Fallen Bear Water Resources Report

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Regulatory Framework

Forest Plan

The Idaho Panhandle National Forests' Forest Plan (USDA FS 1987) defines the following management goals for the water resources on NFS lands:

1. Maintain water quality protective of fisheries habitat, water-based recreation, public water supplies, and to meet or exceed State Water Quality Standards: To help accomplish this objective, BMPs must be applied to management activities. Monitoring efforts must focus on the implementation of BMPs and their effectiveness in protecting water quality. Water quality that is below Forest standards must be improved through restoration projects and through scheduling of timber harvest and road building activities.
2. Protect stream channel integrity: Manage riparian areas to meet objectives for dependent resources (fish and wildlife habitat, water quality, stream channel integrity, and vegetation) while producing other resource outputs.

Forest-wide standards direct the following on NFS lands with respect to the water resource:

1. Management activities on Forest lands would not significantly impair the long-term productivity of the water resource and would ensure that state water quality standards are met or exceeded.
2. Maintain concentrations of total sediment or chemical constituents within State standards.
3. Implement project-level standards and guidelines for water quality contained in the Best Management Practices (Forest Service Handbook 2509.22, available upon request), including those defined by State regulation or agreement between the State and Forest Service such as:
    a. Rules Pertaining to the Idaho Forest Practices Act (IDAPA 20.02.01)
    b. Stream Channel Alterations Rules (IDAPA 37.03.07)
    c. Best Management Practices (Appendix B)
4. Cooperate with the states to determine necessary instream flows for various uses. Instream flows should be maintained by acquiring water rights or reservations.
5. Manage public water system plans for multiple-use by balancing present and future resources with public water supply needs. Project plans for activities in public water systems would be reviewed by the water users and the State. Streams not defined as public water systems, but used by individuals for such purposes would be managed to the standards stated below or to the fisheries standards whichever is applicable.
6. Activities within non-fishery drainages, including first and second order streams, will be planned and executed to maintain existing biota. Maintenance of existing biota will be defined as maintaining the physical integrity of these streams. Best Management Practices (Appendix B), Forest Plan Appendix O, and riparian guidelines will be used to accomplish this objective.
7. It is the intent of the Forest Plan that models be used as a tool to approximate the effects of National Forest activities on water quality values. The models will be used in conjunction with field data, monitoring results, continuing research, and professional judgment, to further refine estimated effects and to make recommendations.

Inland Native Fish Strategy (INFS) Forest Plan Amendment

Standards for managing riparian areas were established as Forest Plan amendments based on the Inland Native Fish Strategy (1995), commonly referred to as INFS. Riparian Habitat Conservation Areas are determined for watersheds and essentially promote water quality benefits through stream shading, vegetative buffers for sediment control, and channel stabilizing features of woody debris and stream bank vegetation.

Clean Water Act

A declared objective of the Clean Water Act (CWA) of 1977 (33 U.S.C. 1323) is to "...restore and maintain the chemical, physical, and biological integrity..." of streams (US Congress, 1988). The CWA directs the Forest Service to meet state substantive and procedural requirements respecting control and abatement of pollution. Through a Memorandum of Understanding Implementing the Non-point Source Quality Program in the State of Idaho of 1994, the Forest Service is responsible for implementing nonpoint source pollution control and the Idaho Water Quality Standards (IDAPA 58.01.02) on National Forest System lands. Forest Service water quality policy within the MOU is to: promote the improvement, protection, restoration and maintenance of water quality to support beneficial uses, promote and apply approved Best Management Practices (BMPs) to control non-point source pollution, comply with state and national water quality goals, and design monitoring programs for specific activities and practices that might affect in-stream beneficial uses.

40 CFR Part 232 identifies Exempt Activities Not Requiring 404 Permits and 232.3(c)(1) identifies that normal silvicultural activities are exempt. 33 CFR Part 323.4 identifies discharges of dredged or fill material that do no require permits under section 404 of the Clean Water Act. For silvicultural activities the discharge of sediment "is not prohibited or otherwise subject to regulation under section 404". 33 CFR Part 323.4(a)(6) identifies that forest roads do not require discharge permits if constructed and maintained in accordance with best management practices where "adverse effect on the aquatic environment will be otherwise minimized".

State Water Quality Laws & Regulations

The State of Idaho established the Idaho Water Quality Law (§39-3601 et. seq.) and Water Quality Standards (IDAPA, 58.01.02) designed to protect beneficial uses. The State's Antidegradation Policy (IDAPA 58.01.02.051) directs that existing uses and the level of water quality necessary to protect those uses must be maintained and protected. In order to meet the intent of the CWA, the Forest Service is responsible for implementing non-point source pollution control and the Idaho Water Quality Standards on National Forest System lands.

Streams in the Fallen Bear Project area are Undesignated Surface Waters (IDAPA 58.01.02.110.11); beneficial uses applied to undesignated waters are cold water aquatic life, and primary or secondary contact recreation (IDAPA 58.01.02.101.01.a).

Idaho State Water Quality Standards has a section for Rules Governing Nonpoint Source Activities (IDAPA 58.01.02.350). This section of the water quality standards identifies that nonpoint source pollution management will occur through the use of best management practices (IDAPA 58.01.02.350.a).

Executive Order 11988

Executive Order 11988, Floodplain Management (W-1) directs that each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities for:

(1) acquiring, managing, and disposing of Federal lands and facilities;

(2) providing Federally undertaken, financed, or assisted construction and improvements;

(3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

Executive Order 11990

The Protection of Wetlands Order 11990 (W-1) directs agencies to provide leadership and take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for (1) acquiring, managing, and disposing of federal lands and facilities; and (2) providing federally undertaken, financed, or assisted construction and improvements; and (3) conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

National Forest Management Act (NFMA)

Timber Harvest on National Forest Lands (16 USC 1604(g)(3)(E)): A Responsible Official may authorize site-specific projects and activities to harvest timber on National Forest System lands only where:

> a. Soil, slope, or other watershed conditions will not be irreversibly damaged (16 USC 1604(g)(3)(E)(i)).
>
> c. Protection is provided for streams, streambanks, shorelines, lakes, wetlands, and other bodies of water from detrimental changes in water temperatures, blockages of water courses, and deposits of sediment, where harvests are likely to seriously and adversely affect water conditions or fish habitat (16 USC 1604(g)(3)(E)(iii)).

Effectiveness of Design Features and Best Management Practices

See Water Report Appendix A for a listing of Soil and Water Conservation Practices which also includes their effectiveness. Design features and BMPs are expected to be effective when correctly applied (W-21). Past monitoring indicates that BMP effectiveness is generally high (W-20). BMP monitoring is conducted by the IPNF to validate the implementation and effectiveness of BMPs associated with land management activities. Monitoring results are used to adapt future management actions where improvements in meeting water quality objectives are indicated. Monitoring of BMPs on the St. Joe Ranger District indicates that they do get implemented and are, in most cases, continuing to function as expected and are meeting their intent (W-21).

Analysis Area

The Fallen Bear Project Area includes the following named watersheds (listed from east to west): Stevens Creek, Bruin Creek, Tumbledown Creek, Shady Creek and Haggerty Creek. All of these watersheds drain to the St. Joe River. The project area also includes small, unnamed tributaries or 'face drainages' that are tributaries to the St. Joe River.

Direct, indirect and cumulative effects from proposed activities are discussed for streams in the project area. Direct and indirect effects would not be appreciable downstream from the project area, so the cumulative effects analysis area is the individual streams within project area. The distance downstream from project activities where cumulative effects are discussed is based on whether effects are likely or whether irreversible harm may result from the proposed activities.

Analysis Methods

The water resource is assessed through:

1) Stream channel form and channel process including:
    - i) water yield
        - (a) peakflow estimate
    - ii) sediment
        - (a) sediment yield estimate
        - (b) particle size distribution
    - iii) cross-sections

    iv) stream channel pattern
    v) transport and storage processes
    vi) streambank vegetation
2) Stream temperature
3) Road influences including:
    i) number of stream crossings
    ii) culvert ability to pass 100-year stream flow
    iii) roads within 50 feet of stream channels
4) Water quality/beneficial uses
5) Wetlands
6) Hydrological connectivity

Stream channel form and process are analyzed in terms of their response to changes in water yield and sediment yield. Stream channel response is also discussed in relation to stream classification developed by Rosgen (1996), Montgomery and Buffington (1998) and Beechie and others (2006).

Models are used for estimating water yield and sediment yield direct effects from proposed management activities for comparison of alternatives and to guide and support professional judgment. The models used in this analysis do not estimate indirect effects from management activities.

Water yield and peak flow are interchangeable in the analysis that follows. Water yield analysis estimates changes in peak flow in cubic feet per second (cfs). Water yield is estimated through the WATSED model.

Sediment from the proposed activities was estimated through the use of the WATSED model. The WATSED model is commonly used throughout Forest Service Region 1. The changes in number of road-stream crossings and the change in length of roads within 50 feet of stream channels are considered in the discussion of water quality.

Stream crossing culvert sizes were field inspected and measured. For each stream crossing culvert the discharge of a 100-year peak flow event was calculated. The existing measured culvert size was determined adequate or inadequate to pass the 100-year peakflow event. The risk of crossing failure was not evaluated, because there is always the potential of inlet blockage and subsequent crossing failure.

Water quality/beneficial uses are assessed through a sediment budget, vegetative buffers, channel form and process, and stream temperature.

Effects to wetland resources are qualitatively analyzed. Hydrological connectivity in three dimensions (lateral, longitudinal and vertical) is also discussed.

