest Service 2001); and the needs, opportunities, and issues identified by a site-specific interdisciplinary watershed assessment and pre-National Environmental Policy Act (pre-NEPA) analysis conducted in 2011 for the Project area. Completing the Project will move the area toward a Desired Future Condition as defined in the Nez Perce National Forest Plan[1] (USDA Forest Service 1987a, pp. II-1 and II-2).

[1] Forest Plan direction for this project is found in the Nez Perce National Forest Plan (USDA Forest Service 1987b) since the project area lies within the administrative boundaries of the Nez Perce National Forest. The Nez Perce and Clearwater National Forests were administratively combined in February 2013, but the existing Forest Plans for each Forest will continue to guide management actions until the Forest Plans are revised. Revision of the 1987 Forest Plans is currently ongoing.

The Clear Creek Project is part of the larger Selway-Middle Fork Clearwater Collaborative Forest Landscape Restoration Project. In 2010, the Clearwater Basin Collaborative (CBC) in partnership with the Nez Perce–Clearwater National Forests produced a comprehensive restoration strategy that was submitted for funding through the Collaborative Forest Landscape Restoration Program (CFLRP). This science-based proposal was designed to restore and maintain ecological conditions within the 1.4 million-acre Selway Middle Fork ecosystem in Idaho. The Selway Middle Fork Clearwater CFLRP proposal includes the following goals:

- Reestablish and perpetuate landscapes that are diverse and resilient
- Restore forest structure, function, and ecologic processes that promote aquatic health
- Restore forest structure, function, and ecologic processes that promote habitat for big game and other terrestrial species
- Contain or eliminate noxious weeds
- Promote landscape conditions that allow fire to function as the primary restoration agent
- Contribute to the economy and sustainability of rural communities

Watershed improvement needs were identified during the pre-NEPA stage of this EIS. To accelerate watershed recovery, some watershed improvement activities were authorized under separate decision documents. The effects of those projects have been incorporated into the existing condition of this EIS or have been addressed in the cumulative effects analysis for this project. Watershed improvement projects associated with the Clear Creek Integrated Restoration project include: 10 miles of system road decommissioning, 73 miles of non-system road decommissioning, 4 miles of road reconstruction, 49 culvert replacements, and 22 culvert removals. Most of these projects have already been implemented. The Clear Ridge Non-System Road Decommissioning Project, which proposes decommissioning 65 miles of non-system roads and removing 15 culverts (see Appendix J of 2015 FEIS for a more detailed outline) was signed on January 15, 2015 but has yet to be implemented.

The Selway–Middle Fork Clearwater area is identified as a top priority for restoration in national, regional, state, and county plans and in a subbasin assessment. The 43,731 acres of National Forest System lands in the Clear Creek watershed lies within the Selway–Middle Fork Clearwater CFLRP area.

The purpose and need for this DSEIS is to further review the project analysis, to correct and update information that was presented in the Final Environmental Impact Statement (FEIS), to consider information that has become available since the FEIS was published in September 2015, and to modify Alternative C based on technical reviews.

Public Involvement

A Notice of Intent (NOI) advertising the scoping period was published in the Federal Register on January 6, 2012. A corrected NOI was published on February 9, 2012, updating the contact information that was published in the original notice. A second corrected NOI was published on February 13, 2012, extending the comment due date to March 1, 2012. A third corrected NOI, advertising two proposed site-specific Forest Plan amendments that are included in this Final Environmental Impact Statement (FEIS), was advertised on February 7, 2013.

The original FEIS was published in February 2015, and was accompanied by a Draft Record of Decision (ROD) identifying the alternative selected by the Forest Supervisor for the Clear Creek Integrated Restoration Project. The 45-day objection period for the Draft ROD began February 26, 2015. In response

to objections received for the Draft ROD, the FEIS was updated and republished in September 2015. The Forest Supervisor issued a Final ROD in December 2015. On July 2, 2016 a complaint was filed with the United States District court for the District of Idaho. The Forest withdrew the decision on August 24, 2016 and published a Notice of Intent to prepare a Supplemental EIS on March 24, 2017.

Alternatives Considered in Detail

The FEIS (September 2015) analyzed a total of four alternatives, including a No Action Alternative. All alternatives **(except for Alternative C)** remain the same as in the 2015 FEIS. The alternatives are briefly summarized below. The issues and alternatives are described in greater detail in Chapter 2 of the 2015 FEIS.

These activities are common to all action alternatives: 41 acres of grass restoration, 1,371 acres of prescribed fire, 1,887 acres of precommercial thinning, 119.8 miles of system road reconstruction, 48.8 miles of system road reconditioning, 13.2 miles of system road decommissioning, and two site specific Forest Plan amendments adopting the Region 1 soil standard of 15% for detrimentally disturbed soils, and clarifying the definition of old growth found in Appendix N of the Nez Perce Forest Plan.

Alternative A (No Action)

This alternative provides a baseline for comparing the environmental consequences of the other alternatives. Under the No Action alternative, no project activities would be implemented.

Alternative B (Proposed Action, as Modified in Response to Scoping Comments)

This alternative was developed in response to the purpose and need for action identified during the pre-NEPA phase of project development. It was presented for public scoping in January 2012. Alternative B would move the project area toward the desired future conditions (DFCs) that were identified for the project during the pre-NEPA phase. In addition to the activities common to all action alternatives, Alternative B proposes 2,609 acres of regeneration harvest, site preparation, and reforestation; 331 acres of improvement harvest; 5,606 acres of commercial thinning; 8.7 miles of temporary road construction on existing templates; and 27.6 miles of new temporary road construction.

Alternative C (Maximal Species Conversion)

This alternative would address vegetative restoration needs described in the purpose and need for action but to a greater degree than Alternative B. Alternative C would regenerate as many stands as possible while meeting objectives for other resources. In addition to the activities common to all action alternatives, the FEIS (2015) Alternative C included 4,156 acres of regeneration harvest, site preparation, and reforestation; 331 acres of improvement harvest; 4,220 acres of commercial thinning; 8.7 miles of temporary road construction on existing templates; and 27.6 miles of new temporary road construction. **Alternative C has been modified from the 2015 FEIS due to technical review and ongoing analysis.** The Responsible Official decided to apply the modifications to Alternative C as it proposes the most potential disturbance within the project area. **Chapter 2 of this DSEIS more fully outlines the modifications to this Alternative.** Briefly, everything remains the same as the 2015 FEIS except: Alternative C Modified would include 3,577 acres (579 acres less than the original Alternative C) of regeneration harvest, site preparation, and reforestation; 288 acres (43 acres less than the original Alternative C) of improvement harvest; 3,937 acres (283 acres less than the original Alternative C) of commercial thinning. The Responsible Official may choose (in whole or in part) to apply the modifications made to Alternative C to any of the other action alternatives in the decision.

Alternative D (Minimal Road Construction)

Alternative D would address the need for vegetative rehabilitation in the Clear Creek watershed but to a lesser degree than Alternative B. Alternative D would use existing road templates as much as possible while still meeting the need for vegetative restoration. In addition to the activities common to all action alternatives, Alternative D would include 2,178 acres of regeneration harvest, site preparation, and reforestation; 211 acres of improvement harvest; 5,141 acres of commercial thinning; 8.7 miles of temporary road construction on existing templates; and 8.8 miles of new temporary road construction.

To help describe the environmental effects of each alternative as they pertain to the identified issues, the interdisciplinary team developed "indicators" that help measure the differences between the alternatives.

Document Organization

The Forest Service prepared this draft SEIS in compliance with NEPA and other relevant Federal and State laws and regulations. This SEIS discloses and supplements the direct, indirect, and cumulative effects that would result from the Proposed Action and action alternatives for aquatics, economics, watershed, and wildlife resources. For the remaining resources, this draft SEIS incorporates the original FEIS (September 2015) analysis by reference. The document is organized into 7 chapters and 5 appendices.

Additional documentation, including more detailed analyses of project area resources, are located in the project planning record located at Nez Perce – Clearwater National Forests, 903 3rd Street, Kamiah, Idaho 83536.

This draft SEIS includes information necessary for the Forest Supervisor to make a decision based on environmental effects of the Proposed Action or the Alternatives. Federal regulations specify the types of information necessary for decision-makers to make good decisions. In so doing, this document is organized as follows:

- Chapter One state the purpose and need for action. The purpose and need is the basis upon which to evaluate any alternatives to the Proposed Action.
- Chapter Two describes the alternatives in detail and summarizes the differences between the alternatives.
- Chapter Three describes the baseline (existing conditions for each resource area that may be affected by the Alternatives and analyzes the potential environmental effects indirect, indirect, and cumulative as a result of implementing the proposed alternatives.
- Chapter Four lists those involved in the preparation and review of the DSEIS, including the IDT and other technical support. It also discloses who this DSEIS was sent to.
- Chapter Five is the incorporation by reference of the glossary of the 2015 FEIS.
- Chapter Six lists references used in the DSEIS.
- Chapter Seven is the index for the DSEIS
- Appendices

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Chapter 1. Purpose of and Need for Action

Introduction

The Forest Service has prepared this draft supplemental environmental impact statement in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and State laws and regulations. This draft supplemental environmental impact statement discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and alternatives.

Additional documentation, including more detailed analyses of project area resources, may be found in the project planning record located at Nez Perce – Clearwater National Forests, 903 3rd Street, Kamiah, Idaho 83536.

Background

The background of the Clear Creek Integrated Restoration Project remains the same as described in the FEIS (September 2015). The FEIS is incorporated by reference and a full description of the background may be found on pages 1-1 through 1-3 of the FEIS.

The original FEIS was published in February 2015, and was accompanied by a Draft Record of Decision (ROD) identifying the alternative selected by the Forest Supervisor for the Clear Creek Integrated Restoration Project. The 45-day objection period for the Draft ROD began February 26, 2015. In response to objections received for the Draft ROD, the FEIS was updated and republished in September 2015. The Forest Supervisor issued a Final ROD in December 2015. On July 2, 2016 a complaint was filed with the United States District Court for the District of Idaho. The Forest withdrew the decision on August 24, 2016 and published a Notice of Intent to prepare a Supplemental EIS on March 24, 2017.

1.2 Project Area

The Clear Creek drainage lies within the Middle Fork Clearwater River drainage near Kooskia, Idaho. The Clear Creek drainage totals 65,000 acres, with 33% (21,269 acres) in private or State ownership and the remaining 67% (43,731 acres) under the management of the Moose Creek Ranger District. The Clear Creek Integrated Restoration Project area includes all 43,731 acres of NFS lands within the Clear Creek drainage (Figure 1-1).

All of the project area lies within the upper two-thirds of the drainage. The project area is located approximately 5 air miles southeast of Kooskia, Idaho, within Townships 30, 31, and 32 N, Ranges 5 and 6 E, Boise Meridian.

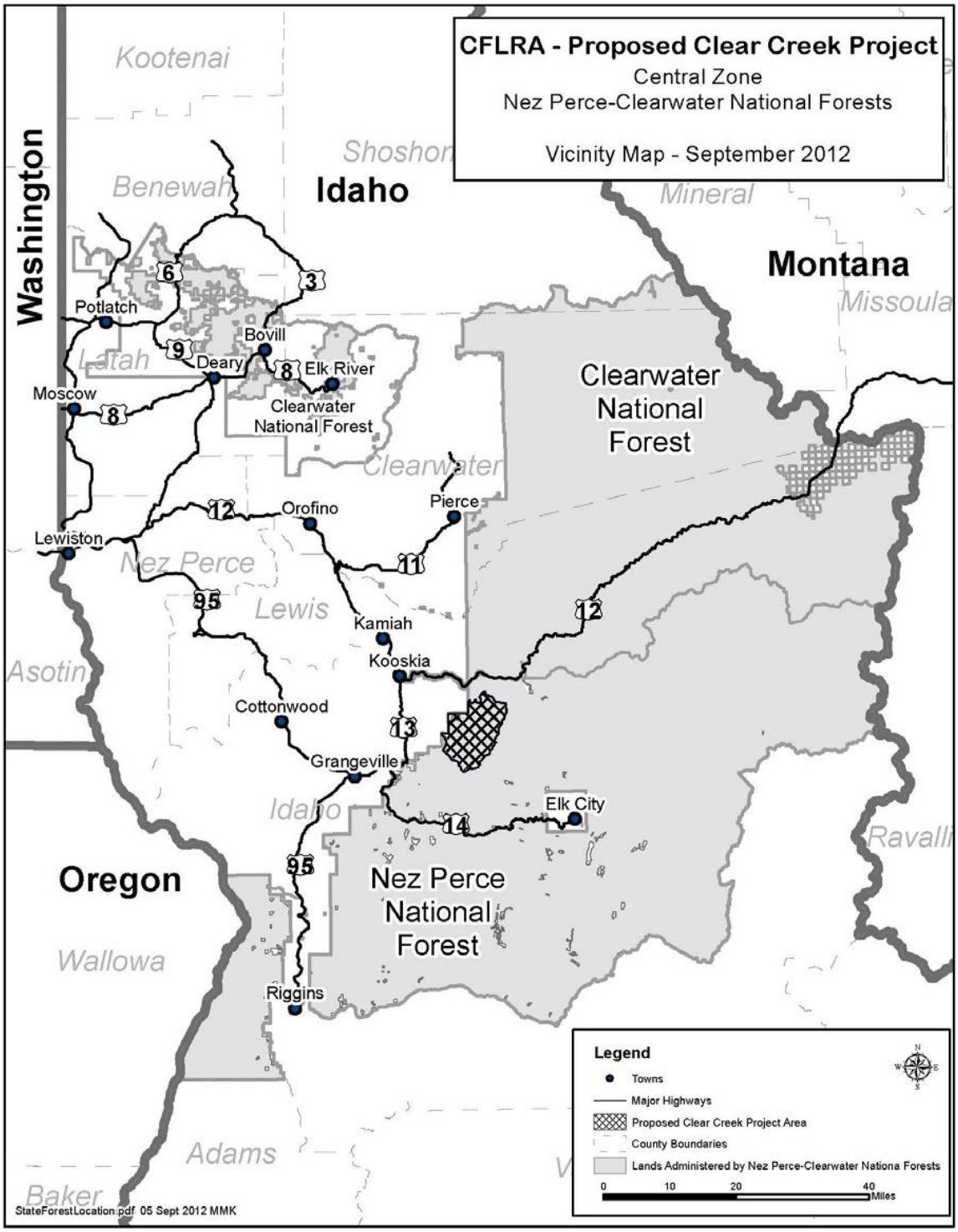


Figure 1: Vicinity Map

1.3 Purpose and Need for Action

The purpose of the Clear Creek Integrated Restoration Project remains the same as described in the FEIS (September 2015). The FEIS is incorporated by reference and a full description of the purpose and need may be found on pages 1-5 through 1-6.

Briefly, the purpose of the Clear Creek Integrated Restoration Project is to manage forest vegetation to restore natural disturbance patterns; improve long-term resistance and resilience at the landscape level; reduce fuels; improve watershed conditions; improve elk habitat effectiveness; improve habitat for early seral species; and maintain habitat structure, function, and diversity. Timber outputs from the proposed action would be used to offset treatment costs, support the economic structure of local communities, and provide for regional and national needs.

1.4 Proposed Action

The proposed action of the Clear Creek Integrated Restoration Project remains the same as described in the FEIS (September 2015). The FEIS is incorporated by reference and a full description of the proposed action may be found in the FEIS on pages 1-6 through 1-8.

Briefly, the proposed action will:

- Improve forest health, provide goods and services, reduce fuels, and improve wildlife habitat,
- Reduce sediment production and address transportation needs,
- Amend the Soils section of the Nez Perce Forest Plan, and
- Amend Appendix N of the Nez Perce Forest Plan (1987).

1.5 Decision Framework

Given the purpose and need, the deciding official reviews the proposed action, the other alternatives, and the environmental consequences in order to make the following decisions:

- Should vegetation restoration in the Project area be completed, and if so, which forested stands should be treated and what silvicultural treatments should be applied?
- Should temporary roads be constructed, and if so, how many miles of road should be constructed and where should they be constructed?
- What design features, mitigation measures, and/or monitoring should be applied to the Project?

1.6 Public Involvement

A Notice of Intent (NOI) advertising the scoping period was published in the Federal Register on January 6, 2012. A corrected NOI was published on February 9, 2012, updating the contact information that was published in the original notice. A second corrected NOI was published on February 13, 2012, extending the comment due date to March 1, 2012. A third corrected NOI, advertising two proposed site-specific Forest Plan amendments that are included in this Draft Supplemental Environmental Impact Statement (DSEIS), was advertised on February 7, 2013.

The original FEIS was published in February 2015, and was accompanied by a Draft Record of Decision (ROD) identifying the alternative selected by the Forest Supervisor for the Clear Creek Integrated Restoration Project. The 45-day objection period for the Draft ROD began February 26, 2015. In response to objections received for the Draft ROD, the FEIS was updated and republished in September 2015. The Forest Supervisor issued a Final ROD in December 2015. On July 2, 2016 a complaint was filed with the United States District Court for the District of

Idaho. The Forest withdrew the decision on August 24, 2016 and published a Notice of Intent to prepare a Supplemental EIS on March 24, 2017.

1.7 Issues

Issues are described in the 2015 FEIS (pages 1-10 to 1-15).

1.8 Regulatory Requirements and Required Coordination

NEPA at 40 CFR 1502.25(a) directs "to the fullest extent possible, agencies shall prepare draft environmental impact statements concurrently with and integrated with …other environmental review laws and executive orders." This DSEIS fully complies with the laws, regulations, and requirements relating to federal land management as described in the 2015 FEIS pages 1-15 to 1-21 and incorporates the information in the 2015 FEIS by reference.

1.9 Other Related Efforts

Since the original December 2015 decision was withdrawn there have been several developments that the Responsible Official will consider as part of the new decision. Some of these items have driven the modification of Alternative C (see DSEIS, Chapter 2). The Responsible Official will evaluate all of the material that has been generated by these additional efforts and will base the final decision on the body of evidence presented in the 2015 FEIS and the final SEIS when complete. The Responsible Official may choose to apply the modifications made to Alternative C (in whole or in part) to any of the other action alternatives.

1.9.1 Gate Replacements and Effective Road Closures

Effective closures on some of the old (non-system) roads in the Clear Creek area have been identified as an issue primarily for elk security. In response to these concerns, we identified roads that could benefit from gate repairs, installation of better earth mounds, or installation of logs or rocks. This work has been analyzed and cleared through a separate NEPA process and is under way (summer, 2018). There are also an additional 7 gates being installed (5 replacement gates and 2 new gates) off of FS 650 in 2018. Information on the exact locations of this work can be found in the project file. The effects are considered in this SEIS.

1.9.2 Clear Creek Aquatic Habitat Condition Assessment and Fish Population Monitoring, 2016 Report (Stillwater Report)

The goal of the Aquatic Habitat Condition Assessment and Fish Population monitoring project is to provide an inventory of habitat conditions, and document fish distribution and relative abundance in the Clear Creek Watershed on the Nez- Perce Clearwater National Forests near Kooskia, Idaho. Stillwater Sciences (2015) summarized results of fish population, aquatic habitat, and channel condition surveys conducted in summer 2015, throughout 43 kilometers (27 miles) of high priority reaches in the Clear Creek Watershed at five long term monitoring stations. These stations were selected at lower mainstem Clear Creek at the National Forest boundary (LMCC), middle mainstem Clear Creek immediately upstream of its confluence with Middle Fork Clear Creek (MMCC), West Fork Clear Creek near its confluence with Clear Creek (WFCC), South Fork Clear Creek (SFCC), and Middle Fork Clear Creek (MFCC). Results from the 2015 assessment serve as a baseline for comparison with future surveys to evaluate trends in habitat conditions, water quality parameters, and fish populations over time, which may be affected by resource management in the basin. As required in the Biological Opinion for the

project (NMFS 2015), two of the long-term monitoring stations established and surveyed in 2015 (LMCC and WFCC) were re-surveyed in summer 2016. This report presents the results of these surveys and compares them with 2015 surveys.

The supplemental Aquatics chapter discusses this report. The entire report can be found in the project file.

1.9.3 Watershed Analysis Using WEPP Technology for the Clear Creek Integrated Restoration Project (RMRS GeoWEPP Analysis)

Introduction

The USDA Forest Service, Rocky Mountain Research Station (RMRS) was asked to help estimate the erosion from units treated by timber removal, prescribed fire and part of the road network, and to compare those estimates to earlier estimates using the NezSed model. Sediment delivery rates from treatment units were estimated using GeoWEPP, a GIS interface to the Water Erosion Prediction Project (WEPP) watershed version. A new road network erosion analysis tool under development by RMRS and the USDA National Soil Erosion Research Laboratory was combined with the FS WEPP:Road Batch to estimate sediment delivery from part of the road network.

Methods

The general approach to the analysis was to determine erosion from the current condition for an undisturbed forest, and following a wildfire, assumed to occur about once every 80 years. The wildfire severity was estimated by the FlamMap fire spread model for the current fuel loads in the LANDFIRE database. From these two runs, a background erosion rate was estimated. The sediment delivery from 646 individual treatment units were then analyzed for prescribed fire (broadcast and jackpot) and timber removal (tractor logging or skyline). Following timber removal, the fuel model that serves as input to FlamMap was changed to a recommended model following fuel reduction, and FlamMap rerun for the landscape. The output from this run was used to run GeoWEPP a final time to estimate erosion rates following wildfire on the proposed treatment units.

Results, Discussion and Synthesis

The Results, Discussion, and Synthesis are found in the body of the analysis which is attached as Appendix M.

Conclusions

This study estimated the erosion on undisturbed forests, burned forests, forests under restoration, and much of the forest road network. The study confirmed that the erosion estimates made using the NezSed technology are similar to those using the WEPP technology, even though the two technologies use very different methods. The NezSed technology is based on locally observed sediment data, and the WEPP technology uses local conditions in a process-based hydrology and erosion model. The WEPP technology has the advantage of allowing managers to better locate hillslopes and road segments of high erosion risk, and adjust the management of those sites to reduce erosion and/or sediment delivery.

The study concluded that increase in erosion associated with the proposed activities will likely be offset by the reduced risk of fire, the reduced severity of a fire should it occur, and the reduction in hillslope sediment delivery following a wildfire.

1.9.4 Statement of Understanding (SOU) with the Nez Perce Tribe

The Forest and the Nez Perce Tribe (NPT) have been meeting regularly since the December 2015 Record of Decision was withdrawn by the Responsible Official to discuss the Nez Perce Tribe's (NPT) concerns with the project. The NPT first raised concerns about the Forest's analysis of the Project's impacts to resources in May of 2013, including potential impacts to elk populations and habitat and the potential for additional sediment impacts to salmon and steelhead spawning habitat and operations downstream at the Kooskia National Fish Hatchery.

In December 2017, the Forest entered into a 1-year Statement of Understanding (SOU) with the NPT, which committed each party to identifying mutual needs and concerns and to cooperating during the National Environmental Policy Act ("NEPA") process. In essence, the SOU outlined a process for the Forest and the NPT to discuss the NPT's concerns regarding the project and to accomplish further analysis. As a result of the SOU, the Forest held a series of meetings and field trips with Tribal staff and both the Forest and Tribe completed additional analyses. Government to government consultation has also been ongoing.

This has led to the following:

1.9.4.1 Multi Parameter Instrument Probes

The Forest purchased and has committed to install two multi parameter instrument probes, one at the Forest boundary and the other at the Kooskia Hatchery, which is managed by the Nez Perce Tribe. The Tribe has already installed a USGS monitoring station at the Kooskia Hatchery. The intent is to compare sediment levels leaving the Forest and those levels reaching the Kooskia Hatchery, downstream of National Forest and private lands. The probes are designed to measure temperature, turbidity, dissolved oxygen, pH, and conductivity at both sites.

1.9.4.2 Data Sharing and Literature Consideration

The Forest and Tribe shared information such as the updated NEZSED sediment model runs, the Stillwater Report, RMRS GeoWEPP Analysis, and all GIS shapefiles as additional, joint analysis was conducted.

The Forest has incorporated and considered the Stillwater and RMRS reports into the project analysis and considered direct, indirect, and cumulative effects of the Project. The Forest has also considered recent literature for evaluating direct, indirect, and cumulative effects of the project on elk habitat security and habitat selection including interactions with livestock and human disturbance (e.g. motorized travel, fuels reduction, other silvicultural prescriptions).

1.9.4.3 Additional Analysis with the Nez Perce Tribe

Forest Service and Tribal technical staff, through a series of meeting and phone calls cooperatively reviewed and analyzed additional information focusing on potential impacts to elk populations and habitat and the potential for additional sediment impacts to salmon and steelhead spawning habitat and operations downstream at the Kooskia National Fish Hatchery.

This included unit by unit and road by road examinations and consideration of the results of those analyses.

1.9.4.4 Alternative Water Supply for the Kooskia Hatchery

Although not associated with the Clear Creek Integrated Restoration Project, the Forest continues to assist the NPT in identifying potential funding sources for an alternative water supply for the Kooskia Hatchery.

1.9.5 Explanation of Updates to the NEZSED Model (2011 Excel Version)

This summarizes new information or changed circumstances in relation to the effects on water quality and quantity that were assessed in the Clear Creek Integrated Restoration Project. The following is an outline of updates to the NEZSED model (version 2011) spreadsheet to better align with the *R1/R4 Guide for Predicting Sediment Yields* (USFS 1981) direction, published research papers, and other Forest documentation noted below. Due to recent retirements/transfers of personnel and digital and hard copy documentation relocations, there was a need to evaluate the current MS Excel spreadsheet consistency with *R1/R4 Guide for Predicting Sediment Yields* (USFS 1981) and compile and synthesize all applicable documentation.

History

The NEZSED model has been used on the Nez Perce National Forest since the mid-1980s and directly relates to Appendix A of the 1987 Nez Perce Forest Plan. The NEZSED model utilizes information, formulas, and coefficients outlined in the *R1/R4 Guide for Predicting Sediment Yields* (USFS 1981), but also includes Nez Perce Forest specific coefficients that were validated based on field-collected data. Several documents outlining definitions, user guides, and supporting information have been created on Forest since 1985.

The Regional Hydrologist and Forest personnel synthesized all data and documentation to provide a comprehensive history of the NEZSED model use and associated direction on the Nez Perce National Forest.

In 2011, the NEZSED model format was transitioned from a FORTRAN /GIS platform to an MS Excel spreadsheet/GIS platform. This new process (GIS and spreadsheets), led by the Forest Hydrologist, eliminated the need to use NEZSED FORTRAN program; eliminated need to develop input files; reduced number of staff needed; reduced analysis time from weeks/months to days; increased flexibility/utility of analytical tool; and made the model more user friendly and trackable. Also at that time, the *"The Care & Feeding of Appendix A"* document (Gerhardt 1991), which discussed NEZSED, Fish/Water Quality Objectives, and upward trend, was updated and renamed *"The implementation guide to Appendix A of the Nez Perce National Forest Plan"* (Conroy and Thompson 2011; FLT decision June 27, 2011). An updated user guide on how to use the most recent MS Excel spreadsheet/GIS platform was never developed.

Updates to NEZSED Model Spreadsheet 2016

The following items were updated to align to the *R1/R4 Guide for Predicting Sediment Yields* (USFS 1981) or other Forest documentation.

- **Existing Road Mitigation Level:** Update Existing Roads spreadsheet to apply existing road mitigation level coefficients based on information extracted from the roads corporate database, i.e. INFRA, that are consistent with pages 33-34 of *The Implementation Guide to Appendix A of the Nez Perce National Forest Plan* (Conroy and Thompson 2011). The current NEZSED model spreadsheet applies Mitigation Coefficients from the variables look up table based on road surfacing, maintenance level, and vegetative buffers, but these coefficients are 10-20% higher than levels identified in Forest documentation (Conroy and Thompson 2011), results from the Horse Creek Studies found in *GTR-INT-264 Reduction of Soil Erosion on Forest Roads* (Burroughs and King 1989) and *Effects of Forest Roads on Watershed Function in Mountainous Areas* (Megahan 1987), and EPA's *National Management Measures to Control Nonpoint Source Pollution from Forestry, EPA-841-B-05-001* (EPA 2005).
- **Road Mitigation Level Coefficients:** Updated coefficients in the Variables Look Up Spreadsheet to align with existing and project mitigation coefficients found on pages 16-17 in *R1/R4 Guide for Predicting Sediment Yields* (USFS 1981), pages C-16 to C-18 in *Appendix C of District Watershed Database Dictionary, and Reduction Of Soil Erosion On Forest Roads* (Burroughs and King 1989). Also established the ability to apply project mitigation coefficient that reflects proposed BMPs as a separate and distinct value compared to existing mitigation coefficients. Current NEZSED model spreadsheet uses Mitigation Coefficients (Surfacing and Maintenance Level) from the variables look up table based on road surfacing, maintenance level, and vegetative buffers, but these coefficients are 10-20% higher than levels identified in Forest documentation (Conroy and Thompson 2011), results from the Horse Creek Studies found in *GTR-INT-264 Reduction of Soil Erosion on Forest Roads* (Burroughs and King 1989) and *Effects of Forest Roads on Watershed Function in Mountainous Areas* (Megahan 1987), and EPA's *National Management Measures to Control Nonpoint Source Pollution from Forestry, EPA-841-B-05-001* (EPA 2005).
- **Disturbed Road Width:** Updated all road spreadsheets to estimate the area of road producing erosion based on an estimated the "Disturbed Road Width." The 2011 model calculates the road area based on the "Travel Way Width" and does not account for cutslopes, fillslopes, or ditches. Disturbed Road Width has been calculated for each 1000-foot long (or less) road segment based on "Travel Way Width" and other information extracted from the roads corporate database, i.e. INFRA, as described on pages C-19 to C-22 in *Appendix C of District Watershed Database Dictionary* and page 15 of the *R1/R4 Guide for Predicting Sediment Yields* (USFS 1981):

(1) Roads

Roads in the Idaho Batholith are assumed to have basic erosion rates (Table 3) based on sediment data from a "standard" maintained 16-foot native material road with ditch (Megahan 1974 and personal communication). Basic road erosion rates are modified by the geologic erosion factor and multiplied by the disturbed area of the road prism segment. The road prism used in this context is the total area disturbed including subgrade, cut and fill slopes, ditches, berms, turnouts, and any other constructed features when present. Tables of geometry for low standard roads (Megahan 1976) are helpful to determine total area disturbed. The total area disturbed factor generally adequately handles deviations from the 16-foot standard road which involves changes in road width. It also handles deviations resulting from roads located on various side slopes. top of cut to toe of fill

- **Land Slope Coefficient:** Updated formulas in Variables Lookup Table to only utilize upper, mid, and lower slope codes and coefficients when calculating hillslope position for harvest and burn units. Ridgetop and streamside coefficients would only be utilized for road specific calculations per the instructions provided on page C-1 in *Appendix C of District Watershed Database Dictionary*. Hillside processes are discussed on pages 14 (Figure 4) and 18-19 in *R1/R4 Guide for Predicting Sediment Yields* (USFS 1981).
- **Logging Systems Coefficient – User Error:** Wording had been switched from clearcut to regen in the logging systems table in the variables sheet, resulting in lookup table formula in the Alternatives sheets that did not match to correct coefficient. This resulted in all clearcut units defaulting to selection harvest coefficients. For example, instead of using 1.0 as the coefficient for clearcut units with tractor logging system, the lookup formula defaulted to 0.71 instead. This was corrected.

Logging System	Logging System Coefficient	
	~~Regen~~ Clearcut	Selection
Tractor	1.00	0.71
Cable	0.62	0.43
Skyline	0.33	0.29

Logging System Coefficients are outlined on page 20 of *R1/R4 Guide for Predicting Sediment Yields (USFS 1981)*

Modeling Temporary Roads in NEZSED Model:

Page 16 of R1/R4 Guide for Predicting Sediment Yields (USFS 1981) states "Roads to be considered include all system roads in the watershed and any other major constructed temporary road systems. Non-specified roads and skid trails internal to logging units are considered as part of logging effects….."

For the Clear Creek Integrated Restoration Project the following were used:

- Model temp roads as part of harvest units when: there are no stream crossings; roads are located on stable, upper slopes; and there is little/discontinuous cut and fill (excavation) – this would equate to no engineered design.

  - Model temp roads as individual segments when: there are stream crossings; roads are located on landslide prone, highly erosive mid-slopes or mass wasting slopes; or roads require continuous excavation where there are deep cuts – this would probably equate to a road that would have some sort of engineered design or oversight.
  - Temporary roads outside of harvest units modeled as individual segments.

- **Add Temporary Road Scenario for 1 Year Plus:** Updated formulas in Variables Look up Table to include temp4 for temporary roads that would occur on the landscape for more than one year (overwinter). This would correspond to Table 2, page 20 in *The Implementation Guide to Appendix A of the Nez Perce National Forest Plan* (Conroy and Thompson 2011).
- **Update Road Reconstruct and Recondition Coefficients:** Updated formulas in Variables Look up Table to replace recondition with "minor", reconstruct with "moderate", and new construction with "major". This would correspond to language on pages 19 and 20 in *The Implementation Guide to Appendix A of the Nez Perce National Forest Plan* (Conroy and Thompson 2011).
- **Update Summary Tables to Calculate Sediment Yields for "True" Watersheds:** Sediment yield guidelines only apply to "true" watersheds. For Forest Plan Prescription watersheds that are designated as not "true" watersheds, routing coefficients were added to summary tables to calculate sediment yields. This would correspond to language on pages 22-23 in *The Implementation Guide to Appendix A of the Nez Perce National Forest Plan* (Conroy and Thompson 2011). Sediment routing is describe on pages 22-14 in *R1/R4 Guide for Predicting Sediment Yields* (USFS 1981).

Changes to the Predicted Percent Sediment yield Over Base Using the Updated NEZSED Model (2016 Excel Version)

The NEZSED model was used to estimate the predicted percent increase in sediment yield over base (natural) conditions to determine if guidelines from Forest Plan Appendix A would be exceeded. The use of the model is a Forest Plan standard and is useful for comparing alternatives to each other. The NEZSED model was derived from the R1/R4 Guide for Predicting Sediment Yields from Forested Watersheds (USDA Forest Service 1981).

The methodology for using the NEZSED model and the model's limitations are described in detail in the Forest's guidance document, Implementation Guide to Appendix A of the Nez Perce National Forest Plan (Conroy and Thompson 2011). Sediment yield is calculated in tons per year and reported as "percent increase over base" conditions. Sediment yield is calculated for base conditions (without management activities), current conditions (cumulative of past and existing management activities combined with base conditions), and predicted conditions (cumulative of past, existing, and proposed activities combined with base conditions) for each of the proposed project alternatives. Activities included in the modeling include timber harvest, road decommissioning, road reconstruction, temporary road construction and prescribed fire.

Modeling was done on a peak year basis in order to meet the assumptions under which Appendix A of the Nez Perce Forest Plan was developed. However, activities proposed would not occur in a single year. The model also reflects short-term changes only and does not reflect long-term benefits in sediment reduction as predicted by NEZSED.

The computed increase is then compared to the values in Appendix A of the Forest Plan to determine if the proposed activities are within the established guidelines for each prescription watershed.

The model simplifies, for analysis, an extremely complex physical system and is developed from a limited data base and scientific knowledge pool. **Although it produces specific quantitative values for sediment yield, the results should be treated as rather broad estimates of how real systems may respond. The validity of the model is best when the results are used to compare alternatives, not for predicting specific quantities of sediment yielded.** Values produced by this procedure are probably valid for comparisons only where large differences among alternatives are produced (Conroy and Thompson 2011, page 24).

Results

As estimated with the NEZSED model version 2016, five of the eight prescription watersheds would remain below the sediment yield guidelines, under all alternatives. Sediment yield percent over base exceeded the Forest Plan Appendix A guidelines for all action alternatives for the Browns Spring Creek prescription watershed and Alternative C for the Clear Creek and Solo Creek prescription watersheds. The highest increases were found in Alternative C, followed by Alternative B, then D. Sediment yields would return to current conditions within seven years, as modeled, and would be approximately 1% less than Alternative A due to road decommissioning activities. An in-depth discussion can be found in the Watershed section of Chapter 2 of this DSEIS.

1.9.6 Road Analysis Summary

1.9.6.1 NFMA Roads Analysis for the CFLRA area 2010 to 2012

An interdisciplinary process was used to complete a roads analysis for the entire CFLRA area. The roads analysis identified risk factors and evaluated maintenance levels, seasonal restrictions, and the need for future administrative use. The IDT made recommendations to either keep the road at current maintenance level, upgrade it to a higher maintenance level, place it into storage, or decommission. In some cases, further review of the road in the field was needed before final recommendations could be made. This roads analysis formed the basis for proposed road actions in several NEPA documents including Lodge Point, Middle Fork Veg, Tinker Bugs, Clear Creek, and miscellaneous stand-alone road projects.

In regard to water quality resource concerns, specialists utilized ArcGIS to identify roads on landtypes with high potential for mass wasting, surface erosion, road bed erosion, cutbank sloughing, and sediment delivery. Fisheries specialists used ArcGIS to identify stream adjacent roads and culverts in need of replacement to accommodate Aquatic Organism Passage (AOP). The INFRA database was used to identify road segments with large fills over aging culverts. LIDAR imagery was also used to delineate non-system roads (primarily old jammer roads and skid trails).

The analysis process also incorporated the Nez Perce National Forest Roads Analysis completed in 2006. The following roads were identified as having a moderate or high risk for surface erosion or had more than 30% of its length adjacent to streams.

Table 1: Nez Perce National Forest Roads Analysis (2006) Risk Ratings

Road #	Miles	Mass Wasting Rating	Surface Erosion Rating	Aquatic Risk Rating
284	0.49	1	1	2
286	21.73	1	2	2
464	1.53	1	3	2
470	1.32	1	1	2
650	11.56	1	3	3
1129	1.16	1	1	2
1842	2.03	1	1	2
1858	0.02	1	3	2

* Risk rating: High Risk = 3; Moderate Risk = 2; Low Risk = 1

Field Reviews for the Clear Creek Integrated Restoration (CCIR) project were conducted during the 2011 and 2012 field seasons. There are 190 miles of Forest system roads within the project area with most occurring along or near ridgetops with mostly small headwater stream crossings. Approximately 147 miles (77%) is graveled and 43 miles (23%) is native surfaced road. IDT members made note of road problems and were documented in the iterative Roads Analysis spreadsheet. The fisheries biologist, hydrologist, and engineers reviewed project area roads and surveyed most culverts on perennial streams and many cross drain culverts. Specialists identified site-specific problems such as road rutting; filled ditches; damaged or filled cross drain culverts; aging, damaged, or undersized stream culverts; road cracking or sloughing, and cutbank raveling. One item noted was aggradation of sediment at the outlets of several perennial stream culverts. Field notes were summarized and added as comments in the Roads Analysis spreadsheet. The Roads Analysis spreadsheet can be found in the CCIR project file.

1.9.6.2 NEPA Analysis 2011 - 2015

Proposed road related actions were identified from the preliminary road recommendations concluded in 2011 and the final recommendations completed in 2012. Originally, all activities in the CCIR project area were to be included in one NEPA EIS document, but it was determined that implementing some of the road activities in separate NEPA decisions and prior to the completion of the EIS would accelerate watershed recovery. As a result, the following projects were completed under separate NEPA decisions:

South Fork/West Fork Clear Creek Road Decommissioning Project EA, 2011

Decommissioning of approximately 10 miles of system road and 73 miles of non-system road, includes removal of 21 stream crossings. No fish bearing streams were involved. This included the decommissioning of 2.5 miles of FS Road #250-D, one of the few stream adjacent roads in the project area.

Clear Creek Culvert Replacements CE, 2011

Culvert removal/replacement of 11 culverts – 9 culverts on fish bearing streams were replaced with culverts that are at or wider than bankfull width to allow for stream bank development within the structure; 1 culvert on a non-fish bearing stream was replaced to accommodate a minimum 100-year stream flow event; and 1 culvert was removed. This project opened 1 mile of previously inaccessible habitat to native fish species.

Browns Spring Culvert Replacement and Road Improvement Project Letter to File, 2012

Road improvement on 1.7 miles of Road 1124 and 1.3 miles of Road 1129. Replacement of two culverts on the 286 road.

Road 286N Road Maintenance Project Letter to File, 2013

Reconstruction of 0.6 miles of Road 286N, including one culvert replacement.

Road 650 Road Maintenance Project Letter to File, 2013

Approximately 15.5 miles of road improvement, including replacement of 35 non-water cross drain culverts. A total of 10.5 miles was conducted by the Forest Service and 5.0 miles were completed by Idaho County.

Clear Ridge Non-System Road Decommissioning Project CE, 2015

This project will decommission approximately 65 miles of non-system road, including removal of 15 stream crossings.

The above projects have mostly been implemented as of 2018. A few of the roads or portions of the roads in the South Fork/West Fork Clear Creek Road Decommissioning Project were identified for the need of use to implement the project CCIR project and would be decommissioned following use. The Clear Ridge Non-System Road Decommissioning Project has not been implemented.

In April of 2013, the DRAFT CCIR EIS was completed. Due to public comments and discussions with the Nez Perce Tribe and NMFS, further roads analysis was completed. This exercise incorporated the use of the Terrain Works NetMap analysis tools, which include WEPP:Road and GRAIP-Lite modules. As a result, additional or more defined road actions were proposed.

The WEPP:Road (Elliot et al. 1999) model was also used during this period to predict the level of erosion and sediment delivery produced and/or reduced from hypothetical “average” temporary road construction and road improvement activities. The values obtained from the hypothetical “average” activities was used to determine the magnitude of difference between activities and incorporated into the upward trend analysis (FEIS Appendix J). Although a sampling of real roads were analyzed using the WEPP:Road model, the exercise was not intended as an overall examination of road generated erosion or sediment for the Clear Creek project and results were only used as rating mechanism in the upward trend analysis.

In February of 2015, the Final CCIR EIS was published. The project included a variety of road related activities: decommissioning of 13.2 miles of system road, including the removal of 8 stream crossings and approximately 3 miles of non-system road (estimated amount that would be ancillary of system roads and would be identified during system road decommissioning surveys); road reconditioning along portions of 49 miles of system road; and road reconstruction along segments of 120 miles of system road, including replacement of 69 culverts on live streams with culverts sized for a 100 year flow event. Most of the roads in the CCIR project area were evaluated in the field and road recondition and reconstruction was prescribed as needed. Road improvement activities are proposed to address existing road concerns by identifying the site-specific segments that are delivering the highest amount of sediment to streams, as well as preparing the roads in a manner so that sediment production from log haul is limited

Road decommissioning practices vary depending on the road location and the risk of road failure. Roads that have moderate to high risk of failure, that are near fish bearing streams, or are being used by unauthorized vehicles will require full decompaction and natural slope recontour. All roads with stream crossings or other watershed concerns will be recontoured including stream grade channel restoration. Roads identified in this project not meeting the above criteria may be abandoned. Abandoned roads have no stream crossings, are well vegetated, are resistant to surface erosion and are not prone to mass failure.

Road reconditioning consists of standard maintenance, such as road blading, brushing, removal of small cutslope failures, applying rock in wet areas and removal of obstructions such as rocks and trees. Reconditioning also includes maintenance of existing culverts.

Road reconstruction improves the roadway. This includes replacing and installing new culverts for cross drains and live water culverts, placement of rock surfacing, placement of roadway fill and installation of new signs or gates. Other activities include installation of drainage dips, road blading, brushing and removal of obstructions. Replace of culverts on live water streams are sized to pass 100 year flood event flows. The intent of the road reconstruction activities is to, as much as possible, hydrologically disconnect the road system from the streams. Cross drain culverts would be installed on either side of all perennial streams, unless unnecessary due to only short lengths of road draining towards stream.

The Watershed and Aquatic sections of the FEIS describe potential effects from roads and discuss project design measures and BMPs that would be utilized to mitigate effects. Appendix B lists out the proposed road work and Appendix K describes the effectiveness of road related BMPs. Appendix J provides a more in depth discussion of culverts in the project area by prescription watershed.

In 2016, a GeoWEPP analysis was completed by the US Forest Service Rocky Mountain Research Station. The results from the analysis will be incorporated into the 2018 Supplemental EIS.

In 2018, the estimated potential erosion produced from roads was evaluated using the NEZSED model. Although the model is usually only applied for the comparison with the Forest Plan Appendix Sediment Yield guidelines, the results were used to look at the erosion potential for each individual road. The NEZSED model estimated 68.3 tons/year of erosion from existing roads. Fifty-two percent of that amount comes from five roads in the CCIR project area. Roads 286, 650, 1106, 1855, and 1114 account for 58 miles of road in the project area and are some of the most traveled roads. These roads will also be used as haul roads for the CCIR project. Road improvement and live-water crossing replacements have already been implemented on these roads through the related Browns Spring Culvert Replacements and Roads 1124 and 1129 Improvement Project, Clear Creek Culvert Replacements, and Road 650 Road Maintenance Project.

Table 2: NEZSED Estimated Erosion and Proposed CCIR Project Action

Road	Length (miles)	NEZSED Estimated Potential Erosion (tons/year)	Percent Of total 68.3 tons	CCIR Project Proposed Action	Related CCIR Projects
286	22.24	15.75	23.1%	Reconstruction - includes culvert replacement	Replaced one 5' cmp with 8' bottomless arch; one 4' cmp with 8' bottomless arch, one 3' cmp with 8' bottomless arch, and one 3' cmp with 5' squash pipe (Clear Creek Culvert Replacements Project and Browns Spring Culvert Replacements and Roads 1124 and 1129 Improvement Project).
650	10.41	7.21	10.6%	Reconstruction - includes culvert replacement	Replaced one 5' cmp with 10' bottomless arch, replaced one 5' cmp with a 12' bottomless arch (Clear Creek Culvert Replacements). Road improvement of 15.5 miles, including replacement of 35 non-water cross drain culverts (Road 650 Road Maintenance Project).
1106	10.26	6.34	9.3%	Reconstruction - includes culvert replacement	Replaced one 4' cmp with 7' bottomless arch (Clear Creek Culvert Replacements).
1855	9.92	3.91	5.7%	Reconstruction - includes culvert replacement	Replaced one 3' cmp with a 5' squash pipe; replaced one 3' cmp with 7' bottomless arch pipe, replaced one 5' cmp with 9' bottomless arch pipe (Clear Creek Culvert Replacements).
1114	5.25	1.95	2.9%	Reconstruction - includes culvert replacement; Decommission 1.7 mile section from junction 1114-C to junction 77774 after use in sale	

Chapter 2. Alternatives, Including the Proposed Action

2.1 Introduction

This chapter briefly describes and compares the alternatives that were considered for the Clear Creek Integrated Restoration Project in the FEIS (September 2015). Alternative C has been modified from the 2015 FEIS due to ongoing analysis and technical review. The modifications are presented below. This section also presents the alternatives in comparative form which has been updated with new information where needed, sharply defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public. Some of the information used to compare the alternatives is based upon the design of the alternative (i.e., helicopter logging versus the use of skid trails) and some of the information is based upon the environmental, social and economic effects of implementing each alternative (i.e., the amount of erosion caused by helicopter logging versus skidding). Please refer to the FEIS (September 2015) pages 2-1 through 2-23 for a full description of alternatives.

2.2 Alternatives Considered in Detail

The FEIS (2015) analyzed a total of four alternatives, including a No Action Alternative. Alternatives A, B, and D remain the same as in the 2015 FEIS and are summarized below. These alternatives are described in greater detail in Chapter 2 of the 2015 FEIS. Alternative C has been modified from the 2015 FEIS due to technical review and ongoing analysis. The Responsible Official decided to apply the modifications to Alternative C as it proposes the most potential disturbance within the project area. The modifications are presented below. The Responsible Official may choose (in whole or in part) to apply the modifications made to Alternative C to any of the other action alternatives in the decision.

These activities remain common to all action alternatives: 41 acres of grass restoration, 1,371 acres of prescribed fire, 1,794 acres of precommercial thinning, 119.8 miles of system road reconstruction, 48.8 miles of system road reconditioning, 13.2 miles of system road decommissioning, and two site specific Forest Plan amendments adopting the Region 1 soil standard of 15% for detrimentally disturbed soils, and clarifying the definition of old growth found in Appendix N of the Nez Perce Forest Plan.

2.2.2 Alternative A (No Action)

This alternative provides a baseline for comparing the environmental consequences of the other alternatives. Under the No Action alternative, no project activities would be implemented.

2.2.3 Alternative B (Proposed Action, as Modified in Response to Scoping Comments)

This alternative was developed in response to the purpose and need for action identified during the pre-NEPA phase of project development. It was presented for public scoping in January 2012. Alternative B would move the project area toward the desired future conditions (DFCs) that were identified for the project during the pre-NEPA phase. In addition to the activities common to all action alternatives, Alternative B proposes 2,609 acres of regeneration harvest, site preparation, and

reforestation; 331 acres of improvement harvest; 5,606 acres of commercial thinning; 8.7 miles of temporary road construction on existing templates; and 27.6 miles of new temporary road construction.

2.2.4 Alternative C MODIFIED (Maximal Species Conversion)

This alternative would address vegetative restoration needs described in the purpose and need for action but to a greater degree than Alternative B. Alternative C would regenerate as many stands as possible while meeting objectives for other resources. In addition to the activities common to all action alternatives, Alternative C Modified would include 3,577 acres (579 acres less than the original Alternative C) of regeneration harvest, site preparation, and reforestation; 288 acres (43 acres less than the original Alternative C) of improvement harvest; 3,937 acres (283 acres less than the original Alternative C) of commercial thinning; 8.7 miles of temporary road construction on existing templates; and 27.6 miles of new temporary road construction.

As part of the additional analysis, areas of potential concern for elk security were identified and include units: 130, 205, 221, 228, 235, 336, 120, 214, 159, and 310, based on layout, topography, large view sheds and screening cover. The following design criteria is added to this alternative: "*Units 130, 205, 221, 228, 235, 336, 120, 214, 159, and 310 will be reviewed by the Biologist and timber team during unit layout. Screening cover will be maintained through use of vegetation and topography in order to limit visibility of big game from year round motorized access points.*"

In response to technical reviews, ongoing analysis, and timbersale layout (proposed), changes to the following units are as follows for Alternative C Modified:

Table 3: Modifications to Alternative C Units

HUC Name	Unit	Original NEPA Acres	FS Unit Reduction Acres[a]	Regen (R) or Com. Thin (CT)	Unit Adjustments	Specific Soils Design Criteria Applied to Unit[b]
Changes to Units by (proposed) Lost Mule Timbersale Layout						
Hoodoo Creek	122	78	~ 23 acres	Regen/Improve	Acres dropped during layout.	2.2.6.1 – #5 2.2.6.1 – #10
Lower Clear Creek Face	123	121	~9 acres	Regen	The layout maps show nearly all erosion risks resolved.	2.2.6.1 – #3 2.2.6.1 – #5 2.2.6.1 – #6 2.2.6.1 – #10
Hoodoo Creek	124	24	~ 15 acres	Regen	Unit layout has eliminated all high delivery terrain.	2.2.6.1 – #3 2.2.6.1 – #5 2.2.6.1 – #10
Hoodoo Creek	125	78	~ 22 acres	Regen	Terrain and layout for Lost Mule show very little delivery risk. The 2 acres of skyline harvest that GIS analysis shows as Landslide Prone did not show field indicators.	2.2.6.1 – #5 2.2.6.1 – #10
Hoodoo Creek	126	68	~ 54 acres	Regen	Soils have high erosion, but the proposed tractor	2.2.6.1 – #5 2.2.6.1 – #10

HUC Name	Unit	Original NEPA Acres	FS Unit Reduction Acres[a]	Regen (R) or Com. Thin (CT)	Unit Adjustments	Specific Soils Design Criteria Applied to Unit[b]
Changes to Units by (proposed) Lost Mule Timbersale Layout						
					ground is ridgetop with limited delivery potential.	
Hoodoo Creek	127	10	~ 5 acres	Regen	About 4 acres were dropped during layout reducing risk.	2.2.6 - General Design Criteria Applied
Hoodoo Creek	130	47	~ 7 acres	Regen	Acres dropped during layout.	2.2.6.1 – #5 2.2.6.1 – #10
Hoodoo Creek	140	31	~ 1 acre	Regen	Decreased acreage due to more precise mapping.	2.2.6.1 – #5 2.2.6.1 – #10
Lower Clear Creek Face	217	41	~22 acres	Regen/CT	Lost Mule layout removed most of the high risk terrain for delivery. Temporary road will be dropped on the high risk terrain; in fact, field layout maps for Lost Mule show the location has been moved.	2.2.6.1 – #3 2.2.6.1 – #5 2.2.6.1 – #7 2.2.6.1 – #10
Hoodoo Creek	218	146	~ 19 acres	Regen	Lost Mule layout removed most of the high risk terrain for delivery. Additional layout will likely remove additional acres.	2.2.6.1 – #5 2.2.6.1 – #6 2.2.6.1 – #10
Hoodoo Creek	219	22	~ (+)1 acre	Regen	Increased acreage due to more precise mapping.	2.2.6.1 – #5 2.2.6.1 – #6 2.2.6.1 – #10
Hoodoo Creek	220	26	~ 5 acres	Regen	Acres dropped during layout.	2.2.6.1 – #5 2.2.6.1 – #7 2.2.6.1 – #10
South Fork Clear Creek	221	26	~ 3 acres	Regen	Acres dropped during layout.	2.2.6.1 – #5 2.2.6.1 – #6 2.2.6.1 – #10
Hoodoo Creek	222	70	~ 42 acres	Regen	Layout dropped higher risk acres, about 13 acres for water and 10 additional acres along ridgetops.	2.2.6.1 – #5 2.2.6.1 – #6 2.2.6.1 – #10
Hoodoo Creek	224	38	~ 15 acres	Regen	Acres dropped during layout.	2.2.6.1 – #3 2.2.6.1 – #5 2.2.6.1 – #10
Hoodoo Creek	340	30	~ 30 acres	CT	Trees are larger than suitable for commercial	2.2.6.1 – #5 2.2.6.1 – #6

HUC Name	Unit	Original NEPA Acres	FS Unit Reduction Acres[a]	Regen (R) or Com. Thin (CT)	Unit Adjustments	Specific Soils Design Criteria Applied to Unit[b]
Changes to Units by (proposed) Lost Mule Timbersale Layout						
					thinning – regeneration prescription not analyzed, so all acres dropped from all alternatives.	2.2.6.1 – #10
Hoodoo Creek	341	276	~ 56 acres	CT	Areas of concern were dropped in layout.	2.2.6.1 – #5 2.2.6.1 – #7 2.2.6.1 – #10
Hoodoo Creek	344	11	~ 11 acres	CT	This area was dropped in layout entirely.	2.2.6.1 – #5 2.2.6.1 – #6 2.2.6.1 – #10 2.2.6.1 - #12
Hoodoo Creek	345	118	~ 73 acres	CT	Approximately 71 acres dropped on eastside and dropped the westside landslide prone areas. Seventeen (17) acres on the ridgetop remain.	2.2.6.1 - #3 2.2.6.1 – #5 2.2.6.1 – #6 2.2.6.1 – #10 2.2.6.1 - #12
South Fork Clear Creek	346	38	~ 38 acres	CT	Trees are larger than suitable for commercial thinning – regeneration prescription not analyzed, so all acres dropped from all alternatives.	2.2.6.1 – #5 2.2.6.1 – #10 2.2.6.1 – #12
Changes to Units by Future Timbersale Layout						
Clear Creek	102	178	~ 45 acres	Regen	Specialist report also flags this Unit as having higher percentage of regeneration which could create higher water yields. 30-45 acres of proposed harvest on moderately high delivery potential (exact acres to be evaluated in the field). Unit will be field verified during layout and higher risk acres will be dropped.	2.2.6.1 – #3 2.2.6.1 – #5 2.2.6.1 – #10
Solo Creek	110	24	To Be Determined During Layout	Regen	Partial terrain with high delivery potential, but Unit boundaries do a good job of screening	2.2.6.1 – #3 2.2.6.1 – #10

HUC Name	Unit	Original NEPA Acres	FS Unit Reduction Acres[a]	Regen (R) or Com. Thin (CT)	Unit Adjustments	Specific Soils Design Criteria Applied to Unit[b]
Changes to Units by (proposed) Lost Mule Timbersale Layout						
					out delivery areas. Unit will be field verified during layout and higher risk acres will be dropped.	
Solo Creek	113	46	To Be Determined During Layout	Regen	Partial terrain with high delivery potential, but Unit boundaries do a good job of screening out delivery areas. Unit will be field verified during layout and higher risk acres will be dropped.	2.2.6.1 – #3 2.2.6.1 – #5 2.2.6.1 – #10
Solo Creek	114	48	To Be Determined During Layout	Regen	Cable Harvest is proposed on the more erosion prone landtypes, below FSR#9703B. No Swing trails proposed. Unit design appears adequate as to mitigate potential sedimentation. Unit will be field verified during layout and unit width may be reduced to decrease disturbance corridor if needed.	2.2.6.1 – #3 2.2.6.1 – #5 2.2.6.1 – #10
Hoodoo Creek	129	53	To Be Determined During Layout	Regen	Jammer roads were recontoured in 2012, significantly reducing erosion risk from the unit. The cable harvest section doesn't have obvious delivery points. Unit will be field verified during layout to ensure temporary roads are constructed on ridgetops.	2.2.6.1 – #5 2.2.6.1 – #10
South Fork Clear Creek	150	147	- 147 acres	Regen	This unit was removed due to further analysis which revealed presence of old growth.	2.2.6.1 – #5 2.2.6.1 – #10
South Fork Clear Creek	152	36	- 36 acres	Regen	This unit was removed due to further analysis which revealed presence of old growth.	2.2.6.1 – #5 2.2.6.1 – #10
South Fork	225	60	~ 4 acres for watershed – Potential	Regen	LiDAR shows several old roads in the unit. One area of cable	2.2.6.1 – #5 2.2.6.1 – #7

HUC Name	Unit	Original NEPA Acres	FS Unit Reduction Acres[a]	Regen (R) or Com. Thin (CT)	Unit Adjustments	Specific Soils Design Criteria Applied to Unit[b]
Changes to Units by (proposed) Lost Mule Timbersale Layout						
Clear Creek			additional areas to be determined during layout.		harvest proposed occurs on breakland slopes. Will be field verified – any landslide prone will be dropped, and PACFISH buffer will be applied.	2.2.6.1 – #10 2.2.6.1 - #12
Hoodoo Creek	229	50	To Be Determined During Layout	Regen	The harvest area shows that there are very low risk areas for delivery. However, there are several abandoned roads evident in LiDAR. 2011 road survey data indicates all non-system roads were recommended for abandonment under SF/WF Clear Decom EA, indicating little risk for delivery to water. Abandoned roads will be re-evaluated to assess original prescription.	2.2.6.1 – #5 2.2.6.1 – #7 2.2.6.1 – #10
Browns Spring Creek	317	78	To Be Determined During Layout	CT	Some higher risk terrain, but no apparent areas of potential delivery. Unit will be field verified during layout adjacent to FS Road #286 for landslide prone. These areas will be removed.	2.2.6.1 - #3 2.2.6.1 – #5 2.2.6.1 – #7 2.2.6.1 – #10 2.2.6.1 - #12
Clear Creek	323	75	To Be Determined During Layout	CT	Low risk for sediment delivery off unit based on terrain. Unit will be field verified during layout	2.2.6.1 – #5 2.2.6.1 – #6 2.2.6.1 – #10 2.2.6.1 - #12
Changes to Units to Reduce Risk of Sediment Delivery						
Clear Creek	103	118	~ 30 acres	Regen	Unit will be field verified – any landslide prone will be dropped, and PACFISH buffer will be applied.	2.2.6.1 - #3 2.2.6.1 – #10
Big Cedar Creek	104	57	0	Regen	Will be field verified - Design Criteria will be applied.	2.2.6.1 - #6 2.2.6.1 – #10

HUC Name	Unit	Original NEPA Acres	FS Unit Reduction Acres[a]	Regen (R) or Com. Thin (CT)	Unit Adjustments	Specific Soils Design Criteria Applied to Unit[b]
Changes to Units by (proposed) Lost Mule Timbersale Layout						
Clear Creek	109	157	~ 26 acres	Regen	Drop ~ 26 acres on High Risk/High Delivery Slopes. Will be field verified – any additional landslide prone will be dropped, and PACFISH buffer will be applied.	2.2.6.1 – #3 2.2.6.1 – #5 2.2.6.1 – #10
Solo Creek	119	64	To Be Determined During Layout	Regen	Unit appears to have screened out terrain with delivery potential…unit is on ridges. Will be field verified – any landslide prone will be dropped, and PACFISH buffer will be applied.	2.2.6.1 – #5 2.2.6.1 – #10
Hoodoo Creek	128	52	~ 10 acres	Regen	Specialist report flags this Unit as having higher percentage of regeneration which could create higher water yields. 30-45 acres of proposed harvest on moderately high delivery potential. Unit will be field verified during future layout and Design Criteria will be applied. Flagged by NOAA as well for amount of regeneration concentration in first and second order streams. Nearby Unit, #126 - 55 out of 69 acres have been dropped – water yield concerns lessened by other units being dropped.	2.2.6.1 – #5 2.2.6.1 – #10
South Fork	141	36	~ 7 acres	Regen	Drop the portion of harvest Unit that is	2.2.6.1 – #5 2.2.6.1 – #10

HUC Name	Unit	Original NEPA Acres	FS Unit Reduction Acres[a]	Regen (R) or Com. Thin (CT)	Unit Adjustments	Specific Soils Design Criteria Applied to Unit[b]
Changes to Units by (proposed) Lost Mule Timbersale Layout						
Clear Creek					above the tributary to S FK Clear Creek with high delivery potential. Timber reviewed this unit and thought normal layout would drop the higher risk portion of the unit. Unit will be field verified during future layout.	
South Fork Clear Creek	145	109	~ 14 acres	Regen	Unit review shows that there is very little high risk terrain in the proposed unit and delivery potential to ephemeral draws seem unlikely. However, specialist report also flags this Unit as having higher percentage of regeneration which could create higher water yields. There are 30 to 45 acres of proposed harvest on moderately high delivery potential. Unit will be field verified during future layout and Design Criteria will be applied.	2.2.6.1 – #5 2.2.6.1 – #10
Browns Spring Creek	155	101	~ 18 acres	Regen	Cable portions above Pine Knob Creek appear to have delivery potential because of steep breakland terrain. The skyline units above Clear Creek and Browns Creek do not appear to have concentrated catchments that would deliver sediment. All that is >60% will be removed and units will be shortened.	2.2.6.1 – #3 2.2.6.1 – #5 2.2.6.1 – #10

HUC Name	Unit	Original NEPA Acres	FS Unit Reduction Acres[a]	Regen (R) or Com. Thin (CT)	Unit Adjustments	Specific Soils Design Criteria Applied to Unit[b]
Changes to Units by (proposed) Lost Mule Timbersale Layout						
					Unit will be field verified – any landslide prone will be dropped, and PACFISH buffer will be applied.	
Pine Knob Creek	160	116	~ 12 acres	Regen	Units are on GIS identified High Risk terrain. Unit layout will make sure there are no field indicators. Unit will be field verified – any landslide prone will be dropped, and PACFISH buffer will be applied. Design Criteria will also be applied.	2.2.6.1 – #3 2.2.6.1 – #5 2.2.6.1 – #10
Hoodoo Creek	230	197	~ 25 acres	Regen	Specialist report also flags this Unit as having higher percentage of regeneration which could create higher water yields. Unit will be Dropped.	2.2.6.1 – #6 2.2.6.1 – #10
Hoodoo	234	172	To Be Determined During Layout	Regen	Low risk for sediment delivery off unit based on terrain. Will be field verified – any landslide prone will be dropped, and PACFISH buffer will be applied.	2.2.6.1 - #3 2.2.6.1 – #5 2.2.6.1 – #6 2.2.6.1 – #10
Hoodoo	238	50	To Be Determined During Layout	Regen	On ridges. No high delivery areas apparent, low gradient and away from streams. Unbuffered streams on map will be buffered during layout. Will be field verified - Design Criteria will be applied.	2.2.6.1 – #5 2.2.6.1 – #6

HUC Name	Unit	Original NEPA Acres	FS Unit Reduction Acres[a]	Regen (R) or Com. Thin (CT)	Unit Adjustments	Specific Soils Design Criteria Applied to Unit[b]
Changes to Units by (proposed) Lost Mule Timbersale Layout						
Pine Knob Creek	304	160	To Be Determined During Layout	Commercial Thin	Harvest activities have low risk of delivery, but the non-system roads have high potential for delivery. Non-system roads covered in Clear Ridge Decom Decision. Will be field verified - Design Criteria will be applied.	2.2.6.1 – #5 2.2.6.1 – #6 2.2.6.1 – #12
Pine Knob Creek	307	326	~ 58 acres	CT	~ 58 acres removed. Some higher risk terrain, map highlights area with potential delivery.	2.2.6.1 – #5 2.2.6.1 – #6 2.2.6.1 – #10
Big Cedar Creek	309	277	To Be Determined During Layout	Commercial Thin	Non-system roads covered in Clear Ridge Decom Decision. Will be field verified - Design Criteria will be applied.	2.2.6.1 – #7 2.2.6.1 – #10 2.2.6.1 – #12
Brown Springs Creek	315	162	To Be Determined During Layout	Commercial Thin	On ridges. No high delivery areas apparent, low gradient and away from streams. Non-system roads covered in Clear Ridge Decom Decision. Will be field verified - Design Criteria will be applied.	2.2.6.1 - #5 2.2.6.1 – #7 2.2.6.1 – #10 2.2.6.1 – #12
Browns Spring Creek	318	64	~ 45 acres (Below 77786 Road)	CT	Commercial Thin proposed harvest activities have low risk of delivery because the terrain has very gentle slope. Potential proposed harvest below FSR#77786 has highest risk of delivery because of ephemeral	2.2.6.1 – #5 2.2.6.1 – #7 2.2.6.1 – #10

HUC Name	Unit	Original NEPA Acres	FS Unit Reduction Acres[a]	Regen (R) or Com. Thin (CT)	Unit Adjustments	Specific Soils Design Criteria Applied to Unit[b]
Changes to Units by (proposed) Lost Mule Timbersale Layout						
					draw tributary to Browns Spring Creek. The non-system roads within this Unit do have a moderately high potential for delivery. Jammer roads and a portion of the 77786 road are covered under Clear Ridge Decom Decision. The harvest proposed method is cable and should have low risk. The higher risk terrain will be buffered out the Unit during normal layout. Unit will be field verified and Design Criteria will be applied.	
Clear Creek	319	150	To Be Determined During Layout	Commercial Thin	Low risk for sediment delivery off unit based on terrain. Has Jammer roads – Non-system roads covered in Clear Ridge Decom Decision. Will be field verified - Design Criteria will be applied.	2.2.6.1 – #5 2.2.6.1 – #6 2.2.6.1 – #10 2.2.6.1 - #12
Clear Creek	320	215	To Be Determined During Layout	Commercial Thin	Non-system roads covered in Clear Ridge Decom Decision. Will be field verified - Design Criteria will be applied.	2.2.6.1 – #5 2.2.6.1 – #6 2.2.6.1 – #10 2.2.6.1 - #12
Clear Creek	324	355	To Be Determined During Layout	Commercial Thin	Numerous incised draws in the tractor harvest portion will be dropped out during normal layout.	2.2.6.1 – #5 2.2.6.1 – #6 2.2.6.1 – #10 2.2.6.1 - #12

HUC Name	Unit	Original NEPA Acres	FS Unit Reduction Acres[a]	Regen (R) or Com. Thin (CT)	Unit Adjustments	Specific Soils Design Criteria Applied to Unit[b]
Changes to Units by (proposed) Lost Mule Timbersale Layout						
					Hydrologist notes low risk of delivery based on terrain. Will be field verified - Design Criteria will be applied.	
Hoodoo Creek	347	98	To Be Determined During Layout	Commercial Thin	Low risk for sediment delivery off unit based on terrain. Will be field verified - Design Criteria will be applied.	2.2.6.1 – #5 2.2.6.1 – #6 2.2.6.1 – #10 2.2.6.1 - #12
Hoodoo Creek	348	43	~ 8 acres	CT	Some higher risk terrain, a portion of this Unit will be dropped. Unit will be field verified and Design Criteria will be applied.	2.2.6.1 – #5 2.2.6.1 – #7 2.2.6.1 – #10 2.2.6.1 - #12
South Fork Clear Creek	356	95	~ 40 acres	CT	Terrain is steep with moderate to high potential delivery of sediment. High densities of existing non-system roads on steep terrain likely result in high existing erosion from this proposed unit. Unit will be modified to drop some steeper terrain. Unit will be field verified and Design Criteria will be applied.	2.2.6.1 – #5 2.2.6.1 – #6 2.2.6.1 – #10 2.2.6.1 - #12
South Fork Clear Creek	358	278	To Be Determined During Layout	Commercial Thin	Will be field verified - Design Criteria will be applied.	2.2.6.1 – #5 2.2.6.1 – #6 2.2.6.1 – #10 2.2.6.1 - #12

[a] All acres are approximate. Field layout of units will determine final acres.

[b] See 2015 FEIS Section 2.2.6 (pages 2-5 through 2-12) for a description of all Design Criteria. See Section 2.2.6.1 (pages 2-5 through 2-9) for a description of all Design Criteria related to soils protection. See 2015 FEIS Appendix E-1 for a summary of Specific Soils Design Criteria applied to each unit.

2.2.5 Alternative D (Minimal Road Construction)

Alternative D would address the need for vegetative rehabilitation in the Clear Creek watershed but to a lesser degree than Alternative B. Alternative D would use existing road templates as much as

possible while still meeting the need for vegetative restoration. In addition to the activities common to all action alternatives, Alternative D would include 2,178 acres of regeneration harvest, site preparation, and reforestation; 211 acres of improvement harvest; 5,141 acres of commercial thinning; 8.7 miles of temporary road construction on existing templates; and 8.8 miles of new temporary road construction.

2.2.6 Design Criteria

The design criteria for the Clear Creek Integrated Restoration Project remains the same as described in the FEIS (September 2015). The FEIS is incorporated by reference and a full description of the design criteria may be found on pages 2-5 through 2-13. Additionally, 2015 FEIS Appendix E-1 provides the summary of Specific Soils Design Criteria applied to each unit.

The following design criteria is added to Alternative C Modified: **Units 130, 205, 221, 228, 235, 336, 120, 214, 159, and 310 will be reviewed by the Biologist and timber team during unit layout. Screening cover will be maintained through use of vegetation and topography in order to limit visibility of big game from year round motorized access points.**

2.3 Alternatives Considered but Eliminated from Detailed Study

Federal agencies are required by NEPA to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public comments received in response to the Proposed Action provided suggestions for alternative methods for achieving the purpose and need. Some of these alternatives would have modified the proposed action to the point where the purpose and need for action would not be met, would have been duplicative of the alternatives considered in detail, or were determined to be components that would cause unnecessary environmental harm.

Therefore, a number of alternatives were considered, but dismissed from detailed consideration for reasons summarized below. See the “Issues” section in Chapter 1 of the FEIS (September 2015) for a more detailed discussion of the alternative-driving issues that were raised during scoping.

Alternatives considered but eliminated from detailed study for the Clear Creek Integrated Restoration Project remain the same as described in the FEIS (September 2015). The FEIS is incorporated by reference and a full description of those alternatives may be found on pages 2-14 through 2-18.

Briefly, alternatives considered but eliminated from detailed study include:

- Old Growth
- Watershed Rehabilitation (Road Decommissioning) Only; No Timber Harvest or Prescribed Burning
- Prescribed Burning-Only Alternative
- No Prescribed Burning
- No Temporary Road Construction/Use Existing Roads Only/Helicopter Logging
- Do Not use Vegetation Response Unit Desired Future Conditions Developed for this Project
- Analyze an Alternative with Opening Sizes 40 Acres or Less

2.4 Comparison of Alternatives

This section provides a summary of the effects of implementing each alternative. The FEIS (September, 2015) includes tables 2-7, 2-8, and 2-9. Information in Table 2-8 is focused on comparison of purpose and need by alternative. This table remains the same and can be reviewed on pages 2-19 through 2-20 of the 2015 FEIS. Table 2-7 compares the alternatives by activity (2015 FEIS pages 2-19 to 2-20). This table has been updated with supplemental information. Changes from the original table in the FEIS are shown in ***bold italics***. As mentioned previously, the Responsible Official may choose (in whole or in part) to apply the modifications made to Alternative C (as described above) to any of the other action alternatives in the decision.

Table 4: Comparison of Alternatives (Alt.) by Activity

Activity	Alt A (No Action)	Alt B (Proposed Action)	Alt C Modified	Alt D	Comments
Regeneration Harvest Acres Within Focus Areas	0	2,609	***3,415***	2,017	
Regeneration Harvest Acres Outside of Focus Areas	0	0	***162***	***162***	Increased by 1 acre due to more precise mapping
Total Regeneration Harvest Acres	0	2,609	***3,577***	2,178	
Commercial Thin Acres Within Focus Areas	0	2,240	***571***	1,997	
Commercial Thin Acres Outside of Focus Areas	0	3,366	***3,366***	3,144	
Total Commercial Thin Acres	0	5,606	***3,937***	5,141	
Precommercial Thin Acres Within Focus Areas	0	904	***902***	998	Less acres due to precommercial thinning units dropped in Lynx Analysis Unit
Precommercial Thin Acres Outside of Focus Areas	0	***892***	***892***	***892***	Increased by 3 acres due to more precise mapping
Total Precommercial Thin Acres	0	***1,796***	***1,794***	1,887	Alt C. Modified: Less acres due to precommercial thinning units dropped in Lynx Analysis Unit; Alt B acres increased by 3 acres due to more precise mapping.
Improvement Harvest Acres	0	331	303	211	
Restoration (Grass)	0	41	41	41	
Prescribed Fire Acres	0	1,371	1,371	1,371	

Activity	Alt A (No Action)	Alt B (Proposed Action)	Alt C Modified	Alt D	Comments
System Road Construction (miles)	0	0	0	0	
System Road Reconstruction (miles)	0	119.8	119.8	119.8	If reconstruction is proposed for any part of a road, the total mileage of the road is included.
System Road Reconditioning (miles)	0	48.8	48.8	48.8	If reconditioning is proposed for any part of a road, the total mileage of the road is included.
Temporary Roads—Existing Template (miles)	0	8.7	8.7	8.7	
Temporary Roads—New Construction (miles)	0	27.6	27.6	8.8	
System Road Decommissioning (miles)	0	13.2	13.2	13.2	
Open Seasonally or Yearlong to Vehicles >50 inches wide (miles)	39.9	39.9	39.9	39.9	From DRAMVU Alt. 5
Open Seasonally or Yearlong to <50-inch motorized vehicles (miles)	26.1	26.1	26.1	26.1	From DRAMVU Alt. 5
Open Seasonally to Motorcycles (miles)	8.2	8.2	8.2	8.2	From DRAMVU Alt. 5
Forest Plan Amendment	0	1	1	1	Soils
Forest Plan Amendment	0	1	1	1	Old Growth
Site Preparation and Reforestation	0	2,609	***3,415***	2,017	Mechanical site prep for ground-based harvest; prescribed fire site prep for skyline harvest.

Table 2-9 (2015 FEIS pages 2-20 through 2-23) compares the alternatives by issue and resource indicators. This table has been updated with supplemental information. Changes from the original table in the 2015 FEIS are shown in ***bold italics***.

Table 5: Comparison of Alternatives by Issue and Resource Indicator

Issue and Resource Indicator	Alt. A	Alt. B	Alt. C Modified	Alt. D
Aquatics/Fisheries Habitat				
RHCA Road Density (HUC5)	1.2 mi/mi^2	1.0 mi/mi^2	1.0 mi/mi^2	1.0 mi/mi^2

Issue and Resource Indicator	Alt. A	Alt. B	Alt. C Modified	Alt. D
– Upper Clear Creek HUC6	1.4 mi/mi^2	1.2 mi/mi^2	1.2 mi/mi^2	1.2 mi/mi^2
– South Fork Clear Creek HUC6	1.0 mi/mi^2	1.0 mi/mi^2	1.0 mi/mi^2	1.0 mi/mi^2
– Lower Clear Creek HUC6	9.3 mi/mi^2	8.9 mi/mi^2	8.9 mi/mi^2	8.9 mi/mi^2
Number of undersized culverts replaced and cross drains added	0	69	69	69
Number of culverts removed	0	8	8	8
FISHSED results for modeled % changes in cobble embeddedness:				
– Hoodoo Creek	***71%***	***76% (+6%)***	***76% (+7%)***	***75% (+5%)***
– Solo Creek	***31%***	***34% (+12%)***	***35% (+13%)***	***34% (+12%)***
– Pine Knob Creek	***44%***	***47% (+6%)***	***47% (+6%)***	***47% (+6%)***
– Clear Creek	***67%***	***70% (+4%)***	***70% (+4%)***	***70% (+4%)***
– Middle Fork Clear Creek	***51%***	***53% (+4%)***	***54% (+5%)***	***53% (+4%)***
– Brown Springs Creek	***30%***	***35% (+15%)***	***35% (+15%)***	***34% (+14%)***
– South Fork Clear Creek	***47%***	***48% (+3%)***	***48% (+3%)***	***48% (+2%)***
– Kay Creek (no data – modeled high)	***50%***	***51% (+2%)***	***51% (+2%)***	***51% (+2%)***
Economics				
Volume Harvested M(MBF)	0	***68.3***	***83.0***	***57.8***
Jobs Sustained	0	***1,502 jobs***	***1,826 jobs***	***1,271 jobs***
Labor Income	0	***$45,556,100***	***$55,361,000***	***$38,552,600***
Goods and Services Value	0	***$262,955,000***	***$319,550,000***	***$222,530,000***
Sale Feasibility (Present Net Value); excess money to the treasury or available for stewardship projects	0	***$5,365,000***	***$6,682,000***	***$3,713,000***
Fuels				
Percentage of Crown Fire Susceptible Landscape	51%	44%	44%	44%
Fire Regime Condition Class	FRCC2 (39%)	FRCC2 (38%)	FRCC2 (37%)	FRCC2 (38%)
Roadless Areas				
Effects to Wilderness Values:				
Natural Integrity	No effect	Beneficial Effect	Beneficial Effect	Beneficial Effect
Undeveloped Characteristics	No effect	Minimal Effect	Minimal Effect	Minimal Effect
Opportunities for Solitude or Primitive Unconfined Recreation	No effect	Temporarily Affected	Temporarily Affected	Temporarily Affected
Special Features and Values	No effect	No Effect	No Effect	No Effect
Manageability	No effect	No Effect	No Effect	No Effect
Soils				
Acres of potential skid trail/landing excavation on landtypes with high subsurface erosion hazard	0	308	308	295

Issue and Resource Indicator	Alt. A	Alt. B	Alt. C Modified	Alt. D
Miles of temporary roads on landtypes with high subsurface erosion hazard	0	30 miles	30 miles	15 miles
Number of commercial harvest units requiring specialized design measures to meet Regional soil standards	0	77	78	75
Vegetation				
Percent Increase in Early Seral Species Forest Cover Type by Eco-setting (Ponderosa Pine/White Pine/Larch)				
Breakland Eco-Setting	0	6	7	4
Upland Eco-Setting	0	5	9	6
Increase in Young (0-40) Age Class by Eco- Setting (Acres based on 2012 existing condition)				
Breakland Eco-Setting	0	1,092	1,329	690
Upland Eco-Setting	0	1,506	2,776	1,471
Percent of FS Lands in Young Age Class	2	6	10	5
Old Growth	4654	4654	4654	4654
Dominant Vertical Structure Pattern Across Landscape	1 and 2 storied	1 and 2 storied	1 and 2 storied	1 and 2 storied
Patch Sizes of the Structural Classes (mean patch size in acres)				
– Seral shrub	179	252	252	252
– Stand initiation	48	96	104	91
– Stem exclusion	115	131	119	128
– Understory reinitiation	62	83	83	83
– Young multi-story	27	26	904	26
– Old single-story	77	116	121	116
– Old multi-story	74	81	72	81
Wildlife				
Wildlife Species' Habitat Effect (acres treated in modeled potential habitat)				
– American Marten	0	1547	1559	1152
– Black-backed Woodpecker	0	276	287	248
– Fisher*	0	2289	3513	1796
– Flammulated Owl	0	8	13	8
– Fringed Myotis*	0	47	47	39
– Long-eared Myotis*	0	1278	1283	877
– Long-legged Myotis*	0	1278	1283	877
– Mountain Quail	0	35	35	35
– Pygmy Nuthatch	0	8	13	8
– Northern Goshawk (Nesting)	0	298	298	290
– Pileated Woodpecker (Nesting)	0	875	875	772

Issue and Resource Indicator	Alt. A	Alt. B	Alt. C Modified	Alt. D
– Ringneck Snake	0	240	240	168
– Western Toad Uplands	0	59	55	63
– Elk Winter Range (acres treated in MA 16)	0	4380	4502	3809
– Elk Summer Range (# of Elk Analysis Areas meeting Forest Plan – Standards)	7	7	7	7
– Elk Security- number of elk analysis areas meeting desired conditions (30%)	6	6	6	6
Canada Lynx				
– Acres of Denning Habitat Treated	0	32	37	20
– Acres of Foraging Habitat Treated	0	66	61	57
Consistent with the Northern Rockies Lynx Management Decision	Yes	Yes	Yes	Yes
North American Wolverine	0	0	0	0
Moose Winter Range (acres treated in MA 21)	0	776	776	630
Watershed				
Percent increase in equivalent clearcut area (ECA)				
– Upper Clear Creek (HUC 12)	***2%***	***15%***	***15%***	***14%***
– South Fork Clear Creek (HUC 12)	***3%***	***9%***	***10%***	***8%***
– Lower Clear Creek (HUC 12)	***6%***	***13%***	***15%***	***12%***
– Clear Creek (HUC 10)	***4%***	***8%***	***9%***	***7%***
Percent Sediment Yield Increased Over Base (Natural) as Modeled By NEZSED (Forest Plan Standard)				
– Pine Knob Creek (45%)	***1%***	***31%***	***31%***	***31%***
– Browns Spring Creek (45%)	***8%***	***50%***	***50%***	***47%***
– Clear Creek (30%)	***4%***	***28%***	***31%***	***28%***
– Solo Creek (45%)	***5%***	***40%***	***45%***	***41%***
– Middle Fork Clear Creek (30%)	***4%***	***25%***	***28%***	***24%***
– Kay Creek (45%)	***5%***	***13%***	***13%***	***11%***
– South Fork Clear Creek (45%)	***3%***	***14%***	***14%***	***12%***
– Hoodoo Creek (60%)	***13%***	***47%***	***53%***	***43%***
Watershed Road Density (mi/mi^2)				
– Pine Knob Creek	4.8	4.3	4.3	4.3
– Browns Spring Creek	4.1	3.2	3.2	3.2
– Clear Creek	2.3	2.3	2.3	2.3
– Solo Creek	3.5	3.1	3.1	3.1
– Middle Fork Clear Creek	2.4	2.2	2.2	2.2
– Kay Creek	2.5	2.4	2.4	2.4
– South Fork Clear Creek	1.6	1.6	1.6	1.6
– Hoodoo Creek	3.8	3.8	3.8	3.8

Issue and Resource Indicator	Alt. A	Alt. B	Alt. C Modified	Alt. D
– Big Cedar Creek	4.6	4.4	4.4	4.4
– Lower Clear Creek Face	1.8	1.8	1.8	1.8

*Acres of commercial thinning and landscape burning are not included in these totals

2.5 Monitoring

The following activities are options being considered for monitoring within the project area. The Responsible Official may choose (in whole or in part) to apply these monitoring alternatives to any action alternative. This section replaces the monitoring section in the 2015 FEIS (pg. 2-24).

2.5.1 PACFISH RHCA Monitoring

This is an ongoing monitoring effort to assess whether or not RHCAs are effective at preventing or minimizing sediment delivery to streams from timber harvest activities. The units are monitored one year after harvested units are burned to capture the time when soils are most exposed and have the greatest potential to erode. The monitoring entails walking the unit boundary and observing and measuring any sediment that may leave the harvest unit and enter the RHCA. Distances are measured as to how far sediment is visible into the RHCA and whether or not it reaches a stream. The selected units have relatively large amounts of buffer length and are near steelhead critical habitat.

Table 6: PACFISH RHCA Monitoring Units

Unit #	Harvest Type	Timber Sale Name (Year of Sale)	Subwatershed
109	Regeneration	Solo (2024)	Clear Creek
214	Commercial Thin	Solo (2024)	Middle Fork Clear Cr
103	Regeneration	Big Cedar (2021)	Clear Creek
160	Regeneration	Pine Knob (2023)	Pine Knob
155	Regeneration	Pine Knob (2023)	Brown Springs/ Clear Cr
315	Commercial Thin	Pine Knob (2023)	Brown Springs
145	Regeneration	Kay (2020)	Kay Cr
141	Regeneration	Clear Corral (2022)	South Fork Clear Cr
142	Regeneration	Clear Corral (2022)	South Fork Clear Cr
218	Regeneration	Lost Mule (2019)	West Fork Clear/Hoodoo Cr

2.5.2 Cross Drain Monitoring

Culvert cross drain culvert monitoring would occur on Forest Roads 650 and 286, the two primary routes used for harvest hauling and access activities. The intent of the monitoring is to demonstrate the effectiveness of the cross drains in directing road related sediment away from live stream crossings. Monitoring would include identification of all cross drains on these two roads, measurement of the width and length of any sediment track leading from the cross drain downhill, and whether or not the sediment track reached a live stream. Where delivery was observed, additional measures would be taken to alleviate the delivery. Initial measurements will be collected in 2018 and 2019 and will be repeated on the segments of road where haul is occurring. Measurements would be taken in late spring/early summer in order to determine if drainage improvements are needed prior to

fall season rains. The sites are not shown on the map as there are over 180 cross drains on Road 286 and over 150 on Road 650.

2.5.3 Channel Cross Section, Turbidity and Temperature Monitoring (Forest Boundary)

One channel cross section would be monitored at the Forest boundary. Monitoring would be conducted to determine if harvest and/or road improvement activities are contributing enough sediment to the stream to cause changes to channel morphology and or degradation of habitat quality for steelhead trout. Other monitoring data collected at these sites would include Wolman pebble counts (stream bed surface substrates), cobble embeddedness, water temperature, and relative fish densities by species. Wolman pebble counts and cobble embeddedness are used to monitor potential changes in substrate composition, particularly sand-sized or smaller fines which can negatively affect the quality of fish spawning and rearing habitat.

Initial cross section measurements were taken in 2015 and again in 2016. The site would be monitored 1, 2, and 5 years after project activities commence. Adjustments could be made to the activities if monitoring shows statistically significant changes in stream channel aggradation/degradation, widening of the channel, or increases in substrate fines. If a large natural flow event were to occur during the monitoring period, or unacceptable channel changes were observed at the monitoring sites, a survey of the streams, logging units and roads would be conducted to determine the location of sediment additions. Adjustments may or may not be required to proposed activities depending on this assessment. Project monitoring will help to ensure that BMPs are sufficient at minimizing adverse effects to ESA-listed species.

2.5.4 Substrate Monitoring Associated with Road Haul

This monitoring would tentatively select up to 4 sites where main haul routes cross on or upstream of steelhead designated critical habitat (Table 2). The objective is to measure changes in cobble embeddedness and substrate composition (particularly fines <6mm) that may be associated with log haul activities. If negative changes are occurring, actions would be taken to assess the entry location and address the haul or road design criteria if necessary. All sampling sites occur in designated critical habitat in a response reach ranging from 3% to 4% stream gradient. Likely roads would include Road 286, 650 and 1114 as they are in or upstream of steelhead designated critical habitat.

Frequency: Once per year in the early summer when hauling occurs on the road. This would allow time for data analysis and resolution of identified problems prior to the fall rains and next hauling season.

2.5.5 GRAIP Inventory of Selected Road Segments

This monitoring would tentatively conduct a detailed inventory of selected road segments that were modeled as potentially producing high amounts of sediment based on WEPP:Road model outputs. The inventory would use the full GRAIP inventory method to assess potential sediment delivery points. These would be compared to proposed road improvement activities to assure the necessary actions are planned to minimize sediment delivery to streams.

Chapter 3. Affected Environment and Environmental Consequences

Introduction

Chapter 3 summarizes the physical, biological, social, and economic environments of the project area and the potential changes to those environments as a result of implementing the proposed alternatives. It also presents the scientific and analytical basis for comparison of each alternative.

The DSEIS incorporates the original FEIS (September 2015) by reference. The following resources are not being carried forward in this DSEIS as the effects analyses have not changed from the original FEIS: Cultural Resources, Noxious Weeds, Rare Plants, Roadless Areas, Soils, Vegetation, and Visuals. For a complete effects analyses of these resources please see the original FEIS, September 2015.

This section also summarizes the potential direct, indirect, and cumulative effects to the Affected Environment as a result of implementing the proposed alternatives. Effects may include ecological, aesthetic, historic, cultural, economic, social, or health. The potential effects may be beneficial or detrimental, and may result from actions possessing both beneficial and detrimental effects, even if on balance the effect would be beneficial (40 CFR 1508.8).

Direct and Indirect Effects

NEPA requires that Federal agencies take a “hard look” at significant environmental effects as a result of implementing a proposed action and any alternatives. The “hard look” requirement has been tempered through the “rule of reason”, which the Supreme Court has characterized as requiring an agency “to furnish only such information as appears to be reasonably necessary under the circumstances for evaluation of the project rather than to be so all-encompassing in scope that the task of preparing it would become either fruitless or well-nigh impossible” [New York Natural Resource Defense Council, Inc. v. Kleppe, 429 U.S. 1307, 1311 (1976), citing Natural Resource Defense Council v. Calloway, 524 F2d 79, 88 (2d Circuit 1975)].