Assumptions and Limitations of Analysis Methods

WATSED Model

WATSED is designed to objectively compare relative differences among forest management alternatives in terms of changes in trend, risks, and regimen of water and sediment yield. Estimates are calibrated using measured data that include a combination of primary watershed processes. The model is driven by local climatic conditions and it uses Equivalent Clearcut Area (ECA) notation to represent the apparent degree of landscape disturbance through time. Recovery curves (W-2) for various road designs and configurations (clearing width, cutslope area, width, and length), logging systems and harvest methods (tractor, cable, aerial), wildfire, and site preparation (mechanical, prescribed fire, or hand) are used to characterize the watershed disturbances that result in cumulative effects. It does not address or analyze the effects of grazing or mining or other non-silvicultural related practices but does address vegetation removal, fire and road construction (W-2).

WATSED Water Yield Estimate

The WATSED model was used to estimate increases in water yield from FS proposed activities. WATSED is not intended to simulate watershed response for individual or episodic storms such as rain-on-snow, snowmelt, mass erosion events or extreme drought or flood years. It is not intended to accurately predict sediment and water yields that might occur as a result of stochastic events or non-forest related actions. The WATSED estimate is not a definitive water yield value, and should be used to compare management alternatives. For this analysis water yield is synonymous with peak flow.

WATSED Sediment Estimate

The WATSED model estimates sediment changes from management activities, but the model has not been recently calibrated for the project area watersheds and thus the accuracy of the estimate for those watersheds from this model is not known. The sediment estimate should be used to compare alternatives. Further, in attempting to calibrate the WATSED model through measuring sediment, one cannot separate natural sediment from management-generated sediment (NCASI 1999, pp. 1-21). For example, say sediment is measured some distance downstream from management activities, but a tree blows over in a windstorm and lands in the stream channel in the reach below activities and above the measurement point. The tree blocks the channel and causes an avulsion (a new channel position in the valley bottom) with down-cutting and sediment generation, which would then be measured at the sediment-sampling site; this would not be management induced sediment. Or a channel-spanning log has stored sediment behind it, but the log rots out and releases this stored sediment. It is infeasible to separate sediment attributable to natural processes from sediment generated by management activities.

The WATSED data set was adjusted to model road recontouring and stream crossing removals and restorations (W-3). Roads proposed for Rx D or recontouring were given a mitigation factor in the WATSED model's data set. Roads proposed for storage, Rx C (decompacted, stream crossing removal and restoration), were also given a mitigation factor within the data set. Comparison of a WATSED estimate with no road treatments, to the estimate of all activities with road treatments (Rx C & Rx D) will provide an estimate of the change in sediment levels from road recontouring and road storage (W-3).

The WATSED model estimates sediment generated from harvest units, but monitoring on the Bitterroot National Forest (USDA 2006a p 81-82) shows there was no movement of sediment from harvest units into Riparian Habitat Conservation Areas. The value for sediment from harvest units in the WATSED model may be overestimated (also see discussion under *Scientific Uncertainty and Controversy, Sediment Estimate and Buffer Efficacy* section below).

MacDonald and Coe (2007 p. 158) state, " [a]lthough increases in suspended sediment were attributed to the watershed area occupied by roads, there was little field evidence of sediment delivery from newly constructed roads (Lewis et al. 2001)." Based on those findings, the WATSED model may overestimate sediment from new road construction.

Timing of Sediment Additions and Reductions

The WATSED sediment estimate is based on timber sale related activities occurring over two years (2010-2011). Road recontouring and road storage sediment reductions could occur any time after the decision appeal period.

Channel Form and Process Assumptions

There are eight interrelated variables involved in the downstream changes in river slope and channel form: width, depth, velocity, slope, sediment load or yield, size of sediment debris, hydraulic roughness, and discharge (Leopold and others 1964 p. 268).

Channel Form

Channel form is addressed through the following parameters:

Channel cross-section (width, depth, sediment yield)

Channel pattern (sinuosity – slope, discharge, sediment yield)

Sediment yield, particle size distribution, large woody debris (sediment load, size of sediment debris, hydraulic roughness)

Channel Process (physical)

A channel's physical process is to convey the water, sediment and wood delivered to it from adjacent areas; also, wood may be stored and sediment deposited or stored in the channel network (Schumm 1977 p. 104-105; Montgomery and others 2003 p. 21; Grunell 2003 p. 75; Gordon and others 1992 p. 319; Gregory 2003 p. 2).

Variables associated with channel form and process are estimated (sediment yield, discharge) and quantified (width and depth through cross-sections, hydraulic roughness and size of sediment debris through pebble counts). Slope is correlated to sinuosity (measured at cross-sections (W-10)). Stream velocity is not quantified or estimated. Stream channel process will be discussed in relationship to the transport and storage of the water, wood and sediment delivered to the channels.

Streambank vegetation and woody debris are discussed in relationship to channel stability. Stream channel pattern is determined through field observation, map and photo interpretation.

Roads

Roads analysis was done with ARCINFO GIS for stream crossings and roads within 50 feet of stream channels. Culvert data was gathered in the field and the 100-year peakflow estimated (W-8, W-19) and compared to existing size. The risk of crossing failure was not analyzed because there is always the possibility that a culvert inlet may become blocked and the crossing fail.

Scientific Uncertainty and Controversy

Stream Channel Form and Process

There is some uncertainty and controversy in estimating effects to stream channels and separating the degree of anthropogenic effects from non-human effects. Human activities can influence the morphology of streams, but the effects may not be different from natural conditions or disturbances – magnitudes of certain variables in the geomorphic system may increase [from human activities] resulting in accelerated or decelerated responses in fundamental geomorphic processes. The appropriate [geomorphic] principles are not abrogated (Leopold and others 1964 p. 434).

Beechie and others (2006) identify that lateral channel migration rates based, in part, on ages of floodplain surfaces increase in this order of channel patterns: straight, meandering, island braided to braided. Residence time of floodplain sediments is short for most braided channels (5 years) and longer for straight channels (average of 89 years), although straight channels may range from 100 to 200 years (Beechie and others 2006 p. 135). Natural changes and their consequences are similar to changes induced by man's activities (Schumm and others 1984 p. 161; Schumm 1977 pp. 133-137). Stream channels evolve: an alluvial river is continually changing its shape, dimension and pattern and "it is the rule rather than the exception that banks will erode, sediment will be deposited and floodplains, islands, chutes and side channels will undergo modification with time" (Schumm 1977 p. 131).

Gregory (2006 p 176) identifies that most human caused changes in stream channels involve changes in channel capacity or channel width.

Ward and others (2001 p. 312) suggest that there may be false perceptions of natural conditions in relation to river systems, that "non-equilibrium conditions prevail" and that there is a "remarkable degree of spatio-temporal heterogeneity that characterizes river corridors in the natural state." They also suggest (2001 p. 316) that "[t]he limited empirical knowledge of dynamic processes operating in natural river corridors means that we lack sound 'benchmarks', not only for assessing human impacts, but also for addressing restoration and conservation strategies." Montgomery (2008, p. 291) suggests that reexamination is necessary for what constitutes a "natural channel".

Recognition of the role of large woody debris (LWD) in streams has grown over the past several decades. Wood debris significantly and sometimes systematically affects channel processes (Montgomery and Piegay 2002). LWD was removed to facilitate fish passage through the Bruin Creek channel in the late 1970s. Large wood was surveyed for the main Bruin and Tumbledown Creek watersheds, but there is no indication of the relative stability of individual LWD or aggregates of LWD in the collected field data (see *Fisheries* section). Because the collected field data did not include the number of pieces of lwd contained in the aggregates, estimating the abundance of lwd in relationship to channel length (length of channel/piece of wood) may give a lower value than actually exists (5 ft/piece vs. 10 ft/piece).

Interpretation of existing condition in relationship to effects from proposed activities is used to estimate channel form and process response. This estimate is based on professional experience and judgment. "Channels are complex systems that need to be interpreted within their local and historical context" (Montgomery and Buffington 1998 p. 38). Uncertainty increases as one attempts to predict the effects of multiple activities over time and space; and it can be very difficult to predict accurately the effects of policies and management activities at the watershed scale (MacDonald and Coe 2007 p. 161).

Stream Classification Response Potential

Rosgen (1996 p. 8-8 & 8-9) and Montgomery and Buffington (1998 p. 31) present classified stream type- and stream reach morphology (respectively) -based response potential to sediment and water yield increases. Analysis of existing channel form, sediment yield and size, channel process, riparian vegetation and inventoried large woody debris amounts, in relation to changes in sediment and water yield does not coincide with the response results presented by Rosgen or Montgomery and Buffington. Because of the diverse and complex nature of the headwater-downstream interaction for water, sediment, large wood, particulate organic matter, nutrients and water temperature (MacDonald and Coe 2007 p. 161) there is a large degree of uncertainty in applying the classification based response potential to effects from management activities.

Cumulative Effects

"One characteristic that is common to both streams and research is that what initially appears complex is even more so upon further investigation (National Council of the Paper Industry for Air and Stream Improvement (NCASI 1999 p. iv)." "Cumulative watershed effects are particularly difficult to predict and identify because the individual water and sediment inputs are delivered to the stream system at different points in time and space, and these interact with the water and sediment already in the stream" (NCASI 1999 p. 1). "The often nebulous relation between management activities and stream response has even resulted in CWEs [cumulative watershed effects] being called the UFOs of hydrology (Rice and Thomas 1986)" (NCASI 1999 p. 5).

There can be a "tremendous amount of uncertainty in how a given policy or management activity in an upslope or upstream area will affect aquatic resources. This uncertainty stems from the wide variability of site conditions, the variability in how a given activity is carried out, the uncertainty with respect to future storm events and the inability to adequately characterize all of the controlling processes and site factors" (MacDonald and Coe 2007 p. 161).