Direct effects are the result of an action and occur at the same time and place. Indirect effects are the result of an action but occur later in time or are further removed in distance, yet are still reasonably foreseeable (40CFR 1508.8). In order for an effect to be considered reasonably foreseeable, it must be “sufficiently likely to occur that a person of ordinary prudence would take it into account in reaching a decision” [Sierra Club v. Marsh, 976 F.2d 763, 767 (1st Circuit 1992)].

Cumulative Effects

In accordance with NEPA and the Council on Environmental Quality (CEQ) guidelines, cumulative effects are to be analyzed as a component of any project undergoing a NEPA analysis. Cumulative effects are incremental effects as a result of implementing an action and consist of any past, present, and reasonably foreseeable future actions on any lands regardless of the agency or person undertaking the action, to include Federal, State, and private. Cumulative effects can be individually minor but collectively significant over a period of time (40 CFR 1508.7). An individual action when considered alone may not have a significant effect, but when

its effects are considered in sum with the effects of other actions, the effects may be significant. The time and spatial area for the analysis of cumulative effects is resource dependent.

Cumulative effects were assessed for this project in terms of how the alternatives would add to the past, present, and reasonably foreseeable future activities. Existing conditions described under each resource section reflect the cumulative effects of past and present activities that have occurred in this area. Each resource section identifies specific past, present, and reasonably foreseeable future actions with a discernible effect on a particular resource as reflected in the existing condition.

3.1 Aquatics

This report provides a variety of new information not displayed in the 2015 FEIS. New baseline aquatic habitat and species information was collected on anadromous fish streams in 2015 and 2016 and summarized here. This additional data resulted in the determination that South Fork and Hoodoo Creek prescription watersheds do not meet their Forest Plan water quality objectives and therefore require an upward trend analysis. Changes to the effects analyses including FISHSED model updates and upward trend for South Fork and Hoodoo are included. Only updated information is presented below.

Additional information is disclosed about geology in the project area and NEZSED modelled cumulative sediment generated by roads. For the DSEIS, NEZSED road sediment data was partitioned by prescription watersheds to see which roads were modeled to produce the most sediment. Those results were used in conjunction with additional WEPP Batch Road analysis. Different than NEZSED, the WEPP Data models specific road segments with multiple attributes to predict which road segments are more likely to produce sediment that could be routed to stream systems. Results of the two models were compared and then investigated in the field in August 2018 to assess model predictions on those segments that were expected to produce the most sediment (Roads 286, 1114, 1855, 1106, and 650). Combined modeled and field review data were used to confirm sediment producing road segments already have treatments planned to ensure that sediment resulting from road use would be minimized. Primarily updated information is presented below.

3.1.1 Analysis Area

The project area is about 43,700 acres and encompasses the upper two-thirds of the Clear Creek drainage and all of its tributaries. Clear Creek flows into the Middle Fork Clearwater River. This same area is considered the analysis area and was selected because it includes all Forest Service–managed lands—and all the streams therein—that could be affected by project activities.

3.1.2 Regulatory Framework

There are no changes to the regulatory framework from the 2015 FEIS. Please refer to the 2015 FEIS pgs. 3-1 through 3-2 for a discussion of the framework.

3.1.3 Analysis Method

3.1.3.1 Stream and Habitat Surveys

The 2015 FEIS (pgs. 3-2 through 3-3) discusses in detail the methodology used to assess existing conditions in the project area. Additional stream channel, habitat and fish density information

was collected on 27 miles of Forest Service and 4 miles of private streams by Stillwater Sciences in 2015. These surveys updated the baseline for the mainstem of Clear Creek, and portions of the West, South, and Middle Forks of Clear Creek as well as Lost Mule, Pine Knob and Brown Springs Creek. They also established two monitoring sites on the West Fork of Clear Creek and the lower mainstem of Clear Creek at the Forest boundary. The two sites were revisited in 2016 and a report discussing the changes between years was prepared (Stillwater Sciences, 2016). Both reports are available in the project file.

Additional road surveys were conducted along two main haul routes (Road 286 and 650) in 2016 in order to locate cross drain culverts in relation to existing stream crossings. Most of the culverts were replaced or added in 2015. Additional drainage work continues under the 2013 Road 286 and Road 650 Reconstruction projects.

3.1.3.2 FISHSED Modeling

The Forest Plan requires the use of the NEZSED and FISHSED models when assessing potential effects to sediment in streams at the Forest Plan prescription watershed level. The 2015 FEIS (p. 3-3) provides an overview and the limitations associated with these models. As disclosed in the model documentation (Stowell 1983), the model outputs are reasonable estimates and not absolute numbers of high statistical precision. Results obtained are to be used in combination with sound biological judgment. The models, therefore, are only useful for comparing alternatives and are not designed to predict actual changes in cobble embeddedness (Conroy and Thompson 2011). Updated FISHSED calculations for the resurveyed streams are summarized in the effects section.

3.1.4 Resource Indicators

The resource indicators and the reasons for their use are discussed in detail in the FEIS (pgs. 3-3 through 3-4). They are:

- RHCA road density
- Number of undersized culverts replaced and cross drains added
- FISHSED results for modeled changes in cobble embeddedness

3.1.5 Affected Environment

3.1.5.1 Aquatic Habitats

Like many watersheds in central Idaho, the Clear Creek watershed has steep valleys with portions of the watershed underlain by the Idaho batholith. Other portions of the middle and upper watershed consist of older and harder belt metasediments that do not erode as easily as granitics. Finally, the lower watershed is overlain by geologically newer basalt flows, the hardest of the 3 rock types (Geology Map, project file).

Stream substrates through the drainage vary from sand in the low gradient channels to boulders, rubble and gravel in the remaining channels. Many low gradient channels have relatively high percentages of fines which may be a combination of batholith geologies (35% of the watershed) and past management activities, mostly roads. Granitic geologies tend to have naturally higher amounts of sand and roads contribute fines through surface erosion. The fine substrates typically settle out in lower gradient stream channels and can embed cobbles and gravels and reduce

habitat quality for fish. The majority of fish spawning habitat occurs in low gradient stream reaches. The highest quality and quantity of salmon and steelhead spawning substrate was observed in the South Fork Clear Creek above the barrier that was removed in 1990. Lower quality habitat was noted below the barrier and in the mainstem of Clear Creek. Overhead cover and wood was noted as limited in the South Fork, lower Middle Fork, and mainstems of Clear Creek. We hypothesize wood and sediment conditions in the lower elevation portions of these prescription watersheds are mostly naturally occurring levels and are an outcome of past wildfires and geology. Similar conditions have been noted in stream reaches that have not been influenced by management as well as in stream reaches that have been (Stillwater, 2015).

Stream surveys conducted on private lands in lower Clear Creek indicated high levels of sediment and higher-than-preferred stream temperatures (NPT 1987). Sediment levels and temperatures were lower on NFS lands (NPT 1984). Recent surveys (2015) showed lower cobble embeddedness levels on the surveyed private lands compared to NFS lands; however the data between the two surveys is not comparable as the same survey method protocols were not used. Temperatures remain higher on private lands due to the natural warming that occurs from the headwaters toward the mouth of a drainage as well as less canopy cover over the mainstem stream (Stillwater Sciences, 2015). Shallow water depths and lack of pool habitat were noted as issues affecting fish production in the middle and upper reaches of Clear Creek. Surveys conducted in 1993 and 2015 also noted the same sediment, wood, and pool limitations. The low number of pools is directly related to low wood levels. This is because wood is the primary creator of pool habitats in these stream types. Low wood levels are mostly a result of a large wildfire that burned the area in 1931. Stream bank stability was noted as good to excellent throughout the drainage due to the presence of dense streamside vegetation and large substrate (cobble, rubble, boulders) which armor the banks against the erosive power of the streams. Bank stability remained in good to excellent condition based on 2010-2012 field observations and 2015 habitat surveys.

Stream Temperatures

General information on stream temperature including what processes affect it and the conditions on private lands related to it can be found in the 2015 FEIS, pgs. 3-5 through 3-8.

Water temperature is an important factor in the successful reproduction of fish and other aquatic organisms. Some species prefer very cold temperatures and others more moderate temperatures. Streamside riparian vegetation provides the greatest protection against changes in water temperature primarily through shading (Sugden et al 2012; Sridhar et al, 2004; Lee, et al 2004; Ott et al 2005; FEMAT, 1993). Water temperature criteria designed to maintain cooler temperatures is provided through both the state of Idaho as well as federal regulations.

Optimal stream temperatures for juvenile chinook salmon and steelhead trout rearing is 14–19 °C (US EPA 2003). Lethal temperatures for juveniles occur if they constantly exceed 21–23 °C for 1 week or longer. Optimal stream temperatures for juvenile bull trout rearing is 9-14°C (IDEQ, 2003; Rieman et al, 2007) which is considerably colder than for other salmonids.

Stream temperatures were monitored throughout Clear Creek and its tributaries between 1991 and 2016. The year and number of times monitored varied by stream (Table 7). The warmest years on record varied by stream as a result of local and annual weather patterns.

Streams on Forest Service managed lands stayed below or at 19 °C maximum temperatures for all sites in all measured years with the exception of Clear Creek at the Forest boundary in 2015 (Table 7). All streams measured had maximum stream temperatures that were within the optimal range for salmon and steelhead juvenile rearing as noted by EPA. No streams exceeded lethal temperatures for juveniles. Streams rarely met optimal requirements for juvenile bull trout rearing during the summer months. IDEQ (2014) reported no water quality limited streams within the drainage.

Table 7: Maximum Stream Temperatures Measured Throughout the Clear Creek Drainage on Forest Service Managed Lands

Stream	Maximum Temperature Range (°C)	Number of Years Monitored Between 1991 and 2016	Warmest Year Recorded
Clear Creek at FS Boundary	15–20	1991, 1993, 2006, 2015, 2016	2015
Clear Creek at Pine Knob	15–19	1995, 2011, 2015	2015
Hoodoo Creek	15–17	1991, 1992, 1995-1998-2001, 2011	1998
WF Clear Creek	15–18	1991, 2011, 2012, 2015, 2016	2015
SF Clear Creek at mouth	19	1991	1991
SF Clear Creek above Kay	14–19	1991-1994, 1996-1998, 2001	1992
Kay Creek	15–17	1991, 1992, 1994, 1997-1999	1998
MF Clear Creek above Solo Creek	14–17	1994, 1995, 2011, 2015	1994
Solo Creek	14–17	2011, 2012	2011
Pine Knob Creek	16–17	2011, 2015	2015
Browns Spring Creek	16-17	2011, 2015	2012

Stream temperatures are likely to increase as a result of climate change which in turn may affect native fish distribution. Issak et al (2016). NorWeST temperature data shows historic temperatures in the mainstem of Clear Creek from 14-16 °C above Big Cedar Creek and 12-14°C in lower West, South, and Middle Forks. Climate change modeling to 2040 based on this data shows a 1-2 degree increase from in the mainstem from Big Cedar to just above the South Fork. The same increase is shown in the lower portions of its tributaries. By 2080, the model indicates another two degree rise in all streams. Modeled temperature at the Forest boundary is 17°C in 2080 and all tributaries above it range from 12 to 16°C.The higher the elevation of the stream, the cooler the temperature. While stream temperatures are expected to warm under climate change, modeled temperatures remain within optimum ranges for steelhead and salmon rearing on Forest managed lands in this project area out to 2080. The Clear Creek Watershed will become increasingly important as a refugia for listed steelhead in future decades.

Aquatic Species

A discussion of the fish species found in the project area, including ESA listed and Region 1 sensitive species, can be found in the 2015 FEIS, pgs. 3-8 through 3-10. Additional surveys were conducted by Stillwater Sciences in 2015 with the resulting information described below. The number of miles of fish bearing streams did not change as a result of the surveys. There are 65

miles of fish bearing and about 185 miles of non-fish bearing streams on Forest managed lands in Clear Creek. The surveys updated the amount of current fish use by prescription watershed.

Adult Chinook salmon were found in the mainstem of Clear Creek to just above its confluence with the Middle Fork of Clear Creek. Juveniles were found 1 mile below the confluence. Densities on Forest lands were highest near the boundary (28 fish /100m) and lowest near Middle Fork Clear Creek (11/100m). Both adults and juveniles were found in the lower 1.5 miles of South Fork Clear Creek in low densities (7 and 2 fish /100m, respectively). A few juveniles were observed in the very lowest reaches of West Fork Clear Creek. Overall, the highest densities (185 fish /100m) were found on private lands. This is likely a result of low stream gradient and large stream size, a requirement for this large bodied species. The area was also characterized by large amounts of suitable spawning substrate, low cobble embeddedness, and the presence of side channels which are important for juvenile.

Coho salmon juveniles were only observed below the Forest boundary in relatively high densities (range 53 to 250 fish/100m), indicating successful spawning in the mainstem.

Steelhead/rainbow trout were the most widely distributed species in Clear Creek and were found in most major tributaries. The highest densities were observed throughout the length of the mainstem of Clear Creek to just above Browns Creek (200 fish/100m). Lower densities were observed in Pine Knob, South Fork Clear, Middle Fork and Brown Springs Creeks (120, 110, 80, and 70 fish/100m, respectively). Densities in Hoodoo and the upper reaches of Clear Creek were lower (40 and 20 fish/100m, respectively) likely as a result of smaller stream size combined with steeper stream gradients.

Westslope cutthroat trout were found in the upper reaches of most tributaries and were patchily distributed in very low densities in the Clear Creek mainstem below Brown Springs. They were not found in the mainstem below Middle Fork Clear Creek. This observation is consistent with those in other streams on the Forest where cutthroat rarely overlap with salmon distribution and only have minor overlaps with steelhead. This is because cutthroat are smaller sized fish, require smaller sized spawning substrate and therefore can utilize smaller streams than the larger anadromous species. Densities of cutthroat were highest in Brown Springs and upper Clear Creek (100 and 60 fish/100m, respectively) and lowest in the West Fork (10 fish/100m). None were observed in the South Fork, Pine Knob or on private lands.

The Stillwater Report also noted extensive western pearlshell beds on private lands and on Forest lands on the mainstem downstream of South Fork Clear Creek.

3.1.5.2 Water Quality Objectives and the Forest Plan

The Forest Plan contains water quality objectives for streams in the project area (USDA Forest Service 1987a, Appendix A). These objectives are assessed using the DFC Analysis developed by Espinosa (1992) and are based on cobble embeddedness levels as directed by the Forest Plan Appendix A Guidance document (USDA 2011). Specifically, the guidance document states the following:

"Of the basinwide stream survey data collected over the years, the habitat components that appear to be the most repeatable and most reliably differentiate between reference and managed watersheds are measures or estimates of substrate condition, including cobble embeddedness and percent surface fines. In addition, fish/water quality objectives in Appendix A were originally established based on substrate sediment only (Stowell 1986).

…The portion of the DFC analysis that provides objectives for cobble embeddedness and percent fines by depth would be retained. Collection of measured substrate data, combined with existing legacy data and current PIBO data, where available, would be used to describe the existing condition. Substrate data would be the primary determinant in assessing whether Appendix A fish/water quality objectives are met."

Appendix A states that an upward trend (improvement) is required for streams that do not currently meet the water quality objectives. Timber management can occur in watersheds not currently meeting their water quality objectives concurrent with improvement efforts as long as a positive, upward trend in habitat carrying capacity is indicated. The Forest Plan provides no timeframe for when objectives must be met.

Cobble embeddedness (CE) is one measurement considered in the upward trend analysis. High cobble embeddedness can smother salmonid eggs and can reduce hiding space for young trout and salmon. Embeddedness can also reduce aquatic insect production which provides food for fish. The long-term trend in embedded cobbles is difficult to ascertain as they are based on weather events large enough to mobilize embedded stream materials, how cobbles interact with the sand that embeds them, and how the streambed interacts with streamflow and stream channel characteristics (Wohl et al, 2015).

In addition to challenges predicting when embedded streambeds mobilize and reorganize to more beneficial conditions, the measurement itself has some challenges. Peer reviewed literature since this methodology was created in the 1980's has identified some limitations. Sylte and Fishenich (2002) reviewed available embeddedness methods and found that not only were there slight differences in descriptions of how to complete data collection, but also that these differences could lead to differences in results. In some instances where embeddedness actually increases over time, one study reported lower values of embeddedness than were actually occurring because substrates accounted for in earlier measurements were completely buried and no longer accounted for. A comprehensive study by McHugh and Budy (2005) also highlights differences in results that correspond to probable methodology inconsistencies and the need for additional quantitative evaluation of methodology. Observer variability can also result in measurement differences (Roper et. al. 2002). Slight changes in location of the measurement could also provide different results, as could stochastic events. While the results can be variable, the embeddedness measures were instrumental in identifying the sediment being generated and deposited in streams by aggressive road building and harvest when they were first used in the 1980s.

Considering the requirement to use CE measures and the challenges with using them to predict improving stream conditions, Wolman pebble counts have also been collected to help describe surface bedload conditions. All subwatersheds, with the exception of Middle Fork Clear Creek, had lower percent of fines than the 22% "good" benchmark in Oregon for the Columbia Plateau, Northern Basin Range, and Snake River Plains (Stillwater, 2015). However, at some stream sites, embeddedness conditions are still considered unfavorable for salmon and trout and appear to be recovering slowly or not at all. At the same time, many roads in sediment generating locations have either been obliterated, stored, or reconstructed to reduce the sediment they can produce. Since the late 1990's, harvest units leave trees and undisturbed ground cover next to all identifiable streams, and roads are not built along stream-courses. These changes are expected to reduce management related sediment and protect riparian and aquatic habitat function over the long term.

The 2015 FEIS showed that Brown Springs, Solo, Hoodoo, Kay, and South Fork Clear Creek prescription watersheds met their objectives. More recent data collected by Stillwater Sciences shows that Pine Knob now meets its objective (Table 8). Hoodoo (West Fork) and South Fork now do not meet their objectives. The Hoodoo data is likely a result of different sampling locations in 2012 and 2015/2016. No new data was collected for Solo and Kay therefore they remain the same as shown in the 2015 FEIS (they meet Forest Plan objectives).

Table 8: Updated Water Quality Objectives for Prescription Watersheds in the Clear Creek Project Area

Forest Plan Prescription Watershed	Forest Plan Water Quality Objective	Fishery Habitat Potential 1987	Percent Cobble Embeddedness (year)[a]	Fishery Habitat Potential[b]	Water Quality Objective Met?
Pine Knob Creek	80%	50%	30% (2015) 44% (2012)	82%	Yes
Browns Spring Creek	80%	50%	30% (2015) 30% (2012)	82%	Yes
Clear Creek	90%	50%	67% (2016) 38% (2012)	40%	No
Middle Fork Clear Creek	90%	50%	32% (2015) 51% (2014) 55% (1993)	81%	No
South Fork Clear Creek	80%	50%	47% (2014)	65%	No
Hoodoo (West Fork) Creek	70%	50%	71% (2016)	37%	No

A comparison of recent data shows that Pine Knob and Brown Springs are meeting and Middle Fork Clear Creek is close to meeting their objectives. Steelhead trout density data indicates Pine Knob has higher steelhead densities than Brown Springs or Middle Fork but all three streams have lower densities when compared to the mainstem of Clear Creek. The mainstem has the highest densities yet is far from meeting its objective based on embeddedness alone. The difference may be explained by the tributaries' smaller stream sizes and higher gradients which result in lesser amounts of suitable spawning and rearing habitat when compared with the mainstem. The South Fork and Hoodoo do not meet their objectives based on embeddedness. Steelhead densities in the South Fork are similar to Pine Knob (105 fish/100m) and are lowest in Hoodoo (40/100m), the lowest of all watersheds surveyed. This is likely due in part to small stream size, higher gradients and complete upstream migration barriers in the drainage. In general, cobble embeddedness may only be a partial limiting factor for steelhead trout in project area streams. Stream size, granitic geologies that typically have a higher component of fine particles and erosion rates, habitat availability and access also play a role.

Although the four prescription watersheds do not meet their Forest Plan water quality objectives, IDEQ (2014) has determined that they do meet their beneficial uses as discussed in the 2015 FEIS, pg.3-11. It is worth noting that even streams in roadless and wilderness areas often do not meet their DFCs (IDEQ 1999; various stream habitat surveys from the Clearwater NF) due to natural processes and the fact that streams systems are not static.

3.1.5.3 Management Activities Affecting Streams

PACFISH was designed to halt degradation and begin recovery of streams where listed fish species occur in the Columbia River drainage. It accomplishes this through streamside RHCA retention and other guidance for management activities within RHCAs. RHCA widths are 300 feet on each side of a fish-bearing stream, 150 feet on perennial non-fish-bearing streams, and 100 feet on intermittent stream channels. A minimum of 10,700 acres (24%) of the analysis area are within PACFISH buffers.

Timber Harvest

About 22% of Forest lands had regeneration harvest and all but 15 miles (8%) of non-fish bearing and/or intermittent streams adjacent to harvest units were buffered. All fish bearing streams were buffered. As a result of minimal harvest and buffering, fifty-seven percent of forested stands within RHCAs are older than 100 years, 34% are 40-100 years old and the remaining 9% are less than 40 years. (Figure 3-1, FEIS p. 3-13). Successional stage information combined with field reviews of the streams from 2010-2012 indicates that RHCAs are well vegetated and only minimally affected by timber harvest activities.

Stream temperature increases as a result of current timber harvest practices on federal lands are not expected. Several studies have shown that stream temperatures are protected by retaining buffers of <150' (Sweeney and Newbold, 2014; NCASI, 2000; Anderson and Poage, 2014; Ott et al 2005; Lee et al 2004; Sridhar 2004; FEMAT 1993). Buffers have been retained for over 50 years and 94% of streamside areas were not harvested, therefore management activities have not likely influenced stream temperatures. All fish bearing streams were buffered.

Several studies also found that buffers of this width are sufficient at minimizing or eliminating sediment delivery to streams from timber harvest (Hatten et al, 2018; Cristan et al, 2016; Sweeney and Newbold, 2014).

Roads

Roads near streams are the primary land management–related activity that may affect stream conditions in the project area as described in detail in the 2015 FEIS, pgs. 3-12 through 3-15. Roads within riparian zones confine channels which can affect sediment, wood and stream flow movement. Undersized culverts can plug with material and fail during high flow events leading to unwanted sediment pulses in streams. Riparian roads can reduce stream shading and disrupt large woody material recruitment through tree removal. Ditchlines that drain roads can direct flow and road surface sediment into perennial streams at crossings. These can be a chronic (ongoing) source of sediment and can increase water yield in streams. These conditions currently exist on many project area roads.

Management and road building in the Clear Creek watershed, especially from the late 1950's to the 1980's likely delivered substantial amounts of sediment that may still moving through lower gradient stream reaches to this day (Espinosa, 1997; Stillwater 2015). Shortly before the Espinosa article was published, the PACFISH decision of 1995 halted much of the aggressive harvest and road building on projects that could affect anadromous fish. While some harvest has continued since that time, RHCA's implemented under that decision stopped harvest next to streams unless it could be proven it was needed to improve riparian function. While it could be considered appropriate in some locations today (Reeves et al, 2016), harvest has not been conducted in project area RHCA's since PACFISH was implemented. Also since the Espinosa (1997) article was published, the US Forest Service passed a temporary road building

moratorium (2000-2001), the Roadless Rule (2001), the Idaho Roadless Rule (2008), and the Access and Travel Management Rule (2005). Combined, these rule makings greatly restricted permanent road building and have led to management that has removed unneeded and potentially harmful road segments. A total of 10 miles of system and 73 miles of non-system roads have been decommissioned in the project area since 2012 and another 65 miles of non-system roads are NEPA cleared for decommissioning. Sediment reduction and maintenance have been the focus of treatments on the remaining roads needed for access. There have been 9 live water culvert replacements and 17.8 miles of road reconstruction including replacement of at least 38 cross drain culvert replacements since 2010. The project has identified additional road segments for treatment that are likely to cause sedimentation.

No new information regarding roads has been collected since the 2015 FEIS with the exception of a 2016 cross drain location survey on the project areas' two main log haul routes. It was conducted in order to assess the Road 650 and Road 286 cross drain culvert projects that were implemented 2014 and 2015. All cross drains were observed and an assessment was conducted to determine if additional cross drains were needed to improve drainage near streams. A total of 152 drains were inventoried on Road 650 and 187 drains on Road 286. A total of only 8 sites were located where additional cross drains are needed on these roads. These would be installed prior to project log haul activities.

3.1.5.4 Upward Trend Determination

Appendix A of the Forest Plan states that where streams do not meet their water quality objectives, timber management can occur concurrent with improvement efforts as long as a positive, upward trend in habitat carrying capacity is indicated. The 2015 FEIS, pgs. 3-16 through 3-23 describes the upward trend analysis process and provides the summarized upward trend discussions for the mainstem and Middle Fork Clear Creek prescription watersheds. A more complete upward trend for these streams is provided in Appendix J of the 2015 FEIS.

The following provides the summarized upward trend analyses for the South Fork Clear and Hooodoo prescription watersheds. The more complete analyses can be found in Appendix J of this DSEIS.

3.1.5.4.1 South Fork Clear Creek Prescription Watershed

The 12,940 acre South Fork Clear Creek Forest Plan prescription watershed does not meet its water quality objective of 80% for fishery habitat potential. Cobble embeddedness was measured at 47% in 2014. When assessed against the DFCs (USDA 1992), the watershed currently is at 65% of habitat potential. It was at 50% of its habitat potential when the Forest Plan was written in 1987. **This is considered an upward trend based on fishery habitat potential.**

There are about 12 miles of fish-bearing and a minimum of 20 miles of non-fish bearing streams in South Fork Clear Creek. Chinook adults and juveniles were found in the lower 1.5 miles (Stillwater Sciences, 2015) in low densities (1.6 and 7 fish /100m, respectively). Steelhead/rainbow were found in the lower 6 miles (220 fish/100m) and cutthroat were not observed; however, they have been documented in past surveys and are likely to occur in the upper half of the drainage.

Surveys in 2015 estimated the amount of anadromous and resident fish spawning habitat in the lower 5 miles of South Fork Clear Creek. Anadromous habitat was rated good to fair in quality but limited in quantity compared to the lower mainstem of Clear Creek (75m2/km vs. 580

m2/km). Resident spawning habitat was also rated as good to fair with roughly 25m^2/km in the surveyed reaches. Spawning is limited both as a result of dominant substrates that are too large for spawning (>6" diameter) and high cobble embeddedness which may be due in part to batholith geologies. About a third of the watershed is underlain by these more erosive geologies. Although the amount of spawning habitat for both anadromous and resident fish is limited, fish densities indicate the availability of suitable spawning habitat. The larger dominant substrates provide for an abundance of rearing habitat as the surveyed reaches are higher gradient channels where there is less likelihood of sediment filling the interstitial spaces between the rocks.

Stream temperatures were measured at the mouth of South Fork Creek in 1991. Daily average temperatures were 13°C, or High (<14°C) for steelhead spawning and Low (>17.8°C) for summer steelhead rearing (18°C) based the NOAA Matrix table. Wildfires in 1870 and 1931 burned 7,085 acres and consumed most of the streamside vegetation which has created RHCAs currently dominated by trees that are about 80 years old. It is possible that they have not yet reached their full stream shading and cooling potential.

Stream temperatures were also measured where the South Fork meets Kay Creek for 9 years (1991-1998, 2001). Stream temperature conditions based on 2001 data showed NOAA Matrix ratings as Moderate (14-15.5°C) for steelhead spawning and High (<14°C) for rearing (14.3°C and 12.5°C respectively). They were Moderate)<15°C) for bull trout rearing (12.5°C) and Low (>10°C) for bull trout spawning/incubation (10.1°C). Stream temperatures in South Fork Creek appear to be adequate for chinook, steelhead and cutthroat production and low for bull trout.

Riffle and pool habitats made up 70% and 30% of stream habitats in 2015, respectively. Shallow water depths and lack of pool habitat were noted in the surveys. The low numbers are directly related to low wood levels (9 pieces/100m). Wood is the primary creator of pool habitats in this stream type. Low wood levels are naturally occurring as there has been no harvest adjacent to the surveyed streams. All lay within the Clear Creek Roadless Area. The low wood levels are due to the wildfires in 1870 and 1931 which consumed most of the riparian vegetation. Trees have reestablished themselves and are now about 80 years old. Timber harvest in the upper South Fork upstream from the surveyed reaches mostly retained streamside buffers. The presence of forested stands along all streams provides for both short and long term upward trends in water depths and pool habitat.

Stream bank stability was noted as good to excellent in both the1988 and 2015 surveys. This is due to the presence of dense streamside vegetation in combination with large substrate (cobble, rubble, boulders) which armors the banks against the erosive power of the stream. This trend has been maintained over time and would continue.

Stream substrate composition in South Fork Clear Creek in 2015 was dominated by boulders and rubble (68%), followed by gravel (18%), sand (12%) and bedrock (3%). Surveys in 1988 showed dominance by large rubble, boulders, and bedrock. Cobble embeddedness was 47% in 2016 and 51% in 1988 indicating a likely positive upward trend. Because the same sampling protocols were not used, the data is not directly comparable; however given the low road densities and no evidence of recent landslides, the assumption of an upward trend is reasonable. A review of roads between 2010 and 2012 found no major sediment issues associated with roads that might affect fine sediment levels in the drainage.

Regeneration timber harvest activities have occurred on 13% of the watershed between the 1930's and 1990's. No regeneration harvest has occurred since then. ECA is currently at 1% as a

result of minimal harvest. Streamside buffers of 100'+ were retained on all but 3.3 miles of non-fish bearing or intermittent streams. Forested stands within RHCAs are aged as follows: 5% are < 40 years old, 54% are between 40 and 100 years and the remaining 41% older than 100 years. The RHCAs are considered fully functional given the age classes and minimal disturbance within them. As a result, they are trending in an upward condition and would continue to provide for shade, wood, and bank stability in the South Fork of Clear Creek.

There are almost 32 miles of Forest system roads within the watershed with less than 4 miles occurring within RHCAs. The overall watershed road density is 1.6 mi/mi2 and the RHCA road density is 1 mi/mi2. A total of 1.5 miles of the RHCA roads are opened to motorized traffic and the remaining are closed. About 20 miles are gravel surfaced and many of the remainder were topped with grasses/mosses and had small trees growing along their margins. There were no obvious signs of road surface erosion (no rilling or gullying) during culvert inventories from 2010 to 2012. A total of 2 miles of system road and 26 miles of non-system road have been decommissioned since 2012. This is a 6% reduction in system road densities. Road treatments included abandonment near ridgetops to full recontouring on midslope roads or roads with stream crossings. Roads with stream crossings were recountoured and roads without them were either recontoured or abandoned depending on their location. Decommissioning results in short term sediment increases at stream crossing removal sites but removes the risk of future crossing failure. Decommissioning is expected to contribute to the long term reduction of sediment delivery to streams.

There are 45 stream crossings within the watershed with none occurring on fish bearing streams. Nineteen of the crossings were identified as needing cross drain additions and 13 need to be replaced as they are undersized. Ditchlines in the drainage were well vegetated which help to filter out sediment to streams. There are no human caused barriers to upstream aquatic organism migration in the watershed.

In summary, Forest Plan Appendix A Guidance (USDA, 2011) states that "…*In previously degraded watersheds, especially those identified as below objective in 1987, if there have been no entries or natural disturbances over the past 10 to 20 years, it could be assumed that trend is either static or improving.*" It also states that "*It was assumed in the Forest Plan that implementation of instream restoration and other watershed restoration activities would result in an upward trend in carrying capacity. Where these activities have been implemented, it could be stated that an upward trend in the habitat conditions has been accomplished*". **It has been 22 years since any timber harvest has occurred in the drainage. When combined with well vegetated riparian areas, relatively few stream crossings, past road decommissioning projects, mostly closed roads and no obvious sources of sediment, an upward trend in fish habitat capacity is indicated in the South Fork Clear Creek.**

3.1.5.4.2 Hoodoo (West Fork Clear) Creek Prescription Watershed

The 6,450 acre Hoodoo Creek Forest Plan prescription watershed, which includes West Fork Clear Creek, does not meet its water quality objective of 70% for fishery habitat potential. Cobble embeddedness was measured at 71% in 2016. When assessed against the DFCs (USDA, 1992), the watershed currently is at 37% of habitat potential. Sediment is likely one of the contributing limiting factors for fish production in this prescription watershed. However, as discussed in the Appendix A Guidance and 2015 FEIS, upward trend is not determined by cobble embeddedness alone (USDA, 2011).

There are about 5 miles of fish-bearing and 20 miles of non-fish bearing streams in the drainage. Fish densities are low due to steeper gradients and larger than preferred spawning substrate. No Chinook salmon were observed in 2015; however 4 juveniles /100m were observed in 2016. Steelhead/rainbow were the most common species found and numbers observed were low at 40 fish/100m, respectively. Westslope cutthroat trout were observed in low densities in 2015 (17 fish/100m).

Surveys in 2015 estimated the amount of anadromous and resident fish spawning habitat in West Fork Clear Creek. Anadromous habitat was rated as fair in quality and low in quantity ($25m^2$/km). Resident spawning habitat was rated as good to fair with only $13m^2$/km in the surveyed reaches. The amount of spawning habitat for both anadromous and resident fish is likely to remain limited. This is due to steeper stream gradients which limits spawning habitat availability, the dominant substrate size which is too large for spawning, and high cobble embeddedness in the few low gradient reaches. High sediment and embeddedness levels may be due in part to the underlying batholith geology which underlies 69% of the watershed.

Stream temperatures were measured in West Fork Clear Creek in various years (1991, 1992, 2011, 2012, 2015, and 2016). Stream temperature conditions based on NOAA matrix ratings were moderate for steelhead spawning and rearing (15°C and 17°C, respectively). Temperatures were low for bull trout spawning and moderate for bull trout rearing (14°C and 15°C, respectively). Summer water temperatures are considered to be warmer than preferred for bull trout.

Stream bank stability was noted as good to excellent in both the 2015 and 1988 surveys as well as during field reviews between 2010 and 2012. This is due to the presence of dense streamside vegetation in combination with large substrate (cobble, rubble, boulders) which armors the banks against the erosive power of the stream.

Stream substrate composition in West Fork Clear Creek in 2015 was composed of 22% fine material (sand/silt <6mm), 26% gravel and 52% large material (rubble to boulders). Cobble embeddedness, which cannot be directly correlated to the percent of fine substrates, was 71% in 2016 and 33% in 2012 (FEIS, pg. 3-11). The data between the two years, however, is not comparable as 2016 sampling occurred near the mouth of the stream and 2012 sampling occurred 1.8 miles upstream near the confluence of Hoodoo and West Fork Clear Creeks.

Instream sediment in the Hoodoo prescription watershed is likely associated with roads. Two road related slides on Road 650 were observed between 2011 and 2017. Repairs were conducted on the slide closest to the Forest boundary in 2012 and repairs are planned for the upper slide in 2018. Both slides delivered unknown quantities of sediment to the stream. While it would be desirable to remove these segments of road from an aquatics perspective, travel management considerations identified the road as essential for providing for management and public access. Overall, sediment levels are very high in the watershed based on limited sampling. However as noted by Sylte and Fischenich (2002), cobble embeddedness exhibits high spatial and temporal variability in both natural and disturbed streams. Sampling must be intensive within streams or stream reaches to detect changes. Intensive sampling has not occurred and surveys were not conducted in the same location between years. Determining a trend for embeddedness is therefore not possible given the lack of available data. Additionally, extensive road decommissioning, has been implemented since 2012 and may also be contributing, in part, to higher levels in the short term.

Riffle and pool habitats made up 65% and 35% of stream habitats in 2015, respectively. While the overall percent of pools was somewhat low, the frequency of those pools were the highest noted in the surveyed watersheds. This is due to relatively high frequencies of large wood present in the stream and the well forested stands along its length.

Regeneration timber harvest activities have occurred on 34% of the watershed between the 1950s and 1996. No harvest has occurred since then. Streamside buffers of 50'or larger were retained on all but 4 miles (13%) of non-fish bearing or intermittent streams beginning in the 1970s. Harvest retained buffers of 100-400' on all fish bearing streams. ECA is currently at 4%, or a high condition. Forested stands within RHCAs are aged as follows: 10% are < 40 years old, 50% are between 40 and 100 years and the remaining 40% older than 100 years. The middle age classes are partly a result of a wildfire which occurred in 1931. The fire burned 27% of the drainage and 43% of the RHCAs. The RHCAs would therefore be considered mostly functional given the large percentage of older age classes and minimal human related disturbance within them. As a result, they are trending in an upward condition and would continue to provide for shade, wood, and stable banks in the West Fork Clear Creek drainage.

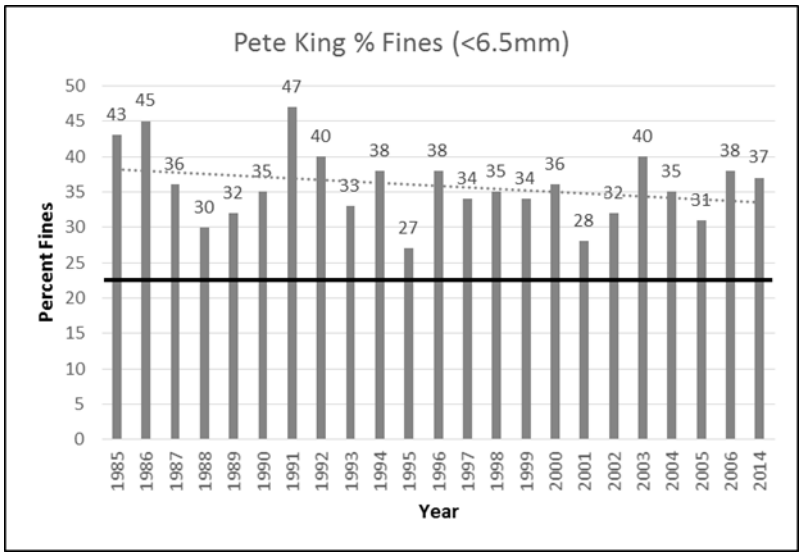
There are 32 miles of Forest system roads within the watershed with 5 miles occurring within RHCAs. A total of 2 miles of the RHCA roads are opened to motorized traffic and the remaining roads are closed. The overall watershed road density is 3.8 mi/mi2. The RHCA and landslide prone road densities are 2.3 mi/mi2 and 0.2 mi/mi2, respectively. A total of 10 miles of system road and 36 miles of non-system road have been decommissioned since 2012. There has been a 20% reduction in system roads since 1995 as a result of the decommissioning. The 36 miles of non-system roads do not contribute to road density calculations but their removal has contributed to the reduction of the potential sediment effects to streams. Improving trends in instream sediment are expected over time as a result.

There are 41 stream crossings within the watershed, one of which occurs on fish bearing streams. It was replaced in 2012 and is no longer a barrier to upstream passage. A total of 30 culverts are appropriately sized and the remaining 11 crossings are undersized for the area they drain. All roads cross perpendicular to the stream channels limiting their effects to riparian vegetation; however portions of the ditchlines drain directly into the streams. These 6 sites may be acting as a chronic sediment source of sediment to streams. Ditchlines leading to the 1 fish bearing crossings currently have cross drain pipes installed and are no longer adding sediment to streams at those sites.

In summary, **it has been 22 years since timber harvest occurred in the Hoodoo (West Fork) Clear Creek prescription watershed. RHCAs are intact and in a state to provide for long term streambank stability, shade and large wood. As a result, they will contribute to long term aquatic habitat maintenance and improvement. Recent road decommissioning, live water culvert replacements, and cross drain culvert replacements have been implemented in order to reduce road related sediment delivery to streams. Also, the majority of roads are closed to motorized use which limits degradation of the road surface and potential sediment delivery to streams. When compared to past watershed conditions, these activities are expected to have initiated an upward trend in fish habitat capacity in this prescription watershed**

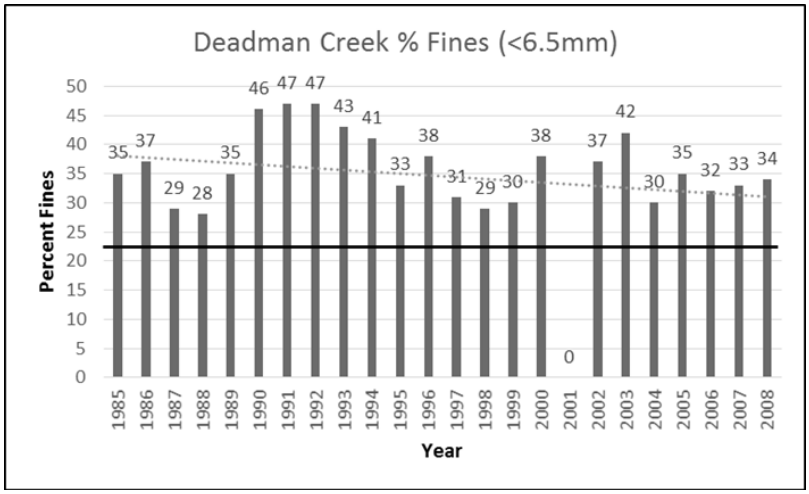
3.1.5.3 General Long –term Trends in Sediment

Long term steelhead spawning gravel monitoring data elsewhere on the Forest suggests overall downward trends in instream sediment. Monitoring was conducted in Pete King and Deadman Creeks, tributaries to the nearby Lochsa River, and was designed to assess the effects of road decommissioning on instream sediment levels. Sediment coring data techniques were used to assess the percent of fine sediment in spawning gravels. Pete King Creek was the study's treatment area where 55 miles of road decommissioning occurred and Deadman was the control drainage. No decommissioning and relatively few roads occur in Deadman. Past timber harvest occurred in both drainages. Figures 2 and 3 display variable levels of fine sediment with overall decreasing trends in both the treated and untreated systems.



Black line denotes Forest Plan desired conditions (22 – 24%) – the long term average was 35%

Figure 2: Comparison of Average Percent Fines (<6.5mm) for Years 1985 to 2006 and 2014 at Permanent Substrate (coring) Monitoring Sites in Pete King Creek within the Lochsa River Drainage. No Data was collected between 2007 and 2013.



Black line denotes Forest Plan desired conditions (22 – 24%) – the long term average was 35%

Figure 3: Comparison of Average Percent Fines (<6.5mm) for Years 1985 to 2008 at Permanent Substrate (coring) Monitoring Sites in Deadman Creek within the Lochsa River Drainage. No data was collected in 2001.

The observed sediment decreases are hypothesized to be a result of improved timber harvest practices which include the application of Best Management Practices and PACFISH, the reduction in overall timber harvest and new road construction, and road decommissioning (Jones, 2001). In summary, we believe these practices are at least partially responsible for the observed declining trends in fine sediment.

3.1.6 Environmental Consequences

3.1.3.1 Direct and Indirect Effects

The analysis area for the direct and indirect effects of the alternatives is the project area as discussed in the 2015 FEIS, pg. 3-1.

Alternative A – No Action

No logging or road-related activities designed to reduce sediment to streams would occur under this alternative. Any watershed improvement activities would require additional NEPA analysis prior to implementation. The effects of the No Action are discussed in the 2015 FEIS, pgs. 3-25 and 3-26.

In addition, this alternative would increase the risk of wildfire within the Clear Creek drainage which could result in sediment inputs to streams as well as riparian vegetation loss. These effects were observed after recent wildfires in the adjacent Lower Selway River drainage. The 11,300 acre Johnson Bar Fire occurred in 2014, the 10,200 acre Slide and 34,300 acre Wash Fires occurred in 2015. The fires were a result of continued surface fuel buildups due to increased insect and disease activity, weather conditions conducive to fire starts, and past fire suppression. The 4,800 acre Baldy Fire, also in 2015, partially burned into the upper South Fork of Clear Creek leaving 500 acres in headwater areas with 100% tree mortality.

Within the Johnson Bar Fire area, a total of five large fire-related landslides occurred, three in Swiftwater Creek in 2017 and two in Goddard Creek in 2018. An estimated 230 tons of material was delivered to Swiftwater Creek. Field reviews showed stream channel downcutting, a reduction in instream wood levels below the slides, loss of pool habitats and an increase in substrate size which reduced the availability of suitable spawning (USDA, 2017). Positive effects included a 5-10% reduction in cobble embeddedness in Swiftwater Creek as a result of fine sediments being flushed out of the system. Gravel suitably sized for spawning was added to the system via the slides. Large amounts of wood were also delivered to the stream; however most currently does not contribute to fish habitat since it deposited on high floodplain areas away from the stream channel. It will likely take decades and many high flow events to move this wood into areas where it can interact with the stream and directly contribute to aquatic habitat. Riparian area tree mortality caused by the fires exceeded 70% in many tributaries to Swiftwater, Goddard and Meadow Creeks. This may lead to stream temperature increases; however, a retrospective fire study in the Boise River basin (Dunham et al 2007) showed that while stream temperatures may remain elevated for at least a decade following wildfire, native aquatic invertebrates (rainbow trout and tailed frogs) were resilient to those increases. Summer temperatures ranged between 11 and 26oC in the study. The upper end of the range is well above measured temperatures in Clear Creek.

Clear Creek forests have evolved with fire; however land management has replaced fire as the primary disturbance on the landscape since the 1930s and fire has been excluded in order to protect the timber resource. Dense tree planting after harvest has led to stands with full touching

canopies and low hanging branches (i.e. ladder fuels) that provide avenues for crown fires. Older, unharvested stands are succumbing to increased insect and disease activity leading to abundant down wood and subsequent increased surface fuels. The combination of ladder and surface fuels is similar to those found in the Lower Selway area prior to 2014 and 2015. With the right weather conditions, fires will occur in Clear Creek.

Under this alternative, no harvest would occur. This would lead to continued increases ladder and surface fuels across the watershed as trees continue to grow, die and fall. The risk of harder to control fires increases with increasing fuels. The resulting effects to streams cannot be estimated, but they would include potential surface erosion from burned slopes as well as landslides. Elliot and Miller (2017) modeled the project area using GeoWEPP. The model showed potential high severity fires along much of the South and Middle Forks of Clear Creek as well as Pine Knob and Brown Springs Creek (Figure 4). Increased erosion was also predicted to be much greater than under the no action alternative. Surface erosion delivered to streams would likely settle out in the lower gradient fish bearing streams potentially reducing the quality and quantity of spawning and rearing habitat. Landslides could result in channel downcutting and both the addition and loss of wood and their associated pools. This could result in both losses and improvements in fish rearing habitat. Gravel deposits from landslides are likely to increase spawning habitat in some areas. Riparian contributions to instream wood levels would increase where riparian areas are burned; however short term stream temperatures may also increase in these areas (Mahlum et al, 2011). Recent observations of fires on the Forest show the areas that are most likely to experience stand replacing fires are near ridgetops and in the headwaters of streams. These headwaters contribute to stream cooling. Their effect on mainstem streams could be reduced in the event of large fires. It is very likely that the 1931 fire resulted in increased stream temperatures in the South Fork Clear Creek due to canopy loss over the mainstem stream. The risk of fires burning along mainstem streams increases with more uncontrollable fire behavior.

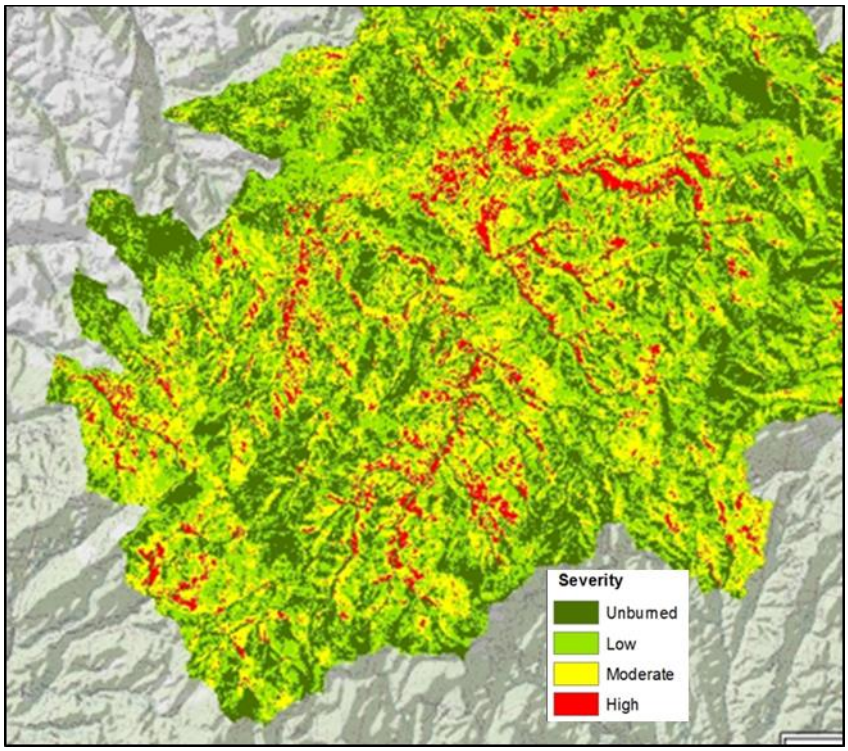


Figure 4: Modeled Burn Severity under Current Conditions in Clear Creek (Elliot and Miller, 2017)

In summary, this alternative would inhibit the ability of the Forest to further limit or reduce sediment delivery to streams from roads in order to meet or maintain Forest Plan water quality objectives. Roadside ditches would continue to deliver sediment to streams indefinitely due to inadequate cross drains. The risk of crossing failures would increase as culverts age and their conditions deteriorate. This alternative would also maintain a greater risk of high severity fire with the resulting positive and negative effects to aquatic habitats and riparian areas. The magnitude of those effects, however, cannot be estimated.

Alternatives B, C, C Modified, and D

The direct, indirect and cumulative effects of action Alternatives B, C, and D are discussed in the 2015 FEIS, pgs. 3-26 through 3-35. The discussion below updates the FISHSED model outputs which were incorrectly calculated and displayed in the 2015 FEIS and analyzes Alternative C Modified. It also includes a brief discussion of why the modeled analyses are considered overestimates through a comparison of the acres analyzed in NEPA versus the acres of harvest after actual on the ground layout occurs as a result of design feature implementation.

Outputs from the NEZSED model were used to identify road segments likely to be producing the most sediment. Field reviews occurred and found that the highest producers would have work conducted on them that is designed to minimize sediment.

FISHSED Updates

The Forest Plan requires the use of the FISHSED model in order to compare modeled changes in cobble embeddedness between action alternatives. It is not design to predict actual changes in embeddedness. It also predicts potential changes in summer and winter rearing habitat capacity as a result of changes in embeddedness. It is most appropriately used to assess the effects of

changes in habitat quality when cobble embeddedness changes are greater than 10-20% (Stowell, et al 1983). Additional information on the model can be found in the FEIS, pg. 3-3. Table 3-3 displays the FISHSED outputs by Forest Plan prescription watershed. Brown Springs and Solo exceed a 10% change for cobble embeddedness under all alternatives. Brown Springs, Solo and Hoodoo exceed a 10% change for winter rearing under all alternatives. The changes remain below the 20% identified by Stowell (1983) but above the 10% suggested by the Forest Plan Appendix A Guidance document (Conroy and Thompson, 2011).

Table 9: FISHSED Model Outputs by Prescription Watershed

Prescription Watershed	Percent Change from Existing Condition		
	Alt B	Alt C	Alt D
Pine Knob			
Cobble Embeddedness	6	6	6
Summer Rearing	2	2	2
Winter Rearing	9	9	9
Brown Springs			
Cobble Embeddedness	***15***	***15***	***14***
Summer Rearing	2	2	2
Winter Rearing	***14***	***14***	***13***
Clear Creek			
Cobble Embeddedness	4	4	4
Summer Rearing	3	4	3
Winter Rearing	8	9	8
Solo			
Cobble Embeddedness	***12***	***13***	***12***
Summer Rearing	1	2	1
Winter Rearing	***12***	***13***	***12***
Middle Fork Clear			
Cobble Embeddedness	4	5	4
Summer Rearing	2	2	2
Winter Rearing	7	8	7
Kay			
Cobble Embeddedness	2	2	2
Summer Rearing	1	1	1
Winter Rearing	4	4	3
South Fork Clear			
Cobble Embeddedness	3	3	2
Summer Rearing	1	1	1
Winter Rearing	4	4	4
Hoodoo			
Cobble Embeddedness	6	7	5
Summer Rearing	6	7	6

Prescription Watershed	Percent Change from Existing Condition		
	Alt B	Alt C	Alt D
Winter Rearing	***13***	***14***	***12***

While modeling indicates potential increases over 10% for some watersheds, local field observations indicate otherwise. Monitoring along 23 miles of RHCAs found no sediment delivery through the buffers (USDA, 2014). In addition, visual observations of post-harvest areas found the same results (K. Smith, personal observations, 2000-2013). This is due to thick ground cover vegetation which filters out sediment that may be moving down slope from harvested areas. The NEZSED model is based on the number of acres of proposed timber harvest, road construction, reconstruction and decommissioning as well as prescribed burning. It also assumes that all activities will occur within one year as opposed to the expected 7 year or more timeframe of project activities. In addition to model assumptions, and as described below, the actual acres of proposed activities are expected to be 20-30% less than the acres analyzed in NEZSED; therefore the FISHSED modeled changes would be less as well. Based on local monitoring results, restricted model assumptions and expected overestimates by the model based on actual harvest acres, no substantial change in cobble embeddedness or winter rearing from proposed activities is expected for Brown Springs, Solo, or Hoodoo prescriptions watersheds where modeled increases are over 10%.

Potential Effects – NEPA vs. Actual Layout Acres

A comparison between the acres analyzed in the 2015 FEIS and actual unit layout was conducted in 2015. The harvest units are within the Hoodoo Prescription watershed and constitute the proposed Lost Mule sale. The actual unit acreage as a result of field layout was 34% less than the NEPA acres analyzed. The reduction is primarily due to the buffering of unmapped streams and the verification and buffering of landslide prone areas. Similar comparisons have been made for other timber harvest units with all resulting in a 20-35% reduction in harvest acres. The FISHSED model results and actual expected effects previously discussed are therefore considered overestimates. The actual effects would be limited in amount and scope based on fewer acres being harvested. RHCA monitoring has confirmed the limited effects as previously discussed (USDA, 2014).

Alternative C Modified

The direct and indirect effects of this alternative are the same as those described for Alternatives B, C, and D shown in the FEIS pgs. 3-25 through 3-31 with the exception of the FISHSED model outputs described above. There would be short term increases in sediment as a result of culvert replacements and road decommissioning. The effects to ESA listed steelhead trout are associated with the culvert replacements and would be minimized through design criteria. Minimal to no effects from harvest are expected due to design feature implementation including RHCA retention and on or near ridgetop locations of temporary roads. There are 579 acres less of regeneration, 283 less acres of commercial thinning, and 43 acres less of improvement harvest than Alternative C under this alterative. Units or portions of units were removed from Clear Creek, Pine Knob, Brown Springs, Kay, South Fork and Hoodoo prescription watersheds. Removal of these acres reduces the risk of potential erosion or landslides on the steeper terrain in which they occur. They were not modeled as landslide prone; however they do occur on relatively steep slopes. Others were removed as they are likely to occur within RHCAs.

All action alternatives would reduce ladder and surface fuels across the Clear Creek drainage through regeneration, intermediate, and improvement harvest as well as prescribed landscape burning. These activities would help to moderate fire behavior which would also reduce the potential for high severity fire (Elliot and Miller, 2017). The risk for increased stream temperatures as a result of high severity fire would be reduced compared to the No Action alternative. The risk of increased surface erosion and sediment delivery to streams would also be reduced.

3.1.6.2 Cumulative Effects

A discussion of the cumulative effects including the analysis area can be found in the 2015 FEIS, pgs. 3-32 through 3-35. The only change in the cumulative effects analysis is the timeframe considered for cumulative effects which is currently 2019 to 2026. There is no change in the cumulative effects analysis for stream crossings from the 2015 FEIS. Other components of the analysis are discussed or reiterated below.

Alternative A

Activities on private and state lands where harvest or fuel reduction treatments has occurred would reduce the risk for high intensity, less controllable fire on those lands. More intense fire behavior risk would be maintained on National Forest lands due to increased surface and ladder fuel loading. This could to lead to increased risk for landslides and riparian area mortality with the resulting negative and positive effects discussed under the indirect effects of the No Action alternative. There could be a reduction in the quality and quantity of steelhead/chinook habitat downstream on private lands (including the Kooskia fish hatchery) from increased sediment as well as potential increases in stream temperatures. Summer stream temperatures below the Forest boundary are nearing sublethal to lethal levels and are projected to increase as a result of climate change (Isaak, et al, 2016). Minor changes on Forest managed lands could result in slightly higher levels downstream. Instream wood levels would increase as a result of landslides and would be beneficial to aquatic habitats. The potential changes in sediment, temperature, and wood are completely dependent on the size and location of wildfires that might occur. The extent of the potential positive and negative effects cannot be assessed; however based on 2014 and 2015 fires in the adjacent Selway River area, they could have large, localized effects.

Alternatives B, C, C Modified, and D

No negative cumulative effects to instream sediment are expected because FISHSED-modeled changes are within the Stowell model (1983) guidelines and 5% or less over Forest Plan Appendix A guidelines. Actual harvest acres are expected to be 20-30% less than those analyzed, therefore the described effects would be less than modeled. Modeled sediment yield at the Forest boundary would be 23%, 24%, and 21% for Alternatives B, C, and D, respectively. All alternatives remain below the Forest Plan objective of 30%. Alternative C Modified was not calculated however it would be less than Alternative C because there are 924 acres less of harvest than Alternative C. Sediment yield would drop to below existing levels within 6 years (Watershed Report). There would be no long term sediment yield increase as a result. When combining local monitoring with modeling outputs, no cumulative sediment increases to downstream areas of Clear Creek, including the Kooskia Hatchery, are expected. Culvert replacement, road reconstruction, road reconditioning, and decommissioning activities result in minor short term increases in sediment. They would provide for long term (>50 years) instream sediment reduction by reducing the risk of road failures where crossings are replaced or removed

and cross drain culverts are installed. Undersized culverts on private lands would still pose a failure risk and could contribute sediment to Clear Creek.

The action alternatives, when combined with harvest or fuel reduction treatments on non-federal lands, would cumulatively reduce the risk for fire and the subsequent effects to aquatic habitats. The amount cannot be estimated; however studies have shown that modification of fuels helps reduce the potential for high intensity fire. Moderated fire behavior is likely to result in less hillslope erosion and riparian tree mortality while allowing for localized sediment and wood delivery from less intense fires. This would help to better maintain streamside shade and provide for long term large wood and streambank stability.

3.1.7 Regulatory Compliance

3.1.7.1 Endangered Species Act

The effects determinations for fish species listed under the Endangered Species Act are the same as described in the 2015 FEIS, pgs. 3-35 through 3-29.

In summary, the project would have both short term negative and long term beneficial effects to steelhead and their designated critical habitat as well as Essential Fish Habitat (EFH) for salmon from road removal, culvert replacement, and road reconstruction/reconditioning activities. The risk for potential effects to steelhead trout, designated critical habitat or EFH from road-related project activities could occur, therefore the ESA effects determination for the project is **may affect, likely to adversely affect steelhead trout, their designated critical habitat, and EFH**. An adverse effect constitutes harm or harassing listed fish. Adverse effects to steelhead, their designated critical habitat, or EFH are expected to be minimal due to BMP implementation.

The Clear Creek IR Project is consistent with the 1998 Biological Opinion for Salmon and Steelhead in the Upper Columbia and Snake River Basins in that it applies PACFISH direction and does not prevent the attainment of PACFISH RMOs, conducted a watershed analysis that identified needs to improve habitat for listed steelhead in Clear Creek, and conducted project level Section 7 consultation.

The project **may affect, but is not likely to adversely affect bull trout** since they were only sporadically found in the lower drainage below the Forest boundary. Temperature regimes are not within desired ranges for bull trout during the spawning migration period. Temperatures at the mouth of the streams create a thermal deterrent during this time. The proposed activities are not expected to directly or indirectly affect the species because the project would allow for the maintenance of natural temperature ranges through PACFISH buffer retention. Timber harvest would increase modeled sediment yield and cobble embeddedness levels but not to measurable levels. There would be **no effect to bull trout designated critical habitat** since none exists in the drainage.

3.1.7.1.1 Region One Sensitive Species

The effects determinations for fish species listed under the Endangered Species Act are the same as described in the 2015 FEIS, pg. 3-39.

3.1.7.2 PACFISH

The project complies with PACFISH and would not retard the attainment of Riparian Management Objectives as described in the 2015 FEIS, pgs. 3-39 through 3-40.

3.1.7.3 Forest Plan

All action alternatives comply with the Forest Plan Water Quality Objectives and the upward trend requirement. FISHSED modeling indicates changes over 10% in cobble embeddedness and winter rearing in three prescription watersheds; however these watersheds remain within acceptable model ranges (Stowell, 1983) and are 5% or less above Appendix A guidance. Actual changes are not expected because harvest acres would be less than modeled, and because of sediment reductions associated with road decommissioning and reconditioning/reconstruction activities. Watersheds are expected to continue on an improving trends as a result of these activities when combined with RHCA retention and other design features. Pine Knob, Clear Creek, and Middle Fork Clear Creek prescription watersheds are discussed in the 2015 FEIS (Pgs. 3-40 to 3-42).The following discusses the effects of the actions on upward trend in the Hoodoo and South Fork Clear Creek prescription watersheds which do not currently meet their water quality objectives based on findings of the 2015 Stillwater survey.

3.1.7.3.1 Upward Trend

All alternatives propose the same actions related to roads including reconditioning, reconstruction and decommissioning as well as culvert replacements. All alternatives would maintain an upward trend. Alternative C was the only alternative assessed as it proposes the most harvest and temporary road building.

Hoodoo (West Fork) Prescription Watershed

The Clear Creek Project would continue the existing upward trend by decommissioning an additional 0.8 miles of road, 0.2 miles of which is within RHCAs. This would not change watershed or RHCA road densities from the existing conditions of 3.8 mi/mi^2 and 2.3mi/mi^2, respectively. The majority of road decommissioning and road improvement were conducted under previous project between 2012 and 2015 (2015 FEIS, Appendix J, pg. J-40).

The Clear Creek Project also reconstructs 15.3 miles of system road (40% of the roads in the prescription watershed) which would reduce sediment delivery by diverting road ditchline flow through cross drain culverts and away from streams. A total of 9.9 miles was already completed under the Road 650 Project in 2014.

The Clear Creek project would replace the 11 existing undersized culverts with those sized for a 100- year flow event. This would reduce the risk of future failure. All crossings in the watershed would be appropriately sized after project completion. The Project would recondition 7.1 miles of road (19% of the roads). Reconditioning would apply gravel where needed to minimize the amount of erosion from road surfaces during log haul operations. The use of dust abatement during log haul would also minimize road surface erosion and potential input of sediment to streams.

All project activities are expected to have a negative effect on aquatic condition in the short term based on sediment yields as modeled in NEZSED. Model results from NEZSED indicate sediment yield increases at the mouth of West Fork Clear Creek to 55% as a result of project activities. This meets the Forest Plan standard of 60%. The FISHSED model was used in conjunction with NEZSED to determine potential changes in fish habitat carrying capacity. The model predicted a 7% increase in cobble embeddedness and decreases in summer/winter juvenile steelhead rearing capacity of 7% and 14%, respectively. Winter rearing capacity exceeds the level of 10% where changes in habitat quality could occur (Stowell et al. 1983); however, local RHCA monitoring found no sediment delivery through the buffers (USDA, 2014). Visual

observations of post-harvest areas found the same results elsewhere on the Forest (K. Smith, personal observations, 2000-2013). With no delivery, cobble embeddedness levels are not expected to increase as a result of harvest. FISHSED model documentation states that the effects evaluation should be adjusted if riparian areas are to be treated differently than surrounding land. PACFISH RHCAs retain no harvest buffers that are much wider than those used when FISHSED was developed; therefore the model results are considered overestimates, particularly when combined with fewer actual acres of harvest (NEPA vs. layout acres).

Modeled ECAs would increase to 26% under Alternative C, a Moderate condition class rating based on the NOAA matrix (1998). This exceeds the desired threshold of 20%. However, no channel alterations as a result of increased water yield are expected. This is due to the loss of 20-30% of the harvest acres during unit layout, compared to those modeled, as previously discussed. Alternative C Modified would harvest 418 less acres than Alternative C, therefore ECA would be slightly lower than modeled estimates.

An upward trend has been established through mostly intact RCHAs, a lack of recent timber harvest, previous road decommissioning, culvert replacement, and road improvement projects. The Clear Creek Integrated Restoration Project would maintain that trend through additional road improvement when combined with design features, and BMP implementation. Many studies have confirmed the success of the BMPs in reducing sediment delivery to streams and maintaining stream temperatures (Sugden, 2018; Arismendi et al, 2107; Hatten et al 2017; Sugden et al 2012; USDA Forest Service 2009; USDA Forest Service, 2006; Sridhar et al, 2004; Lee, et al 2004; Ott et al 2005).

South Fork Clear Creek Prescription Watershed

The Clear Creek Project would continue the existing upward trend through road improvement activities including the replacement of 27 stream crossing culverts, 16.5 miles of road reconstruction (51% of the roads in the prescription watershed) and 9.8 miles of reconditioning (30% of the roads in the prescription watershed). All of these are designed to reduce the amount of sediment delivery to streams from roads. Road decommissioning and reconstruction activities were conducted under previous projects between 2012 and 2014 (2015 FEIS, Appendix J, pg. J-37).

All project activities are expected to have a negative effect on aquatic condition in the short term based on sediment yields as modeled in NEZSED. Model results from NEZSED indicate sediment yield increases at the mouth of South Fork Clear Creek to 14% as a result of project activities. This meets the Forest Plan standard of 45%. The FISHSED model was used in conjunction with NEZSED to determine potential changes in fish habitat carrying capacity. The model predicted a 3% increase in cobble embeddedness, a 1% decrease in summer rearing and a 4% decrease in winter rearing capacity. These are well below the threshold of 10% where changes in habitat could occur (Stowell et al. 1983).

ECAs would increase to 9% under Alternative C, a High (good) condition class rating based on the NOAA matrix (1998). This meets the desired threshold of <20%. No stream channel alterations are expected as a result of minor increases in water yield. Alternative C Modified would harvest 289 less acres than Alternative C, therefore ECA is expected to be slightly lower than modeled estimates.

An upward trend in aquatic habitat conditions in South Fork Clear Creek has been established through previous road decommissioning and road improvement projects. The Clear Creek Project would maintain that trend through additional road improvement activities when combined with relatively intact RHCAs, and design feature and BMP implementation.

3.3 Economics

This report replaces the one in the FEIS (September 2015).

3.3.1 Analysis Area

The project area is located within Idaho County, Idaho. The economic analysis area includes local towns and communities influenced by the timber sale activities. These towns include Grangeville, Elk City, Kamiah, Kooskia, Harpster, Stites, Clearwater, Orofino, Pierce, Weippe, and Lewiston. The timber sale influence on these towns depends on their proximity to the watershed, their economic dependence on it, and their historic use of the watershed dating to settlement more than 100 years ago. The Nez Perce National Forest has provided wood to local mills since the 1930s. The Forest's output, along with BLM timber outputs, accounted for half the total timber harvested in Idaho County in the mid-1990s. Most of the Forest timber output was processed in mills located in or near the towns mentioned previously.

3.3.2 Regulatory Framework

The project complies with Forest Plan direction to develop cost-effective projects, and it complies with the NFMA by emphasizing resource management over timber volume output.

The Clear Creek Integrated Restoration project is being considered at least partially as a Land Stewardship Project under Section 347 of the Omnibus Consolidated Appropriations Act of FY 1999. This Act allows flexibility in combining traditional service and timber sale contract activities to more effectively accomplish ecosystem restoration through forest management. It also allows more flexibility in funding projects by using the timber stumpage value generated from selling the trees to pay for doing the other resource activities. One drawback to stewardship contracting is that those projects would not contribute any revenue to the Treasury or to the 25% Fund for counties with acreage within the Forest. All the proposed activities other than the actual timber harvesting, such as precommercial thinning, road decommissioning, and grass restoration, would be considered for inclusion as stewardship projects.

3.3.2.1 National Forest Management Act

The NFMA requires that a sale "consider the economic stability of communities whose economies are dependent on such national forest materials, or achieve such other objectives as the Secretary deems necessary" (NFMA, Sec. 14e1c). The NFMA also requires that "the harvesting system to be used is not selected primarily because it will give the greatest dollar return or the greatest unit output of timber" (NFMA, Sec. 6, g,3,E,IV). The project meets the requirements of the NFMA by using the IMPLAN model to evaluate how each alternative would affect economic stability in local communities. The project also uses harvest systems that are based on ground-truthed silvicultural practices, not on the highest dollar return, to achieve the desired long-term forest and access needs.

3.3.2.2 Forest Service Manual

The FSM directs that economic feasibility be considered in project design during the early planning and NEPA documentation. A sale feasibility analysis was done at Gate 1, which led to consideration of treatments providing cost-reducing economic benefits. One major adjustment was the use of mechanical site preparation versus burning site preparation methods where possible. The mechanical methods provide better leave tree survival and utilize cheaper purchaser-supplied equipment.

3.3.2.3 Forest Plan

The Forest Plan requires that the project provide a sustained yield of resource outputs at a level that will help support the economic structure of local communities and provide for regional and national needs (USDA Forest Service 1987a, Goal A.1, p. II-1).

Alternative A would not contribute toward the Forest Timber sale program or support the economic timber harvesting structure of the local communities, while Alternatives B, C, and D would. Alternative C would best meet this goal.

3.3.2.4 Executive Order 12898; Environmental Justice

EO 12898 requires that each federal agency make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories.

Idaho County, Clearwater County, Lewis County and Nez Perce County are the counties most directly impacted by this proposal. According to a Headwaters Economics, A Profile of Demographics (Economic Profile System Report - generated August 1, 2018), within this area approximately 8.8% of people are minority populations and below poverty people (low income populations) are approximately 14.3%.

The Executive Order requires agencies to work to ensure effective public participation and access to information. The 2015 FEIS and this DSEIS document all of the efforts that have been made to date for public participation. This project was first introduced to the public in 2011 and a project website with applicable information as the project developed has been available since then. Additionally, as described in section 1.9.4 of this DSEIS, the Forest and the Nez Perce Tribe (NPT) have been meeting regularly since the original 2015 Record of Decision was withdrawn to discuss the Nez Perce Tribe's concerns with the project. The Nez Perce Tribe manages a fish hatchery on Clear Creek, which flows out of the project area. The hatchery relies on water from this drainage to supplement the water needed for the hatchery production. The Clear Creek 2015 FEIS and the DSEIS analysis determined that with pre-defined design features and mitigation measures there would not be an effect to the water quality, including temperature, sediment and water yield that would adversely affect the water going into the hatchery or the hatchery function. Clean water that supports a dynamic fishery is important to the tribe as well as the rest of the local community for subsistence use, sport fishing, and business opportunity.

Protection and enhancement of wildlife is a concern to the Tribe and members of the local community. The wildlife analysis indicates that overall there would be no lasting effects to threatened, endangered, or Forest Plan management indicator species. Specifically for elk, a Forest Plan management indicator species and an animal hunted within the project area and widely hunted throughout the affected counties, analysis determines that the combined effects of

regeneration and improvement harvest proposed in the action alternatives would result in the temporary reduction of elk hiding cover. Conversely, the proposed harvests would reduce tree canopy cover and allow sunlight, water, and nutrients to become more available for shrubs, forbs, and grasses. This would increase forage production for elk and other ungulates. Alternative A would provide both summer and winter range that continues to decline as forage is shaded out. As far as the project effects on Elk Vulnerability, the open motorized road densities proposed in the action alternatives would be reduced from 1.6 miles/sq. mile in the Project Area to 1.1 miles/sq. mile. Under Alternative A, they would remain static at 1.6 mi/sq. mi.

The economic analysis reveals that Alternative A (No Action) would not sustain any timber harvest jobs. Alternative C would sustain the most jobs and revenue, because it generates the most timber volume, followed by Alternatives B and D. Please see Table 10 for an estimation of the timber harvest jobs and income that each alternative would sustain in the local community. Other activities being proposed along with timber management, such as road decommissioning, pre-commercial thinning, broadcast burning, and reforestation, also provide jobs and income to the local economy.

In summary, the Clear Creek analysis did not reveal any disproportionately high and adverse impacts to minority populations, or low-income populations. None of the action alternatives are expected to negatively affect minority or low-income populations or any United States citizen. No environmental health hazards or adverse impacts to the fishery or wildlife population are expected to result from implementation of any alternative. This project would not disproportionately affect income levels in the economic analysis area.

3.3.3 Resource Indicators

3.3.3.1 Timber Harvest – Related Jobs and Income

Jobs and income generated from the project contribute to community stability.

3.3.3.2 Sale Feasibility

Sale feasibility is represented by the Present Net Value (PNV). A project with a positive PNV would be a sellable project. A project with a negative PNV would either not sell or require supplemental funding to make it sellable. The PNV is also an indicator of the amount of timber generated funding that would be available for stewardship projects or returned to the Treasury Analysis Methodology

The Nez Perce National Forest Plan Final Environmental Impact Statement (FEIS) (USDA Forest Service 1987b) describes the economic impacts of implementing the Forest Plan. The Forest Plan addresses the economic analysis process and values placed on non-consumptive items such as recreation opportunities, community stability, cultural resources, habitats, and populations. This economic analysis will not revisit the information presented in the Forest Plan and will focus only on those costs and revenues associated with implementing the proposed activities in the project area.

The University of Idaho Forest Products Department and the Bureau of Business and Economic Research at the University of Montana produce annual Economic Outlook Reports for the forest products industry in Idaho and Montana (Cook et al. 2016). Utilizing economic data from the IMPLAN model and the Forest Industries Data Collection System (FIDACS), these reports provide statistics that articulate the economic value of timber harvest projects to derive the

indirect and induced economic effects. In Table 10, the number of forest product industry (FPI) jobs supported; the amount of wages and salaries generated; and the quantity of goods and services sold per million board feet of timber harvested, is displayed. In addition, a publication from the University of Idaho, College of Natural Resources, Economic Contributions of Idaho's Forest Products Industry 2017, provides a more recent value for jobs provided both directly and through support.

Table 10: Economic Results per Million Board Feet of Timber Harvested

Forest product Industry Jobs Sustained[1]	22 jobs per 1.0 MMBF
Revenue to Communities Through Wages and Salaries[2]	$667,000 per 1.0 MMBF
Revenue to Communities Through Sales of Goods and Services[2]	$3,850,000 per 1.0 MMBF

[1] Source: University of Idaho, CNR, "Economic Contributions of Idaho's Forest Products Industry 2017."

[2] Source: Cook, et al. "Idaho's Forest Products industry Current Conditions and 2016 Forecast" (These numbers were revisited for the DEIS by the timber group and remain valid)

The Region 1 Gate 1 and 2 spreadsheets and the Quicksilver model with Nez Perce– Clearwater National Forests area factors were used to determine sale feasibility and appraised value. The Quicksilver model uses recent transactional evidence based on local timber sales to determine sale value. The timber stand database and extensive field reviews were used to determine timber volume and species composition; these are the two primary factors determining gross value of a timber sale. Net value depends on costs for logging system, haul distance, slash disposal, planting, and mitigation activities. The cost estimates for this sale are based on recent similar sales in the vicinity.

3.3.4 Affected Environment

In a report for the Interior Columbia River Basin Ecosystem Management Project (Columbia Basin Assessment), titled "Rural Communities in the Inland Northwest," (Harris, et al. 2000) communities are characterized in terms of their ability to manage change and adapt to it in positive, constructive ways. The report emphasizes community resiliency, which is a function of community conditions such as economic structure, infrastructure, civic leadership, cohesiveness, and amenities.

In a 2000 report for the Interior Columbia River Basin Ecosystem Management Project (Columbia Basin Assessment), titled "Rural Communities in the Inland Northwest," (Harris, et al. 2000) communities are characterized in terms of their ability to manage change and adapt to it in positive, constructive ways. The report emphasizes community resiliency, which is a function of community conditions such as economic structure, infrastructure, civic leadership, cohesiveness, and amenities.

The Integrated Scientific Assessment for Ecosystem Management in the Interior Columbia Basin Assessment resiliency ratings for Lewis County (Kamiah), Idaho County (Kooskia and Grangeville) and Clearwater County (Orofino, Pierce, and Weippe) are low (Thomas, et al. 1996). However, preliminary conclusions from Harris et al. (2000) explains many timber-dependent communities tend to be more resilient and able to tolerate change than is commonly assumed. The resiliency rating for Nez Perce County (Lewiston) is high. The towns of Kamiah, Grangeville, Orofino, Weippe, Pierce, and Lewiston all show high to very high historic employment in the wood products manufacturing industry per Harris et al. Based on reports from the Idaho Department of Labor, as of May 2018, Lewis County had an unemployment rate of

5.1%, Idaho County had a rate of 4.8%, and the rate in Clearwater County was 6.6%. The average unemployment rate in Idaho reported was 2.9%, and the national average is 3.8%. In addition, counties dependent on federal timber receipts to help fund schools and highways find that this source of funding is drying up, so they have relied more heavily on taxes to bolster their income, to the detriment of low-income families and the unemployed who feel that timber harvest should contribute more.

Two saw mills in the Clearwater basin, one in Kamiah and the other in Orofino, closed in 2016. Both mills attributed lack of sufficient timber supply as contributing to their closure.

Idaho has always been a natural resource–based state, although as natural resource extraction declines, the state has moved toward diversification. Many communities have made impressive strides in achieving Idaho Gem Community status and working to diversify their economies. (The Gem Community program was established by the Idaho Department of Commerce to encourage communities to plan their futures.) As reported by the Idaho Department of Labor, the timber products industry went through hard times in the early 1980s, but the firms that survived were streamlined and modernized with the hope to have a consistent supply of timber from National Forest System lands.

3.3.5 Environmental Consequences

3.3.5.1 Direct and Indirect Effects

3.3.5.1.1 Alternatives A, B, C, and D

Table 11 displays the Job and Income effects as a result of implementing the timber harvest alternatives. The table does not reflect additional jobs and income related to implementation of the non-timber harvest stewardship activities, such as precommercial thinning and road decommissioning, which are the same for all the action alternatives. These stewardship activities would generate some additional jobs, but not to a level like timber harvesting and would not point to any alternative as generating more than the other because they would be the same between alternatives, except for the no action alternative.

Alternative A (No Action) would not generate any timber harvest jobs. Alternative C would generate the most jobs and revenue, because it generates the most timber volume, followed by Alternatives B and D.

The other activities being proposed along with timber management, such as road decommissioning, precommercial thinning, broadcast burning, and reforestation, also provide jobs and income to the local economy. For example, in addition to providing jobs for heavy equipment operators required to decommission the roads, the project will create jobs for laborers performing erosion control and project inspection.

Table 11: Timber Harvest Jobs and Income for Each Alternative

Alternative	VOLUME (MMBF)	Jobs Sustained (FTE)	Labor Income	Goods and Services Value
A	0	0	0	0
B	68.3	1,502	$45,556,100	$262,955,000
C Modified	83.0	1,826	$55,361,000	$319,550,000
D	57.8	1,271	$38,552,600	$222,530,000

Predicted Stumpage and Present Net Value

Each alternative produces different benefits and costs associated with the timber harvest, roadwork, fuel treatment, reforestation, mitigation measures (skid trail decompaction), and other related timber harvest activities. This part of the economic analysis compares the differences in benefits and costs by examining the timber's appraised value and PNV for each alternative. The appraised value is the timber value based on recent bidding; that is, the amount the Nez Perce National Forest anticipates the timber would sell for minus costs for logging, road reconstruction, site preparation/fuel abatement, and mitigation. The PNV is the anticipated selling value minus the costs to implement the sale and reforest the land. An alternative with a positive PNV has stumpage values exceeding costs, whereas an alternative with a negative PNV has costs in excess of stumpage values and may require supplemental funding to complete all activities. The PNV money is an indicator of funding that could be available to fund stewardship projects on sales designated for stewardship contracting.

Information provided by the economic models is used as a tool to understand the relative monetary differences between alternatives rather than to predict exact values for each alternative, since the variables may change between now and the time the timber sells.

Alternative A (No Action) does not generate any value or accrue any costs associated with the NEPA decision, so its PNV is zero. However, Alternative A would not be able to offset the cost of doing the NEPA analysis. Tree mortality is occurring in many of the areas planned for regeneration. If a large wildfire (100+ acres) were to start as a result of fuel buildup from the anticipated tree mortality, fire suppression costs would likely exceed $300,000 (for comparison, the 350-acre Granite Fire of 2011 cost $2.2 million).

Alternatives B, C, and D are all predicted to generate enough stumpage value to cover all of the sale costs, plus reforestation, while also capturing the timber value before it deteriorates from tree mortality. All of these alternatives should generate revenue, with Alternative C being the most economically feasible and generating the highest revenue (Table 11).

An item that contributes to these Alternatives' efficiency is that the harvest units are large in size and focused in a localized area, which reduces mobilization costs. In addition, completing the vegetation treatments in larger areas, such as in Alternative C which regenerates larger patches, allows for areas to be completed, and is then closed for an extended period of time while the new trees grow. This reduces road maintenance costs and the continued costs of multiple entries.

All the action alternatives would use a combination of Forest Service burning and/or machine piling for the reforestation site preparation. Site preparation and tree planting are the two largest single-cost activities associated with implementing the different alternatives, but since each action alternative has the same costs per acre, the economic effect is proportional to the amount of acres needing site preparation and planting. To reduce reforestation costs, natural regeneration should be implemented where possible and where it meets the project purpose and need. Table 12 displays the predicted appraised total and PNV for each alternative. As noted in the Table 12, Alternative C produces the most volume, and provides the greatest revenue, because Alternative B requires less site preparation and involves lower planting costs than Alternative C. Alternative B has higher site preparation and planting costs than Alternative D, but Alternative B generates

enough commercial thin volume, which doesn't require reforestation costs, to offset the other costs (Alternative B thus produces a higher overall economic return).

The economic impact of using fewer roads in Alternative D with respect to Alternative B and Alternative C equates to a 15% to 30% reduction in volume outputs, a 6% to 12% reduction in acres treated, and a $3.0 million to $1.7 million reduction in PNV. Alternative D would utilize longer skidding distances to bring logs to a landing, which can result in undesirable soil impacts due to logs dragging on the ground for a longer distance verse being carried on a truck.

Table 12: Predicted Stumpage and Present Net Value

Alt.	Volume		Appraised Total[a]	Reforestation[b]	Implementation[c]	Present Net Value	Stewardship Costs[d]
	CCF	MBF					
A	0	0	$0	$0	$0	$0	$0
B	133,559	68,289	$7,773,000	$1,569,000	$839,000	$5,365,000	$1,258,000
C	162,307	82,988	$9,867,000	$2,364,000	$821,000	$6,682,000	$1,258,000
D	113,018	57,786	$5,529,000	$1,288,000	$528,000	$3,713,000	$1,258,000

[a] Appraised value bid includes s slash treatment, skid trail decommissioning, and road costs associated with the harvest.
[b] Reforestation costs include planting costs (trees, labor, and pre/post-treatment exams with overhead).
[c] Implementation costs include presale, engineering, and administration costs. NEPA costs, are not included in this cost total.
[d] Stewardship costs include precommercial thinning, road decommissioning, grass restoration, and landscape prescribed burning.

3.3.5.2 Cumulative Effects

The cumulative effects area includes Clearwater, Idaho, Lewis, and Nez Perce counties in Idaho. The timber volume is scheduled to be sold through 5 different sales over a 5-year period, starting in 2019. Typical sale duration would be 4 years each; the last sale would be completed in 2029 (harvest activities usually do not start on the first year a sale is sold), for a total of about 10 years of harvest activities. Post-harvest reforestation and site preparation work could continue for up to 5 years following harvest on the last sale, creating a potential end date of 2034, for a total of 15 years of harvest plus post-harvest activities.

Economic impacts for an activity, such as logging and sawmilling lumber, are shown in the previous section. These are described as direct and indirect effects, but they are also cumulative impacts due to the additional jobs, taxes, and income they provide throughout the Counties. When considering impacts of additional jobs and income created, this sale would contribute towards the Forest's 5-year timber sale plan, but not beyond the level of current employment. The Nez Perce-Clearwater National Forest 5-year timber sale plan is currently projected to be about 60 million board feet (MMBF) per year. Sold or foreseeable local sales affecting the same communities and contributing to the long-term timber flow of these communities include Swede, Preacher Dewey, Lochsa Thin, Lowell WUI and Lolo Insect and Disease.

During the spring of 2016, the Blue North mill in Kamiah shut down. This mill employed about 65 people from the market area (Lewiston Tribune, 5/4/16). In October of 2016, the TriPro mill in Orofino, which employed about 50 people, shut down citing a lack of trees being sold for harvest and the Johnson Bar litigation, which removed available logs they had under contract to purchase (Lewiston Tribune 10/6/2015).

3.3.5.2.1 Alternative A – No Action

Since this alternative does not propose any timber harvest or other stewardship activities, it would not contribute cumulatively to local community jobs and income. Alternative A would maintain current unmanaged use and related income. It could potentially increase future firefighting costs and locally generated income as trees die and create excessive fuel loadings susceptible to wildfire ignitions.

3.3.5.2.2 Alternatives B, C Modified, and D

Added to the Forest's 5-year timber sale plan, these alternatives would sustain jobs (ranging from 1,071 to 1,454 jobs). However, Alternatives B, C, and D are not expected to generate a large number of jobs or significant amounts of income from timber harvest or roadwork; therefore, these alternatives would not be likely to cumulatively affect local communities beyond the past 3-year employment averages. The mills tend to adjust their annual production to sustain long-term outputs (instead of boom-and-bust cycles) by purchasing private and State timber along with National Forest sales.

The loss of the Blue North and TriPro mills could cause a change in timber stumpage values within the Clearwater market area, because of reduced competition. However, the area milling capacity is expected to be absorbed by the remaining mills as they strive to meet their full production potential (personal conversation with G.Danly; Empire Lumber and B.Higgins; IFG 2016). There will not be an excess of timber that no one would purchase due to the mill closures. In fact one reason cited for both mill closures was the lack of continuous timber to support all the mills in the market area (Lewiston Tribune 5/5/2016 and 10/6/2016). There would not be a noticeable change in area jobs due to the mill closure either, because the number of jobs associated with the timber harvest and processing is connected to the amount of volume processed. Since all the loggers and mills are using the same methods and technology to complete the work, more workers may be needed at the remaining mills to as they increase production in response to loss production from the two mill closures.

Prescribed burning is planned in association with the previously mentioned timber sale projects. Prescribed burning is mostly handled internally by the Forest Service. Forest Service employees are supported by local community services. The prescribed burning proposed under other projects in the area can be handled with the normal Forest Service workforce and therefore would not have a cumulative effect on the local communities.

Additional stewardship items including road decommissioning, precommercial thinning, and grass restoration would also contribute money to the local communities. If additional forestry activities are implemented within the counties by the State or by private industry, additional forestry workers may be needed.

3.4 Fuels

The FEIS (September 2015) information for fuels remains valid and is incorporated by reference.

In late summer 2015, the Baldy Fire burned approximately 753 acres within the Clear Creek Integrated Restoration project area in the headwaters of the South Fork of Clear Creek, which is a tributary to Clear Creek and the Middle Fork Clearwater River. The Baldy Fire was a mixed severity burn, with high severity (54 acres) occurring near Baldy Mountain along the ridge top due to a crown fire, low severity (384 acres) near the bottoms of the drainages and Road 1855,

and moderate severity (315 acres) elsewhere in the burned area. No proposed harvest areas were burned, and a post-fire Burned Area Emergency Rehabilitation (BAER) review did not recommend any treatments in the Clear Creek drainage.

The Forest Supervisor directed project specialists to assess effects of the 2015 wildfires on the project area. Her findings regarding this new information and potentially changed circumstances related to this project are documented in a November 4, 2015 memo that is available in the project file. Based on her review, she found that the wildfire effects do not significantly change the environmental effects of the project, nor do they change the basis or nature of considerations and rationale for reaching a decision on this project. Supplementing the Clear Creek Integrated Restoration FEIS is not necessary.

3.9 Vegetation

The FEIS (September 2015) information for Vegetation remains valid and is incorporated by reference. Due to proposed unit refinements, Table 3-27 (FEIS pg. 2-3) is updated as follows:

Table 13: Updated 2015 FEIS Table 3-27. Acres of Proposed Vegetation Management Activities, by Alternative

Activity	Alternative B	Alternative C	Alternative D
Within Focus Areas			
Regeneration (acres)	Original 2,609	Original 3,995 New Info 3,577	Original 2,017
Commercial thin (acres)	Original 2,240	Original 854 New Info 571	Original 1,997
Precommercial thin (acres)	Original 998	Original 904 New info 902	Original 998
Burn (acres)	Original 1,371	Original 1,371	Original 1,371
Improvement (acres)	Original 331	Original 331 New info 288	Original 211
Restoration (acres)	Original 41 New Info 42	Original 41 New Info 42	Original 41 New Info 42
Retention (acres)	Original 3,940	Original 3,940 New info 3,819	Original 4,892
Outside of Focus Areas			
Regeneration (acres)	Original 0 New info 0	Original 161 New info 162	Original 161 New info 162
Commercial thin (acres)	Original 3,366	Original 3,366	Original 3,144
Precommercial thin (acres)	Original 889 New info 892	Original 889 New info 892	Original 889 New info 892

Note: Acre differences are due to Unit refinement and rounding in GIS. Please see Appendix H-1 for summary of each unit.

3.10 Visuals

This report replaces the one in the FEIS (September 2015).

3.10.1 Analysis Area

The Clear Creek Integrated Resources Project area of interest is located in the rolling uplands to the south of the Lochsa River canyon between the South Fork of the Clearwater River drainage to the west and the Selway River Drainage to the east. The area of interest is approximately 5 miles from the community of Kooskia, Idaho. Treatment areas are located to the south of Forest Road (FR) 286 and north of FR 284, also known as the Elk City Wagon Road.

The Clear Creek project proposes management activities including prescribed fire, commercial and pre-commercial thinning, reforestation and timber harvest to achieve more healthy and resilient vegetation across the landscape. These activities are designed to create a landscape that exhibits more natural disturbance patterns. Also included in the project are road decommissioning, culvert replacement, and road activities designed to improve watershed health. Vegetative diversity improvements will not be limited to coniferous vegetation, approximately 41 acres of bunch grass communities are proposed for restoration through re-vegetation with native grasses and forbs.

Planned activities would be visible in foreground, middleground and background views from FR 286 and FR 284 which are identified as visual travel corridors in the Nez Perce National Forest Plan. Also within the area of interest is the Lookout Butte Lookout which is utilized as a recreation rental during the summer season. Corral Hill Lookout and Trails 130, 728, 723, 139, 150, and 151, are designated in the Forest Plan as travel corridors or use areas and have mixed levels of recreation use associated with them.

This report analyzes the visual impacts of the proposed management activities and determine whether the activities would meet Forest Plan standards for scenic quality. Visual simulation techniques are used to analyze these visual impacts. Numerous viewpoints have been reviewed to determine the short and long term impacts to scenery within the resource area.

3.10.2 Regulatory Framework

3.10.2.1 Forest Plan

The 1987 Nez Perce National Forest Land and Resource Management Plan provide standards and guidelines for scenic quality for the Nez Perce – Clearwater National Forests within the area of interest.

Table 14: Nez Perce National Forest Plan 1987 - Visual Quality Objectives for Clear Creek

View Point or Viewing Corridor	Sensitivity Level	Foreground 0 – ¼ mi.	Middleground ¼ mi. – 3 mi.	Background 3 mi. – 5+ mi.
FR 284 (Pilot Creek to China Pt.)	1	Retention	Modification	Modification
FR 284 (China Pt. to Forest Bound.)	2	Partial Retention	Modification	M. Modification
FR 286	2	Partial Retention	Modification	M. Modification
Lookout Butte Lookout Rental	1	Partial Retention	Modification	M. Modification
Corral Hill Lookout	2	Partial Retention	Modification	M. Modification
Trail 130	1	Partial Retention	Modification	M. Modification
Trail 150	1	Partial Retention	Modification	M. Modification
Trail 151	2	Modification	Modification	M. Modification

View Point or Viewing Corridor	Sensitivity Level	Foreground 0 – ¼ mi.	Middleground ¼ mi. – 3 mi.	Background 3 mi. – 5+ mi.
Trail 197	2	Modification	Modification	M. Modification
Trail 723	2	Modification	Modification	M. Modification
Trail 728	1	Partial Retention	Modification	M. Modification

3.10.3 Resource Indicators

General direction for scenery management is provided Forest Service Manual 2380 (Landscape Management). Specific visual resource management direction is provided by the 1987 Nez Perce National Forest Plan and is described in terms of Visual Quality Objectives (VQO). Forest Plan VQO standards and guidelines were based on the Visual Management System described in Agriculture Handbook Number 462, National Forest Landscape Management, Volume 2 (PF-Doc. PI-R02). The visual management system was revised in 1995, and is now known as the Scenery Management System. The revised guidelines are provided in Agricultural Handbook 701, Landscape Aesthetics: A Handbook for Scenery Management (USDA Forest Service, 1995; PF Doc. VIS-R01).

VQOs provide measurable standards for scenery management in conjunction with demands for goods and services from the forest. Scenic resource management is integral to all management areas and implied in all management goals. The Forest Plan standard relevant to the Clear Creek visual resources are:

1. Meet adopted visual quality objectives (VQO's).
2. The visual resource has been evaluated based on visual sensitivity levels assigned to travel routes, use areas and water bodies.

The analysis considers the character and appearance of the surrounding natural landscape and the VQOs of areas proposed for treatments as assigned under the current Forest Plan. VQOs are a desired level of scenic quality and diversity of natural features based on physiological and sociological characteristics of an area, and refers to the degree of acceptable alterations of the landscape Management activities such as commercial timber harvest, prescribed burning, and road construction can alter the scenic character of the landscape. There is a potential concern that activities proposed under the action alternatives could adversely affect visual resources to the extent that the Visual Quality Objectives (VQOs) established by the current Forest Plan (1987) would not be met.

Effects to the visual resource are discussed in general terms; however, the indicator used to measure effects is whether or not VQOs are achieved. Visual Quality Objectives are listed in Table 14 (above) for the Clear Creek Project. Below is a brief description of each objective level.

- Preservation: In general, human activities are not detectable to the visitor.
- Retention: Human activities are not evident to the casual Forest visitor.
- Partial Retention: Human activities may be evident, but must remain subordinate to the character of the landscape.

- Modification: Human activities may dominate the characteristic of the landscape but must, at the same time, utilize naturally established form, line, color, and texture.
- Maximum Modification: Human activity may dominate the characteristic landscape, but should appear as natural occurrences when viewed as background.

Scenic resources are managed using the Visual Management System (VMS) which specifies the Visual Quality Objectives (VQOs) for designated areas. VQOs are based on the area seen from sensitive viewpoints such as travel corridors and other features where there may be a high visual sensitivity level.

Table 15: Resource Indicators and Measures for Assessing Effects

Resource Element	Resource Indicator (Quantify if possible)	Measure (Quantify if possible)	Used to address: P/N, or key issue?	Source (Forest Plan S/G; law or policy, BMPs, etc.)?
Scenic Quality	Visual Quality Objectives	Meet Visual Quality Objectives	No	Forest Plan

3.10.4 Methodology

Although the Visual Management System (PF Doc. VIS-R02) has been replaced by the Scenery Management System (PF Doc. VIS-R01), this analysis uses terminology used in the Forest Plan which was developed and written under the former. A crosswalk between the two systems is found in Agricultural Handbook 701, Appendix A (PF Doc. VIS-R01). A variety of tools were used in the visual resource analysis including analyzing VQO maps and visibility modeling.

Treatment units and their associated VQOs were evaluated in relation to visually sensitive viewpoints to determine the extent to which proposed activities would likely be seen, and the likelihood that those activities would adversely affect VQOs. VQO maps prepared under the Forest Plan are very general in nature. Scenic class and sensitivity level can provide a general understanding; however, the maps can't always illustrate how visible specific treatments would be from locations of concern, or the extent to which treatments are likely to stand out or blend with existing scenic features.

Points on VOQ maps with direct line of site to treatment units were identified. Units were observed from these locations, using unit maps. Units are found in the foreground, middleground, and in the backgroundwhen viewed from key viewpoints. To assist in determining unit visibility, the analysis utilized Google Earth (Google Inc. 2012). Treatment units for each alternative were imported into Google Earth and draped over the landscape. Units were then viewed from ground-level or "street view" at a variety of representative sensitive locations, including: Forest Road 286, 284, Lookout Butte Lookout, Corral Hill Lookout, and Trails 723, 728, 130, 150, 151 and 197. This 3-D modeling gives a different perspective on how visible a given area is from a specific geographic location. A limitation of using Google Earth for determining visibility is that near view screening from adjacent trees cannot be taken into consideration; for instance, if you are on a trail or road, the 3-D imaging cannot place you down amongst the trees, where your view might be obscured by trees and other vegetation in the foreground.

Figure 5: Areas of past harvest are intermingled with areas of mature forest

After establishing relative sensitivity of affected areas when viewed from key viewpoints, Agricultural Handbooks 462 and 701 were used as references to determine if proposed activities were likely to modify the landscape to the extent that visual quality objectives could not be met.

3.10.5 Affected Environment

The Clear Creek Integrated Resources Project is located in the Columbia Rockies Subregion, within the Bitterroot Mountain Range. The existing landscape character is one of rolling hills, deep canyons and mixed conifer vegetation. These features are commonly found throughout the Middle and South Fork of the Clearwater drainages and their tributaries.The vegetation is continuous coniferous cover consisting of mostly late seral, non-fire resistant mixed conifer and lodgepole pine forests.

Figure 8: Close up of coniferous vegetation, dominated in this area by grand fir

There are some areas of rock outcrops and some natural vegetative openings, but these elements are a minor component of the landscape character. Broad views of the rolling hills are commonly found along FR 286. Much of the vegetative cover shows evidence of aging and disease. Within the viewshed of the FR 286 the rolling hills have numerous man-made openings in various stages of regeneration.

Figure 6: Intermediate harvest visible along FR 286

Figure 7: Lookout Butte Rental Lookout

There are a number of recreation activities that occur within the Clear Creek drainage including dispersed camping, motorized and non-motorized trail use, driving for pleasure, berry picking and firewood gathering. Lookout Butte Rental Lookout is a popular destination. To the south of the project area is the Elk City Wagon Road and the route of the Southern Nez Perce Trail. Located adjacent to the Elk City Wagon Road is the Corral Hill Lookout. The Elk City Wagon Road route is heavily vegetated, allowing few views north toward the project area.

Minor trail segments are found throughout the area of interest, but the most popular destinations for trail use are found in the central portion of the Middle Fork of Clear Creek drainage. Bisecting the area west to east are Trails 728, 130 and 151. These trails follow the ridgeline above Clear Creek and have view into the drainage. Trail 723 is found in the canyon of Clear Creek and Trail 150 is found east of the South Fork of Clear Creek.

Figure 9: Looking north into the Clear Creek drainage from FR 1855

The Clear Creek area is easily accessed by local residents of Kooskia and other small communities along FR 286. Access from the Elk City Clearwater area is more difficult, with travel over FR 284 which is generally only suitable for high clearance all-wheel drive vehicles. Within the central portion of the area of interest is the Clear Creek Roadless Area which has the theme backcountry restoration.

3.10.5.1 Resource Indicator

While there is evidence of past harvest activities and manmade improvements, these modifications do not dominate the existing landscape character and therefore meet the existing visual quality objectives of partial retention, modification and maximum modification. Areas of vegetative mortality within the existing vegetation do affect the scenic nature of the canyon area.

3.10.6 Environmental Consequences

3.10.6.1 Desired Condition

The desired condition for scenic quality within the area of interest is to retain the existing landscape character and maintain the designated visual quality objectives of partial retention, modification and maximum modification from travel corridors and use areas. The foreground viewing zone of FR 284 and 286 and the trails listed below have the VQO of partial retention (see table below) while several minor trails have VQO of modification in the foreground.

3.10.6.2 Alternative A – No Action

With no harvest activity planned to occur under Alternative A (no-action) there would be no direct or short-term affects to the scenic condition of the area. The openings in forest cover that are visible as a result of past forest management would continue to recover tree growth, and overtime would recover unnatural appearing openings. Processes affecting forest dynamics would continue, including continuing insect and disease related mortality. The amount of dead and diseased coniferous vegetation would continue to increase. While for some this may have a negative impact on the scenic quality of the area, these are considered natural processes therefore the resource area would continue to meet assigned VQOs

3.10.6.2.1 Cumulative Effects

There would be no change in the scenic quality of the area of interest in Alternative A in the short term, but the risk of wildfire would increase with time. The existing openings would continue to regenerate and within 10 - 15 years would no longer appear as openings. The

potential for wildfire would remain. Alternative A would not change the landscape character of the geographic area encompassed within the Clear Creek drainage and its tributaries.

3.10.6.2.2 Compliance with Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

This area currently meets the Nez Perce National Forest Plan Visual Quality Objectives of Partial Retention in the foreground and Modification/Max. Modification in the middle and background viewing zones from all identified viewpoints and viewing corridors. Although there are currently harvest units that appear as openings they do not dominate the existing landscape character of the area.

3.10.6.3 Effects Common to All Action Alternatives

Pre-commercial Thinning – In all action alternatives 1,887 acres are proposed for pre-commercial thinning. The activities outlined for pre-commercial thinning would retain the majority of canopy cover within those harvest units and would there have no long term effect on the scenic quality of the analysis area.

Grass Restoration – In all action alternatives 41 acres are proposed for restoration of native grasses and forbs. This proposal would rehabilitate the area and would therefore have a positive long term effect on the scenic quality of that landscape.

Fuels Treatment – 1,371 acres of prescribed fire are proposed in all action alternatives. The effect of these activities would appear as a natural occurring event and although the burns would change the appearance of the landscape they would appear as a natural process. These activities would meet the scenic quality objectives for the area of interest.

Transportation System – There is no new road construction proposed in this project. There are 119.8 miles of road reconstruction and 13.2 miles of road decommissioning proposed in all action alternatives. There may be some short term effects from ground disturbance related to these activities, but the effect would be limited to the existing road template and its immediate surroundings. The scenic impact of these activities would be minimal and would not affect the scenic quality of the area.

3.10.6.4 Alternative B – Proposed Action

Alternative B proposes to modify the existing vegetation through harvesting and burning activities improve forest health, improve wildlife habitat and reduce the fire hazard. Activities would be grouped in “focus areas” where use of “variable retention” techniques would be used to improve patch size, increase the amount of early seral forest and replant with a mix of species that would improve the long-term resilience of these stands. Healthy stands would be commercially thinned, while stands where root disease was detected would be deferred. The project proposes to treat approximately 8546 acres of the area of interest using regeneration harvest (2,609 acres), improvement harvest (331 acres), and commercial thinning (5,606). Approximately 36.3 miles of temporary road would be needed to complete this alternative including 8.7 miles of temporary road on existing templates and 27.6 miles of new construction.

3.10.6.4.1 Project Design Features and Mitigation Measures

Design features used to reduce the visual impact of the harvest areas include retention of vertical structure within the harvest units and edge treatment that emulates natural openings. Leave trees, that provide vertical structure within the harvest area, may be both live and dead trees

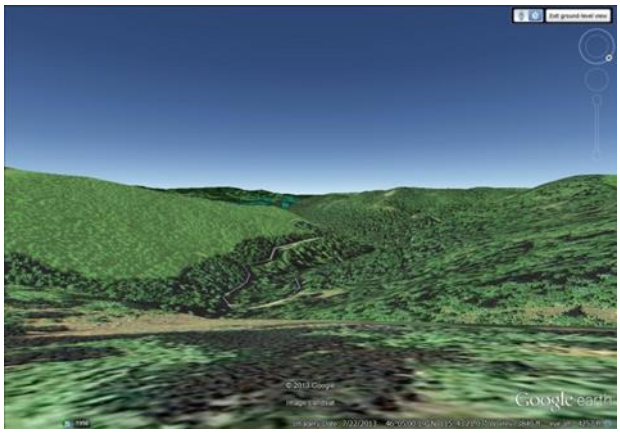
emulating the same structure that would remain after a natural mixed severity wildfire. These leave areas would range from ¼ to 3 acres in size and may include leave areas adjacent to unit boundaries. Unit boundaries for units visible in the foreground would be shaped and feathered to reduce any unnaturally shaped edges and would reduce the hard edges that appear as a man-made features on the landscape.

3.10.6.4.2 Direct and Indirect Effects

This analysis is mainly concerned with the landscape that can be observed from viewpoints identified in the Forest Plan. Proposed activities that are blocked from these viewpoints by terrain are considered to be in compliance with VQOs. Proposed management actions that have concern from a scenic resource standpoint are evaluated for how they conform to naturally occurring features that exist or could be created by natural events. Many of the proposed management features would have short term visual effects, but would not have long term effects on the overall landscape character of the area of interest.

The management activities proposed for the Clear Creek area are located within the middle-ground and background view sheds of Forest Roads 286 and 284, Lookout Butte Rental Lookout, Corral Hill Lookout, and Trails 130, 150, 151, 723 and 728. Although not included in the Nez Perce National Forest Plan, the area is also visible from several minor trails found throughout the Clear Creek drainage. Most of the proposed units would be visible from one or more of the viewpoints found within and surrounding the area of interest.

Figure 10: Looking southwest from FR 286 where units 108, 109, 122, 126, and 130 are seen in the middle ground view.



View from FR 286 - For the most part, views of the area of interest are screened by vegetation and topography for this major access road. There are some viewpoints where there are limited views of the area. Near unit 101 retain vegetative screening to protect views of unit 101 in the foreground in the northwest portion of the area of interest. In the northeastern portion middle-ground views of units 108, 109, 122, 126, and 130 would meet the VQO of Modification from the roadway. These units would remove vegetation that is adjacent to past harvest units reducing some of the straight edges of those existing openings. The new opening would be larger, but would have the appearance of a natural opening created by fire or other natural event.

View from Lookout Butte Lookout Rental – The only harvest activities in the foreground views of the lookout are commercial thinning, which would retain the majority of the canopy cover and would not appear as openings. In the middle-ground view are a number of regeneration harvest units. Units 103, 109 and 114 would be seen along several of the ridgelines, but should be viewed from the side so that the edges are not as apparent. With edge feathering and some retention of vegetative structure these openings should meet the VQO of modification in the middle-ground. Unit 159 to the northwest of the lookout is a large unit that borders past harvest units. The boundary of the unit follows natural breaks where possible, and even though large in size still is within the scale of existing natural openings created by fire events. There are also natural rock outcrops in this unit that would increase the natural appearance of the opening. Thinning in unit 307 can be increased along the boundary with unit 159 also to create a more natural edge.

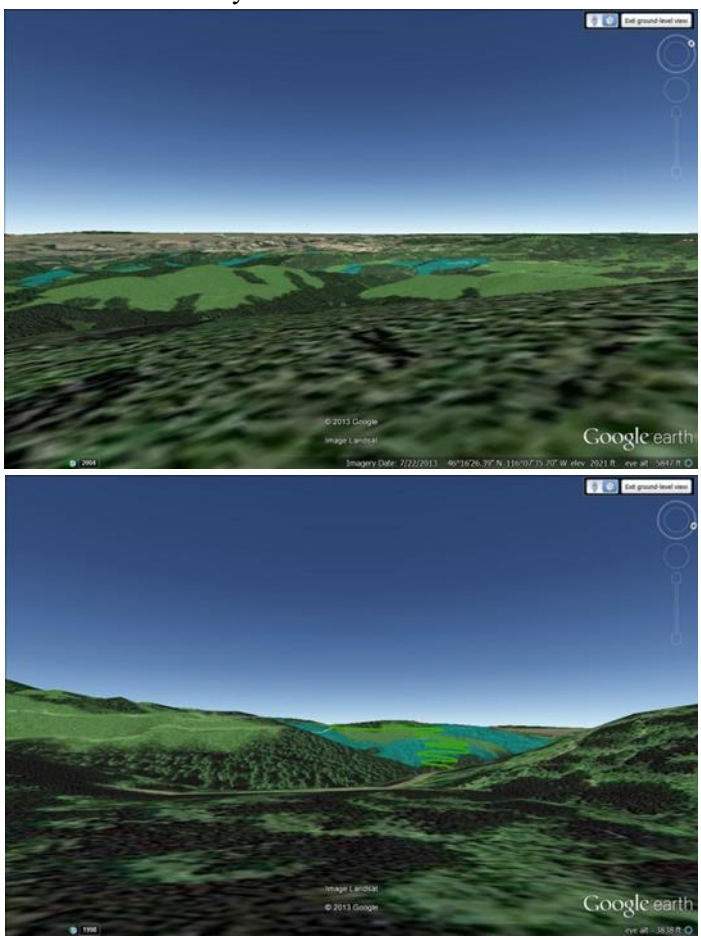


Figure 12: Views from Trail 130 looking toward switchback area of Trail 155. Units 122 and 130 are found on either side of Trail 155

Views from Trails – The trails with the highest sensitivity level are found to the north and south of the South Fork Clear Creek drainage. They include Trails 728, 130 and 150. VQOs in the foreground from these trails are partial retention and modification/maximum modification in the middle-ground. These trails are found on either side of the drainage and are within the Clear Creek Roadless Area. For the most part these trails are screened with vegetation and topography from the proposed harvest activities, but there are some areas where there are viewpoints. Units adjacent to Trail 155 to the south of Trail 130 can be seen from limited viewpoints in the middle-ground, but there are no proposed harvest activities adjacent to these trails except for the commercial thinning unit 122. Vegetation within the immediate foreground of the trail should be retained, but commercial thinning should not alter the view shed and would therefore meet the VQO of partial retention in the foreground. Design measures of edge feathering and retention of stand structure in units 122 and 130 would meet the criteria for modification in the middle-ground for these trails.

Views from Corral Hill Lookout – A number of the focus areas for vegetative treatment can be seen from Corral Hill Lookout. Units 134 and 135 can be seen in the close middle-ground view shed. Treatment of the edges and retention of some stand structure would be critical to retain the natural appearance of these openings. Units 101 – 103 appear in the far middle-ground view. These units would harvest several ridgelines above clear creek. Edge feathering would be critical to maintain the appearance of natural openings in the far middle-ground view shed. Units 150-154 will appear as one large opening to the northeast of the lookout in the middle-ground view. Units 147 – 149 can be seen in the background view of the lookout. The large improvement cut, 505 would also be visible from this lookout. Commercial thinning units throughout the area of interest are also seen from this viewpoint. The appearance from this viewpoint would be changed from the existing condition, but with design measures, openings would emulate natural processes and would reduce the existing straight edges of past harvest activities.

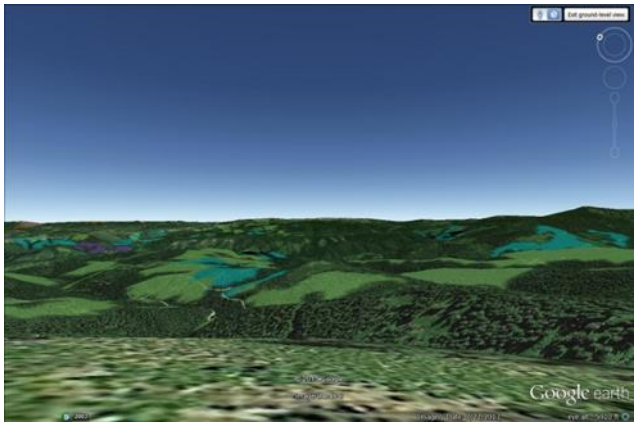


Figure 13: Views north from Corral Hill Lookout. Units 150-154 are located on the left. Units 134 & 135 are visible in the central portion of the view shed.

Overall there would be significant changes to the visual appearance of the Clear Creek drainage and its tributaries. Most proposed units are located adjacent to past harvest areas and would be designed to emulate the visual appearance of past fire activity or other natural openings. With design measures to reduce the man-made appearance of proposed openings, these focus areas would be returned to a more resilient vegetative cover with appropriate seral species and age class mix.

Temporary Road Building – There are 36.3 miles of temporary road building proposed in Alternative B. Of that total, 8.7 miles of temporary road would be built on existing road templates and should have minor visual impacts. The remaining 27.6 miles would be new construction. There would be some visual affect when these roads are constructed, but all of the new construction would only be evident in the middle-ground view shed and would meet the VQOs of Modification and Maximum Modification for those areas.

3.10.6.4.3 Resource Indicator

Past activities are in various stages of re-vegetation, with young timber stands blending in with more mature vegetation. Past activities have utilized harvest methods that left some geometric appearance that emphasizes the man-made opening. Proposed activities would reduce the visual effects of those unnatural openings and openings would be natural appearing in the middle and background view shed so they would not dominate the existing landscape character and therefore meet the Forest Plan Standards for Visual Quality Objectives.

3.10.6.4.4 Cumulative Effects

3.10.6.4.4.1 Past, Present, and Reasonably Foreseeable Activities Relevant to Cumulative Effects Analysis

Since the 1970s there have been timber harvest activities throughout the drainage. Evidence of these activities is visible, but does not dominate the existing landscape character of rolling hills with continuous coniferous vegetation. Past harvesting is in various stages of regrowth, with many areas no longer having the appearance of an opening. There are a number of openings to the within the Clear Creek area of interest that still appear as opening, but they have young plantations that will continue to mature and will no longer appear as an opening within 10 to 15 years.

There is some evidence of past burning activities, but they are minimal and will only have an impact in the short term. Within 5 years these activities will no longer be visible.

The proposal would blend existing units with the proposed units, emulating the appearance of areas that have undergone changes through the natural processes of fire and insect and disease. Thinning is proposed for the previously harvested area, designed to blend into the proposed harvest areas so that unnatural geometric openings are not created. Given the aspect and growing history of the area, the openings created by this proposal would no long appear as openings within 25 – 30 years, but should appear as an area that has experienced the natural process of wild fire rather than man-made openings.

3.10.6.5 Alternative C Modified

Alternative C Modified also proposes to modify the existing vegetation through harvesting and burning activities to improve forest health, improve wildlife habitat and reduce the fire hazard. This alternative proposes to use regeneration harvest rather than commercial thinning in areas that may be experience disease outbreaks. This alternative proposes to treat approximately 8,707 acres of the area of interest using regeneration harvest (4,156 acres), improvement harvest (331 acres), and commercial thinning (4,220). Temporary road construction of 36.3 miles would be the same as proposed in Alternative B.

3.10.6.5.1 Project Design Features and Mitigation Measures

Design features used to reduce the visual impact of the harvest areas would be the same as alternative 2 and would include retention of vertical structure within the harvest units and edge treatment that emulates natural openings. Leave trees, that provide vertical structure within the harvest area, may be both live and dead trees emulating the same structure that would remain after a natural mixed severity wildfire. These leave areas would range from ¼ to 3 acres in size and may include leave areas adjacent to unit boundaries. Unit boundaries for units visible in the foreground would be shaped and feathered to reduce any unnaturally shaped edges and would reduce the hard edges that appear as a man-made features on the landscape.

3.10.6.5.2 Direct and Indirect Effects

Harvesting and burning activities in Alternative C would have greater impacts to the visual resource than Alternative B. Twenty-five of the commercial thinning units proposed in Alternative B would be regeneration units in Alternative C. The change is most evident from Corral Hill Lookout, but can also be seen from Lookout Butte Lookout. The close middle-ground views would have larger and more numerous large openings requiring design measures

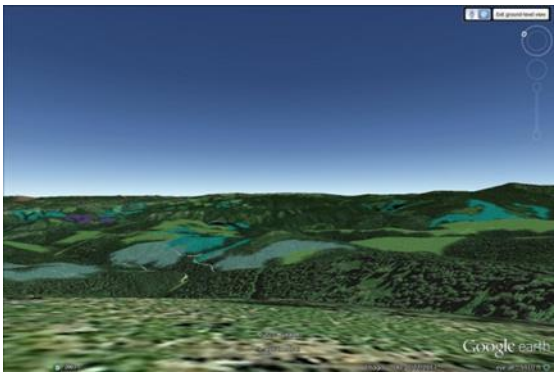


Figure 14: View shed from Corral Hill for Alternative C modified. Units proposed for regeneration harvest instead of commercial thinning can be seen in the central portion of the simulation in the lighter blue color.

of edge feathering and retention of stand structure to maintain the VQO of modification in the middle-ground.

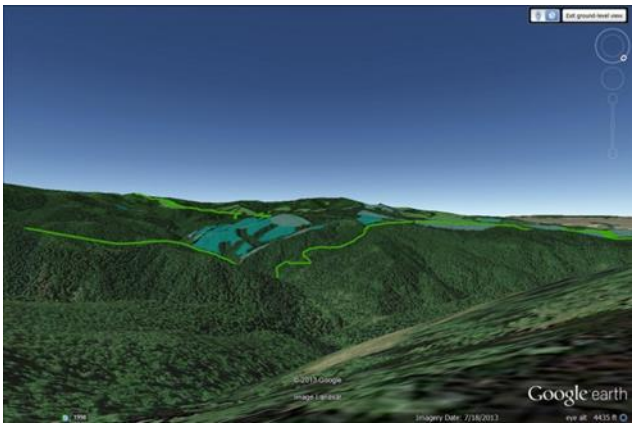


Figure 15: View shed from Trail 728 looking toward Trail 150

The view shed from trail 728 and trail 150 would be affected near units 139 – 141. Commercial thinning units within this focus area would become regeneration units. Unit 221 which is immediately adjacent to trail 150 would now be a regeneration unit. Retention of vegetative screening would be required to maintain the VQO of partial retention in the foreground from this trail. Edge treatment and careful retention of stand structure through the remainder of the units would be needed to maintain the natural appearance of the area in order to meet the VQO of partial retention from these trails.

There would be no temporary road building within the Clear Creek Roadless Area. The total number of miles of road building would be reduced to 5 miles rather than 7. This would reduce the amount of temporary road building that would be visible from FR 233 and from the residences located in the southern portion of the area of interest. It would also eliminate the temporary road building that effected Trail 805.

3.10.6.5.3 Resource Indicator

Past activities are in various stages of re-vegetation, with young timber stands blending in with more mature vegetation. Past activities have utilized harvest methods that left little stand structure within the harvest areas and most areas do have geometric appearance that emphasizes the man-made opening. Past activities either no long appears as openings or are small enough that they do not dominate the existing landscape character and therefore meet the Forest Plan Standards for Visual Quality Objectives. The effects of temporary road building would be minimal, since most will not be visible.

3.10.6.5.4 Cumulative Effects

3.10.6.5.4.1 Past, Present, and Reasonably Foreseeable Activities Relevant to Cumulative Effects Analysis

The cumulative effects in Alternative C would be more visually apparent than alternative B. This would be especially evident from the Corral Hill Lookout and from Trail 150 and 728.

3.10.6.5.4.2 Required Monitoring

This project would be monitored according to Forest Plan requirements.

3.10.6.6 Alternative D

Alternative D proposes harvest of the existing vegetation through harvesting and burning activities to improve forest health, improve wildlife habitat and reduce the fire hazard, but uses more commercial thinning rather than regeneration harvest proposed in either Alternative A or B. This alternative proposes to treat approximately 7.530 acres of the area of interest using regeneration harvest (2,178 acres), improvement harvest (211 acres), and commercial thinning (5,141). Temporary road construction is proposed to be 17.5 miles to reduce effect on wildlife and water resources.

3.10.6.6.1 Project Design Features and Mitigation Measures

Design features used to reduce the visual impact of the harvest areas would be the same as Alternative B and would include retention of vertical structure within the harvest units and edge treatment that emulates natural openings. Leave trees, that provide vertical structure within the harvest area, may be both live and dead trees emulating the same structure that would remain after a natural mixed severity wildfire. These leave areas would range from ¼ to 3 acres in size and may include leave areas adjacent to unit boundaries. Unit boundaries for units visible in the foreground would be shaped and feathered to reduce any unnaturally shaped edges and would reduce the hard edges that appear as a man-made features on the landscape.

3.10.6.6.2 Direct and Indirect Effects

Harvesting and burning activities in Alternative D would have the fewer impacts on the scenic quality of the Clear Creek drainage and its associated recreation facilities as Alternative B or C. The number of regeneration harvest units would be reduced by eleven from Alternative B and by 36 from Alternative C.

There would also be fewer miles of temporary road building with a reduction from approximately 36 to 17 miles of temporary roads.

3.10.6.6.3 Resource Indicator

Past activities are in various stages of re-vegetation, with young timber stands blending in with more mature vegetation. Past activities have utilized harvest methods that left little stand structure within the harvest areas and most areas do have geometric appearance that emphasizes the man-made opening. Past activities either no long appears as openings or are small enough that they do not dominate the existing landscape character and therefore meet the Forest Plan Standards for Visual Quality Objectives. The effects of temporary road building would be minimal, since most will not be visible.

3.10.6.6.4 Cumulative Effects

3.10.6.6.4.1 Past, Present, and Reasonably Foreseeable Activities Relevant to Cumulative Effects Analysis

The cumulative effects in Alternative D would be the less than either Alternative B or C. Regeneration harvesting would be reduced and temporary road building would be reduced in this alternative.

3.10.6.6.4.2 Compliance with Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

All alternatives in this project would meet the Nez Perce National Forest Land Management Plan Visual Quality Objectives.

3.10.6.6.4.3 Required Monitoring

This project would be monitored according to Forest Plan requirements.

3.10.6.7 Degree to Which the Alternatives Address the Issues

Alternative A, the no action alternative, would not improve the scenic condition in the short term or the long term. The existing mixed conifer and lodgepole stands would continue to be effected by insect and disease. Alternative B, while creating multiple openings and thinning stands extensively throughout the Clear Creek drainage and its tributaries would be developed to improve the resilience and health of the vegetation in the long term which would have a positive effect on the scenic resources in the long term. Design measures would be employed to insure that the harvest activities emulate natural processes in the middle and background viewing zones. Construction of temporary roads in alternative B would have a short term effect, but would not be an impact long term. Alternative C would have a greater effect on the visual resource than Alternative B and Alternative D would have fewer regeneration harvest units and would therefore have fewer effects on the visual resource.

Table 16: Alternative Comparison for Visuals

Issue Indicator/Measure	Alt 1 – No Action	Alt B – Proposed Action	Alt C	Alt D
Meeting VQOs	Will meet VQO, but the scenic character of the area will continue to be affected by increases in dead and dying vegetation due to insect and disease. The area will also be susceptible to catastrophic wildfire.	Although activities will be visible, the harvest and burning proposed will meet the VQO of partial retention in the foreground, modification and Modification/Max. Modification in the middle-ground and background. Temporary roads will be visible but will not dominate the existing landscape character. Design measures will be needed for some units to maintain the natural appearance of the area	Harvest activities will have the greater effect on the scenic character of the area. Trail 150 and 728 will have regeneration harvest activity within the foreground viewing zone. Design measures will be critical to maintain the natural appearance of the view shed especially in the foreground and near middle-ground views from critical travel corridors and use areas.	Harvest activities will have less impact to the scenic resources that Alternatives B or C. Regeneration harvest and temporary road building have been reduced in this alternative. Design measures will still be needed to maintain the VQO objectives in foreground and near middle-ground view sheds from critical travel corridors and use areas

3.11 Watershed

This report replaces the one in the FEIS (September 2015).

This section summarizes the effects of the alternatives on water quality and quantity of the Clear Creek Integrated Restoration Project. The revisions in this report include an updated Equivalent Clearcut Analysis, which includes private lands, and an updated NEZSED output utilizing an improved version (2016) of the model and an additional 93 miles of non-system road within the project area watersheds. The differences between the 2011 and 2016 versions of the NEZSED model are discussed in Chapter 1, section 1.9.5 Explanation of Updates to the NEZSED Model of this document and further information can be found in the project file.

Watershed improvement needs were identified during the pre-NEPA stage of this EIS. To accelerate watershed recovery, some watershed improvement activities were authorized under separate decision documents. The effects of those projects have been incorporated into Upward Trend Analysis (Appendix J of FEIS), the existing condition of this EIS, or have been addressed in the cumulative effects analysis. Watershed improvement projects associated with the Clear Creek Integrated Restoration project include: 10 miles of system road decommissioning, 73 miles of non-system road decommissioning, 4 miles of road reconstruction, 49 culvert replacements, and 22 culvert removals. Most of these projects have already been implemented. Future projects include the Clear Ridge Non-System Road Decommissioning Project, which proposes decommissioning 65 miles of nonsystem roads and removing 15 culverts (see Appendix J of FEIS for a more detailed outline).

3.11.1 Analysis Area

The Clear Creek Integrated Restoration Project encompasses 43,730 acres within the greater 58,990 acre Clear Creek watershed (HUC10 #1706030401). Clear Creek is a tributary to the Middle Fork Clearwater River.

The direct and indirect effect areas for sediment yield, water yield, ECA, and road density indicators are the ten Forest Plan prescription watersheds located within the project area. Water yield, ECA, and road density were also analyzed for the three HUC12 subwatersheds within the project area: Upper Clear Creek, South Fork Clear Creek, and Lower Clear Creek. The cumulative effects area for most indicators is the Clear Creek watershed (HUC10). The sediment yield cumulative effects area, as modeled by NEZSED, is the FS lands within the Clear Creek watershed (HUC10) and routed to Clear Creek where it crosses the FS boundary.

3.11.2 Regulatory Framework

Nez Perce Forest Plan direction and all Federal and State laws and regulations applicable to watershed resources would be applied to the Clear Creek project, including the Clean Water Act, Idaho Water Quality Standards, Idaho Forest Practices Act, Idaho Stream Channel Protection Act, and EOs 11988 and 11990, and Soil and Water Conservation Practices (SWCP) Handbook, FSH 2509.22.

The Clear Creek project was designed to comply with these directions and water quality conditions would be improved or maintained following project activities. Streams would continue to support beneficial uses.

3.11.2.1 Nez Perce National Forest Plan

Forest standards for water resources are found in the Nez Perce National Forest Plan on pages II-21 through II-22 and Appendix A (USDA Forest Service 1987a) and are shown in Table 14.

The Forest Plan was amended in 1995, following a joint decision (commonly called PACFISH) by the U.S. Forest Service and BLM for managing anadromous fish producing watersheds on federal lands (Forest Plan Amendment 20). This amendment also includes direction for restoration opportunities and cooperation with other agencies and individuals. For the Clear Creek project, PACFISH riparian habitat conservation areas (RHCA) are considered no-cut stream buffers and are excluded from harvest activities. PACFISH RHCA widths exceed State stream management zone requirements as defined in the Idaho Forest Practices Act.

Forest Plan standards for water quality apply to this project, and compliance would be achieved via field reviews, effects analyses, project design criteria, and BMP implementation.

Table 17: Compliance with Nez Perce National Forest Plan Water Standards

Standard Number[a]	Subject Summary	Compliance Method
Nez Perce Forest Plan Standards		
1	Apply Idaho Water Quality Standards and BMPs.	Project design features and BMPs listed in Chapter 2
2	Utilize R1/R4 sediment yield and R1 water yield guidelines.	Effects analysis
3	Evaluate site-specific water quality effects.	Field reviews (conducted in 2011 and 2012). See project file for field notes and photos.
4	Complete watershed cumulative effects analysis.	A cumulative watershed effects analysis for Clear Creek Watershed was completed for this project.
8	Meet fish and water quality objectives in Forest Plan Appendix A (includes Forest Plan amendments 5, 11, and 26). Eight of 10 prescription watersheds have an upward trend requirement.	Project design criteria and BMPs listed in Chapter 2
Forest Plan Amendment 20 (PACFISH)		
WR-1	Promote ecological integrity through watershed restoration projects.	Project design criteria
WR-2	Cooperate with agencies, tribes, and private individuals.	Ongoing cooperation
WR-3	Prevent degradation (restoration is not a substitute for preventing degradation).	Project design criteria

[a] Standards 5, 6, and 7 do not apply within the context of this project

3.11.2.2 Clean Water Act

The Clean Water Act stipulates that states are to adopt water quality standards. Included in these standards are provisions for identifying beneficial uses, establishing the status of beneficial uses, setting water quality criteria, and establishing BMPs to control nonpoint sources of pollution. EO 12088 also requires the Forest Service to meet the requirements of the Clean Water Act.

Section 313 of the Clean Water Act requires federal agencies to comply with all federal, state, interstate, and local requirements with respect to control and abatement of water pollution, and to cooperate with relevant processes and sanctions and administrative authority.

Section 303(d) of the Clean Water Act stipulates that states must identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). For waters identified on this list, states must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve water quality standards. No streams in the project area are listed for pollutants in the EPA-approved 303(d)/305(b) 2012 Integrated Report (IDEQ 2014).

Section 404 of the Clean Water Act requires permits to dredge or fill within waters of the United States. The U.S. Army Corps of Engineers administers these provisions. Culvert removal and

replacement activities proposed under the Clear Creek project would require authorization under section 404, through application of either nationwide or site-specific permits.

3.11.2.3 Idaho Water Quality Standards

EPA regulations require each state to adopt an anti-degradation policy as one component of its water quality standards. The objective of the Idaho Anti-degradation Policy is, at a minimum, to maintain and protect existing instream water uses and the level of water quality necessary to protect those uses (IDAPA 16.012501.01). Beneficial uses and water quality criteria and standards are identified in the Idaho Water Quality Standards and Wastewater Treatment Requirements (IDAPA 58.01.02, IDAPA 37.03.02).

3.11.2.4 Idaho Forest Practices

This legislation regulates forest practices on all land ownership in Idaho. Forest practices on NFS lands must adhere to the rules pertaining to water quality (IDAPA 20.02.01). These rules are also incorporated as BMPs in the Idaho Water Quality Standards.

3.11.2.5 Idaho Stream Channel Protection Act

This legislation regulates stream channel alterations between mean high water marks on perennial streams in Idaho. Instream activities on NFS lands must adhere to the rules pertaining to the Idaho Stream Channel Protection Act (IDAPA 37.03.07). These rules are also incorporated as BMPs in the Idaho Water Quality Standards.

3.11.2.6 Executive Orders 11988 and 11990

These orders provide for protection and management of floodplains and wetlands.

3.11.3 Resource Indicators

Water Quality and Quantity:

The balance of water yield and sediment yield in a watershed influences the water quality/quantity of a stream system. Water yield refers to stream flow quantity and timing and is a function of water, soil, and vegetation interactions. Changes in amount or distribution of vegetation can affect water yield and ultimately alter stream channel conditions. Although there are no Federal, State of Idaho, or Forest Plan standards governing increases in water yield, there is general guidance on thresholds (NOAA 1998, Gerhardt 2000, USDA Forest Service 1973). Equivalent Clearcut Area (ECA) analysis is a tool used to correlate the relationship between water yield and the extent of forest canopy openings from fire, harvest, and roads.

Active erosion of the landscape yields sediment to streams and occurs naturally. When an excess of sediment—that is, over the natural (balanced) amount—is delivered to a stream, the stream's ability to route the sediment out of the system is diminished, and water quality is reduced. Harvest, temporary road construction, prescribed fire, and road-related activities have the potential to increase erosion production and sediment delivery into streams.

Roads influence both water quantity and quality. Roads concentrate surface water and are a source of sediment entering streams. Watershed road densities >3 miles per square mile (mi/mi^2) are categorized as low condition (i.e., poor conditions for watershed resources) (NOAA 1998).

Resource Indicators:

- Percent increase in ECA for HUC10 and HUC12 watersheds (compare to thresholds in NOAA 1998)
- Percent increase in ECA for Forest Plan Prescription watersheds (compared to guidance limiting increase in ECA to 20-25%, Gerhardt 2000)
- Percent increase in average annual water yield for HUC10 and Forest Plan Prescription watersheds
- Percent sediment yield increase over base (natural), as modeled by NEZSED, for Forest Plan Prescription watersheds and measured to Forest Plan Appendix A sediment yield guidelines (USDA Forest Service 1987a)
- Percent sediment yield increase over base (natural), as modeled by NEZSED, for Clear Creek at the FS boundary.
- Reduction in watershed road miles (HUC10, HUC12, Forest Plan Prescription watersheds)

3.11.4 Analysis Methodology

The watershed analysis was completed at different scales based on designation of Strahler stream order. Stream order is a term used to characterize the branching of a drainage system. A first order stream is a perennial, mapable, unbranched tributary. A second order stream is formed when two unbranched first order channels join together, and continues as a second order stream until it meets another second order channel to become a third order channel, or enters a third order or higher channel as a side drainage. The term "headwaters" are often used to refer to first and second order streams. Forest Plan prescription watersheds are generally 3rd to 5th order streams. USGS watersheds are part of the Watershed Boundary Dataset and the different levels are based on the number of digits in their Hydrologic Unit Code (HUC).This analysis will focus on the Clear Creek HUC10 and the three HUC12s Upper Clear Creek, South Fork Clear Creek and Lower Clear Creek.

GIS-generated reports and maps, aerial photos, and field reviews were used to analyze effects to water quality and quantity from the Clear Creek proposed activities. Resource condition observations were conducted in the field during 2011 and 2012. Headwater channels, ephemeral swales, and springs/seeps in the proposed treatment units and downstream of them were examined and recorded on a map. Forest stand database (FSVeg) queries were conducted to identify past harvest activities and the time frame during which they occurred (see project file). Information from the Selway and Middle Fork Clearwater Rivers Subbasin Assessment (USDA Forest Service 2001) and from the Clear Creek Watershed NFMA Assessment (2012) was used to develop the existing condition and cumulative effects evaluation.

Several analysis tools and models were utilized to calculate resource indicator values in order to compare to threshold levels. Models were used to provide estimates, not absolutes, for comparison of alternatives.

Equivalent Clearcut Area (ECA) analysis is a tool used to index the relationship between vegetation condition and water yield from forested watersheds. The ECA model evaluates vegetation removal and the resulting potential changes to stream flow, timing, and water yield. The ECA analysis for this project utilized treatment and recovery coefficients from Ager and Clifton (2005) to determine existing and percent increase in ECA at the HUC10, HUC12, and Forest Plan Prescription watershed scales. Because harvest and burn history were not available

for private or state lands, size and date of forest openings were determined using NAIP imagery in ArcGIS and Google Earth software.

The ECA model was developed in Region 1 of the Forest Service to analyze the effects of timber harvest and road construction on average annual water yield. The method was developed in the early 1970s by research scientists and several Region 1 Forest Service hydrologists and culminated in the publication Forest Hydrology - Hydrologic Effects of Vegetation Manipulation, Part II (USDA Forest Service 1973). Early guidance for vegetation management recommended that ECA not exceed 20-25% in third to fifth order drainages (Silvey 1973). Stream orders for HUC10, HUC12, and Forest Plan Prescription watersheds are displayed in Table 18 Existing Condition for Clear Creek.

When the ECA model was developed and during the time that many paired watershed studies on clearcut harvesting were conducted, general forest practices included clearcutting with no retention trees; larger harvest units; distinct, linear unit edges; harvest right up to stream channels; higher severity slash removal burns (site prep); and different Best Management Practices than are used today.

Studies by Belt (1980) and King (1989) have served as field tests of the ECA procedure. Belt concluded that the ECA procedure is a rational tool for evaluation of hydrologic impacts of forest practices on third to fifth order drainages, which are typically similar in size or smaller than current HUC12 subwatersheds. King recommended local calibration of the model and a greater emphasis on conditions in first and second order headwater streams.

The Matrix of Pathways and Indicators of Watershed Condition for Chinook, Steelhead, and Bull Trout is an analysis tool adopted by federal agencies to describe the condition and function of many watershed processes (NOAA1998). ECA is one of several indicators used in the matrix. High quality habitat is associated with ECA of less than 15% in a HUC10 watershed and all internal HUC12 subwatersheds, moderate quality is associated with 15-20% ECA in HUC10 watersheds, with one or more internal HUC12 subwatersheds at 15-30% ECA, and low quality is associated with ECA of greater than 20% in a HUC10 watershed, with one or more internal HUC12 watersheds at greater than 30%.

Increases in average annual water yield for the HUC10 and Forest Plan prescription watersheds were calculated for Alternative C using formulas and graphs from Forest Hydrology - Hydrologic Effects of Vegetation Manipulation, Part II (USDA FS 1973).

A Rosgen classification was determined for each of the evaluated streams and sensitivity to disturbance ratings and associated recovery potential ratings were assigned (Rosgen 1994 and Rosgen and Silvey 1996). The streams were also evaluated using the Stream Reach Inventory and Channel Stability Evaluation Guide (USDA FS 1975, Pfankuch 1975). It was used to determine how resistant streams are to recent flow forces exerted on them and the capacity of streams to adjust and recover from potential changes in flow and/or increases in sediment production.

USGS StreamStats was utilized to compute ungagged stream flow information and stream reach information.

The Disturbed WEPP erosion model (Elliot et. al. 2000), and WEPP:Road (Elliot et al. 1999) were used to predict the level of erosion and sediment delivery produced from hypothetical

"average" ground based harvest, prescribed burning, temporary road construction and road improvement activities. The WEPP model is designed to predict sediment yield resulting from various forest management activities and the probability of sediment delivery, erosion, and runoff. The values obtained from the hypothetical "average" activities was used to determine the magnitude of difference between activities and incorporated into the upward trend analysis (Appendix J).

The NEZSED model was used to estimate the predicted percent increase in sediment yield over base (natural) conditions to determine if thresholds from Forest Plan Appendix A would be exceeded. The use of the model is a Forest Plan standard and is useful for comparing alternatives. The NEZSED model was derived from the R1/R4 Guide for Predicting Sediment Yields from Forested Watersheds (USDA Forest Service 1981). The methodology for using the NEZSED model and the model's limitations are described in detail in the Forest's guidance document, Implementation Guide to Appendix A of the Nez Perce National Forest Plan (Conroy and Thompson 2011). Sediment yield is calculated in tons per year and reported as "percent increase over base" conditions. Sediment yield is calculated for base conditions (without management activities), current conditions (cumulative of past and existing management activities combined with base conditions), and predicted conditions (cumulative of past, existing, and proposed activities combined with base conditions) for each of the proposed project alternatives. These percentages of sediment yield over base conditions are then compared to the sediment yield guidelines for prescription watersheds listed in Appendix A of the Forest Plan. Disturbance entries or the numbers of large activities in a decade are also calculated to compare with guidelines established in Appendix A of the Forest Plan. Modeling was done on a peak year basis in order to meet the assumptions under which Appendix A of the Nez Perce Forest Plan was developed. It is highly unlikely, however, that all of the activities proposed would occur in a single year. Additional information about the models used in this analysis and limitations can be found in the project file.

In 2016, changes were made to the NEZSED model (version 2011) spreadsheet to better align with the R1/R4 Guide for Predicting Sediment Yields (USFS 1981) direction, published research papers, and other Forest documentation. The differences between the 2011 and 2016 versions of the NEZSED model is discussed in Chapter 1, section 1.9.5 Explanation of Updates to the NEZSED Model of this document and further information can be found in the project file.

3.11.1.5 Affected Environment

3.11.5.1 Watershed Descriptions

The Clear Creek project area (43,730 acres) is encompassed by the Clear Creek watershed (HUC10), which flows into the Middle Fork Clearwater River. The 58,990-acre Clear Creek watershed contains 3 HUC12 subwatersheds: Upper Clear Creek, South Fork Clear Creek, and Lower Clear Creek. These HUC12 subwatersheds are further divided into 10 Forest Plan prescription watersheds. Leitch Creek and Little Cedar Creek subwatersheds were not considered in the analysis, as they have no Forest Service ownership within them. The existing conditions of the watersheds are shown in Table 18. Watershed boundaries and stream locations are displayed in Figure 16 and Figure 17. No municipal water supplies are within, adjacent to, or downstream of the project area.

There are no Source Water Protection areas that extend into the Clear Creek project area, although the Source Water Area for the city of Orofino (PWS# 2180024 - City of Orofino)

extends to main stem Clear Creek downstream of the project area (Clear Creek and Big Cedar Creek confluence). The IDEQ Source Water Assessment database was used to identify public water systems in Clearwater and Idaho counties that are located downstream of the Clear Creek project. Other than Orofino, all other public water systems including Kooskia and Kamiah originate from wells. Surface Source Water Protection areas extend 25 miles upstream and 500 feet on each side of stream reaches. Implementation of BMPs, including the Idaho Forest Practices Act and Soil and Water Conservation Practices (FSH 2509.22) are sufficient to maintain water quality at the Orofino surface water intake and meet BMPs listed in EPA Region 10 Source Water Protection Best Management Practices for USFS and BLM (Draft October 12, 2005).

A search of water rights applications, permits, decrees, licenses, claims, and transfers was made for the areas located in the Clear Creek project area. Twenty water rights were identified: 19 for the U.S. Forest Service and 1 for the State of Idaho. Uses include minimum stream flow, stock water, and federal reserved use. Further details of each water right are located in the project file. The proposed action alternatives analyzed for this project would not alter any existing water rights claims or decrease the available water relative to these claims.

Table 18: Existing Condition Information for Clear Creek Watersheds

Drainage	Stream Order[c]	Watershed Acres (100% Forest Service [FS] land unless indicated)	Percent of National Forest System Lands with Past Harvest (1956–2005) (%)	Road Density (miles/mile^2)[a]	Percent Equivalent Clearcut Area (ECA) (%)
Clear Creek HUC10 1706030402	**5**	**58,990 (72% FS)**	**26**	**2.7**	**4**
Upper Clear Creek HUC12 170603040201	5	19,166 (97% FS)	36	3.1	3
Pine Knob Creek Forest Plan 170603040601	3	2,622	50	4.8	3
Browns Spring Creek FP 170603040610	3	3,057	40	4.1	3
Clear Creek[b] FP 170603040611	4	7,234 (91% FS)	31	2.3	3
Solo Creek FP 170603040612	3	2,226	51	3.5	3
Middle Fork Clear Creek FP 170603040613	4	4,025	26	2.4	2
South Fork Clear Creek HUC12 170603040202	4	16,478	14	1.8	1
Kay Creek FP 170603040614	3	3,537	13	2.5	2
South Fork Clear Creek FP 170603040615	4	12,941	14	1.6	1
Lower Clear Creek HUC12 170603040203	5	23,346 (33% FS)	40	3.0	6
Hoodoo Creek FP 170603040616	3	6,446	38	3.8	4
Big Cedar Creek[b] FP 170603040618	3	5,542 (13% FS)	70	4.6	10

[a] Includes 10 miles of decommissioning under decision of 2011 South Fork/West Fork Clear Creek Road Decommissioning EA.

[b] ECA and road density calculations include privately owned land portions of the watershed.

[c] Stream orders are based on highest extent of streams as identified during field surveys in 2011 and 2012.

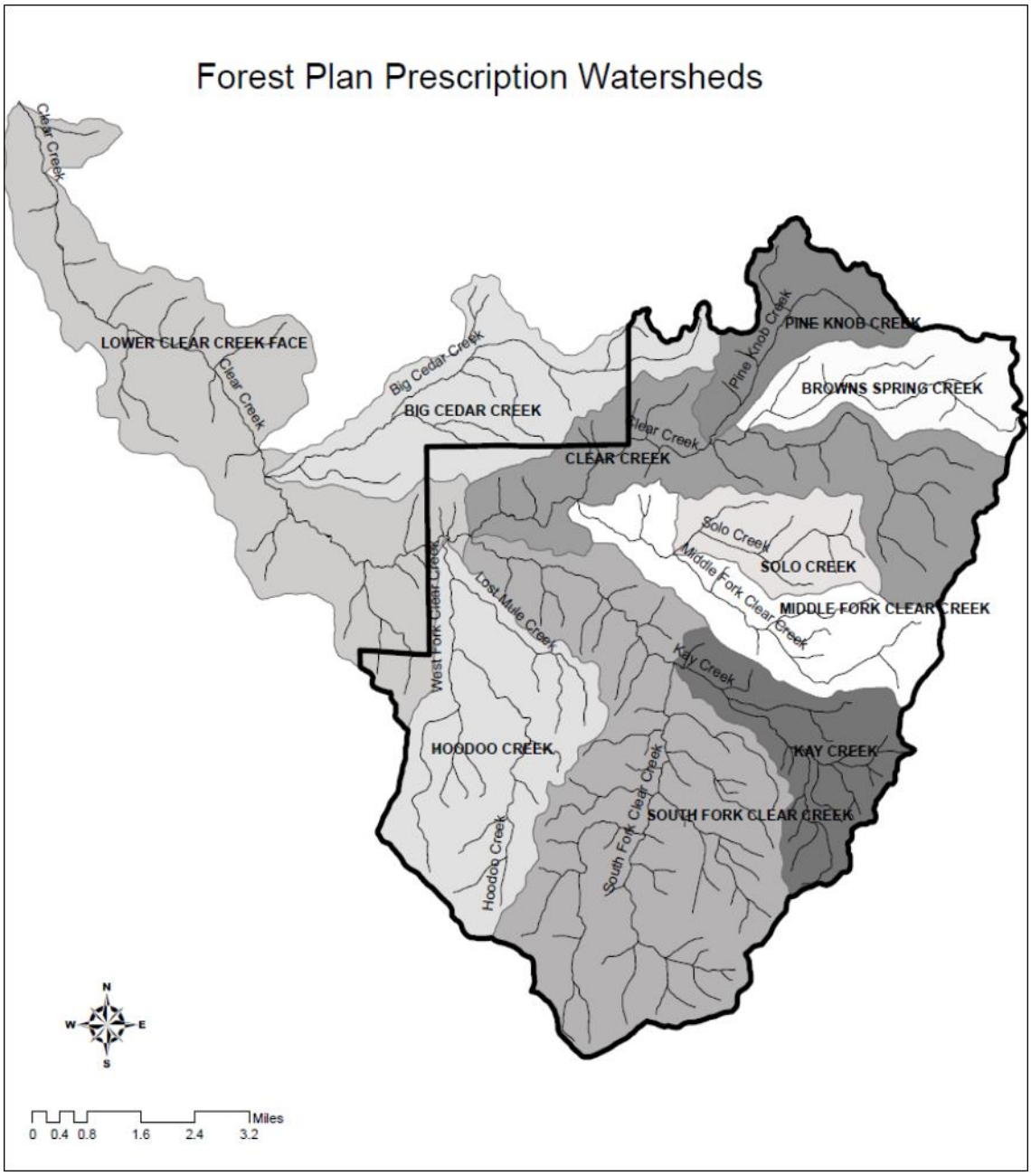


Figure 16: Forest Plan Prescription Watershed and Major Streams in the Clear Creek Watershed

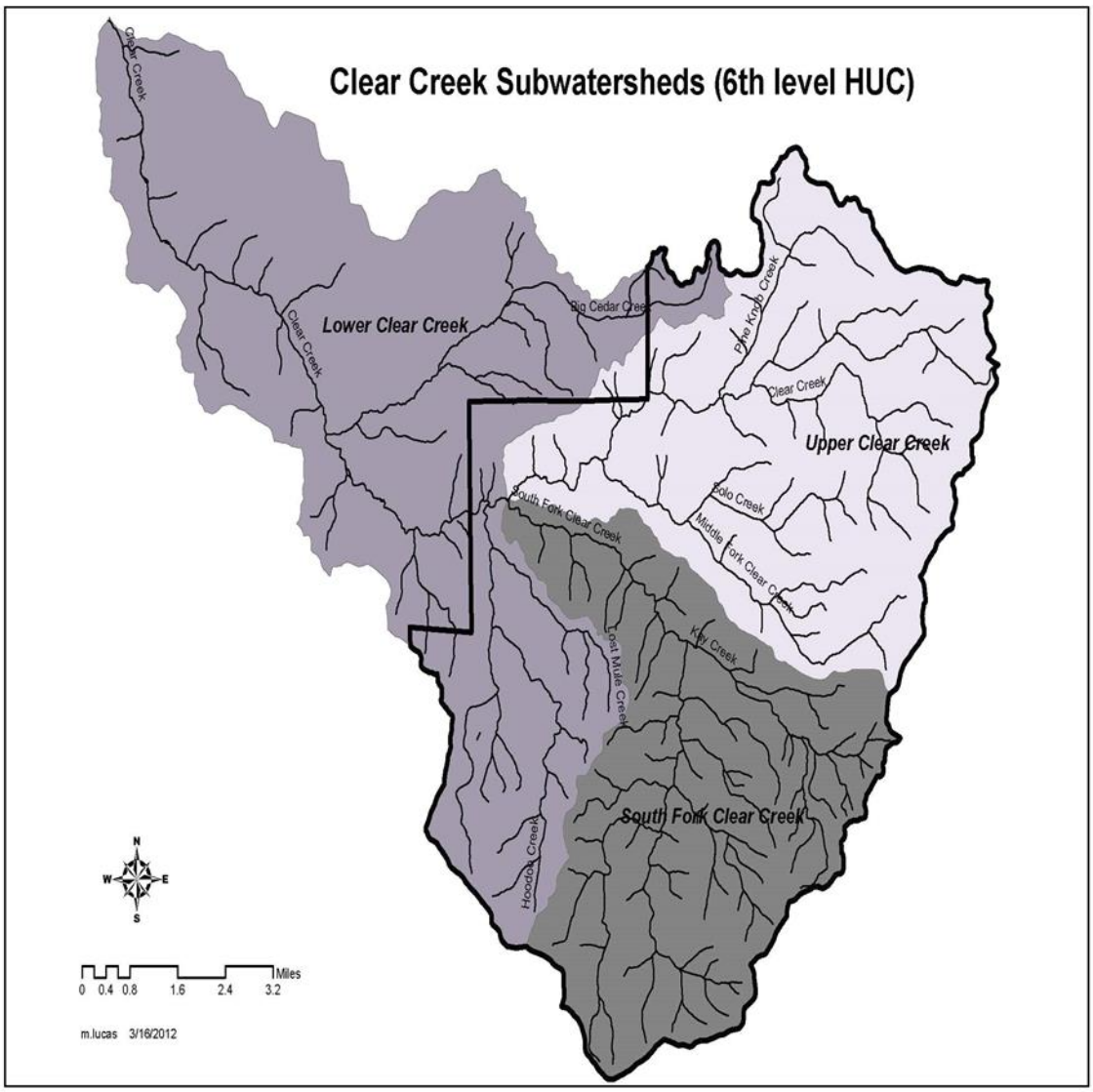


Figure 17: Clear Creek Subwatersheds (HUC12)

Forested seeps and springs are found throughout the project area and often mark the upper extent of perennial flow. Stream channels range from headwater channels that are relatively steep and confined (Rosgen A) to lower-gradient Rosgen B channels (classifications were based on parameters found in Rosgen and Silvey 1996).

Prior to project initiation, the Forest conducted a NFMA analysis (USDA Forest Service 2012) for the Clear Creek Watershed tiered from the Middle Fork Clearwater Rivers Subbasin Assessment (USDA Forest Service 2001). Both the Subbasin and NFMA assessments identified conditions for terrestrial and aquatic habitats. Results were then used to inform and develop the purpose and need for the project. In addition, Nez Perce Forest Plan direction was also reviewed and used to identify prescription watersheds in the project area that did not meet fish/water quality objectives in 1987.

Conditions in the Clear Creek project area are a result of both natural processes and human activities. Past human-related activities include recreation, fire suppression, road building and

maintenance, and harvest activities (1950s–2000s). Past harvest and associated road construction have had the most impact, with some increases in water yield and sediment yield. Harvest activities from 1950s to 2005 have occurred from 5%–70% of the Forest Service owned portions of the prescription watersheds in the Clear Creek project area.

During the summers of 2011 and 2012, resource specialists evaluated conditions of headwater perennial and intermittent channels, ephemeral draws, and springs and seeps within and downstream of the proposed harvest units. Information collected included stream gradient, substrate configuration, bank condition, wetted, bankfull, and floodplain widths, erosion hazards (mass wasting/headcutting), road and culvert conditions at stream intersections, and determining if streams were in equilibrium in regards to cutting and deposition. Headwater channels in this area were found to be generally A3 and B3 channels (Rosgen and Silvey 1996) with well vegetated stream banks and stable substrates. Ephemeral draws showed no evidence of downcutting. In addition, temperature data and instream channel conditions of 3rd to 5th order streams were gathered (see aquatics section). During 2012 field reviews, bank cutting and deposition from 2011 runoff events were noted in Pine Knob and Browns Spring creeks. Comparison of stream conditions in nearby Selway and Middle Fork Clearwater drainages showed similar channel conditions and gage data indicated flows were higher than usual for the area.

Channels are primarily stable and not entrenched, and are fully accessible to their floodplains (which are generally less than 30 feet wide). Banks are stable, and channel substrate consists of silts and sands, gravels, cobbles and small boulders. Based on the indicators observed, most stream segments were considered to be in a stable condition, with balanced cutting and deposition (effectively storing and routing sediment). Aggradation (deposition of fine substrate) was noted upstream of several culverts, particularly culverts that were undersized or were at a flatter gradient than the stream channel. Some stream bank damage was noted in isolated locations where livestock crossed streams or at watering locations. Most of the disturbance occurred on closed roads where roads bisected streams.

Additionally, road and culvert related concerns were identified in the field and prioritized for repair. Some of these items were addressed under separate NEPA decision documents and were incorporated into the existing condition of the EIS or the cumulative effects analyses as a future project. Although assessed during the same pre-NEPA assessment as this EIS, it was determined that implementing these projects through separate NEPA and prior to the completion of this EIS would accelerate watershed recovery. For example the stream adjacent 650D road complex was included in the South Fork/West Fork Clear Creek Road Decommissioning Project EA (2011) and approximately 2.0 miles of road along Hoodoo Creek was decommissioned (see Appendix J Upward Trend Assessment).

A stream stability evaluation was conducted for the 48 stream reaches reviewed in the field to determine how resistant streams were to recent flow forces exerted on them (USDA FS 1975, Pfankuch 1975). The evaluation also helps predict the resistive capacity of streams to detachment of bed and bank materials due to changes in flow and/or increases in sediment production, as well as assessing the ability of channels to adjust and recover from those changes (Phankuch 1975). Fifteen indicators are evaluated and scored a certain value. A final score is achieved by adding the fifteen values. Scores range from 38 to 152. An “Excellent” score is 38 and all 15 indicators have to rate as excellent to obtain this rating. A score of “Good” ranges between 39 to 76, “Fair” ranges between 77 to 114, and a >115 is a “Poor” rating. A stream

channel reach that rates "poor" has a combination of attributes that would require more judicious upstream management of forest lands than one rated "excellent". Rapid changes in the density and aerial extent of vegetation on a watershed can increase stream discharges. Channel systems rated "excellent" can withstand these increases with less damage than systems rated "poor". Most of the streams inventoried rated as Good and would be able to withstand some level of increased stream flows. One of the indicators for upper banks is landform slope and to achieve an excellent rating, bank slope must be <30%. For most of the "V" shaped first and second order streams associated with this project area, bank slopes are generally greater than 30%, making it difficult to achieve an excellent score. (see project file for individual stream reach ratings, photos, and map).

A Rosgen classification was also determined for each of the evaluated streams and sensitivity to disturbance ratings and associated recovery potential ratings were assigned (Rosgen 1994 and Rosgen and Silvey 1996). For the A2 and B3/4 channel types, there is a low to moderate sensitivity to disturbance (includes increases in streamflow magnitude and timing and/or sediment increases) and recovery potential is excellent. The A3/4 channel types are more sensitive to disturbance with a rating of very high to extreme and a very poor recovery potential. These sensitivity parameters were originally designed for livestock grazing management but are still useful in demonstrating that headwater channels in the project area may be more sensitive to disturbance than the larger B channels.

Beneficial uses and water quality criteria and standards are identified in the Idaho Water Quality Standards and Wastewater Treatment Requirements (IDAPA 58.01.02). Designated Beneficial Uses (IDAPA 58.01.02, Section 120) for the Middle Fork Clearwater River Subbasin are cold water biota, salmonid spawning, domestic water supply, and primary contact recreation. Designated Beneficial Uses for Pine Knob Creek, Browns Spring Creek, and Clear Creek (mainstem) are cold water biota, secondary contact recreation, and salmonid spawning. The Idaho Department of Environmental Quality (IDEQ) has determined that the streams are fully supporting those beneficial uses (IDEQ 2012 Integrated Report 2014). For those streams not individually listed (undesignated surface waters), beneficial uses include cold water biota and secondary contact recreation. Solo Creek and Middle Fork Clear Creek were found to be fully supporting these beneficial uses, while Kay Creek, South Fork Clear Creek, Hoodoo Creek, and Big Cedar Creek have not been assessed. The IDEQ direction is to improve or maintain water quality conditions in order to support beneficial uses. No streams within the Clear Creek drainage are listed for impairment by pollutants in the EPA-approved 2012 IDEQ 303(d)/305(b) Integrated Report (IDEQ 2014).

Water Yield: Compaction, disturbance, or removal of the ground surface and disturbance or removal of vegetation can alter water yield. Water yield refers to the volume and timing of stream flow at a given point. In the absence of major disturbance, a stream channel is typically dynamically in balance with its flow regime, which is a key determinant of the energy available for erosion, transport, and deposition of sediment within channels. Increased water yields may be associated with increased probability of peak flow events, which could lead to increased channel and bank adjustment through scour, bedload movement, or redistribution of sediment in depositional areas.

Water yield can increase after loss of mature trees (e.g. through harvest or wildfire) due to a reduction in transpiration and precipitation interception losses. Removal of forest canopy can also affect snow accumulation and melt processes, often resulting in an increase in snowpack

accumulation and melt rates, which can lead to altered timing of peak snowmelt runoff, depending on the size, orientation and total area of clearcuts in a given drainage (Storck et al. 2002, Winkler et al. 2005). The presence of roads and skid trails typically increases overland flow due to soil compaction; these impacts are similar to those of canopy removal from timber harvest. ECA is often used as an indicator of potential changes in water yield and represents the amount of forest canopy openings in the watershed. Existing roads are considered permanent openings in ECA estimates. Lower ECAs generally indicate a higher likelihood that stream channels are in balance with their flow regime.

There are no Federal or State of Idaho standards govern changes in peak flow or water yield. The Forest Plan calls for maintaining the stability, equilibrium, and function of all streams on the Forest, but does not specify a threshold for ECA or increase in water yield. The plan does require that water yield not increase beyond acceptable limits. This guidance was subsequently refined to state that water yield analysis should be done where vegetation removal occurred over a high proportion of a watershed area. High proportion was recognized to vary with watershed and climatic characteristics, but was generally considered to occur when ECA exceeded 25-30% (Gerhardt, 1991). Early Forest guidance for vegetation management recommended that ECA not exceed 20-25% in third to fifth order drainages (Silvey 1973). ECA is also used as an indicator in ESA consultation for habitat condition. An ECA of <15% at the HUC10 and HUC12 scales are associated with high quality habitat (NOAA 1998).

An ECA analysis was conducted to determine the existing ECA condition. Past harvest, wildfire, and roads were included in the analysis and included roads and forested openings on private and state lands. Existing ECAs at the HUC12 scale range from 1% to 6% (Table 18). Each of the subwatersheds is considered in high (good) condition of <15% ECA (NOAA 1998). Existing ECAs in the Forest Plan prescription watersheds ranged between 1% and 10% (Table 18) and are below the recommended threshold of 20 to 25% for 3rd to 5th order streams (Gerhardt 2000).

Sediment Yield: Active erosion of the landscape yields sediment to streams and occurs naturally or as the result of management activities. When an excess of sediment—that is, over the natural (balanced) amount—is delivered to a stream, the stream's ability to route the sediment out of the system is diminished, and water quality is reduced.

Prescription watersheds were assigned fish/water quality objectives in Appendix A of the Forest Plan. These objectives provide management direction in terms of the maximum estimated increase in sediment over baseline conditions that can be approached or equaled for a specific number of years per decade. In 1987, the eight Forest Plan prescription watersheds with assigned objectives did not meet their fish/water quality objectives, and sediment was the primary limiting factor. These same watersheds have an Upward Trend Requirement, which allows timber management to occur, concurrent with improvement efforts, as long as a positive, upward trend in habitat carrying capacity is indicated. Objectives for Big Cedar Creek and Lower Clear Creek Face were not designated, nor were sediment yield guidelines assigned. The sediment yield guidelines (the maximum sediment yield allowable to meet fish/water quality objectives) for each watershed are shown in Table 22. Appendix A of the Forest Plan also assigned entry frequency guidelines for each of the watersheds. Few activities have occurred in any of the watersheds in the past 10 years to qualify as an entry, when considering sediment production. The most recent harvest was the Middle Fork timber sale in the Pine Knob Creek drainage in 2005.

Roads are a source of sediment to streams, particularly at culvert inlets where cutslope slumping occurs and on roads in need of more drainage structures. Road densities within the prescription watersheds range from 1.6 to 4.8 mi/mi^2. A watershed in high (good) condition generally has a road density of <1 mi/mi^2. Watersheds with 1–3 mi/mi^2 are rated as moderate, and those with >3 mi/mi2 are rated as low (poor) condition (NOAA 1998). Of the 10 Forest Plan prescription watersheds, 5 are rated as moderate condition, and 5 are rated as low condition. The baseline road miles for this project include the 10 miles of road decommissioning that occurred under the South Fork/West Fork Clear Creek Road Decommissioning 2011 decision. The 65 miles of non-system roads proposed for decommissioning under the Clear Ridge project were included in NEZSED simulations for estimating sedimentation from recently decommissioned roads.

3.11.1.6 Environmental Consequences

Due to the scale of resource indicator guidance thresholds, direct and indirect effects areas are the three HUC12 subwatersheds and the 10 Forest Plan prescription watersheds. In addition, headwater streams (first and second order) were also evaluated as these areas represent the lowest level at which effects would be detected.

3.11.6.1.1 Alternative A – No Action

Under this alternative, no proposed management actions would occur. Actions occurring on state and private lands would continue. Because no vegetation removal or ground disturbing activities would occur, no direct effects would result from this alternative. Under Alternative A, road density and road-related erosion (indirect effects) would remain unchanged. Benefits from the reconditioning, reconstruction, and decommissioning of roads, proposed as part of the action alternatives, would not be attained. These roads would continue to be a potential source of sediment and would continue to intercept water and reroute it to stream systems.

Forested stands would continue to decline due to insect and disease and lack of regenerating disturbance. Maintenance and re-establishment of long-lived, early seral species would not occur. Risk of large scale, stand replacing fire would increase over time, although the timing, size, or severity of such an event cannot be predicted. Increase in ECA for this scenario was not estimated due to unpredictability of extent of mortality from insect and disease or future wildland fires, but ECA could exceed levels estimated from the action alternatives. Alternative A does not propose any new activities that would directly or indirectly affect wetlands or floodplains or increase water temperatures.

3.11.6.1.2 Alternatives B, C, And D – Action Alternatives

3.11.6.2 Regeneration Harvest, Improvement Harvest, and Commercial Thinning

The CCIR project proposes a mix of regeneration harvest, improvement harvest, and commercial thinning. Acres of each activity by subwatershed are displayed in Table 19. The vegetation treatments would maintain or reestablish long-lived, early seral species and would create a healthier, more resilient landscape better able to survive natural disturbances. Table 19 displays vegetation removal activities by alternative for the three HUC12 subwatersheds. The most harvest occurs under Alternative C, followed by Alternative B, and then D. Harvest activities

were assessed using ECA, increases in percent water yield, and the NEZSED model (sediment yield).

Table 19: Vegetation Removal Activities (Acres) for Each Alternative (Alt.), by HUC12

Subwatershed (HUC12)	Upper Clear Creek 170603040201			South Fork Clear Creek 170603040202			Lower Clear Creek 170603040203		
	Alt. B	Alt. C	Alt. D	Alt. B	Alt. C	Alt. D	Alt. B	Alt. C	Alt. D
Regeneration	1,209	1,486	993	698	868	518	700	1,798	667
Commercial thin	2,774	2,625	2,699	883	714	719	1,946	880	1,720
Improvement	227	227	140	0	0	0	97	98	65
Temporary roads outside units	9.1	9.1	5.2	3.5	3.5	2.9	5.7	5.7	1.9
Prescribed burn	601	601	601	326	326	326	445	445	445

Note: Does not include precommercial thinning

<u>The following water yield and sediment yield analyses are based on the original acreages as proposed in the FEIS (2015) and do not include the reduced harvest acres proposed in this SEIS. It is assumed that with less harvest acres, the effects would be less than that described in the below analyses.</u>

3.11.6.2.1 Resource Indicator: Water Yield

The effects of vegetative manipulation on water yield are complex, highly variable, and depend on many independent factors such as elevation, climate, aspect, and especially precipitation. Removal of vegetation has the potential to increase stream flow in the short term (0–10 years) due to changes in evaporation, precipitation, wind patterns, and soil infiltration and percolation (Fowler et al. 1987; Dunne and Leopold 1978).

In studies summarized by Grant et al. (2008), detectable increases in peak flow (10%) generally occur when more than 20% of a watershed (<10 km2 drainages) is harvested. Clearcut harvest prescriptions were the primary focus of those studies. Increase in stream flow is generally not measurable until at least 20 to 30% of a watershed's forest cover is removed (MacDonald and Stednick 2003). Stednick (1996) suggests that flow changes are not measurable when <25% of the watershed is clearcut. Conclusions from the studies are mostly based on research in small tributary watersheds (approximately 200 acres, but Troendle et al. (2001) found that the hydrologic effects of forest management on a 6.5 mi2 basin were directly comparable to the results from much smaller basins. At Coon Creek in south-central Wyoming there was a detectable change in annual water yield as a result of harvest and road-building on 24% of the watershed (Troendle et al. 2001). The size of the study area was 6.5 mi^2 (approximately 4,000 acres) and roughly the equivalent of the Forest Plan prescription watersheds. Changes in runoff measured on small experimental basins can be scaled up to much larger basins (MacDonald and Stednick 2003). A review of paired catchment experiments concluded that at least 15-20% of a forested basin must be treated within a short time period in order to detect a change in runoff (Bosch and Hewlett 1982). Troendle and Leaf (1980) noted that 20-30% of a watershed must be treated to detect a statistically significant change in flow. Recommendation in USDA Forest Service (1970) suggested not clearcutting more than 25 to 30 percent of a 3rd order drainage area to stay below a 8-10% increase in average annual water yield (recommended threshold).

As shown in Table 21, regeneration harvest activities would occur on 1% to 22% of the Prescription watersheds (Alt. C). Proposed regeneration harvest accounts for <8% of any of the HUC12 subwatersheds.

The effect of thinning overstocked stands on water yield is usually minor, and hydrologic recovery can occur within 5 years (USDA Forest Service 1973). Analysis of water yield is probably not necessary for treatments that remove 20% or less of basal area, because the effects are not likely measurable (Troendle et al. 2009). Effects of thinning, fuel treatments, and partial cuts on water yield are likely to be short-lived and may not even be measurable (Troendle et al. 2009). ECA is used as an indicator of change in water yield resulting from reductions in forest canopy. The ECA analysis takes into account the initial percentage of crown removal and the recovery through vegetative regrowth since the initial disturbance. Existing roads are considered permanent openings in ECA estimates. The analysis takes a simple snapshot in time, with the assumption that all Clear Creek project activities would be implemented in a single year. ECA predictions are used to compare alternatives and are not viewed as absolutes. This water yield indicator serves only as a red flag that suggests a potential for decreased stability due to sustained increased energy in the stream channel. ECA is used in combination with other indicators such as channel stability and channel type to determine hydrologic risk.

The ECA method was developed to address concerns regarding water yield increases and potential effects on channel morphology. In the 1970s and 1980s, channel impacts (primarily scouring) were often observed, and these impacts were thought to be caused by water yield increases. During that period, clear-cutting was common, timber harvest levels were substantially higher, and impacts to streams were common. Forest management practices have changed dramatically since that time. Streams now have no harvest buffers of 100–300 feet on both sides of the watercourse, and BMPs are implemented on all projects. These changes have greatly reduced the impacts of forest management on stream channels and aquatic habitat.

ECA was calculated at two scales: 1) the HUC12 scale in order to compare to the thresholds in The Matrix of Pathways and Indicators of Watershed Condition for Chinook, Steelhead, and Bull Trout (NOAA 1998) and 2) the Forest Plan prescription watershed scale to compare to guidance limiting ECA to 20 to 25% for 3rd to 5th order streams (Gerhardt 2000). ECA calculations include vegetation alteration from the 2015 Baldy Fire.

ECA at HUC12 subwatershed scale: A lower ECA values corresponds to a lower likelihood that undesirable effects of increased water yield (e.g. elevated channel and bank scour) would occur. An ECA value of less than 15 percent is unlikely to result in measurable change in water yield, a condition rated as “high” or healthy by NOAA Fisheries (1998). At the HUC12 scale, ECAs of <15% indicate high (good) condition. ECAs of 15%–30% indicate moderate condition and ECAs of >30% are considered low (poor) condition (NOAA 1998). The estimated percent increase in ECA from harvest activities, temporary road construction, and prescribed burning ranges from 5% to 13%, depending on watershed and alternative (Table 20). When these increases are added to the existing ECAs, they produce ECA estimates that predict what watershed conditions would be like after the Clear Creek project. These ECA estimates range from 9% to 15% for Alternative B, 10% to 15% for Alternative C, and 8% to 14% for Alternative D. The highest increases in ECA occur under Alternative C, followed by Alternative B, then D.

For the Upper Clear Creek HUC 12 subwatershed, watershed condition would move from high (good) condition to a moderate condition for Alternatives B and C, but would remain in good condition for Alternative D. South Fork Clear Creek subwatershed would remain in good

condition for the ECA indicator for all alternatives. For the Lower Clear Creek subwatershed, watershed condition would move from a good to moderate condition for Alternative C, but would remain good for Alternatives B and D. Although two subwatersheds would change from a good to moderate condition, the percent ECAs are on the low end of values within the moderate category.

Table 20: Estimated Percent Increase in Equivalent Clearcut Area (ECA) from Project Activities (HUC12) for Modeled Year 2015, by Alternative (Alt.)

HUC12 Subwatershed	Existing ECA[a]	Estimated Increase in Percent ECA from Project Activities			Final Percent ECA (Existing plus Project)		
	Alt. A	Alt. B	Alt. C	Alt. D	Alt. B	Alt. C	Alt. D
Upper Clear Creek	2	13	13	13	15	15	14
South Fork Clear Creek	3	6	7	5	9	10	8
Lower Clear Creek	6	7	9	6	13	15	12

[a] ECA calculations include privately owned land portions of the watershed and 2015 Baldy Fire.

Note: Vegetation removal activities include prescribed burning, regeneration, commercial thinning (but not precommercial thinning), improvement, and construction of temporary roads. Numbers are rounded up or down to the nearest whole number.

ECA at Forest Plan prescription watershed scale: As suggested in Belt (1980), ECA calculations were originally proposed for third to fifth order stream drainages. Early guidance suggested ECAs not exceed 20 to 25% in 3rd to 5th order drainages (Gerhardt 2000). Forest Hydrology - Hydrologic Effects of Vegetation Manipulation, Part II (USDA FS 1973) describes that most 3rd through 5th order drainage channels on the Nez Perce National Forest can sustain a 10% increase in average annual runoff as a result of timber harvest before increases are detectable. Using calculations and graphs documented in Forest Hydrology, Part II (USDA FS 1973), it was determined that for an average 5,000 foot elevation (range of 3,500 to 6,000 feet), a limitation of 10% increase in average annual runoff, and a water yield increase factor of 40% (F factor), an allowable ECA for these drainages equate to 25% (ranges between 22% to 29% depending on elevation).

Final ECAs for the Forest Plan prescription watersheds range from 3% to 20% for Alternative B, 3% to 26% for Alternative C, and from 2% to 19% for Alternative D. The highest increases in ECA occur under Alternative C, followed by Alternative B, then D (Table 21).

Table 21: Estimated Percent Increase in Equivalent Clearcut Area (ECA) from Project Activities in Forest Plan Prescription watershed for Modeled Year 2016, Percent of Regeneration Harvest, and Percent Increase in Average Annual Water Yield by Alternative (Alt.)

Forest Plan Prescription Watershed	Existing ECA[a]	Final Percent ECA (Existing plus Project)			Percent of watershed with proposed Regen Harvest (Alt. C)	Percent increase in average annual water yield* (Alt. C)
	Alt. A	Alt. B	Alt. C	Alt. D		
Pine Knob Creek	3	14	14	14	4%	5%
Browns Spring Creek	3	19	19	17	9%	8%
Clear Creek	3	15	15	12	7%	6%
Solo Creek	3	16	19	18	17%	8%

Forest Plan Prescription Watershed	Existing ECA[a]	Final Percent ECA (Existing plus Project)			Percent of watershed with proposed Regen Harvest (Alt. C)	Percent increase in average annual water yield* (Alt. C)
	Alt. A	Alt. B	Alt. C	Alt. D		
Middle Fork Clear Creek	2	7	9	7	5%	<5%
Kay Creek	2	3	3	2	2%	<5%
South Fork Clear Creek	1	8	9	7	6%	<5%
Hoodoo Creek	4	20	26	19	22%	10%
Big Cedar Creek	10	14	15	13	5%	6%
Lower Clear Creek Face	5	6	6	6	1%	<5%

* Formulas, assumptions and calculations can be found in the project file; calculations include 2015 Baldy Fire.

Estimated final ECAs were highest in the Hoodoo, Browns Spring, and Solo Creek watersheds, but are within the range of recommend allowances. As stated above, these ECA estimates are based on the assumption that all project activities would occur in 1 year. In reality, these activities would be staggered over several years. For example, this project could be broken up into seven different timber sales and harvested over a 7-year period. Units in Browns Spring and Solo Creek areas (Upper Clear Creek) would be split out into two to three timber sales and harvested at different time periods. The same would be done for those units in the Hoodoo and West Fork Clear Creek areas (Lower Clear Creek).

Additionally, increases in average annual water yield for each of the Forest Plan prescription watersheds were calculated for Alternative C using formulas and graphs from Forest Hydrology - Hydrologic Effects of Vegetation Manipulation, Part II (USDA FS 1973). Isaacson (1997) concluded that when average annual flows are exceeded by more than 10 percent channel damage could begin to occur. Most 3rd through 5th order drainage channels on the Nez Perce National Forest can sustain a 10% increase in average annual runoff as a result of timber harvest before increases are detectable (USDA Forest Service 1973). Other guidance documents (USDA Forest Service 1970) indicated that when the average annual water yield is increased by 8-10%, stream channel damage (aggradation-degradation) could be initiated. The potential for alteration develops during the spring runoff period. The degree of change or rate at which it occurs is dependent upon the degree of stream channel stability that presently exists and the type of stream channel that would carry the increased yield. Increases in water yield from the proposed activities were estimated to be 10% or less for the Forest Plan prescription watersheds (Table 19), which are predicted to be below detectable limits. Increases over the recommended 10% increase in average annual water yield are generally allowed when stream banks are more than 60% stable. As stated above, most of the streams reviewed in the field were in a stable condition with Phankuch ratings of Good.

Morphologic and hydrologic condition on third order or larger streams may minimize their vulnerability to harvest-related flow increases. The morphology of most third order and larger stream bottoms tend to minimize the scour of increased flows (Rainville 1987). Stream channels naturally experience bank full flows about once every two years (Leopold et al. 1964). Flows that exceed the channel capacity flood into the riparian zone. This reduces the erosion potential of peaks because the water flows over a much wider area and flows over energy reducing

vegetation and wood. For flood flows to cause significant channel scour, they would have to be large enough to overcome this energy dissipating system. If canopy removal affects only small to moderate sized peaks and generally results in less than a 20% increase in water yield, the increase in flow may be insufficient to overcome the energy absorbing affect (Rainville 1987).

Much research has been conducted on harvest activities and the potential for increased water yield. Most of the studies conclude that removal of forest vegetation increases water yield to some extent, but there is much variability in conclusions (summarized in Grant et al. 2008, Bosch and Hewlett, 1982; Stednick, 1996, MacDonald and Stednick 2003). The broad variation in findings suggests that one or more studies can be found to support nearly any point of view. Several of the earlier studies regarding harvest and increased water yields analyzed paired watersheds—one watershed with no harvest as the control and another usually 100% clear cut (summarized in Stednick 1996 and Bosch and Hewlett 1982). Forest practices in these studies included cutting up to the stream channels and hot, broadcast burning of slash. Newer practices include retention of large green trees, snags, and downed wood material, utilization of Riparian Habitat Conservation Area no cut buffers, less ground disturbing logging systems, and less intense slash reduction methods.

Many of these studies looked at clearcut activities in areas with openings of >2–5 tree heights distributed over a substantial portion of a watershed (Kendall 1999, Troendle and King 1987, Winkler et al. 2005). The mechanism for altering flows is largely from two sources: reduced evapotranspiration rates following vegetation removal and altered rates and patterns of snow accumulation and melt (Grant et al. 2008). The rate of snowmelt depends upon many factors such as the silvicultural treatment, size of openings, aspect, and climate. Increased exposure of snowpacks to solar radiation and thermal radiation from surrounding trees or stands, melts snow faster and earlier in the spring (Troendle 1983), which can result in increased water yields and peak flows. A substantial portion of a watershed would have to be effectively treated to cause a significant change in the timing and magnitude of snowmelt (Kendall 1999). In general, maximum snow retention occurs in clearings of approximately 5 tree heights in diameter (approximately 500 to 600 feet) (USDA Forest Service 1973). Although studies have shown localized increases in snow accumulation, they found no statistically significant change in mean snow water equivalent over the entire watershed as a result of clear-cut openings (Troendle 1983). The increases in snow water equivalent found in clearings were balanced by losses from adjacent forested areas. Clear-cuts that are small enough to be shaded by nearby forest (1 to 3 tree heights) will melt later and may not contribute to streamflow at all (MacDonald 1989).

Proposed variable tree retention levels of 14–28 trees per acre for this project would be left as singles or clumps depending on the locations of the larger legacy trees and species wanted for retention and could look similar to Figure 18. No cut riparian buffers would also provide retention areas within and adjacent to regeneration harvest units. Snow accumulations would occur in the smaller openings between clumps within the regeneration harvest units, but larger accumulations are not expected, due to design criteria limiting openings to 2 acres in size without leave tree retention.

Figure 18: Variable Retention Example from the Nez Perce - Clearwater National Forest

The magnitude of any peak flow increase in response to forest management diminishes with increasing basin area for several reasons, including attenuation of flood peaks because of channel resistance, flood-plain storage, and transmission losses, as well as effects of storm size and origin (Archer 1989, Garbrecht 1991, Shaman et al. 2004, Singh 1997, Grant et al. 2008, MacDonald and Stednick 2003)

No hydrologic mechanism exists by which peak flow increases, when measured as a percentage change, can combine to yield a higher percentage increase in peak flows in a larger basin. As a consequence, the magnitude of peak flow increases for larger basins will necessarily be equal to or smaller than those reported for small watersheds. (Grant et al. 2008). Some factors affecting timing and amount of runoff include: variability of snow accumulation, timing of snow melt due to aspect and elevation, amount of available water storage in the soil, and underlying parent material. King's studies (1994) conducted on the Nez Perce National Forest showed that while there was evidence of peak flow increases in the headwater first and second order streams, they were cumulatively not detectable on the main stem (third order). The larger the drainage area, the less likely synchronization of flows will occur due to the greater opportunity for storage (Megahan 1972). Most stream channels experience bank full flows about once every 2 years. Flows which exceed the channel capacity flood into the riparian zone, which reduces the erosion potential of peaks by flowing over a larger area containing vegetation, trees, and other obstructions.