"Uncertainty is a hallmark of all CE [cumulative effects] assessments, and this must be recognized by managers, regulators, and the public. The problem of scope, scale, and predictability are based in science, but their resolution is a question of values and will therefore be a continuing source of controversy" (MacDonald 2000 p. 312).

MacDonald (2000 p 309) identifies that a better understanding of the uncertainties and limitations in a CE [cumulative effects] analysis is critical to eliminate unrealistic expectations and determine what level of analysis is appropriate for a particular situation. Although not all-inclusive, the key limitations are: (1) the variability and uncertainty in quantifying management effects; (2) the inability to predict secondary or indirect effects; (3) the difficulty in defining recovery rates; (4) the difficulty of validation; and (5) the uncertainty of future events.

Sediment and Wildfire Compared to Human Activity

MacDonald and Coe (2007 p. 154-155) state that severe wildfire can increase the production and delivery of sediment by several orders of magnitude and that moderate-and low-severity wildfires are an order or more magnitude lower. Nitschke (2005 p. 315) identifies that wildfire increases sedimentation more than harvesting. The delivery of sediment to stream channels can be from discrete events (mass failure) or chronic (storm-by-storm sediment from roads) (MacDonald and Coe 2007 p. 152) or short-term episodic from wildfire until vegetative regrowth. The amount of sediment generated by human activities is, as modeled here, no where near an order of magnitude increase and is believed to be substantially less than what could occur under natural conditions caused by wildfire. There is no data on sediment delivery to stream channels following wildfire in watersheds within the Fallen Bear Project Area. Larsen and others (in review W-17 p. 3) identify that "[w]ildfires increase hillslope- and watershed-scale runoff and sediment yields by several orders of magnitude…)". Cannon and others (1998 p 217-218) identified that there was 70,000 cubic meters of sediment delivered downslope from areas burned in the 800 ha (1974 acres) South Canyon Fire in Colorado, following a convective storm a few months after the fire.

WATSED Sediment Estimate

The sediment estimate from the WATSED model includes a mitigation value assigned to roads proposed for long-term storage (Rx C – decompaction, stream crossing removal and restoration) and the removal of roads proposed for recontouring (Rx D – road recontouring) (W-3). There is some degree of uncertainty in applying these methods to the WATSED model. The sediment estimate is for comparison between alternatives.

Sediment Estimate and Buffer Efficacy

It is not known if the WATSED model incorporates vegetative buffers' ability to prevent sediment from entering the stream system from proposed harvest units. RHCA monitoring conducted on the Bitterroot National Forest found no movement of sediment into or through RHCA buffers (USDA 2006a p 81-82).

Previous BMP monitoring in harvest units identifies that there is little to no exposed soil (SSW-14, 50, 59, 61; SW-13). Erosion is unlikely to occur if there is no exposed soil to erode.

The ability of vegetative buffers to filter sediment from non-channelized flow (such as from stand harvesting) is documented in INFS (1995 p. A-5) and in monitoring conducted on the Bitterroot National Forest (USDA 2006a p 81-82). Vegetative buffers around streams, wetlands, and high mass failure potential areas are included in the proposed action. It is believed that these buffers are adequate for protecting the stream from potential harvest-generated sediment.

Jackson and others (2007) document response and recovery of channels, macroinvertebrates and amphibians following harvest in headwater streams in the Coast Ranges of Washington State. They found that "[d]istribution of mesoscale habitat types [pool, riffle, run, step, subsurface flow and bedrock], as well as sediment particle size distributions and amphibian assemblages, were largely unchanged in the buffered streams following harvest." Buffers in the streams studied ranged from 8-10 meters (26-32 feet), which are less than the RHCA buffers in the proposed action.

Stream Crossing Restoration Sediment Addition

Short-term sediment additions were estimated for stream crossing restoration using the average value identified by Foltz and others (2008). Foltz and others (2008) monitored culvert removals at 11 sites in Idaho and one in Washington and found that with mitigation there was an average sediment yield of 1.6 kg (3.52 lbs or 0.0018 tons). There is uncertainty in the estimated sediment from the restoration activities because conditions at individual sites may vary. Other monitoring data of culvert removal and stream crossing restoration on the Clearwater NF indicates that small amounts of sediment were generated (W-4). In both monitoring studies State Water Quality Standards for turbidity were temporarily exceeded.

Water Yield

There is some degree of uncertainty and controversy in attempting to quantify changes in water yield peak discharge related to forest harvest activities. Kattelmann and Ice (2004 p.194) cite various authors and disparate conclusions from analysis of the same data related to timber harvest and peakflows within the transient snow zone. They further state (p. 192), “The role of logging in the rain-on-snow or transient snow zone is controversial” and invite readers (p. 194) “…who wish to delve deeper into the debate about forest management and changes in peak flow” to “review the articles and the numerous ‘comments’ that were published in the exchanges between the authors”.

MacDonald and Coe (2007 p.151) identify numerous difficulties in trying to determine management-induced changes in streamflow, including spatial scale, contradictory results from various analyses, modeling and field studies.

Stednick and Troendle (2004 pp. 169-186) document water yield and peakflow increases from timber harvesting practices in the central Rocky Mountains. They state (p. 176) in a discussion of peak flows on Fool Creek: “Timber harvesting can increase the size of the peak flow, but that change is less evident for recurrence intervals greater than two years.” (A two-year recurrence interval peak flow has a 98% chance of occurring in any year.) They also identify that no change from harvest was detectable for seasonal low flows (p. 175).

Ice and others (2004 p. 248) state that “Debate continues about the magnitude of road effects on peak flows.”

In northwestern Montana and northeastern Idaho, rain-on-spring-snowmelt was the most common cause of annual maximum daily flows, although relatively infrequent mid-winter rain-on-snow events caused the largest flows on record (MacDonald and Hoffman 1995 p. 90). In their study of causes of peak flows in NW Montana and NE Idaho, MacDonald and Hoffman (1995 p. 94) state: “For the six study basins there was no apparent correlation between the magnitude of peak flows and the amount of forest harvest”, and they also state (p. 94) that “Forest harvest would be expected to cause differential increases in the magnitude of observed peak flows, but climatic differences are the dominant control on the size of peak flows within the study area.”

The WATSED model was used to estimate changes in water yield related to the proposed activities. WATSED compares management activities’ effect on the peak flow month discharge. Further WATSED documentation is found in project file documents (W-3) for the model and results.

Additionally, analysis was conducted on peak flow data from a USGS gauging station on the St. Joe River (W-5). Peak flow data was extrapolated for Tumbledown and Bruin Creeks from St. Joe River gauge station data based on the area/discharge relationship, because these streams do not have gauging stations. The trend lines for the St. Joe River and for Tumbledown and Bruin Creeks (with extrapolated data) do not display increasing peak flows (W-5). The level of timber harvest and roading above Calder, Idaho has not led to a trend in peakflow increases at the St. Joe River gauging station (W-5). There is some degree of uncertainty in extrapolating discharge from the St. Joe gauged data to Tumbledown and Bruin Creeks based on the area/discharge relationship, because there is likely spatial and temporal variability in precipitation and runoff over a large watershed (1,030 sq. miles) like the St. Joe River above the gauging station at Calder, Idaho.

Particle Size Distributions (Pebble Counts for Sediment Size)

Sampling stream substrate in pebble counts may have inherent error because of individual bias, such as not identifying sand, silt or clay sized particles as the first particle encountered by the samplers’ fingers or hand underwater. Also pure randomness could lead to disparate results over time or the sampling location may be slightly different between years. There could also be a shift in the particle size distribution from natural occurrences or human activity. Particle size distribution through pebble count samplings is believed to be representative of sediment entering, moving and in storage in the stream channels. There is some degree of uncertainty in ascribing the pebble count size distribution as representative of particle sizes found throughout the channel network.

Beneficial Use

The cold water aquatic life beneficial use designation states: "water quality appropriate for the protection and maintenance of a viable aquatic life community for cold water species" (IDAPA 58.01.02.100.01). For DEQ determination of beneficial use support status (IDAPA 58.01.02.053), the "Department shall employ a weight of evidence approach in evaluating a combination of water quality data types (including but not limited to aquatic habitat and biological parameters), when such a combination of data are available, in making its final support determination." The St Joe River Subbasin Assessment and TMDL (Idaho DEQ 2003) does not indicate when, how often or how rigorous the data collection is for determination of beneficial use support.

The issue of viability of aquatic life communities is somewhat controversial because of scale considerations, population estimates, what numbers of organisms are required to perpetuate a species and the ability of migrating organisms to repopulate an area with low population estimates.

Existing Condition

Watersheds

Table 1 displays the watersheds found in the project area. Watershed size, length of stream channel and gradients derived from ARCINFO GIS (W-6). The streams in the project area are typically set in steep mountainous terrain with high stream gradient and low sinuosity. They have straight channel patterns (Beechie and others 2006 p. 128).

Table 1 - Watershed Acres, Stream Channel Length and Channel Gradient

Watershed	Acres	Channel Length (ft)	Channel Gradient (%)
Haggerty Creek	566	17,483	25.1%
Shady Creek	247	7,641	28.7%
Tumbledown Creek	3185	91,721	8.3%
Bruin Creek	4400	116,839	7.1%
Stevens Creek	337	11,637	25.7%
face drainages	1704	45,380	~25% to 29%

Water Yield

The WATSED model estimated water yield for streams in the project area (W-3). Table 2 displays the estimated existing water yield over natural for Bruin, Tumbledown, Stevens Creeks and the combined Haggerty, Shady and other small 'face' drainages.