Water yield changes resulting from timber harvest in the northern Rockies typically includes an advance in the timing of the rising limb of the snowmelt hydrograph and an increase in the total volume of runoff. Changes were most evident in the first 10 years after harvest (Hicks et al.

1991, Jones 2000. Even where rain-on-snow is an issue, the biggest effect on smaller peak flows is at recurrence interval (RI) less than one year (i .e., lower than the bankfull event) (Harr 1976, Harr 1986, Zeimer 1998). Larger flows tend to be dominated by the rainfall component of the storm, and the snowmelt component has little influence on the flood size. Increases in runoff following forest harvest are substantially greater in wet years than in dry years (MacDonald and Stednick 2003). Early studies, such as Wagon Wheel Gap (1928) and Fools Creek (1969), demonstrated that in areas where the majority of precipitation is in the form of snow, increase in water yield occurred primarily during the snow melt runoff season. Although water yield increases of 16% and 25% were noted in these studies, both reported that no damage to channels occurred nor was sediment increased significantly (USDA Forest Service 1973). Utilizing predictions from Bosch and Hewlett (1982) there would be an approximate 20% increase in water yield if 50% of forest vegetation was removed in small tributary drainages (study areas were about 50-300 acres in size). This calculation is based on a 40 mm increase in water yield per 10% change in cover and a mean annual precipitation for the project area of 1100 mm.

Research in the nearby Horse Creek watershed study area (Nez Perce National Forest) demonstrated instantaneous peak flow increases of up to 34 percent and maximum monthly flow increases up to 44 percent, resulting from road construction and timber harvest (patch clearcutting) in small catchments (King, 1989). The East and Main forks of Horse Creek are third order streams with watersheds of approximately 4,000 acres. The Horse Creek study watersheds were first and second order drainages ranging between 60 and 380 acres in size. Although there were increases in stream flows noted at the smaller tributary watersheds, there was no detectable change in any stream flow parameters at the Main Fork Horse Creek gage station (King 1989).

For first order drainages, approximately 50 percent (range 40 to 60 percent) of a drainage could be regeneration harvested (utilizing variable tree retention with approximately 20% tree retention, including no-cut buffers) and still fall within the approximately 40% PECA (range 20 to 60%) allowable in first order drainages before increases in water yield exceed 10% (Benoit 1973). This estimate is for first and second order drainages (generally 50 to 300 acres in size) with elevations of 3,500 to 5,500 feet and with stream channels of Good condition. The Probable Equivalent Clearcut Area (PECA) was originally created for the Clearwater National Forest. Additionally, guidance in Forest Hydrology - Hydrologic Effects of Vegetation Manipulation, Part II (USDA Forest Service 1973) recommends a 50% maximum area in clearcut condition for second order streams and 70% for first order streams.

There are some first and second order stream drainages within the project area that have 50% or more proposed regeneration harvest treatment within their drainages. These regeneration treatment areas include portions of Units 103 and109 (Clear Creek drainage); 128, 229, and 234 (West Fork Clear Creek drainage); 139, 141, and 226 (South Fork Clear Creek drainage) and 145 (Kay Creek drainage).

Generally, a 20% reduction in unit acres occurs due to additional wetlands and streams being located during marking of unit boundaries in the field. These areas receive no-cut harvest buffers. Also any additional landslide prone areas identified during unit boundary layout and marking of trees are dropped and protected with no-cut harvest buffers.

Most of the first and second order streams in the within and adjacent to harvest units are greater than 10% gradient, with gravel/cobble substrates, and have small average annual water yields and peak flows. For example a tributary to Clear Creek (located between Units 102 and 103)

with a drainage area of 320 acres, has a stream gradient of over 10%, cobble substrate, an average annual flow 0.4 cfs, and a bankfull peak flow of 5.5 cfs. Clear Creek at that point has an annual flow of 20 cfs and bankfull flow (peak1.5) of 130 cfs. Third to fifth order streams downstream of harvest units range between 4 and 10%. As discussed in Grant et al. (2008) peak flow effects on channel morphology are generally limited to stream reaches where channel gradients are less than approximately 2% and in which streambeds are composed of gravel and finer substrate material. There are very few areas in the Clear Creek project area with these characteristics (see stream evaluation field notes in the project file. There are short sections (100-500 feet in length) in the third to fifth order streams that have a <2% gradient, but sections have predominantly cobble sized substrate. Longer sections of <2% gradient occur in main stem Clear Creek (300 to 2500 feet in length) on Forest Service land and downstream of the project area on privately owned lands, but again, substrates are moderate in size (cobbles and some small boulders) and not subject to scour. Peak flow effects on channel morphology are generally not found on high-gradient (>10%) streams and are minor in most step-pool systems (Grant et al. 2008).

Stream channels directly downstream of harvest units are Rosgen A and B channels (Rosgen and Silvey 1996). Based on the bank and channel substrate of these streams, they have a low (Rosgen B3) to extreme (Rosgen A4) sensitivity to disturbance rating and a very poor (Rosgen A4) to excellent (Rosgen B3) recovery potential. Field assessments confirmed that streams in the project area are in good condition. Changes in channel conditions are not expected to occur because gradients are mostly >10%, large wood material is present and anchored, steam banks are well armored with vegetation and rock, substrates are primarily cobble size and angular and are unlikely to be displaced by elevated water yield or peak flows.

3.11.6.2.2 Resource Indicator: *Sediment Yield*

Ground-disturbing harvest activities can also increase erosion and sediment loads in the intermittent and small perennial channels within and adjacent to treatment units (0–2 years). Topography, retained woody material, and no-cut PACFISH buffers would capture and store most of the erosion material. As ground cover is reestablished, hillslope erosion would diminish (0–3 years). Headwater streams and wetlands typically trap and retain much of the sediment that washes into them. The faster the water travels, the larger the particles it can carry. Natural obstructions in small streams, such as rocks, downed logs, or even just a bumpy stream bottom, slow water and cause sediment to settle out of the water column (Meyer et al. 2003). Also, as gradient flattens and stream energy diminishes fine sediment is deposited. Deposition often occurs at area where higher gradient tributaries or sections of streams meet lower gradient streams. As noted above in the water yield section, lower gradient areas (<2%) occur in short, dispersed segments in most of the main channels and are the areas where larger amounts of fine materials are located and stored (see field survey information).

The NEZSED model was used to estimate the predicted percent increase in sediment yield from the proposed activities under Alternatives B, C, and D. **The predicted increases in sediment production by the NEZSED model are for relative comparison to existing conditions and do not reflect actual instream sediment yields expected from the project.** Modeling was done on a peak year basis in order to meet the assumptions under which Appendix A of the Nez Perce Forest Plan was developed. It is highly unlikely, however, that all of the activities proposed would occur in a single year. The 2015 Baldy Fire was included in the NEZSED model calculations.

The NEZSED model results have their primary utility in comparing differences between each proposed alternative and the no action alternative. Model results are also useful for comparing the proposed alternative to the guidelines in Appendix A of the Forest Plan. The sediment yield guidelines were established to reflect the sediment-carrying capacity of the stream system. A more detailed discussion of the NEZSED model can be found in the Forest Plan Appendix A guidance document (Conroy and Thompson 2011).

Table 22 displays the natural (base) erosion rate, the percent increase sediment yield over base, due to project activities, and the sediment yield guidelines delineated in Forest Plan Appendix A (USDA Forest Service 1987a). Five of the eight prescription watersheds would remain below the sediment yield guidelines, under all alternatives. Sediment yield percent over base exceeded the Forest Plan Appendix A guidelines for all action alternatives for the Browns Spring Creek prescription watershed and Alternative C for the Clear Creek and Solo Creek prescription watersheds. The highest increases were found in Alternative C, followed by Alternative B, then D. Sediment yields would return to current conditions within seven years, as modeled, and would be approximately 1% less than Alternative A due to road decommissioning activities.

Table 22: NEZSED Estimated Sediment Yield

Forest Plan Prescription Watershed[a]	Cumulative (Existing Sediment + Project) Percent over Base (Natural)				
	Alt. A	Alt. B	Alt. C	Alt. D	Forest Plan Appendix A Sediment Yield Guidelines[b]
	Peak Year				
Pine Knob Creek Natural erosion rate[c] = 111 T/yr/mi^2	4%	31%	31%	31%	45%
Browns Spring Creek NER = 121	8%	50%	50%	47%	45%
Clear Creek NER = 383	4%	28%	31%	28%	30%
Solo Creek NER = 79	5%	40%	45%	41%	45%
Middle Fork Clear Creek NER = 169	4%	25%	28%	24%	30%
Kay Creek NER = 121	5%	13%	13%	11%	45%
South Fork Clear Creek NER = 622	3%	14%	14%	12%	45%
Hoodoo Creek NER = 247	11%	47%	53%	43%	60%

a Big Cedar Creek and Lower Clear Creek Face watersheds were not assigned fish/water quality objectives or sediment yield guidelines, primarily because most of the area is on private lands.

b Forest Plan Appendix A guidelines to meet fish/water quality objectives.

c Natural erosion rate is the base sediment yield (Tons/year/square mile) a watershed would produce under natural conditions.

No adjustment was made in the modeled sediment yield for increased traffic associated with project activities. It is acknowledged that additional sediment yield would occur due to traffic increases from logging operations. This would be mitigated through road maintenance, road

improvements, rock surfacing, application of dust abatement material, and timber contract provisions. Foltz (1996) found that rock surfacing with good quality aggregate reduced the sediment produced from unpaved forest roads. The addition of cross drain adjacent to perennial streams would further reduce the potential sediment delivery from ditches to streams.

At the levels planned, proposed harvest and burning activities would be considered an entry when compared to the Forest Plan standard. This entry is within Forest Plan Appendix A guidelines because no activities qualifying as and entry have occurred in the last decade in nine of the ten Forest Plan prescription watersheds. For Pine Knob Creek, an entry was made in 2005 for the Middle Fork timber sale. This watershed is allowed 2 entries per decade, so it also meets the Forest Plan guideline.

Implementation of project design measures, adherence to BMPs, and maintenance of no-cut PACFISH buffers would reduce potential erosion and further limit the risk of sediment reaching streams. Any sediment yield increases would be short-term (0–6 years following project activities), and beneficial uses in Clear Creek and the Middle Fork Clearwater River would be maintained.

3.11.6.2.3 Conclusion: Regeneration Harvest, Improvement Harvest, and Commercial Thinning Activities:

The combination of water yield and sediment yield effects from harvest activities are not anticipated to result in changes in channel morphology of sufficient magnitude to alter physical parameters such as width/depth ratio or pool volume in 3rd to 5th order streams. Some changes could occur in limited reaches, especially in small headwater streams, where localized bank cutting or scouring could occur.

Forest harvest and fuels treatments should have minimal adverse effects on water quality if they are carefully designed and conducted in accordance with best management practices (MacDonald and Stednick 2003). Proposed harvest activities are currently planned to be separated into seven different timber sales over a 7-year period (see tables and map below). This is only an estimate and is subject to change based on the decision made as a result of this EIS. Proposed timber sales are staggered across the Clear Creek watershed to better distribute harvest activities. For example proposed harvest in the Upper Clear Creek subwatershed is scheduled to be separated into four sales (see figures below for further information). Project specific design measures (see 2015 FEIS Chapter 2 pgs. 2-5 to 2-9) were created to minimize potential increases in sediment and water yields. Best Management Practices and Soil and Water Conservation Practices (FSH 2509.22) are incorporated into the design criteria.

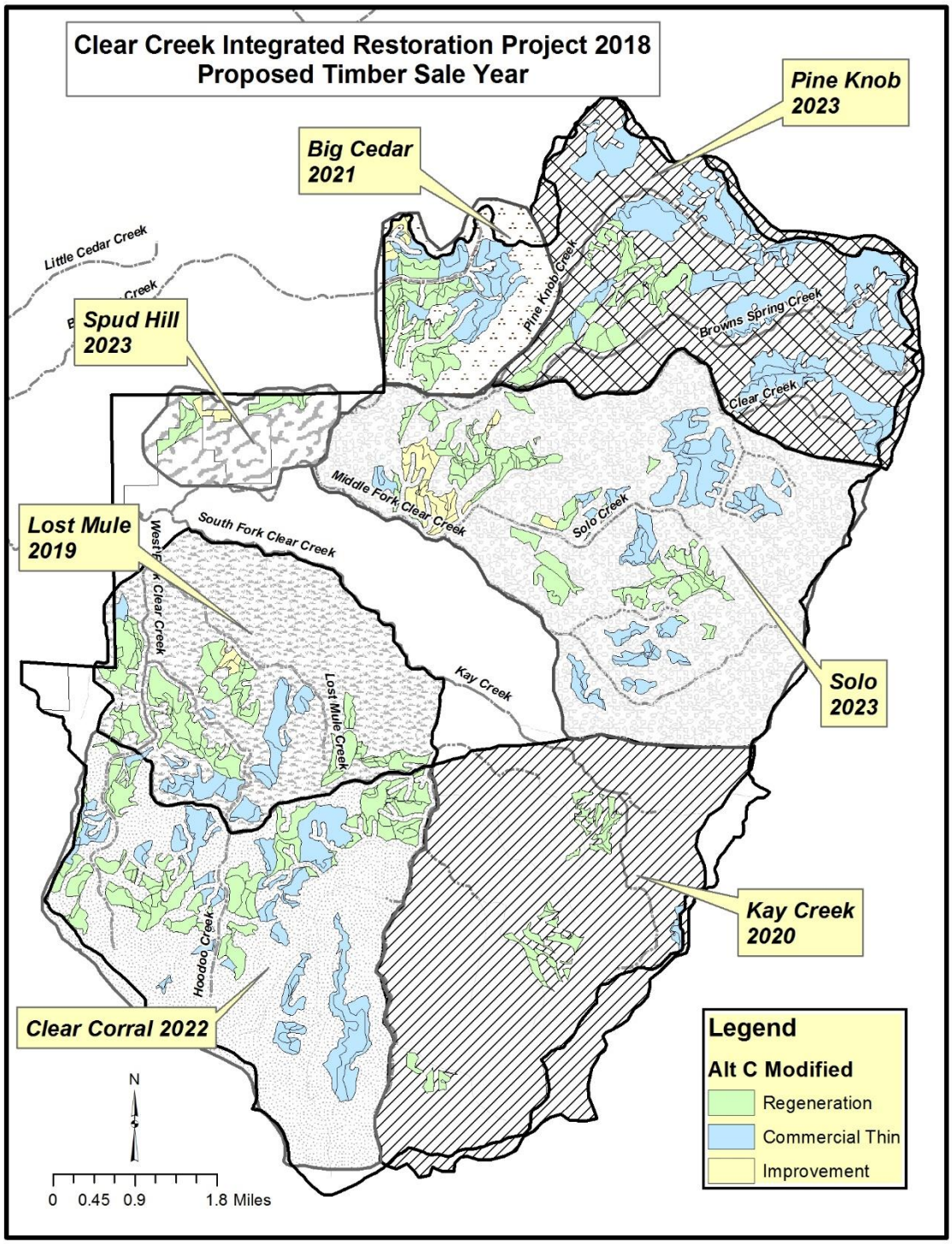
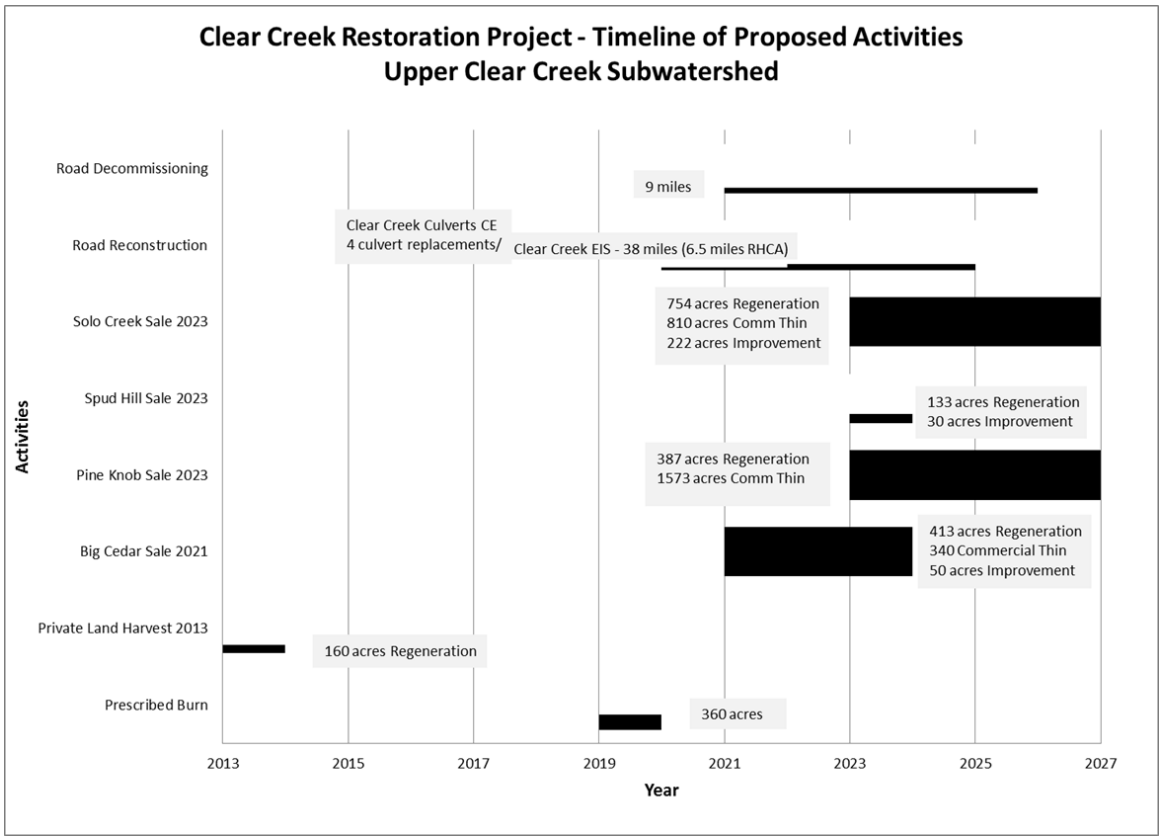


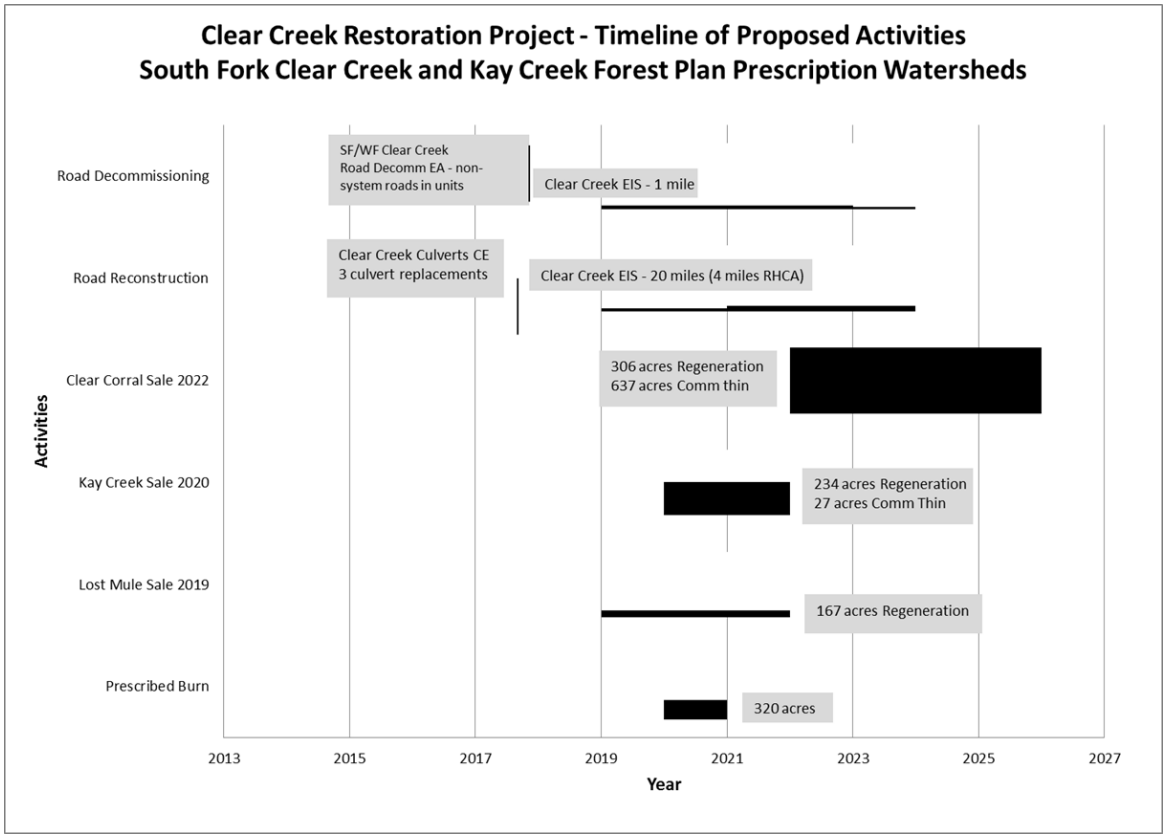
Figure 19: Proposed Timber Sale Year Map

Figure 20: Timeline of Proposed Activities - Upper Clear Creek Subwatershed



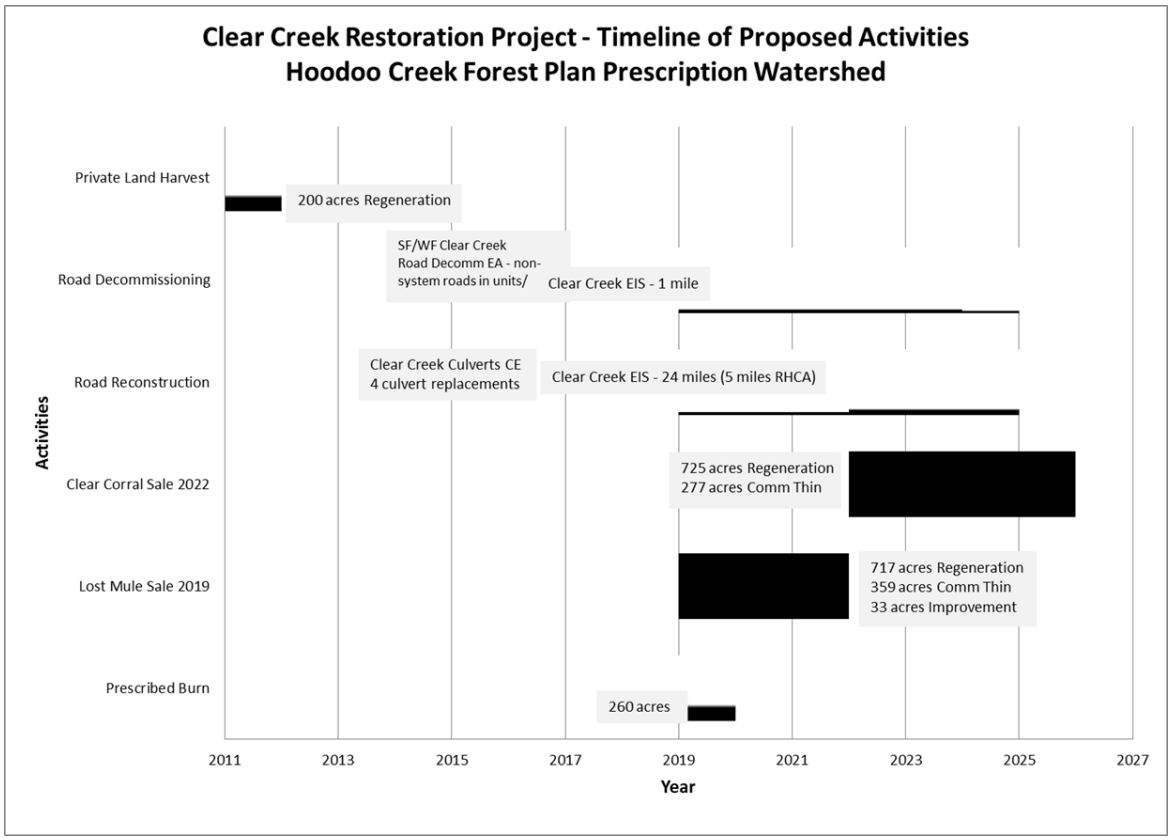
Bar height indicates the relative acreage of activity and width indicates estimated length of activity. Occurrence of activities is based on the current 10 year planning schedule and is subject to change. Implementation of prescribed burns is dependent on burn prescription and airshed quality/smoke guidelines. Includes Pine Knob, Browns Spring, Clear Creek, Solo Creek, and Middle Fork Clear Creek Forest Plan Prescription Watersheds.

Figure 21: Timeline of Proposed Activities - south Fork Clear Creek and Kay Creek Forest Plan Prescription Watersheds



Bar height indicates the relative acreage of activity and width indicates estimated length of activity. Occurrence of activities is based on the current 10 year planning schedule and is subject to change. Implementation of prescribed burns is dependent on burn prescription and airshed quality/smoke guidelines. Includes South Fork Clear Creek and Kay Creek Forest Plan Prescription Watersheds.

Figure 22: Timeline of Proposed Activities - Hoodoo Creek Forest Plan Prescription Watershed



Bar height indicates the relative acreage of activity and width indicates estimated length of activity. Occurrence of activities is based on the current 10 year planning schedule and is subject to change. Implementation of prescribed burns is dependent on burn prescription and airshed quality/smoke guidelines.Includes Hoodoo Forest Plan Prescription Watershed.

3.11.6.2.4 Landscape Prescribed Burning

Low- and mixed-severity landscape prescribed fire is proposed on 1,371 acres in 15 units (701–715) for all action alternatives. This activity was assessed using ECA and the NEZSED model. The NEZSED results are included in the calculations displayed in Table 22 above. Resulting ECA increases are included in Table 21 above.

Burn severity would be low enough to maintain much of the duff layer to help prevent germination of invasive species. Fire would not be ignited within PACFISH buffers (riparian or landslide prone), although fire would be allowed to back into these areas. This design measure would reduce the potential for erosion on sensitive landscapes and areas close to stream channels. There will be some increases to Water Yield where overstory trees are removed through burning, cumulatively the burning with proposed harvest will remain below levels where stream function would be diminished through increases in water yield. Prescribed burning is a moderate contributor to sediment yield and cumulatively the likely increases in sedimentation to streams should be below levels where stream function will be altered as show in the NEZSED results in Table 22.

In addition the proposed burning in Units, 42 acres of restoration is proposed in bunchgrass communities. This area would be treated through prescribed burning and revegetated with native grasses and forbs. Burn severity is expected to be low, with no increase in soil erosion to contribute to sediment yield.

3.11.6.2.5 Precommercial Thinning

Although precommercial thinning would cause some opening of the canopy, ECA would not increase; therefore, water yield would not increase either. Ground vegetation would be left undisturbed. Thinning would be completed with chainsaws, so no ground-disturbing activities would take place; therefore, neither soil erosion nor sediment input to streams would increase.

3.11.6.2.6 Temporary Road Construction

Approximately 36 miles of temporary roads would be constructed to access harvest units for Alternatives B and C, 8.7 miles of which occur on existing templates. Alternative D proposes 17.5 miles of temporary roads, including 8.7 miles located on existing templates. Temporary roads generate the most erosion when they are first constructed, and lesser erosion would occur during the 1–2 years the proposed roads would be open. Erosion would stabilize 2 years after decommissioning occurs. Temporary roads were included in the ECA and NEZSED analyses. Increase in ECA from temporary road construction is <1% for all watersheds and increase in water yield from this activity is unlikely. As outlined in the Implementation Guide to Appendix A (Conroy and Thompson 2011), temporary roads interior to harvest units are not modeled by NEZSED separately, but are incorporated into the computation for the harvest unit. When a temporary road is located on unstable mid-slopes or crosses streams, the road is modeled separately. Roads exterior to harvest units are modeled separately.

Temporary roads on existing templates calculated individually are modeled as having an erosion rate increase of 18,000 tons/square mile the year of construction, 5,000 tons/square mile for the years the road is being used and one year after decommissioning, and then goes to zero two years after decommissioning. Newly constructed temporary roads calculated individually are modeled as having an erosion rate increase of 67,500 tons/square mile the year of construction, 18,000 tons/square mile in year two, and 5,000 tons/square mile for the years the road is being used and one year after decommissioning, and then goes to zero two years after decommissioning.

The erosion potential from temporary roads for all alternatives would be short-term (5years), since the roads would be built, used, and decommissioned over a period of 1–3 years and located on low-gradient, dry ridges or upper slopes, away from water, with no stream crossings.

Project design measures for temporary roads would minimize the erosion produced over the short life of these roads. For example, temporary roads would be closed to public motorized use during project activities, reducing the chance of increased erosion from vehicles driving on wet roads and rutted surfaces. Water bars and placement of roads on the landscape help to reduce the likelihood of channelized flow leaving the road surface and entering riparian areas or system road ditches. Temporary roads would be decompacted and fully recontoured following project activities. Large wood material and organic materials would be positioned over exposed soils to reduce erosion potential and better accelerate recovery.

3.11.6.2.7 Road Reconditioning and Reconstruction

Road improvement activities are proposed to address existing road concerns as well as preparing the roads in a manner so that sediment production from log haul is limited. Road reconditioning of system roads is proposed on approximately 48.8 miles. Each of the roads proposed for reconditioning are listed in Appendix B of the 2015 FEIS. Reconditioning is a combination of road ditch clean-out, blading and shaping the road surface to maintain a proper road template and drainage, or surfacing. This treatment is similar to road maintenance. Road reconditioning was calculated as an increase in sediment yield in the NEZSED model. As outlined in Conroy and

Thompson (2011), road reconditioning is modeled as moderate reconstruction with an erosion rate increase of 18,000 tons/square mile the year of work. Erosion rates return to the existing 5,000 tons/square mile in year 2.

Road reconstruction of system roads is proposed on approximately 119.8 miles. Each of the roads proposed for reconstruction are listed in Appendix B. Reconstruction includes replacing and installing new culverts for cross drains and live water crossings, placement of rock surfacing, placement of roadway fill, and installation of new signs or gates. Road reconstruction was calculated as an increase in sediment yield in the NEZSED model. As outlined in Conroy and Thompson (2011), road reconstruction is modeled as major reconstruction with an erosion rate increase of 67,500 tons/square mile the year of work and 18,000 tons/square mile in year 2 (similar to new permanent road construction). Erosion rates return to the existing 5,000 tons/square mile in year 3.

Most of the roads in the Clear Creek project area were evaluated in the field and road recondition and reconstruction was prescribed as needed. These road improvement activities are meant to address the key points that are delivering the highest amount of sediment to streams. For example, a recent study using GRAIP monitoring showed that 7% of all drainage points in the study area delivered 90% of the road related sediment, and 2% delivered 50% of sediment (Black et al. 2013). Adding cross drains to roads in order to drain ditches prior to entering perennial stream channels would reduce sediment delivery dramatically.

Road maintenance and improvements are considered a beneficial effect to water quality (Burroughs 1990; Grace and Clinton 2006; Swift and Burns 1999). Surface graveling has been shown to be effective at reducing erosion from road surfaces, especially at road/stream crossings. Studies have found gravel reduces sediment by 70%–79% (Burroughs and King 1989). Increased drainage culverts, especially on either side of stream channels, would further disconnect the road system from the perennial stream network; lessening sediment delivery. Although this activity is designed to reduce sediment input over the long term, a minor increase in sediment is expected to occur at the time of the activity and the year following (2 years).

3.11.6.2.8 Road Decommissioning

Road erosion and sediment yield usually decline over time but continue at a chronic level indefinitely (USDA Forest Service 1981). Approximately 13.2 miles of road are proposed for decommissioning with this project. Road removal would reduce road density (Table 20) and provide an improvement in the overall watershed condition. However, even with the proposed road decommissioning, the current (existing) watershed condition ratings would remain the same for each of the watersheds. For Big Cedar Creek, road miles on the Forest Service portion of the watershed were reduced by 20% and road miles on landslide prone areas were reduced by 15%.

At the HUC12 level, road density in Upper Clear Creek went from 3.1 mi/mi^2 (high/poor condition) to 2.8 mi/mi^2 (moderate condition). In Lower Clear Creek, road density went from 3.0 mi/mi2 to 2.9 mi/mi^2. South Fork Clear Creek road density remained moderate at 1.8 mi/mi^2. Table 23 displays the number of road miles proposed for decommissioning within each of the Forest Plan Prescription watersheds and resulting road densities. Table 23, Column 2, shows road density prior to the South Fork/West Fork Clear Creek road decommissioning project that was completed under a separate Environmental Assessment (USDA Forest Service 2011b) and was incorporated into the existing condition of this project. Although assessed during the same NFMA as this project, it was determined that decommissioning 10 miles of system road prior to the completion of this project would accelerate watershed recovery.

Table 23: Estimated Reduction in Road Density from Clear Creek Project Activities

Forest Plan Prescription Watershed	Road Density Before EA[a] (2011)	Existing Road Density[b] (miles/miles^2)	Proposed Road Decommissioning (miles)	Road Density after Clear Creek Activities[b]
Pine Knob Creek	4.8	4.8	1.81	4.3
Browns Spring Creek	4.1	4.1	4.52	3.2
Clear Creek	2.3	2.3	0.52	2.3
Solo Creek	3.5	3.5	1.34	3.1
Middle Fork Clear Creek	2.4	2.4	1.29	2.2
Kay Creek	2.6	2.5	0.94	2.4
South Fork Clear Creek	1.6	1.6	0	1.6
Hoodoo Creek	4.6	3.8	0.78	3.8
Big Cedar Creek	4.6	4.6	1.72	4.4
Lower Clear Creek Face	1.8	1.8	0	1.8

[a] South fork/West Fork Clear Creek Road Decommissioning 2011 decision
[b] Includes private and Forest Service roads

Road decommissioning activities would benefit water resources by reducing flow energy on roadbeds and within ditches, while reducing road-related sediment. The proposed road decommissioning projects include the removal of culverts, which would improve stream bank stability, width-to-depth ratio, and floodplain connectivity at localized sites.

Road decommissioning was included in the NEZSED model calculations displayed in Table 18. Decommissioning is modeled as having an erosion rate of 18,000 tons/square mile the year of obliteration, 5,000 tons/square mile the year following, and then drops to zero two years after decommissioning.

Road decommissioning activities would produce some short-term sediment, both temporally and spatially (Foltz et al. 2007). Some short-term sediment delivery is expected in the smaller tributaries that bisect the decommissioned roads. Sediment would be delivered during project implementation and during the stream channel stabilization period of 2–3 years. Past monitoring of road obliteration showed only minor amounts of sediment delivered to headwater streams, mostly in the form of suspended sediment, as indicated by increases in turbidity.

Design criteria and BMPs would be applied to each of these activities to minimize increases of sediment delivery to stream channels. Road decommissioning may produce short-term (0–3 years) and localized sediment increases, but it would produce both immediate and long-term recovery benefits.

3.11.6.2.9 Water Temperature

The Clear Creek project is not expected to measurably influence stream water temperatures. This is primarily due to implementation of no-cut PACFISH buffers, where there would be no removal of trees within RHCAs, and thus would have minimal impact on stream shading in the project area. Other stream channel features and processes that support or enhance cold stream temperatures, including variability and duration of floodplain inundation, channel complexity,

balanced scour/fill, high pool volume, and downed trees in riparian areas would also be maintained. The aquatics specialist report discusses stream temperature in more detail.

3.11.6.2.10 Floodplains and Wetlands

US Fish and Wildlife Service National Wetlands Inventory maps were initially reviewed for inventoried wetlands. Approximately 1525 acres of wetlands were identified in the project area and 103 acres are located within proposed harvest units. Field reviews by hydrologists, fish biologists, botanists, and soil scientists were conducted within all timber harvest and burn units and on all roads where work would be performed under this project. Stream channels, seeps, springs, wet areas, hydrophilic vegetation, hydric soils, and wetlands were identified and were mapped using field GPS techniques and subsequently digitized into GIS to ensure they were tracked.

Within harvest units all wetlands, including seeps, springs, and streams would be protected by no-cut PACFISH RHCAs. There would be no temporary road construction constructed within floodplains or wetlands.

Direct and indirect effects could occur on wetland areas and within stream floodplains during installation, replacement and/or removal of culverts. However these effects, both undesirable and beneficial, are expected to be insignificant.

Section 404 of the Clean Water Act requires permits to dredge or fill within waters of the United States. The U.S. Army Corps of Engineers administers these provisions. Each year, the Forest consults with appropriate agencies to evaluate permitting needs on all actions that could affect stream channels (including wetlands). Culvert removal and replacement activities proposed under the Clear Creek project would require authorization under section 404, through application of either nationwide or site-specific permits.

No proposed project activities are expected to negatively change the functions or values of wetlands and floodplains as they relate to protection of human health, safety, and welfare; preventing the loss of property values, and; maintaining natural systems. The goals of Executive Orders 11988 and 11990 would be met.

3.11.6.3 Cumulative Effects

Cumulative effects arise when the incremental impact of an action is added to impacts from past, present, and reasonably foreseeable actions. Past harvest activities and associated road construction have had the most impact, with increases in water yield and sediment yield in the Clear Creek drainage and its tributaries.

The cumulative effects area is the Clear Creek watershed (HUC10), which encompasses the entire Clear Creek project area and state and private lands.

The temporal scope for watershed effects extends from the 1950s to 2037. The beginning date is based on the time frame of the first harvest and road construction activities in the watershed. Evidence from those events is still noticeable on the landscape in the form of old skid trails and landings and the current road system. The scope continues to year 2037, which is approximately 24 years after project implementation, the estimated amount of time required for ECA levels from this project to be no longer perceptible.

3.11.6.3.1 Past, Present and Reasonable Foreseeable Actions

Several timber sales have occurred in the Clear Creek watershed (see project file and ECA analysis). Timber sales conducted between the early 1950s and late 1990s involved many miles of new road construction, little to no tree retention in regeneration harvest areas, and dozer piling of slash. These activities resulted in widespread and persistent impacts on the subwatersheds and caused increased sedimentation and increased water yields. The Forest Service manages 72% of the Clear Creek watershed, and past harvest activities have occurred on approximately 28% of that Forest Service land.

Forest practices have changed over the last few decades. Project design measures, BMPs, and Forest Plan guidelines have been developed in order to reduce ground-disturbing activities and subsequent sediment delivery. Operating under dry conditions, implementing no-cut PACFISH buffers, retaining trees in regeneration harvest units, and limiting ground-based yarding to slopes <35% have become common practices.

Over 30 miles of Forest Service system roads have been decommissioned in the Clear Creek watershed since 1996. This activity produced localized short-term sediment during implementation but created long-term sediment reductions and benefits to overall channel conditions.

Present actions include permitted grazing, recreation, fire suppression, road maintenance, and control of noxious weeds using chemical, mechanical, and biological methods. Recreational activities produce little to no impact to water quality or quantity or to floodplain/wetland functions. Most effects from recreation are primarily due to associated road use, especially during wet conditions. Effects from grazing include stream bank instability and reduced water infiltration rates in areas with soil compaction (localized areas). Fire suppression activities are infrequent and limited in size. Road maintenance has minimal short-term effects and long-term benefits (Burroughs and King 1989).

Watershed improvement needs were identified during the pre-NEPA stage of this EIS. Some of the concerns were addressed through projects that were completed under separate decision documents and were incorporated into the existing condition of this EIS and were included in the NEZSED analysis. Although assessed during the same pre-NEPA assessment as this EIS, it was determined that implementing these projects through separate NEPA and prior to the completion of this EIS would accelerate watershed recovery. Watershed improvement projects associated with this project and which a majority have been implemented: 10 miles of system road decommissioning, 73 miles non-system road decommissioning, 4 miles road reconstruction, 49 culvert replacements, and 22 culvert removals. (See Appendix J for a more detailed outline.)

The following concurrent or foreseeable future actions may occur in the Clear Creek watershed:

- Eastside Allotment project: This project includes an adaptive management plan to improve pasture and water quality conditions while keeping livestock numbers the same.
- Clear Ridge Road Decommissioning: This project proposes 65 miles of non-system roads for decommissioning, which will improve water infiltration and reduce soil erosion potential.
- Harvest of state of Idaho lands: The Bruin Storm project seed tree harvested approximately 160 acres in the Lower Clear Creek subwatershed in 2013. This activity was included in the ECA analysis.

- Private land harvest: This project includes undetermined amount and prescription of harvest of private lands in the Crane Hill area (Upper Clear Creek subwatershed) in the next 5 years. Harvest is expected to occur on less than 200 acres.

The first two projects are considered watershed improvement projects and will help to improve water quality and quantity. Any increases in erosion and subsequent sediment yield would be short-term and in isolated locations.

The last two projects are harvest activities that could increase ECA and soil erosion. The small amount of acreage involved would increase ECA by <1% in the Clear Creek watershed. These projects would follow water and soil quality protection practices regulated through the Idaho Forest Practices Act.

Alternative A – No Action

Cumulative effects arise when the incremental impact of an action is added to impacts from past, present, and reasonably foreseeable actions. Alternative A would create no direct or indirect effects; therefore, no cumulative effects to water yield or sediment yield would occur under this alternative.

Alternatives B, C, and D – Action Alternatives

3.11.6.3.2 Water Yield

Even though NFS lands comprise 72% of the Clear Creek watershed, they contribute 84% of the average annual flow of Clear Creek. The estimated existing ECA for the Clear Creek watershed is 4% and includes past activities on Forest Service, state, and private lands. Because harvest and burn history were not available for private or state lands, size and date of forest openings were determined using NAIP imagery in ArcGIS and Google Earth software.

Estimated increases in ECA from the Clear Creek project are 9% for Alternative C, 8% for Alternative B, and 7% for Alternative D. When these increases are added to the existing ECAs, they produce ECA estimates that predict what watershed conditions will be like after the Clear Creek project. Final ECA estimates are 13% for Alternative C, 12% for Alternative B, and 11% for Alternative D. A lower ECA indicates a higher (better) watershed condition. ECAs of <15% at the HUC10 scale indicate high (good) condition (NOAA 1998).

A 6% increase in average annual water yield for Clear Creek was calculated for Alternative C using formulas and graphs from Forest Hydrology - Hydrologic Effects of Vegetation Manipulation, Part II (USDA FS 1973). Most 3rd through 5th order drainage channels on the Nez Perce National Forest can sustain a 10% increase in average annual runoff as a result of timber harvest before increases are detectable (USDA Forest Service 1973). Clear Creek is a 5th order stream starting two miles from within the Forest Boundary (confluence with Middle Fork Clear Creek) to the mouth. ECA estimates predict that watershed conditions would remain high (good) under all three action alternatives and percent increase in annual water yield is below the 10% detectable level. Therefore, no stream channel alteration from increased water yield is expected from the Clear Creek project in main stem Clear Creek.

As shown in Figure 23, ECA would decrease to its pre-project level (4%) after 12 years for Alternatives B and D and after 14 years for Alternative C. ECA from Clear Creek activities would no longer be discernible after 22 years.

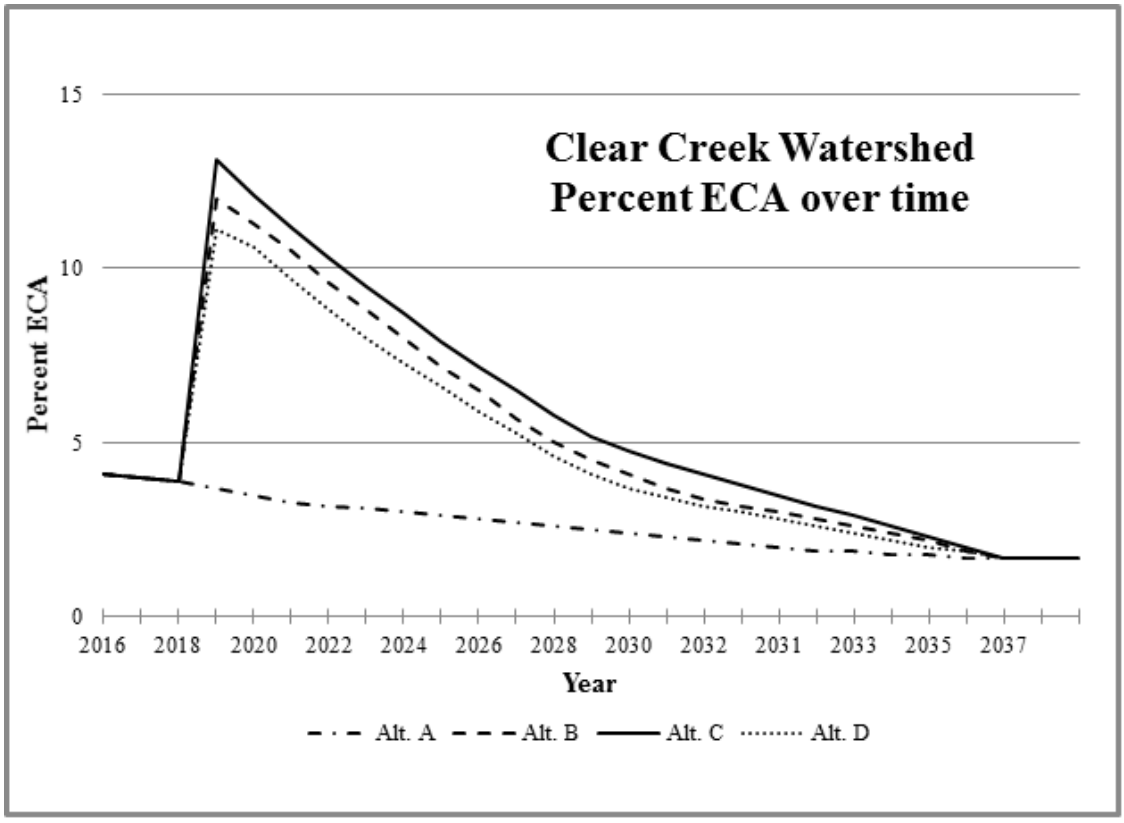


Figure 23: Percent Equivalent Clear Cut Area (ECA) Over Time for Clear Creek Watershed (HUC10) (Note: Includes Forest Service and private lands)

As shown in the above discussions, a broad review of available literature discussing harvest activities and water yield/peak flows was conducted. Much of the analysis regarding water yield for this project was based on older literature (1970s) that established general thresholds and guidance for determining ECA, ECA recovery, and increases in water yield. They also created the foundation for Nez Perce Forest Plan (1987) direction.

Alternatively, new research indicates that water yield increases (and associated effects on streams) may not be as important as previously thought, especially in the context of contemporary forest management. The primary concern about changes in water yield is how they may directly or indirectly affect stream channels, aquatic habitat, and water quality. Numerous studies have documented the effects of forest canopy removal on water yield, but surprisingly, very few have demonstrated a direct link between water yield changes and channel impacts in a forested environment. For example, Schnakenberg and MacDonald (1998) found no correlation between ECA and stream channel characteristics in forested catchments in Colorado.

MacDonald et al. (1995) studied the relationship between WATSED predicted water yield increases and channel characteristics on the Kootenai National Forest. None of the channel types (pool riffle or colluvial step-pool) showed any increase in bankfull width or width-to-depth ratio with more intensive management. However, correlations were found between management indices and sediment characteristics; these correlations suggest that sediment delivery is a more important consideration than water yield.

Analysis of reference and managed streams on the Flathead National Forest suggests no relationship between bankfull width and the degree of management (Kendall 2011), a finding that is consistent with the results of MacDonald et al. (1995).

Grant et al. (2008) conducted a comprehensive literature review and determined no field studies have made a direct link between peak flow increases and channel impacts. Grant et al. (2008) concluded that the effects of peak flow increases are relatively minor in comparison to other anthropogenic changes to streams and watersheds. In general, channel impacts associated with peak flow increases alone are likely to be much less significant than other impacts associated with forest management activities. Management-induced increases in peak flow generally diminish with the percentage of watershed impacted and increasing recurrence interval. Management effects on peak flow events over a 6-year recurrence interval are highly speculative (Grant et al. 2008).

Considering the merits of all viewpoints and the above analysis, increases in water yield or peak flows are not anticipated to be detectable at the HCU10 scale (5th order stream) and negligible stream channel alteration form increased flows are expected from the Clear Creek project. Project design measures including no-cut harvest buffers, green tree retention guidelines, low to moderate severity prescribed burning, and implementation of Best Management Practices would reduce likelihood of increased water yields.

3.11.6.3.3 Sediment Yield

As described in direct effects section, the NEZSED model predicted an increase in sediment yield as a result of proposed activities.

For a true cumulative effects analysis, sediment yield, as modeled by NEZSED, would have been calculated for the entire HUC10 watershed and routed to the mouth of Clear Creek. Since the downstream half of the watershed does not include FS lands, no landtype information is available, which is a necessary component of the NEZSED model. Instead, sediment yield was routed to Clear Creek at the Forest Service Boundary. There is no Forest Plan Appendix A sediment yield guideline at this scale.

Figure 24 shows the predicted sediment yield percent over base increased at the Forest boundary from Clear Creek project activities for each alternative. Estimated percent increase in sediment yield is highest in Alternative C at 24%, followed by 23% for Alternative B, and then 21% for Alternative D. Estimates included the existing sediment yield over base from past project activities, plus the additional sediment yield generated from the Clear Creek project. Sediment yield percent over base declines below the existing amount in 2025 (as modeled) due to road decommissioning activities. Road density in the Clear Creek watershed was reduced from 2.7 mi/mi^2 to 2.6 mi/mi^2.

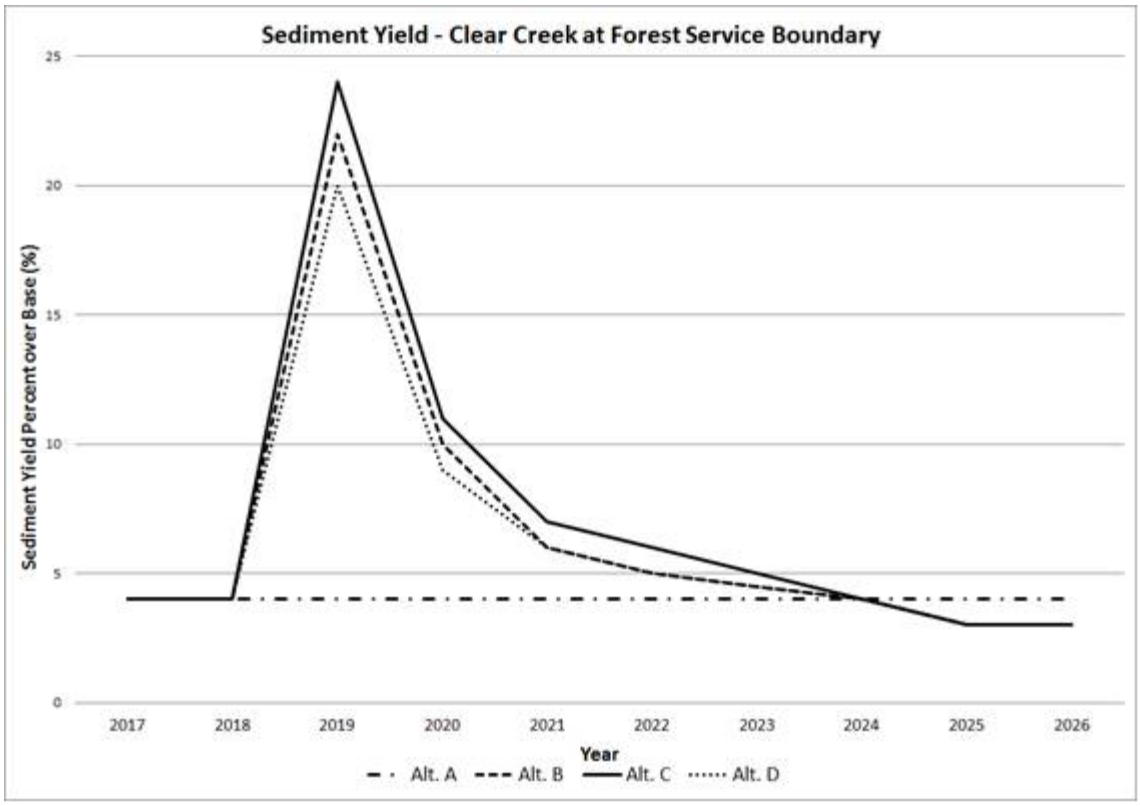


Figure 24: Sediment Yield Percent over Base (Natural) for Clear Creek at Forest Service Boundary (Note: Includes National Forest System land only)

An upward trend analysis following guidance from Conroy and Thompson (2011) was completed for the project (Appendix J). The analysis showed that although there would be short term increase in sediment yield, there would be long term improvement over the existing condition (Appendix J).

Implementation of project design measures, adherence to BMPs, and maintenance of no-cut PACFISH buffers would reduce potential erosion and further limit the risk of sediment reaching streams. Any sediment yield increases would be short-term (0–6 years following project activities), and beneficial uses in Clear Creek and the Middle Fork Clearwater River would be maintained.

3.11.6.4 Potential Changes to Conditions from the 2015 Baldy Fire

The Baldy Fire started August 10, 2015 and was included in the Elk City Complex incident. A portion of the Baldy Fire extended into the Clear Creek project area, although no proposed treatment units were affected. The fire perimeter encompassed approximately 1381 acres in the Clear Creek project, of which 369 acres resulted with moderate or high soil burn severity. Only the South Fork Clear Creek HUC12 watershed was affected by the fire. This watershed contains the Kay Creek and South Fork Clear Creek Forest plan prescription watersheds. Table 24 displays the acres of unburned area and acres of soil burn severity for the two prescription watersheds.

Table 24: Soil Burn Severity for Baldy Fire within the Clear Creek project area

Prescription Watershed	Fire Perimeter (Acres)	Unburned (Acres)	Low Burn Severity (Acres)	Moderate Burn Severity (Acres)	High Burn Severity (Acres)
Kay Creek	10	7	2	1	0
South Fork Clear Creek	1,371	620	383	314	54

Definitions of burn severity and vegetation lethality are described in the Table 25. Burn severity does not directly equate to fire intensity. Burn severity is field verified during Burned Area Emergency Response (BAER) assessments.

Table 25: Soil Burn Severity and Vegetation Lethality (Debano et al. 1998)

High	High Fire Severity: High soil heating, or deep ground char, occurs, where the duff is completely consumed and the top of the mineral soils is visibly reddish or orange on severely burned sites. Logs can be consumed or deeply charred, and deep ground char can occur under slash concentrations or burned our logs. All shrub stems are consumed and only the charred remains of large stubs may be visible. This generally equates to less than 40 percent of the trees exhibit no visible damage, with the remainder fire-damaged, largely by root-kill; less than 60 percent of the fire-damaged trees survive.
Moderate	Moderate Fire Severity: Moderate soil heating, or moderate ground char, occurs where the litter on forest sites is consumed and the duff is deeply charred or consumed, but the underlying mineral soil surface is not visibly altered. Light colored ash is present. Woody debris is mostly consumed, except for logs, which are deeply charred. On shrubland or grassland sites, gray or white ash is present and char can be visible in the upper 1 cm of mineral soil, but the soil is not altered. This generally equates to 30 to 70 percent of the trees exhibit no visible damage, with the remainder fire-damaged; 40 to 80 percent of the fire-damaged trees survive.
Low	Low Fire Severity: Low soil heating, or light ground char, occurs where litter is scorched, charred, or consumed, but the duff is left largely intact, although it can be charred on the surface. Woody debris accumulation are partially consumed or charred. Mineral soil is not changed. Fire severity in forest ecosystems is low if the litter and duff layers are scorched but not altered over the entire depth. The surface is mostly black in a shrubland or grassland ecosystem, although gray ash can be present for a short time. This generally equates to at least 60 percent of the trees exhibit no visible damage, with the remainder fire-damaged by scorched crowns, shoot-kill (top kill but sprouting), or root-kill (top kill and no sprouting); over 80 percent of the fire-damaged trees survive.

ECA numbers were updated due to the change in vegetation. Using the information from Table 26, percent of vegetation survival was used to determine the extent of equivalent clearcut acres for low, moderate, and high burn severity acres. For example, on high burn severity acres, it was assumed that only 30% of the trees survived; while on low severity burned acres, it was assumed 80% of the trees survived. Table 26 displays the increase in ECA for each of the watershed size scales used in the FEIS analysis for Alternative C. The final ECA amounts are below the threshold guidance set in the FEIS analysis.

Table 26: ECA Summary for Alternative C Modified

Watershed	Existing ECA	Clear Creek Project Percent Increase in ECA (2015 FEIS)	Baldy Fire Percent Increase in ECA	Total Percent ECA	Threshold Guidance ECA Percent
Kay Creek Forest Plan Prescription Watershed	2%	1%	0%	3%	20-25%
SF Clear Creek Forest Plan Prescription Watershed	1%	8%	2%	11%	20-25%

Watershed	Existing ECA	Clear Creek Project Percent Increase in ECA (2015 FEIS)	Baldy Fire Percent Increase in ECA	Total Percent ECA	Threshold Guidance ECA Percent
South Fork Clear Creek HUC12	1%	7%	1%	10% (rounding)	15%
Clear Creek HUC10	4%	9%	<1%	13%	15%

The NEZSED model was also updated to include the Baldy fire (NEZSED version 2016). Low severity acres were modeled as "low" with a coefficient of 0.2, moderate severity acres were modeled with a 0.5 coefficient, and high severity acres were modeled as "wildfire" with a coefficient of 1. Results were an estimated increase of 0.01 tons/year for Kay Creek (<1% over base) due to the Baldy fire and 2.9 tons/year for South Fork Clear Creek ((<1% over base). These amounts were incorporated into the management existing estimates in the 2016 NEZSED model runs.

3.12 Wildlife

This incorporates the Clear Creek Integrated Restoration project FEIS (September 2015) by reference. The following sections of the FEIS are updated to reflect new, different, or additional information:

- **3.12.3.1.1 Snags**
- **3.12.4 Methodology**
- **3.12.5.2 Threatened, Endangered, Candidate or Proposed Species (TES)**
    - 3.12.5.2.1 Canada Lynx
- **3.12.5.3 Region 1 Sensitive Species**
    - 3.12.5.3.1 Fringed Myotis
    - 3.12.5.3.2 Black-backed Woodpecker
    - 3.12.5.3.3 Fisher
    - 3.12.5.3.4 Flammulated Owl
    - 3.12.5.3.7 Wolverine
    - 3.12.5.3.8 Pygmy Nuthatch
    - 3.12.5.3.10 Western Toad
- **3.12.5.4 Management Indicator Species**
    - 3.12.5.4.1 American Marten
    - 3.12.5.4.2 Northern Goshawk
    - 3.12.5.4.3 Pileated Woodpecker
    - 3.12.5.4.4 Rocky Mountain Elk

Additionally, the Baldy Fire (2015) burned approximately 750 acres within the project boundary of the Clear Creek Integrated Restoration Project. The following discussion summarizes the effects to wildlife in the project area caused by wildfire. Following this discussion are the specific updates to the FEIS (2015) for each species listed above.

Wildfire Effects

Wildfire occurrence in the past eight years (2010 to 2017) has burned approximately 418,035 acres on the Nez Perce Forest. Of this potential habitat for woodpeckers, only 3,228 acres (less than 0.01%) have been salvaged or reduced by some form of timber harvest.

While recent snag habitat created by wildfires in the CCIR Project Area appears low, the Nez Perce Forest offers a large amount of habitat for woodpeckers, especially the black-backed woodpecker. Hutto and Patterson (2016) found an 11-year period of the woodpecker's presence in a mixed fire event that contained moderate to low-severity burned areas that bordered the more severely burnt areas. Presence of the woodpecker's occupancy in severely burned forest conditions was noted in many studies that suggested a 4-8 year post-fire window (Saab et al. 2007, Hoyt and Hannon 2002, Murphy and Lehnhausen 1998, and Hutto 1995). Research in Idaho fire events (Dudley et al. 2012, Dudley and Saab 2007, Saab et al. 2007) found that beyond 8 years, food availability decreased and the foraging habitat declined rapidly. Potential wildlife snag habitat in ponderosa pine declined by over 50% in about 8 years after the fire event (Ritchie et al. 2013). The researchers also noted that the increase in downed woody material created a higher fire risk that potentially threatened the existence of the standing snags.

Of this potential habitat for woodpeckers, only 3,228 acres have been salvaged or some other form of timber harvest. This is less than 0.01% of woodpecker habitat affected on the NP Forest.

Effects of Baldy Wildfire 2015

The Baldy Fire occurred in the summer and fall of 2015. The fire burned 5,121 acres, with about 750 acres located within the project boundary of the Clear Creek Integrated Restoration Project (CCIR). Three proposed regeneration harvest units were affected: 48 acres at low burn severity, 40 acres in 2 of the units were moderate severity. The effects of the wildfire to analyzed species (TES, Sensitive Species and MIS) and their respective wildlife habitats within the CCIR Project Area follows.

Threatened Species

Canada Lynx A portion of the CCIR encompasses a lynx analysis unit (LAU). The latter unit is used for determining disturbances (natural and man-made) and effects on lynx habitat.

The Baldy Fire burned in LAU (Lynx Analysis Unit) 30. The fire burned with mixed severities in 775 acres of lynx habitat (denning and foraging habitats). Low fire severities were considered as unburned or low burn severity. The latter burned light fuels, and left trees, some shrubs, and downed woody material. These low burn severities would not be considered as a factor in changing lynx habitat to a stand initiation phase.

Fire severities from moderate to high affected about 238 acres of lynx habitat (denning and foraging habitats). These burn severities would return the affected area to a stand initiation phase (early seral forest succession), which creates a temporary loss of lynx foraging habitat. In 25 to 30 years, the vegetation would be recovered to the stage of providing foraging opportunities to a

lynx. Standing snags would fall to the ground in 5-20 years from the effects of decay, wind or snow. Large piles of downed woody material would create potential lynx denning habitat.

Cumulative effects of the recent fire, past fires, harvest history, and proposed CCIR harvest present a 20% disturbance of lynx habitat in the LAU. Guidance from the NRLMD (USDA 2007), Standard Veg S1 states no more than 30% of the lynx habitat in an LAU should be in a stand initiation structural stage for additional vegetation management projects to occur. The LAU meets the standard, and provides about 80% of denning and foraging habitat for lynx. All other NRMLD objectives, standards and guidelines for lynx are being met.

Wildfire effects to lynx would be displacement to other habitats in the LAU for denning and foraging opportunities. Small mammals would be displaced from the burned areas until forage develops (5-15 years). In 25-30 years, the trees would be tall enough to protrude above the winter snowpack. At this stage, the snowshoe hare (preferred prey for lynx) would have habitat for its survival and expansion. As the prey base moves into the recovering forest, lynx hunting opportunities would return to these areas again. In summary, the wildfire event created a short-term loss (25-30 years) of habitat that will be regenerated into forage and denning habitat in 5-20 years. **Discussion with FWS 11-10-2015: Service agrees that a natural event occurred, and no re-initiation of a BA is necessary.**

Sensitive Species

Black-backed Woodpecker About 650 acres of dead or dying trees would count as new habitat for the woodpecker. This habitat would be available for up to 8 years after the fire event. The fire was a positive event for this species: creating foraging and potential nesting habitat.

Fisher The fire burned about 380 acres of potential fisher probable habitat. Tree canopy was basically consumed and the affected trees are dead or dying; basically they have become snags. Individuals may be displaced from the burned areas for 20-30 years, until recovering trees offer the canopy cover and tree structure the fisher prefers. During the period of reduced tree canopy, snags would fall to the ground, creating forage habitat for the predator. A fisher may wander from the adjacent unburnt forest edges into the burnt areas to hunt for prey.

Flammulated Owl About 1 acre of potential owl habitat was burned by the fire. This would likely create a minimal to no effect on the owl or its habitat.

Fringed Myotis About 1 acre of potential bat roosting habitat was burned by the fire. This would likely create a minimal to no effect on the owl or its habitat.

Long-legged and Long-eared Myotis About 380 acres, or 2% of bat roosting habitat were affected by the fire. Loss of snags would reduce habitat, while trees burned by low to moderate severities may become snags that offer new habitat for roosting bats. After these snags age and fall to the ground, it may take another 80-90 years for snags to develop in the area that could function as roosting habitat. About 3-10 years postfire, vegetation recovery would create habitat for insects that nectar or feed on plants. These invertebrates would provide foraging opportunities for the bat species. This recovery is beginning to occur, as it has been about 3 years since the wildfire occurred. Summary: short-term loss/gain of snags for roosting habitat, long-term recruitment of next snag cohort, short to midterm (3-40 years) gain of forage for the bat species.

Mountain Quail No effects from fire to habitat.

North American Wolverine No loss of habitat for critical winter period.

Pygmy Nuthatch Less than one acre of habitat affected. Fire would increase habitat potential in any fire-killed ponderosa pine or Douglas-fir.

Ring-necked Snake No effects from fire to habitat or animal.

Western Toad The western toad has shown an increased occurrence in burned habitats: more so in severely burned habitats than partially burned habitats (Guscio et al. 2008) Fire has increased habitat on southerly aspects for the toad. Approximately 110 acres of new habitat was created for the toad.

Management Indicator Species (MIS)

American Marten About 593 acres (3%) of marten habitat were burned by the fire. This a loss of habitat that won't become suitable for 50 to 150 years post fire.

Northern Goshawk The fire created a loss of 134 acres (6%) of potential nesting habitat. About 80% of goshawk nesting habitat remains, with future recruitment of more habitat from unburned riparian areas. Goshawks would hunt the burned areas after forage has recovered in 5-15 years.

Pileated Woodpecker 11 acres, or less than 1% of woodpecker nesting habitat was burned by the fire. The pileated woodpecker would benefit from any fire-killed tress that become snags.

Rocky Mountain Elk Elk would be temporarily displaced from the burned areas for about 3 years. At this date, vegetation is beginning to recover in the areas affected by fire. As grass, herbs and shrubs grow in the burned areas, forage would continue to increase for elk. This forage production would last up to 15-20 years post fire.

Shiras Moose The fire did not burn in any MA-21 (designated moose winter range) in the CCIR project area. The fire did burn in other areas that are potential winter moose habitat. Most of these areas were burned at low severity, which would not cause a loss of habitat potential. About 316 acres experienced moderate burns, which would temporarily remove the habitat potential for these affected acres. This would reduce the available potential habitat by 4%. Shrubs will become available as moose forage in 5-15 years. The preferred tree structure for moose habitat would return to the burned landscape in about 90 years.

Neo-tropical Migratory Birds The fire would displace all birds preferring unburned forest conditions. Depending on the bird species the displacement may last for up to 2 years in lightly burned areas, while more severely burned areas may not recover a dense tree canopy for up to eighty or more years. Other species that thrive on burned areas or regeneration in such areas would benefit.

3.12.3.1.1 Snags

The myotis bats analyzed in the FEIS use tree snags, as well as large live trees, caves, mines, buildings, bridges and crevices in rocks. Snags may offer roosting habitat for the bats during their summer stays on the Forest. Roost-site selection for long-legged myotis in Idaho were found in forested areas that were surrounded by lesser amounts of edge than forests in Oregon and Washington (Lacki et al. 2010). Pileated woodpeckers would use retained snags in units, if a supply of prey is apparent in the dead or dying tree. Large ponderosa pine snags would be retained in units in the design criteria; which is also a recommendation by McClelland and

McClelland (1999). Black-backed woodpeckers prefer dead or dying trees infested with beetle outbreaks for up to 8 years. After this period the bird moves on to more recently created habitat by fires and insect or disease infestations.

Researchers have found that snags provide resting and denning sites for marten (Buskirk and Ruggiero 1994, Bull and Heater 2000, Bull et al. 2005), as well as fisher (Raley et al 2012, Schwartz et al. 2013). Stumps and cavities in snags can serve as protection from predators, provide thermal insulation, and birth sites for both weasels.

Snag retention is discussed in the Design Criteria section of Chapter 2 (p. 2-9) of the FEIS. Forest Plan Amendment #42 (FEIS, Appendix D), would increase the amount of retained snags above the Forest Plan Standard, Appendix N. The latter appendix required 1-2 snags/acre with tree sizes between 12-20" DBH (diameter at breast height).

Snag retention would follow Regional guidance (Bollenbacher 2009). Large snags would be retained among live trees in clumps of 7-10 trees or more per acre. Green tree retention in all regeneration and improvement harvests would average 14-28 trees per acre: which would include 9-14 snags/acre. Of this, an average 5 snags of 15" or greater would be retained in areas affected by timber harvest. The snag retention recommended by the Regional guidance is the average number of snags/acre found in untreated forests on the Nez Perce Forest. Thereby, timber harvest prescriptions would be maintaining snag numbers found in the natural state.

In the proposed harvest units, snags may be lost or reduced due to safety issues that may endanger personnel involved in timber activities. Post logging activities may reduce snags during site preparation (prescribed burns). Additionally, wind events may knock down snags left in the recently harvested unit.

In some cases, the burns may kill live," retained", trees; thus creating new snags. The prescribed burning for the Clear Creek Project has potential to create new snag habitat for both bats, woodpeckers, and the pygmy nuthatch.

Silvicultural prescriptions would retain all large Ponderosa Pine, as well as plant the tree species in units in drier sites. Though action alternatives would occur in 11-14% of the bird's potential habitat, the retained (pine) trees would continue to provide nesting and foraging habitat for the nuthatch.

American marten and fisher generally avoid open areas, such as those created by timber harvest. However, retained snags near the forested edge of harvest units may offer potential resting or denning habitat for these mammals. As these harvest units transition to young forest (10+ years after the disturbance), both predators are known to use these areas for sources of prey. Non-forest associations are used upon occasion during summer, and martens may hunt in open meadows bordering dense forests if hiding cover is present (Hargis et al. 1999, Buskirk and Powell 1994).The fisher is known to hunt in harvested units that are producing young forest if overhead cover is present (Sauder and Rachlow 2014, Raley et al. 2012, Weir and Harestead 2003, Jones and Garton 1994).

The Clear Creek Project would use Forest Plan Amendment #42 (FEIS, Appendix D) to retain or recruit more snags per acre than the Forest Plan Standards. The numbers and diameter at breast height (dbh) for snags would vary according to the habitat type of the unit (see FEIS 2015, Appendix D).

3.12.4 Methodology

Table 3-44 of the 2015 FEIS (page 3-191) is updated as follows:

Table 27: UPDATED Table 3-44 (2015 FEIS p. 3-191) Habitat Criteria Used to Identify Suitable Wildlife Habitat in Analysis Area

Wildlife Species	Primary Tree Species[a]	Tree Diameter (inches dbh)	Tree Canopy Cover (%)	Age Class (years)	Suitable Habitat (Acres)
Canada Lynx (Threatened)	Denning Foraging	–	–	–	1,102 1,309
North American Wolverine	Modelled areas of persistent snow period	-	-	-	95
American Marten	SAF, S, LLP, GF, WRC	-	>30	>100	19,712
Black-backed Woodpecker	All Species; burnt, diseased or insect infested	>10	>40	>40	2,971
Fringed Myotis	PP, DF	>12	<30	>100	276
Long-legged Myotis Long-eared Myotis	All Species	>15	All	>100	16,464
Fisher – Summer – Winter	WRC, GF, DF, LPP, SAF, S	>13 Sapling/Young	>40 >40	>100 -	9,847 13,380
Flammulated Owl	PP, DF	>15	40-60	-	983
Mountain Quail	All Habitats in VRU 3	-	-	-	187
Northern Goshawk Nesting	PP, DF, WL, LPP, GF, WWP	>13	>35-70	>50	1,932
Pileated Woodpecker Nesting	Dead or dying PP, WL, DF, WWP, GF, WRC	>20	25-60%	-	3,131
Pygmy Nuthatch	PP, DF	>15	25-60%	-	983
Ringneck Snake	VRU 3	–	–	–	3,030
Western Toad Uplands	All species on southerly aspects	All	<30	–	620
Moose Winter (MA 21)	Mapped MA 21 Outside MA 21	–	–	–	2,700 7,840

[a] PP- ponderosa pine; DF- Douglas-fir; WL-Western larch; WWP-Western white pine; LPP- Lodgepole pine; GF- grand fir; WRC- Western redcedar; S- Englemann spruce; SAF- Subalpine fir

3.12.5.2 Threatened, Endangered, Candidate or Proposed Species (TES)

3.12.5.2.1 Canada Lynx

During the Baldy Fire (2015) 1,824 acres burned at moderate to high severities in lynx habitat, reverting the affected forest to a stand initiation stage. Cumulative effects to the affected Lynx Analysis Unit (LAU) include past disturbances, the Baldy Fire (2015) and the action Alternatives for the CCIR Project. Combined this would create 20% stand initiation stage in the Project Area. This is below the 30% threshold for disturbance as established by the NRLMD (USFS Regional Guidance for lynx management). Foreseeable Projects (Tinker Bugs and Red Moose Project would not occur in the LAU evaluated for the CCIR Project. All other guidelines in the NRMLD are met, and **review by the USFWS concurs that the CCIR Project would still meet the May Affect-Not likely to Adversely Affect determination as originally designated in the FEIS.**

3.12.5.3 Region 1 Sensitive Species

3.12.5.3.1 Fringed Myotis

Habitat loss from the Baldy Fire was 1 acre. The cumulative effects, including the wildfire, did not change the effects determination found in the 2015 FEIS.

3.12.5.3.2 Black-backed Woodpecker

This discussion provides supplemental information to the FEIS 2015 (pages 3-205 to 3-209)

Discussion The woodpecker does not undergo latitude migrations as other species do, but responds to dramatic changes in forest structure such as fire and insect outbreaks (Dixon and Saab 2000). The authors considered the bird as an “Irruptive” species that forages on beetle larvae found in recently burned habitats or areas of insect outbreaks (Dixon and Saab 2000).

Though mainly associated with burnt habitat, the woodpecker has been observed in various conifer-type forests. However, the species may also respond positively to lower intensity fires such as controlled burns (Russell et al. 2009), and it also occurs to some extent in unburned forests (Dixon and Saab 2000, Tremblay et al. 2009). Hutto and Patterson (2016) found the woodpecker’s presence in a mixed fire event that contained moderate to low-severity burned areas that bordered the more severely burnt areas over an 11-year period.

The movements of black-backed woodpeckers to the periphery of the burns suggest that beetle populations may have decreased within the interior of the burns (Rasmussen et al. 1996). Beetle dispersal into adjacent unburned forests could potentially provide critical foraging habitat at 4–5 years post-fire, when black-backed woodpecker nesting densities decline in burned forests (Saab et al. 2007). During periods of infrequent forest fires, green forests adjacent to old burns may play a role in maintaining local populations of black-backed woodpeckers until new forest burns are created. Additionally, unburned areas adjacent to the burns likely provide fledglings with increased hiding cover from avian predators. This might be particularly important when fledglings are <15 days old, a time when fledglings are relatively immobile and adults deliver their food. After the 15-day period, fledglings are more fully developed and better able to fly long distances, up to 2 km between successive relocations (Saab et al. 2007).

Presence of the woodpecker's occupancy in severely burned forest conditions was noted in many studies that suggested a 4-8 year post-fire window (Dudley et al. 2012, Nappi et al. 2010, Saab et al. 2007, Hoyt and Hannon 2002, Murphy and Lehnhausen 1998, and Hutto 1995b). Research in Idaho fire events (Dudley et al. 2012, Dudley and Saab 2007, Saab et al. 2007) found that beyond 8 years, food availability decreased and the foraging habitat declined rapidly. Potential wildlife snag habitat in ponderosa pine declined by over 50% in about 8 years after the fire event (Ritchie et al. 2013). The researchers also noted that the increase in downed woody material created a higher fire risk that potentially threatened the existence of the standing snags.

Dudley and Saab (2007) examined home range size of Black-backed Woodpeckers in forests of southwestern Idaho during 2000 and 2002 (6 and 8 years following fire). Black-backed Woodpeckers are closely associated with disturbed habitats where beetle populations may readily colonize (e.g., especially early post-fire habitats; Hutto 1995). One male had a home range 2–3 times larger than other males; and was often located at distances of >1.4 km into adjacent unburned forest, where he foraged in patches with scattered dead and dying trees. Mixed fire severities may create conditions that promote a steady supply of dying trees, diverse prey resources, and habitat longevity extending beyond the first few years post-fire (Nappi et al. 2010).

Updated Habitat The 2008 fire mentioned in the FEIS (FEIS, p. 3-206) is currently not likely providing habitat for the black-backed woodpecker. The event is past the time period for offering the best forage. Habitat likely remains available from the 2011 moth outbreak that affected about 2,321 acres. The burned area from 2015 Baldy Fire, within the CCIR Project Area, provides about 650 acres of potential habitat. Combined habitat from these disturbances provide about 2,971 acres of current habitat to the woodpecker in the Project Area. The woodpecker would remain in or near the Baldy Fire perimeter until its food source diminishes to the point where forage efforts are not beneficial to the bird.

The modelled habitat for the woodpecker (Samson 2006b, Bush and Lundberg 2008) is now outdated. The District Biologist utilizes updated database records on wildfire history on the Nez Perce Forest as the best available science for discussion of potential habitat available for the black-backed woodpecker. Wildfire occurrence in the past eight years (2010 to 2017) has burned approximately 418,035 acres on the Nez Perce Forest. Of this potential habitat for woodpeckers, only 3,228 acres (less than 0.01%) have been salvaged or reduced by some form of timber harvest.

While recent snag habitat created by wildfires in the CCIR Project Area appears low, the Nez Perce Forest offers a large amount of habitat for woodpeckers, especially the black-backed woodpecker. It is important to reference the larger scale of habitat, since this species is known to respond and relocate to such disturbances as fire and insect outbreaks (Dixon and Saab 2000). These more recent fires would host new generations of bark and tree-boring beetles that would provide a large pulse of forage for the BBWP and other woodpeckers, over a period of less than a decade.

Direct and Indirect Effects

Alternative A – No Action

No changes from the 2015 FEIS (page 3-207)

Alternatives B, C, and D

Updates to 2015 FEIS (pages 3-207, 3-208) Acres of habitat affected by the action alternatives would not change, however, percentages are adjusted to change in potential habitat of 2,971 acres. So potential habitat affected by Alternative B is 17%, Alternative C (17%), and Alternative D (15.5%).

Project activities may disturb (noise, movement by man or machine) an individual black-backed woodpecker located in an area undergoing timber harvest activities.

Cumulative Effects

Updates to 2015 FEIS (pages 3-207, 3-208) The Baldy Fire (2015) created an additional 650 acres of potential black-backed woodpecker habitat. The roadside salvage project in 2016 reduced about 27 acres of burnt trees adjacent to roads that are located outside of the CCIR Project Area. This did not affect the 2,971 acres evaluated as habitat for the woodpecker in the project area. On the Forest scale, about 415,000 acres are available as potential habitat for the woodpecker. Snag standards would meet Forest Plan standards and proposed landscape burning (Action Alternatives) on 1,370 acres would create more potential woodpecker habitat. The Action Alternatives would create more potential habitat for the bird than the No Action Alternative.

Two other projects are proposed for areas adjacent to the CCIR Project area. The Tinker Bugs and Red Moose Projects are proposing timber harvest of dead or dying trees as an activity for both projects. At this point, the scale of harvest and/or other activities have not been proposed for analysis: so potential affects to the woodpecker and/or its habitat are unknown.

3.12.5.3.3 Fisher

This information supplements 2015 FEIS (pages 3-209 to 3-213)). A more recent study (Schwartz et al. 2013) of fisher habitat corroborated the findings of Jones 1991: fishers appeared to avoid stands of ponderosa or lodgepole pine. The 2013 study also found that fishers selected mature and old growth forests during the summer in Idaho: similar results as Jones and Garton (1994).

Cumulative Effects

Alternatives B, C, D (2015 FEIS, page 3-212)

Cumulative effects changes include two projects proposed for areas adjacent to the CCIR Project area. The Tinker Bugs and Red Moose Projects are proposing timber harvest of dead or dying trees as an activity for both projects. At this point, the scale of harvest and/or other activities have not been proposed for analysis: so potential affects to the fisher and/or its habitat are unknown.

3.12.5.3.4 Flammulated Owl

This discussion provides supplemental information to the FEIS 2015 (pages 3-213 to 3-216). The last regional update of flammulated owl habitat showed 39,579 acres of potential habitat on the Nez Perce Forest (Bush and Lundberg 2008).

Some public comments questioned the analysis of habitats for the pygmy nuthatch and flammulated owl. The comments indicated that the amount of habitat for both species would be the same.

Both species are associated with dry forest habitats that host ponderosa pine. Upon review of the comment the Biologist found that the differences in habitat between the two birds cannot be analyzed due to the VMap model ranges for canopy cover. Therefore, the same habitat was delineated for both birds. Tree ages do not necessarily capture the size of the tree for this analysis. Therefore, the age factors in Table 3-44 of the 2015 FEIS (page 3-191) are dropped, and changed to 0. Potential habitat was calculated at 983 acres for both species, as reflected in the DSEIS (Table 27).

Changes in DSEIS compared to the FEIS In the 2015 FEIS analysis of the flammulated owl (FEIS pp. 3-213 to 3-216), an age factor of 100+ years was used as a factor for determining potential habitat. In discussions with the silviculturist, tree growth on the NPCNF could attain a 15" dbh in 50 to 60 years , and trees aged between 60 to 100 years could attain a dbh of 15-20" dbh. Therefore, the tree age factor of 100 years used in the FEIS did not capture all the potential habitat (trees > 15 dbh) available to the flammulated owl as shown in Table 3-44 in the FEIS (page 3-191). Therefore, this update for the SEIS drops the 100-year age factor to capture the full potential of habitat for the owl, and effects from the Baldy Fire, resulting in 983 acres of available nesting habitat for the raptor.

Direct and Indirect Effects – Alternatives B, C, and D

Correction of 1,371 acres proposed for landscape burning. All action alternatives propose the same amount of acres to be burned. This treatment would occur in 138 acres of owl habitat (habitat found through use of V-Map model, which was not available for 2015 FEIS). The treatment would improve affected owl habitat by decreasing the density of smaller trees by low severity burns, and maintaining the large trees and overstory. More openings would result: providing a plant understory that would support increased insect populations as forage for the bird. The 1,100 acres proposed for burning that is outside of present owl habitat would likely increase owl foraging habitat by hundreds of acres in areas that burn at low to moderate severities.

PCT would occur in owl habitat, and would increase foraging habitat, as it occurs in younger, dense stands that are not presently providing habitat. The treatment would open up the canopy, reducing competition among trees and creating small openings that may attract flying insects and bugs for the owl. All action alternatives would affect 25 acres (2.5%) with this treatment. PCT is an improvement treatment for maintaining the owl's forage opportunities in young seral forest.

Commercial thinning would occur in owl habitat, and it would improve flammulated owl foraging habitat opportunities: the prescription would reduce tree densities, creating more open forest structure where flying insects would be easier to detect by the raptor. The benefits of more accessible forage would probably last no more than 15 years, as the treatment would encourage natural succession of grand fir or Douglas-fir (species that would shade out open areas and reduce prey for the owl). Nesting habitat would remain the same in these units, as most large ponderosa pine would be retained. Potential nesting habitat may be lost if dead or dying mature pine is removed, as this is the likely structure (dead branches, tree cavities) the owl would prefer for nesting. Forage for the owl would improve under Alt. B in 14 acres, Alt. C (9 acres) and Alt. D (14 acres).

No improvement harvests would occur in flammulated owl habitat.

Regeneration harvest prescriptions would create openings in the unit, with some individual trees or patches of trees being retained. Large ponderosa pines and other species of legacy trees would be retained. However, this type of harvest unit would be very open with a single tree canopy, and likely not provide nesting structure and limited foraging habitat for the owl. Forage would recover over time, but the sparse retention of ponderosa pine would probably not support habitat for the owl. Proposed regeneration harvest in flammulated owl habitat would reduce habitat by 8 acres in Alt. B, 13 acres in Alt. C, and 8 acres in Alt. D.

Tree retention would consist of an average of 14-28 trees per acre with a focus on ponderosa pine, western larch and healthy Douglas-fir.

To summarize the treatments in owl habitat, PCT would improve owl habitat by 2.5%, and prescribed fire would improve habitat by 14%. Burns would potentially increase habitat by a few hundred acres. Commercial thinning would improve habitat by approximately 1% in all action alternatives. Regeneration harvest would reduce potential owl habitat by 1% in all alternatives. Prescribed burning, CT and PCT would improve owl habitat by producing more open areas for forage opportunities. Additionally, burning has the potential to increase owl habitat by nearly 1,100 acres.

Cumulative Effects (Replacements)

Flammulated owl habitat would be reduced about 1% from regeneration harvest. All other treatments would improve owl habitat by approximately 17.5% in all action alternatives. Prescribed burning is likely to increase flammulated owl habitat in the Project Area by a few hundred acres.

All proposed activities would have the potential of disturbing or displacing the owl during implementation of the Project. Disturbance factors of noise and movement by man and machine are likely to cause a nearby bird to leave or flee the area of operations. Fire suppression discussion in FEIS still applies in this section.

Besides the Clear Ridge Project mentioned in the FEIS, the Johnson Bar Fire Salvage is at or near completion. Two other projects are proposed for areas adjacent to the CCIR Project area. The Tinker Bugs and Red Moose Projects are proposing timber harvest of dead or dying trees as an activity for both projects. At this point, the scale of harvest and/or other activities have not been proposed for analysis: so potential affects to the flammulated owl and/or its habitat are unknown.

The rest of the Cumulative Effects Summery still applies as well as the determination of effects (2015 FEIS pp. 3-215, 3-216). In summary, the Action Alternatives would improve and increase flammulated owl habitat.

3.12.5.3.7 Wolverine

The mammal's status changed from a Forest sensitive species to Proposed Threatened in July 2016. The Wolverine model used in the FEIS has been replaced with a more recent model available to the Region. The latter model was based on research published in Inman et al. 2012, and is relevant to this Forest as it provides for the species viable population in the Greater Yellowstone Ecosystem. Primary habitat for the dispersal of female wolverine was considered as alpine areas or elevations near tree line that experience persistent snow periods. The Project Area

contains about 95 acres of such habitat: spread out among six small polygons that lie partially within CCIR boundary. None of the alternatives propose activities in these potential habitats. Therefore, no primary habitat would be affected by the proposed project, and the project will not jeopardize the continued existence of the Wolverine.

This is a change to the FEIS report (FEIS, pp.3-319 to 3-321), and replaces the effects section of the Wolverine report. For more information on the analysis, consult the Programmatic Biological Analyses in the Wildlife (Appendix F).

3.12.5.3.8 Pygmy Nuthatch

The following is supplemental information to the 2015 FEIS (page 3-22 to 3-222)

As mentioned in the Flammulated Owl section (Section 3.12.5.3.4) of this document, the nuthatch is analyzed with the same habitat attributes as the owl. Research on the nuthatch shows the mean tree dbh (size class) of the nest tree was ≥ 15" dbh (Ghalambor and Dobbs 2006). So the wildlife "habitat criteria table" (Table 3) has been adjusted for tree size, the tree age factor will be removed (similar rationale as explained in the owl section), and canopy cover has been modified to 25-60%. Other changes to the 2015 FEIS section of this species follows:

Direct and Indirect Effects – Alternatives B, C, and D

Correction of 1,371 acres proposed for landscape burning (FEIS pp. 3-221). All action alternatives would prescribe burning in 138 acres (14%) of nuthatch habitat. This treatment would improve or increase habitat for the nuthatch by decreasing the density of smaller trees by low severity burns, and maintaining the large trees and overstory. More openings would result: providing a plant understory that would support increased insect populations as forage for the bird. 1,100 acres proposed for burning that is outside of present pygmy nuthatch habitat would likely increase foraging habitat by hundreds of acres in areas that burn at low severities.

PCT would increase foraging habitat, as it occurs in younger, dense stands that are not presently providing habitat. The treatment would open up the canopy, reducing competition among trees and creating small openings that may attract prey for the nuthatch. It would not impact trees greater than 10" dbh: retaining all large trees in the units. All action alternatives would improve habitat by 25 acres (2.5%) with this treatment.

Commercial thinning would occur in the bird's habitat. The prescription would reduce tree densities and creates a more open forest structure. This structure would enable some species of flying insects to deposit egg masses in the crevices of tree bark where the nuthatch forages (Kingery and Ghalambor 2001). The authors note that the bird also forages on beetles, wasps, ants, caterpillars and true bugs, and during winter the nuthatch consumes pine nuts. Nesting habitat would remain the same in these units, as most large ponderosa pine would be retained. Potential nesting habitat may be lost if dead or dying mature pine is removed, as this is the likely structure (dead branches, tree cavities) the nuthatch would prefer for nesting. Forage for the owl would improve under Alternatives B and C by 14 acres, and by 9 acres in Alternative C. Forage improvement would be about 1% in all action alternatives.

No improvement harvests would occur in pygmy nuthatch habitat. Regeneration harvest prescriptions would create openings in the unit, with some individual trees or patches of trees being retained. Large ponderosa pines and other species of legacy trees would be retained, and included in the 14-28 trees/acre on average in the unit. This type of harvest unit would be very

open with a single tree canopy. This prescription is the most likely action that would reduce some nesting habitat for the bird. Therefore, regeneration harvest is considered as a harvest that would reduce potential nesting habitat for the bird. Proposed regeneration harvest would reduce nuthatch habitat by about 1%: 8 acres in Alternatives B and D, and 13 acres in Alternative C.

Other discussion in FEIS (pp. 3-221, 3-222) is still relevant to this chapter.

Cumulative Effects

Pygmy nuthatch habitat would be improved by about 17.5 % from prescribed burning and thinning in the action alternatives. Regeneration harvest would reduce nuthatch habitat by about 1% in these alternatives. Burning that occurs outside of the bird's present habitat has the potential to increase habitat for the bird in the Project Area.