Table 2 - Estimated Existing Water Yield Over Natural Conditions

Drainage	Natural Peak (cfs)	Existing Percent Over Natural	Existing Increase Over Natural (cfs)
Bruin	37.4	8	40.4
Tumbledown	27.7	5	29.1
Stevens	2.4	3	2.5
Haggerty/Shady/face drainages	25.4	4	26.4

There was an estimated discharge of 189 cfs for Tumbledown Creek and 261 cfs for Bruin Creek during the rain-on-snow event in 1996, based on the area-discharge relationship for that event at the St. Joe River gauging station at Calder Idaho (W-5).

Water Quality/Beneficial Uses

Idaho DEQ completed an Integrated 2002 303(d) and 305(b) Report, which was approved by the US Environmental Protection Agency (EPA) in 2005. The Integrated Report identifies impaired water bodies, waters to be removed from the impaired list and water bodies with approved Total Maximum Daily Loads (TMDL). No streams in the project area are listed as impaired or having a TMDL. The 2002 Integrated Report identifies the St Joe River (source to North Fork St. Joe River) as impaired due to stream water temperatures that exceed water quality standards (W-7 303(d) list). For the St. Joe River, source to the North Fork St. Joe River includes the drainages within the project area.

Idaho Department of Environmental Quality (DEQ) conducted an assessment for the St. Joe River (DEQ 2003). The assessment addressed water bodies that were included in previous 303(d) reports as being impaired water bodies (DEQ 2003 p xiii). None of the streams in the Fallen Bear Project Area are included in the DEQ assessment.

Total Maximum Daily Loads (TMDLs)

No temperature TMDL has been developed for the St. Joe River.

Sediment

The WATSED model estimated sediment levels for streams in the project area (W-3). Table 3 displays the estimated existing sediment yield over natural for Bruin, Tumbledown, Stevens Creeks and the combined Haggerty, Shady and other small 'face' drainages.

Table 3 - Estimated Existing Sediment Yield over Natural Conditions

Drainage	Estimated Natural Sediment (tons/yr)	Estimated Existing Sediment Over Natural (%)	Estimated Existing sediment (tons/year)
Haggerty/Shady/Face	25.0	111	52.8
Tumbledown Creek	15.9	22	19.4
Bruin Creek	16.5	97	32.5
Stevens Creek	24.7	21	29.9

Sediment Size

The sediment from roads is typically fine-grained material – sand, silt and clay sized particles (MacDonald and Coe 2007 p. 154; Burroughs and others 1983 p. 216) unless there is road associated mass failure. Sediment from harvest units is also expected to be fine-grained material (Megehan and King 2004 p.213).

Past Road-related Mass Failures

There are two roads in the project area that experienced mass-failure. Road 3310UA has two areas that slumped at an unknown time in the recent past (perhaps about 10-15 years ago) (W-8). Road 1223 had fill erosion at mile 0.2 and a small debris flow at mile 0.08 from a storm event and/or runoff in 1997 (ACT-7). The estimated size of the slumps on 3310UA is estimated at about 200 cubic yards (W-9). The fill erosion of road 1223 is estimated at about 20 cubic yards and the debris flow at about 12 cubic yards. Some of the slump material from Road 3310UA (W-9) made it to the channel of Haggerty Creek. The estimated fill erosion and debris flow material was likely delivered to the Bruin Creek channel.

Sediment delivered to stream channels from past mass failures, has been stored and transported within and through Haggerty and Bruin Creeks. Some of the finer materials (sand, silt and clay) may be transported annually from about 3,000 feet for a three-foot bankful channel width to about 20000 feet for a 30-foot bankful channel width (MacDonald and Coe 2007 p 156). Larger gravel, cobble and boulder sized material may only move a few feet to a few hundred feet annually (MacDonald and Coe 2007 p 156) with smaller particles moving furthest. Particle sizes up to the D44-D100 (44th percentile to 100th percentile particle size) may move during bankful flows (King and others 2004 p 23) but are not transported large distances. In the Pacific Northwest and Alaska large woody debris stored on average 17.7 cubic feet per yard of channel length (MacDonald and Coe 2007 p 156) or about 1.1 tons per yard of channel length. Large and fine material may be stored in the lee of large boulders, behind large woody debris, under the surface armor layer, in the channel margins and on floodplains and terraces.

Because of the large amount of coarse woody debris in Haggerty Creek (photographs, W-8) most of the sediment from the past mass failures is expected to be stored within the channel, behind large woody debris and boulders or have formed small alluvial valley terraces. The sediment particle sizes associated with the mass failures in Haggerty Creek are expected to range from fine material to small boulders (field notes W-9). Some portion of the fine material was likely transported to the St. Joe River.

In Bruin Creek the locations of the mass-failures are in the lower 0.8 mile to the mouth. As is the case with Haggerty Creek the particle sizes delivered to the Bruin stream channel are expected to range from fine material to small boulders (photographs ACT-7). The Bruin Creek channel would have stored some of the delivered sediment, with a portion of the smaller-sized material being transported downstream and into the St. Joe River.

In both streams where mass failures occurred there may have been a response in macroinvertebrate populations, with declines in some species and increases in others (MacDonald and Coe 2007 p 158); or as Jackson and others (2006 p 368) found that “[s]hifts in the macroinvertebrate communities over time were not characterized by large additions or deletions to the taxa list or by changes in richness” for streams with increased fine sedimentation and woody debris from timber harvest activities and blowdowns within vegetative buffers.

The increased sediment in Bruin Creek may have caused some loss of aquatic habitat through aggradation or pool filling but this is only in the lower 4200 feet of a stream with an estimated channel length of over 116, 000 feet. Because the sediment delivery occurred in the lower 4200 feet of the stream channel and this sediment has been stored or transported through this reach, the current aquatic ecosystem in Bruin Creek is not expected to be substantially impacted.

The range of natural variability from mass failure includes episodic sediment delivery from large events (Kirchner and others 2001 p 593, Cannon and others 1998 p 218). The response of stream channels from the road related mass failure is no different than what would occur if natural mass failures occurred. It is believed that both streams that experienced mass failure sediment delivery have assimilated the sediment load through storage and transportation processes.

Particle Size Distribution

Table 4 displays stream bed particle size distribution measured near cross-section locations on Tumbledown and Bruin Creek through Wollman pebble counts (W-10). The particle size distribution does not include large percentages of fine-grained material at the locations sampled.

Table 4 - Percent Particle Size Distribution

Drainage	Year	Cross-section Number	Percent silt/clay (0-.062 mm)	Percent sand (0.062-2 mm)	Percent gravel (2-64 mm)	Percent cobble (64-256 mm)	Percent boulder (264-4096 mm)	Percent bedrock
	2008	2A	0	13	59	28	0	0
	2007	2A	0	14	57	29	0	0
	2008	2B	5	11	54	30	0	0
	2007	2B	0	0	60	38	2	0

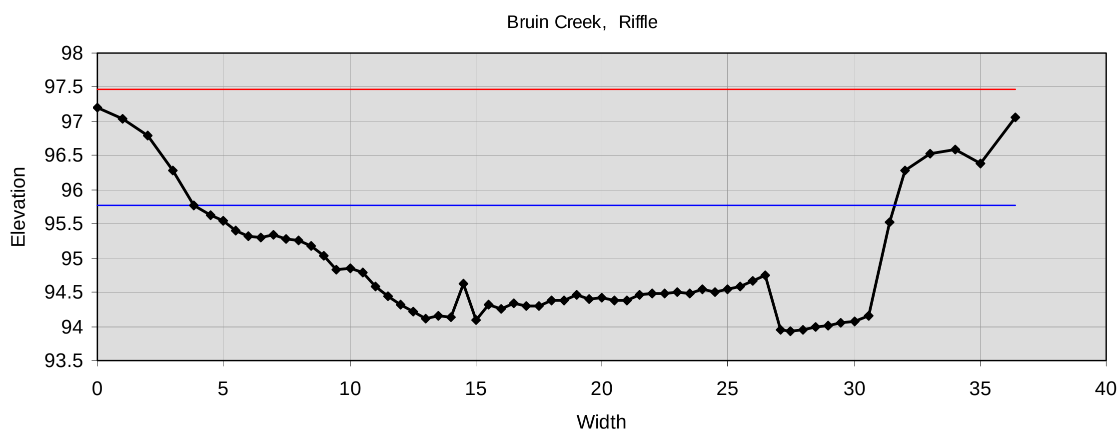
Drainage	Year	Cross-section Number	Percent silt/clay (0-.062 mm)	Percent sand (0.062-2 mm)	Percent gravel (2-64 mm)	Percent cobble (64-256 mm)	Percent boulder (264-4096 mm)	Percent bedrock
Bruin	2006	3	0	0	74	25	1	0
	2006	4	4	4	82	10	0	0
	2001	1	6	3	63	15	12	0
	2001	2	7	6	70	16	0	0
Tumbledown	2008	1	0	4	67	28	1	0
	2007	1	3	1	42	35	6	12
	2006	1	1	2	44	47	4	2
	2008	2	0	1	67	25	7	0
	2007	2	10	0	25	48	17	0
	2006	2	12	1	6	69	12	0
Haggerty	2001	1	10	2	30	26	30	2

Stream Channel Form

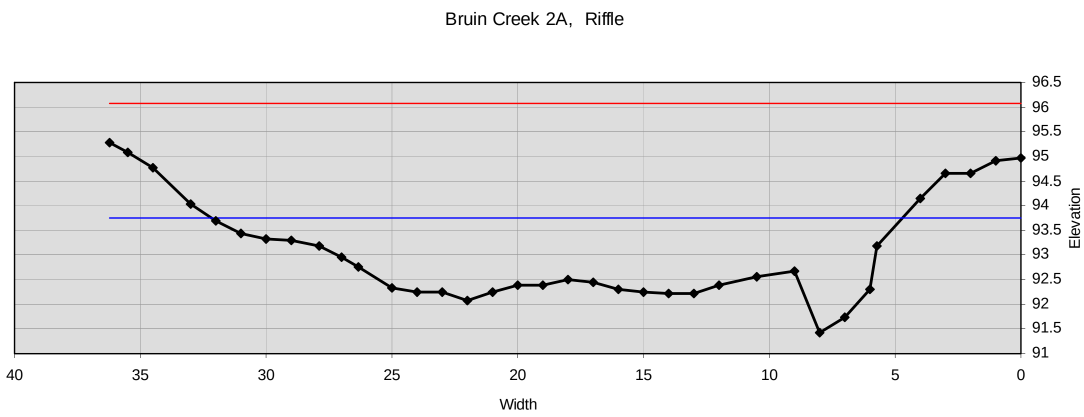
Stream Cross-sections

Stream channel cross-sections were measured for Tumbledown and Bruin Creeks with the same cross-sections measured each year over a two-year or three-year interval. The following charts are of the individual cross-sections for locations (i.e. Bruin #2A) for the year shown.

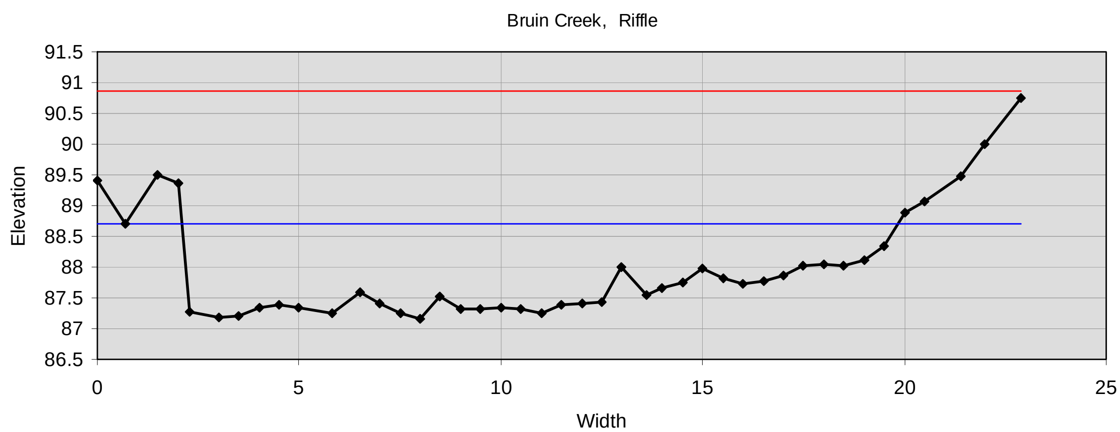
Bruin #2A 2007 (bkf area = 33.3 sq ft)



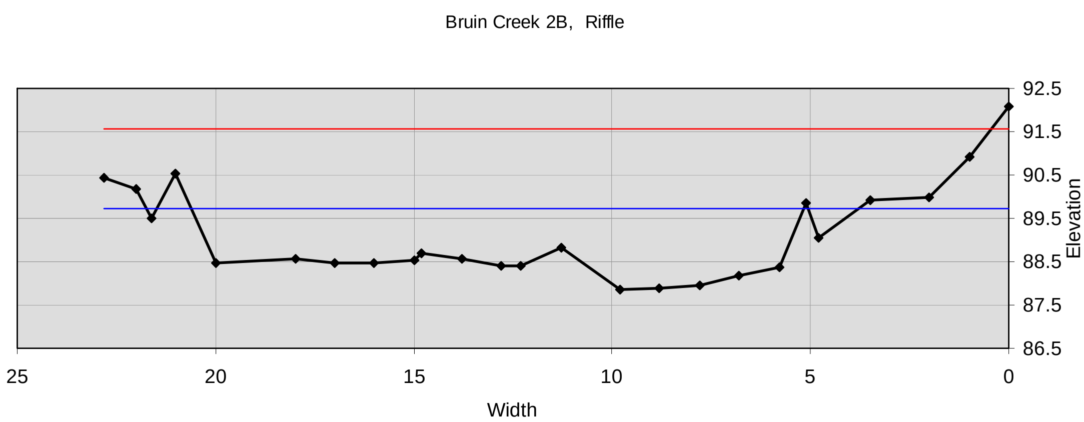
Bruin #2A 2008 (bkf area = 33.0 sq ft)



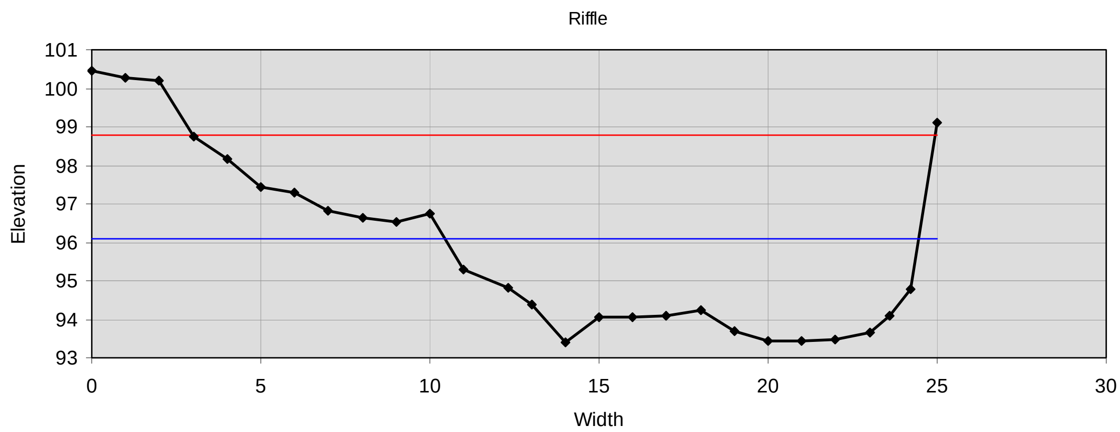
Bruin #2B 2007 (bkf area = 20.0 sq ft)



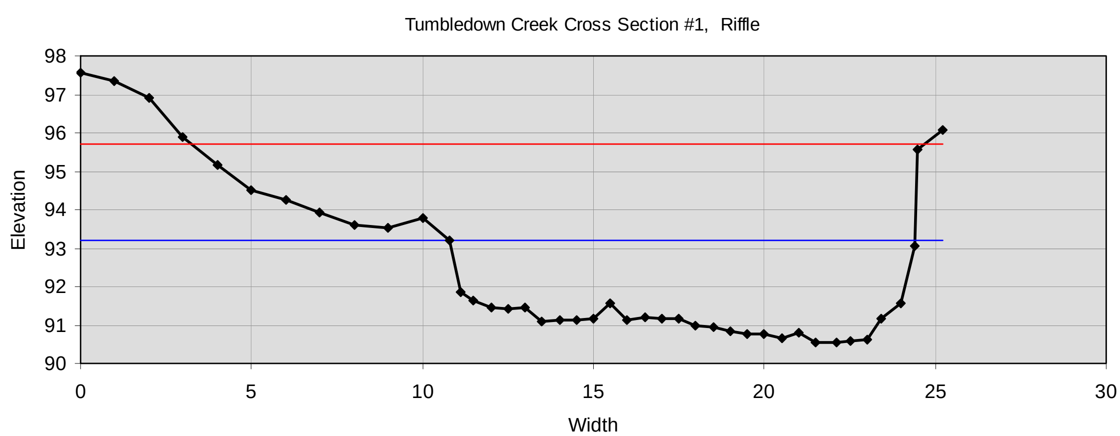
Bruin #2B 2008 (bkf area = 20.4 sq ft)



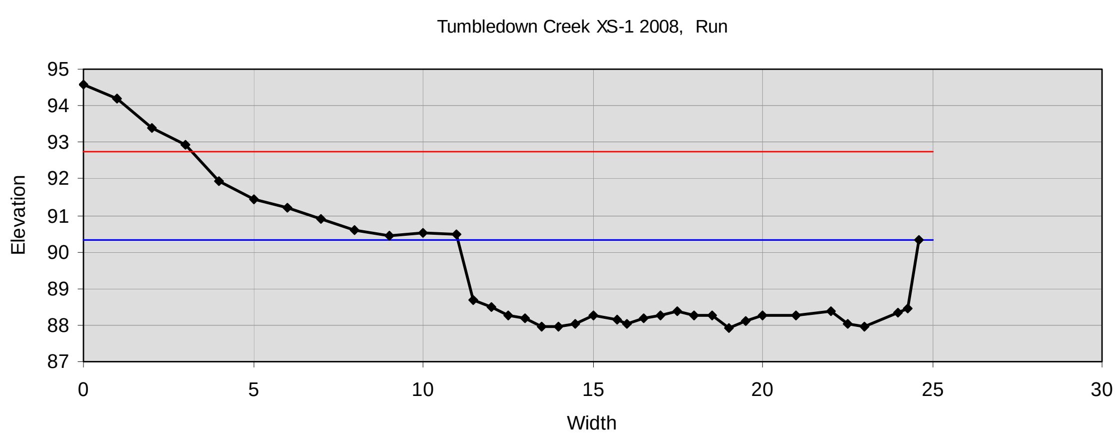
Tumbledown #1 2006 (bkf area = 28.2 sq ft)