All proposed activities would have the potential of disturbing or displacing the nuthatch during implementation of the Project. Disturbance factors of noise and movement by man and machine are likely to cause a nearby bird to leave or flee the area of operations.

The rest of the Cumulative Effects Summery still applies. In summary, the Action Alternatives would increase pygmy nuthatch habitat.

Cumulative effects changes include two projects proposed for areas adjacent to the CCIR Project area. The Tinker Bugs and Red Moose Projects are proposing timber harvest of dead or dying trees as an activity for both projects. At this point, the scale of harvest and/or other activities have not been proposed for analysis: so potential affects to the nuthatch and/or its habitat are unknown.

3.12.5.3.10 Western Toad

The Baldy Fire increased habitat by approximately 110 acres for the Western Toad on southern aspects burnt by the fire. The cumulative effects, including the wildfire, did not change the effects determination found in the FEIS (2015).

3.12.5.4 Management Indicator Species

3.12.5.4.1 American Marten

Marten habitat was analyzed at the same canopy cover and tree species as Bush and Lundberg (2008), with the exception of tree dominance groups not represented in the project area: popular, birch, and hemlock.

Cumulative Effects

The following is supplemental information to the cumulative effects section of the 2015 FEIS (page 3-229)

Past harvest history (1930s to present) in marten habitat affected 3,157 acres. The age class for stands of 100 years or older was obtained from TSMRS data (old stand exams). Such data showed the 20,305 acres of such age. Reduction of habitat by the Baldy Fire left 19,712 acres.

Additional foreseeable actions include two projects proposed for areas adjacent to the CCIR Project area. The Tinker Bugs and Red Moose Projects are proposing timber harvest of dead or dying trees as an activity for both projects. At this point, the scale of harvest and/or other activities have not been proposed for analysis: so potential affects to the marten and/or its habitat are unknown.

3.12.5.4.2 Northern Goshawk

The following is supplemental information to the cumulative effects section of the 2015 FEIS (page 3-230 to 3-232). One study found that timber harvest treatments had no effects on goshawk re-occupancy, nesting success, or number of fledglings between harvested and unharvested nesting areas (Moser and Garton 2009).

Cumulative Effects

Cumulative effects changes include two projects proposed for areas adjacent to the CCIR Project area. The Tinker Bugs and Red Moose Projects are proposing timber harvest of dead or dying trees as an activity for both projects. At this point, the scale of harvest and/or other activities have not been proposed for analysis: so potential affects to the goshawk and/or its habitat are unknown.

3.12.5.4.3 Pileated Woodpecker

The following is supplemental information to the cumulative effects section of the 2015 FEIS (page 3-233 to 3-236). Some comments on the CCIR Project DEIS desired the inclusion of a couple of research articles: Bull et al. 2007 and Bull and Holthausen 1993. Though both references are included in the FEIS (3-233 and 3-234) the Biologist has included a short segment from the research.

One group of researchers conducted a study on the density of pileated woodpecker nesting pairs in areas before and after timber harvest activities (Bull et al. 2007). In six of the seven study areas, the density of the nesting pairs were unchanged, or increased or decreased by only one pair. In these sampled areas, the amount of mature and old forests decreased by less than 25%, with consistent pileated woodpecker densities.

One area had a nesting decline from five pairs of nesting birds to one pair over the period, after earlier timber harvests. Mature or old-growth stands had been reduced from 50% to 3% in this study area, over a 30-year period. One effect of forest disturbance on the woodpecker was an increase of raptor predation on pileated woodpeckers in the study areas. The decrease in protective cover was considered a factor in the decline of woodpecker presence in the study areas (Bull et al. 2007).

Bull and Holthausen (1993) recommended that home range habitat should consist of about 75% in grand fir forest types of mature and older trees with >50% canopy closure and limited harvest activities. This was based on the forest type and research the authors conducted in northeast Oregon. The research was conducted on unharvested green forests before large insect outbreaks occurred across landscapes in northeastern Oregon.

Old growth areas in the Project Area would probably be the closest comparison as to the conditions the authors refer to. The Project Area supports 11% verified old growth, and another 4% of unverified old growth. There would be no harvest of old growth in this Project.

Both research articles were conducted in different forest habitats than what is present in the CCIR Project. The moister habitat types in the Project Area host a greater variety of disease and rots in tree species, which can make trees more susceptible to insect infestations. The vegetation section of the FEIS mentions that approximately 76% of the PA may be susceptible to insect and disease activity. This process would create more potential for dead and dying trees, and thereby the potential for increased woodpecker habitat.

As mentioned in the FEIS (2015), no harvest would occur in old growth forest and snag retention guidelines would leave more tree structure in units than the prescribed standards in the Nez Perce Forest Plan. Direct, indirect and cumulative effects are the same as in the FEIS (page 3-236).

Cumulative Effects

Cumulative effects changes include two projects proposed for areas adjacent to the CCIR Project area. The Tinker Bugs and Red Moose Projects are proposing timber harvest of dead or dying trees as an activity for both projects. At this point, the scale of harvest and/or other activities have not been proposed for analysis: so potential affects to the pileated woodpecker and/or its habitat are unknown.

3.12.5.4.4 Rocky Mountain Elk

This section replaces the elk analysis completed in the FEIS (pp 3-236 to 3-243). Direction from the Forest is to utilize the elk analysis by Servheen et al. 1997, instead of the older elk guidelines referenced in the 1987 NP Forest Plan. The more recent guidelines were developed from multi-agency input: Forest Service, IDFG and the Nez Perce Tribe. Additionally, the Forest has assigned road and trail access designations in a more recent document (pending signature): “Designated Routes and Areas for Motor Vehicle Use, or DRAMVU, for the Nez Perce Forest. The selected alternative for DRAMVU is a science-based approach that identifies risks and benefits of forest system roads as they pertain to safe and efficient travel and the protection, management, and use of the national forest. Relevant literature concerning elk management on the Forest is described in the next few paragraphs.

Background: Elk is a MIS for commonly hunted big game species on the Nez Perce National Forest, and a management indicator species for general forest seral species easily affected by management activities. Elk are habitat generalists and use a diversity of forest types and structures that provide forage and hiding cover (Unsworth et al. 1998). They forage in meadows and early seral communities from spring through early summer, use more closed canopies from late summer through fall, and rely upon low elevation, warm aspect, and snow-free or snow-limited areas for foraging in the winter. Adult bulls often winter at much higher elevations than cows and immature elk. Elk also require forest cover for security and thermal regulation (Thomas et al. 1979); although the results of Cook et al. (1998) did not find that such forest cover significantly enhanced the condition of elk in winter or summer. The latter study did not assess effects of topographic or other landscape features that could enhance energy conservation by protecting from wind or enhancing absorption of solar radiation.

Nutritional resources are the most important factors associated with elk summer resource selection (Ranglack et al. 2016, Alldredge et al. 2002). Recent nutritional studies have employed models for analyzing seasonal forage to the autumn body condition and pregnancy rates (Cook et al. 2017, 2016), calf recruitment (Middleton et al. 2013), and body-fat-pregnancy relationships (Proffitt et al. 2016, Ranglack et al. 2016). Wildfire, prescribed fire and thinning would create forage for elk, though nutritional quality of the new or recovering forage would vary during the growing seasons (Proffitt et al. 2016, Long et al. 2008b), as well as the type of forest habitat being managed. Selection of such forage would vary among elk bulls and cows (Long et al. 2008a, 2009).

Both elk and cattle graze on grasses, while elk are more likely to browse on leguminous plants (Stewart et al. 2003). Elk appear to avoid areas that cattle are using if other foraging habitat is available (Coe et al. 2001, Christensen et al. 1993). Other research showed elk would forage in the same areas/pastures as cows (Yeo et al. 1993). Elk foraged at lower elevations when cattle were absent, but moved to higher elevations and steeper country when cows occurred (Stewart et al. 2002). The latter study surmised that this behavior indicated a shift in niche for elk; or a competitive displacement of elk by cattle.

Calving areas can be traditional and preferred sites are generally large meadows, shrub fields and early seral forest openings in close proximity to water. A mosaic of diverse forest, shrub field, and meadow conditions with available water, productive winter range, and adequate security characterizes good elk habitat.

Elk and Forest Roads: Roads affect elk security/vulnerability, as they can fragment habitat, create disturbances that shift elk distribution away from roads, and decrease daily movements and size of home ranges of elk (Rowland et al. 2005). Individual animals can be displaced from preferred habitat due to increased disturbance, and the animals are more vulnerable to human-caused mortality (Servheen et al. 1997). Roads built into elk habitat increase hunter access and elk vulnerability to harvest (Unsworth et al.1993, Christensen et al. 1993). The type of road, type of vehicle, traffic volumes, timing of vehicle use, and visibility (topography, vegetative cover, etc.) all play a part in how roads affect elk vulnerability and security across the landscape. During archery season elk may use areas further from (Ranglack 2016, Ranglack 2017), or closer to (Rumble 2005), roads as compared to pre-season. However, elk consistently use areas away from roads during rifle season.

Security is the result of a combination of factors that allow elk to remain in a specific area while under stress from hunting (Christensen et al. 1993). "Security area" (the structural constituent of security) is the area that will, during periods of hunting stress, hold elk because of geography, topography, vegetation, or a combination of those features (Lyon and Christensen 1992). A security area is defined as at least 250 contiguous acres that are more than one half mile from open roads (Hillis et al. 1991). The security area would provide hiding cover, which is defined as ". . . vegetation capable of hiding 90% of a standing adult elk from human view at 200'; generally, any vegetation used by elk for security or escape from danger (Thomas etal. 1979)."

Reducing the effects of disturbance from roads and hunting has been suggested by expanding vegetation buffers (Ranglack et al. 2017, Frair et al. 2008, Rowland et al. 2005, Rowland et al. 2000), or adjusting the size of elk unit to be analyzed (Rowland et al. 2005, Boyce et al. 2003, Unsworth et al. 1998, Christensen et al. 1993). (Montgomery et al. 2012), discussed the influence of different road types on elk space use across seasons by gender, and other elk habitat considerations.

Data was analyzed on how road closures to motorized vehicles during the elk seasons of 1992-1995 on the NPCNF would influence hunter density and success (Gratson and Whitman 2000). The authors concluded that road closures may significantly reduce densities of elk hunters during general elk seasons. However, the study suggests that some hunters benefited from changes in both elk behavior and environmental factors associated with road closures: such roads may have provided quiet access in elk habitat, leading to increased encounter rates between hunters and elk. Closing roads also may have increased elk use of habitat along roads due to the lack of motorized disturbance (Wisdom 2004), as elk can return with-in days to weeks after disturbance (Lyon and Ward 1982). Thus, rates of encounter between hunters and elk may have been greater along closed roads than encounter rates along open roads (Gratson and Whitman 2000).

Population Trends: Elk populations in the Analysis Area were relatively insignificant until a series of major fire events occurred in 1919, 1928, and 1934. These wildfires increased forage availability and population levels up to the 1950s. Since then, lower forage levels and increased predator pressure have decreased numbers of elk in the Rocky Mountain areas of central Idaho. In response to declines in elk numbers, IDFG replaced the either-sex hunting regime in 1976 with an antlered-only general hunting season. Elk herds then began rebuilding. (IDFG 2017). Short-term goals are to stabilize the current population and increase control management of predators in this zone.

The proposed project lies within the Elk City Zone, which consists of three Game Management Units (GMUs). The zone has experienced historical reductions in elk habitat from agriculture and ranching on the prairie areas, mining along river valleys, and logging and road development in the general forest (IDFG 2017). Besides human factors, natural predation of elk occurs from mountain lion, black bears and wolves. During elk surveys in 2015, the zone's population was below objectives for cows and bulls. IDFG states the numbers were under-estimated, due to the lack of snow and elk not present on the winter range due to climatic conditions (IDFG 2017). State biologists mention that the survey results were not representative of actual elk numbers. IDFG aerial winter surveys in 2008 estimated over 4,200 cows and 863 bulls (218 of those were adult bulls). The 2008 harvest count was considered as achieving its objective in 2008 (IDFG 2017).

The CCIR Project Area is located in the west portion of Game Management Unit 16. Unit data between 2006 and 2008 show cow and bull elk numbers increased and both sexes met population objectives. However, calf recruitment decreased from 27 calves per 100 cows (2006) down to 21 in 2008. The calf:cow ratio is an important indicator of population recruitment and long-term herd viability. A ratio of at least 25 calves to 100 cows is needed to offset natural mortality. Reasons for the decline are unclear but may be related to reductions in forage quality (poor condition of cows and low calf weights), high predation rates, less security area, and greater human disturbance and/or hunting pressure. The IDFG mentions that low calf recruitment is a concern in GMU 16 (IDFG 2017).

The table below shows a more current status of the estimated elk population (aerial and other surveys): cows are meeting population objectives and bulls/adult bulls are above objectives for 2008, but not for 2015 as stated earlier. The number of calves was estimated at 154 during 2008, and no information for the 2015 survey flight (IDFG 2017).

Table 28: Elk Population Status and Objectives for Management Unit 16 based on the Most Recent Survey Update (IDFG 2010-2015 Average)

Mgmt. Unit	Survey Year	Current Status				Population Objectives		
		Cows	Bulls	Calves	Total	Cows	Bulls	Adult Bulls
16	2010-2015	897	275	154	1,326	800-1200	175-200	100-150
16	2015*	127	27	22	176	800-1200	175-200	100-150

* IDFG explains that the winter aerial survey (2015) shows elk numbers were below objectives. The agency warns that the survey should not have been conducted due to lack of snow, as elk were not on winter ranges, and survey results were not representative of actual elk numbers. (IDFG 2017).

In the guidelines (Servheen et al. 1997) for elk analysis, the elk vulnerability (EV) model is used to measure hunter and motorized route densities to predict elk mortality rates. The EV model was designed to be applicable during hunting seasons for elk (Servheen et al. 1997), and is still used by the IDFG in their periodic reports. The Forest contacted Mr. Servheen in 2018 and asked about the bull adjustment factor in his vulnerability model. Upon review he replied that it is for standard use across the board and not just specific to the example [project]. (J. Lutes, personal communication, 2018) The Forest obtained data from the IDFG in the past year concerning information that can be utilized for calculating Elk vulnerability. GMU 16 encompasses around 248,350 acres, or about 388 square miles. Of this acreage, open road/trail density is 1.4 miles/square mile in the GMU. Hunter density during 2010-2015 hunting seasons averaged 6 hunter days/ square mile. The IDFG calculated an average annual (hunting or natural caused) mortality rate of 9% for cows and 42% for bulls, during the six year time period. Estimation of mortality rates (2008-2014) resulted in the predicted Bull:100 Cow ratio of 31:100 (IDFG 2015). This ratio appears high to the Biologist, as it is above the population objective for the zone (18-24 bulls:100 cows), and the latest elk report (IDFG 2017) states that "current perceptions are that elk have declined" in GMU 16. Lacking confident data, no current conclusion for elk vulnerability can be assessed from the inconclusive results of the 2015 aerial survey.

Summary of EV discussion*:* The most recent data does not include statistics for 2016 or 2017, and survey data from 2015 was considered an underestimation by IDFG (2017). Comparisons of data from 2006, 2008 and 2010-2014 show elk numbers increasing for bulls and cows. Forest Service road and trail density in GMU 16 is 1.4 miles, with private or other ownerships comprising 0.4 miles. Elk Vulnerability is apparent from natural causes, hunting, predators (ie: mountain lions, wolves, and bears), and habitat (weed displacement of desirable forage, or diminished forage production from tree canopy closure).

Elk Winter Range

The Forest Plan (USDA Forest Service 1987a, p. III-46) designated MA 16 as big game winter range. The goal for MA 16 is to improve the quality of the winter range habitat for deer and elk through timber harvesting, prescribed burning, and other management practices. Winter range is primarily below 4,500 feet in elevation with southern-to-western exposures. The vegetative types included are non-forest grasslands, seral brushfields, and timbered lands.

High quality forage is an important component of elk winter range. Elk eat grasses, forbs, shrubs and the tips of twigs from some woody vegetation. Shrub species such as redstem ceanothus, syringa, serviceberry, mountain maple, chokecherry and bitter cherry, provide much of the winter forage available to elk. When grass and forbs are covered in snow, elk mostly utilized shrubs in winter (Hodder et al. 2013).

About 60,000 acres are located in winter range within the GMU. The Analysis Area contains about 15,060 acres of MA 16 winter range (34% of the Project Area). Winter range may be in contiguous blocks or occur in isolated parcels surrounded by summer range. In the CCIR Project Area, one block containing a 5,165-acre area is considered strictly winter range. Adjacent to this area is an elk analysis area (EAA) containing another 6,250 acres of winter range. The latter area also contains summer range. The remaining 3,600 acres are spread out in the Project Area: interspersed among six other summer range EAAs.

The majority of winter range occurs in part of the Clear Creek Roadless Area or in areas closed to motorized use: providing high levels of secure habitat during the winter months. Most of the wintering elk in Clear Creek watershed are found in the Solo Creek and upper Clear Creek; where low open road densities provide security areas from winter recreation disturbances.

Elk Winter Range, Direct and Indirect Effects

Alternative A – No Action

There would be no direct effects to elk winter range under Alternative A as no activities would occur. In the absence of natural disturbances winter range forage quality and quantity would continue to decline as tree canopy cover increases and shades out understory forage. Insect and disease impacts may create openings for shrubs, forbs, and grasses, although not to the scale of wildfires. Fire suppression may reduce potential forage recruitment or increase the severity of wildfires due to increased fuel loading. Large wildfires would increase the amount of available winter forage though space and time. Without further disturbance after a fire event, forage quantity would decline and hiding cover would increase in about 20 years.

Regeneration harvests from 1997 to present created 412 acres of forest openings within winter range in the project area. When forest succession ages to about 20 years, tree density and canopy cover has replaced most of the understory plants (grass, herbs, shrubs). Forage habitat is minimal to none, as the habitat becomes hiding cover. Harvests older than 20 years would be functioning as hiding cover for elk. Alternative A does nothing to create early seral habitats that would provide high quantities of forage.

Cattle grazing occurs in the Project Area. The animals are mostly seen moving or grazing adjacent or near roads in the Project Area. Their permit for use does not include grazing during the winter months in the Project area; therefore, cattle are not competing with elk for winter forage on the Forest. However, their summer grazing and occasional browsing may reduce some potential elk winter forage in the locations the cows were present during the preceding seasons.

Alternatives B, C, and D

All alternatives use landscape burning on 536 acres (3.5%) and grass restoration on 41 acres of MA 16. Burning in late summer or early fall would increase growth or recruitment of shrub species and mimic natural fire seasons. Prescribed burns are usually ignited for reducing fine fuels and managed at low severities to avoid the loss of control or large hot fires. The burning of some small trees, shrubs and understory would reduce competition for sunlight and nutrients for the new grass and herbs that would pioneer plant succession the following spring. Long et al. (2008) found that forage cover was higher the following spring after a burn as compared to unburned areas, but the opposite occurred during the summer. About five years after the burn, new shrub growth would become available browse on the winter ranges. Shrubs would increase or persist for ten or more years, until trees overtake them or some other disturbance occurs. Winter elk habitat would be created, restored or maintained from the prescribed burns.

The affected acres would likely provide improved forage opportunities for female elk during the following spring seasons (Long et al. 2008a & b, 2009). The authors found that male elk rarely used the newly burnt habitat, however, an overlap of both sexes occurred during summer. As the grasses and forbs senesce from the summer heat in open areas, elk are likely attracted to the forage in shaded areas along edges of the treated areas where forage is less cured. The burns would be spread out to create a mosaic of burned and unburned areas: a preferred situation to provide a long-term forage component on the landscape (Long et al. 2009). Burning may reduce hiding cover depending on the fire severity. The Biologist estimates that treatments at low intensity may affect hiding cover by 5-10% in the affected areas.

Regeneration harvests (photo below) would remove hiding cover and leave less than 10% canopy cover in the units. Clumps of live trees and snags would be retained along with about 10-15 trees on average per acre. Alternative C proposes the most (1,800 acres) of this prescription, while Alt. B would affect 1,233 acres and Alt. D would affect the least (992 acres) amount of forest habitat. These areas would be very open, and elk security would be unlikely during daylight periods.

Figure 25: Example of Regeneration Harvest

Improvement harvests would retain more trees/acre (60-150) than the above timber prescription. Additionally, larger patches of live and dead trees would be retained, compared to the regeneration prescriptions. Upon completion, these units would retain about 40% canopy cover. Alternatives B and C would affect about 270 acres with this prescription, while Alternative D would affect about 158 acres. Upon completion of these harvests, the units would appear somewhat open (see photo below). However if an elk is present in or near one of the clumps, it may be screened from visual detection by the retained trees. Elk security would marginal: near clumps or areas of the unit not visible from roads.

Figure 26: Example of Improvement Harvest

The combined effects of regeneration and improvement harvest would result in the temporary reduction of elk hiding cover. The largest decrease of such would occur under Alternative C: 2,070 acres or about 14% of winter range in the Project Area. Alternative B would affect 1,503 acres (10%), and Alternative D would affect the least amount of hiding cover: 1,150 acres (less than 8%).

Commercial thinning is a prescription for enhancing growth in desired trees. Smaller or less desirable trees would be removed, to allow more available sunlight and nutrients for the desired trees. Tree density would range between 100-200 trees per acre, with reserve clumps of live trees and snags no more than 1/4 acre in size. Harvest prescriptions for this type of thinning would basically consist of even spacing of retained trees and small patches of live and dead trees.

Alternative C proposes the most commercial thinning: 953 acres or 6% of winter range in the Project Area. Alternative D would thin 747 acres (5%), and Alternative B would propose the least of the alternatives (513 acres or 3%). Thinning would have short term (<10 years) benefits on elk winter range forage. Thinning retains 40-60% of the canopy cover which allows limited shrub growth. Hiding cover would be reduced under all alternatives; yet the retained tree density and clumps would provide hiding cover for elk in areas of the units that are furthest from an open road. Elk security would be marginal: near retained tree clumps or areas of the unit that are not visible from a road.

Figure 27: Example of Commercial Thin

All the Alternatives propose precommercial thinning (PCT) in 559 acres (3.7%) of winter range. PCT reduces competition among the growing young trees. Tree densities are reduced in order to supply more space and nutrients for the retained trees to grow faster and develop into older trees. This treatment would have minimal effects on elk winter forage; as much of the upper canopy cover would be retained, while thinning of the smaller trees would encourage growth of grass, herbs and shrubs. After the treatment, tree densities about 100 yards from an open road would be thick enough to provide hiding cover for elk to forage or rest in the units. Human detection of elk along a road in these units is may be difficult.

Figure 28: Before and After Photos - Precommercial Thinning

A summarization of harvest prescriptions by action alternatives is displayed below. Winter range = 15,060 acres in the Project Area.

Table 29: Summary of Harvest Prescriptions - Hiding Cover Reduction and Winter Forage Increase

Action Alt.	Regen & Improvement			Commercial Thinning			Precommercial Thinning		
	Acres	Hiding cover Reduction	Winter forage Increase	Acres	Hiding cover Reduction	Winter forage Increase	Acres	Hiding cover Reduction	Winter forage Increase
B	1500	10%	10%	953	6%	6%	559	4%	4%
C	2070	14%	14%	513	3%	3%	559	4%	4%
D	1150	8%	8%	747	5%	5%	559	4%	4%

Elk Winter Range, Cumulative Effects

The cumulative effects analysis is the MA-16 elk winter range, within the Project area. The timeframe is 20 years: the time when tree canopy cover would begin to close and reduce the quality of elk winter forage. During 2014 the Johnson Bar Fire burnt about 4,500 acres of winter range that is adjacent to the proposed CCIR Project. The Johnson Bar Salvage Project proposed to harvest about 1,500 acres that were burned in the fire. During 2015, the Baldy Fire burned about 775 acres in the Project area. The fire was not located in or affected winter range. The combination of fire effects and salvage harvest would contribute to increased forage availability for elk on winter ranges adjacent to or within the CCIR Project Area. The developing forage in the burned areas is available for elk that may be displaced during the implementation of activities for the CCIR Project. Foreseeable projects include two proposed projects. The Red Moose Project is located at higher elevations and probably is not providing winter range. The Tinker Bugs Project is located adjacent to the Middle Fork of the Clearwater River: between the confluences of Clear Creek and the Selway River. Portions of the project lie in elk winter range. Both projects propose timber harvest, but only the Tinker Bugs Project would propose harvest in elk winter range. At this time, both projects are in the planning stages, and effects to elk and their habitat has not been analyzed.

Alternative A – No Action

The mentioned wildfire events and salvage harvest adjacent to the Project Area have reduced canopy cover and provided openings for elk forage to recover. Within the Project Area, winter range would continue to decline as forage is shaded out by the developing tree canopy. Some elk would likely move to recently burned or harvested areas at lower elevations outside of the Project Area. Forage could increase in the event of a wildfire however it is not possible to predict the amount or location.

Alternatives B, C, and D

The Action Alternatives would conduct regeneration or improvement harvest and landscape burning on up to 23% of MA 16 winter range. Alternative C would create the most openings and potential forage for elk winter range, followed by Alternative B, then D. In 2-5 years after prescribed burns, the digestibility and percent of nitrogen increased in forbs and grass for elk. By the fifth year these variables exceeded values found in unburned areas (Long et al. 2008)., The most benefit of forage availability would be for cow elk, as they selected for areas burned between 2-5 years post-burn during the spring (Long et al. 2009). The authors noted that male elk appeared to avoid these areas. Not all prescribed burning would occur at once. The treatment would occur over the implementation period of the Project, when conditions for low severity burns are appropriate. These treatments would create early seral habitats that provide high quantities of quality forage for about 20 years. Such treatments would meet the management intent to increase or improve big game winter range. All harvest units would be restocked with

tree species that are more resistant to root rots, such as ponderosa and white pine, and western larch. The growth of the planted stock would gradually shade out understory vegetation.

The action alternatives would meet Forest Plan standards for MA 16 by implementation of seasonal road closures as per the motorized travel guide, and restricting public access to temporary roads or other roads utilized by harvest activities. Upon completion of the proposed activities and the return of road closures according to DRAMVU direction, elk will use habitat near road networks that are consistently closed to vehicle traffic and receive modest levels of use by humans on foot (Montgomery et al. 2012).

Project activities (timber harvest, road work (construction, maintenance, decommissioning), would disturb or create short-term displacement of individual elk. Timber sales would be spread out over a period of years, which would provide non-disturbed or recently created portions of winter range for elk to forage. Road access for motorized vehicles would decrease: creating less traffic disturbance to elk, and more or larger security areas. Road densities would drop from over 3 miles/square mile to 1.1 mile/square mile. The overall change in motorized access would create less elk vulnerability in the Project area. During winter months snowmobile activity would be restricted to roads that are open to motorized access. Such access would be limited to 75 miles.

Insects and disease would continue to create openings for the limited growth of shrubs, forbs, and grasses. Fire suppression would continue and fuels would continue to increase in untreated areas. A large fire could significantly increase the amount of winter forage and would decrease hiding cover for elk; however predicting the time and size is not possible. Habitats would be less susceptible to wildfire because proposed treatments (improvement, regeneration, CT), and reduce crown fire potential on 4-6% of the Analysis area.

Elk Summer Range

The majority of the Analysis Area is considered summer range for elk. Important habitat components for elk include foraging sites, hiding cover, calving areas, rutting, and security areas. Forage availability and abundance has declined throughout the area due to a lack of disturbance (fire, timber harvest) and subsequent increases in tree copy cover. Hiding cover is available in forested stands that are 20 years or older. Elk Security areas are places where wildlife can retreat for safety when affected by disturbance. In general, security areas are over 250 acres in size and ≥0.5 miles from an open road or trail (Hillis et al. 1991). There are no forest plan standards for the amount of security areas to be managed. More recent studies have proposed larger buffer zones than the Forest direction of one half-mile on either side of a road. One study from the Starkey Research Station in north-east Oregon buffered roads up to 1.1 mile from a road (Rowland et al. 2005). Road densities in the study area varied (3.85 to 4.99 miles/sq. mile) depending on the alternative. The CCIR Project sits at 2.72 miles/sq. mile in the existing condition, potentially increases to 3.3 mi./sq. mi., then drops to 1.1 mi./sq. mi. upon completion of the Project. The road densities in the Project Area are much lower than those found in the north-eastern Oregon study area.

Another group of researchers (Ranglack et al. 2017) suggest different metrics for hunting seasons in southwestern Montana. The habitat in their study area included conifers, sagebrush and grasses (fescue and wheatgrass). They proposed a mile buffer for motorized routes with a canopy cover >9% during rifle season and a 1.7 mile buffer with >13% canopy cover during archery season. Rationale for the varied recommendations were based on perceived elk

vulnerability from disturbance by motorized traffic or potential mortality from hunting. Additional factors in the analyses include habitat type, topography, canopy cover, road densities, and motorized vehicle use (type of vehicle, traffic volumes, and timing of vehicle use).

Both articles analyzed areas with different habitats than the Project Area. Road densities remained higher in the Starkey study, compared to any condition found in the Clear Creek IR Project. The lower canopy cover in the Montana study created more open habitats and an increased opportunity to detect elk: thus the greater buffers from roads. Both studies were in drier habitat types that support more open terrain: resulting in less tree canopy cover and sparser hiding cover for elk. All of these factors contributed to the concern for elk vulnerability to motorized access and hunting. The various road buffers mentioned by the researchers reflect their analysis of, and recommendations for consideration of disturbance and elk mortality in their respective study areas. Ranglack et al. (2017) took an additional step to distinguish different buffers according to the season of weapon type for elk hunting.

The CCIR Project area is more densely vegetated with moister habitats as compared to the studies conducted in northeastern Oregon and southwestern Montana. Tree species in the Project Area range from ponderosa pine to western red cedar. Elk hiding cover is ubiquitous, with the exceptions being in areas of disturbances that have occurred in the past 5-10 years by fire or timber harvest, managed roads, or habitats that do not support tree growth. Such openings and cover have been analyzed for each alternative in each of the Elk Analysis Areas, using Servheen et al. (1997). This analysis is available for review in the Project file.

Forest correspondence with Mr. Ranglack on the applicability of his model to the NPCNF revealed that it may perform poorly when applied to areas that are ecologically different from where the models were created (J. Lutes pers. comm. 2018). These findings allowed the Biologist to consider current literature and its potential application as analysis in the CCIR Project. Primarily due to the differences in habitats and road densities on the Forest compared to the Rowland et al. 2005 and Ranglack et al. 2017 reports, the Biologist's professional opinion considers studies on the NP-CNF or other areas of similar habitats are the most appropriate to address elk vulnerability and security in this Project.

Literature relevant to the NP-CNF included Christensen et al. 1993, and Hillis et al. 1991. Their findings contributed to the guidelines the forest uses for elk analysis. The half mile road buffer is appropriate for the habitat types and terrain located on the Forest. The "Interagency Guidelines for managing elk habitats and populations on U.S. Forest Service lands in Central Idaho" (Servheen et al. 1997) was used to evaluate summer elk range and considers road open road density, livestock grazing, cover-forage ratios, and security areas. Part of the guidelines included an analysis of elk vulnerability, which was discussed under the table in the "Population Trends" section of this elk report. The roads analysis employs the selected Alternative 5 modified of the pending DRAMVU project.

Table 30: Elk Analysis Area, Summer Range Acres, and Open Road Densities

Elk Analysis Area		EAA Acres		Summer Range Acres		Open Road Density	
Name	Number	Total	Project Area	Total	Project Area	Existing	Post Project (Range)
Clear Creek 1	304064022	5059	4772	4733	4733	1.2	0.5
Clear Creek 2	304064021	6370	6184	5928	5830	0.8	0.5

Elk Analysis Area		EAA Acres		Summer Range Acres		Open Road Density	
Name	Number	Total	Project Area	Total	Project Area	Existing	Post Project (Range)
Clear Creek 3	304064031	4702	4208	4593	4103	1.6	0.7
Brown Springs	304067152	7214	7103	6060	6060	1.0	1.0
Pine Knob	304067151	5425	2908	3022	1778	1.6	1.1
Solo Creek	304067171	5304	5203	4505	4413	1.5	0.8
S. Fork Clear Creek	304064011	8117	7786	1955	1615	0.3	0.3

The Forest Plan objective for summer range elk habitat effectiveness (EHE) is to achieve a minimum of 50% effectiveness in each EAA affected by the CCIR Project. There are seven EAAs, and all areas would meet the objective of ≥50% EHE upon completion of the project (see table below).

Table 31: Elk Summer Range Habitat Effectiveness by Alternative in the Clear Creek Analysis Area.

Elk Analysis Area		Summer Elk Habitat Effectiveness (%)			
Name	Number	Existing Condition	During & Post Alternative B	During & Post Alternative C	During & Post Alternative D
Clear Creek 1	304064022	51	52/69	52/69	52/68
Clear Creek 2	304064021	65	65/75	65/71	65/75
Clear Creek 3	304064031	48	43/64	43/64	43/63
Brown Springs	304067152	54	52/56	52/56	54/56
Pine Knob	304067151	48	48/50	50/55	49/55
Solo Creek	304067171	49	48/60	46/61	46/60
S. Fork Clear Creek	304064011	76	74/77	74/77	73/76

The Forest Plan Objective is 50% for each Elk Analysis Area (EAA)

The existing condition in each EAA is the present status of elk habitat effectiveness (EHE) based on habitat (forage, cover and security), effects of road or motorized trail densities and disturbance (openings, cattle presence). The table above shows that three EAAs in the existing condition are currently below the 50% EHE recommended by the Forest Plan.

Table 31 displays the EHE condition during implementation, and upon completion of each proposed alternative. During implementation of the alternatives, EHE may be reduced due to the increase of roads and openings created from harvest operations. In some cases EHE may remain the same or increase due to newly created openings that create forage in EAAs that are deficient in forage. Post project activities, all EAAs would improve. The three EAAs that were below 50% EHE standard would improve under all action alternatives to meet Forest Plan recommendations. If Alternative D was selected as the preferred alternative, EHE would remain the same as the existing condition for two EAAs: Brown Springs and South Fork Clear Creek. Spreadsheets for analysis of the EAAs under the alternatives are available in the Project File.

Elk Summer Range, Direct and Indirect Effects

Alternative A – No Action

Livestock are present in the Project Area, but represent a negligible factor to elk. The Project area lies in 2 cattle allotments. About 70 head use about 8 square miles for just the summer. The cattle usually move in small groups along a few road systems in the area, and graze along flats and spurs adjacent to the roads. They are unlikely to graze on steep slopes; leaving their activities and impacts confined to a very small part of the project area. Due to the low numbers, short period of use and use of about ten percent of the Project Area—livestock use did not create a deduction factor on elk use in the CCIR Project area.

Weeds are present in the Project Area. They are mainly found along roads, but may also appear in units. Measures are taken to spray/wash down timber or fire equipment before their deployment on the Forest. About 7% of the Project Area is highly susceptible to weeds, and elk potential elk forage is likely affected by non-native vegetation. The Noxious Weed section in the 2015 FEIS goes into more detail about weed species.

There would be no direct effects to summer EHE under Alternative A because no activities would occur. The lack of disturbance (natural or man-made) would create denser tree stands, and a reduction of potential forage for elk. Summer range would be more susceptible to wildfire when compared to the Action Alternatives due to increasing fuel loads resulting from fire suppression. A large wildfire would reduce hiding cover in the short-term (10–20 years) but would increase forage. All EAAs are meeting Forest Plan standards of at least 50% EHE.

Alternatives B, C, and D

All three alternatives propose prescribed burns in about 560 acres of winter range. Selection of new or recovered browse after burns or fire appeals to cow elk more so than bull elk, as mentioned in the winter range section of this report. Though the treatment is for creating or maintaining winter habitat, it would be grazed or browsed from the first spring after the burn, and up to five years at least by cow elk (Long et al. 2009). In other words, the fire treatment would benefit spring and summer forage for elk, as well as provide winter forage.

Regeneration and improvement harvests would remove hiding cover and increase summer forage in the Project area. Alternative B treats 1,235 acres (8%), Alternative C (2,223 acres; 15%), and Alternative D (1,037 acres; 7%) of the Project area. Commercial and pre-commercial thinning would open the tree canopy to allow more sunlight and nutrient availability for the retained trees. Both prescriptions would maintain overhead canopy and some hiding cover, as well as create conditions for forage production. PCT would retain hiding cover within the treated units, and therefore is a minor contribution as effecting calculations for elk habitat effectiveness (Leege 1984).

Table 32: Summer Range Harvest Treatments - Hiding cover and Forage Increase

Action Alt.	Regen & Improvement			Commercial Thinning			Precommercial Thinning		
	Acres	Hiding cover Reduction	Summer Forage Increase	Acres	Hiding cover Reduction	Summer Forage Increase	Acres	Hiding Cover Reduction	Summer Forage Increase
B	1235	4%	4%	4644	15%	15%	1259	1%	1%
C	2209	7%	7%	3701	12%	12%	1259	1%	1%
D	1034	3%	3%	4383	14%	14%	1259	1%	1%

Summer Range in Project Area = 30,796 acres

Hiding cover is vegetation capable of hiding 90% of a standing adult elk from human view at 200'; generally, any vegetation used by elk for security or escape from danger (Thomas etal. 1979). The treatments would create a change in vegetation: from closed canopy to more open. With the increase in light and nutrients, the vegetation understory would begin to recover. Grass, herbs and shrubs would become available as potential forage for elk. Invasive weeds may also become apparent in the more disturbed areas of the treated units: landings, roads, temporary roads and trails. Units adjacent to roads may provide forage for cattle that may be present in the Project Area.

After the timber harvest units would be restocked with seral tree species that prefer more open canopies: ponderosa and white pine, and western larch. Over time the understory forage would decrease as Elk would take advantage of new forage at any season.

During implementation of the proposed activities, road densities would increase due to the use of seasonal or closed roads and construction of temporary roads. None of the alternatives would construct permanent roads or change access restrictions on existing roads or trails.

Increased road densities and new openings created by the alternatives from regeneration and improvement harvests would reduce security areas (see SDEIS Appendix F). A security area consists of at least 250 acres of contiguous cover, located at least ½ mile from an open road (Hillis et al. 1991), or motorized trail. All open roads and those used for project activities are buffered by one-half mile on each side of the road, due to potential disturbance to elk. All temporary roads opened or created for harvest operations would be closed to general public motorized access; though their use during operations would be considered an increase in road densities which would reduce security areas.

Upon completion of Project activities, security areas are re-adjusted to accommodate for road closures and recently created openings. All temporary roads would be decommissioned. Road density in the Project Area would drop to 1.1mile/sq. mi (see DEIS Appendix F). Security areas would recover or increase with road/motorized trail closures and as vegetation matures to the point of providing hiding cover: about 10-20 years after treatment and tree planting. That said, Naylor (2009) found that elk avoided or travelled away from roads or trails with any type of activity: hiking, biking, horseback riding and ATV. His study showed that the greatest disturbance to elk or avoidance behavior toward a road or trail were related to ATV activity. Roads proposed for decommissioning are currently closed to the public, or are impassable to motorized vehicles due to fallen trees or thick vegetation. Decommissioning would have minimal effects on current elk security. It would permanently prevent any future motorized access, which would maintain elk security areas indefinitely.

The EHE analysis is run as if all roads are open and all proposed units are being treated simultaneously. This exercise overestimates the impacts of project activities to elk. In reality, the harvest contractor would work a cluster of units within close proximity of one another. This reduces transportation costs and focuses the work to complete each unit before moving to the next. During treatment activities, roads used for access to units would remain closed to public motorized access. Direct and indirect effects would be disturbance to elk from activities conducted by machines and presence of man. Elk may be temporarily avoid areas with the above activities during daylight hours. However, during hours of darkness, elk may move into these areas to forage on the downed vegetation.

Upon completion of treatments in the units, all temporary roads would be decommissioned and Forest Service system roads would revert to their present travel management restrictions (in most cases, closed to public motorized access by a barrier). So activities in the affected EAAs would occur as pulses of disturbance over time, leaving available areas for elk security that are not affected.

Analyses during the implementation of each action alternative generally resulted in temporary reductions in EHE values below the existing condition (due to higher road densities and less security habitat). However, in some EAAs, the EHE level increased due to the expansion or creation of forage openings in Areas that had few to no openings. Upon completion of the action alternatives, all EAAs were meeting Forest Plan standards for EHE: equal to or greater than 50%. The CCIR Project would improve EHE levels in all seven EAAs beyond the existing condition!

Upon completion of the proposed action Alternatives, forage quantity would increase for up to 20 years and then decline as tree canopy cover closes. Improvements in the quantity and quality of forage would benefit the condition of cow elk going into winter and ultimately improve calf survival.

Elk Summer Range, Cumulative Effects

The geographic boundary for assessing cumulative effects on elk summer habitat effectiveness is the combined seven EAAs within the 43,700 acre Project area. The time frame for cumulative effects is 20 years: the time it takes for new trees to provide elk hiding cover in the harvested areas.

Alternative A – No Action

The Baldy Fire in 2015 burned about 775 acres in the Project area. The fire was not located in or affected winter range. Two summer range EAAs were affected. The wildfire burned about 190 acres at high severity in the Clear Creek 1 EAA, and about 28 acres in the Clear Creek 2 EAA. The consumed trees are dead and will fall to the ground, over time, and create openings. Less severe fire severities caused a 50% tree mortality in 336 acres of Clear Creek 1 and about 200 acres in Clear Creek 2. The latter mortality would create some small openings, and leave pockets of trees and vegetation as hiding cover and forage. In 2016, a roadside salvage project occurred within the fire perimeter, and harvested about 39 acres of burnt trees adjacent to roads. The latter project was adjacent to the CCIR Project, but no harvest occurred in the affected EAAs. The ongoing Johnson Bar Fire Salvage Project is adjacent to the CCIR Project Area, and is salvaging dead trees in EAAs that are adjacent to those in the CCIR Project. This project will be completed in the near future, and before implementation of the currently proposed Project.

Direct or indirect effects from the Johnson Bar Salvage Project may be noise (from man and machine) and increased traffic along open roads. Elk may move away from the noise and activity if disturbed. The salvage project will be completed before the CCIR Project begins. The new openings from the salvage Project would be producing forage for elk that may be temporarily displaced during the CCIR Project implementation.

Foreseeable projects include two proposed projects: Red Moose and Tinker Bugs. The Red Moose Project is located to the east and northeast of the CCIR Project Area. The Tinker Bugs Project is adjacent to the CCIR Project: south of the Middle Fork of the Clearwater River, along ridges and pockets of dead or dying trees. Both projects propose timber harvest that may occur in

elk summer habitat. At this time, both projects are in the planning stages, and effects to elk and their habitat has not been analyzed.

Inside the CCIR Project area, Alternative A would not create direct or indirect effects. Therefore no cumulative effects would occur to modeled EHE since fire suppression is not considered in the model. Firewood cutting would continue to occur along roads that are open to public motorized access. Elk would probably avoid these areas until the activities are finished and the humans have departed. Summer forage would remain minimal, unless wildfire activity increases in the Project Area.

Alternatives B, C, and D

As mentioned, direct effects would be a reduction in hiding cover (7% to 15% depending on the alternative) across most of the EAAs. This reduction would create an increase in forage for the same percentage range. Indirect effects would be improved forage habitat for elk up to approximately 20 years. An increase in forage is desirable; as nutritional limitations are presumed to be a factor in low body fat found in autumn elk samples (Cook et al. 2016). The authors surmise that lower than expected productivity is occurring due to pregnancy rates in the GMU due to low summer nutrition (Cook et al. 2016, 2017).

Elk security areas would be temporarily reduced from roads used and openings created during implementation of the action alternatives. Upon completion, most roads would be decommissioned or closed to public motorized access, increasing elk security to levels near the existing or pre-project conditions. Hiding cover would recover in 10-15 years. Elk habitat effectiveness would improve for all action alternatives, except for two EAAs if Alternative D was selected as the preferred Alternative. This Alternative would be the same as the existing condition, and greater than the 50% threshold recommended by the Forest Plan.

Past road decommissioning from the South Fork/West Fork EA was already considered in the existing condition. The completed Clear Ridge Road Decommissioning project (2015) reduced roads and improved elk security areas. The ongoing Johnson Bar Salvage Sale (2016) would create additional foraging opportunities for elk. The foreseeable DRAMVU project would eliminate cross-country motor vehicle use on the forest. As mentioned, the foreseeable Tinker Bugs Project and the Red Moose project would conduct some timber harvest and road closures. The potential benefit to elk would be an increase of forage and reduction of roads that potentially affect elk security in the area.

Besides the conclusion for the preceding effects, no other cumulative effects are anticipated except for wildfires or fire suppression. Wildfires may create more forage for summer range. Effects are unknown, as timing and size of such events are unpredictable. Fire suppression would strive to contain fires in the affected area(s). Firewood cutting would occur as mentioned under Alternative A. All proposed project activities would maintain EHE above Forest Plan minimal standards.

Summary of Summer and Winter Range

In summary, the action alternatives are meeting the Forest Plan standards for MA 16 winter range and EHE for summer habitat (all affected EAAs would be ≥50% EHE). Ongoing and foreseeable actions would disturb elk in or adjacent to such activities; however, habitat would not be lost, with the exception of potential private land harvest. The conclusion of the road decommissioning would increase elk security after the vegetation matures to a level of density

that offers elk cover. Overall, the Forest Plans standards that this project meets Standards 1,5, 6, 10, Page II-5, and 6 from the 1987 Forest Plan (see 2015 FEIS, Table 3-42 pgs. 3-184 & 3-185).

As far as the CCIR Project effects on Elk Vulnerability, the open motorized road densities would be reduced from 1.6 miles/sq. mi. in the CCIR Project Area to 1.1 mi./sq. mi.) During implementation of the proposed Project, the highest road density (1.6) would occur during the action alternatives in the Solo Creek EAA. Post project road densities for the seven EAAs range from 0.4 to 1.2. Road management activities that reduce motorized access can be positively associated with elk survivability (Cole et al. 1997). The openings created by the project would increase potential elk forage by 7-15%. This may increase elk numbers in the area, which may increase predation by hunters or other predators.

Upon conclusion of each proposed action alternative, some sections of open roads and one trail (hereafter, referred as motorized routes) would be adjacent to harvested units that reduce elk hiding cover (regeneration, improvement or commercial thinning). These motorized routes adjacent to, or in recently harvested units may increase elk vulnerability during hunting season. Alternative B has the highest amount of roads adjacent to, or in such units (21.26 miles). Alternative C would have 20.38 miles and Alternative D would have 20.31 miles. For all of the action alternatives, the largest treatment prescription along roads is commercial thinning. This treatment retains more trees than the other two prescriptions, and the tree density would likely mask or hide an elk at 400 yards from an open road. Elk vulnerability may increase, but it cannot be quantified. Due to topography, and/or retention of trees and tree clumps, the location of the roads may not provide full view of the unit(s). Elk would likely forage in the affected units during hours of darkness. However, the tendency of bull and cow elk to avoid roaded areas in the fall (Montgomery 2013, Rowland et al. 2000) and open areas during the daytime (Rumble, 2005) would also mitigate some of the risks associated with increased vulnerability. Please see Appendix F for units associated with open roads.

The action alternatives would meet Forest Plan standards for MA 16 winter range, and maintain EHE above the 50% threshold for each EAA in the Project Area. There are no Forest Plan standards for elk security. Ongoing and foreseeable actions would disturb elk in or adjacent to such activities. Habitat would not be lost, with the exception being land management on private property. Upon the conclusion of road decommissioning, road densities would decrease and elk security would increase as vegetation recovers in the abandoned and altered road prisms. Overall, the Project would meet Forest Plan Standards for elk: 1, 5, 6, and 10 in the 1987 Forest Plan.

3.13 Short-term Uses and Long-term Productivity

NEPA requires consideration of “the relationship between short-term uses of man’s environment and the maintenance and enhancement of long-term productivity” (40 CFR 1502.16). As declared by the Congress, this includes using all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans (NEPA Section 101).

Short-term uses are those that generally occur annually. Long-term productivity refers to the ability of the land to produce a continuous supply of a resource. The Clear Creek Integrated Restoration project would result in short-term impacts, but maintain the long-term productivity

of the area through the use of specific Nez Perce Forest Plan standards and guidelines, design measures built into the project's design, and project design criteria. A description of impacts expected by alternative can be found by resource area in the 2015 FEIS and the above supplemental discussions. The project would result in a long-term yield of forest stands by reducing competition and improving growth of individual trees. The project would also result in an economic return from wood products produced and jobs created.

3.14 Unavoidable Adverse Effects

No unavoidable adverse effects have been identified.

3.15 Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species or the removal of mined ore. Irretrievable commitments are those that are lost for a period of time such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line rights-of-way or road.

The action alternatives are not expected to create any impacts that would cause irreversible damage to soil productivity. The development and use of temporary roads and logging facilities is considered an irretrievable loss of soil productivity until their functions have been served and disturbed sites are returned back to a productive capacity.

Chapter 4 – Consultation and Coordination

We consulted the following individuals, Federal, State, and local agencies, tribes and other organization and individuals during the development of this draft supplemental environmental impact statement:

4.1.1.1 Interdisciplinary Team Members (DSEIS - 2018)

Jennifer Blake	Responsible Official's Representative
Zoanne Anderson	Team Leader & NEPA Specialist
Margaret Kirkeminde	GIS Specialist
Joe Sullivan	Fire / Fuels / Air Quality / Roadless
Tam White, Dan Fabbi	Economics / Logging Systems
TBD	Engineering
Glen Gill	Wildlife Biologist
Karen Smith	Fisheries / Aquatics
Becca Lloyd	Hydrologist / Soils
John Warofka	Rare plants / Non-native Invasive Plants
Wes Case	Silviculture
Kearstin Edwards	Recreation
Mike Ward	CFLR Coordinator / Roadless
Cindy Schaecher	Archaeologist
Diana Jones	Visual Quality
Jenna Becar	Public Affairs Specialist
Christine Bradbury	Tribal Liaison

4.1.1.2 Federal, State, and Local Agencies

National Marine Fisheries Service

National Oceanic and Atmospheric Administration

U.S. Fish and Wildlife Service

4.1.1.3 Tribes

The Clear Creek Integrated Restoration project has been presented at quarterly meetings with the Nez Perce Tribe since April 2012. Additionally, continued formal discussions with Forest and Tribal Leadership have been ongoing, as well as, meetings, discussions, and field trips between forest and tribal staff.

4.1.1.4 Others:

The Clearwater Basin Collaborative

4.2 Distribution of the Draft Supplemental Environmental Impact Statement

This draft supplemental environmental impact statement has been distributed to individuals who specifically requested a copy of the document and those who submitted substantive comments on the final environmental impact statement. In addition, copies have been sent to the following Federal agencies, federally recognized tribes, State and local governments, organizations, and individuals representing a wide range of views.

Table 33: Distribution List for the Draft Supplemental Environmental Impact Statement

Federal Agencies, Tribes, and Officials	
Nez Perce – Clearwater National Forests Moose Creek Ranger District, White Bird, Idaho	U.S. Army Corps of Engineers Eric Gerke and Kelly Urbanek
Nez Perce-Clearwater National Forests, Office in Grangeville and Orofino, Idaho	U.S. Army Corps of Engineers Northwest Division – Portland, Oregon
Nez Perce – Clearwater National Forests, Supervisor's Office – Kamiah, Idaho	U.S. Coast Guard, Chief of Naval Operations
Northern Regional Office, USDA – Forest Service Missoula, Montana	USDA – APHIS PDD/EAD
Advisory Council on Historic Preservation Planning and Review, Director	USDA – Natural Resources Conservation Service National Environmental Coordinator
Federal Aviation Administration – Northwest Mountain Regional Director	USDI – Regional Environmental Protection
Federal Highway Administration Division Administrator	US – Office of the Secretary Office of Environmental Policy and Compliance
National Agricultural Library Acquisitions and Serials Branch	EPA Local, Boise, Idaho
Nez Perce Tribal Executive Committee and staff, Lapwai, Idaho	EPA Regional, Seattle, Washington EIS Review Coordinator
National Marine Fisheries Service (NMFS) Boise, Idaho	EPA, Washington, D.C. EIS Filing Section
NOAA – Office of Policy and Strategic Planning	US – Fish and Wildlife Service Spokane, Idaho - Laura Williams, Megan Kosterman Northern Idaho –Field Office – Ben Conrad
NOAA – Habitat Conservation Division, Seattle, Washington	U.S. Department of Energy – Washington, D.C. Director, NEPA Policy & Compliance
Bureau of Indian Affairs, Lapwai	National Agricultural Library

State, County, and Local Agencies and Officials	
Office of the Governor, Boise	Idaho Department of Parks and Recreation, Boise, Idaho
Idaho Senator – Mike Crapo	Idaho State Historic Preservation Office
Idaho County Commissioners Skip Brandt, Mark Frei, Denis Duman	Idaho Department of Fish and Game
Idaho Department of Environmental Quality Grangeville, Idaho	Idaho Department of Lands
Businesses and Organizations	
Tricon Timber	Friends of the Clearwater – Gary Macfarlane
Clearwater Basin Collaborative Group	Lewis & Clark ATV club
Idaho Conservation League – Brad Smith	The Lands Council
Native Ecosystems Council	Alliance for the Wild Rockies
Individuals	
Harry Jageman	Private Land Owners within the project area
Dick Artley	Permitted Outfitter & Guides in the project area
Harry Jageman	Bill Mulligan
Tom Peterson	Al Espinoza
Dennis Baird	Nick Hazlebaker
Brad Chinn	Wayne Paradis
Dennis Talbert	

Chapter 5 – Glossary and Acronyms

Glossary and acronyms remain the same as in the 2015 FEIS (pages 5-1 to 5-24) and are incorporated by reference. The following terms are added:

C

Commercial Thinning	Thinning is a treatment primarily used to improve tree growth by reducing tree crowding and may recover valuable wood products from potential tree mortality. Commercial thinning is an intermediate harvest in which the primary goal is to improve growth rates in young, healthy stands by reducing crowding.

I

Improvement Cutting	An improvement harvest is an intermediate harvest that removes less desirable trees to improve the composition and quality of the remaining stand.
Intermediate Treatment	A collective term for any treatment or tending designed to enhance growth, quality, vigor, and composition of the stand after establishment or regeneration and prior to final harvest.

P

Precommercial Thinning	Pre-commercial thinning (PCT) is the removal of trees not for immediate financial return, but to improve growth rates for the more desirable remaining trees. Pre-commercial thinning is used in young stands of relatively small trees to reduce crowding which improves growth rates.

V

Variable Retention Regeneration System (clear-cut with reserves)	A regeneration method to produce a two-aged stand in which varying numbers of reserve trees are retained to achieve goals other than regeneration.

Chapter 6 – References

Original references for this project are located on pages 6-1 to 6-38 of the 2015 FEIS and are incorporated by reference. Additional references used for this DSEIS are listed below.

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Appendices

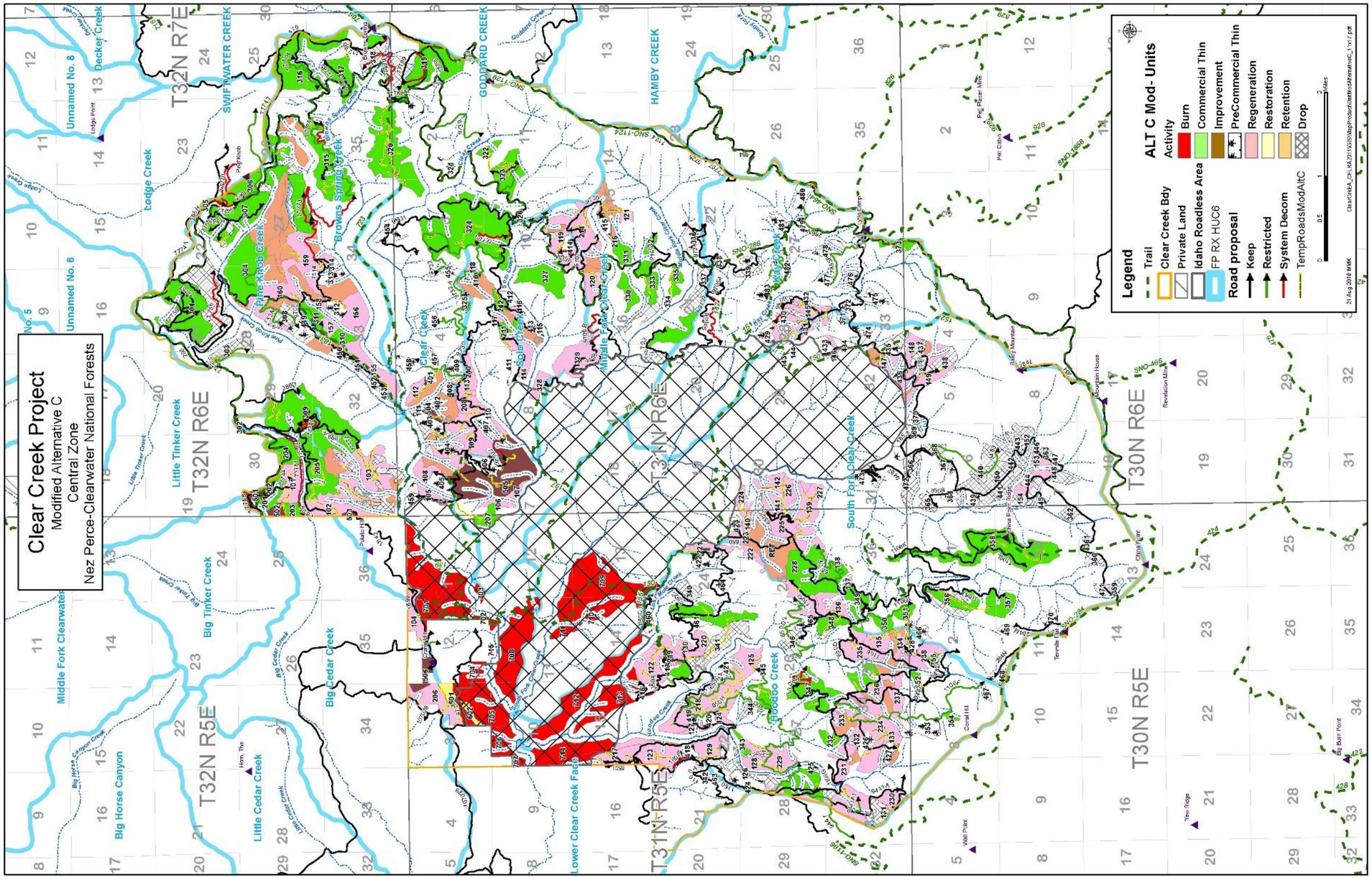
The 2015 FEIS includes appendices: A (Maps), B (Road Work), C (Proposed Site-Specific Forest Plan Amendment – Soils), D Proposed Site Specific Forest Plan Amendment – Old Growth), E (Soils Design Criteria Summary), F (Wildlife), G (Target Stands for Multiple Objectives), Table H-1 (Unit Summary), Table I-1 (Past Activities by Sale Name), J (Upward Trend Evaluation), K (Effectiveness of Road Best Management Practices), and L (Responses to DEIS Comments).

The 2015 FEIS is incorporated by reference. This DEIS updates or supplements the following 2015 FEIS appendices:

- **Appendix A – Maps**
    - Adds Alternative C Modified Map
- **Appendix F – Wildlife**
    - Section 1 – Wildlife List for Analysis
        - Adds Wolverine Programmatic BA
        - Replaces 2015 FEIS Flammulated Owl / Pygmy Nuthatch Habitat Map
    - Section 3 – Elk Analysis
        - Adds Elk Security Maps (based on various literature)
        - Adds Open Road Density Maps
        - Adds Open Road and Unit Adjacency Maps
    - Section 4 – Moose Winter Range (MA 21)
        - Adds Moose Winter Range Map
- **Table H-1**
    - Replaces 2015 FEIS Table H-1 (Unit Summary)
- **Appendix J – Upward Trend Evaluation**
    - Replaces 2015 FEIS Upward Trend Evaluation
- **Appendix M (New) – RMRS Watershed Analysis**
    - Adds RMRS Watershed Analysis

Appendix A – Maps

The 2015 FEIS is incorporated by reference for Alternative B, C, & D Unit Maps, Regeneration Harvest by Decade Map, Intermediate Harvest by Decade Map, & WUI and Private Lands Map. This DEIS adds Map: Alternative C Modified


Clear Creek Project
Modified Alternative C
Central Zone
Nez Perce-Clearwater National Forests
Legend
Trail
Clear Creek Bdy
Private Land
Idaho Roadless Area
FP RX HUC6
Road proposal
Keep
Restricted
System Decom
TempRoadsModAltC
ALT C Mod- Units
Activity
Burn
Commercial Thin
Improvement
PreCommercial Thin
Regeneration
Restoration
Retention
Drop
T32N R7E
T32N R6E
T32N R5E
T31N R6E
T31N R5E
T30N R6E
T30N R5E
SWIFTWATER CREEK
GOODARD CREEK
HAMBY CREEK
Lodge Creek
Little Tinker Creek
Big Tinker Creek
Middle Fork Clearwater
Big Horse Canyon
Little Cedar Creek
Big Cedar Creek
Lower Clear Creek Face
Hoodoo Creek
South Fork Clear Creek
Clear Creek
Middle Fork Clear Creek
Pine Knob Creek
Browns Spring Creek
Decker Creek
Unnamed No. 8
Unnamed No. 6
Pegleg Mountain
Pete Peak
Bailey Mountain
Mountain House
Revelation Mine
Cottonwood Camp
Pete Cabin
Pilot Rock
Public Hill
Coral Hill
Wall Point
Yew Ridge
Big Burn Point
Horn, The
Lodge Point
Terrible Hill
Cirque Tower
21 Aug 2018 MMK
ClearCreekA_CPI_BA2011\GIS\Map\Projects\AltMod\AltModAltC_11x17.pdf

Appendix F – Wildlife

Appendix F of the 2015 FEIS is supplemented with the following information:

Section 1 – Supplemental Wildlife Analysis

Appendix F, Section 1 of the 2015 FEIS is updated as follows:

- Wolverine Programmatic BA is added
- Flammulated Owl / Pygmy Nuthatch Habitat is updated (Replaces 2015 FEIS information)

Wolverine Programmatic BA

After a few years of review, US Fish and Wildlife Service (Service) reaffirmed the status of the North American wolverine as Proposed Threatened in July 2016. Recent actions leading to that decision, included a February 4, 2013 proposed rule to list the Distinct Population Segment (DPS) of North American wolverine in the contiguous United States as a threatened species by the Service under the Endangered Species Act. On August 13, 2014 the Service withdrew this proposed rule. In May of 2014, while the wolverine was initially proposed for listing, U.S. Forest Service Region 1 (Northern Region) developed a Programmatic Biological Assessment (Programmatic) for activities routinely conducted on National Forest Service Lands within the Northern Region, including the Nez Perce-Clearwater National Forest. This Programmatic relied on analysis presented in the Federal Register for the development of the original 2013 proposed rule and incorporated a category for specific activities regarding Forest management. The Service finding in the 2013 proposed rule was that the following proposed activities (listed below, and included in the Clear Creek Integrated Restoration Project) were not a threat to the DPS of North American wolverine. On May 23, 2014 the Service agreed with the U.S. Forest Service determination that the actions included in the Programmatic represented no jeopardy to the DPS of the North American wolverine. On June 15, 2016 the Service issued a memo to the Regional Forester confirming that the May 2014 concurrence letter regarding the Programmatic remains valid. Per FSM 1909.15 Section 18.1 the Responsible Official has reviewed this project for compliance with the Programmatic and has determined that the project falls under the Programmatic Biological Assessment for activities which represent no jeopardy to the DPS of North American wolverine.

1. Timber Harvest
2. Mechanical Equipment Use
3. Existing Gravel Pit Use
4. Roads and Road Maintenance
5. Silvicultural Activities
6. Recreation (and associated infrastructure) Management
7. Forest Products
8. Habitat Maintenance and Restoration
9. Prescribed Fire
10. Watershed Restoration

Species Assessment

This programmatic BA relies upon the analysis presented in the Federal Register (FR, V.78, No. 23, USDIFWS 2013) for the proposed rule and cites additional references, when necessary. Federal Register citations are presented by reference to the specific page number where the information is found.

Currently, the northern Rocky Mountains (in Idaho, Montana, Wyoming and the Wallowa Range in Oregon) contain one of the two functioning populations of wolverines in the contiguous United States (FR at 7871). Most of this habitat (94%) is in Federal ownership, most managed by the U.S. Forest Service (FR at 7874). Year-round habitat for the wolverine is found at high elevations centered near the tree line in conifer forests (below tree line), rocky alpine habitat above tree line, cirque basins, and avalanche chutes that have food sources (FR at 7868). Deep, persistent, and reliable spring (mid-April to mid-May) snow cover is the best overall predictor of wolverine occurrence, possibly due to the species' need for deep snow during the denning period (FR at 7872).

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Federal Register. 2013. Part II: Department of the Interior, Fish and Wildlife Service, 50 CFR Part 17, Endangered and Threatened Wildlife and Plants; Endangered and Threatened Wildlife and Plants; Threatened Status for the Distinct Population Segment of the North American Wolverine Occurring in the Contiguous United States; Establishment of a Nonessential Experimental Population of the North American Wolverine in Colorado, Wyoming, and New Mexico; Proposed Rules. Federal Register Vol. 78, No. 23, Monday, February 4, 2013, pages 7864 – 7890.

Wolverine Programmatic BA – (APPENDIX A)

National Forest System Activities under the Proposed Action and USFWS Finding with respect to the DPS

(FR at 7874-7866)

#	Activity Type	Activity Component	Threat Factor	Finding
1	Timber Harvest	Harvest, skidding, and/or hauling of timber products by ground-based equipment, cable operations, and/or helicopter	A 2 (d)	Not a threat
2	Mechanical Equipment Use	Off-road heavy equipment operation associated with timber harvest, such as site preparation, fuel spilling, log yarding, etc.	A 2 (d)	Not a threat
		Other helicopter or equipment use for monitoring, prescribed fire ignition, wildlife relocations, etc.	A 2 (d)	Not a threat
		Small mechanical equipment used on or off roads for watershed and wildlife habitat improvement work, etc.	A 2 (d)	Not a threat
3	Existing Gravel Pit Use	Existing gravel pit use for road construction and/or maintenance, etc.	A 2 (b)	Not a threat

#	Activity Type	Activity Component	Threat Factor	Finding
4	Roads and Road Maintenance	Re-opening a closed road or road segment	A 2 (b)	Not a threat
		New permanent road or road segment construction	A 2 (b) or (c)	Not a threat
		New temporary road construction	A 2 (b)	Not a threat
		Bridge or stream culvert repair or replacement	A 2 (b) or (c)	Not a threat
		Road Maintenance: Blading, culvert cleaning, brushing, etc.	A 2 (b)	Not a threat
		Closures and/or decommissioning of a road or road segment, including installation of closure devices, revegetation, and/or re-contouring of the road prism.	A 2 (b)	Not a threat
5	Silvicultural Activities	Timber Stand Improvement (thinning, planting, etc.)	A 2 (d)	Not a threat
		Reforestation via hand planting	A 2 (d)	Not a threat
		Reforestation via mechanical treatments	A 2 (d)	Not a threat
		Insect suppression – Aerial chemical application	A 2 (d)	Not a threat
		Insect suppression – Ground chemical application	A 2 (d)	Not a threat
6	Range Management	Infrastructure development and maintenance (fences, water developments. Etc.)	A 2 (b)	Not a threat
		Grazing by Domestic Livestock (sheep, goats, cattle,horses, etc.)	A 2 (d)	Not a threat
7	Recreation (and associated infrastructure) Management	Trail maintenance or reconstruction	A 2 (a)	Not a threat
		New trail construction	A 2 (a)	Not a threat
		Dispersed camping and other recreation (snowmobiling, heli-skiing, cross-country skiing, hiking, etc.)	A 2 (a)	Not a threat
		Developed recreation (use and operation of campgrounds, permitted ski areas, etc.)	A 2 (b)	Not a threat
		Recreation Special Uses and their administration, such as outfitter/guide permits, poker runs, trail rides and other cross country events, group gatherings, etc.	A 2 (b)	Not a threat
8	Forest Products	Personal use firewood collection, berry picking, and “other forest products” (such as bear grass greens, medicinal herbs, pachistima, mushrooms, etc.)	A 2 (a) or (d)	Not a threat
		Commercial firewood collection, berry picking, and “other forest products” (such as bear grass greens, medicinal herbs, pachistima, mushrooms, etc.)	A 2 (d)	Not a threat

#	Activity Type	Activity Component	Threat Factor	Finding
9	Habitat Maintenance and Restoration	See timber harvest, mechanical treatments, roads, weed control, and prescribed fire; also includes (but not limited to) inventory/monitoring activities; fencing construction, repair, and/or removal; fish barrier development or removal; fish species removal/trapping; rotenone treatment; interpretation/conservation education; meadow and/or aspen stand maintenance and restoration; riparian planting and restoration; snag creation; water source development, etc.	A 2 (d)	Not a threat
10	Prescribed Fire	General support, ignition, control, and mop-up	A 2 (d)	Not a threat
		File line construction (by hand or mechanical equipment)	A 2 (d)	Not a threat
11	Watershed Restoration	Includes erosion control structures, sediment control, monitoring; also, see reforestation, timber harvest, mechanical treatments, etc.	A 2 (d)	Not a threat
12	Weed Management	Aerial or ground application of approved chemical or biological control agents	A 2 (d)	Not a threat
		Hand or mechanical removal and/or re-vegetation treatments	A 2 (d)	Not a threat
		Livestock grazing	A 2 (d)	Not a threat
13	Administrative and Non-recreational Special Uses and Infrastructure	This includes maintenance of existing sites or new construction at existing sites, corridors, or other facilities and is often carried out by the entity that owns the structures or facilities	A 2 (b)	Not a threat
		Construction of facilities and/or new sites – this includes microwaves, cell towers, substation communications, powerlines, sand/gravel pits, mineral and energy exploration and extraction, etc.	A 2 (b) or (c)	Not a threat

Wolverine Programmatic BA – (APPENDIX B)

Summary Sheet for Wolverine Programmatic Assessment

Instructions

Summary sheets will be filled out by Project Biologists and reviewed by Forest Biologists. Project Biologists will submit summary sheets to Forest Biologists on a project-by-project basis and maintain a copy as part of the project administrative record. Forest Biologists will maintain summary sheets (one project per sheet) and, as needed, these projects will be reviewed and discussed by the Level One Team to ensure the screening criteria are adequately interpreted and applied.

Page ___ of ___

Administrative Unit: ___Moose Creek RD of the Nez Perce-Clearwater National Forest_____ Contact: _____***Project Biologist***: Glen Gill_____ Reviewed by: _____***Forest Biologist*** : Mike Pruss _____ Date: ___5/17/2018_____			
Project Name and Description	Project Activity Number (from Appendix A)	Units	Comments
Project description should provide pertinent information including but not limited to: project name, project location including management unit if applicable, timing of implementation and details of project activities. The purpose of the Clear Creek Integrated Restoration Project (Project) is to manage forest vegetation to restore natural disturbance patterns; improve long-term resistance and resilience at the landscape level; reduce fuels; improve watershed conditions; improve elk habitat effectiveness; improve habitat for early seral species; and maintain habitat structure, function, and diversity. The Nez Perce–Clearwater National Forests are proposing a combination of timber harvest, commercial thinning, precommercial thinning, prescribed fire, and reforestation to achieve desired age and size classes, species distributions, habitat diversity, and landscape patterns across forested portions of the Clear Creek drainage. Road decommissioning, culvert replacements, and road improvements are proposed to improve watershed health, and the restoration of 41 acres of bunchgrass communities through re-vegetation with native grasses and forbs is proposed to improve vegetative diversity.	***List broad categories of project activities separately (i.e., timber harvest; road reconstruction; prescribed burning; etc.)*** Timber harvest; Mechanical Equipment Use; Roads and Road Maintenance; Silvicultural Activities; Habitat Maintenance and Restoration; Prescribed Fire; Watershed Restoration	***(acres of timber harvest; acres burned; miles of trail maintained, etc.)*** 10,500 acres of timber harvest; 1,371 acres of prescribed fire; 36 miles of temporary road construction (to be obliterated upon project completion); 13.2 miles of road decommissioning	All Activity types proposed in this project show a finding in Appendix A of "Not a Threat." Therefore, the determination for the Clear Creek Restoration Project is not likely to jeopardize the continued existence of the DPS of the North American wolverine.

Continuation of Column A: The Clear Creek drainage lies within the Middle Fork Clearwater River drainage near Kooskia, Idaho. The Clear Creek drainage totals 65,000 acres, with 33%

(21,269 acres) in private or State ownership and the remaining 67% (43,731 acres) under the management of the Moose Creek Ranger District, of the Nez Perce-Clearwater National Forest. The Clear Creek Integrated Restoration Project area includes all 43,731 acres of NFS lands within the Clear Creek drainage (See Figure 1. Figure 1. All of the project area lies within the upper two thirds of the drainage. The project area is located approximately 5 air miles southeast of Kooskia, Idaho, within Townships 30, 31, and 32 N, Ranges 5 and 6 E, Boise Meridian. All proposed activities would take place within the boundaries of the Action area.

Timing and Duration of project-Activities would begin in 2019 and have an end date around 2032. The action area would be parceled into 5 different timber sales over a 5-year period.

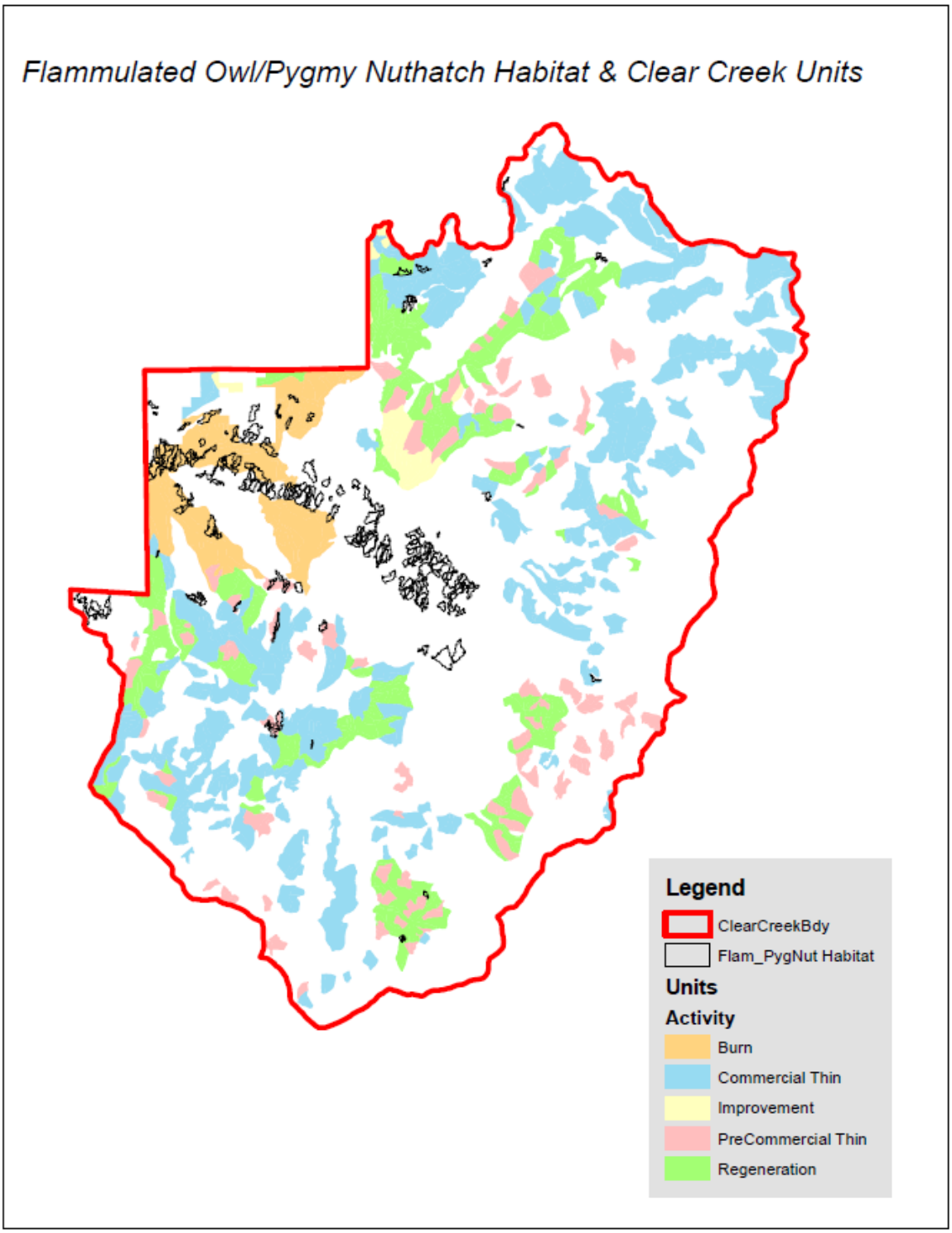


Figure 29: UPDATED Flammulated Owl/Pygmy Nuthatch Habitat and Clear Creek Units

Section 3 – Elk Analysis

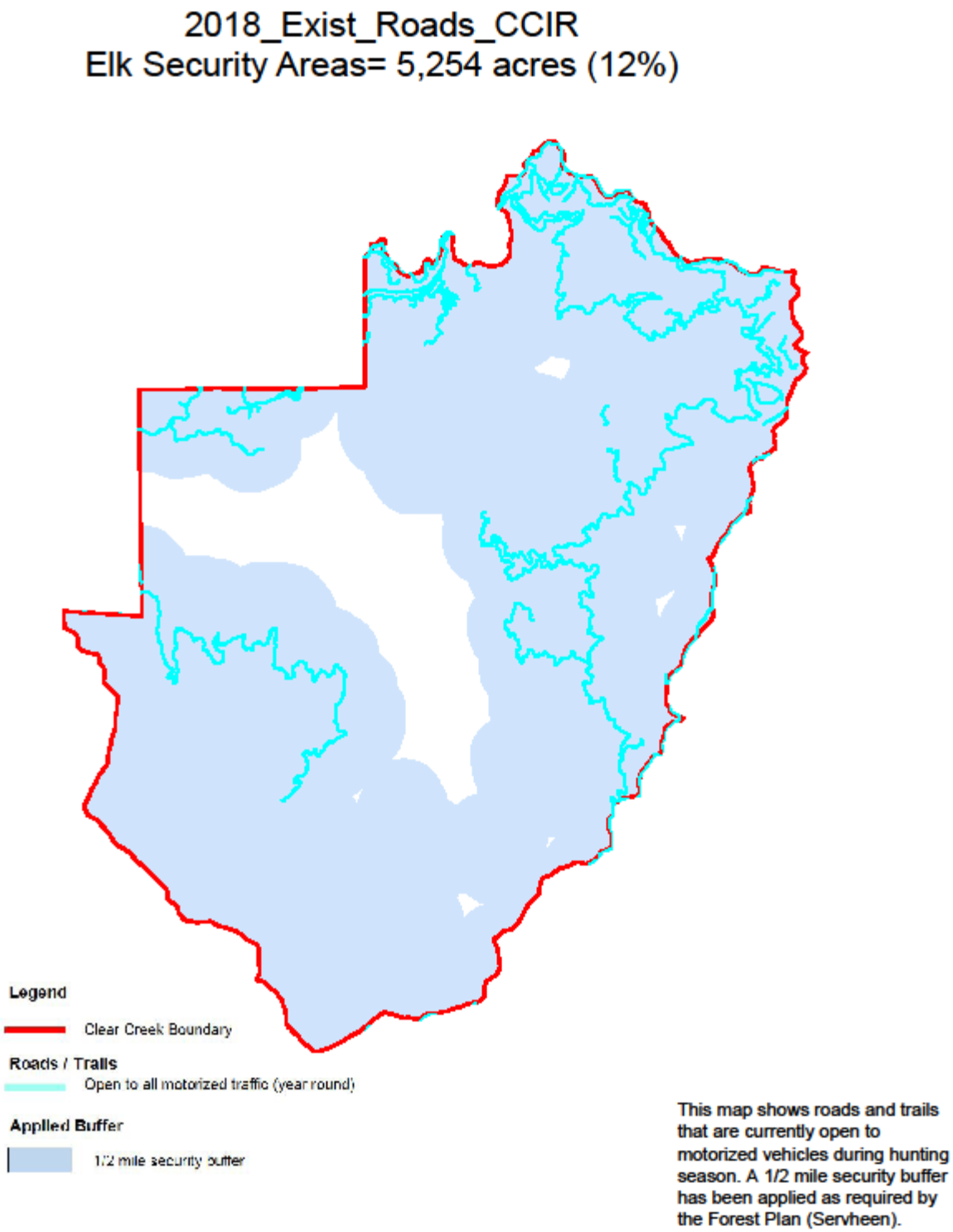
Appendix F, Section 3 of the 2015 FEIS is updated as follows:

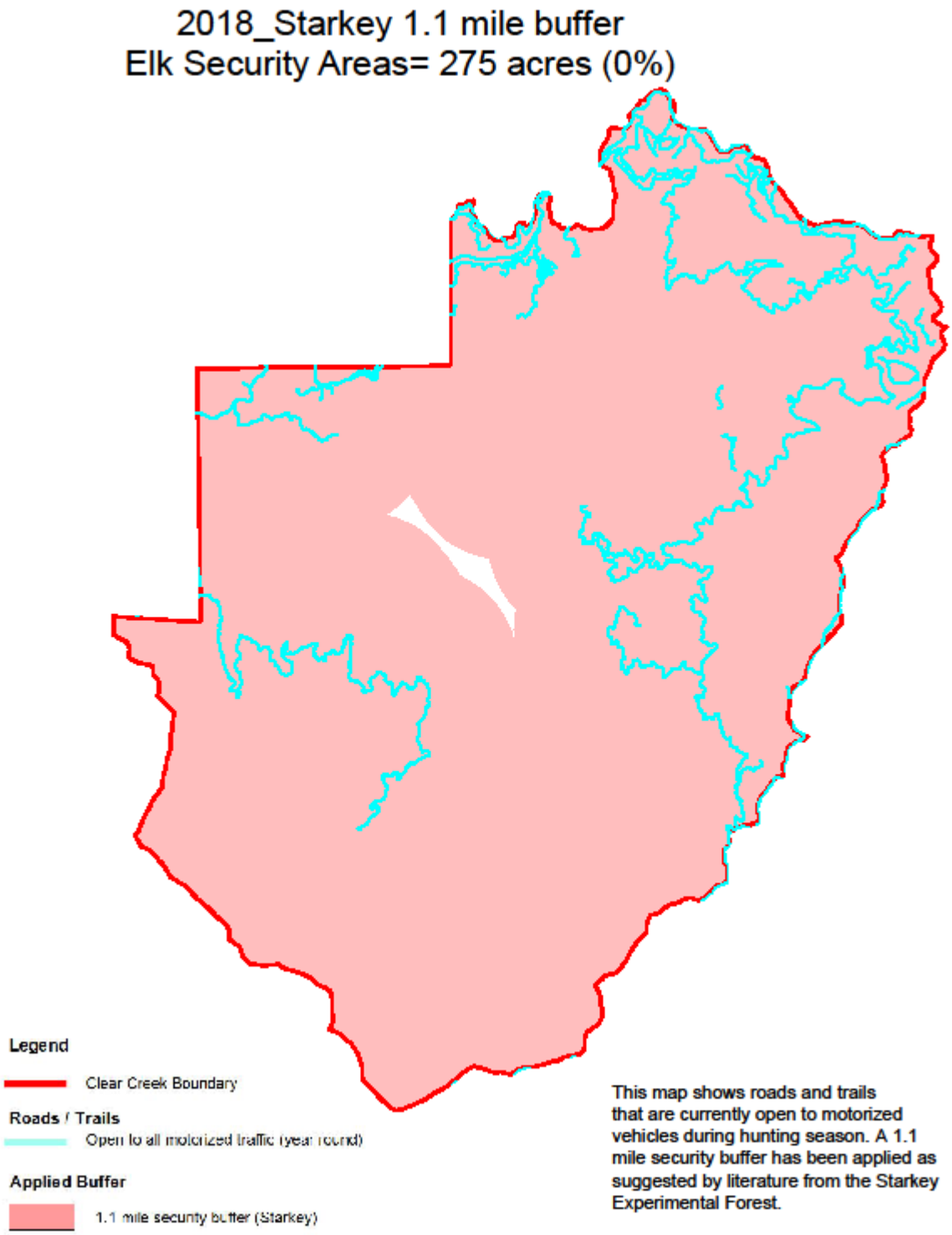
- Elk Security Map Analysis is added

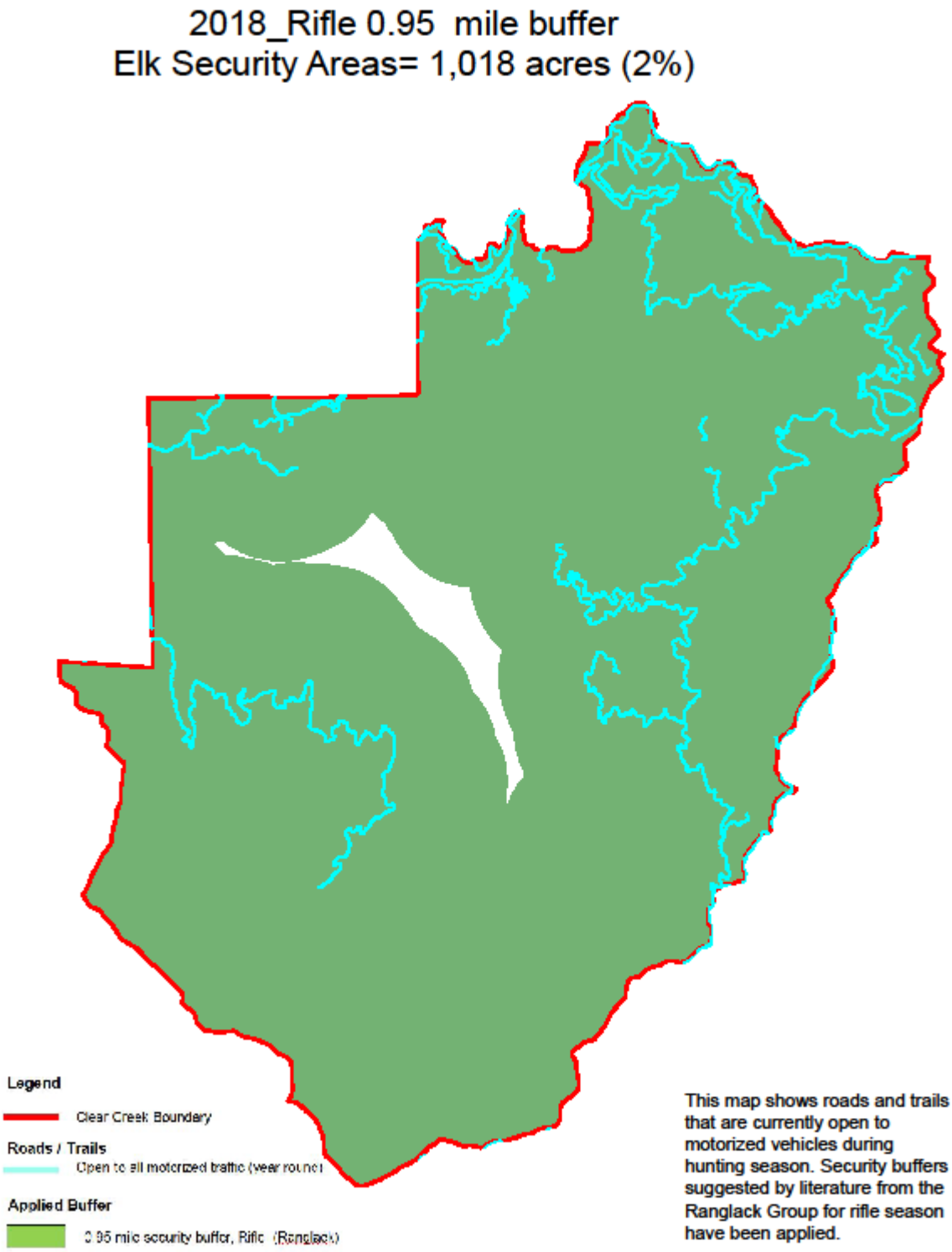
- Open Road Density Map Analysis is added
- Open road Density and Unit Adjacency Map Analysis is added

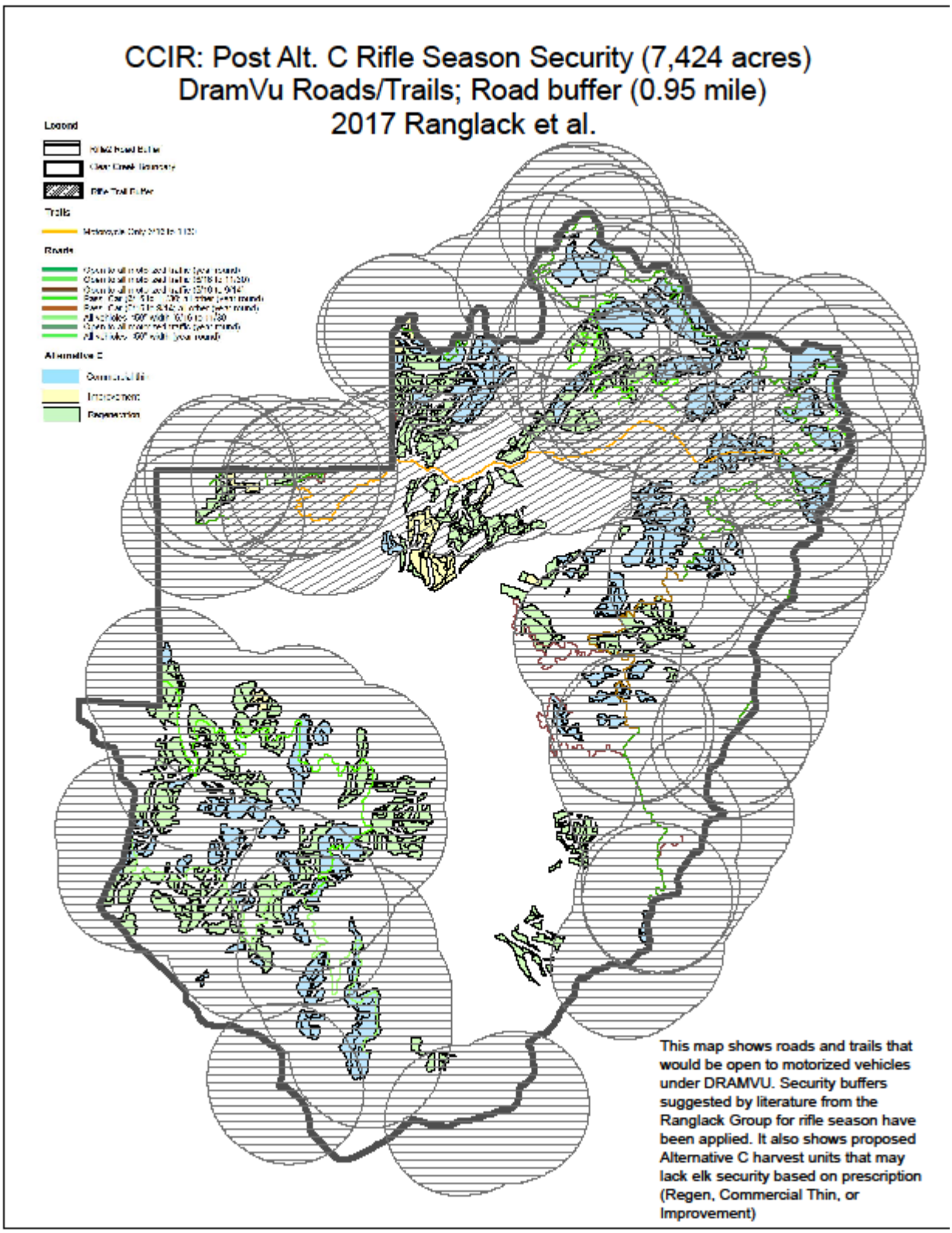
Elk Security

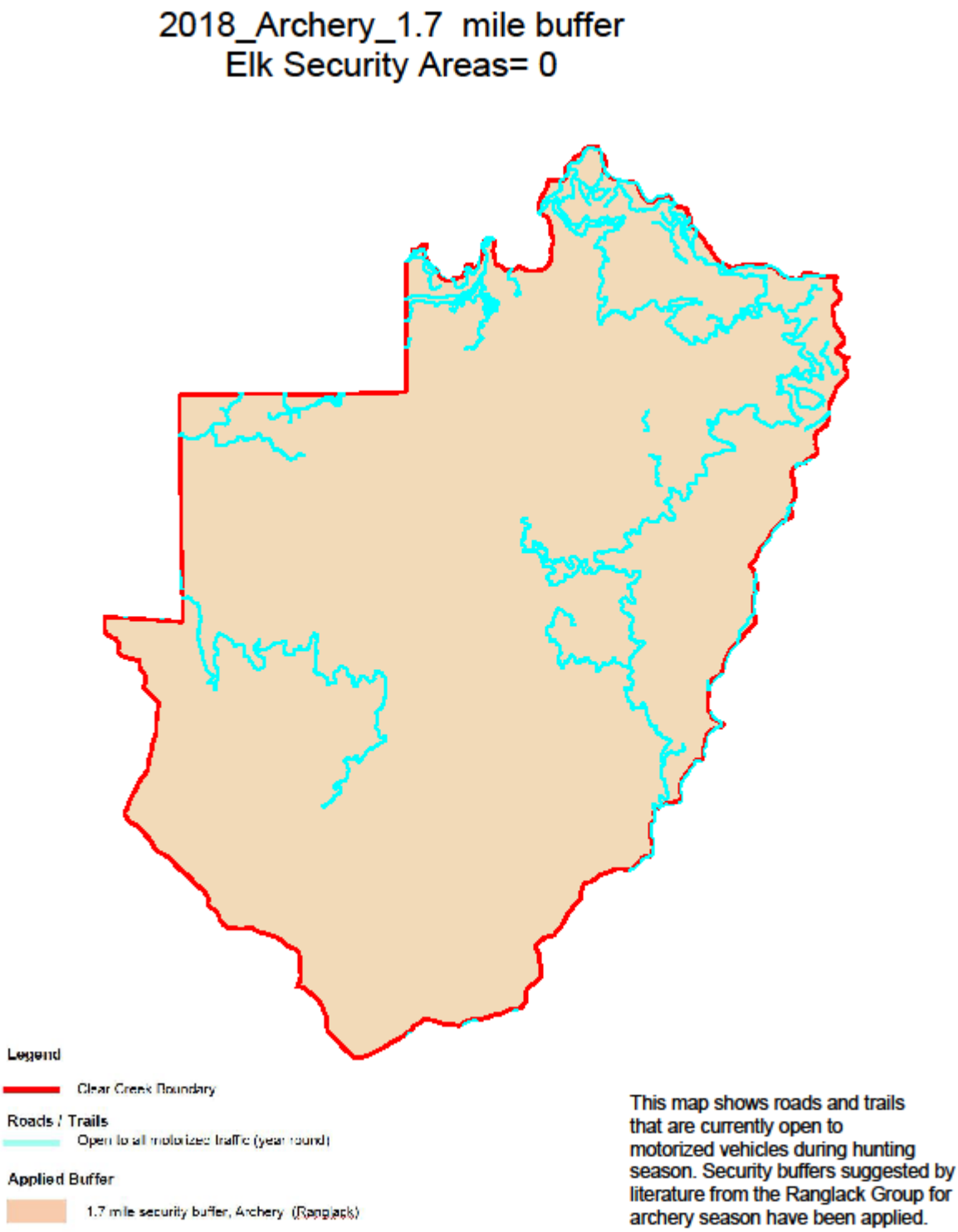
The Forest analyzed road buffers mentioned in recent literature (Rowland et al. 2005 and Ranglack et al. 2017) to determine if these studies would apply to the project concerning elk security areas. The Forest also analyzed proposed harvest units outside the suggested buffer to determine where there may be additional security issues. The following maps show a pictorial view of the analysis that has been completed.