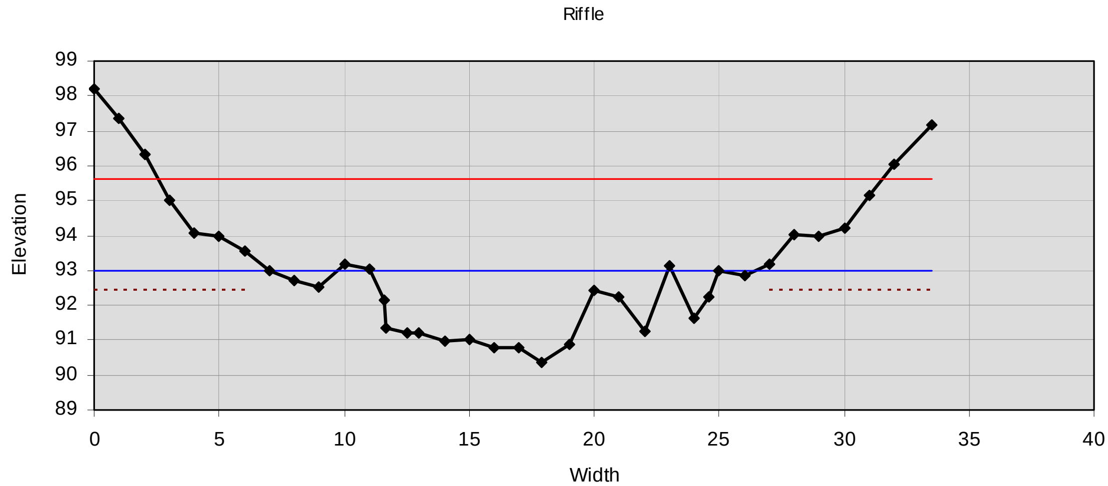
Tumbledown #1 2007 (bkf area = 28.0 sq ft)



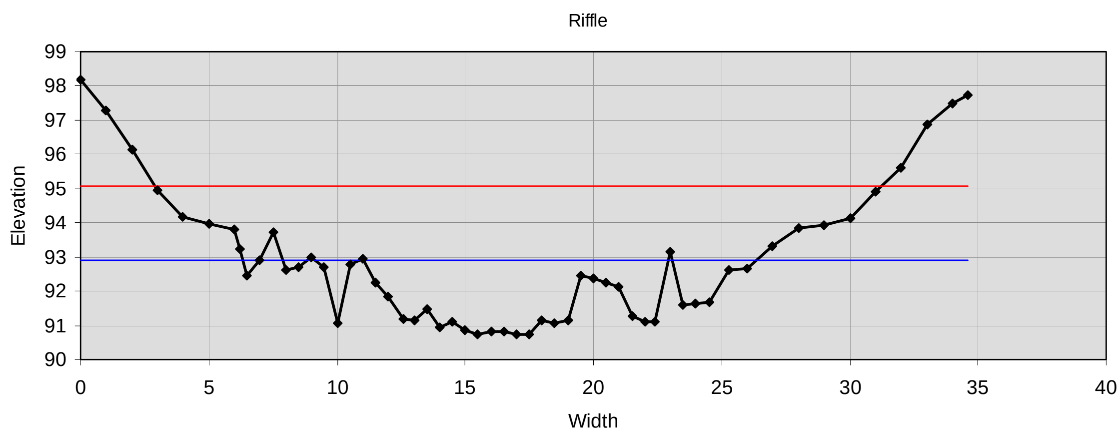
Tumbledown #1 2008 (bkf area = 28.0 sq ft)



Tumbledown #2 2006 (bkf area = 21.8 sq ft)



Tumbledown #2 2007 (bkf area = 21.7 sq ft)



Tumbledown #2 2008 (bkf area = 22.4 sq ft)

Stream Channel Form and Process

Stream channel cross-sections were surveyed on Tumbledown and Bruin Creeks (W-10). Tumbledown Creek has two cross-section locations approximately 150 feet and 500 feet above the mouth surveyed annually from 2006-2008. Bruin Creek had two cross-sections in 2001; two cross-sections measured in 2006; and two cross-sections measured annually from 2006-2008. Bruin Creek cross-sections are within the first three miles of the stream channel. Photos were taken of cross-section locations with up and downstream views (W-10).

Bankfull cross-sectional area at repeat cross-section locations for the years 2006, 2007 and 2008 remained substantially unchanged over this time-period (W-10). The repeat cross-sections on Tumbledown and Bruin Creeks do not show substantial evidence of aggradation, degradation or channel changes in the cross-sectional charts (W-10). The charts do identify some changes in the stream bed that is shifting of logs, rocks or pool locations that is a natural occurrence.

Photographic documentation indicates well-vegetated conditions upstream, downstream and on the banks of the cross-sections, and an abundance of large woody debris (W-10). Vegetative conditions and abundance of large woody debris do not show substantial changes for the years surveyed at Tumbledown and Bruin Creeks.

The stream substrate particle size distribution sampled near the cross-sections shows some variation between years but is substantially the same for the repeat cross-sections. Pure randomness, shifts in sediment moving through a stream reach, sample location and individuals sampling the substrate particle size distribution may cause variance from year to year. Gravel and cobble sized particles are the majority of the particle size distribution: for Bruin Creek gravel/cobbles ranged from 78%-99% and for Tumbledown Creek gravel/cobbles ranged from 73%-95% depending on the year and location (W-10, 12). There is not a large amount of fine material (sand, silt or clay) at the sites sampled, with Bruin Creek having an average of 2.8% silt/clay and 6.4% sand and Tumbledown having an average of 4.3% silt/clay and 1.5% sand (W-10, 12).

Large woody debris surveys measured material from 2 inch diameter to greater than 24 inches diameter and from 9.8 feet in length to greater than 35 feet in length. Surveys of large woody debris for Tumbledown and Bruin Creeks show an abundance of woody material (as do photographs at cross-sections) associated with the stream channels (W-11, 12, 15). In Tumbledown Creek there are about 2400 pieces of large wood over 2.4 miles or an average of 1 piece of wood every 5.4 feet. In Bruin Creek there are about 3690 pieces of large wood over 4 miles or an average of 1 piece of wood every 5.8 feet (W-11).

Based on stream channel conditions identified from the surveyed data the form of major streams in the project area are functioning for the existing water and sediment yield and are believed to be in dynamic equilibrium. Stream processes of storing and transporting material delivered to them appear to be functioning without unnatural changes to the stream channel. This is likely a function of the hydraulic roughness of larger particle sizes, amounts of large woody debris and well-vegetated stream banks. Haggerty and Bruin Creek stream channels appear to have adjusted to the past road-related mass failure material that may have been delivered to them, based on the existing form, particle size distribution, LWD and streambank vegetation. Road related mass failure sediment has been assimilated into the stream channels which adjusted to this input in the same way as if there were natural mass failures storing and transporting this material.

Stream Channel Pattern

The stream channel pattern for drainages found in the project area is straight with low sinuosity (Beechie and others 2006, p. 128) within relatively confined valleys. There is minimum floodplain development for these stream valleys because of their confinement within steep valley walls.

Stream Channel Classification

Table 5 displays channel types for the major named streams from Montgomery and Buffington (1997) and Rosgen (1994) morphologic classifications (W-10).

Table 5 - Stream Channel Types in the Fallen Bear Project Area and Adjacent St. Joe River

Watershed	Montgomery and Buffington	Rosgen
St. Joe River	Plane-bed and pool-riffle	B
Haggerty Creek	Cascade and colluvial	A
Shady Creek	Cascade and colluvial	A
Tumbledown Creek	Step-pool, plane-bed and colluvial	A and B
Bruin Creek	Step-pool, plane bed, and colluvial	A and B
Stevens Creek	Step-pool and colluvial	A

Cascade and step-pool stream channels are resilient to most discharge and sediment supply perturbations because of high transport capacities and generally supply-limited conditions while lower gradient plane bed and pool-riffle channels are considered more transport-limited with greater potential for response to altered sediment and discharge regimes (Montgomery and Buffington 1997 p 607-608). Colluvial channels are small headwater streams at the heads of the channel network and typically are transport limited with sediment delivered to them from hillslope processes stored as valley fill (Montgomery and Buffington 1997 p 602).

Road Influences

Stream Crossings

The number of stream crossings for the project watersheds is displayed in Table 6. The number of stream crossings was identified by the intersection of ARCINFO GIS road and stream layers (W-13, 14).

Table 6 - Existing Stream Crossing

Stream	Number of Stream Crossings
Haggerty Creek	12
Shady Creek	4
Tumbledown Creek	40
Bruin Creek	94
Stevens Creek	2
Unnamed face drainages	16

Roads Located Within 50 feet of Stream Channels

Roads located within 50 feet of stream channels were determined through ARCINFO intersection of roads and a 50-foot buffer around streams (W-13, 14). There are a total of about 206 road segments identified from this intersection. The total mileage of road within this 50-foot buffer is about 4.5 miles. Within this 50-foot buffer there are about 10 road segments that are not associated with a stream crossing. The 10 road segments not associated with stream crossings are about 0.4 miles in length (W-14). Table 7 displays existing roads located within 50 Feet of stream channels.

Table 7 - Existing Roads Located Within 50 Feet of Stream Channels

Drainage	Number Segments	Length (miles)
Haggerty	13	0.29
Shady	6	0.11
Tumbledown	47	1.00
Bruin	118	2.74
Stevens	2	0.04
Face drainages	18	0.38

Hydrologic Connectivity

Hydrologic connectivity is: 1) longitudinal – up and downstream; 2) Lateral – riverine and floodplain interactions; 3) vertical – riverine and subsurface or groundwater interactions (Kondolf and others 2006 p. 1; Beechie and others 2006 p. 125; Ward and others 2001 pp. 312-314).

Wetlands

Wetland maps from the National Wetland Inventory (NWI) of the US Fish and Wildlife Service were used in an initial attempt to identify wetlands in Fallen Bear project area watersheds. The NWI internet mapping site identifies that there is no data for this area (W-16).

Wetlands are often associated with stream channels and areas that are temporarily flooded or small springs and seeps. The single feature that most wetlands share is soil or substrate that is at least periodically saturated with or covered by water. The water creates severe physiological problems for all plants and animals except those that are adapted for life in water or in saturated soil.

No wetlands have been identified within the project area, but design feature would protect any wetland found during implementation of the proposed activity.

Range of Natural Variability

Within a watershed, the "range of natural variability" of sediment and water yields is a product of historical disturbances such as fire and floods. Human activities such as logging, road construction and development affect natural processes such as sediment and water yield. For the purposes of this analysis, the focus is upon how logging and road construction affect sediment and water yields in light of the natural range of variability.

In an unmanaged landscape in northern Idaho, wildfires were the significant disturbance factor influencing erosional processes, hydrology, and stream channel morphology. In this part of northern Idaho, fires of variable intensities occurred at 50 to 150-year intervals. More severe stand-replacing or "lethal" fires occurred about every 200 years or so, depending upon variables described further in the fire section of this report.

During and after severe fires, water yield can increase due to canopy removal and decreases in evapotranspiration (McCaughey, Farnes and Hansen 1997; Beschta 1990; Tiedemann and others 1978). The shifts in water yield may cause adjustments within the stream channel through changes in water quantity, timing, and duration. Adjustments can include increases in bank erosion, increases in the sorting and transport of bedload sediment, and potential stream bank erosion. Surface erosion can increase due to the reduction of hillslope vegetation. As a result, movement of bedload and fine sediment through stream channels is accelerated. When severe fires remove large woody debris and vegetation in the riparian zones, stream velocities increase, bank stability decreases, pool habitat is removed and stream temperatures increase (Minshall and Brock 1991).

Fire affected streams by killing trees within and on the fringes of the riparian zones. Over time this fire-killed timber gradually fell over and supplied large woody debris to the streams. The fires also affected the streams by reducing the forest canopy, which allowed greater snow accumulation on the ground and increased water yields during spring flows. In-stream erosion might increase slightly in channels in response to increased water yields. Sediment transported during these peak flows would settle out at breaks in the stream gradient and/or behind channel obstructions.

Researchers have attempted to compare the effects of both logging and road construction to the effects of wildfire. Nitschke (2005 p. 315) states that wildfires may significantly increase sediment yield and thus be more detrimental than typical harvesting systems. Forest road construction and maintenance appears to emulate sediment from wildfire in the short-term, but forest roads as a long-term sediment source differs from wildfire (Nitschke 2005 p. 316). Another study by MacDonald and Coe (2006 pp. 154-155), states that high severity wildfires may increase the production and delivery of sediment by several orders of magnitude. Larsen and others (in review, W-17 p. 3) identify that "[w]ildfires increase hillslope- and watershed-scale runoff and sediment yields by several orders of magnitude…)". Cannon and others

(1998 p 217-218) identified that there was 70,000 cubic meters of sediment delivered downslope from areas burned in the 800 ha (1974 acres), July, 1994 South Canyon Fire in Colorado, following a torrential convective storm in September.

Stream channel form and processes of transport and storage respond to the episodic disturbance of catastrophic sediment delivery; aquatic ecosystems adjust to this disturbance regime and it may be essential for maintaining diversity and productivity in the long term (Kirchner and others 2001 p 593-594). Roper and others (2007 p 235) identify that watersheds they studied had high natural vegetative disturbance rates that would likely result in continuous inputs of sediment and wood and that most stream reaches are constantly adjusting to natural vegetative disturbances that occurred at some time in the past.

Environmental Consequences

Direct and Indirect Effects of Alternative A

Effects of Alternative A are essentially the values displayed for Existing Condition, above. Stream channel form and process is not expected to change. There would be no adverse change in estimated flood flows and annual water or sediment yields from this alternative. There would be no change in hydrologic connectivity. There would be no change in existing beneficial use support.

Cumulative Effects of Alternative A

Past, present and reasonably foreseeable activities and their possible effects are included in Table 8.

As identified in Table 8, the following activities were modeled for cumulative effects: timber harvest, pre-commercial timber stand improvement (thinning), and road construction. The following activities may have some cumulative effects: road maintenance, Conrad Campground, trail maintenance, and in-stream fish habitat improvements. The large woody debris removal in Bruin Creek likely had an effect but that effect may no longer be present because large woody debris has fallen into the stream since 1987 when this occurred.

The stream channel form and processes discussed under the existing condition is the cumulative result of all past and present activities on the stream channel. The future activities identified in Table 8 with 'possible' cumulative effects are discussed below and are not expected to appreciably affect stream channel form or processes because of BMP implementation, dispersed activity location and timing, relatively low impact with minimal ground disturbance or no additional new ground disturbance.

Road Maintenance and Reconstruction

Road maintenance and reconstruction activities utilize BMPs. No substantial impacts are expected from road maintenance activities such as blading, drainage improvements, culvert maintenance and surfacing on existing dedicated roads when BMPs are utilized to minimize adverse effects on the aquatic environment. These activities are designed to prevent erosion and also prevent hydrologic connectivity of roads to the stream network. Utilizing BMPs to minimize adverse effects on the aquatic environment is consistent with the Clean Water Act (CFR 33 & CFR 44) and Idaho water quality standards (IDAPA 58.01.02.350 Rules Governing Nonpoint Source Activities).

Past Road-related Mass Failures

There are two roads in the project area that experienced mass-failure. Road 3310UA has two areas that slumped at an unknown time in the recent past (perhaps about 10-15 years ago) (W-9). Road 1223 had fill erosion at mile 0.2 and a small debris flow at mile 0.08 from a storm event and/or runoff in 1997 (W-9). The estimated size of the slumps on 3310UA is estimated at about 200 cubic yards (W-9). The fill erosion of road 1223 is estimated at about 20 cubic yards and the debris flow at about 12 cubic yards. Some of the slump material from Road 3310UA may have made it to the channel of Haggerty Creek. The estimated fill erosion and some of the debris flow material was delivered to the Bruin Creek channel. See existing condition for effects from these mass failures.

Conrad Campground

Conrad Crossing Campground is located near the mouth of Stevens Creek at the eastern boundary of the project area. Future use of this campground is not expected to increase water or sediment yields because no further development is foreseeable. Water and sediment yields from the roadways within the campground were estimated using WATSED. There is always the possibility of accidental or deliberate introduction of chemicals from vehicles or other sources. It is speculation to try and determine effects from any possible chemicals added to streams in the vicinity of the campground.

General Public Activities

Recreational activities are expected to increase over time and may contribute to localized, small-scale disturbances. Future small-scale disturbances or their effects are not estimated because these are impossible to predict and constitute speculation.

Trail Maintenance

Trail maintenance generally consists of clearing rocks, fallen logs or brush from the trail area. It also may include maintaining drainage features such as water bars or drainage dips. Trails in the project area do not parallel stream channels and are not located within the 50-foot buffer except Trail 5, which crosses Haggerty Creek and a small face drainage. Trail maintenance activities are not expected to have an appreciable effect on stream channel form or processes.

Instream Fish Habitat Improvement

Fish habitat improvement activities occurred in 1987 and 1993. There likely was minor sediment additions from these activities, but their effects have dissipated and are not appreciable as a current cumulative effect.

Large Woody Debris (LWD) Removal

Removal of LWD from the Bruin Creek channel last occurred in 1987 when a logjam was removed. There had been some LWD removal in Bruin Creek previous to 1987. The removal of LWD in the lower 4.4 mile reach that is accessible by road increased the sediment transport capacity of the stream. The increased transport capacity means that sediment more easily moved through this reach when the wood was removed because wood stores sediment and wood increases hydraulic roughness which in turn reduces stream power and the ability to transport material. The removal of the wood did not introduce sediment into the channel but allowed stored sediment more freedom to move. Since 1987 large woody debris has fallen into the stream, and the current LWD amounts (see existing condition) have likely returned the transport capacity to levels similar to those prior to the removal.

Table 8 - Past, Present and Reasonably Foreseeable Actions Considered for Cumulative Effects

Action	Past	Present	Future	May Have Cumulative Effects	Explanation
Timber Harvest	X			Modeled	Modeled in WATSED
Tree Planting	X			Not likely	Usually hand work minimal ground disturbance
Precommercial Timber Stand Improvement	X			Modeled	Modeled in WATSED
Prescribed Burning for Site Preparation and Slash Treatment	X			Modeled	Modeled in WATSED
Wildfires	X		**unknown**	Not likely	Effects likely dissipated because of time passage (see fire section)
Fire Suppression	X	X	X	Not likely	Usually hand work minimal ground disturbance

Action	Past	Present	Future	May Have Cumulative Effects	Explanation
Clearing Brush and Trees to Maintain Helispots	X	X	X	Not likely	Usually hand work minimal ground disturbance
Wildlife Burns	X			Not likely	Minimal ground disturbance
Road Construction	X			Modeled	Modeled in WATSED
Road Decommissioning (3.6 mi)	X			Not likely	Previous work in mid 1990s effects likely dissipated
Road Maintenance	X	X	X	Possible	Not likely because BMPs are used to control non-point pollution (per CFRs) and no additional new ground disturbance
Conrad Campground	X	X	X	Possible	Not likely except for accidental chemical discharges. There is no new ground disturbance
General Public Activities: firewood cutting, driving roads, camping, snowmobiling, hunting, hiking, berry picking, fishing, Christmas tree cutting	X	X	X	Possible	Not likely, not appreciable because of dispersed nature of activities and minimal ground disturbance
Trail Maintenance	X	X	X	Not likely	Because of trail location, BMPs used to control non-point pollution and no new ground disturbance
In-stream Fisheries Habitat Improvement Projects	X			Possible	Minor sediment addition for improved beneficial use support. Effects dissipated over time.
Spraying Herbicides to Control and Prevent Noxious Weeds Under the St. Joe Noxious Weed EIS	X	X	X	Not likely	Effects displayed in Weeds EIS, buffers to streams or wetlands required
Outfitting: • Simmons/Quartz Designated Outfitter Area: year-round operations; snowmobile use for hunting operations only on routes open to public; horseback tours; Whitetail Peak Spike Camp • Fishing in St. Joe River from Red Ives to Avery • Rafting in St. Joe River from Spruce Tree CG to Avery	X	X	X	Not likely	No appreciable increase in sediment or water yield is expected because of dispersed nature of activities and no to minimal level of ground disturbance
Baffling a culvert under FH 50 at Bruin Creek	X			Not likely	Improvement for beneficial use support, no change in water or sediment yield
Large woody debris removal from Bruin Creek	X			Likely	Increased sediment transport, may have recovered (see LWD discussions)

Cumulative Effects on Stream Channel Form and Process

Cumulative effects of past, present or foreseeable activities are not expected to appreciably affect stream channel form or processes because existing stream channels have adjusted to their current water and sediment yield as evidenced by the relative stability of stream channels, the current riparian vegetation and the amount of large woody material present (W-15). Road related mass failure sediment has been assimilated into the stream channels of Haggerty and Bruin Creeks and the channels adjusted to this input in the same way as if these were natural mass failures.