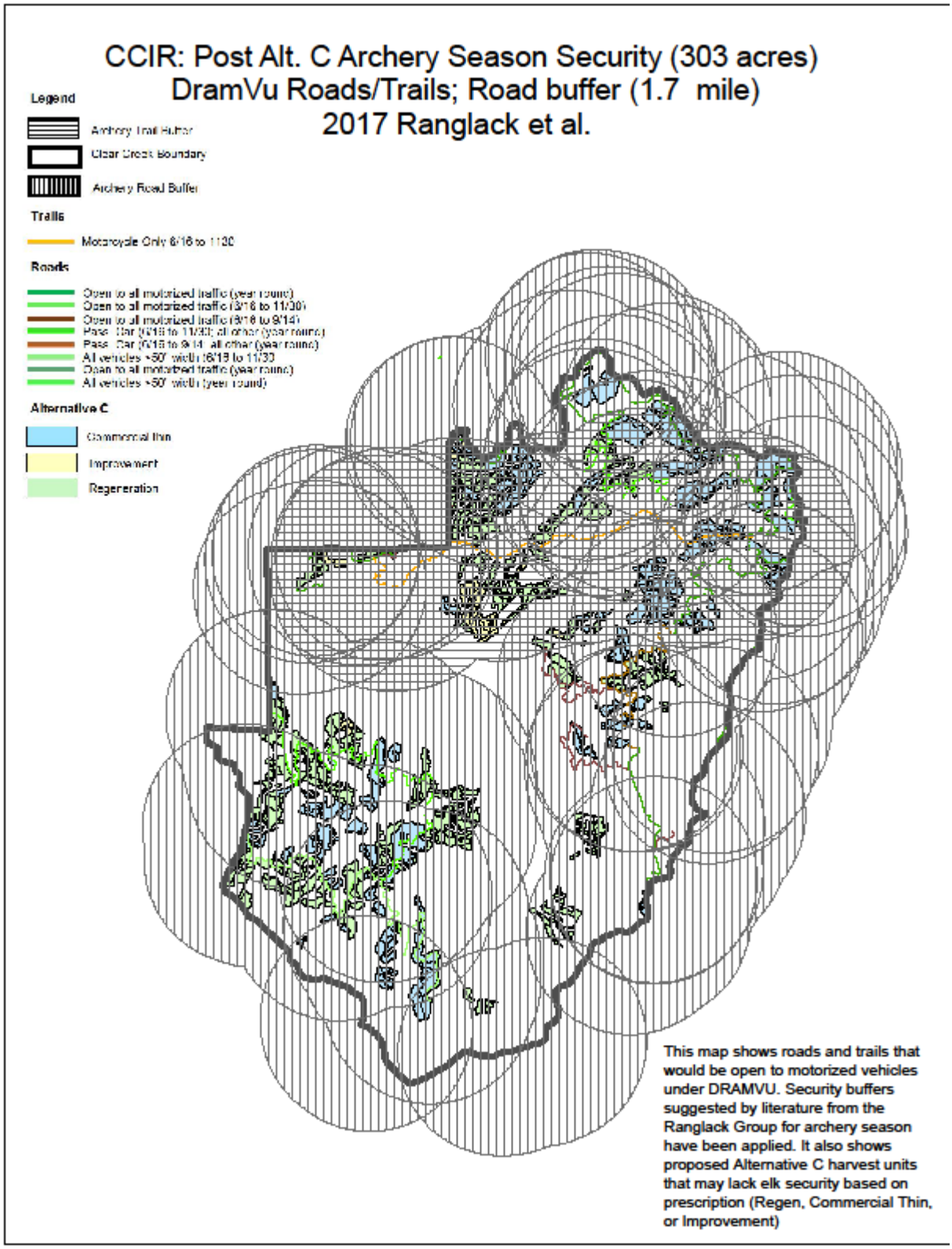

2018_Exist_Roads_CCIR
Elk Security Areas= 5,254 acres (12%)
Legend
Clear Creek Boundary
Roads / Trails
Open to all motorized traffic (year round)
Applied Buffer
1/2 mile security buffer
This map shows roads and trails that are currently open to motorized vehicles during hunting season. A 1/2 mile security buffer has been applied as required by the Forest Plan (Servheen).


2018_Starkey 1.1 mile buffer
Elk Security Areas= 275 acres (0%)
Legend
Clear Creek Boundary
Roads / Trails
Open to all motorized traffic (year round)
Applied Buffer
1.1 mile security buffer (Starkey)
This map shows roads and trails that are currently open to motorized vehicles during hunting season. A 1.1 mile security buffer has been applied as suggested by literature from the Starkey Experimental Forest.


2018_Rifle 0.95 mile buffer
Elk Security Areas= 1,018 acres (2%)
Legend
Clear Creek Boundary
Roads / Trails
Open to all motorized traffic (year round)
Applied Buffer
0.95 mile security buffer, Rifle (Ranglack)
This map shows roads and trails that are currently open to motorized vehicles during hunting season. Security buffers suggested by literature from the Ranglack Group for rifle season have been applied.

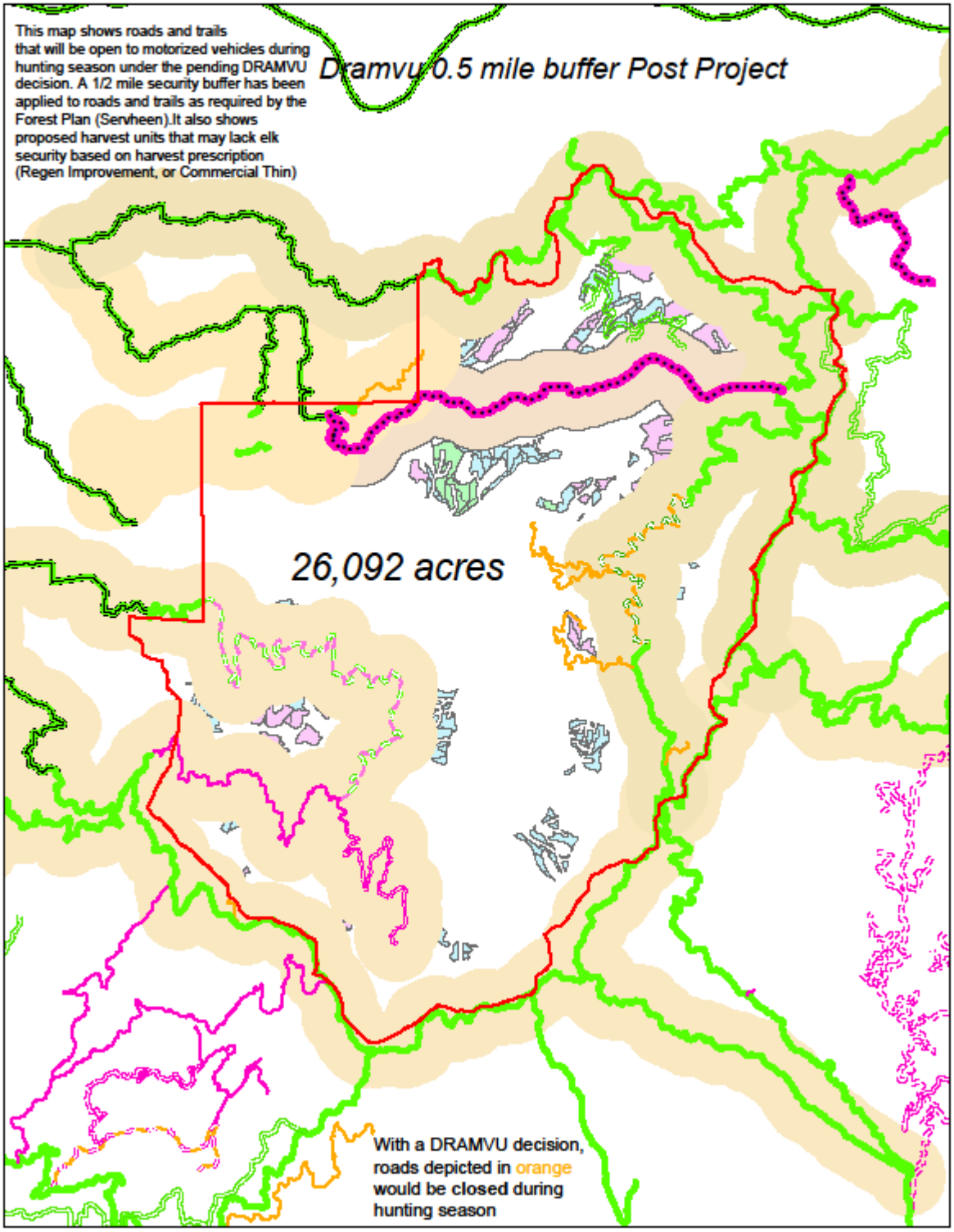

CCIR: Post Alt. C Rifle Season Security (7,424 acres)
DramVu Roads/Trails; Road buffer (0.95 mile)
2017 Ranglack et al.
Legend
Trails
Roads
Alternative C
This map shows roads and trails that would be open to motorized vehicles under DRAMVU. Security buffers suggested by literature from the Ranglack Group for rifle season have been applied. It also shows proposed Alternative C harvest units that may lack elk security based on prescription (Regen, Commercial Thin, or Improvement)


2018_Archery_1.7 mile buffer
Elk Security Areas= 0
Legend
Clear Creek Boundary
Roads / Trails
Open to all motorized traffic (year round)
Applied Buffer
1.7 mile security buffer, Archery (Ranglack)
This map shows roads and trails that are currently open to motorized vehicles during hunting season. Security buffers suggested by literature from the Ranglack Group for archery season have been applied.



Analysis reveals that for this project, literature relevant to the Nez Perce – Clearwater Forests included Christensen et al. 1993, and Hillis et al. 1991 whose findings contributed to the

guidelines the forest uses for elk analysis. A one half mile road buffer is appropriate for the habitat types and terrain located on the Forest. The following map depicts the roads, trails and units that may lack elk security at the completion of the project under Alternative C.


This map shows roads and trails that will be open to motorized vehicles during hunting season under the pending DRAMVU decision. A 1/2 mile security buffer has been applied to roads and trails as required by the Forest Plan (Servheen).It also shows proposed harvest units that may lack elk security based on harvest prescription (Regen Improvement, or Commercial Thin)
Dramvu 0.5 mile buffer Post Project
26,092 acres
With a DRAMVU decision, roads depicted in orange would be closed during hunting season

Open Road Densities

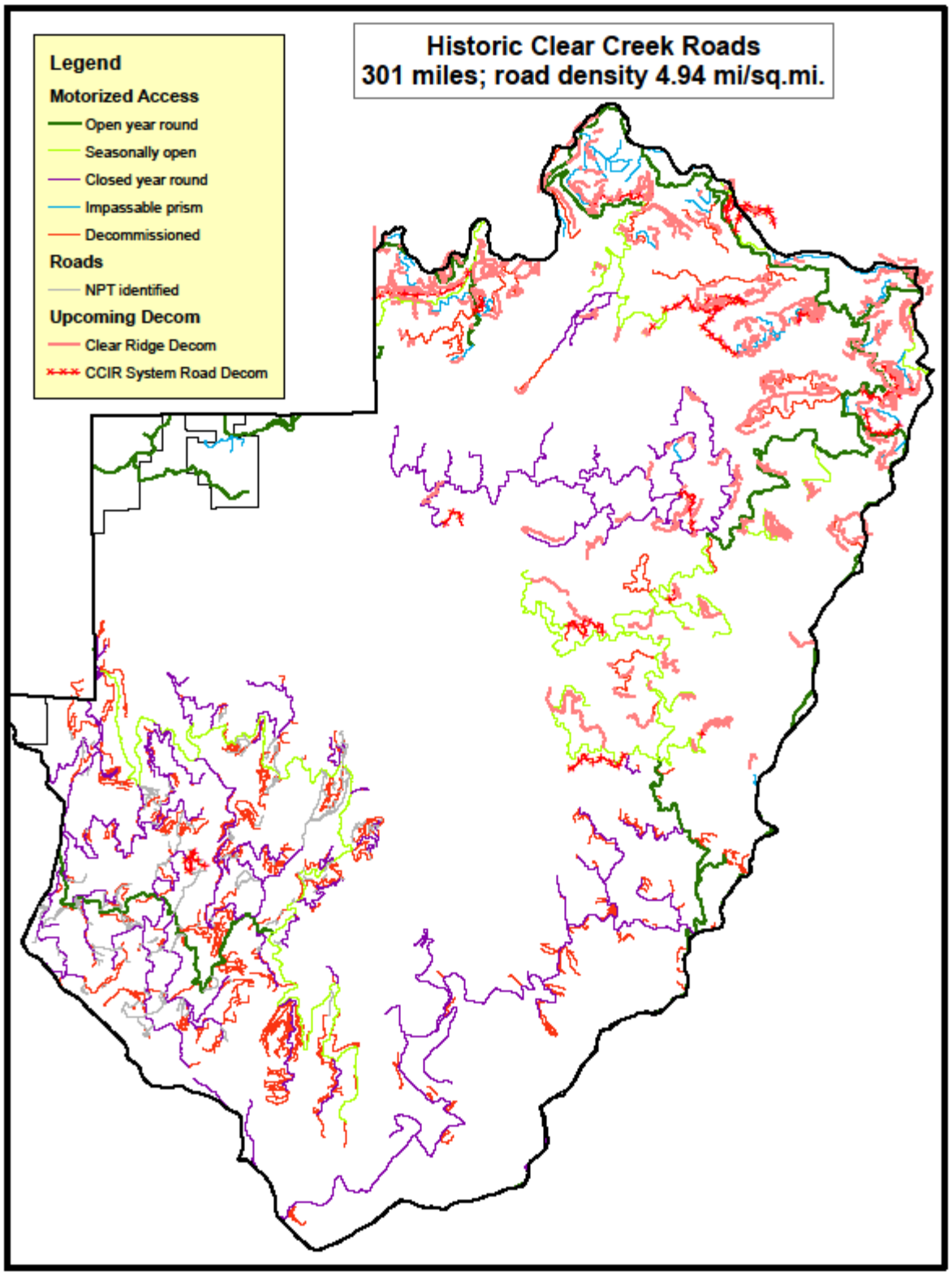
Open road densities may also effect elk security. The Forest analyzed road densities to determine how they would be effected should this project be implemented.

The first map in this analysis shows all potential motorized access for roads and trails known in the project area from various data layers: open roads/trails, closed roads/trails, decommissioned roads/trails and unknown linear prisms that appeared as some type of motorized prism with the use of a Lidar layer was calculated at 338 miles, with a road density of 4.95 miles/square mile.

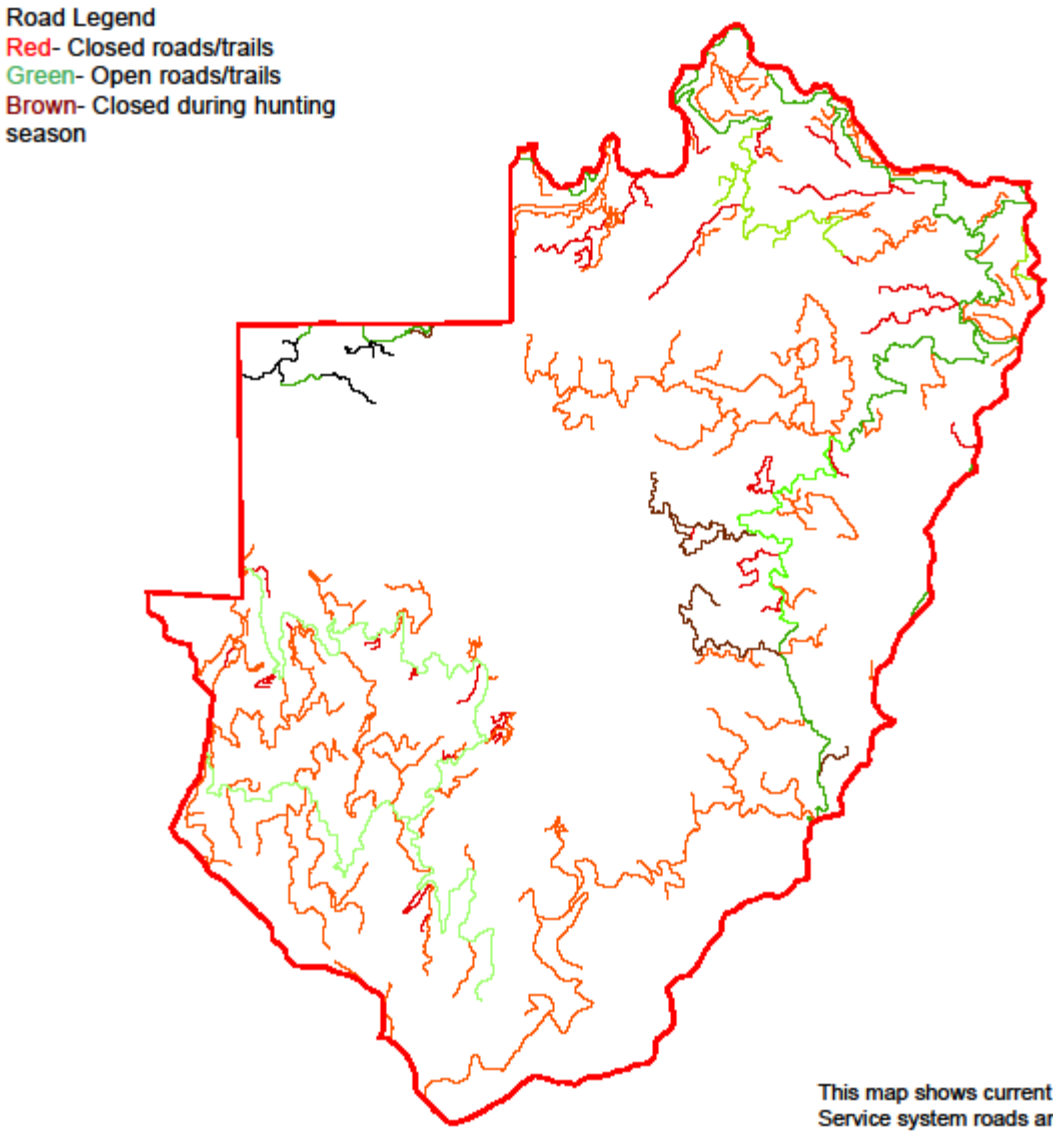
The second map examines all known roads in the area during the existing condition. Older decommissioned roads and unknown prisms were not evaluated, as they are not managed or recognized as accessible roads. This analysis showed about 207 miles of road, or a road density of around 3 miles/square mile.

The third map displays Alternative C during Project implementation. This alternative proposes the most timber harvest. New temporary roads would be constructed and some previously closed roads would be opened to support access to timber units and haul roads. As expected, road density would increase (228 miles), resulting in an estimate of 3.3 miles/square mile.

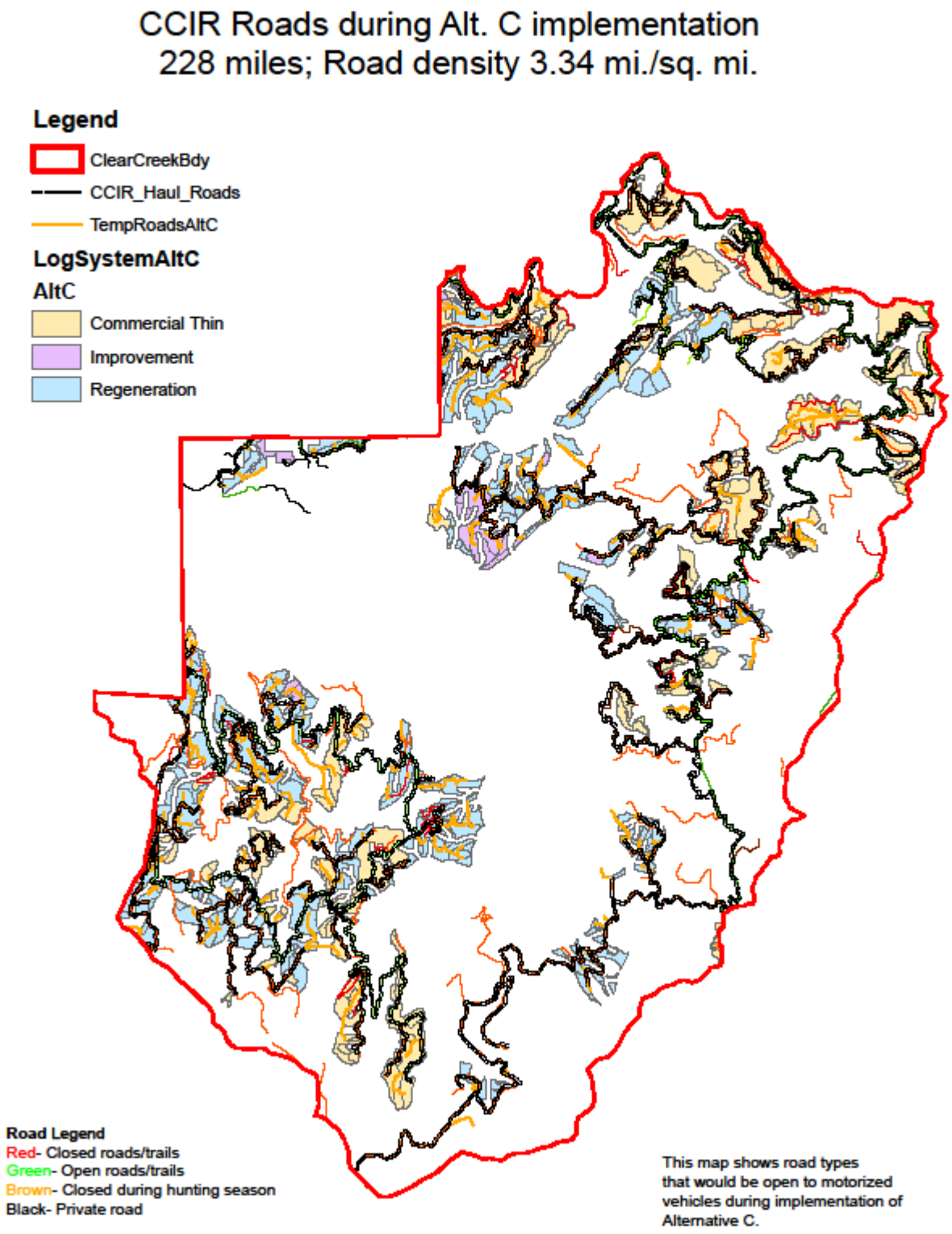
The final map shows the motorized access upon project completion and the anticipated signing of a new document for motorized use (DRAMVU). Road density in the Project Area would decrease to about 75 miles: road density would become 1.1 miles/square mile. The following maps show a pictorial view of the analysis that has been completed.

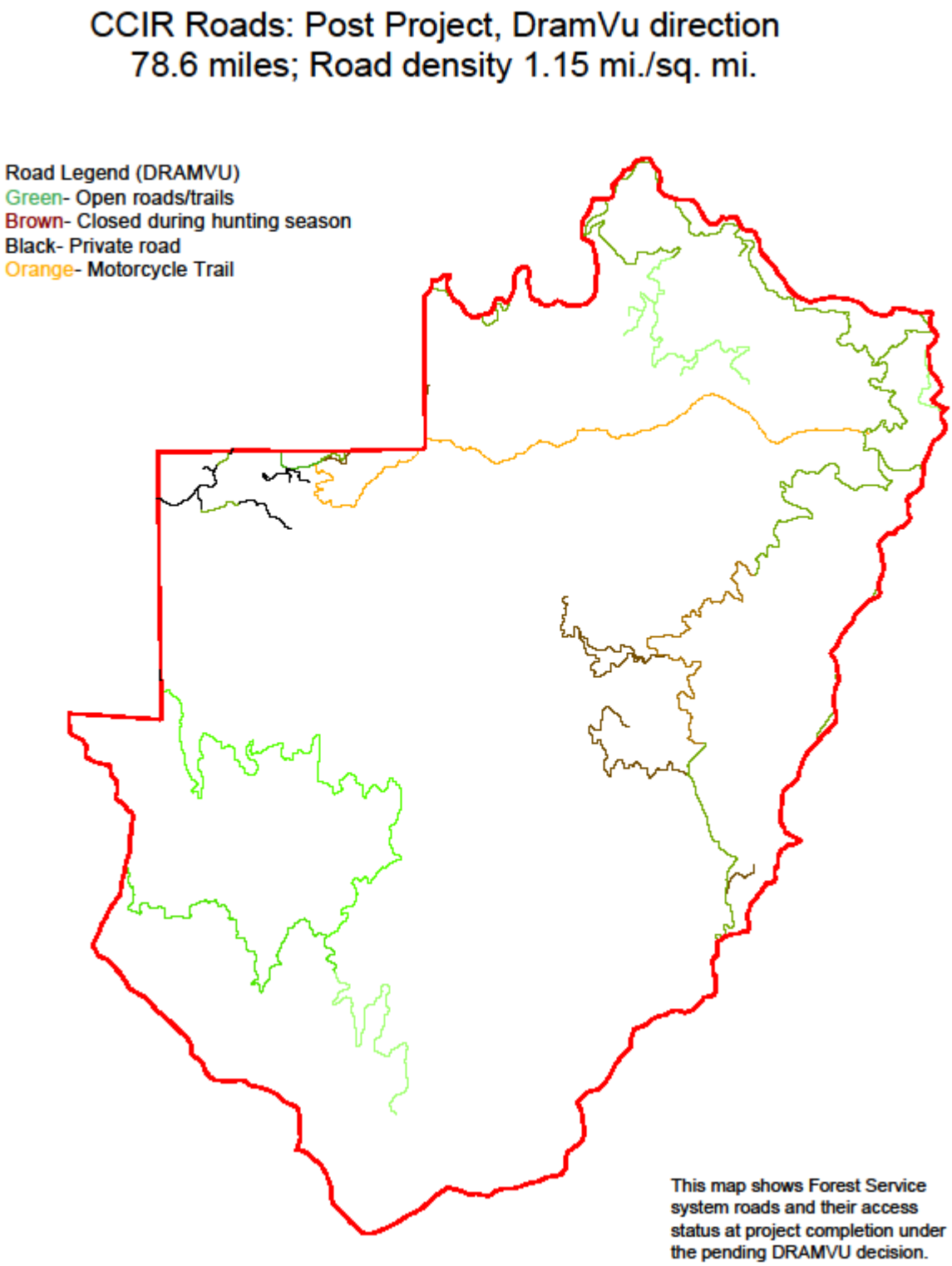

Historic Clear Creek Roads
301 miles; road density 4.94 mi/sq.mi.
Legend
Motorized Access
Open year round
Seasonally open
Closed year round
Impassable prism
Decommissioned
Roads
NPT identified
Upcoming Decom
Clear Ridge Decom
CCIR System Road Decom

CCIR Roads (existing condition)
207 miles; Road density 3.03 mi./sq. mi.



This map shows current Forest Service system roads and their access status within the project area.

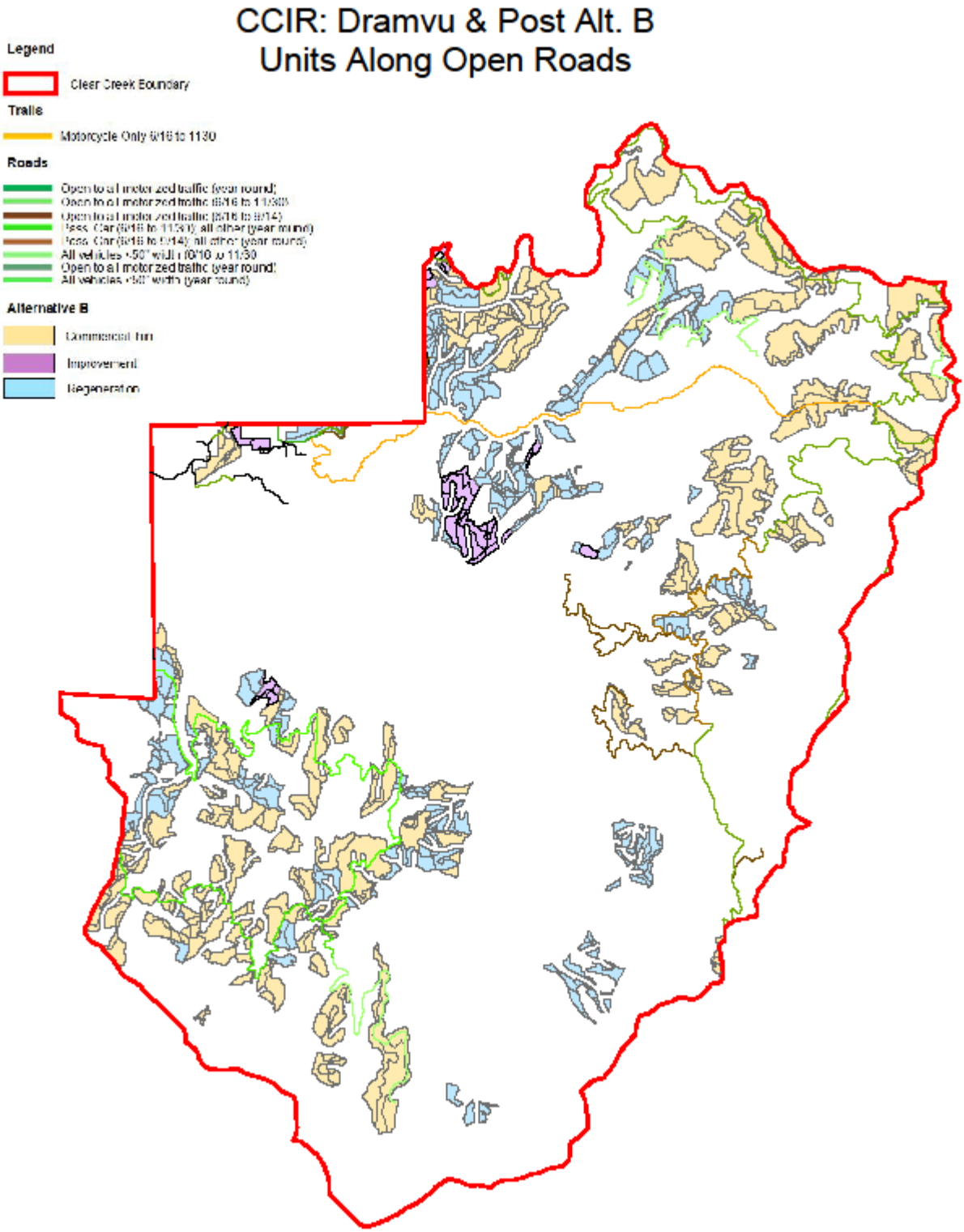

CCIR Roads during Alt. C implementation
228 miles; Road density 3.34 mi./sq. mi.
Legend
ClearCreekBdy
CCIR_Haul_Roads
TempRoadsAltC
LogSystemAltC
AltC
Commercial Thin
Improvement
Regeneration
Road Legend
Red- Closed roads/trails
Green- Open roads/trails
Brown- Closed during hunting season
Black- Private road
This map shows road types that would be open to motorized vehicles during implementation of Alternative C.

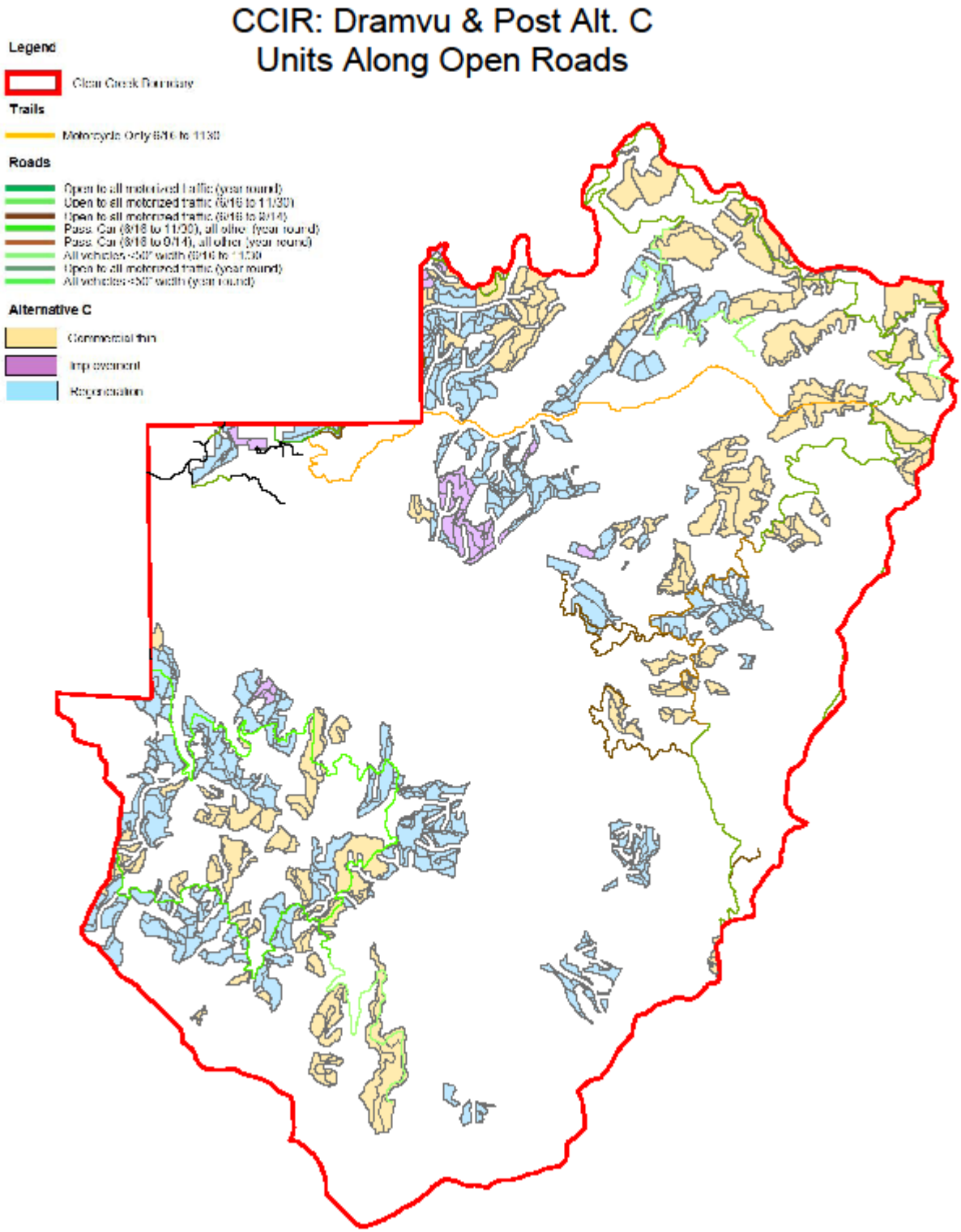


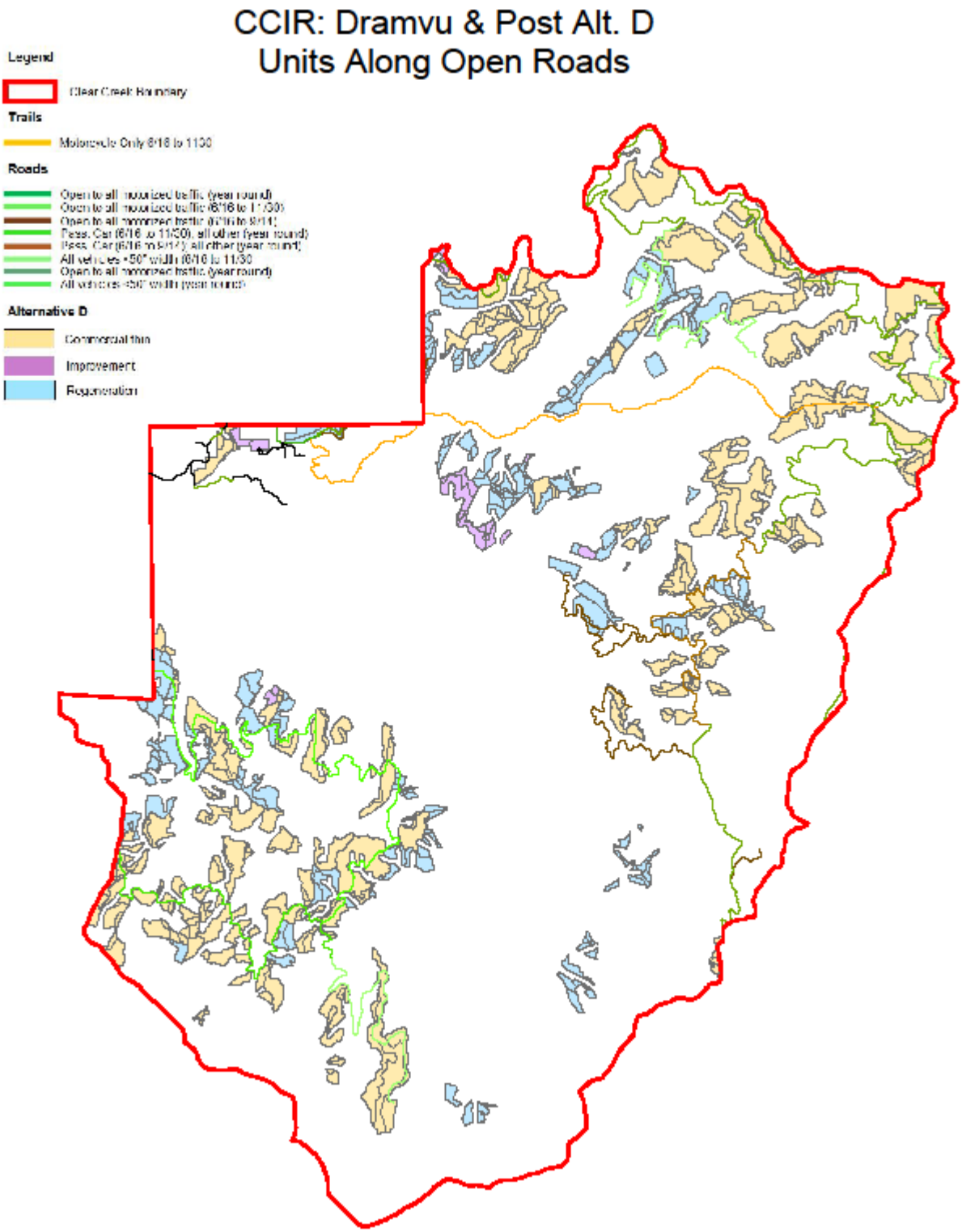
Open Roads and Unit Adjacency

Upon conclusion of each proposed action alternative, some sections of open roads and one trail (hereafter, referred as motorized routes) would be adjacent to harvested units that reduce elk

hiding cover (regeneration, improvement, or commercial thinning). These motorized routes adjacent to, or in recently harvested units may increase elk vulnerability during hunting season. Alternative B has the highest amount of roads adjacent to, or in such units (21.26 miles). Alternative C would have 20.38 miles and Alternative D would have 20.31 miles. The following maps depict road and harvest unit adjacency by alternative.


CCIR: Dramvu & Post Alt. B
Units Along Open Roads
Legend
Clear Creek Boundary
Trails
Motorcycle Only 6/16 to 11/30
Roads
Open to all motorized traffic (year round)
Open to all motorized traffic (6/16 to 11/30)
Open to all motorized traffic (6/16 to 8/14)
Less Car (6/16 to 11/30); all other (year round)
Less Car (6/16 to 8/14); all other (year round)
All vehicles <50" wide (6/16 to 11/30)
Open to all motorized traffic (year round)
All vehicles <50" width (year round)
Alternative B
Commercial Thin
Improvement
Regeneration


CCIR: Dramvu & Post Alt. C
Units Along Open Roads
Legend
Clear Creek Boundary
Trails
Motorcycle Only 6/16 to 11/30
Roads
Open to all motorized traffic (year round)
Open to all motorized traffic (6/16 to 11/30)
Open to all motorized traffic (6/16 to 9/14)
Pass Car (8/16 to 11/30), all other (year round)
Pass Car (8/16 to 9/14), all other (year round)
All vehicles <50" width (6/16 to 11/30)
Open to all motorized traffic (year round)
All vehicles <50" width (year round)
Alternative C
Commercial thin
Improvement
Regeneration


CCIR: Dramvu & Post Alt. D
Units Along Open Roads
Legend
Clear Creek Boundary
Trails
Motorcycle Only 6/16 to 11/30
Roads
Open to all motorized traffic (year round)
Open to all motorized traffic (6/16 to 11/30)
Open to all motorized traffic (6/16 to 8/14)
Pass. Car (6/16 to 11/30), all other (year round)
Pass. Car (6/16 to 8/14), all other (year round)
All vehicles <50" width (6/16 to 11/30
Open to all motorized traffic (year round)
All vehicles <50" width (year round)
Alternative D
Commercial thin
Improvement
Regeneration

Section 4 – MA 21 Moose Winter Range

Appendix F, Section 4 is a NEW SECTION.

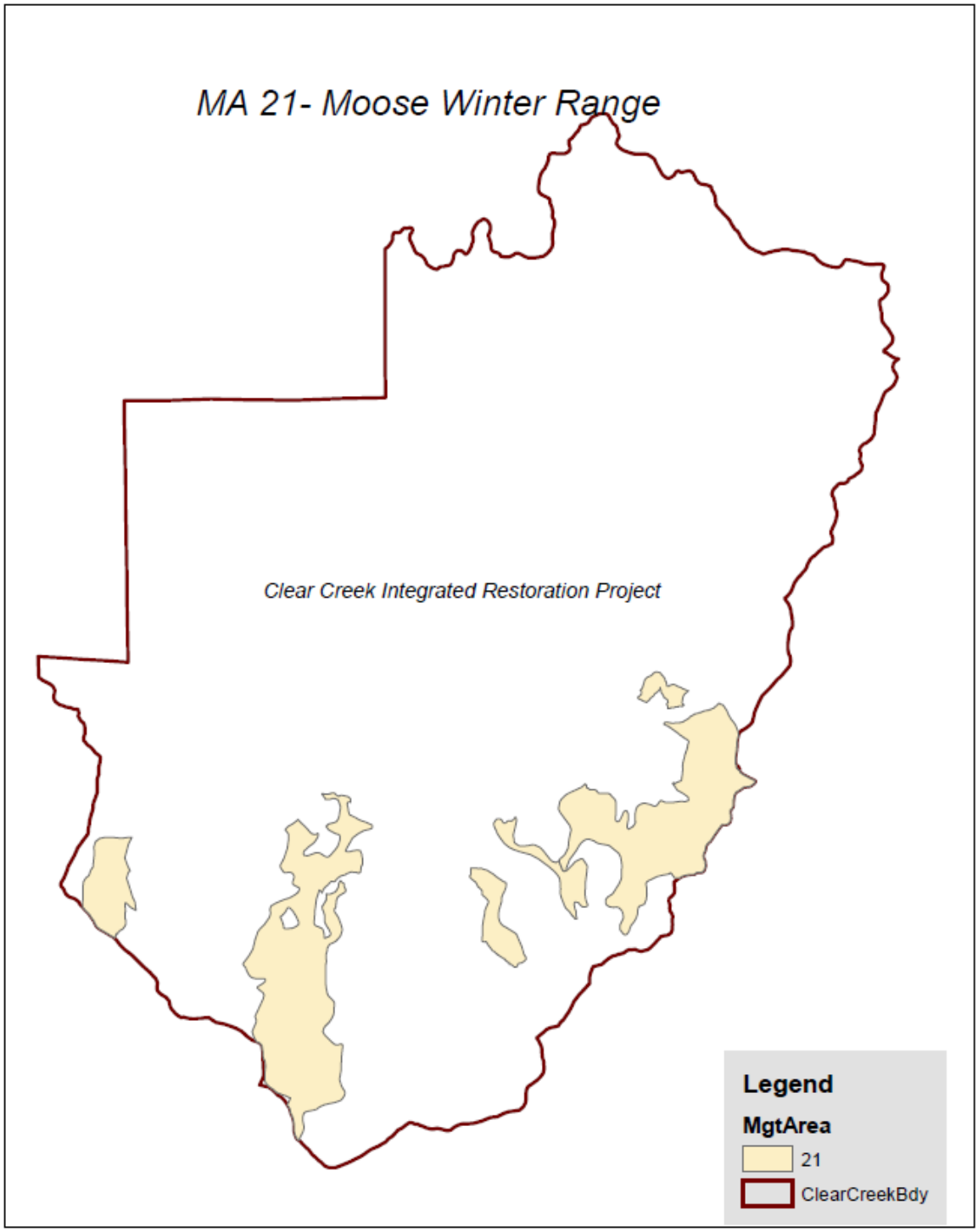


Figure 30: SUPPLEMENTAL MA21 - Moose Winter Range Map

Table H-1 – Unit Summary

Table H-1 in the 2015 FEIS is replaced by the following table:

Table 34: UPDATED Table H-1 - Unit Summary

Unit Number	Patch Area	Acres	Alternative B	Alternative C	Alternative D	Changes to 2015 FEIS
101	NFA	63	Regeneration	Regeneration	Regeneration	None
102	NFA	178	Regeneration	Regeneration	Regeneration	Approx. 45 acres dropped from Alternative C Modified.
103	NFA	118	Regeneration	Regeneration	Drop	None
104	NFE	57	Regeneration	Regeneration	Regeneration	None
105	NFB	18	Regeneration	Regeneration	Regeneration	None
106	NFB	15	Regeneration	Regeneration	Drop	None
107	NFB	10	Regeneration	Regeneration	Drop	None
108	NFB	31	Regeneration	Regeneration	Drop	None
109	NFB	157	Regeneration	Regeneration	Regeneration	Drop approx. 26 acres from Alternative C Modified
110	NFB	24	Regeneration	Regeneration	Drop	To be determined during layout.
111	NFB	5	Regeneration	Regeneration	Drop	None
112	NFB	21	Regeneration	Regeneration	Drop	None
113	NFB	46	Regeneration	Regeneration	Regeneration	To be determined during layout.
114	NFC	48	Regeneration	Regeneration	Regeneration	To be determined during layout.
115	NFC	1	Regeneration	Regeneration	Regeneration	None
116	NFC	10	Regeneration	Regeneration	Regeneration	None
117	NFC	4	Regeneration	Regeneration	Regeneration	None
118	NFC	8	Regeneration	Regeneration	Regeneration	None
119	NFD	64	Regeneration	Regeneration	Regeneration	None
120	NFD	42	Regeneration	Regeneration	Regeneration	None
121	NFD	11	Regeneration	Regeneration	Drop	None
122	SFG	77	Regeneration	Regeneration/ Improvement	Regeneration	Drop approx. 23 acres of Improvement from Alternative C Modified
123	SFE	121	Regeneration	Regeneration	Regeneration	Drop approx. 9 acres from Alternative C Modified

Unit Number	Patch Area	Acres	Alternative B	Alternative C	Alternative D	Changes to 2015 FEIS
124	SFE	24	Regeneration	Regeneration	Regeneration	Drop approx. 15 acres from Alternative C Modified
125	SFE	78	Regeneration	Regeneration	Regeneration	Drop approx. 22 acres from Alternative C Modified
126	SFJ	69	Regeneration	Regeneration	Regeneration	Drop approx. 13 acres from Alternative C Modified
127	SFE	10	Regeneration	Regeneration	Regeneration	Drop approx. 5 acres from Alternative C Modified
128	SFJ	52	Regeneration	Regeneration	Regeneration	Drop approx. 10 acres from Alternative C Modified
129	SFE	53	Regeneration	Regeneration	Regeneration	To be determined during layout.
130	SFG	47	Regeneration	Regeneration	Regeneration	Drop approx. 7 acres from Alternative C Modified
131	SFJ	32	Drop	Drop	Drop	None
132	SFK	3	Regeneration	Regeneration	Drop	None
133	SFK	17	Regeneration	Regeneration	Regeneration	None
134	SFK	17	Regeneration	Regeneration	Regeneration	None
135	SFK	34	Regeneration	Regeneration	Regeneration	None
136	SFC	49	Regeneration	Regeneration	Regeneration	None
137	SFC	6	Regeneration	Regeneration	Regeneration	None
138	SFC	5	Regeneration	Regeneration	Regeneration	None
139	SFC	90	Regeneration	Regeneration	Regeneration	None
140	SFC	31	Regeneration	Regeneration	Regeneration	1 Acre is dropped due to more precise mapping
141	SFC	36	Regeneration	Regeneration	Regeneration	Drop approx. 7 acres from Alternative C Modified
142	SFC	28	Regeneration	Regeneration	Drop	None
143	SFA	1	Drop	Drop	Drop	None
144	SFA	0	Drop	Drop	Drop	None
145	SFA	109	Regeneration	Regeneration	Drop	Drop approx. 14 acres from Alternative C Modified

Unit Number	Patch Area	Acres	Alternative B	Alternative C	Alternative D	Changes to 2015 FEIS
146	SFA	14	Drop	Drop	Drop	None
147	SFM	33	Regeneration	Regeneration	Regeneration	None
148	SFM	38	Regeneration	Regeneration	Regeneration	None
149	SFM	51	Regeneration	Regeneration	Regeneration	None
150	SFH	147	Regeneration	Regeneration	Regeneration	Drop entire unit from all Alternatives
152	SFH	36	Regeneration	Regeneration	Regeneration	Drop entire unit from all Alternatives
153	SFH	13	Regeneration	Regeneration	Regeneration	None
154	SFH	81	Regeneration	Regeneration	Regeneration	None
155	NFG	101	Regeneration	Regeneration	Regeneration	Drop approx. 18 acres from Alternative C Modified.
156	NFG	73	Regeneration	Regeneration	Regeneration	None
157	NFG	19	Regeneration	Regeneration	Regeneration	None
158	NFG	9	Regeneration	Regeneration	Regeneration	None
159	NFG	102	Regeneration	Regeneration	Regeneration	None
160	NFG	116	Regeneration	Regeneration	Regeneration	Drop approx. 12 acres from Alternative C Modified
201	NFA	3	Commercial Thin	Commercial Thin	Commercial Thin	None
202	NFA	28	Commercial Thin	Commercial Thin	Commercial Thin	None
203	NFA	21	Commercial Thin	Commercial Thin	Drop	None
204	NFA	55	Commercial Thin	Commercial Thin	Commercial Thin	None
205	NFA	109	Commercial Thin	Commercial Thin	Commercial Thin	None
206	NFE	77	Commercial Thin	Regeneration	Commercial Thin	None
207	NFB	30	Commercial Thin	Commercial Thin	Drop	None
208	NFB	30	Commercial Thin	Regeneration	Commercial Thin	None
209	NFB	2	Commercial Thin	Regeneration	Commercial Thin	None
210	NFB	3	Commercial Thin	Regeneration	Commercial Thin	None
211	NFC	12	Commercial Thin	Commercial Thin	Commercial Thin	None
212	NFC	17	Commercial Thin	Commercial Thin	Commercial Thin	None

Unit Number	Patch Area	Acres	Alternative B	Alternative C	Alternative D	Changes to 2015 FEIS
213	NFC	8	Commercial Thin	Commercial Thin	Commercial Thin	None
214	NFD	102	Commercial Thin	Regeneration	Commercial Thin	None
215	NFD	4	Commercial Thin	Regeneration	Commercial Thin	None
216	NFD	5	Commercial Thin	Regeneration	Commercial Thin	None
217	SFE	41	Commercial Thin	Regeneration / Commercial Thin	Commercial Thin	Drop approx. 22 acres from Alternative C Modified.
218	SFE	146	Commercial Thin	Regeneration	Commercial Thin	Drop approx. 19 acres from Alternative C Modified
219	SFG	22	Commercial Thin	Regeneration	Commercial Thin	Increase 1 acre due to more precise mapping
220	SFG	26	Commercial Thin	Regeneration	Commercial Thin	Drop approx.5 acres from Alternative C Modified
221	SFC	26	Commercial Thin	Regeneration	Commercial Thin	Drop approx. 3 acres from Alternative C Modified
222	SFC	70	Commercial Thin	Regeneration	Commercial Thin	Drop approx. 42 acres from Alternative C Modified
223	SFC	2	Commercial Thin	Regeneration	Commercial Thin	None
224	SFC	38	Commercial Thin	Regeneration	Drop	Drop approx. 15 acres from Alternative C Modified
225	SFC	60	Commercial Thin	Regeneration	Commercial Thin	Drop approx. 4 acres from Alternative C Modified
226	SFC	28	Commercial Thin	Regeneration	Drop	None
227	SFC	15	Commercial Thin	Regeneration	Drop	None
228	SFC	209	Commercial Thin	Commercial Thin	Commercial Thin	None
229	SFJ	50	Commercial Thin	Regeneration	Commercial Thin	To be determined during layout
230	SFJ	197	Commercial Thin	Commercial Thin	Commercial Thin	Drop approx. 25 acres from

Unit Number	Patch Area	Acres	Alternative B	Alternative C	Alternative D	Changes to 2015 FEIS
						Alternative C Modified
231	SFK	39	Commercial Thin	Regeneration	Commercial Thin	None
232	SFK	21	Commercial Thin	Commercial Thin	Commercial Thin	None
233	SFK	12	Commercial Thin	Regeneration	Commercial Thin	None
234	SFK	172	Commercial Thin	Regeneration	Commercial Thin	To be determined during layout
235	SFK	74	Commercial Thin	Regeneration	Commercial Thin	None
236	SFK	38	Commercial Thin	Regeneration	Commercial Thin	None
237	SFK	37	Commercial Thin	Regeneration	Commercial Thin	None
238	SFK	49	Commercial Thin	Regeneration	Commercial Thin	To be determined during layout
301	NA	333	Commercial Thin	Commercial Thin	Commercial Thin	None
302	NA	2	Drop	Drop	Drop	None
303	NA	55	Drop	Drop	Drop	None
304	NFG	160	Commercial Thin	Commercial Thin	Commercial Thin	To be determined during layout
305	NA	4	Commercial Thin	Commercial Thin	Commercial Thin	None
306	NA	60	Commercial Thin	Commercial Thin	Commercial Thin	None
307	NA	326	Commercial Thin	Commercial Thin	Commercial Thin	Drop approx.58 acres from Alternative C Modified
308	NFG	30	Drop	Drop	Drop	None
309	NA	277	Commercial Thin	Commercial Thin	Commercial Thin	To be determined during layout
310	NFG	24	Commercial Thin	Commercial Thin	Commercial Thin	None
311	NFG	30	Commercial Thin	Commercial Thin	Commercial Thin	None
312	NFG	29	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
313	NFG	19	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
314	NFG	8	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
315	NA	162	Commercial Thin	Commercial Thin	Commercial Thin	To be determined during layout

Unit Number	Patch Area	Acres	Alternative B	Alternative C	Alternative D	Changes to 2015 FEIS
316	NA	189	Commercial Thin	Commercial Thin	Commercial Thin	None
317	NA	78	Commercial Thin	Commercial Thin	Commercial Thin	To be Determined During Layout
318	NA	64	Commercial Thin	Commercial Thin	Commercial Thin	Drop approx. 45 acres below 77786 road for Alternative C Modified
319	NA	244	Commercial Thin	Commercial Thin	Commercial Thin	To be Determined During Layout
320	NA	215	Commercial Thin	Commercial Thin	Commercial Thin	None
321	NA	34	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
322	NA	16	Commercial Thin	Commercial Thin	Commercial Thin	None
323	NA	75	Commercial Thin	Commercial Thin	Commercial Thin	To be Determined During Layout
324	NA	355	Commercial Thin	Commercial Thin	Commercial Thin	To be Determined During Layout
325	NA	20	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
326	NA	36	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
327	NA	89	Commercial Thin	Commercial Thin	Commercial Thin	None
328	NA	26	Drop	Regeneration	Regeneration	None
329	NA	103	Drop	Regeneration	Regeneration	None
330	NA	33	Commercial Thin	Commercial Thin	Commercial Thin	None
331	NA	27	Commercial Thin	Commercial Thin	Commercial Thin	None
332	NA	15	Commercial Thin	Commercial Thin	Commercial Thin	None
333	NA	75	Commercial Thin	Commercial Thin	Commercial Thin	None
334	NA	2	Drop	Drop	Drop	None
335	NA	26	Commercial Thin	Commercial Thin	Commercial Thin	None
336	NA	29	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
337	NA	143	Drop	Drop	Drop	None
338	NA	10	Drop	Drop	Drop	None
339	NA	30	Drop	Drop	Drop	None
340	NA	30	Commercial Thin	Commercial Thin	Commercial Thin	Drop approx. 30 acres from

Unit Number	Patch Area	Acres	Alternative B	Alternative C	Alternative D	Changes to 2015 FEIS
						Alternative C Modified
341	NA	276	Commercial Thin	Commercial Thin	Commercial Thin	Drop approx. 56 acres from Alternative C Modified
342	NA	3	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
343	NA	13	Commercial Thin	Commercial Thin	Drop	Unit acres for all alternatives are 13 – FEIS Unit Summary did not present unit size.
344	NA	11	Commercial Thin	Commercial Thin	Commercial Thin	Drop approx. 11 acres from Alternative C Modified
345	NA	118	Commercial Thin	Commercial Thin	Commercial Thin	Drop approx. 73 acres from Alternative C Modified
346	NA	38	Commercial Thin	Commercial Thin	Commercial Thin	Trees are larger than suitable for commercial thinning – regen prescription not analyzed, so all acres dropped from all alternatives.
347	NA	98	Commercial Thin	Commercial Thin	Commercial Thin	To be Determined During Layout
348	NA	43	Commercial Thin	Commercial Thin	Commercial Thin	Drop approx. 8 acres from Alternative C Modified
349	NA	53	Commercial Thin	Commercial Thin	Commercial Thin	None
350	NA	23	Commercial Thin	Commercial Thin	Commercial Thin	None
351	NA	21	Commercial Thin	Commercial Thin	Drop	None
352	NA	13	Commercial Thin	Commercial Thin	Commercial Thin	None
353	NA	61	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	Unit acres for all alternatives are 61 – FEIS Unit Summary incorrectly presented unit size as 6 acres.
354	NA	8	Commercial Thin	Commercial Thin	Commercial Thin	None

Unit Number	Patch Area	Acres	Alternative B	Alternative C	Alternative D	Changes to 2015 FEIS
355	NA	8	Commercial Thin	Commercial Thin	Commercial Thin	To be Determined During Layout
356	NA	95	Commercial Thin	Commercial Thin	Commercial Thin	Drop approx. 40 acres from Alternative C Modified.
357	NA	54	Commercial Thin	Commercial Thin	Drop	None
358	NA	278	Commercial Thin	Commercial Thin	Commercial Thin	To be Determined During Layout
359	NA	14	Drop	Drop	Drop	None
360	NA	18	Drop	Drop	Drop	None
361	NA	4	Drop	Drop	Drop	None
362	NA	19	Drop	Drop	Drop	None
363	NA	8	Drop	Drop	Drop	None
364	NA	9	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
365	NA	20	Drop	Drop	Drop	None
366	NA	72	PreCornmercial Thin	PreCommercial Thin	PreCommercial Thin	None
367	NA	9	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
368	NA	19	Drop	Drop	Drop	None
369	NA	14	PreCommercial Thin	PreCornmercial Thin	PreCommercial Thin	None
370	NA	12	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
371	NA	10	PreCommercial Thin	PreCommercial Thin	PreCornmercial Thin	None
372	NA	9	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
373	NA	27	Commercial Thin	Commercial Thin	Commercial Thin	None
401	NFB	12	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
402	NFB	11	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
403	NFB	31	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
404	NFB	15	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
405	NFB	35	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
406	NFB	55	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
407	NFB	23	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None

Unit Number	Patch Area	Acres	Alternative B	Alternative C	Alternative D	Changes to 2015 FEIS
408	NFB	16	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
409	NFB	27	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
410	NFC	5	PreCommercial Thin	PreCommercial Thin	PreCommercial Thln	None
411	NFC	29	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
412	NFC	15	PreCommercial Thin	PreCommercial Thin	PreCornmercial Thin	None
413	NFC	21	PreCommercial Thin	PreCommerciai Thin	PreCommercial Thin	None
414	NFD	22	PreCommercial Thin	PreCommercial Thin	PreComrnercial Thin	None
415	NFD	16	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
416	SFG	21	PreCommercial Thin	PreCommercial Thin	PreComrnercial Thin	None
417	SFG	16 '	PreCommercial Thin	PreCommercial Thin	PreCornmercial Thin	None
418	SFE	23	PreComrnercial Thin	PreCommercial Thin	PreCommercial Thin	None
419	SFE	4	PreCommercial Thin	PreCommercial Thin	PreComrnercial Thin	None
420	SFE	16	PreCommercial Thin	PreCommercial Thin	PreCornmercial Thin	None
421	SFE	19	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
422	SFC	36	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
423	SFC	14	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
424	SFJ	41	PreCommercial Thin	PreCommercial Thin	PreComrnercial Thin	None
425	SFJ	8	PreComrnercial Thin	PreCommercial Thin	PreCommercial Thin	None
426	SFK	23	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
427	SFK	20	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
428	SFK	31	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
429	SFA	26	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
430	SFA	8	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None

Unit Number	Patch Area	Acres	Alternative B	Alternative C	Alternative D	Changes to 2015 FEIS
431	SFA	12	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
432	SFA	5	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
433	SFA	21	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
434	SFA	15	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
435	SFM	37	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
436	SFM	13	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
437	SFM	23	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
438	SFM	37	Drop	Drop	Drop	None
439	SFH	20	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
440	SFH	20	Droo	Droo	Drop	None
441	SFH	17	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
442	SFH	31	Drop	Drop	Drop	None
443	SFH	14	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
444	SFH	11	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
445	SFH	8	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
446	SFH	7	Droo	Drop	Drop	None
447	SFH	2	Droo	Droo	Drop	None
448	SFH	4	Drop	Drop	Drop	None
449	NFG	58	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
450	NFG	16	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
451	NFG	5	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
452	NFG	4	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
453	NFG	6	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
454	NA	38	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
455	NA	19	PreCommercial Thin	PreCommercial Thin	PreCommercia lThin	None
456	NA	31	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None

Unit Number	Patch Area	Acres	Alternative B	Alternative C	Alternative D	Changes to 2015 FEIS
457	NA	10	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
458	NA	27	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
459	NA	24	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
460	NA	27	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
461	NA	19	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
463	NA	8	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
464	NA	27	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
465	NA	21	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
466	NA	21	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
467	NA	9	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
468	NA	27	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
469	NA	10	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
470	NA	25	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
471	NA	11	Drop	Drop	Drop	None
472	NA	5	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
473	NA	32	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
474	NA	20	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
475	NA	23	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
476	NA	16	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
477	NA	14	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
478	NA	21	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
479	NA	14	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
480	NA	27	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
481	NA	25	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None

Unit Number	Patch Area	Acres	Alternative B	Alternative C	Alternative D	Changes to 2015 FEIS
482	NA	32	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
483	NA	33	PreCommercial Thin	PreCommercial Thin	PreCommercial Thin	None
501	NFA	29	Improvement	Improvement	Improvement	None
502	NFA	16	Improvement	Improvement	Drop	None
503	NFA	5	Improvement	Improvement	Improvement	None
504	NFB	11	Improvement	Improvement	Drop	None
505	NFB	197	Improvement	Improvement	Improvement	None
506	NFE	30	Improvement	Improvement	Improvement	None
601	NFE	28	Restoration	Restoration	Restoration	None
602	NFE	13	Restoration	Restoration	Restoration	None
701	NFE	257	Burn	Burn	Burn	None
702	NFE	13	Burn	Burn	Burn	None
703	NFE	10	Burn	Burn	Burn	None
704	NFE	13	Burn	Burn	Burn	None
705	NFE	164	Burn	Burn	Burn	None
706	NFE	15	Burn	Burn	Burn	None
707	NFE	17	Burn	Burn	Burn	None
708	NFF	187	Burn	Burn	Burn	None
709	SFF	303	Burn	Burn	Burn	None
710	SFF	5	Burn	Burn	Burn	None
711	SFF	18	Burn	Burn	Burn	None
712	SFG	150	Burn	Burn	Burn	None
713	SFG	93	Burn	Burn	Burn	None
714	SFE	127	Burn	Burn	Burn	None
715	NFE		Burn	Burn	Burn	None
RET	NFA	911	Retention	Retention	Retention	None
RHCA	Na	3710	RHCA	RHCA	RHCA	None

Appendix J – Upward Trend Evaluation

Appendix J in the 2015 FEIS is replaced by the following evaluation:

Upward Trend Evaluation for the Clear Creek Integrated Restoration Project (Updated June 2018)

The analysis of expected trend in aquatic conditions is an important component of the aquatic and watershed assessments. Nez Perce Forest Plan Appendix A addresses trends in below objective watersheds with upward trend direction. Upward trend means that stream conditions determined through analysis to be below the Forest Plan objective will move toward the objective over time. Only streams that do not meet Forest Plan water quality objectives require an upward trend analysis. Cobble embeddedness is the measure used to determine whether an upward trend analysis is required. It is not the only parameter used to assess trend as directed by Forest Plan Appendix A guidance.

It was determined that an upward trend analysis is required for: Pine Knob Creek, Middle and South Forks of Clear Creek, Hoodoo Creek, and Clear Creek prescription watersheds. A relative cumulative upward trend analysis, although not required by the Forest Plan, was also completed for all Forest managed lands in the Clear Creek watershed for the purpose of consultation. Additional information regarding restoration projects in the remaining prescription watersheds that do meet their water quality objectives is also included.

Forest Plan Direction for Upward Trend

The water quality objectives make up only a small part of the upward trend determination. The guidance for implementing Appendix A (Conroy and Thompson 2011) states the following:

"Upward trend means that stream conditions that are below the Forest Plan objective will move toward the objective over time. Stream specific determination of existing condition and present or future improving trend should be done through a convergence of evidence using stream surveys, monitoring results, watershed condition inventories, literature reviews, predictive modeling, and professional judgment. It must be demonstrable that an improving trend is either in place and will continue, or that an improving trend will be initiated as a result of past, present and future management activities. The Forest Plan did not specifically intend that the improving trend be in place prior to initiation of new activities. It also did not specify a time factor for achieving fish/water quality objectives in below objective watersheds."

It goes on to say that,

"It was assumed in the Forest Plan that implementation of instream restoration and other watershed restoration activities would result in an upward trend in carrying capacity. Where these activities have been implemented, it could be stated that an upward trend in the habitat conditions has been accomplished. In previously degraded watersheds, especially those identified as below objective in 1987, if there have been no entries or natural disturbances over the past 10 to 20 years, it could be assumed that trend is either static or improving. If any watershed restoration has been implemented, or if a change in management (e.g. grazing and roads management) has resulted in fewer potential adverse effects to streams, an upward trend could be assumed in these cases as well."

Based on the Forest Plan guidance discussed above, and shown in the analysis that follows, upward trends have been initiated in watersheds not meeting their water quality objectives. This is due primarily to watershed restoration activities (road related work) since 2010 and the lack of timber harvest or road building in the last 20 years.

Information Included in the Analysis

Upward trend guidance is outlined in the "Implementation Guide to Appendix A of the Nez Perce Forest Plan" (Conroy and Thompson 2011). To assess the expected trend in aquatic conditions a variety of information and tools are used to arrive at a professional conclusion. Information used for this analysis includes stream surveys, monitoring results, professional judgment based on field surveys in Clear Creek, and recent literature. Modeling tools used to determine the potential effects of the actions include the NEZSED and FISHSED, and ECA. These models were used to assess potential changes on sediment and water yields. A more detailed effects analyses for all proposed Clear Creek Project activities can be found in the Aquatics and Watershed sections of the 2015 FEIS and this DSEIS.

The most recent stream surveys were conducted by Stillwater Sciences on 27 miles of anadromous fish bearing streams. This information was used to update the baseline habitat data for project area streams. Different survey methods were used to collect cobble embeddedness between the 2011/2014 Forest Service data and the 2015 Stillwater data. The data are therefore not directly comparable; however both data sets are useful in assessing general stream conditions. Stillwater also collected embeddedness data in 2016 using FS protocols on the West Fork and mainstem Clear Creek monitoring sites. These data are comparable and were used to determine that neither the Hoodoo or Clear Creek prescription watershed met their Forest Plan water quality objectives. As noted by Sylte and Fischenich (2002) cobble embeddedness exhibits high spatial and temporal variability in both natural and disturbed streams. Sampling must be intensive within streams or stream reaches to detect changes. Intensive sampling has not occurred within Clear Creek or its tributaries so determining a trend for embeddedness based on limited data points is not appropriate. Cobble embeddedness alone is not used to determine upward trend.

The presence, absence, or densities of fish species can aid in the determination of overall stream health, however densities can be highly variable and are difficult to tie specifically to land management activities or upward trend. This is especially true for salmon, steelhead, and lamprey which migrate to the ocean then return to spawn in local streams. These species are heavily influenced by factors that occur outside of the Clear Creek watershed (i.e., dams, fishing, and ocean conditions). If adults return in low numbers, then subsequent juvenile densities would also be low and not necessarily associated with watershed conditions in Clear Creek. The following Forest Plan upward trend analyses are associated with habitat conditions and not fish densities. This is in part due to these influencing factors combined with the lack of multiple data points. Trends in fish populations would be useful, if available, but are not required for determining whether or not an upward trend exists (Conroy and Thompson 2011).

Stream temperature data is presented, however due to the influence of year to year weather patterns, trends cannot be easily determined. For example, several sites saw their warmest temperatures in 2015, a hot year regionally, but others were highest in 2011. At the Forest boundary, the warmest temperature was 20.1°C in 2015 and 19.6 °C in both 2016 and 1991, and coolest was in 1992 (14.7°C).

Watershed Improvement Activities Included in the Analysis

The Clear Creek Integrated Restoration project proposes a variety of watershed improvement projects to improve watershed health and function and help to achieve upward trend. The project includes: decommissioning of 13.2 miles of system road, including the removal of 8 stream crossings and approximately 3 miles of non-system road (estimated amount that would be ancillary of system roads and would be identified during system road decommissioning surveys); road reconditioning along portions of 49 miles of system road; and road reconstruction along segments of 120 miles of system road, including replacement of 69 culverts on live streams with culverts sized for a 100 year flow event.

Watershed improvement needs were identified during the pre-NEPA stage of the 2015 FEIS. Some of the concerns were addressed through projects that were completed under separate decision documents and were incorporated into the existing condition of the 2015 FEIS or the cumulative effects analyses as a future project. Although assessed during the same pre-NEPA assessment as the 2015 FEIS, it was determined that implementing these projects through separate NEPA and prior to the completion of the Clear Creek Integrated Restoration Project would accelerate watershed recovery. The associated projects are described below and cumulatively summarized by project type in Table 35.

South Fork/West Fork Clear Creek Road Decommissioning Project EA, 2011

Decommissioning of approximately 10 miles of system road and 73 miles of non-system road, includes removal of 21 stream crossings. No fish bearing streams were involved.

Clear Creek Culvert Replacements CE, 2011

Culvert removal/replacement of 11 culverts – 9 culverts on fish bearing streams were replaced with culverts that are at or wider than bankfull width to allow for stream bank development within the structure; 1 culvert on a non-fish bearing stream were replaced to accommodate a minimum 100-year stream flow event; and 1 culvert was removed. This project opened 1 mile of previously inaccessible habitat to native fish species.

Browns Spring culvert Replacements and Road improvement Project Letter to File, 2012

Road improvement on 1.7 miles of Road 1124 and 1.3 miles of Road 1129. Replacement of two culverts on the 286 road.

Road 286N Road Maintenance Project Letter to File, 2013

Reconstruction of 0.6 miles of Road 286N, including one culvert replacements.

Road 650 Road Maintenance Project Letter to File, 2013

Approximately 15.5 miles of road improvement, including replacement of 35 non-water cross drain culverts. A total of 10.5 miles was conducted by the Forest Service and 5.0 miles were completed by Idaho County.

Clear Ridge Non-System Road Decommissioning Project CE, 2015

Proposed project to decommission approximately 65 miles of non-system road, including removal of 15 stream crossings. This project has not yet been implemented.

Table 35: Summary of Watershed Improvement Projects Proposed and Implemented in the Clear Creek Watershed 2011 - 2015

Activity	Quantity	Description
Road System Decommissioning	23 miles	Road decommissioning practices vary depending on the potential of landslides and other erosion conditions associated with the road, the land type the road is on, and its proximity to fish bearing streams. While some roads can be abandoned, most roads require full decompaction and slope recontouring. Generally, abandoned roads have no stream crossings, are well vegetated, are resistant to surface erosion, and are not prone to mass failure.
Non-System Road Decommissioning	141 miles	Non-system roads are old skid trails, jammer roads, or temporary roads used for past harvest activities. Soil would be decompacted and roads would be fully recontoured.
Road Recondition	49 miles	Portions of the total length would be treated as needed. Consists of standard maintenance, such as road blading, brushing, cleaning of culverts, removal of small cutslope failures, application of rock in wet spots and removal of obstructions such as trees, rocks, etc.
Road Reconstruction	214 miles	Portions of the total length would be treated as needed. Includes spot aggregate placement, blading, brushing and removal of obstructions, reshaping of drainage dips and road bed, and replacement or addition of cross drain and live water culverts.
Culvert Replacements	113	On fish bearing streams, pipes are replaced with larger culverts that provide for all aquatic organism passage. They are wider than bankfull width and are open bottom arches or circular pipes with substrate added for stream simulation. On non-fish bearing streams, culverts are sized to accommodate a minimum 100-year stream flow event.
Culvert Removal	45	Culverts are removed, stream banks are sloped back, and stream channels are restored.

Vegetation Management and Temporary Road Construction Activities Included in the Analysis

Vegetation management activities and temporary road construction proposed in the Clear Creek Integrated Management Project with the potential to increase erosion/sediment delivery or increase water yield are displayed in the table below.

Table 36: Vegetation Management and Temporary Road Construction Activities Included in the Analysis

Activity	Alt. B	Alt. C	Alt. C Modified	Alt. D
Regeneration Harvest	2,609	4,156	3,621	2,178
Commercial Thinning	5,606	4,220	3,897	5,141
Improvement Harvest	331	331	303	211
Prescribed Burning	1,371	1,371	1,371	1,371
Temporary Road Construction	110 (36.3 miles)	110 (36.3 miles)	109 (35.6 miles)	53 (17.5 miles)

Clear Creek Upward Trend Assessment

The following is a summary of the overall aquatic conditions in the Clear Creek watershed, potential trends to aquatic habitats and the processes that affect them, and the potential effects of

the Clear Creek Integrated Restoration Project may have on those trends. Alternative C was used for this assessment as it has the largest NEZSED and FISHSED modeled effects. All other alternatives would have lesser effects than those discussed here.

Current Condition Summary

The upper two-thirds (43,700 acres) of the Clear Creek watershed is managed by the Forest Service and the lower third by state/private landowners. There are a minimum of 250 miles of streams on Forest Service lands and 17 miles on state/private. Roughly 65 miles are considered fish bearing on Forest Service lands and 15 miles occur on state/private. Streams throughout Clear Creek are important for Chinook salmon, steelhead, and westslope cutthroat trout as well as other non-game aquatic species. There are about 23 miles of suitable chinook habitat (primarily on the mainstem), 45 miles of steelhead habitat, and 80 miles usable by cutthroat trout.

Stream temperatures on Forest Service lands are considered within optimal ranges (14–19°C) for juvenile salmon and steelhead, and cutthroat trout rearing for the majority of the year (EPA 2003). Temperatures on the mainstem below the Forest boundary are less than suitable for salmon and trout during the months of July, August, and early September but are suitable for the remainder of the year. The probability of finding bull trout is very low (range 9-14%) due to warmer than preferred stream temperatures throughout the watershed (Isaac, 2014). There is currently no trend data available for fish species in the watershed but based on recent surveys (Stillwater Sciences, 2015) and field observations in 2010 through 2012, fish are well distributed throughout the watershed. Overall fish distribution is consistent with 1988 and 1993/94 surveys as well.

Stream substrates throughout the drainage vary from sand in the low gradient channels to boulders, rubble and gravel in the remaining channels. Cobbles and larger substrates dominate the streams. The larger substrates provide good rearing habitat for aquatic species. The most abundant anadromous spawning gravel is located in the mainstem and South Fork of Clear Creek. Resident spawning habitat occurs throughout the remaining streams. The percent of sand/silt ranged from 12 to 24%. Fish embryo survival is highest when the percent of fines is below 20% (Meehan, et al 1991). Cobble embeddedness showed a range of 30 to 37% on Forest lands and 20% in lower Clear Creek on private lands (Stillwater Sciences, 2015). Forest Service data from 2011/2014 ranged from 30% to 51%. The desired level (DFC) for cobble embeddedness is 20% or less (USDA, 1992) therefore existing conditions (regardless of the survey method used) remain above desired conditions. Granitic geologies that typically have a higher component of fine material and higher erosion rates can also contribute to higher embeddedness levels. Sediment levels that exceed desired conditions have likely affected the quality and quantity of habitat available for native fish species; however the extent is not known.

Shallow water depths and lack of pool habitat were noted as issues affecting fish production in the middle and upper reaches of Clear Creek (USFS, survey data 1988). The same sediment, wood, and pool limitations were noted by surveys in 1993 (Forest Service) and again in 2015 (Stillwater Sciences). Low wood levels are considered to primarily be a result of large wildlfires that occurred over 45% of the area in the early 1900s. Stream bank stability was noted as good to excellent throughout the drainage from the 1988 through 2015 surveys due to the presence of dense streamside vegetation and large substrate (cobble, rubble, boulders) which armor the banks against the erosive power of the streams. Stable banks are more resistant to stream channel adjustments and bank erosion resulting from high stream flows.

Regeneration timber harvest activities have occurred on approximately 22% of Forest Service managed lands since the 1930s with an associated 190 miles of road building. The current ECA associated with management activities both on federal and private/state lands is 4%, or a good condition based on the NOAA Matrix table (1998). An assessment of aerial photos shows that no-harvest buffers in riparian areas were retained since the 1960s on all but about 8% (15 miles) of the intermittent or non-fish bearing streams. Of the remaining 92%, buffers were a minimum of 50 to 100'wide and were retained on all fish bearing streams. Since PACFISH was adopted a total of 440 acres of regeneration harvest has occurred with appropriate sized buffers retained. Streamside buffers protect aquatic habitats by limiting sediment input and providing for shade and future woody material important for aquatic habitat development.

A review of vegetative successional stages within PACFISH RHCAs indicates that 9% are early successional (< 40 years old), 34% are mid-seral (41-100 years), 57% older than 100 years. The majority of mid-seral forest is located in the South Fork, lower Hoodoo and lower West Fork Clear Creeks and are a result of the 1931 wildfire. Successional stage information combined with field reviews of the streams from 2010-2012 indicates that RHCAs are well vegetated and only minimally (9%) affected by previous timber harvest activities. No activities have taken place that would affect the RHCAs since the 2010-2012 field reviews with the exception of road decommissioning and culvert replacement projects.

There are 190 miles of Forest system roads within the project area with most occurring along or near ridgetops with mostly small headwater stream crossings. There are 147 miles (77%) of graveled and 43 miles (23%) of native surfaced road. Placing gravel on roads has been shown to reduce sediment runoff from the road surface (Meehan 1991). Burroughs and King (1985) also conducted a study on the Nez Perce Forest using simulated rainfall to generate runoff and sediment yield from forest roads, ditchlines, and fill slopes. The reduction in sediment production by graveling the road was 79% with reductions lasting several years depending on the level of road use. They also found that where dense grass cover was present on the fill slopes of the road, sediment yield was reduced by 99%. The cut and fill slopes of roads within the Clear Creek project area are densely vegetated with grasses, shrubs, and trees. The majority of ditchlines also contain grasses, which can trap sediment. These conditions, along with the perpendicular stream/road crossings mentioned previously, help to minimize the risk of roads contributing large amounts of sediment to streams.

The US Forest Service, BLM, USFWS, and NOAA (NOAA 1998) have determined that watershed conditions can be rated "good" when streamside road densities are <1 mile per square mile (mi/mi2), "moderate" at 1–2 mi/mi2, or "poor" at >2 mi/mi2. A total of 20 miles of NFS system roads exist within PACFISH buffers, contributing to an overall RHCA road density of 1.2 mi/mi2. RHCA roads are currently in a moderate condition. The majority of Forest roads in Clear Creek have been constructed perpendicular to streams in headwater areas where stream size is relatively small. This design limits the negative effects from roads on streams by minimizing the interaction and connectivity between the two. Some sediment contribution is occurring because roadside ditches have been constructed to drain into live streams however the amount is not known. Roughly 75% of RHCA road miles are graveled which helps to reduce the contribution of sediment to streams from roads.

Roads on landslide prone landscapes have the potential to fail and contribute large quantities of sediment to streams. These roads may remain unstable over time and may contribute to chronic sediment erosion if not stabilized. Watersheds are in a high condition when landslide prone road

densities are <1 mi/mi^2 (NOAA, 1998). Landslide prone road densities are <1 mi/mi^2 and in a high (good) condition on federal lands. Only one road-related landslide was observed during the road surveys. The majority of roads in Clear Creek occur on stable ridgetops with minimal risk of failure.

The Watershed Condition Framework (USDA 2011) was used to assess watershed condition based on a variety of factors including forest health, soil, water, and roads. Watershed ratings reflect the level of watershed health or integrity. A watershed in good condition is one that is functioning in a manner similar to natural wildland conditions. The South Fork Clear Creek was rated as having high integrity or functionality. The Upper and Lower Clear Creek subwatersheds received moderate ratings and have been targeted for integrated restoration efforts through the road-related projects previously mentioned in combination with the Clear Creek Integrated Restoration Project. The road projects focused on the most direct long term benefits to water quality and aquatic habitats while the Clear Creek Integrated Restoration project focuses on forest health and diversity. The road-related projects were designed to achieve a continued long term upward trend throughout the Clear Creek drainage.

Evaluations conducted during the previous Forest Plan Revision efforts in 2006 showed that the South Fork, Upper and Lower Clear Creek subwatersheds were not meeting water quality or fish habitat desired conditions. The subwatersheds were rated as a High Priority for Restoration with the number of roads being the primary limiting factor to improved aquatic habitat conditions. The Clear Creek Project addresses these effects through project activities.

Proposed Activity Effects to Streams

The trend assessment used a variety of quantitative and qualitative data sources. Project activities and their expected influence on aquatic conditions are summarized in Table 37 and narratives below. The information when considered collectively helps to assess the expected influence of the alternatives on the aquatic conditions in the Clear Creek watershed as a whole. **It does not represent an assessment of cumulative effects, or expected trend within specific subwatersheds**. Various activities are considered with respect to the variety of aquatic processes that they potentially affect. The contribution to the overall aquatic condition is estimated in terms of positive influence (denoted by "+") where the activity is expected to contribute to an improvement in condition, and a negative influence (denoted by "-") where the activity is expected to contribute to degradation in aquatic condition. The amount of influence a specific activity is expected to have on the overall aquatic condition (either positive or negative) is represented by a ranking of high (H), moderate (M), or low (L). Activities rated "High" are those that are expected to have a significant effect at the watershed scale (considering both scope and magnitude). Those rated as "Moderate" are those activities that are expected to have a significant local effect (i.e. at the subwatershed scale), but not result in a significant effect at the watershed scale. Those activities rated "Low" are expected to have only a negligible effect both at the subwatershed and watershed scale.

All of the processes potentially affected by an activity are listed in Table 30. **No ranking, or areas left blank, represent no expected influence on this process or resulting aquatic conditions from this project.** The expected contribution of a specific activity on aquatic condition is considered both in terms of short-term and long-term. Short-term influence is judged to be the immediate results of implementing the activity, generally expected to be around a 5-year timeframe. Long-term influence is judged to be the influence the activity will have on aquatic

condition as a result of changes in processes and resource conditions that will over time result in changes in aquatic habitat condition. The timeframe for this influence is greater than 5 years.

Each of the processes and indicators in the trend analysis table functions in different time frames. For example, the effectiveness of culverts replacements at improving accessibility or fish habitat is almost immediate. At the other extreme is the effectiveness of stream side road decommissioning at providing shade and bank stability, which can take decades to achieve full potential. Between these two poles are processes such as sediment yield increases or decreases, the effects of which can range from immediate to many years, depending on the specific pathway affected. Similarly, the effects to substrate sediment can be relatively fast in terms of deposition, but can range widely in subsequent entrainment and transport.

Table 37: Upward Trend Indicators and Ratings for Clear Creek

Activity	Process Affected	Characteristic Indicator	Alt A Long Term	Alt B Short Term	Alt B Long Term	Alt C[1] Short Term	Alt C[1] Long Term	Alt D Short Term	Alt D Long Term
Vegetation Treatments	Surface erosion	Pulse & Chronic Sediment		-M		-M		-M	
	Mass failure risk	Pulse sediment							
	Infiltration, runoff	Hydrologic process		-M	-L	-M	-L	-M	-L
	Solar heating	Riparian shade							
Temporary Road Construction	Surface erosion	Pulse & Chronic Sediment		-L		-L		-L	
	Mass failure risk	Pulse sediment							
	Infiltration, runoff	Hydrologic process		-L		-L		-L	
	Riparian shade	Riparian condition							
Road Improvement	Surface erosion	Pulse & Chronic Sediment	-M	-L		-L		-L	
	Mass failure risk	Pulse sediment							
	Infiltration, runoff	Hydrologic process	-M	+L		+L		+L	
	Fish Passage	Habitat availability							
Road Decommissioning (includes RHCA roads and non-system roads)	Surface erosion	Pulse & Chronic Sediment	-L	-L	+L	-L	+L	-L	+L
	Mass failure risk	Pulse sediment							
	Infiltration, runoff	Hydrologic process	-L	+L	+L	+L	+L	+L	+L
	Riparian Shade	Riparian condition	-L		+L		+L		+L
Stream Crossing Improvement	Surface erosion	Pulse & Chronic Sediment	-L	-M	+L	-M	+L	-M	+L

Activity	Process Affected	Characteristic Indicator	Alt A Long Term	Alt B Short Term	Alt B Long Term	Alt C[1] Short Term	Alt C[1] Long Term	Alt D Short Term	Alt D Long Term
	Mass failure risk	Pulse sediment	-M	+L	+M	+L	+M	+L	+M
	Infiltration, runoff	Hydrologic process							
	Fish Passage	Habitat availability	-L	+L	+L	+L	+L	+L	+L

[1] Alt C Modified has less acres than Alt C and will therefore have less impact and greater benefit than depicted in Alt. C.

* No ranking, or areas left blank, represent no expected influence on this process or resulting aquatic conditions from this project

The above ratings by activity can be summarized by the effect pathways by assigning a value to the Low, Moderate, and High ranking (L=1, M=2, H=3). Table 38 below summarizes the alternatives by the effect pathway and for the alternative in general. It provides and overall total score for each of the processes affected both in the short and long term.

Table 38: Summary of Upward Trend Indicators and Ratings for Clear Creek

Activity	Process Affected	Characteristic Indicator	Alt A Long Term	Alt B Short Term	Alt B Long Term	Alt C[1] Short Term	Alt C[1] Long Term	Alt D Short Term	Alt D Long Term
Summary	Surface erosion	Pulse & Chronic Sediment	-4	-8	2	-8	2	-8	2
	Mass failure risk	Pulse Sediment	-2	1	2	1	2	1	2
	Infiltration, runoff	Hydrologic Process	-3	-1	0	-1	0	-1	0
	Riparian Shade	Riparian Condition	-1	0	1	0	1	0	1
	Fish Passage	Habitat Availability	-1	1	1	1	1	1	1
Total			**-11**	**-7**	**6**	**-7**	**6**	**-7**	**6**

[1] Alt C Modified has less acres than Alt C and will therefore have less impact and greater benefit than depicted in Alt. C.

The above table of indicators of aquatic trend is a tool that is used in reaching a conclusion about what the expected trends from this project are expected to be in the Clear Creek watershed. This table illustrates the general relationships between project activities and expected consequences in aquatic conditions. At the watershed scale, the three action alternatives would essentially produce the same Upward Trend conclusions.

The expected short-term consequences of the Clear Creek Integrated Restoration project on aquatic condition in the Clear Creek watershed is principally related to the surface erosion process and sediment conditions. The other short-term negative consequences of the project on aquatic conditions were related to the hydrologic processes of runoff and infiltration from temporary road construction and harvest. All of the activities are expected to have a negative

effect on aquatic condition in the short term based on sediment yields as modeled in NEZSED. The Nez Perce Forest Plan requires the use of the NEZSED model in order to compare the difference between action alternatives. Results from NEZSED indicate sediment yield increases at the Forest boundary of 24% (Alt. C) as a result of project activities. The Forest Plan objective is 30%

Results from NEZSED are entered into the FISHSED model to determine potential changes in fish habitat carrying capacity based on modeled changes to cobble embeddedness. **The model results are only used to compare alternatives and do not represent actual changes in conditions** (Stowell, 1983). FISHSED predicted a 2–15% change in cobble embeddedness, 1-8% for summer rearing capacity, and 2 to 15% for winter rearing capacity depending on the action alternative. FISHSED is used to assess the effects of changes in habitat quality when cobble embeddedness changes are greater than 10% (Stowell et al. 1983). Cobble embeddedness and winter rearing capacity exceeds the level of 10% where changes in habitat quality could occur (Stowell et al. 1983) under Alternatives B, C and C Modified. However, local RHCA monitoring found no sediment delivery through the buffers (USDA, 2014). Visual observations of post-harvest areas found the same results elsewhere on the Forest (K. Smith, personal observations, 2000-2013). With no delivery, cobble embeddedness levels are not expected to increase as a result of harvest. FISHSED model documentation states that the effects evaluation should be adjusted if riparian areas are to be treated differently than surrounding land. PACFISH RHCAs retain no-harvest buffers that are much wider than those used when FISHSED was developed. Typically there is a reduction of 20-30% in the NEPA analyzed acres after on-the-ground harvest unit layout occurs, primarily due to RHCA identification and buffering; therefore the model results are considered overestimates.

ECAs in Clear Creek would range from 3% to 26% depending on the alternative. All alternatives remain in the good to moderate Matrix categories (<20%) with the exception of Hoodoo Creek under Alternative C (26%). Increased stream flows are not expected to result in stream channel alterations in Hoodoo prescription watershed. Actual harvest acres would be reduced by 20-35% during layout based on recent comparisons of NEPA versus layout units, as described in Alternative C Modified. Additional acreages were identified through further analysis and coordination with the Nez Perce Tribe. Portions of the acreages identified by the Tribe are reflected in the deductions in Alternative C Modified. The Responsible Official has the option of applying all or part of the modifications to any action alternative as part of the decision. As noted previously, Alternative C was chosen for modification because it proposes the most potential disturbance within the project area. Application of the modifications to any of the other action alternatives would result in even less potential impacts. The reduced acres would result in lower ECAs. All other watersheds remain below the 20% threshold, therefore, no stream channel alteration from increased water yield is expected from the Clear Creek project.

The expected short-term positive consequences of the project on aquatic conditions in the Clear Creek watershed are associated with watershed improvement projects where an immediate improvement in condition results from project implementation. The greatest benefit in this category is associated with the increased habitat availability that resulted from culvert replacements designed for fish passage. Road decommissioning, road improvements, and stream crossing improvements will result in some minor immediate enhancements, principally through the lowered risk of stream crossing failure and the subsequent delivery of large amounts of sediment into streams.

The expected long-term consequences of the project on aquatic condition in the Clear Creek watershed are all considered positive, with the exception of some continued minor negative effects on the water yield (as measured by ECA) associated with regeneration harvest openings. The watershed improvement projects would also have long term positive consequences on aquatic conditions in the watershed. They are the same as the short-term consequences including improved fish passage, the reduced risk of stream crossing failure, and reducing hydrologic connectivity between roads and streams through the addition of cross drain culverts.

The conclusions regarding aquatic trend display the consequence of subtle balances between the short-term impacts and long-term improvements. A relatively modest shift in those balances could result in a different set of conclusions regarding aquatic trends. The trend conclusions must also be tempered with knowledge of the inherently variable conditions within the watershed and the unpredictability of weather and natural disturbance events such as fire and subsequent landslides. Future trends continue to be influenced by future management activities and natural events.

Forest Plan Prescription Watershed Upward Trend Assessments

The following tables display the vegetation treatment, temporary road construction, and watershed improvement activities by prescription watershed for all actions associated with and including the Clear Creek Integrated Restoration project. The associated decision documents through which actions were proposed or decisions made are indicated by the numbers below and are later referred to in the summary tables for each of the prescription watersheds:

1. South Fork/West Fork Clear Creek Road Decommissioning Project EA, 2011
2. Clear Creek Culvert Replacements CE, 2011
3. Browns Spring Culvert Replacements and Roads 1124 and 1129 Improvement Project Letter to File, 2012
4. Road 286N Road Maintenance Project Letter to File, 2013
5. Road 650 Road Maintenance Project Letter to File, 2013
6. Clear Creek Integrated Restoration Project EIS, 2015
7. Clear Ridge Non-System Road Decommissioning Project CE, 2015.

An Upward Trend assessment was conducted for each of the Forest Plan Prescription watersheds. Alternative A (existing condition) was compared to Alternative C (maximum alternative) for the short term (0-5 years) and long term (>5 years). Activities were given a rating based on the indicators shown in Table 39. Number ranges for each of the ratings were based on the relative impact at the Prescription watershed scale. The Upward Trend determination was calculated by assigning a value to the Low, Moderate, and High ranking (L=1, M=2, H=3) and then summarized.

Table 39: Rating Indicators

Proposed Activity	High	Moderate	Low
Vegetation Treatments			
Total Harvest and Burn	>40% of Watershed Acres	15-40% of Watershed Acres	<15% of Watershed Acres
Regen Harvest	>25% of Watershed Acres	10-25% of Watershed Acres	<10% of Watershed Acres

Proposed Activity	High	Moderate	Low
Temporary Road Construction	>5% of Watershed Acres	2-5% of Watershed Acres	<2% of Watershed Acres
Road Improvement			
Road Reconstruction	>75% of Total Roads	50-75% of Total Roads	<50% of Total Roads
Road Reconditioning	>25% of Total Roads	15-25% of Total Roads	<15% of Total Roads
Road Decommissioning	>50% Reduction	25-50% Reduction	<25% Reduction
RHCA Road Decommissioning	>50% Reduction	25-50% Reduction	<25% Reduction
Non-system Road Decommissioning	>40 miles	20-40 miles	<20 miles
Riparian Shade	>10 miles RHCA	5-10 miles RHCA	<5 miles RHCA
Stream Crossing Improvements	>20	10-20	<10
Fish Passage Culverts	>3	2-3	<2

Pine Knob Prescription Watershed

The 2,622 acre Pine Knob Forest Plan prescription watershed does not meet its water quality objective of 80% for fishery habitat potential. Cobble embeddedness was less than 30% in 2015 (Stillwater Sciences). When assessed against the DFCs (USDA 1992), the watershed currently is at 82% of habitat potential. Embeddedness was 44% with a 65% habitat potential in 2012 using FS data. It was at 50% of its habitat potential when the Forest Plan was written in 1987. This would be considered an upward trend in cobble embeddedness since 1987 based on limited cobble embeddedness data. Higher levels of embeddedness may also be in part a result of the granitic geology that occurs where substrate was sampled. Granitic geologies typically have a higher component of finer particles than other geologies found in the drainage.

There are about 3 miles of fish-bearing and 7 miles of non-fish bearing streams in Pine Knob Creek. The stream is mostly suitable for steelhead trout and westslope cutthroat trout. The lower 0.5 miles may be used by juvenile Chinook salmon for rearing. The substrate is generally too small for Chinook salmon spawning. Surveys in 2015 showed low steelhead densities of 0.9 fish/m^2 and no westslope cutthroat trout during snorkel surveys. Cutthroat were visually observed in 2015 and are known to occur in the drainage.

Stream temperatures were measured in Pine Knob Creek in the summer of 2015. Stream temperature conditions based on NOAA matrix ratings were high for steelhead spawning in all months except for June and July. The two months rated out as low (16.4°C). Steelhead rearing temperatures were rated as high from December to June and again in September and October, moderate in June, the latter half of July through August and low for two weeks in July (17-18°C). Cool temperatures most of the year are a result of well forest areas adjacent to streams (see RHCA discussion below). Temperatures were moderate for bull trout rearing and low for bull trout spawning/incubation. This is consistent with the Climate Shield model results (Isaac, 2014) which showed a zero probability of bull trout presence based on warmer than preferred temperatures.

Shallow water depths and low to moderate numbers of pool habitat were noted in the 2015 surveys. The low number of pools and lack of depth is directly related to low wood levels. Wood

is the primary creator of pool habitats in this stream type. Low wood levels appear to be natural as streamside buffers of 100' to 120+' were retained during previous timber harvest (see management actions discussion below). FEMAT (1993) showed that the probability that a falling tree will enter the stream is a function of slope distance from the channel in relation to the tree height. The analysis showed that 100% of wood delivered to streams comes from within one site potential tree height of the stream (150' in Clear Creek). Roughly 95% of the wood subsequently comes from within 120' therefore wood levels in Pine Knob are considered mostly natural. The low wood levels may be due to the dominance of western red cedar that dominates the riparian areas. Red cedar is a long lived species and remains standing for long periods even when dead. Water depths and pool habitat availability are considered to be trending upward trend since buffers were retained and would provide both the short and long term wood necessary to create pools as trees die and fall into the stream. Previously harvested areas that occur within current RHCAs are forested. Standard RHCAs are expected to be retained during the next harvest rotation which would maintain the necessary wood component over time, thus maintaining the upward trend.

Stream bank stability was noted as good to excellent in the 1988, 1993, and 2015 surveys as well as the 2010-2012 field observations. This is due to the presence of dense streamside vegetation in combination with large substrate (cobble, rubble, boulders) which armors the banks against the erosive power of the stream. Excellent bank stability has been maintained in the watershed.

Stream substrate composition in Pine Knob in 2015 was composed of 15% fine material (sand/silt), 37% gravel and 48% large material (rubble to boulders). There was a decrease in fines and increase in gravels suitable for spawning when compared to the 1993 surveys. This indicates an improving trend in larger substrate size and decrease in fine substrate.

There was one road related failure that was deposited in Pine Knob Creek; however it occurred prior to the 1993 surveys. No other obvious sources of sediment were observed at road crossings or along roads within the watershed during 2010-2012 field reviews nor were any other potential management-related sources.

Regeneration timber harvest activities have occurred on 36% of the watershed between the 1960's and 1988. No regeneration harvest has occurred since then. Commercial thinning occurred on 11% of the area between the 1970's and 2005. As a result ECA is currently at 3%, or a high condition. Streamside buffers were retained on all but 0.5 miles of stream in the upper portion of the drainage. Where buffers were retained they ranged from 100' to 150' from the stream channel. This means that based on FEMAT (1993) 90 to 100% of all wood likely to fall into the stream was retained during timber harvest. Forested stands within PACFISH buffers are aged as follows: 6% are < 40 years old, 19% are between 40 and 100 years and the remaining 75% older than 100 years. No future foreseeable harvest in the RHCAs is expected therefore they would be considered fully functional given the age classes and minimal disturbance within them. As a result, they are trending in an upward condition and would continue to provide for shade, wood, and bank stability in Pine Knob Creek.

There are almost 20 miles of Forest system roads within the watershed with less than 2 miles occurring within RHCAs. A total of 0.5 miles of the RHCA roads are graveled and opened to motorized traffic and the remaining are closed. Gravel helps to minimize sediment production from roads (Swift, 1984: Burroughs and King, 1989) as does minimizing motorized use on roads. There were no obvious signs of road surface erosion (no rilling or gullying) during culvert inventories in Pine Knob Creek. Many roads were dominated by a base rock surface topped with

grasses/mosses and small trees growing along their margins. The overall watershed road density is 4.8 mi/mi^2 and the RHCA road density is 2.2 mi/mi^2. This is an 11% reduction from densities in 1995 and is a result of past road decommissioning projects. Prior to 2014, there were 11.5 miles of non-system roads in the prescription watershed. The Clear Ridge project decommissions all but 0.5 miles resulting in an almost elimination of these roads and the conversion of 44 acres (4 acres/mile) of road back into productive forested habitats.

There are 9 stream crossings within the watershed with 8 occurring on very small seeps or streams (18-24”). Two of the crossings were identified as needing cross drain additions and 3 need to be replaced as they are undersized or are in poor condition. Roads are expected to be contributing very little sediment to streams due to an overall low number of crossings (0.5 culverts/mile of road), well vegetated/rocked road surfaces that showed very little erosion, the need for cross drains on only 2 small streams, and well vegetated ditchlines which are helping to filter out sediment to streams. There are no human caused barriers to upstream aquatic organism migration in the watershed.

Based on the Forest Plan guidance, an upward trend has been initiated in the Pine Knob prescription watershed. This is due primarily to the lack of recent timber harvest combined with few stream crossings, mostly closed roads and only one pre-1993 road failure. The stream has an excellent and fully functioning riparian vegetation component, stable banks, cool stream temperatures, and increasing amounts of gravel which would allow for the continued improvement of fish habitat capacity over time.

Proposed Activity Effects to Streams

The expected short-term consequences of the Clear Creek Integrated Restoration project on aquatic conditions in Pine Knob Creek is principally related to the surface erosion and sediment conditions. Other short-term negative consequences are related to the hydrologic processes of runoff and infiltration from temporary road construction and harvest. All of the activities are expected to have a negative effect on aquatic condition in the short term based on sediment yields as modeled in NEZSED. Model results from NEZSED indicate sediment yield increases at the mouth of Pine Knob to 31% as a result of project activities. This meets the Forest Plan standard of 45% or less. The FISHSED model was used in conjunction with NEZSED to determine potential changes in fish habitat carrying capacity as previously discussed. The model predicted a 6% increase in cobble embeddedness and subsequent decrease of 2% for summer and 9% for winter rearing capacity for juvenile steelhead trout rearing for the action alternatives. This is below the 10% where changes in habitat quality could occur (Stowell et al. 1983). No substantial changes in cobble embeddedness and summer/winter habitat rearing capacity are therefore expected based on this modeling and on local effectiveness monitoring (USDA Forest Service 2009 and 2014). ECAs would increase to 14% under all alternatives and would remain within the High (good) condition class based on the NOAA matrix (1998) therefore no channel alterations as a result of increased water yield is expected.

The Clear Creek Project would decommission an additional 1.8 miles of road, 0.1 miles of which is within RHCAs. This would reduce watershed road densities to 4.3 mi/mi^2 and RHCA densities to 2.0 mi/mi^2. The result would be a 9% reduction in overall road miles and a 6% reduction in RHCA road miles. The Clear Creek Project would decommission the remaining 0.5 miles of non-system road resulting in the watershed and would convert 2 acres of road back into a forested condition. The Clear Creek Project would reconstruct 8.5 miles of system road (48% of the roads in the prescription watershed) which would help to reduce sediment delivery by diverting road

ditchline flow away from streams through the addition of cross drain culverts. The project would also replace the 2 existing undersized culverts with those sized for a 100- year flow event. Small amounts of sediment delivery would occur as a result of the culvert replacements and would last up to 2 years. In the long run, the replacements would reduce the risk of future failure. All 8 crossings in the watershed would be appropriately sized after project completion. The Project would recondition 5.8 miles of road (69% of the roads). Reconditioning would apply gravel where needed to minimize the amount of erosion from road surfaces during log haul operations. The use of dust abatement during log haul would also minimize road surface erosion and potential input of sediment to streams during harvest operations.

Overall Trend Summary for the Pine Knob Prescription Watershed

The current upward trend for aquatic habitat conditions and fish habitat capacity is expected to continue in the Pine Knob prescription watershed because of road improvements associated with the project, the relatively intact RHCAs, the expected minimal effects of modeled sediment to streams, water yields that would remain below levels where alterations in streams channels could occur, and the implementation of design features and BMPs which have been shown to be effective at minimizing effects to streams (Sugden, 2018; Arismendi et al, 2017; Hatten et al 2017; Sugden et al 2012; USDA Forest Service, 2009). The Clear Creek Project therefore complies with the Forest Plan upward trend requirement.

Pine Knob Creek Prescription Watershed Activities

Watershed Area 4.1 Sq. Miles (2,622 acres) 0.78 RHCA Sq. miles

Road Density	Roads Total 1995	Road Decomm 1996-2011	Roads Total 2011	SF/WF Road Decomm[1]	Roads Total 2014	Clear Creek IR Project[6]	Roads Final Total	Percent Reduction
miles	22.1	2.5	19.6	0.0	19.6	1.8	17.8	9.2%
Road Density	5.4		4.8		4.8		4.3	
RHCA miles	1.9	0.2	1.7	0.0	1.7	0.1	1.6	5.9%
RHCA Road Density	2.4		2.2		2.2		2.0	

Percent road reduction: 9% total miles; 6% RHCA miles

Culverts	Clear Creek IR Project[6]
Replaced	2
Removed	0

All fish bearing pipes: AOP; All Undersized pipes replaced

Road Reconstruction	Clear Creek IR Project[6]	Percent of Total Miles
Total miles	8.5	48%
Miles outside RHCA	7.4	
Miles in RHCA	1.1	69%

Road Recondition	Clear Creek IR Project[6]	Percent of Total Miles
Total miles	5.8	33%
Miles outside RHCA	5.8	
Miles in RHCA	0	0%

Non-System Road Decomm	Clear Creek IR Project[6*]	Clear Ridge Non-System Road Decomm[7]	Total
Total miles	0.5	11	11.5
Miles outside RHCA	0.5	9.7	10.2
Miles in RHCA	0	1.3	1.3

*Estimated 25% of proposed system road decommission miles

Other actions proposed in the prescription watershed

Clear Creek IR Project6 (Alt C – max alternative)	Commercial Harvest (acres)	Temporary Roads (acres)	Prescribed Burning (acres)
	7631 (28% of watershed) 110 Regen Harvest – (4% of watershed)	1	0

Table 40: Upward Trend Indicators and Ratings for Pine Knob Creek Forest Plan Prescription Watershed

Action	Process Affected	Characteristic Indicator	Alt A (Existing Condition)	Alt C Short Term	Alt C Long Term	Explanations
Vegetation Treatments	Surface erosion	Pulse & Chronic Sediment		-M		Exposed soil on skid and landings - mostly in the form of channelized delivery from ruts on skid trails - reduced by design measures
	Mass failure risk	Pulse sediment				No vegetation treatment or skid trail construction would occur on landslide prone or high mass wasting areas
	Infiltration, runoff	Hydrologic process		-L	-L	Compacted soils and vegetation openings
	Solar heating	Riparian shade				No vegetation treatment would occur in RHCAs
Temporary Road Construction	Surface erosion	Pulse & Chronic Sediment		-L		Channelized deposition in system road ditches – reduced by design measures and cross drain culverts diverting material prior to stream crossings.
	Mass failure risk	Pulse sediment				No temp road construction would occur on landslide prone or high mass wasting areas
	Infiltration, runoff	Hydrologic process		-L		Compacted soils could limit infiltration and concentrate flow in the short term. Roads would be decompacted, recontoured, and revegetated.
	Riparian shade	Riparian condition				No temp road construction would occur in RHCAs
Road Improvement	Surface erosion	Pulse & Chronic Sediment	-M	-M	+L	Ditch cleaning, soil disturbance, and logging truck haul could increase sediment delivery in the short term. Gravel placement and additional cross drain culverts would reduce sediment delivery in the short and long term.
	Infiltration, runoff	Hydrologic process	--M			Gravel placement and addition of cross drain culverts would slow overland flow and reduce runoff, and better hydrologically disconnect roads from streams.
Road Decommissioning (including RHCA	Surface erosion	Pulse & Chronic Sediment	-L	-L	+L	Potential for increased sediment delivery during road decomm activites, especially at stream crossings, and until road is revegetated. Design measures and BMPs would be followed. Long term benefit due to recovery of soil function and hydrologic processes.

Action	Process Affected	Characteristic Indicator	Alt A (Existing Condition)	Alt C Short Term	Alt C Long Term	Explanations
and non-system roads)	Infiltration, runoff	Hydrologic process	-L	+L	+L	Compacted soils allow for increased overland flow. Once roads are decompacted and recontoured infiltration would increase and concentrated overland flow would diminish. Culverts would be removed.
	Riparian Shade	Riparian condition	-L		+L	Vegetative recovery and tree growth in long term
Stream Crossing Improvement	Surface erosion	Pulse & Chronic Sediment	-L	-L	+L	Undersized/failing culverts have the potential for chronic sediment delivery or get plugged/collapse causing road fill failure. Short term, localized sediment could be delivered during implementation and until road fill slopes are stabilized and revegetated. Long term culverts would allow for 100 year flows.
	Mass failure risk	Pulse sediment	-L	+L	+L	Undersized/failing culverts have the potential to get plugged/collapse causing road fill failure. Long term culverts would allow for 100 year flows.
	Fish Passage	Habitat availability				Replacing culverts to allow for Aquatic Organism Passage increase available habitat
Summary of Upward Trend Indicators for Pine Knob Creek			-9	-7	4	Positive Upward Trend Long Term[1]

[1]The expected long-term consequences of the CCIR project on aquatic conditions are all considered positive, with the exception of possible increased peak flows due to vegetation removal. Full vegetative recovery would be achieved within 30 years. All of the aquatic restoration projects are expected to have positive long-term consequences on the aquatic conditions in the watershed. The greatest effect from these activities is associated with the increased habitat availability from fish passage improvements, the reduced risk of mass failures associated with the stream crossing improvements, the addition of cross drain culverts which better hydrologically disconnect roads from streams, and the road decommissioning projects providing recovery of soil function and hydrologic processes.

Browns Spring Creek Prescription Watershed Activities

Brown Springs Creek meets its Forest Plan water quality objective based on cobble embeddedness and therefore does not require an upward trend analysis narrative. The following tables however provide a quick assessment of the trend in the watershed and the effects of the project on that trend.

Watershed Area 4.8 Sq. Miles (3,057 acres) 1.3 RHCA Sq. miles

Road Density	Roads Total 1995	Road Decomm 1996-2011	Roads Total 2011	SF/WF Road Decomm[1]	Roads Total 2014	Clear Creek IR Project[6]	Roads Final Total
miles	23.1	3.3	19.8	0.0	19.8	4.5	15.3
Road Density	4.8		4.1		4.1		3.2
RHCA miles	3.8	0.3	3.5	0.0	3.5	1.7	1.8
RHCA Road Density	2.9		2.6		2.6		1.4

Percent Road Reduction: 23% total miles; 49% RHCA miles

Culverts	Clear Creek Culvert Replacements[2]	Browns Spring Project[3]	Clear Creek IR Project[6]	Total
Replaced	1 (fish)	2	3	6
Removed	0	0	5	5

All fish bearing pipes: AOP; All Undersized pipes replaced

Road Reconstruction	Clear Creek IR Project[6]	Percent of Total Miles
Total miles	9.7	63%
Miles outside RHCA	7.8	
Miles in RHCA	1.9	100%

Road Recondition	Clear Creek IR Project[6]	Percent of Total Miles
Total miles	4.2	28%
Miles outside RHCA	4.2	
Miles in RHCA	0	0%

Non-System Road Decomm	Clear Creek IR Project[6*]	Clear Ridge Non-System Road Decomm[7]	Total
Total miles	1.1	19.6	20.7
Miles outside RHCA	0.7	15.9	16.6
Miles in RHCA	0.4	3.7	4.1

* Estimated 25% of proposed system road decommissioned miles

Other Actions Proposed in the Prescription

Clear Creek IR Project6 (Alt C – max alternative)	Commercial Harvest (acres)	Temporary Roads (acres)	Prescribed Burning (acres)
	1113 (36% of watershed) 290 Regen Harvest – (9% of watershed)	9	0

Table 41: Upward Trend Indicators and Ratings for Browns Spring Creek Forest Plan Prescription Watershed

Action	Process Affected	Characteristic Indicator	Alt A (Existing Condition)	Alt C Short Term	Alt C Long Term	Explanations
Vegetation Treatments	Surface erosion	Pulse & Chronic Sediment		-M		Exposed soil on skid and landings - mostly in the form of channelized delivery from ruts on skid trails - reduced by design measures
	Mass failure risk	Pulse sediment				No vegetation treatment or skid trail construction would occur on landslide prone or high mass wasting areas
	Infiltration, runoff	Hydrologic process		-M	-L	Compacted soils and vegetation openings
	Solar heating	Riparian shade				No vegetation treatment would occur in RHCAs
Temporary Road Construction	Surface erosion	Pulse & Chronic Sediment		-L		Channelized deposition in system road ditches – reduced by design measures and cross drain culverts diverting material prior to stream crossings.
	Mass failure risk	Pulse sediment				No temp road construction would occur on landslide prone or high mass wasting areas
	Infiltration, runoff	Hydrologic process		-L		Compacted soils could limit infiltration and concentrate flow in the short term. Roads would be decompacted, recontoured, and revegetated.
	Riparian shade	Riparian condition				No temp road construction in RHCAs
Road Improvement	Surface erosion	Pulse & Chronic Sediment	-M	-M		Ditch cleaning, soil disturbance, and logging truck haul could increase sediment delivery in the short term. Gravel placement and additional cross drain culverts would reduce sediment delivery in the long term.
	Infiltration, runoff	Hydrologic process	-M			Gravel placement and addition of cross drain culverts would slow overland flow and reduce runoff
Road Decommissioning (including RHCA and non-system roads)	Surface erosion	Pulse & Chronic Sediment	-L	-M	+M	Minimal road maintenance on closed roads has the potential for sediment delivery, especially at stream crossings. Potential for increased sediment delivery during road decomm activities and until road is revegetated.
	Infiltration, runoff	Hydrologic process	-L	+L	+L	Compacted soils allow for increased overland flow. Once roads are decompacted and recontoured infiltration would increase and concentrated overland flow would diminish. Culverts would be removed.

Action	Process Affected	Characteristic Indicator	Alt A (Existing Condition)	Alt C Short Term	Alt C Long Term	Explanations
	Riparian Shade	Riparian condition	-L		+L	Vegetative recovery and tree growth in long term
Stream Crossing Improvement	Surface erosion	Pulse & Chronic Sediment	-L	-M	+L	Undersized/failing culverts have the potential for chronic sediment delivery or get plugged/collapse causing road fill failure. Short term, localized sediment could be delivered during implementation and until road fill slopes are stabilized and revegetated.
	Mass failure risk	Pulse sediment	-M	+L	+L	Undersized/failing culverts have the potential to get plugged/collapse causing road fill failure. Long term culverts would allow for 100 year flows.
	Fish Passage	Habitat availability	-L	+L	+L	Replacing culverts to allow for Aquatic Organism Passage increase available habitat
Summary of Upward Trend Indicators for Browns Spring Creek			-11	-9	+ 6	Positive Upward Trend Long Term[1]

1The expected long-term consequences of the CCIR project on aquatic conditions are all considered positive, with the exception of possible increased peak flows due to vegetation removal. Full vegetative recovery would be achieved within 30 years. All of the aquatic restoration projects are expected to have positive long-term consequences on the aquatic conditions in the watershed. The greatest effect from these activities is associated with the increased habitat availability from fish passage improvements, the reduced risk of mass failures associated with the stream crossing improvements, the addition of cross drain culverts which better hydrologically disconnect roads from streams, and the road decommissioning projects providing recovery of soil function and hydrologic processes.

Clear Creek Prescription Watershed

The 7,234 acre Clear Creek Forest Plan prescription watershed does not meet its water quality objective of 90% for fishery habitat potential. Cobble embeddedness was less than 30% in 2015 (Stillwater Sciences). When assessed against the DFCs (USDA 1992), the watershed currently is at 82% of habitat potential. Embeddedness was 38% with a 75% habitat potential in 2012 using FS data. It was at 50% of its habitat potential when the Forest Plan was written in 1987. This would be considered an upward trend in cobble embeddedness since 1987 based on limited cobble embeddedness data. Higher levels of embeddedness may also be in part a result of the granitic geology that occurs where substrate was sampled. Granitic geologies typically have a higher component of finer particles than other geologies found in the drainage.

There are about 11 miles of fish-bearing and 17 miles of non-fish bearing streams in Clear Creek. The stream is suitable for Chinook salmon, steelhead trout and westslope cutthroat trout. Juvenile Chinook salmon densities were low in 2015 (28 juveniles and 4 adults/100m) while steelhead trout densities were the highest found on Forest lands (210 fish/100).

Stream temperatures were measured in Clear Creek near Pine Knob in the summer of 2011, 2012 and 2015. Stream temperature conditions based on NOAA matrix ratings were High for steelhead spawning in 2011 and 2012 (11°C and 13.1°C respectively) and Moderate in 2015 between mid-June and mid-July (17°C). Rearing was High in 2011 and 2012, and Moderate from July through September (15.7°C) with the exception of 10 days July where it was Low (19°C). Cool temperatures most of the year are a result of well forest areas adjacent to streams. Temperatures were moderate for bull trout rearing for most of the year and low for bull trout spawning/incubation. This is consistent with the Climate Shield model results (Isaac, 2014) which showed only a 9% probability of bull trout presence on 1.6 miles of headwater stream in 1980 and a zero percent probability in 2040. Temperatures are warmer than preferred for bull trout.

Pools made up only 23% of the stream habitats in 2015. This is due to low wood levels which resulted from the 1931 wildfire. Recent observations showed well vegetated riparian areas with a component of young trees where the fire burned. Buffers were also retained adjacent to past harvest units. Riparian areas, and therefore wood levels, are trending upward. The necessary wood component and pools created by that wood would be provided for over time.

Stream bank stability was excellent in the 2015 surveys. This is due to the presence of dense streamside vegetation in combination with large substrate (cobble, rubble, boulders) which armors the banks against the erosive power of the stream. Similar conditions were noted from 2010-2012 field observations. Streambank stability trends are being maintained.

Stream substrate composition in Clear Creek in 2015 was composed of 14% sand/silt, 23% gravel and 53% large material (rubble to boulders). No obvious sources of sediment were observed at road crossings or along roads within the watershed during 2010-2012 field reviews. Levels of sand/silt were relatively low and adequate for fish embryo survival (Meehan et al 1991).

Regeneration timber harvest activities have occurred on 15% of the watershed between the 1970s and 1990s. No regeneration harvest has occurred since then. Commercial thinning occurred on 11% of the area between the 1980s and 1990s. As a result ECA is currently at 3%, or a high condition. Buffers of 150'+ along the mainstem of Clear Creek, and 50+' on the smaller tributaries were retained during harvest beginning in the 1970s. Forested stands within what are now PACFISH buffers are aged as follows: 13% are < 40 years old, 20% are between 40 and 100

years and the remaining 67% older than 100 years. The middle age classes are partly a result of a wildfire which occurred in 1931 and burned roughly 23% of the area. The RHCAs therefore would be considered fully functional given the large percentage of older age classes and minimal disturbance within them. As a result, they are trending in an upward condition and would continue to provide for shade, wood, and stable banks in Clear Creek.

There are 26 miles of Forest system roads within the watershed with 2 miles occurring within RHCAs. A total of 0.5 miles of the RHCA roads are graveled and opened to motorized traffic and the remaining are closed. The overall watershed road density is 2.3 mi/mi^2 which is a 16% reduction in roads since 1995 and is a result of past road decommissioning projects. The RHCA and landslide prone road densities are 0.8 mi/mi^2 and 0.04 mi/mi^2, respectively. Both are considered to be in a High condition. Prior to 2014, there were 16.5 miles of non-system roads in the prescription watershed. The Clear Ridge project decommissioned all but 0.2 miles resulting in an almost elimination of these roads and the conversion of 65 acres of road back into productive forested habitats.

There are 27 stream crossings within the watershed, 3 of which occur on fish bearing streams and are not barriers to aquatic organism passage (replaced in 2012/2013). A total of 17 culverts are appropriately sized and the remaining 10 crossings are undersized for the area they drain. All roads also cross perpendicular to the stream channels which limit their effects to riparian vegetation; however portions of the ditchlines leading to those crossings are draining directly into the streams. These may be acting as a chronic sediment source of sediment to streams. Ditchlines leading to the 3 fish bearing crossings currently have cross drain pipes installed and are no longer adding sediment to streams at those sites.

Based on the Forest Plan guidance, an upward trend has been initiated in the Clear Creek prescription watershed. This is due primarily to the lack of recent timber harvest combined with intact RHCAs, low RHCA road densities, no fish passage barriers, and mostly closed roads. The stream has an excellent riparian vegetation component, stable banks, and cool stream temperatures for most of the year. When combined, these factors show that an upward trend in fish habitat capacity has been initiated and would continue over time.

Proposed Activity Effects to Streams

The expected short-term consequences of the Clear Creek Integrated Restoration project on aquatic conditions in the Clear Creek prescription watershed is principally related to the surface erosion process and sediment conditions. The other short-term negative consequences of the project on aquatic conditions were related to the hydrologic processes of runoff and infiltration from temporary road construction and harvest. All of the activities are expected to have a negative effect on aquatic condition in the short term based on sediment yields as modeled in NEZSED. Model results indicate sediment yield increases in Clear Creek near the confluence with the South Fork to 31% as a result of project activities. This is just above the Forest Plan standard of 30% (Alt C only). The FISHSED model was used in conjunction with NEZSED to determine potential changes in fish habitat carrying capacity. The model predicted a 4% increase in cobble embeddedness, a 4% decrease in summer rearing capacity and a 9% decrease in winter rearing for juvenile steelhead trout rearing. This is below the 10% where changes in habitat quality could occur (Stowell et al. 1983). No substantial changes in cobble embeddedness and summer/winter habitat rearing capacity are therefore expected based on this modeling and on local effectiveness monitoring (USDA Forest Service 2009 and 2014). ECAs would increase to between 12% and 15% depending on the alternative and would remain within the High condition class based on the

NOAA matrix (1998) therefore no channel alterations as a result of increased water yield is expected.

The Clear Creek Project would decommission an additional 0.6 miles of road in the prescription watershed. This would not change the existing watershed road density of 2.3 mi/mi^2. RHCA densities would remain at 0.8 mi/mi^2. The Clear Creek Project would decommission the remaining 0.2 miles of non-system road resulting in the watershed and would convert 1 acre of road back into a forested condition. The Clear Creek Project would reconstruct 2.7 miles of system road (18% of the roads in the prescription watershed) which would help to reduce sediment delivery by diverting road ditchline flow away from streams through cross drain culvert additions. The project would also replace the 10 existing undersized culverts with those sized for a 100- year flow event. This would reduce the risk of future failure. All crossings in the watershed would be appropriately sized after project completion. The Project would recondition 2.7 miles of road (18% of the roads). Reconditioning would apply gravel where needed to minimize the amount of erosion from road surfaces during log haul operations. The use of dust abatement during log haul would also minimize road surface erosion and potential input of sediment to streams.

Overall Trend Summary for the Clear Creek Prescription Watershed

The current upward trend in aquatic habitat conditions is expected to continue in the Clear Creek prescription watershed because of road improvements associated with the project, mostly intact RHCAs, the expected minimal effects of modeled sediment to streams, water yields that would remain below levels where alterations in streams channels could occur, and the implementation of design features and BMPs which have been shown to be effective at minimizing effects to streams (Sugden, 2018; Arismendi et al, 2017; Hatten et al 2017; Sugden et al 2012; USDA Forest Service, 2009). The Clear Creek Project therefore complies with the Forest Plan upward trend requirement.

Clear Creek Prescription Watershed Activities

Watershed Area 11.3 Sq. Miles (7,234 acres) 2.7 RHCA Sq. miles

Road Density	Roads Total 1995	Road Decomm 1996-2011	Roads Total 2011	SF/WF Road Decomm[1]	Roads Total 2014	Clear Creek IR Project[6]	Roads Final Total
miles	31.1	4.9	26.6	0.0	26.2	0.6	25.6
Road Density	2.8		2.3		2.3		2.3
RHCA miles	2.7	0.5	2.2	0.0	2.2	0.0	2.2
RHCA Road Density	1.0		0.8		0.8		0.8

Percent road reduction: 2% total miles; 0% RHCA miles

Culverts	Clear Creek Culvert Replacements[2]	Clear Creek IR Project[6]	Total
Replaced	3 (fish)	10	13
Removed	0	0	0

All fish bearing pipes: AOP; All Undersized pipes replaced

Road Reconstruction	Clear Creek IR Project[6]	Percent of Total Miles
Total miles	13.2	52%
Miles outside RHCA	11.9	
Miles in RHCA	1.3	59%

Road Recondition	Browns Spring Project[3]	Clear Creek IR Project[6]	Total	Percent of Total Miles
Total miles	2.0	2.7	4.7	18%
Miles outside RHCA	2.0	2.7	4.7	
Miles in RHCA	0.0	0.0	0.0	0%

Non-system Road Decomm	Clear Creek IR Project[6*]	Clear Ridge Non-System Road Decomm[7]	Total
Total miles	0.2	16.3	16.5
Miles outside RHCA	0.2	14.3	14.7
Miles in RHCA	0.0	1.8	1.8

*Estimated 25% of proposed system road decommission miles

Other Actions Proposed in the Prescription Watershed

Clear Creek IR Project6 (Alt C – max alternative)	Commercial Harvest (acres)	Temporary Roads (acres)	Prescribed Burning (acres)
	1222 (17% of watershed) 500 Regen Harvest – (7% of watershed)	19	601

Table 42: Upward Trend Indicators and Ratings for Clear Creek Forest Plan Prescription Watershed

Action	Process Affected	Characteristic Indicator	Alt A (Existing Condition)	Alt C Short Term	Alt C Long Term	Explanations
Vegetation Treatments	Surface erosion	Pulse & Chronic Sediment		-M		Exposed soil on skid and landings - mostly in the form of channelized delivery from ruts on skid trails - reduced by design measures
	Mass failure risk	Pulse sediment				No vegetation treatment or skid trail construction would occur on landslide prone or high mass wasting areas
	Infiltration, runoff	Hydrologic process		-L	-L	Compacted soils and vegetation openings
	Solar heating	Riparian shade				No vegetation treatment would occur in RHCAs
Temporary Road Construction	Surface erosion	Pulse & Chronic Sediment		-L		Channelized deposition in system road ditches – reduced by design measures and cross drain culverts diverting material prior to stream crossings.
	Mass failure risk	Pulse sediment				No temp road construction would occur on landslide prone or high mass wasting areas
	Infiltration, runoff	Hydrologic process		-L		Compacted soils could limit infiltration and concentrate flow in the short term. Roads would be decompacted, recontoured, and revegetated.
	Riparian shade	Riparian condition				No temp road construction in RHCAs
Road Improvement	Surface erosion	Pulse & Chronic Sediment	-M	-M		Ditch cleaning, soil disturbance, and logging truck haul could increase sediment delivery in the short term. Gravel placement and additional cross drain culverts would reduce sediment delivery in the long term.
	Infiltration, runoff	Hydrologic process	-L			Gravel placement and addition of cross drain culverts would slow overland flow and reduce runoff
Road Decommissioning (including RHCA	Surface erosion	Pulse & Chronic Sediment	-L	-L	+L	Potential for increased sediment delivery during road decomm activities, especially at stream crossings, and until road is revegetated. Design measures and BMPs would be followed. Long term benefit due recovery of soil function and hydrologic processes.

Action	Process Affected	Characteristic Indicator	Alt A (Existing Condition)	Alt C Short Term	Alt C Long Term	Explanations
and non-system roads)	Infiltration, runoff	Hydrologic process	-L	+L	+L	Compacted soils allow for increased overland flow. Once roads are decompacted and recontoured infiltration would increase and concentrated overland flow would diminish. Culverts would be removed.
	Riparian Shade	Riparian condition	-L		+L	Vegetative recovery and tree growth in long term
Stream Crossing Improvement	Surface erosion	Pulse & Chronic Sediment	-L	-M	+L	Undersized/failing culverts have the potential for chronic sediment delivery or get plugged/collapse causing road fill failure. Short term, localized sediment could be delivered during implementation and until road fill slopes are stabilized and revegetated.
	Mass failure risk	Pulse sediment	-M	+L	+M	Undersized/failing culverts have the potential to get plugged/collapse causing road fill failure. Long term culverts would allow for 100 year flows.
	Fish Passage	Habitat availability	-M	+M	+M	Replacing culverts to allow for Aquatic Organism Passage increase available habitat
Summary of Upward Trend Indicators for Clear Creek			-12	-6	+7	Positive Upward Trend Long Term[1]

[1]The expected long-term consequences of the CCIR project on aquatic conditions are all considered positive, with the exception of possible increased peak flows due to vegetation removal. Full vegetative recovery would be achieved within 30 years. All of the aquatic restoration projects are expected to have positive long-term consequences on the aquatic conditions in the watershed. The greatest effect from these activities is associated with the increased habitat availability from fish passage improvements, the reduced risk of mass failures associated with the stream crossing improvements, the addition of cross drain culverts which better hydrologically disconnect roads from streams, and the road decommissioning projects providing recovery of soil function and hydrologic processes.

Solo Creek Prescription Watershed Activities

Solo Creek meets its Forest Plan water quality objective based on cobble embeddedness and therefore does not require an upward trend analysis narrative. The following tables however provide a quick assessment of the trend in the watershed and the effects of the project on that trend.

Watershed Area 3.5 Sq. Miles (2,226 acres) 1.1 RHCA Sq. miles

Road Density	Roads Total 1995	Road Decomm 1996-2011	Roads Total 2011	SF/WF Road Decomm[1]	Roads Total 2014	Clear Creek IR Project[6]	Roads Final Total
miles	14.1	1.8	12.3	0.0	12.3	1.4	10.9
Road Density	4.0		3.5		3.5		3.1
RHCA miles	1.8	0.0	1.8	0.0	1.8	0.0	1.4
RHCA Road Density	1.6		1.6		1.6		1.4

Percent road reduction: 11% total miles; 22% RHCA miles

Culverts	Clear Creek IR Project[6]
Replaced	4
Removed	1

All fish bearing pipes: AOP; All Undersized pipes replaced

Road Reconstruction	Clear Creek IR Project[6]	Percent of Total Miles
Total miles	9.1	84%
Miles outside RHCA	8.1	
Miles in RHCA	1.0	71%

Road Recondition	Clear Creek IR Project[6]	Percent of Total Miles
Total miles	1.8	17%
Miles outside RHCA	1.8	
Miles in RHCA	0.0	0%

Non-System Road Decomm	Clear Creek IR Project[6*]	Clear Ridge Non-System Road Decomm[7]	Total
Total miles	0.4	3.7	4.1
Miles outside RHCA	0.3	3.5	3.8
Miles in RHCA	0.1	0.2	0.3

* Estimated 25% of proposed system road decommission miles

Other Actions Proposed in the Prescription Watershed

Clear Creek IR Project[6] (Alt C – max alternative)	Commercial Harvest (acres)	Temporary Roads (acres)	Prescribed Burning (acres)
	646(29% of watershed) 375 are Regen Harvest – (17% of watershed)	6	0

Table 43: Upward Trend Indicators and Ratings for Solo Creek Forest Plan Prescription Watershed

Action	Process Affected	Characteristic Indicator	Alt A (Existing Condition)	Alt C Short Term	Alt C Long Term	Explanations
Vegetation Treatments	Surface erosion	Pulse & Chronic Sediment		-M		Exposed soil on skid and landings - mostly in the form of channelized delivery from ruts on skid trails - reduced by design measures
	Mass failure risk	Pulse sediment				No vegetation treatment or skid trail construction would occur on landslide prone or high mass wasting areas
	Infiltration, runoff	Hydrologic process		-M	-L	Compacted soils and vegetation openings
	Solar heating	Riparian shade				No vegetation treatment would occur in RHCAs
Temporary Road Construction	Surface erosion	Pulse & Chronic Sediment		-L		Channelized deposition in system road ditches – reduced by design measures and cross drain culverts diverting material prior to stream crossings.
	Mass failure risk	Pulse sediment				No temp road construction would occur on landslide prone or high mass wasting areas
	Infiltration, runoff	Hydrologic process		-L		Compacted soils could limit infiltration and concentrate flow in the short term. Roads would be decompacted, recontoured, and revegetated.
	Riparian shade	Riparian condition				No temp road construction in RHCAs
Road Improvement	Surface erosion	Pulse & Chronic Sediment	-M	-M		Ditch cleaning, soil disturbance, and logging truck haul could increase sediment delivery in the short term. Gravel placement and additional cross drain culverts would reduce sediment delivery in the long term.
	Infiltration, runoff	Hydrologic process	-L			Gravel placement and addition of cross drain culverts would slow overland flow and reduce runoff
Road Decommissioning (including RHCA	Surface erosion	Pulse & Chronic Sediment	-L	-L	+L	Potential for increased sediment delivery during road decomm activities, especially at stream crossings, and until road is revegetated. Design measures and BMPs would be followed. Long term benefit due recovery of soil function and hydrologic processes.

Action	Process Affected	Characteristic Indicator	Alt A (Existing Condition)	Alt C Short Term	Alt C Long Term	Explanations
and non-system roads)	Infiltration, runoff	Hydrologic process	-L	+L	+L	Compacted soils allow for increased overland flow. Once roads are decompacted and recontoured infiltration would increase and concentrated overland flow would diminish. Culverts would be removed.
	Riparian Shade	Riparian condition	-L		+L	Vegetative recovery and tree growth in long term
Stream Crossing Improvement	Surface erosion	Pulse & Chronic Sediment	-L	-L	+L	Undersized/failing culverts have the potential for chronic sediment delivery or get plugged/collapse causing road fill failure. Short term, localized sediment could be delivered during implementation and until road fill slopes are stabilized and revegetated.
	Mass failure risk	Pulse sediment	-L	+L	+L	Undersized/failing culverts have the potential to get plugged/collapse causing road fill failure. Long term culverts would allow for 100 year flows.
	Fish Passage	Habitat availability				Replacing culverts to allow for Aquatic Organism Passage increase available habitat
Summary of Upward Trend Indicators for Solo Creek			-9	-8	+4	Positive Upward Trend Long Term[1]

[1]The expected long-term consequences of the CCIR project on aquatic conditions are all considered positive, with the exception of possible increased peak flows due to vegetation removal. Full vegetative recovery would be achieved within 30 years. All of the aquatic restoration projects are expected to have positive long-term consequences on the aquatic conditions in the watershed. The greatest effect from these activities is associated with the increased habitat availability from fish passage improvements, the reduced risk of mass failures associated with the stream crossing improvements, the addition of cross drain culverts which better hydrologically disconnect roads from streams, and the road decommissioning projects providing recovery of soil function and hydrologic processes.

Middle Fork Clear Creek Prescription Watershed

The 4,025 acre Middle Fork Clear Creek Forest Plan prescription watershed does not meet its water quality objective of 90% for fishery habitat potential. Cobble embeddedness was less than 30% in 2015 (Stillwater Sciences). When assessed against the DFCs (USDA 1992), the watershed currently is at 82% of habitat potential. Cobble embeddedness was measured at 51% with a 59% habitat potential in 2014 using FS data. It was at 50% of its habitat potential when the Forest Plan was written in 1987. This would be considered an upward trend in fishery habitat potential since 1987 based on limited cobble embeddedness data.

There are about 7 miles of fish-bearing and 13 miles of non-fish bearing streams in Middle Fork Clear Creek. The stream is only suitable for steelhead and westslope cutthroat trout. Surveys in 2015 found steelhead densities of 75 fish/100m. No cutthroat were observed; however, they have been observed in previous surveys and are expected to occur in the drainage above the 2015 surveyed reaches.

Stream temperatures were measured in Middle Fork Clear Creek in the summer of 2011 and above Solo Creek in 2015. Stream temperature conditions based on NOAA matrix ratings were High for steelhead spawning and rearing in 2011 (10.7°C and 13.6°C respectively) and all but 2 weeks in July where it was Moderate. Cool temperatures are a result of well forest areas adjacent to streams. Temperatures were moderate for bull trout rearing (13.6°C) and low for bull trout spawning/incubation (10.2°C). This is consistent with the Climate Shield model results (Isaac, 2014) which showed only a 14% probability of bull trout presence on 1.4 miles of headwater stream in 1980 and a zero percent probability in 2040. Temperatures are warmer than preferred for bull trout.

Pools made up only 25% of the stream habitats in 2015. Wood levels were low (5 key pieces/km). Low wood levels appear to be natural as streamside buffers were retained during previous timber harvest (see management actions discussion below). Water depths and pool habitat availability are considered to be trending upward trend since buffers were retained and would provide both the short and long term wood necessary to create pools as trees die and fall into the stream. Previously harvested areas that occur within RHCAs are forested. Standard RHCAs are expected to be retained during the next harvest rotation which would maintain the necessary wood component over time, thus maintaining the upward trend.

Stream bank stability was noted excellent in 2015. This is due to the presence of dense streamside vegetation in combination with large substrate (cobble, rubble, boulders) which armors the banks against the erosive power of the stream.

Stream substrate composition in Middle Fork Clear Creek in 2015 was composed of 24% sand/silt, 36% gravel and 40% large material (rubble to boulders). There was an increase, or upward trend, in gravels since 1994. No obvious sources of sediment were observed at road crossings or along roads within the watershed during 2010-2012 field reviews.

Regeneration timber harvest activities have occurred on 18% of the watershed between the 1970's and 1980s. No regeneration harvest has occurred since then. Commercial thinning occurred on 9% of the area between the 1970's and 1990s. As a result ECA is currently at 2%, or a high condition. About 6% of the RHCAs were affected by past timber harvest. Buffers were retained on all units with the exception 2 small headwater streams. Forested stands within the buffers are aged as follows: 7% are < 40 years old, 54% are between 40 and 100 years and the

remaining 39% older than 100 years. The RHCAs therefore would be considered fully functional given the age classes and minimal disturbance within them. As a result, they are trending in an upward condition and would continue to provide for shade, wood and bank stability in Middle Fork Clear Creek.

There are almost 15 miles of Forest system roads within the watershed with less than 2 miles occurring within RHCAs. All RHCA roads are graveled and are open to either seasonal or year round motorized traffic. The overall watershed road density is 2.4 mi/mi2 which is a 12% reduction in roads since 1995 and is a result of past road decommissioning projects. RHCA road density is 0.9 mi/mi^2 and landslide prone density is 0.08 mi/mi^2, both High ratings. Prior to 2014, there were 7.2 miles of non-system roads in the prescription watershed. The Clear Ridge project decommissioned all but 0.3 miles resulting in an almost elimination of these roads and the conversion of 28 acres of road back into productive forested habitats.

There are 13 stream crossings within the watershed, 2 of which are on fish bearing streams and are passable to aquatic organisms. Four other crossings have been identified for replacement and these plus an additional 2 require cross drain additions. Roads are expected to be contributing very little sediment to streams due to an overall low number of crossings (<1/mile), low RHCA densities, and the need for the replacement of only 4 crossings.

Based on the Forest Plan guidance, an upward trend has been initiated in the Middle Fork Clear Creek prescription watershed. This is due primarily to the lack of recent timber harvest combined with relatively few stream crossings, low RHCA road densities, intact RCHAs, stable banks, and cool temperatures and increasing amounts of gravel which would allow for the continued improvement of fish habitat capacity over time.

Proposed Activity Effects to Streams

The expected short-term consequences of the Clear Creek Integrated Restoration project on aquatic conditions in Middle Fork Clear Creek are principally related to the surface erosion process and sediment conditions. The other short-term negative consequences of the project on aquatic conditions were related to the hydrologic processes of runoff and infiltration from temporary road construction and harvest. All of the activities are expected to have a negative effect on aquatic condition in the short term based on sediment yields as modeled in NEZSED. Model results indicate sediment yield increases at the mouth of Middle Fork to 28% as a result of project activities. This is meets the Forest Plan standard of 30% or less. The FISHSED model was used in conjunction with NEZSED to determine potential changes in fish habitat carrying capacity. The model predicted a 5% increase in cobble embeddedness, a 2% decrease in summer and 8% decrease in winter rearing capacity for juvenile steelhead. This is below the 10% where changes in habitat quality could occur (Stowell et al. 1983). No substantial changes in cobble embeddedness and summer/winter habitat rearing capacity are therefore expected based on this modeling and on local effectiveness monitoring (USDA Forest Service 2009a and 2014). ECAs would increase to 9% and would remain within the High condition class based on the NOAA matrix (1998) therefore no channel alterations as a result of increased water yield is expected.

The Clear Creek Project would decommission an additional 1.3 miles of road in the prescription watershed, 0.1 of which is in RHCAs. This would reduce watershed road densities to 2.2 mi/mi^2 and RHCA densities to 0.9 mi/mi^2. The result would be a 9% reduction in overall road density and a 6% reduction in RHCA density. The Clear Creek Project would decommission the remaining 0.3 miles of non-system road resulting in the watershed and would convert 1 acre of

road back into a forested condition. The Clear Creek Project would reconstruct 6.9 miles of system road (51% of the roads in the prescription watershed) which would help to reduce sediment delivery by diverting road ditchline flow away from streams through cross drain culvert additions. The project would also replace the 4 existing and remove 1 undersized culverts with those sized for a 100- year flow event. This would reduce the risk of future failure. All crossings in the watershed would be appropriately sized after project completion. The Project would recondition 3.2 miles of road (24% of the roads). Reconditioning would apply gravel where needed to minimize the amount of erosion from road surfaces during log haul operations. The use of dust abatement during log haul would also minimize road surface erosion and potential input of sediment to streams.

Overall Trend Summary for the Middle Fork Clear Creek Prescription Watershed

The current upward trend for aquatic habitat conditions and fish habitat capacity is expected to continue in the Middle Fork prescription watershed because of road improvements associated with the project, the intact RHCAs, the expected minimal effects of modeled sediment to streams, water yields that would remain below levels where alterations in streams channels could occur, and the implementation of design features and BMPs which have been shown to be effective at minimizing effects to streams (Sugden, 2018; Arismendi et al, 2017; Hatten et al 2017; Sugden et al 2012; USDA Forest Service, 2009). The Clear Creek Project therefore complies with the Forest Plan upward trend requirement.

Middle Fork Clear Creek Prescription Watershed Activities

Watershed Area 6.3 Sq. Miles (4,025 acres) 1.7 RHCA Sq. miles

Road Density	Roads Total 1995	Road Decomm 1996-2011	Roads Total 2011	SF/WF Road Decomm[1]	Roads Total 2014	Clear Creek IR Project[6]	Roads Final Total
miles	16.9	2.0	14.9	0.0	14.9	1.3	13.6
Road Density	2.7		2.4		2.4		2.2
RHCA miles	1.8	0.2	1.6	0.0	1.6	0.1	1.5
RHCA Road Density	1.1		0.9		0.9		0.9

Percent road reduction: 9% total miles; 6% RHCA miles

Culverts	Clear Creek IR Project[6]
Replaced	4
Removed	1

All fish bearing pipes: AOP; All Undersized pipes replaced

Road Reconstruction	Clear Creek IR Project[6]	Percent of Total Miles
Total miles	6.9	51%
Miles outside RHCA	6.0	
Miles in RHCA	0.9	60%

Road Recondition	Brown Springs Project[3]	Clear Creek IR Project[6]	Total	Percent of Total Miles
Total miles	1.0	2.2	3.2	24%
Miles outside RHCA	1.0	2.2	3.2	
Miles in RHCA	0.0	0.0	0.0	0%

Non-system Road Decomm	SF/WF Road Decomm[1]	Clear Creek IR Project[6*]	Total
Total miles	6.9	0.3	7.2
Miles outside RHCA	6.4	0.3	6.7
Miles in RHCA	0.5	0.0	0.5

* Estimated 25% of proposed system road decommission miles

Other Actions Proposed in the Prescrition Watershed

Clear Creek IR Project[6] (Alt C – max alternative)	Commercial Harvest (acres)	Temporary Roads (acres)	Prescribed Burning (acres)
	627(16% of watershed) 218 are Regen Harvest – (5% of watershed)	10	0

Table 44: Upward Trend Indicators and Ratings for Middle Fork Clear Creek Forest Plan Prescription Watershed

Action	Process Affected	Characteristic Indicator	Alt A (Existing Condition)	Alt C Short Term	Alt C Long Term	Explanations
Vegetation Treatments	Surface erosion	Pulse & Chronic Sediment		-M		Exposed soil on skid and landings - mostly in the form of channelized delivery from ruts on skid trails - reduced by design measures
	Mass failure risk	Pulse sediment				No vegetation treatment or skid trail construction would occur on landslide prone or high mass wasting areas
	Infiltration, runoff	Hydrologic process		-L	-L	Compacted soils and vegetation openings
	Solar heating	Riparian shade				No vegetation treatment would occur in RHCAs
Temporary Road Construction	Surface erosion	Pulse & Chronic Sediment		-L		Channelized deposition in system road ditches – reduced by design measures and cross drain culverts diverting material prior to stream crossings.
	Mass failure risk	Pulse sediment				No temp road construction would occur on landslide prone or high mass wasting areas
	Infiltration, runoff	Hydrologic process		-L		Compacted soils could limit infiltration and concentrate flow in the short term. Roads would be decompacted, recontoured, and revegetated.
	Riparian shade	Riparian condition				No temp road construction in RHCAs
Road Improvement	Surface erosion	Pulse & Chronic Sediment	-M	-M		Ditch cleaning, soil disturbance, and logging truck haul could increase sediment delivery in the short term. Gravel placement and additional cross drain culverts would reduce sediment delivery in the long term.
	Infiltration, runoff	Hydrologic process	-M			Gravel placement and addition of cross drain culverts would slow overland flow and reduce runoff
Road Decommissioning (including RHCA and non-system roads)	Surface erosion	Pulse & Chronic Sediment	-L	-L	+L	Potential for increased sediment delivery during road decomm activities, especially at stream crossings, and until road is revegetated. Design measures and BMPs would be followed. Long term benefit due to recovery of soil function and hydrologic processes.

Action	Process Affected	Characteristic Indicator	Alt A (Existing Condition)	Alt C Short Term	Alt C Long Term	Explanations
	Infiltration, runoff	Hydrologic process	-L	+L	+L	Compacted soils allow for increased overland flow. Once roads are decompacted and recontoured infiltration would increase and concentrated overland flow would diminish. Culverts would be removed.
	Riparian Shade	Riparian condition	-L		+L	Vegetative recovery and tree growth in long term
Stream Crossing Improvement	Surface erosion	Pulse & Chronic Sediment	-L	-L	+L	Undersized/failing culverts have the potential for chronic sediment delivery or get plugged/collapse causing road fill failure. Short term, localized sediment could be delivered during implementation and until road fill slopes are stabilized and revegetated.
	Mass failure risk	Pulse sediment	-L	+L	+L	Undersized/failing culverts have the potential to get plugged/collapse causing road fill failure. Long term culverts would allow for 100 year flows.
	Fish Passage	Habitat availability				Replacing culverts to allow for Aquatic Organism Passage increase available habitat
Summary of Upward Trend Indicators for Middle Fork Clear Creek			-9	-7	+4	Positive Upward Trend Long Term[1]

[1]The expected long-term consequences of the CCIR project on aquatic conditions are all considered positive, with the exception of possible increased peak flows due to vegetation removal. Full vegetative recovery would be achieved within 30 years. All of the aquatic restoration projects are expected to have positive long-term consequences on the aquatic conditions in the watershed. The greatest effect from these activities is associated with the increased habitat availability from fish passage improvements, the reduced risk of mass failures associated with the stream crossing improvements, the addition of cross drain culverts which better hydrologically disconnect roads from streams, and the road decommissioning projects providing recovery of soil function and hydrologic processes.

Kay Creek Prescription Watershed Activities

Kay Creek meets its Forest Plan water quality objective based on cobble embeddedness and therefore does not require an upward trend analysis narrative. The following tables however provide a quick assessment of the trend in the watershed and the effects of the project on that trend.

Watershed Area 5.5 Sq. Miles (3,537 acres) 1.7 RHCA Sq. miles

Road Density	Roads Total 1995	Road Decomm 1996-2011	Roads Total 2011	SF/WF Road Decomm[1]	Roads Total 2014	Clear Creek IR Project[6]	Roads Final Total
miles	14.5	0.0	14.5	0.6	13.9	0.9	13.0
Road Density	2.6		2.6		2.5		2.4
RHCA miles	2.2	0.0	2.2	0.5	1.7	0.2	1.5
RHCA Road Density	1.3		1.3		0.9		0.9

Percent road reduction: 10% total miles; 32% RHCA miles

Culverts	Clear Creek Culvert Replacements[2]	Road 286N Project[4]	Clear Creek IR Project[6]	Total
Replaced	1 (fish)	1	6	9
Removed	0	0	0	0

All fish bearing pipes: AOP; All Undersized pipes replaced

Road Reconstruction	Road 286N Project[4]	Clear Creek IR Project[6]	Total	Percent of Total Miles
Total miles	0.6	9.2	9.77	75%
Miles outside RHCA	0.4	8.7	8.7	
Miles in RHCA	0.2	1.1	1.1	73%

Road Recondition	Clear Creek IR Project[6]	Percent of Total Miles
Total miles	2.2	17%
Miles outside RHCA	2.2	
Miles in RHCA	0.0	0%

Non-system Road Decomm	SF/WF Road Decomm[1]	Clear Creek IR Project[6*]	Total
Total miles	8.1	0.2	8.3
Miles outside RHCA	7.0	0.2	7.2
Miles in RHCA	1.1	0.0	1.1

* Estimated 25% of proposed system road decommission miles

Other Actions Proposed in the Prescription Watershed

Clear Creek IR Project[6] (Alt C – max alternative)	Commercial Harvest (acres)	Temporary Roads (acres)	Prescribed Burning (acres)
	105(3% of watershed) 75 are Regen Harvest – (2% of watershed)	2	0

Table 45: Upward Trend Indicators and Ratings for Kay Creek Forest Plan Prescription Watershed

Action	Process Affected	Characteristic Indicator	Alt A (Existing Condition)	Alt C Short Term	Alt C Long Term	Explanations
Vegetation Treatments	Surface erosion	Pulse & Chronic Sediment		-L		Exposed soil on skid and landings - mostly in the form of channelized delivery from ruts on skid trails - reduced by design measures
	Mass failure risk	Pulse sediment				No vegetation treatment or skid trail construction would occur on landslide prone or high mass wasting areas
	Infiltration, runoff	Hydrologic process		-L	-L	Compacted soils and vegetation openings
	Solar heating	Riparian shade				No vegetation treatment would occur in RHCAs
Temporary Road Construction	Surface erosion	Pulse & Chronic Sediment		-L		Channelized deposition in system road ditches – reduced by design measures and cross drain culverts diverting material prior to stream crossings.
	Mass failure risk	Pulse sediment				No temp road construction would occur on landslide prone or high mass wasting areas
	Infiltration, runoff	Hydrologic process		-L		Compacted soils could limit infiltration and concentrate flow in the short term. Roads would be decompacted, recontoured, and revegetated.
	Riparian shade	Riparian condition				No temp road construction in RHCAs
Road Improvement	Surface erosion	Pulse & Chronic Sediment	-M	-M		Ditch cleaning, soil disturbance, and logging truck haul could increase sediment delivery in the short term. Gravel placement and additional cross drain culverts would reduce sediment delivery in the long term.
	Infiltration, runoff	Hydrologic process	-M			Gravel placement and addition of cross drain culverts would slow overland flow and reduce runoff
Road Decommissioning (including RHCA and non-system roads)	Surface erosion	Pulse & Chronic Sediment	-L	-L	+L	Potential for increased sediment delivery during road decomm activities, especially at stream crossings, and until road is revegetated. Design measures and BMPs would be followed. Long term benefit due recovery of soil function and hydrologic processes.
	Infiltration, runoff	Hydrologic process	-L	+L	+L	Compacted soils allow for increased overland flow. Once roads are decompacted and recontoured infiltration would increase and concentrated overland flow would diminish. Culverts would be removed.

Action	Process Affected	Characteristic Indicator	Alt A (Existing Condition)	Alt C Short Term	Alt C Long Term	Explanations
	Riparian Shade	Riparian condition	-L		+L	Vegetative recovery and tree growth in long term
Stream Crossing Improvement	Surface erosion	Pulse & Chronic Sediment	-L	-L	+L	Undersized/failing culverts have the potential for chronic sediment delivery or get plugged/collapse causing road fill failure. Short term, localized sediment could be delivered during implementation and until road fill slopes are stabilized and revegetated.
	Mass failure risk	Pulse sediment	-L	+L	+L	Undersized/failing culverts have the potential to get plugged/collapse causing road fill failure. Long term culverts would allow for 100 year flows.
	Fish Passage	Habitat availability				Replacing culverts to allow for Aquatic Organism Passage increase available habitat
Summary of Upward Trend Indicators for Kay Creek			-9	-6	+4	Positive Upward Trend Long Term[1]

[1]The expected long-term consequences of the CCIR project on aquatic conditions are all considered positive, with the exception of possible increased peak flows due to vegetation removal. Full vegetative recovery would be achieved within 30 years. All of the aquatic restoration projects are expected to have positive long-term consequences on the aquatic conditions in the watershed. The greatest effect from these activities is associated with the increased habitat availability from fish passage improvements, the reduced risk of mass failures associated with the stream crossing improvements, the addition of cross drain culverts which better hydrologically disconnect roads from streams, and the road decommissioning projects providing recovery of soil function and hydrologic processes.

South Fork Clear Creek Prescription Watershed Activities

The 12,940 acre South Fork Clear Creek Forest Plan prescription watershed does not meet its water quality objective of 80% for fishery habitat potential. Cobble embeddedness was measured at 47% in 2014 (Stillwater Sciences). When assessed against the DFCs (USDA 1992), the watershed currently is at 65% of habitat potential. It was at 50% of its habitat potential when the Forest Plan was written in 1987. This would be considered an upward trend in cobble embeddedness since 1987 based on limited cobble embeddedness data

There are about 12 miles of fish-bearing and a minimum of 50 miles of non-fish bearing streams in South Fork Clear Creek. Chinook adults and juveniles were found in the lower 1.5 miles (Stillwater Sciences, 2015) in low densities (1.6 and 7 fish/100m, respectively). Steelhead/rainbow were found in the lower 6 miles (110 fish/100m) and cutthroat were not observed; however, they have been documented in past surveys and are likely to occur in the upper half of the drainage.

Surveys in 2015 estimated the amount of anadromous and resident fish spawning habitat in South Fork Clear Creek. Anadromous habitat was rated good to fair in quality but limited in quantity compared to the lower mainstem of Clear Creek (75m2/km vs. 580 m2/km). Resident spawning habitat was also rated as good to fair with roughly 25m2/km in the surveyed reaches. Although the amount of spawning habitat for both anadromous and resident fish is limited due to large substrate size (see below), fish densities indicate the availability of suitable spawning habitat. The larger dominant substrates provide for an abundance of rearing habitat as the surveyed reaches are higher gradient channels where there is less likelihood of sediment filling the interstitial spaces between the rocks.

Stream temperatures were measured at the mouth of South Fork Creek in 1991. Daily average temperatures were 13°C, or High for steelhead spawning and Low for summer steelhead rearing (18°C) based the NOAA Matrix table. Wildfires in 1870 and 1931 burned 7,085 acres and consumed most of the streamside vegetation which has created RHCAs currently dominated by trees that are about 80 years old. It is possible that they have not yet reached their full stream shading and cooling potential.

Stream temperatures were also measured where the South Fork meets Kay Creek for 9 years (1991-1998, 2001). Stream temperature conditions based on 2001 data showed NOAA Matrix ratings as Moderate for steelhead spawning and High for rearing (14.3°C and 12.5°C respectively). They were moderate for bull trout rearing (12.5°C) and Low for bull trout spawning/incubation (10.1°C). Stream temperatures in South Fork Creek appear to be adequate for chinook, steelhead and cutthroat production and low for bull trout.

Riffle and pool habitats made up 70% and 30% of stream habitats in 2015, respectively. Shallow water depths and lack of pool habitat were noted in the surveys. Wood is the primary creator of pools in this stream system. The low numbers of pools are considered to be closely related to natural low wood levels (9 pieces/100m) which are likely a result of wildfires in 1870 and again in 1931. No timber harvest has occurred adjacent to the surveyed streams as all lay within the Clear Creek Roadless area. Trees have reestablished themselves and are now about 80 years old. Timber harvest in the upper South Fork upstream from the surveyed reaches mostly retained streamside buffers. The presence of forested stands along all streams provides for both short and long term upward trends in water depths and pool habitat.

Stream bank stability was noted as good to excellent in both the1988 and 2015 surveys. This is due to the presence of dense streamside vegetation in combination with large substrate (cobble, rubble, boulders) which armors the banks against the erosive power of the stream. This trend has been maintained over time.

Stream substrate composition in South Fork Clear Creek in 2015 was dominated by boulders and rubble (68%), followed by gravel (18%), sand (12%) and bedrock (3%). Surveys in 1988 showed dominance by large rubble, boulders, and bedrock. Cobble embeddedness was 37% in 2015 and 51% in 1988 indicating a likely positive upward trend. Because the same sampling protocols were not used, the data is not directly comparable; however given the low riparian and watershed road densities and no evidence of recent landslides, the assumption of an upward trend is reasonable. A review of roads between 2010 and 2012 found no major sediment issues associated with roads that might affect fine sediment levels in the drainage. Levels of sand/silt were relatively low (<20%) and adequate for fish embryo survival (Meehan et al 1991).

Regeneration timber harvest activities have occurred on 13% of the watershed between the 1930's and 1990's. No regeneration harvest has occurred since then. ECA is currently at 1% as a result of minimal harvest. Streamside buffers of 100'+ were retained on all but 3.3 miles of non-fish bearing or intermittent streams. Forested stands within RHCAs are aged as follows: 5% are < 40 years old, 54% are between 40 and 100 years and the remaining 41% older than 100 years. The RHCAs are considered fully functional given the age classes and minimal disturbance within them. As a result, they are trending in an upward condition and would continue to provide for shade, wood, and bank stability in the South Fork of Clear Creek.

There are almost 32 miles of Forest system roads within the watershed with less than 4 miles occurring within RHCAs. The overall watershed road density is 1.6 mi/mi^2 and the RHCA road density is 1 mi/mi^2. A total of 1.5 miles of the RHCA roads are opened to motorized traffic and the remaining are closed. About 20 miles are gravel surfaced and many of the remainder were topped with grasses/mosses and had small trees growing along their margins. There were no obvious signs of road surface erosion (no rilling or gullying) during culvert inventories from 2010 to 2012. A total of 2 miles of system road and 26 miles of non-system road have been decommissioned since 2012. This is a 6% reduction from densities in 1995 and is a result of past road decommissioning projects. The 26 miles of non-system roads do not contribute to road density calculations but their decommissioning has contributed to the reduction of sediment to streams.

There are 45 stream crossings within the watershed with none occurring on fish bearing streams. Nineteen of the crossings were identified as needing cross drain additions and 13 need to be replaced as they are undersized. Ditchlines in the drainage were well vegetated which help to filter out sediment to streams. There are no human caused barriers to upstream aquatic organism migration in the watershed.

Based on the Forest Plan guidance, an upward trend has been initiated in the South Fork Clear Creek prescription watershed. This is due to a lack of recent timber harvest combined with well vegetated riparian areas, relatively few stream crossings, past road decommissioning projects, mostly closed roads and no obvious sources of sediment. The stream has a mostly functioning riparian vegetation component, stable banks, and cool stream temperatures which would allow for the continued improvement of fish habitat capacity over time.

Proposed Activity Effects to Streams

The Clear Creek Project would continue the existing upward trend through road improvement activities including the replacement of 27 stream crossing culverts, 16.5 miles of road reconstruction (51% of the roads in the prescription watershed) and 9.8 miles of reconditioning (30% of the roads in the prescription watershed). All of these are designed to reduce the amount of sediment delivery to streams from roads. Road decommissioning and reconstruction activities were conducted under previous projects between 2012 and 2014 (FEIS, Appendix J, pg. J-37).

All project activities are expected to have a negative effect on aquatic condition in the short term based on sediment yields as modeled in NEZSED. Model results from NEZSED indicate sediment yield increases at the mouth of South Fork Clear Creek to 14% as a result of project activities. This meets the Forest Plan objective of 45%. The FISHSED model was used in conjunction with NEZSED to determine potential changes in fish habitat carrying capacity. The model predicted a 3% increase in cobble embeddedness, a 1% decrease in summer rearing and a 4% decrease in winter rearing capacity. These are well below the threshold of 10% where changes in habitat could occur (Stowell et al. 1983).

ECAs would increase to 9% under Alternative C, a High (good) condition class rating based on the NOAA matrix (1998). This meets the desired threshold of <20%. No stream channel alterations are expected as a result of minor increases in water yield. Alternative C Modified harvests 289 less acres therefore ECA is expected to be slightly lower than discussed above.

An upward trend in aquatic habitat conditions in South Fork Clear Creek has been established through previous road decommissioning and road improvement projects. The Clear Creek Project would maintain that trend through additional road improvement activities when combined with relatively intact RHCAs, and design feature and BMP implementation

South Fork Clear Creek Prescription Watershed Activities

Watershed Area 20.2 Sq. Miles (12,941 acres) 4.8 RHCA Sq. miles

Road Density	Roads Total 1995	Road Decomm 1996-2011	Roads Total 2011	SF/WF Road Decomm[1]	Roads Total 2014	Clear Creek IR Project[6]	Roads Final Total
miles	35.9	2.6	33.3	1.2	32.1	0.0	32.1
Road Density	1.8		1.6		1.6		1.6
RHCA miles	5.2	0.4	4.8	0.0	4.8	0.0	4.8
RHCA Road Density	1.1		1.0		1.0		1.09

Percent road reduction: 4% total miles; 0% RHCA miles

Culverts	Clear Creek Culvert Replacements[2]	Road 650 Project[5]	Clear Creek IR Project[6]	SF/WF Decomm Non-system Roads	Total
Replaced	2	22	27	0	29
Removed	0	0	0	1	1

Road Reconstruction	Road 650 Project[5]	Clear Creek IR Project[6]	Total	Percent of Total Miles
Total miles	4.5	16.5	21	65%
Miles outside RHCA	4.1	14.1	18.2	
Miles in RHCA	0.4	2.4	2.8	58%

All fish bearing pipes: AOP; All Undersized pipes replaced

Road Recondition	Clear Creek IR Project[6]	Percent of Total Miles
Total miles	9.8	31%
Miles outside RHCA	9.8	
Miles in RHCA	0.0	0%

Non-system Road Decomm	SF/WF Road Decomm[1]	Clear Creek IR Project[6*]	Total
Total miles	27.8	0.0	27.8
Miles outside RHCA	25.0	0.0	25.0
Miles in RHCA	2.8	0.0	2.8

* Estimated 25% of proposed system road decommission miles

Other Actions Proposed in the Prescription Watershed

Clear Creek IR Project[6] (Alt C – max alternative)	Commercial Harvest (acres)	Temporary Roads (acres)	Prescribed Burning (acres)
	1476(12% of watershed) 782 are Regen Harvest – (6% of watershed)	20	326

Table 46: Upward Trend Indicators and Ratings for South Fork Clear Creek Forest Plan Prescription Watershed

Action	Process Affected	Characteristic Indicator	Alt A (Existing Condition)	Alt C Short Term	Alt C Long Term	Explanations
Vegetation Treatments	Surface erosion	Pulse & Chronic Sediment		-L		Exposed soil on skid and landings - mostly in the form of channelized delivery from ruts on skid trails - reduced by design measures
	Mass failure risk	Pulse sediment				No vegetation treatment or skid trail construction would occur on landslide prone or high mass wasting areas
	Infiltration, runoff	Hydrologic process		-L	-L	Compacted soils and vegetation openings
	Solar heating	Riparian shade				No vegetation treatment would occur in RHCAs
Temporary Road Construction	Surface erosion	Pulse & Chronic Sediment		-L		Channelized deposition in system road ditches – reduced by design measures and cross drain culverts diverting material prior to stream crossings.
	Mass failure risk	Pulse sediment				No temp road construction would occur on landslide prone or high mass wasting areas
	Infiltration, runoff	Hydrologic process		-L		Compacted soils could limit infiltration and concentrate flow in the short term. Roads would be decompacted, recontoured, and revegetated.
	Riparian shade	Riparian condition				No temp road construction in RHCAs
Road Improvement	Surface erosion	Pulse & Chronic Sediment	-M	-M		Ditch cleaning, soil disturbance, and logging truck haul could increase sediment delivery in the short term. Gravel placement and additional cross drain culverts would reduce sediment delivery in the long term.
	Infiltration, runoff	Hydrologic process	-M			Gravel placement and addition of cross drain culverts would slow overland flow and reduce runoff
Road Decommissioning (including RHCA and non-system roads)	Surface erosion	Pulse & Chronic Sediment	-L	-L	+L	Potential for increased sediment delivery during road decomm activities, especially at stream crossings, and until road is revegetated. Design measures and BMPs would be followed. Long term benefit due recovery of soil function and hydrologic processes.
	Infiltration, runoff	Hydrologic process	-L	+L	+L	Compacted soils allow for increased overland flow. Once roads are decompacted and recontoured infiltration would increase and concentrated overland flow would diminish. Culverts would be removed.

Action	Process Affected	Characteristic Indicator	Alt A (Existing Condition)	Alt C Short Term	Alt C Long Term	Explanations
	Riparian Shade	Riparian condition	-L		+L	Vegetative recovery and tree growth in long term
Stream Crossing Improvement	Surface erosion	Pulse & Chronic Sediment	-L	-M	+L	Undersized/failing culverts have the potential for chronic sediment delivery or get plugged/collapse causing road fill failure. Short term, localized sediment could be delivered during implementation and until road fill slopes are stabilized and revegetated.
	Mass failure risk	Pulse sediment	-M	+L	+M	Undersized/failing culverts have the potential to get plugged/collapse causing road fill failure. Long term culverts would allow for 100 year flows.
	Fish Passage	Habitat availability				Replacing culverts to allow for Aquatic Organism Passage increase available habitat
Summary of Upward Trend Indicators for SF Clear Creek			-10	-7	+5	Positive Upward Trend Long Term[1]

[1]The expected long-term consequences of the CCIR project on aquatic conditions are all considered positive, with the exception of possible increased peak flows due to vegetation removal. Full vegetative recovery would be achieved within 30 years. All of the aquatic restoration projects are expected to have positive long-term consequences on the aquatic conditions in the watershed. The greatest effect from these activities is associated with the increased habitat availability from fish passage improvements, the reduced risk of mass failures associated with the stream crossing improvements, the addition of cross drain culverts which better hydrologically disconnect roads from streams, and the road decommissioning projects providing recovery of soil function and hydrologic processes.

Hoodoo Creek Prescription Watershed Activities

The 6,450 acre Hoodoo Creek Forest Plan prescription watershed, which includes West Fork Clear Creek, does not meet its water quality objective of 70% for fishery habitat potential. Cobble embeddedness was measured at 71% in 2016. When assessed against the DFCs (USDA, 1992), the watershed currently is at 37% of habitat potential. It was at 50% of its habitat potential when the Forest Plan was written in 1987. No upward trend in cobble embeddedness has occurred since 1987 based on limited cobble embeddedness data. Sediment is likely a contributing limiting factor for fish production in this prescriptions watershed. However, as discussed in the Appendix A Guidance and FEIS, upward trend is not determined by cobble embeddedness alone (Conroy and Thompson, 2011).

There are about 5 miles of fish-bearing and 20 miles of non-fish bearing streams in the drainage. Fish densities are low due to steeper gradients and larger than preferred spawning substrate. No Chinook salmon were observed in 2015; however 4 juveniles /100m were observed in 2016. Steelhead/rainbow were the most common species found and numbers observed were low at 40 fish/100m, respectively. Westslope cutthroat trout were observed in low densities in 2015 (17 fish/100m).

Surveys in 2015 estimated the amount of anadromous and resident fish spawning habitat in West Fork Clear Creek. Anadromous habitat was rated as fair in quality and low in availability (25m2/km). Resident spawning habitat was rated as good to fair with only 13m2/km in the surveyed reaches. The amount of spawning habitat for both anadromous and resident fish is likely to remain limited due to steeper stream gradient and the dominant substrate size which is too large for spawning habitat.

Stream temperatures were measured in West Fork Clear Creek in various years (1991, 1992, 2011, 2012, 2015, and 2016). Stream temperature conditions based on NOAA matrix ratings were moderate for steelhead spawning and rearing (15°C and 17°C, respectively) but were within optimum ranges for steelhead trout rearing (14 – 19°C, EPA 2003). Temperatures were low for bull trout spawning and moderate for bull trout rearing (14°C and 15°C, respectively). Summer water temperatures are considered to be warmer than preferred for bull trout and they are not expected to utilize this watershed for spawning or rearing.

Stream bank stability was noted as good to excellent in both the 2015 and 1988 surveys as well as during field reviews between 2010 and 2012. This is due to the presence of dense streamside vegetation in combination with large substrate (cobble, rubble, boulders) which armors the banks against the erosive power of the stream. The trend for bank stability has been maintained.

Stream substrate composition in West Fork Clear Creek in 2015 was composed of 22% sand/silt, 26% gravel and 52% large material (rubble to boulders). Cobble embeddedness, which cannot be directly correlated to the percent of fine substrates, was 71% in 2015 and 33% in 2012 (FEIS, pg. 3-11). The data between the two years, however, is not comparable as 2015 sampling occurred near the mouth of the stream and 2012 sampling occurred 1.8 miles upstream near the confluence of Hoodoo and West Fork Clear Creeks. Instream sediment is likely associated with many roads in the watershed. Two road related slides on Road 650 were observed between 2011 and 2017. Repairs were conducted on the slide closest to the Forest boundary in 2012 and repairs are planned for the upper slide in 2018. Both slides delivered unknown quantities of sediment to the stream. While it would be desirable to remove these segments of road from an aquatics

perspective, travel management considerations identified the road as essential for providing for management and public access. Overall, sediment levels are very high in the watershed based on limited sampling. However as noted by Sylte and Fischenich (2002), cobble embeddedness exhibits high spatial and temporal variability in both natural and disturbed streams. Sampling must be intensive within streams or stream reaches to detect changes. Intensive sampling has not occurred and surveys were not conducted in the same location between years. Determining a trend for embeddedness is therefore not possible given the lack of available data. Additionally, extensive road decommissioning, has been implemented since 2012 and may also be contributing, in part, to higher levels in the short term.

Riffle and pool habitats made up 65% and 35% of stream habitats in 2015, respectively. While the overall percent of pools was somewhat low, the frequency of those pools were the highest noted in the surveyed watersheds. This is due to relatively high frequencies of large wood present in the stream and the well forested stands along its length.

Regeneration timber harvest activities have occurred on 34% of the watershed between the 1950s and 1996. No harvest has occurred since then. Streamside buffers of 50'or larger were retained on all but 4 miles (13%) of non-fish bearing or intermittent streams beginning in the 1970s. Harvest retained buffers of 100-400' on all fish bearing streams. ECA is currently at 4%, or a high condition. Forested stands within RHCAs are aged as follows: 10% are < 40 years old, 50% are between 40 and 100 years and the remaining 40% older than 100 years. The middle age classes are partly a result of a wildfire which occurred in 1931. The fire burned 27% of the drainage and 43% of the RHCAs. The RHCAs would therefore be considered mostly functional given the large percentage of older age classes and minimal human related disturbance within them. As a result, they are trending in an upward condition and would continue to provide for shade, wood, and stable banks in the West Fork Clear Creek drainage.

There are 32 miles of Forest system roads within the watershed with 5 miles occurring within RHCAs. A total of 2 miles of the RHCA roads are opened to motorized traffic and the remaining roads are closed. The overall watershed road density is 3.8 mi/mi^2. The RHCA and landslide prone road densities are 2.3 mi/mi^2 and 0.2 mi/mi^2, respectively. A total of 10 miles of system road and 36 miles of non-system road have been decommissioned since 2012. A minimum of 30 water crossings were removed. There has been a 20% reduction in system roads since 1995 as a result of the decommissioning. Road treatments included abandonment to full recontouring and stream crossing removal. Decommissioning results in short term sediment increases at stream crossing removal sites but removes the risk of future crossing failure. Decommissioning is expected to contribute to a long term reduction in sediment delivery to streams.. Improving trends in instream sediment are expected over time as a result.

There are 41 stream crossings within the watershed, one of which occurs on fish bearing streams. It was replaced in 2012 and is no longer a barrier to upstream passage. A total of 30 culverts are appropriately sized and the remaining 11 crossings are undersized for the area they drain. All roads cross perpendicular to the stream channels limiting their effects to riparian vegetation; however portions of the ditchlines drain directly into the streams. These 6 sites may be acting as a chronic sediment source of sediment to streams. Ditchlines leading to the 1 fish bearing crossings currently have cross drain pipes installed and are no longer adding sediment to streams at those sites.

In summary, timber harvest has not occurred in the Hoodoo (West Fork) Clear Creek prescription watershed for 22 years. RHCAs are intact and in a state to provide for long term streambank

stability, shade and large wood. As a result, they will contribute to long term aquatic habitat maintenance and improvement. Recent road decommissioning, live water culvert replacements, and cross drain culvert replacements have been implemented in order to reduce road related sediment delivery to streams. Also, the majority of roads are closed to motorized use which limits degradation of the road surface and potential sediment delivery to streams. When compared to past watershed conditions, these activities are expected to have initiated an upward trend in fish habitat capacity in this prescription watershed.

Proposed Activity Effects to Streams

The Clear Creek Project would continue the existing upward trend by decommissioning an additional 0.8 miles of road, 0.2 miles of which is within RHCAs. This would not change watershed or RHCA road densities from the existing conditions of 3.8 mi/mi^2 and 2.3 mi/mi^2, respectively. The majority of road decommissioning and road improvement were conducted under previous projects between 2012 and 2015.

The Clear Creek Project also reconstructs 15.3 miles of system road (40% of the roads in the prescription watershed) which helps reduce sediment delivery by diverting road ditchline flow through cross drain culverts and away from streams. A total of 9.9 miles was already completed under the Road 650 Project in 2014.

The Clear Creek project would replace the 11 existing undersized culverts with those sized for a 100- year flow event. This would reduce the risk of future failure. All crossings in the watershed would be appropriately sized after project completion. The Project would recondition 7.1 miles of road (19% of the roads). Reconditioning would apply gravel where needed to minimize the amount of erosion from road surfaces during log haul operations. The use of dust abatement during log haul would also minimize road surface erosion and potential input of sediment to streams.

All project activities are expected to have a negative effect on aquatic condition in the short term based on sediment yields as modeled in NEZSED. Model results from NEZSED indicate sediment yield increases at the mouth of West Fork Clear Creek to 55% as a result of project activities. This meets the Forest Plan standard of 60%. The FISHSED model was used in conjunction with NEZSED to determine potential changes in fish habitat carrying capacity. The model predicted a 7% increase in cobble embeddedness and decrease in summer/winter juvenile steelhead rearing capacity of 8% and 15%, respectively. Winter rearing capacity exceeds the level of 10% where changes in habitat quality could occur (Stowell et al. 1983); however, local RHCA monitoring found no sediment delivery through the buffers (USDA, 2014). Visual observations of post-harvest areas found the same results elsewhere on the Forest (K. Smith, personal observations, 2000-2013). With no delivery, cobble embeddedness levels are not expected to increase as a result of harvest. FISHSED model documentation states that the effects evaluation should be adjusted if riparian areas are to be treated differently than surrounding land. RHCAs retain no harvest buffers that are much wider than those used when FISHSED was developed; therefore the model results are considered overestimates, particularly when combined with fewer actual acres of harvest (NEPA vs. layout acres).

ECAs would increase to 26% under Alternative C, a Moderate condition class rating based on the NOAA matrix (1998). This exceeds the desired threshold of 20%. However, no channel alterations as a result of increased water yield is expected. This is due to the loss of 20-35% of the harvest acres that will occur during unit layout. The expected loss is based on recent comparisons

of NEPA versus layout units (see project file for the Lost Mule Timber Sale). The reduced acres would result in lower ECAs.

Overall Trend Summary for the Hoodoo Creek Prescription Watershed

In summary, the current upward trend has been established through intact RHCAs, a lack of recent timber harvest, previous road decommissioning, culvert replacement, and road improvement projects. The Clear Creek Project would maintain that trend through additional road improvement activities when combined with design feature and BMP implementation. These have been shown to be effective at minimizing effects to streams (Sugden, 2018; Arismendi et al, 2017; Hatten et al 2017; Sugden et al 2012; USDA Forest Service, 2009). The Clear Creek Project therefore complies with the Forest Plan upward trend requirement.

Hoodoo Creek Prescription Watershed Activities

Watershed Area 10.1 Sq. Miles (6,446 acres) 2.4 RHCA Sq. miles

Road Density	Roads Total 1995	Road Decomm 1996-2011	Roads Total 2011	SF/WF Road Decomm[1]	Roads Total 2014	Clear Creek IR Project[6]	Roads Final Total
miles	48.9	2.6	46.3	7.6	38.7	0.8	37.9
Road Density	4.8		4.6		3.8		3.8
RHCA miles	9.1	0.7	8.4	2.7	5.7	0.2	5.5
RHCA Road Density	3.8		3.5		2.3		2.3

Percent road reduction: 18% total miles; 35% RHCA miles

Culverts	SF/WF Decomm Non-system Roads	Clear Creek Culvert Replacements[2]	Road 650 Project[5]	Clear Creek IR Project[6]	Total
Replaced	0	3 (fish)	13	11	27
Removed	21	1 (fish)	0	0	22

Road Reconstruction	Road 650 Project[5]	Clear Creek IR Project[6]	Total	Percent of Total Miles
Total miles	11	15.3	26.3	69%
Miles outside RHCA	9.9	13.9	23.8	
Miles in RHCA	1.1	1.4	2.5	46%

All fish bearing pipes: AOP; All Undersized pipes replaced

Road Recondition	Clear Creek IR Project[6]	Percent of Total Miles
Total miles	7.1	19%
Miles outside RHCA	6.2	
Miles in RHCA	0.9	16%

Non-system Road Decomm	SF/WF Road Decomm[1]	Clear Creek IR Project[6*]	Total
Total miles	34.9	0.2	35.1
Miles outside RHCA	28.4	0.1	28.5
Miles in RHCA	6.5	0.1	6.6

* Estimated 25% of proposed system road decommission miles

Other Actions Proposed in the Prescription Watershed

Clear Creek IR Project[6] (Alt C – max alternative)	Commercial Harvest (acres)	Temporary Roads (acres)	Prescribed Burning (acres)
	2,124(33% of watershed) 1,445 are Regen Harvest – (22% of watershed)	33	325

Table 47: Upward Trend Indicators and Ratings for Hoodoo Creek Forest Plan Prescription Watershed

Action	Process Affected	Characteristic Indicator	Alt A (Existing Condition)	Alt C Short Term	Alt C Long Term	Explanations
Vegetation Treatments	Surface erosion	Pulse & Chronic Sediment		-M		Exposed soil on skid and landings - mostly in the form of channelized delivery from ruts on skid trails - reduced by design measures
	Mass failure risk	Pulse sediment				No vegetation treatment or skid trail construction would occur on landslide prone or high mass wasting areas
	Infiltration, runoff	Hydrologic process		-M	-L	Compacted soils and vegetation openings
	Solar heating	Riparian shade				No vegetation treatment would occur in RHCAs
Temporary Road Construction	Surface erosion	Pulse & Chronic Sediment		-L		Channelized deposition in system road ditches – reduced by design measures and cross drain culverts diverting material prior to stream crossings.
	Mass failure risk	Pulse sediment				No temp road construction would occur on landslide prone or high mass wasting areas
	Infiltration, runoff	Hydrologic process		-L		Compacted soils could limit infiltration and concentrate flow in the short term. Roads would be decompacted, recontoured, and revegetated.
	Riparian shade	Riparian condition				No temp road construction in RHCAs
Road Improvement	Surface erosion	Pulse & Chronic Sediment	-M	-M		Ditch cleaning, soil disturbance, and logging truck haul could increase sediment delivery in the short term. Gravel placement and additional cross drain culverts would reduce sediment delivery in the long term.
	Infiltration, runoff	Hydrologic process	-M			Gravel placement and addition of cross drain culverts would slow overland flow and reduce runoff
Road Decommissioning (including RHCA and non-system roads)	Surface erosion	Pulse & Chronic Sediment	-L	-M	+M	Potential for increased sediment delivery during road decomm activities, especially at stream crossings, and until road is revegetated. Design measures and BMPs would be followed. Long term benefit due recovery of soil function and hydrologic processes.
	Infiltration, runoff	Hydrologic process	-L	+L	+L	Compacted soils allow for increased overland flow. Once roads are decompacted and recontoured infiltration would increase and concentrated overland flow would diminish. Culverts would be removed.

Action	Process Affected	Characteristic Indicator	Alt A (Existing Condition)	Alt C Short Term	Alt C Long Term	Explanations
	Riparian Shade	Riparian condition	-L		+L	Vegetative recovery and tree growth in long term
Stream Crossing Improvement	Surface erosion	Pulse & Chronic Sediment	-L	-M	+L	Undersized/failing culverts have the potential for chronic sediment delivery or get plugged/collapse causing road fill failure. Short term, localized sediment could be delivered during implementation and until road fill slopes are stabilized and revegetated.
	Mass failure risk	Pulse sediment	-M	+L	+M	Undersized/failing culverts have the potential to get plugged/collapse causing road fill failure. Long term culverts would allow for 100 year flows.
	Fish Passage	Habitat availability	-H	+H	+H	Replacing culverts to allow for Aquatic Organism Passage increase available habitat
Summary of Upward Trend Indicators for Hoodoo Creek			-13	-7	+9	Positive Upward Trend Long Term[1]

[1]The expected long-term consequences of the CCIR project on aquatic conditions are all considered positive, with the exception of possible increased peak flows due to vegetation removal. Full vegetative recovery would be achieved within 30 years. All of the aquatic restoration projects are expected to have positive long-term consequences on the aquatic conditions in the watershed. The greatest effect from these activities is associated with the increased habitat availability from fish passage improvements, the reduced risk of mass failures associated with the stream crossing improvements, the addition of cross drain culverts which better hydrologically disconnect roads from streams, and the road decommissioning projects providing recovery of soil function and hydrologic processes.

Big Cedar Creek Prescription Watershed Activities

Big Cedar Creek was not assigned a Forest Plan water quality objective. The following tables however provide a quick assessment of the trend in the watershed and the effects of the project on that trend.

Watershed Area 8.7 Sq. Miles (5,542 acres) 0.3 RHCA Sq. miles

Road Density	Roads Total 1995	Road Decomm 1996-2011	Roads Total 2011	SF/WF Road Decomm[1]	Roads Total 2014	Clear Creek IR Project[6]	Roads Final Total
miles	40.0	0.5	39.5	0.0	39.5	1.7	37.8
Road Density	4.6		4.6		4.6		4.4
RHCA miles	3.6	0.0	3.6	0.0	3.6	1.0	2.6
RHCA Road Density	12.3		12.3		12.3		8.7

Percent road reduction: 4% total miles; 28% RHCA miles

Culverts	Clear Creek IR Project[6]
Replaced	2
Removed	1

All fish bearing pipes on FS land AOP; All Undersized pipes replaced; 3 fish barriers left on private land

Road Reconstruction	Clear Creek IR Project[6]	Percent of Total Miles
Total miles	2.1	6%
Miles outside RHCA	2.0	
Miles in RHCA	0.1	4%

Road Recondition	Clear Creek IR Project[6]	Percent of Total Miles
Total miles	2.1	4%
Miles outside RHCA	2.0	
Miles in RHCA	0.1	0%

Non-System Road Decomm	Clear Creek IR Project[6*]	Clear ridge Non-system Road Decomm[7]	Total
Total miles	0.4	8.3	8.7
Miles outside RHCA	0.2	7.0	7.2
Miles in RHCA	0.2	1.3	1.5

* Estimated 25% of proposed system road decommission miles

Other Actions Proposed in the Prescription Watershed

Clear Creek IR Project[6] (Alt C – max alternative)	Commercial Harvest (acres)	Temporary Roads (acres)	Prescribed Burning (acres)
	567(10% of watershed) 283are Regen Harvest – (5% of watershed)	8	0

Table 48: Upward Trend Indicators and Ratings for Big Cedar Creek Forest Plan Prescription Watershed

Action	Process Affected	Characteristic Indicator	Alt A (Existing Condition)	Alt C Short Term	Alt C Long Term	Explanations
Vegetation Treatments	Surface erosion	Pulse & Chronic Sediment		-L		Exposed soil on skid and landings - mostly in the form of channelized delivery from ruts on skid trails - reduced by design measures
	Mass failure risk	Pulse sediment				No vegetation treatment or skid trail construction would occur on landslide prone or high mass wasting areas
	Infiltration, runoff	Hydrologic process		-L	-L	Compacted soils and vegetation openings
	Solar heating	Riparian shade				No vegetation treatment would occur in RHCAs
Temporary Road Construction	Surface erosion	Pulse & Chronic Sediment		-L		Channelized deposition in system road ditches – reduced by design measures and cross drain culverts diverting material prior to stream crossings.
	Mass failure risk	Pulse sediment				No temp road construction would occur on landslide prone or high mass wasting areas
	Infiltration, runoff	Hydrologic process		-L		Compacted soils could limit infiltration and concentrate flow in the short term. Roads would be decompacted, recontoured, and revegetated.
	Riparian shade	Riparian condition				No temp road construction in RHCAs
Road Improvement	Surface erosion	Pulse & Chronic Sediment	-M	-M		Ditch cleaning, soil disturbance, and logging truck haul could increase sediment delivery in the short term. Gravel placement and additional cross drain culverts would reduce sediment delivery in the long term.
	Infiltration, runoff	Hydrologic process	-M			Gravel placement and addition of cross drain culverts would slow overland flow and reduce runoff
Road Decommissioning (including RHCA and non-system roads)	Surface erosion	Pulse & Chronic Sediment	-L	-L	+L	Potential for increased sediment delivery during road decomm activities, especially at stream crossings, and until road is revegetated. Design measures and BMPs would be followed. Long term benefit due recovery of soil function and hydrologic processes.
	Infiltration, runoff	Hydrologic process	-L	+L	+L	Compacted soils allow for increased overland flow. Once roads are decompacted and recontoured infiltration would increase and concentrated overland flow would diminish. Culverts would be removed.

Action	Process Affected	Characteristic Indicator	Alt A (Existing Condition)	Alt C Short Term	Alt C Long Term	Explanations
	Riparian Shade	Riparian condition	-L		+L	Vegetative recovery and tree growth in long term
Stream Crossing Improvement	Surface erosion	Pulse & Chronic Sediment	-L	-L	+L	Undersized/failing culverts have the potential for chronic sediment delivery or get plugged/collapse causing road fill failure. Short term, localized sediment could be delivered during implementation and until road fill slopes are stabilized and revegetated.
	Mass failure risk	Pulse sediment	-L	+L	+L	Undersized/failing culverts have the potential to get plugged/collapse causing road fill failure. Long term culverts would allow for 100 year flows.
	Fish Passage	Habitat availability				Replacing culverts to allow for Aquatic Organism Passage increase available habitat
Summary of Upward Trend Indicators for Big Cedar Creek			-9	-6	+4	Positive Upward Trend Long Term[1]

[1]The expected long-term consequences of the CCIR project on aquatic conditions are all considered positive, with the exception of possible increased peak flows due to vegetation removal. Full vegetative recovery would be achieved within 30 years. All of the aquatic restoration projects are expected to have positive long-term consequences on the aquatic conditions in the watershed. The greatest effect from these activities is associated with the increased habitat availability from fish passage improvements, the reduced risk of mass failures associated with the stream crossing improvements, the addition of cross drain culverts which better hydrologically disconnect roads from streams, and the road decommissioning projects providing recovery of soil function and hydrologic processes.

Lower Clear Creek Face Prescription Watershed Activities

There are no fish/water quality objectives for Lower Clear Creek Face Prescription watershed in the Forest Plan, Appendix A. Clear Creek project activities affect less than 1% of the prescription watershed. Any impacts to water quality or quantity would be non-measurable at the watershed scale. The following tables however provide a quick at the effects of the recent projects on Forest lands within the watershed.

Watershed Area 17.7 Sq. Miles (11,358 acres) 0.3 RHCA Sq. miles

Road Density	Roads Total 1995	Road Decomm 1996-2011	Roads Total 2011	SF/WF Road Decomm[1]	Roads Total 2014	Clear Creek IR Project[6]	Roads Final Total
miles	31.6	0.3	31.3	0.2	31.1	0.0	31.1
Road Density	1.8		1.8		1.8		1.8
RHCA miles	7.7	0.0	7.7	0.0	7.7	0.0	7.7
RHCA Road Density	25.7		25.7		25.7		25.7

Percent road reduction: 0% total miles; 0% RHCA miles

Road Reconstruction	Clear Creek IR Project[6]	Percent of Total Miles
Total miles	1.6	5%
Miles outside RHCA	1.6	
Miles in RHCA	0.0	0%

Road Recondition	Clear Creek IR Project[6]	Percent of Total Miles
Total miles	1.8	6%
Miles outside RHCA	1.4	
Miles in RHCA	0.4	5%

Non-System Road Decomm	SF/WF Road Decomm[1]
Total miles	2.3
Miles outside RHCA	1.8
Miles in RHCA	0.5

Other Actions Proposed in the Prescription Watershed

Clear Creek IR Project[6] (Alt C – max alternative)	Commercial Harvest (acres)	Temporary Roads (acres)	Prescribed Burning (acres)
	84(1% of watershed) 68 are Regen Harvest – (1% of watershed)	1	120

Upward Trend Summary

A positive upward trend was determined for each of the Forest Plan Prescription watersheds with Forest Plan, Appendix A fish/water quality objectives. Big Cedar Creek and Lower Clear Creek Prescription watersheds do not have assigned objectives in the Forest Plan. The upward trends for Clear Creek and its prescription watersheds are primarily a result of riparian areas that are intact with minimal effects from management and a majority of roads that are graveled and positioned to have minimal effects on streams. In addition, the Appendix A Implementation Guide (Conroy and Thompson 2011) states ***"It was assumed in the Forest Plan that implementation of instream restoration and other watershed restoration activities would result in an upward trend in carrying capacity. Where these activities have been implemented, it could be stated that an upward trend in the habitat conditions has been accomplished."*** Watershed restoration activities in the form of road improvement, culvert replacement and road decommissioning have been, and continue to be implemented since 2011. These have contributed to the upward trend in fish habitat carrying capacity throughout the watershed.

Although short term impacts to modeled water and sediment yield are expected with the implementation of the Clear Creek project, they are less than those that could occur under Alternative A (No Action). The No Action alternative does not address road-related sediment issues beyond what projects have already been completed. Short term (<5 years) negative impacts with long term beneficial impacts to sediment yield are expected as a result of the Clear Creek IR Project road improvement and road decommissioning activities. Modeled sediment yield using NEZSED shows an increase in all prescription watersheds but all remain below Forest Plan water quality objectives with the exception of Hoodoo under Alternative C which exceeds the objectives by 1%. Modeling in FISHSED shows increases in cobble embeddedness or reductions in fish habitat capacity of 1-15% depending on the alternative. Alternative B exceeds 10% for winter rearing in the Hoodoo watershed. Alternative C exceeds 10% for cobble embeddedness in Brown Springs and Solo and exceeds for winter rearing in Brown Springs, Solo and Hoodoo watersheds. Alternative D exceeds 10% for cobble embeddedness in Brown Springs. Upward trend of aquatic and watershed conditions, particularly related to sediment, would be realized in the long term (>5 years). The short term impacts represent the maximum potential for erosion/sediment delivery and/or increase in water yield. Best Management Practices and project specific design measures would be implemented to minimize these impacts.

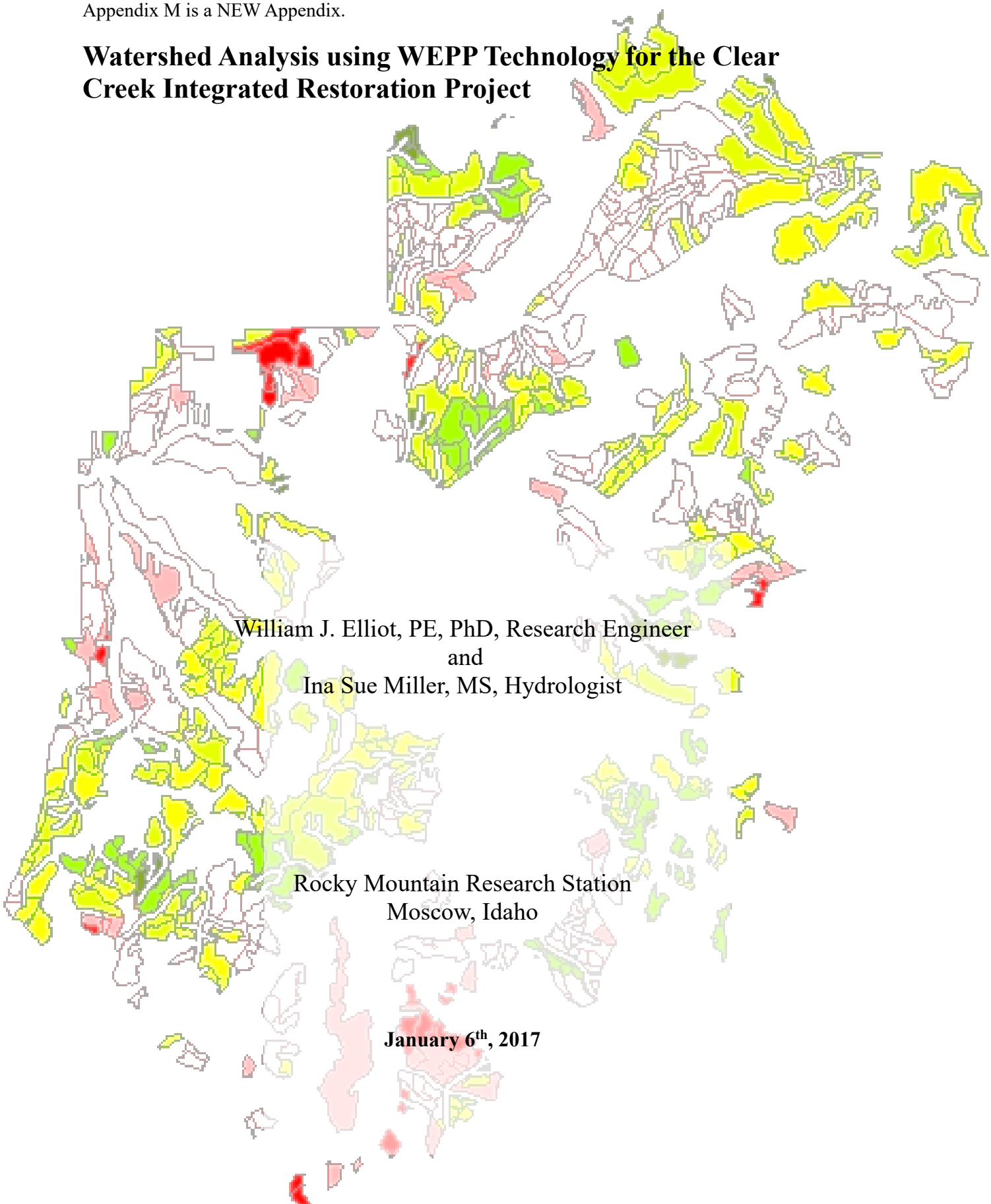
In summary, the Clear Creek IR Project would have minimal short term negative effects associated with modeled water and sediment yield increases but would have a long term positive effect associated with road improvements. The combined road-related projects are expected to maintain an upward trend through reduced sediment delivery and runoff from roads to streams and aquatic habitats throughout the watershed. Reduced chronic sediment delivery is expected to allow for improved fish habitat carrying capacity and a continued upward trend over time. This is consistent with and follows the direction of the Forest Plan Appendix A Guidance document.

The conclusions regarding aquatic trends in the prescription watersheds are the consequence of subtle balances between the short-term impacts and long-term improvements. Trend conclusions must also be tempered with knowledge of the variability of conditions within the watersheds and the unpredictability of weather and natural disturbance events. Future trend will likely be very much influenced by future events –both management activities and natural events, including climate change.

Appendix M – RMRS Watershed Analysis

Appendix M is a NEW Appendix.

Watershed Analysis using WEPP Technology for the Clear Creek Integrated Restoration Project



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January 6th, 2017

Introduction

The Clear Creek Integrated Restoration Project (approximately 18,000[2] ha (44,000 acres)) is located 8 km (5 mi) southwest of Kooskia, Idaho in the Nez Perce-Clearwater National Forest (NPC). The goal of the project is to restore desired silvicultural distributions and diversity within areas of even aged stands on 3400 ha (8400 acres) within the project area. The proposed activities included commercial harvesting and thinning by skyline or tractor methods, and prescribed burns, either broadcast or jackpot. The Clear Creek watershed is a sensitive area as it is an historic spawning area for Pacific salmon, and is upstream a Tribal fish hatchery that depends on the creek for high quality water.

The USDA Forest Service, Rocky Mountain Research Station (RMRS) was asked to help estimate the erosion from units treated by timber removal, prescribed fire and part of the road network, and to compare those estimates to earlier estimates using the NezSed model. Sediment delivery rates from treatment units were estimated using GeoWEPP, a GIS interface to the Water Erosion Prediction Project (WEPP) watershed version. A new road network erosion analysis tool under development by RMRS and the USDA National Soil Erosion Research Laboratory was combined with the FS WEPP:Road Batch[3] to estimate sediment delivery from part of the road network.

Methods

The general approach to the analysis was to determine erosion from the current condition for an undisturbed forest, and following a wildfire, assumed to occur about once every 80 years. The wildfire severity was estimated by the FlamMap fire spread model for the current fuel loads in the LANDFIRE database. From these two runs, a background erosion rate was estimated. The sediment delivery from 646 individual treatment units were then analyzed for prescribed fire (broadcast and jackpot) and timber removal (tractor logging or skyline). Following timber removal, the fuel model that serves as input to FlamMap was changed to a recommended model following fuel reduction, and FlamMap rerun for the landscape. The output from this run was used to run GeoWEPP a final time to estimate erosion rates following wildfire on the proposed treatment units.

Flammap Intensity and Soil Burn Severity Prediction

The FlamMap model considers slope, aspect, available fuel ("fuel model"), canopy cover, stand height, canopy base height and canopy bulk density to estimate wildfire intensity. The FlamMap input variables are incorporated into a landscape (LCP) file that can be downloaded from the LANDFIRE database web site[4]. The distributed fuel model layer as recommended by the LANDFIRE database was used for the initial run. For the post treatment run, several fuel models as recommended by the ArcFuels user guide for treated conditions were run for the entire landscape (Vaillant et al., 2013). We decided to use the model that resulted in the highest flame lengths, model TU1 (161) "Low Load Dry Climate Timber – Grass-Shrub" (Scott and Burgan, 2005). Weather, wind and fuel moisture data needed to run FlamMap were based on weather

[2] All areas will be rounded off to make for easier reading.
[3] https://forest.moscowfsl.wsu.edu/fswepp/
[4] http://landfire.gov/

Table 1. Classification of flame lengths into soil burn severity, and assumed ground cover for each severity.

Burn Severity Category	Percent of landscape	Range of Flame Lengths (m)	Ground Cover (percent)	Repellency
Unburned	32.5	< 1.2	100	No
Low	38.5	1.2 – 1.8	60	No
Moderate	22.6	1.9 – 3.8	40	No
High	6.4	> 3.9	30	Yes

records from the Fenn Ranger Station, located about 20 km (12 miles) east of the study area. The weather data were downloaded from the FAMWEB[5] web site and into the Fire Family Plus software. Fire Family Plus software provided the tools to format the weather data for use in FlamMap. FlamMap provides a number of outputs. For this analysis, the flame length in each pixel was used as a surrogate for fire energy release or fire intensity.

An investigation of recent wildfire soil burn severity distributions of the NPC was done to determine the distribution of wild fire soil burn severity. Ten fires from 2015 were analyzed. The results showed a distribution of fire burn severities were: high = 6.4%; moderate = 22.6%; low = 38.5%; and unburned = 32.5%. This distribution was used to classify burn severity from the flame length predicted by the FlamMap model, with the longest flame lengths assumed to result in the highest burn severities (Elliot at al., 2016).

The flame length raster output from FlamMap for the current fuel loads was classified as unburned, low, moderate, or high severity so that the fraction of each severity was similar to what had been observed for recent wildfires (Table 1). A second FlamMap flame length raster was generated for the treated condition. The same flame length classification ranges from the initial run were used to estimate burn severity following a second FlamMap run, this time for the treated fuel condition. The maximum predicted flame lengths for the fuel model were about 1.6 m, so the entire landscape was classified as either unburned or low severity.

The flame length (raster) maps were uploaded into the Burned Area Emergency Response, Spatial WEPP Model Inputs Generator[6]. This site combines a fire intensity or burn severity map with soil properties from the SSURGO OR STATSGO databases and the Forest Service Disturbed WEPP soil erodibility database to generate soil files formatted specifically for use with the Geo Spatial GIS Wizard for the WEPP Watershed Version (GeoWEPP) (Miller et al., 2016).

Management Activities

The NPC had proposed numerous treatments to obtain a desired forest condition. Only those activities that would likely result in an increase in sediment delivery were modeled. They were

[5] https://fam.nwcg.gov/fam-web/
[6] http://geodjango.mtri.org/geowepp/

Table 2. Details of the silt loam soil files and management files used to describe each of the treatments

Treatment	WEPP Silt Loam Soil Category File and Management File	Ground Cover (Percent)
Undisturbed Forest	Mature Forest	100
Skyline Logging	Mature Forest	90
Tractor Logging	Shrub	85
Jackpot Burning	Low severity fire	90
Broadcast Burning	Low severity fire	85

timber harvest with tractor logging and skyline/cable logging, prescribed fire as a broadcast burn, and prescribed fire as a jackpot burn. Each activity affects ground cover and soil properties. To address these impacts within the WEPP technology, the modeler selects an appropriate vegetation category for each treatment and a ground cover amount for each treatment. Table 2 shows the categories and ground covers assumed for these activities. The ground cover values are based on observations on numerous studies that have been carried out in the Interior Pacific Northwest where impacts of skyline and tractor logging, and prescribed fire have been measured.

Research studies by the Rocky Mountain Research Station have shown that soil texture has much less influence on soil erodibility than vegetation category. For this study, we assumed that the dominant texture was silt loam, and used that for all vegetation categories (Table 2).

WEPP Hillslope Erosion Prediction

Two types of modeling conditions were developed: 1) the post wildfire for current and treated vegetation conditions, where soil properties were determined by fire intensity as estimated from FlamMap outputs and the underlying SSURGO/STATSGO soil database; and 2) the treated conditions where a silt loam soil was assumed, and soil properties depended on the proposed management actions. FlamMap burn severity distributions varied across the landscape. For the treated conditions, we assumed a constant condition for each of the proposed activities as shown in Table 2. The depth of soil for all treated conditions was assumed to be the same as the average depth of soils in the SSURGO database, about 1500 mm (60 inches).

The GeoWEPP Tool is best run for subwatersheds under 5 km^2 (2 mi^2). To achieve this within a large area such as the Clear Creek watershed, the modeled area needs to be subdivided. Dr. Mary Ellen Miller (Michigan Tech Research Institute) developed a GIS addin (Fire ToolBox) specifically designed to break up a large watershed (raster) into smaller, subwatersheds, where the user defines the desired area (Elliot and Miller, 2016). We used the Fire ToolBox to obtain the desired watershed areas (approximately 5 km^2) for the GeoWEPP runs. This procedure resulted in 40 subwatersheds that incorporated all of the proposed treatment units. Within each subwatershed, GeoWEPP defined hillslope polygons of approximately 4 ha (10 acres) and

estimated the erosion rate for each polygon. Each of the subwatersheds was run for each of the 7 conditions: undisturbed forest, wildfire under current fuel loads, wildfire following fuel treatment, tractor logging, skyline logging, broadcast prescribed fire and jackpot prescribed fire. This resulted in a total of 7 x 40 = 280 separate GeoWEPP runs. When a set of 40 runs for one of the conditions had been complete, we utilized the merge function in ArcMap to reunite the smaller watersheds back into the original larger watershed.

The current version of GeoWEPP does not allow the user to specify undisturbed streamside buffers. This means that the estimated upland erosion rate may be over predicted by a small amount, but it would not be advisable to assume sediment detached in the upland areas was all delivered to the streams. The online Disturbed WEPP hillslope interface[7] or Great Lakes Watershed interface[8] can be used to evaluate buffer effectiveness. This detailed analysis was beyond the scope of this project.

To complete the analysis, it was necessary to combine the results from the individual GeoWEPP hillslopes with the 646 proposed treatment units. Each treatment unit could intersect one or more GeoWEPP hillslopes. To estimate the erosion within each treatment unit, we used ArcToolbox's *Analysis Tools* such as "spatial join" then choosing to "intersect the mean", defining treatment units on each of the erosion maps. Using this process estimated the area-weighted erosion as a mean within each treatment unit. All of these results are available within the attribute tables in ArcMap and in spreadsheets by treatment units, in either English or metric units. The resulting distributions of erosion were sorted in spreadsheets to determine the average erosion rate for each treatment.

WEPP Road Erosion Prediction

The GIS Road layers were provided by the NPC. For the road analysis, we dropped all roads that were specified as "nonexistent." Map 10 shows the network that was modeled in black. We formatted and uploaded the road network layers into an online GIS tool designed to determine road segment length and steepness, and whether the segment intersected a stream, or not[9]. We developed a cross walk table for the NPC road status and the road designations recognized by the online interface. Table 3 summarizes the crosswalk categories. The online tool is run by sub watershed, where the roads are subdivided into eroding segments based on the underlying topography and user input. We specified a maximum road segment length of 90 m (300 ft). As an output file, the interface specified the road segment length and steepness, whether it was a stream crossing, and the online category (Table 3). Using logic statements in a spread sheet, we defined the WEPP:Road Design, Road Surface, Traffic Level and Width for each road segment as shown in Table 3. Once the characteristics of each road segment were defined in WEPP:Road terms, those values were input into the FSWEPP WEPP:Road Batch program and the road erosion and runoff, and sediment delivery to a channel from each road segment were estimated. For road segments not at a stream crossing, we assumed a very conservative buffer width of 15 m (50 ft). The output amounts for road surface erosion and sediment delivery to a channel for each WEPP:Road segment were recombined in a spreadsheet totaling all original NPC segments to

[7] https://forest.moscowfsl.wsu.edu/
[8] http://cals-wepponlinegis.ag.uidaho.edu/gl/
[9] http://milford.nserl.purdue.edu/ol/roads/

Table 3 Crosswalk between road status in the Nez Perce Clearwater (NPC) Road database, the categories for the online GIS tool, and the WEPP Road categories to predict road erosion.

NPC Road Status	Online Watershed Road Category	WEPP:Road Categories			
		Design	Surface	Traffic	Width (ft)
Asphalt and passenger cars	Road - Light Duty Paved	Inslope, Veg Ditch	Paved	High	18
High clearance vehicles	Road - 4WD	Rutted	Native	Low	10
Improved native material	Road - Light Duty Dirt	Rutted	Native	Low	12
Crushed aggregate or gravel	Road - Light Duty Gravel	Inslope, Veg Ditch	Gravel	High	16
Native material	Road - Unimproved	Rutted	Native	Low	12

determine the erosion and sediment delivery associated with each of these original NPC road segments.

Results

The spatial results of the distribution of fire intensity from the FlamMap runs are presented on Map 1 for wildfire for the current condition and Map 2 if the entire area were treated. The erosion associated with the FlamMap run (Map 1) for current conditions is presented in Map 3, averaging the GeoWEPP polygons within each treatment unit. The total area of the proposed treatments is 3500 ha (8400 acres).

Map 4 shows the distribution of erosion for undisturbed upland forest conditions for the treatment polygons. The 45 and 90 m (150 and 300 ft) PACFISH buffers are shown on the treatment map, but were not included in the erosion analysis.

Map 5 shows the potential erosion associated with skyline logging for all of the treatment units. There are 1500 ha (3715 acres) schedule for this action (Table 4). Map 6 is the potential erosion from tractor logging. There are 2000 ha (4900 acres) scheduled for tractor logging (Table 4). GIS layers are provided as an addendum to this report should the forest wish to develop a merged map of these two treatments.

The erosion estimated where all of the treatment units subjected to jackpot burning is shown in Map 7. Only 200 ha (490 acres) of the 3500 ha (8400 acres) shown on the map are being considered for jackpot burning, about 35 percent of the total area to be burned. The erosion

Table 4 Summary of areas and erosion associated with each treatment.

Treatment	Proposed Area (ha (acres))	Estimated Erosion Rate (Mg/ha)
Wildfire under Current Conditions	3500 (8600)	4.56
Wildfire following fuel treatments	3500 (8600)	0.047
Undisturbed Forest	3500 (8600)	0.22
Precommercial Thin, Tractor	1300 (3200)	0.86
Precommercial Thin, Skyline	400 (1000)	0.44
Regeneration, Tractor Logged	675 (1660)	0.93
Regeneration, Skyline Logged	1000 (2500)	0.49
Improvement, Tractor Logged	25 (60)	0.73
Improvement, Skyline Logged	110 (470)	0.29
Prescribed Fire, Broadcast Burn	360 (900)	1.24
Prescribed Fire, Jackpot Burn	200 (500)	1.89

estimated for prescribed fire for all treatment units is shown in Map 8. Only 360 ha (885 acres) of broadcast burning are in the restoration plan, about 65 percent of the area proposed to be burned.

Map 9 is the predicted erosion rate for all the treatment units should a wildfire occur following treatment. As all units are at risk to wildfire, the predictions on this map apply to all 3500 ha (8400 acres) scheduled to be treated. Map 10 shows the difference in post wildfire resulting from the proposed restoration treatments. The more red the polygon, the greater the benefit from reduced erosion due to the restoration treatments.

The spreadsheets that were developed summarizing the erosion from each treatment were sorted, so that only the units scheduled for treatment were considered in summarizing the tabular erosion by treatment. These results are shown in Table 4. Note that the erosion values presented represent not only the effect of the treatment as shown in Table 2, but also the length and steepness of the slope as determined by GeoWEPP from the underlying digital elevation model. The spreadsheets are appended to this report, so that additional analyses of specific treatments can be considered, as well as the erosion risks of the other alternatives, or applying those treatments to areas not currently scheduled for a given treatment. For the prescribed fire, the treatment units were not specific as to which method would be used. We assumed that the 360 ha with the lowest erosion rates would be broadcast burned, whereas the 200 ha with the highest erosion rates would be jackpot burned, as they would likely be prescribed for steep slopes. Because the jackpot burning

Table 5. Summary of results of road erosion analysis

Average Annual Precipitation	960 mm	37.72 in.
Average Runoff from Rain Average Runoff from Snow Total Runoff	210 mm 240 mm 450 mm	8.30 in. 9.36 in. 17.66 in.
Total Sediment leaving the road surface Total sediment entering upland channels	980 Mg 735 Mg	1079 tons 809 tons
Total Length of road analyzed	270 km	166 miles
Average erosion rate of road surface (NezSed Range 5,000 – 67,500 tons/mi^2) Average sediment delivery to stream assuming a (15 m) 50 ft buffer Fraction delivered	3.7 Mg/km or 860 Mg/km^2 2.8 Mg/km or 640 Mg/km^2 0.75	6.5 tons/mile or 2,450 tons/mi^2 4.9 tons/mile or 1,840 tons/mi^2 0.75
If total area of the watershed is 18,000 ha (44,000 acres), Average sediment delivery	4.1 Mg/km^2	11.8 tons/mi^2
Sediment reduction from removing 15 km (9.5 miles) of road	41.7 Mg	45.9 tons

was attached to the areas with highest erosion, the average value for jackpot burning is greater than for broadcast burning on the more gentle slopes.

The road erosion analysis is summarized in Table 5. Roads specified as non-existing were dropped from the analysis, leaving 248 distinct road segments. By specifying a maximum road segment length of 90 m (300 ft), the 248 segments provided by the NPC were disaggregated into nearly 3,000 segments with lengths of 90 m or less by the online watershed interface, and were then formatted for the WEPP:Road analysis. These 3,000 segments were run in lots of about 200 through WEPP Road Batch. The results of the 3,000 segments were then recombined by their NPC designations to determine road erosion and sediment delivery by the original NPC road segment modeled, and can be found in the appended spreadsheets.

Table 5 shows that the average annual amount of sediment entering the stream system was 809 tons from a total of 270 km (166 miles) of road, or about 2.8 Mg of sediment per km road (4.9 tons/mile). The average road surface erosion rate was 860 Mg per square kilometer of road surface (2,500 tons/square mile).

Discussion

The undisturbed forest soil erosion rate (0.22 Mg/ha) can be converted to about 60 tons per square mile. This is similar to the NezSed “Background” rate of 30-40 tons per square mile. The WEPP values are for hillslope erosion, whereas the NezSed values are for the expected sediment to be delivered from sub basins within the study area. Regular monitoring of sub basin sediment delivery was the source of the NezSed values. It is widely accepted that sediment delivery from watersheds is lower than upslope erosion. For a 4 sq km (2 sq mile) watershed, the estimated sediment delivery ratio would be about 0.3 (Huffman et al., 2013), reducing the predicted hillslope erosion rate of 60 tons per square mile to a sediment delivery amount of about 20 tons per square mile. This sediment yield would need to be increased to account for sediment from

mass wastage by about 10 tons per square mile per year in the Clearwater Basin (McClelland et al., 1997). Thus it is clear that the overall predicted upland erosion and sediment delivery rates are similar when comparing the NezSed estimates to the WEPP estimates.

The hillslope erosion rate (0.22 Mg/ha (0.1 ton/acre)) is higher than we have measured in situ on numerous studies. This may be because the WEPP technology is over predicting, or it may be because we have not had any studies in place during years of very high erosion, like 1995-96. On many multi-year studies we have measure no surface erosion. We have measured soil displacement, which has often been due to animal activity. Further work is warranted to determine whether the discrepancy is due to modeling error, or a lack of field data from rare highly erosive years.

The results shown in Table 4 can be analyzed to find that the total sediment from the proposed treatments (erosion rate x area) is about 15 percent of the total predicted for the undisturbed forest. This is similar to the NezSed estimates of sediment yield in the EIS that stated that on the average, Alternative C would cause an “increase over base” of 13 percent. If wildfire is assumed to have a fire return interval of about 80 years, and the average erosion from the wildfire added to the “background”, then the increase over base from the values in Table 4 is about 12 percent. Thus the sediment estimates from NezSed, using a completely different approach to modeling, is similar to what has been predicted by this analysis. The main benefit of the WEPP analysis, aside from confirming the validity of the NezSed estimates, is that the GIS layers showing the distribution of erosion by specific treatment unit may assist managers to better target less aggressive treatments to areas of greatest erosion risk.

The erosion maps presented in Maps 3-8 are by proposed action. More detailed maps by hillslope polygon are included in the appended files, and we can provide guidance on accessing that information should the NPC want to look more closely at some of the more sensitive treatment areas.

The unexpectedly low erosion rate following the wildfire for the treated condition is likely due to the large areas of low severity and unburned patches predicted from the FlamMap run for the fuel model selected. The fact that the value is lower than the treatments is likely because the soil database is not the same. The SSURGO soils are often deeper, this leads to less runoff and erosion when modeled with WEPP rather than the 1500 mm assumed for all of the treatment runs.

One of the important results in Table 4 is the major reduction in wildfire erosion that can be expected from the proposed restoration activities. Reducing understory fuel loads and increasing canopy spacing as proposed in the restoration plan will both contribute to reduced fire risk, and reduced fire intensity. This prediction is supported by anecdotal observations within the NPC following recent wildfires.

Generally, all of the predicted erosion rates except the post treatment wildfire estimate, are greater than we have measured from undisturbed and treated forests. Most of the erosion we have measured from forest activities, including both timber removal and prescribed fire, is movement on the hillslope, and not from the hillslope. This is due in part to the lack of severe hydrologic events, such as the floods of 1995 and 1996, occurring during our studies that were carried out between 2000 and 2014.

The proposed large buffers in the restoration will further reduce the likelihood of sediment delivery. The estimated benefits of a buffer can readily be seen by using the Disturbed WEPP Hillslope[10] or Great Lakes Watershed[11] online interfaces.

Another consideration with the restoration plan is that not only will the proposed activities lead to much lower post wildfire erosion risks, but they will reduce the likelihood of a serious fire occurring for ten or more years because of the lack of fuel to carry a fire.

When comparing the WEPP:Road results shown in Table 5 to NezSed, the NezSed model had gross surface erosion ranging from 5,000 to 67,500 tons per square mile of road surface, depending on the road condition, compared to 2,453 tons per square mile of surface erosion from the WEPP Road predictions. Most of the NezSed road erosion categories were for 5,000 tons per square mile, and these values were then reduced by a number of factors resulting in surface erosion values similar to the WEPP predictions. The very short buffers assumed for the WEPP:Road analysis resulted in delivery of 75 percent of the eroded sediment, whereas the NezSed model appears to have sediment delivery coefficients averaging 17 percent for road segments. Table 5 shows that if the total road sediment delivery (809 tons) is divided by the area of the Clear Creek Watershed (44,000 acres), the resulted erosion rate is about 12 tons/square mile. This is similar to values predicted by the WEPP Fume online interface, but is greater than the 2.2 tons/square mile predicted by NezSed. Were a sediment delivery ratio of 0.17 applied to the WEPP:Road results, the sediment delivery would be 2.67 tons/square mile, similar to the NezSed results. A more detailed analysis beyond the scope of this study is planned to better determine the buffer lengths for the WEPP:Road analysis. It is anticipated that buffer lengths will increase from the conservative estimate of 50 feet to more than 200 feet for most road segments, significantly reducing the estimated sediment delivery. These results will be provide to the NPC once the analysis is complete.

Synthesis

[10] https://forest.moscowfsl.wsu.edu/fswepp/
[11] http://cals-wepponlinegis.ag.uidaho.edu/gl/

Table 6. Summary of sources of sediment in the 18,000-ha (44,000-acre) Clear Creek Basin

Source	Frequency of Disturbance (years)	Tons/sq mile the year of Disturbance	Average Annual Tons/sq mile	NezSed tons/sq mile
Forest Surface Erosion	1	-	20	30-40
Landslides	20	200	10	
Wildfire on 44,000 acres every 80 years	80	1,300	16	-
Treatment of 10,000 acres once every 20 years	20	53	3	12% Increase => 4.2
Road Network	1	-	12	2.2

Table 6 provides a synthesis of estimated sources of sediment in this watershed. It appears that the estimated sediment from surface erosion in the undisturbed forest and landslides are the greatest source of sediment in this watershed. As previously discussed, the erosion from the forest may be overestimated. As managers can do little about forest erosion or landslides, any desire to reduce sediment must occur in the other categories.

This study shows that the proposed restoration actions can reduce wildfire intensity and subsequently reduce estimated post wildfire erosion by 99 percent. This reduction in likely sediment delivery is much less than the predicted increase in sedimentation associated with the restoration activities.

The estimated erosion associated with restoration treatments will be less if the proposed Pacfish buffers are incorporated into the analysis. Further analysis can estimate the change in sediment delivery from such buffers. This study has provided erosion by hillslope segment. The spatial results can be studied, and the treatments adjusted to be less severe on the most erodible hillslopes identified by the study. The estimated sediment from the road network will also likely be less if a more detailed analysis that better accounts for forested buffers between the roads and the stream system is carried out. This analysis will be done, but is beyond the scope of this study. The NPC practice of installing cross drains on roads from either side of all stream crossings will also result in reduced sediment delivery from roads, as the majority of road sediment is delivered at stream and channel crossings.

The equivalent estimates from the initial NezSed analysis are presented in Table 6 for comparison. NezSed lumps the undisturbed forests and landslide sediment into a single value, which is similar to the sum of the WEPP predictions for the undisturbed forest plus the landslide sediment delivery estimated by McClelland et al. (1997). The original EIS estimated an average increase in sediment delivery due to treatments of 12 percent above background, or about 4.2 tons/square mile. This is in the same range as the 3 tons/square mile predicted from this study. The sediment delivery estimated by NezSed from roads is less than that initially estimated by

WEPP in this study, but the WEPP value will likely decrease significantly when an improved estimate for buffers between roads and streams is incorporated into the WEPP analysis. NezSed does not explicitly include erosion from wildfire in its analysis, but sediment delivery measured from streams in the forest that was used for developing NezSed likely included sediment that was delivered to the stream system by a fire in decades preceding the monitoring period.

Conclusions

This study estimated the erosion on undisturbed forests, burned forests, forests under restoration, and much of the forest road network. The study confirmed that the erosion estimates made using the NezSed technology are similar to those using the WEPP technology, even though the two technologies use very different methods. The NezSed technology is based on locally observed sediment data, and the WEPP technology uses local conditions in a process-based hydrology and erosion model. The WEPP technology has the advantage of allowing managers to better locate hillslopes and road segments of high erosion risk, and adjust the management of those sites to reduce erosion and/or sediment delivery.

The increase in erosion associated with the proposed activities will likely be offset by the reduced risk of fire, the reduced severity of a fire should it occur, and the reduction in hillslope sediment delivery following a wildfire.

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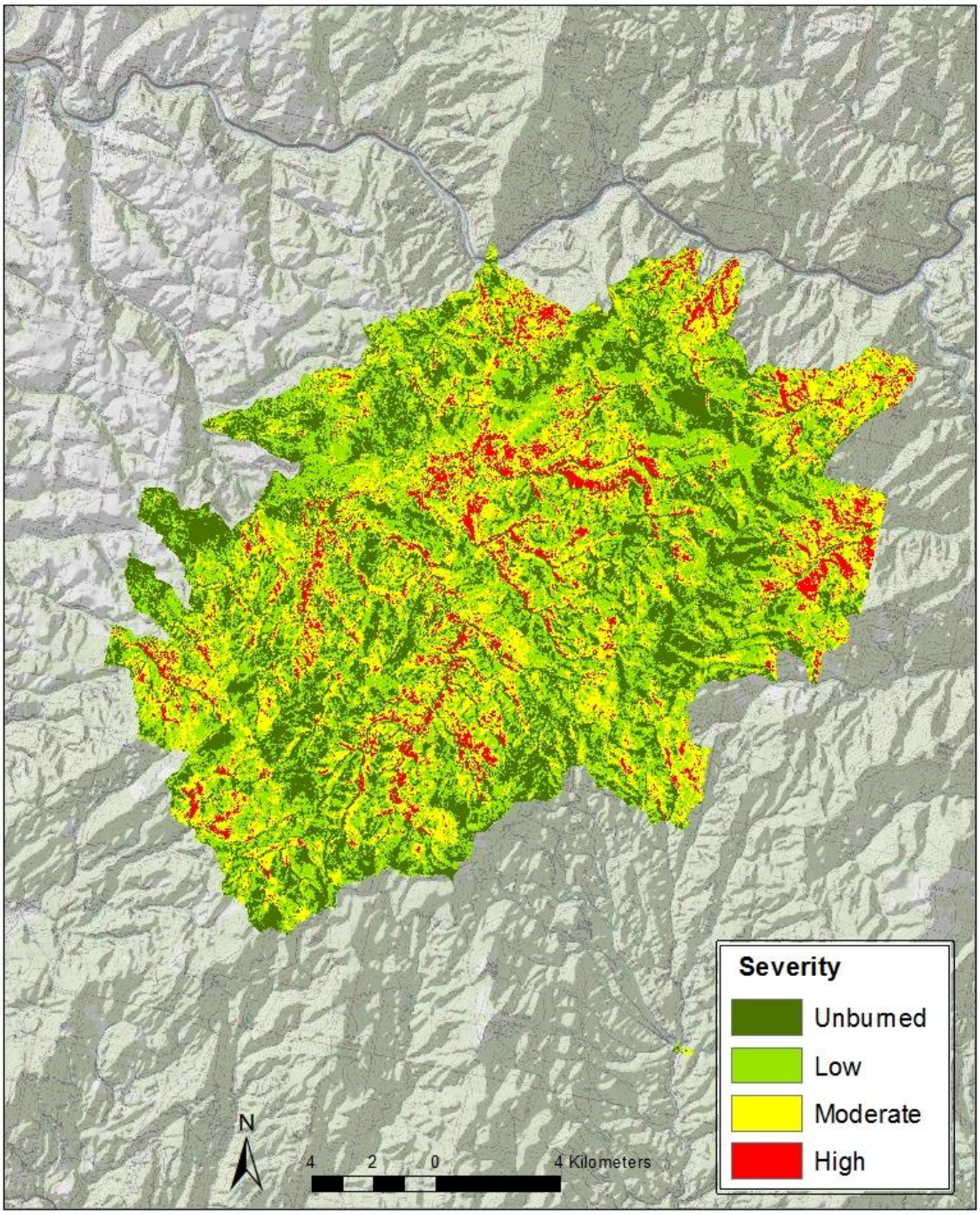
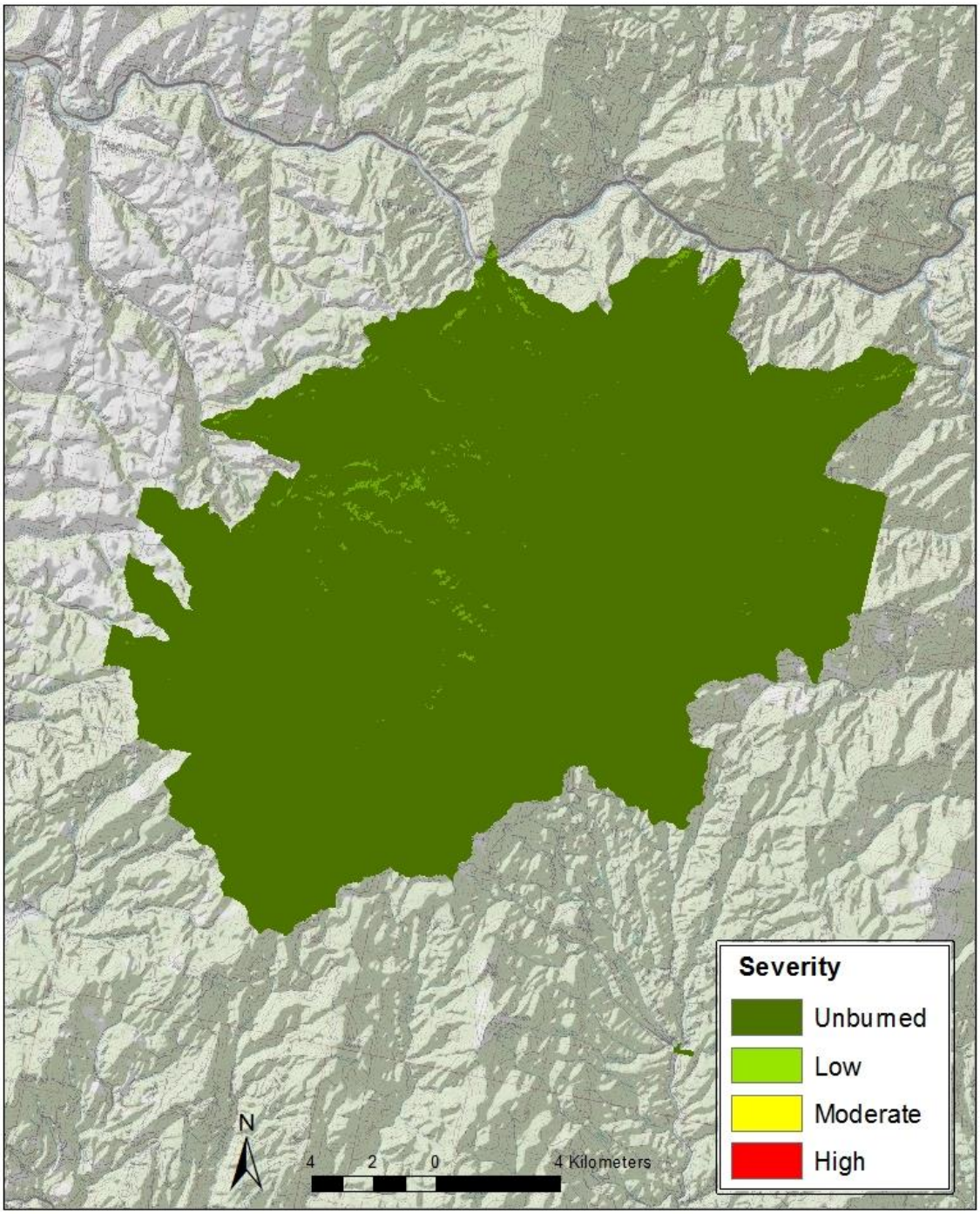
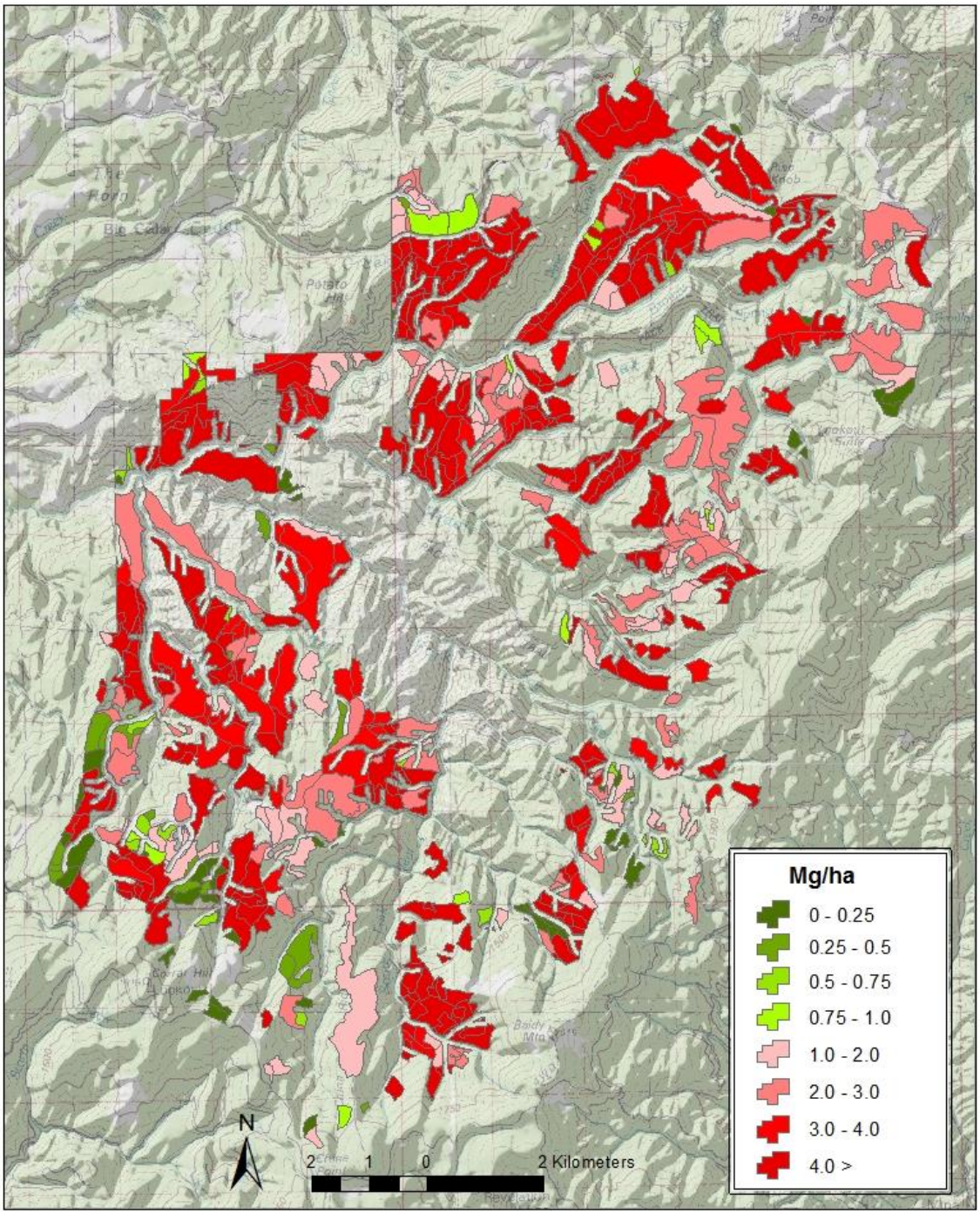
Map 1. Clear Creek Watershed fire severity map using fuel models for current conditions.



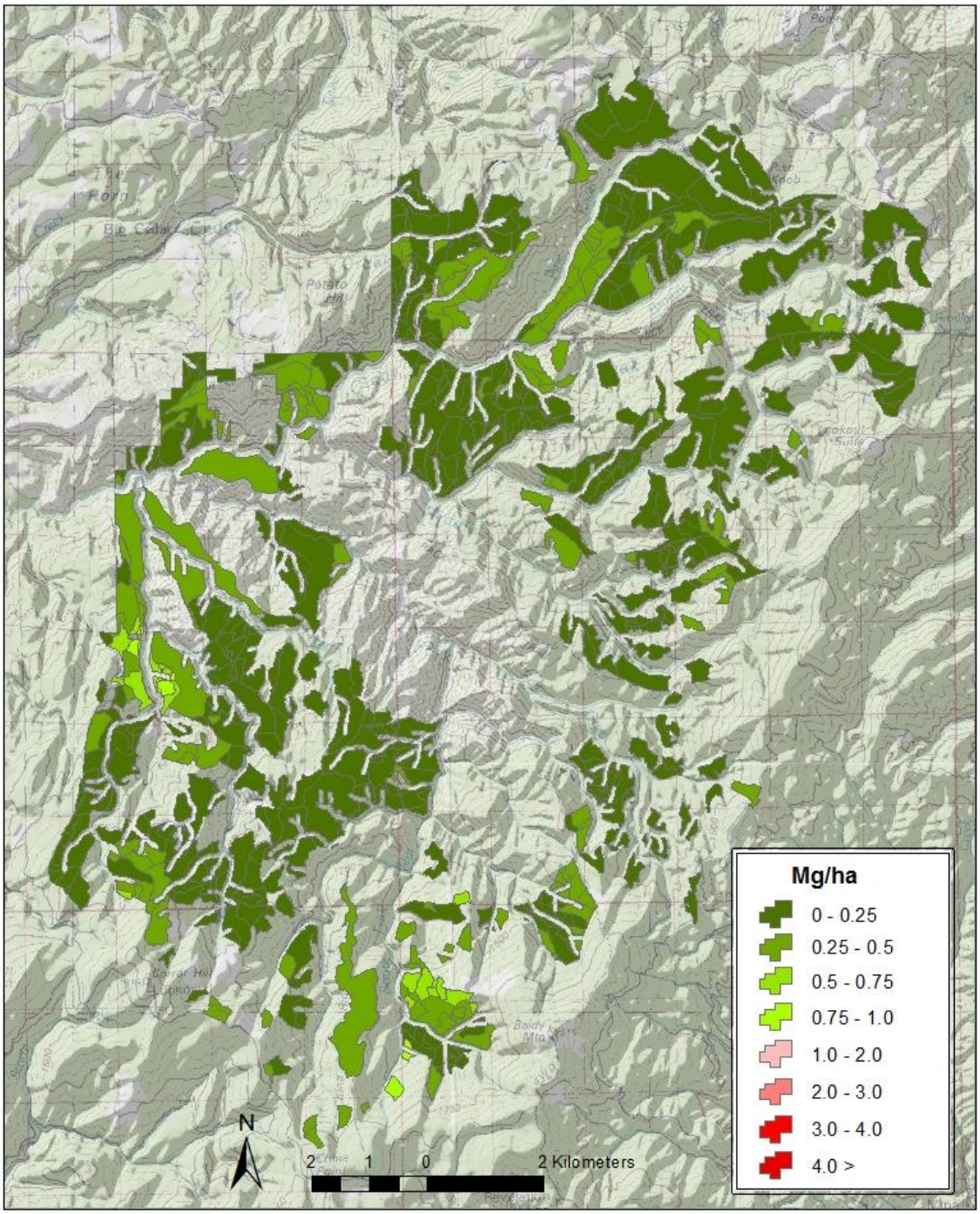
Map 2. Clear Creek Watershed fire severity map using a fuel model following the proposed treatments.



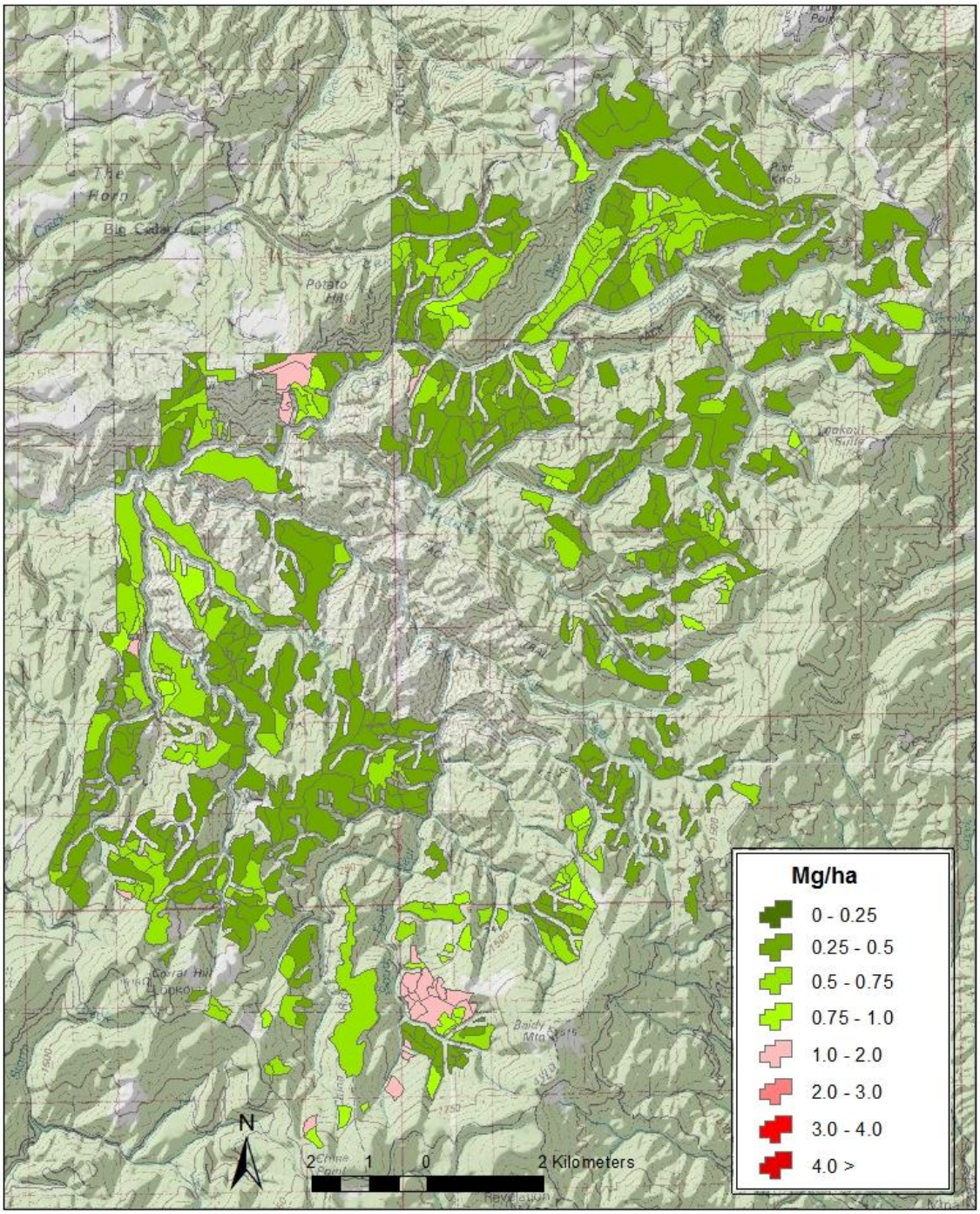
Map 3. Clear Creek Watershed estimated erosion rates following a wildfire under current fuel load conditions.



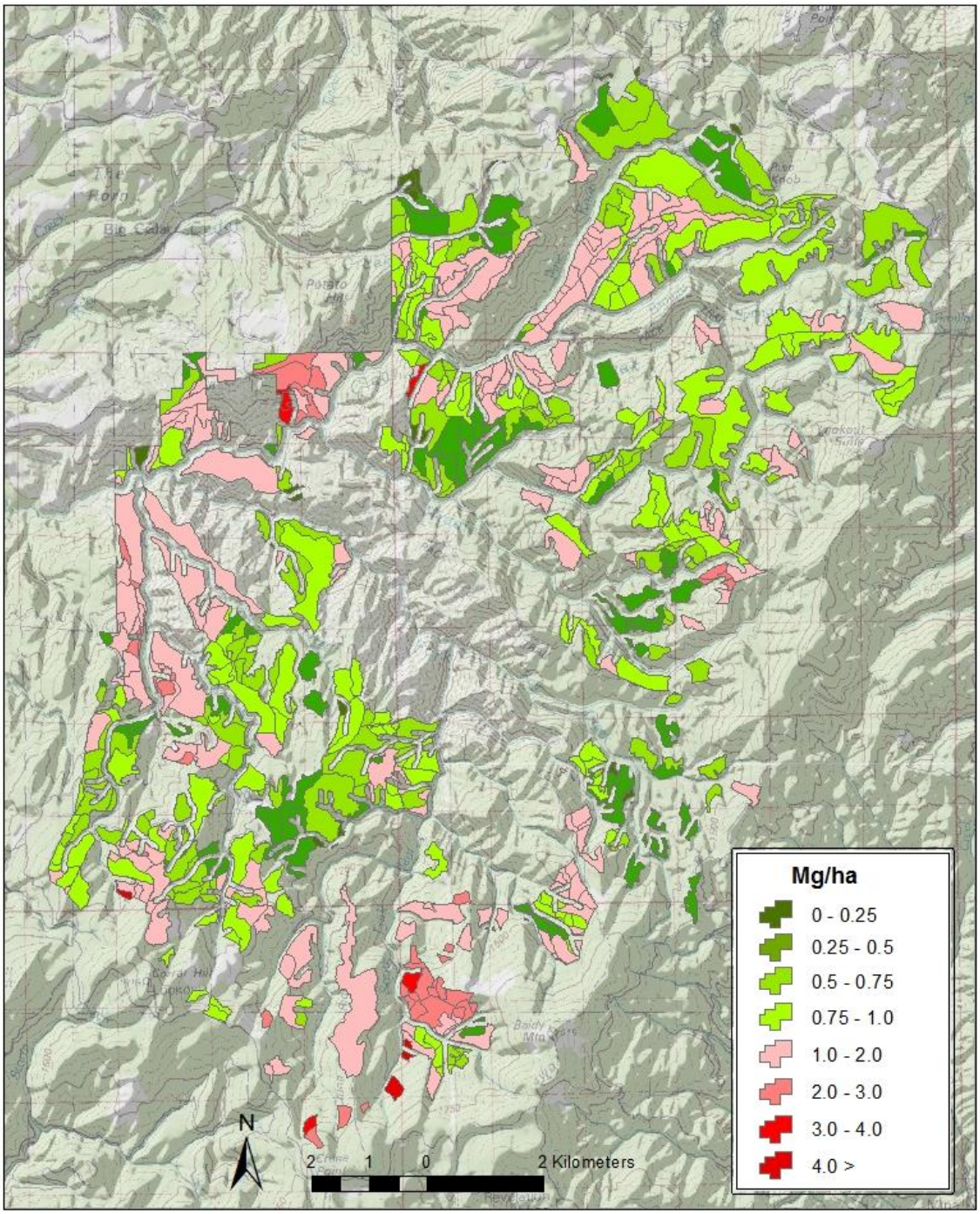
Map 4. Clear Creek Watershed estimated upland erosion for an undisturbed forest condition.



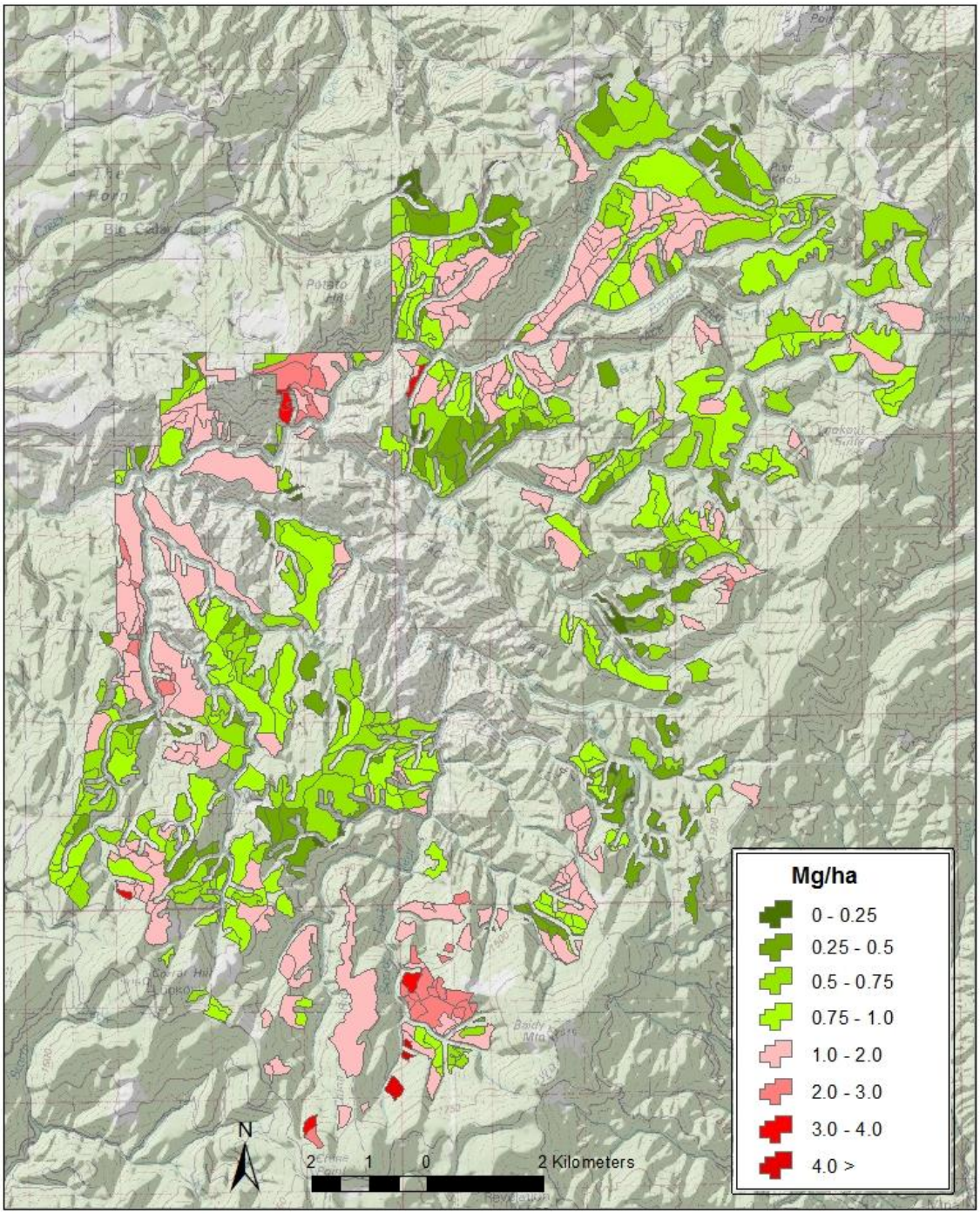
Map 5. Clear Creek watershed estimated erosion if all treatment units were thinned by skyline logging.



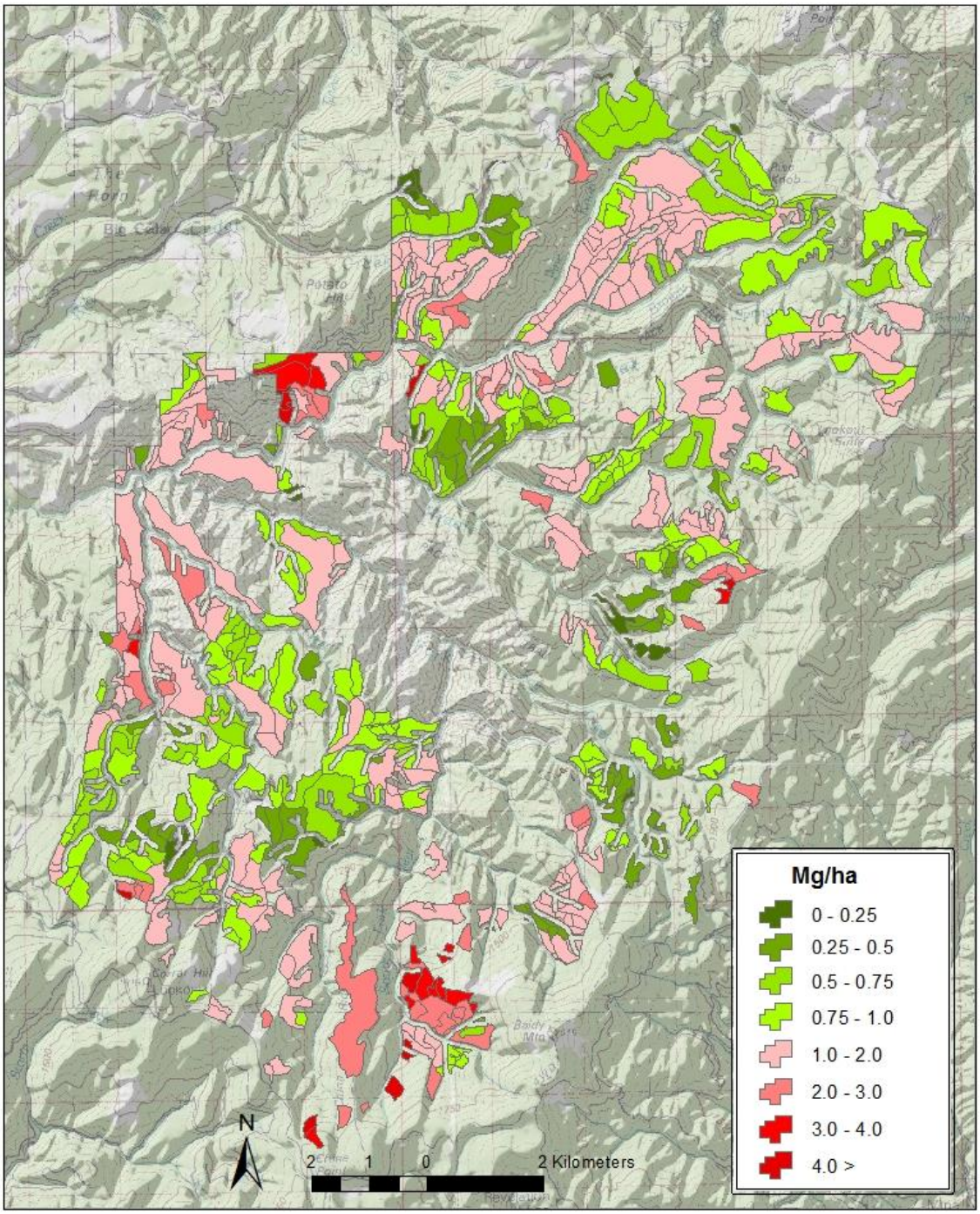
Map 6. Clear Creek watershed estimated erosion if all treament units were thinned by tractor logging.



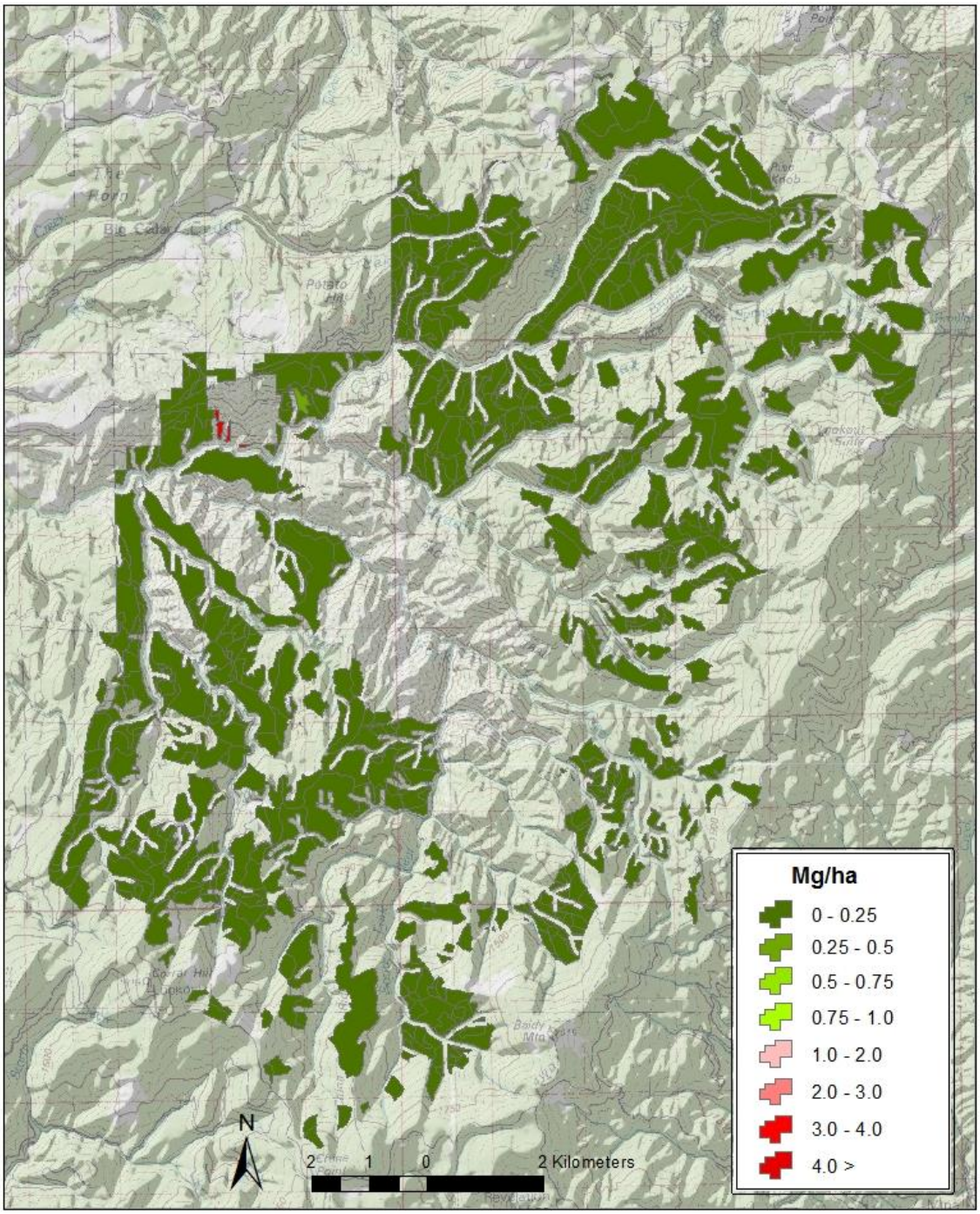
Map 7. Clear Creek watershed estimated erosion if all treatment units were jackpot burned.



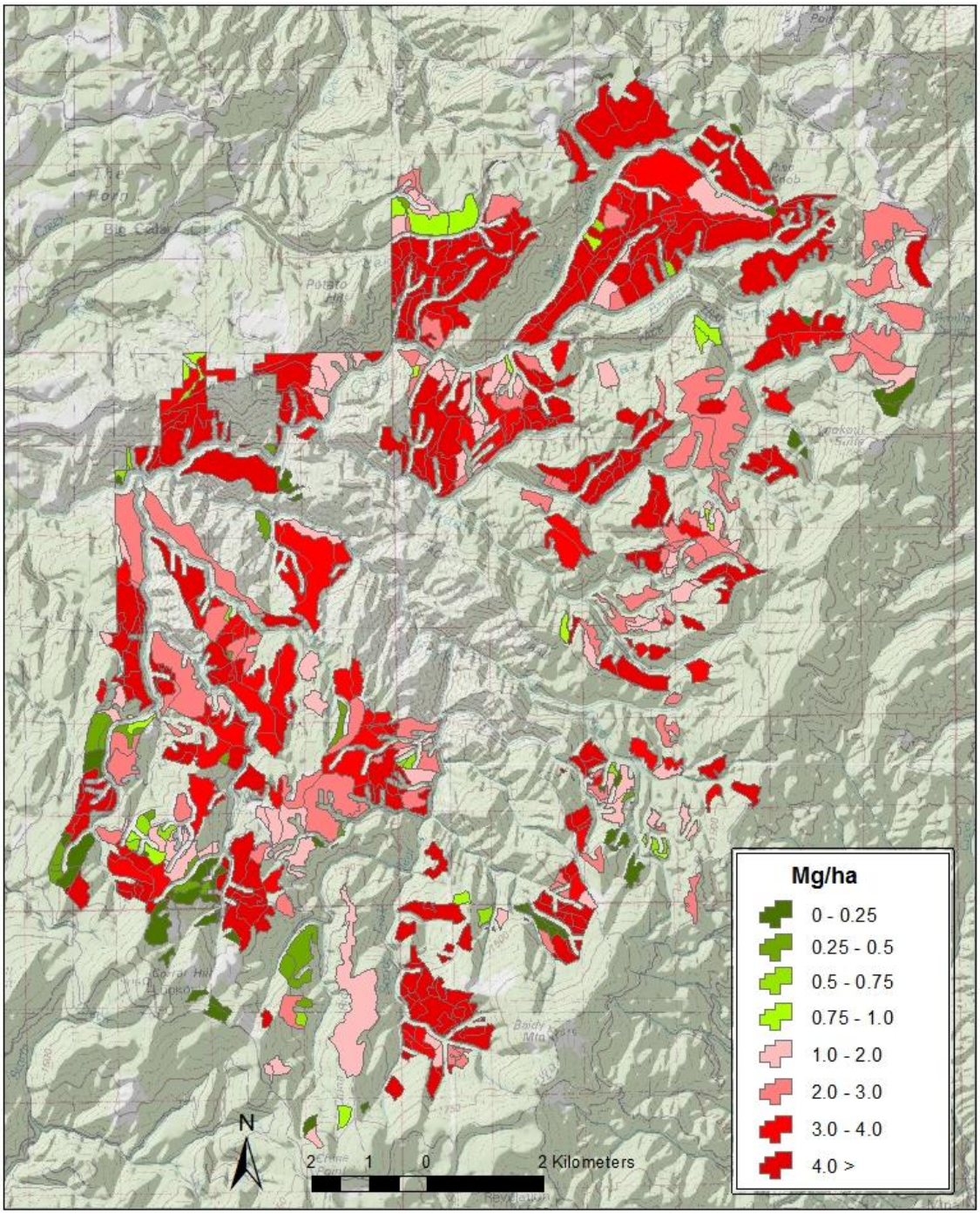
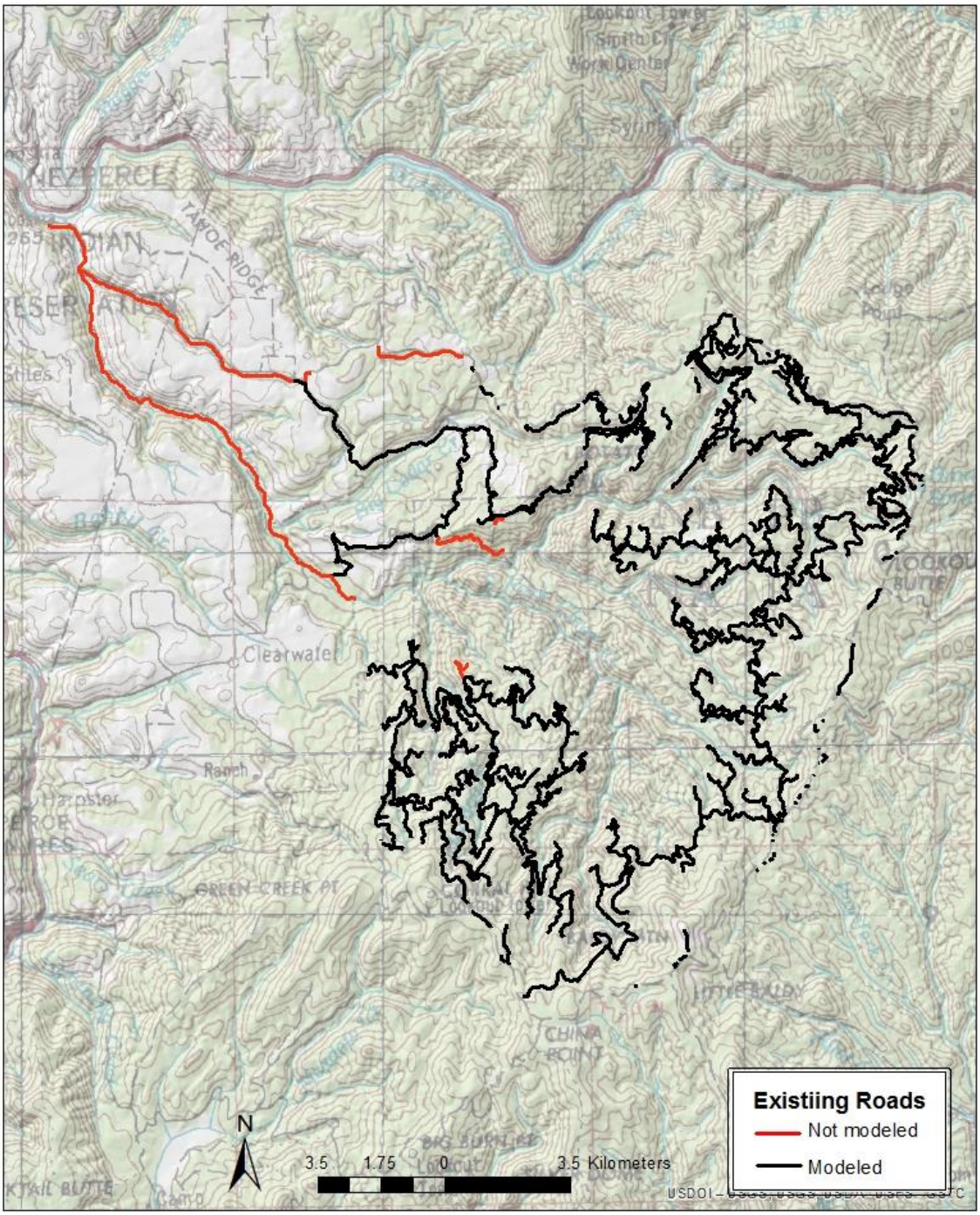
Map 8. Clear Creek Watershed estimated erosion if all treatment units were subjected to a broadcast prescribed fire.



Map 9. Clear Creek Watershed estimated erosion following a wildfire that occured after the proposed treatments had been completed.



Map 10. Clear Creek watershed estimated erosional difference between wildfire and postfire after treatments.



Map 11. Clear Creek Watershed road segments that were analyzed to estimate road erosion.