Temperature

No direct change in stream temperature will occur because there would be no change in vegetation within the RHCA buffers; however, stream temperature may be reduced over time from increased stream shade as vegetation continues to grow in RHCA areas adjacent to stream channels.

Road Influences

There would be no change in road influences because no roads would be constructed, reconstructed, stored or decommissioned. Roads would continue to be sources of sediment as identified in the existing condition. There would be no cumulative change from the existing condition.

Wetlands

No wetlands have been identified within the project area, and no activities are proposed with Alternative A, so there would be no cumulative effect to wetlands.

Water Quality/Beneficial Uses

Current beneficial uses are supported in the existing condition except for temperature, and there would be no increase in stream temperature with Alternative A. No cumulative change in support of beneficial uses is expected. Stream temperature may become reduced from increased stream shade as vegetation continues to grow in areas adjacent to stream channels. The existing condition is a reflection of the cumulative effects to streams in the project area. There would be no appreciable cumulative effects from Alternative A.

Proposed Activities Common to Action Alternatives

Table 9 displays the proposed activities common to the action alternatives.

Table 9 – Proposed Activities Common to Alternatives B and C

Proposed Activity	Amount	Estimated Implementation Date
White Pine Pruning & Precommercial Thinning	777	2009
Girdling existing larch seed trees to limit spread of dwarf mistletoe	161 acres	2009
Inoculating girdled trees with heart rot to create cavity habitat sooner	50-100 trees	2009
Planting conifer seedlings	195 acres	2013-2014
Pocket Gopher Control on Planted Areas	195 acres	2013

Direct and Indirect Effects of Proposed Activities Common to Action Alternatives

The proposed activities of white pine pruning, precommercial thinning, girdling and inoculating larch trees and planting conifer seedlings are not expected to have any effect because there would be no ground disturbance or only minimal ground disturbance from seedling planting, no substantial removal of vegetative cover and no use of soil compacting mechanized equipment. These activities involve the use of hand-held and manually operated loppers, seedling planting tools and chainsaws. There would be no substantial change in water yield or sediment generation from these activities because of the reasons stated above.

Effects of proposed gopher control through the use of pesticides were documented in the St. Joe Ranger District Pocket Gopher Control Project Decision Memo dated January 24, 2008. The effects would be applicable to the same proposed activity in the Fallen Bear Project Area. Following the identified design features would prevent substantial direct or indirect effects to the water resource.

Cumulative Effects of Proposed Activities Common to Action Alternatives

Because there are no direct or indirect appreciable effects from the proposed activities common to the action alternatives, these activities are not expected to contribute to a cumulative effect within the project area or downstream from the project area.

Direct and Indirect Effects of Alternative B

Stream Channel Form and Channel Process

Water Yield

Table 10 displays the estimated change in water yield from proposed harvest, road construction, road decommissioning, and fuels treatment activities for Alternative B. The WATSED model was used to estimate water yield changes for streams in the project area from proposed activities occurring in 2010-2011 (W-3). Table 11 displays the time frame for water yield recovery to existing levels or a steady state (the lowest water yield recovery value that is maintained through 2050) (W-3).

Table 10 - Estimated Change in Water Yield from Proposed Activity

	Existing	Alternative B	
Drainage	Estimated Discharge (cfs)	Estimated Peak Increase (percent)	Estimated Peak Increase (cfs)
Haggerty/Shady/Face	26.4	2	26.9
Tumbledown Creek	29.1	2	29.6
Bruin Creek	40.4	2	41.1
Stevens Creek	2.5	1	2.5

Table 11 displays the estimated year of water yield recovery to existing condition and 'steady state' recovery year with the lowest water yield value estimated by the WATSED model that would continue to the year of 2050 without future activities (W-3).

Table 11 - Estimated Water Yield Recovery from Proposed Activity

Drainage	Year of Return to Existing Water Yield (percent over natural)	Year Steady State Water Yield Achieved (percent over natural)
Haggerty/Shady/Face	2020 (4%)	2025 (3%)
Tumbledown Creek	2015 (5%)	2032 (3%)
Bruin Creek	2013 (8%)	2026 (6%)
Stevens Creek	2013 (3%)	2032 (2%)

Sediment

Sediment Increase

Table 12 displays the increase in sediment from the proposed harvest, road construction and fuels treatment (burning) activities. The WATSED model was used to estimate sediment yield changes for streams in the project area from proposed harvest, road construction and fuels treatment activities occurring in the years 2010-2011 (W-3). The values displayed in Table 11 do not include reductions in sediment from road recontouring and storage. The sediment from roads is typically fine-grained material – sand, silt and clay sized particles (MacDonald and Coe 2007 p 154; Burroughs and others 1983 p 216) unless there is road associated mass failure. Sediment from harvest units (if any is generated) is also expected to be fine-grained material (Megehan and King 2004 p 213). The WATSED model estimated maximum increase in sediment occurs in the second year and then begins recovering (W-3).

Table 12 – Alternative B Estimated Sediment Yield Increase from Proposed Harvest, Road Construction and Fuels Treatment (burning) Activities Occurring in 2010-2011

Drainage	Natural Sediment (tons/yr)	First-Year Sediment Increase From Roads		Second-Year Sediment Increase From Roads, Harvest & Burning*	
		Percent Increase	Increased Sediment (tons/yr)	Percent Increase	Increased Sediment (tons/yr)
Haggerty/Shady/Face	25.0	1	0.25	5	1.25
Tumbledown Creek	15.9	5	0.80	5	0.80
Bruin Creek	16.5	2	0.33	5	0.83
Stevens Creek	24.7	1	0.25	0	0.00

**values include some second-year increase from roads*

Sediment Size

Road construction may increase the sand, silt or clay sediment particle size distribution because roads typically produce sediment in these size classes (MacDonald and Coe 2007 p 154; Burroughs and others 1983 p 216). The estimated sediment increase is not expected to be appreciable or measurable in project area streams. Sediment from harvest units is also expected to be fine-grained material (Megehan and King 2004 p 213). The estimated sediment volume would be reduced overall through road recontouring and storage (Table 14) which would reduce the amount of fine material delivered to stream channels.

Sediment Recovery

Table 13 displays the WATSED estimated sediment recovery after proposed road construction, harvest and burning activities without reductions from road recontour and road storage (W-3). This table shows what would happen without road recontouring and road storage.

Table 13 - Estimated Sediment Recovery after Proposed Road Construction, Timber Harvest and Burning Activities

Drainage	Year	Percent Over Existing Condition*
Haggerty/Shady Face	2014	0
Tumbledown Creek	2020	1
Bruin Creek	2014	0
Stevens	2010	1

**Sediment level would continue at this rate at least until 2050, but this table does not include the sediment reduction from road recontouring and storage.*

Overall Sediment Reduction

Table 14 displays the estimated sediment reduction from the proposed activities of road recontouring (Rx D) and storage (Rx C) when combined with proposed harvest, fuels treatment and road construction activities (W-3).

Table 14 - Estimated Sediment Yield Decrease after Completion of all Proposed Activities

Drainage	Existing sediment (ton/year)	Sediment Decrease (percent)	Sediment Decrease (ton/year)
Haggerty/Shady/Face	52.8	22	11.6
Tumbledown Creek	19.4	11	2.0
Bruin Creek	32.5	53	17.2
Stevens Creek	29.9	1	0.3

Stream Channel Form

No appreciable effects to stream channel form or cross-sectional areas are expected from changes in water yield because the magnitude of the estimated peak increase is small (0.5-0.7 cfs) (Table 10, W-3) and of short duration, returning to pre-activity levels within 4 to 11 years (W-3). Channel pattern is not expected to change from the current straight pattern classification because the streams are confined by valley walls.

Stream channel form or cross-sectional areas is not expected to be substantially affected by the estimated sediment increase from proposed activities because the short-term increase would be of small magnitude and there would be an overall estimated decrease in sediment up to 53% once all activities are completed (Table 14, W-3). There may be short-term storage of sediment within stream channels, on the stream bed, on channel margins, behind boulders and large woody debris and on adjacent floodplains; but because there is a large network of stream channels (Table 1) sediment storage is not expected to appreciably affect channel form at any given location because substantial aggradation is not expected. Aggradation is not expected to occur unless there is a 100% increase in sediment (Megehan and King 2004 p 217). Channel pattern and channel classification are not expected to appreciably change from changed sediment yield and size because of relatively stable cross-sections, the existing riparian vegetation, amount of LWD and the confined nature of the stream channel.

Stream Channel Process

No substantial change is expected in stream channel processes of storing and transporting material because the estimated small increase in water yield would not substantially change stream flows outside the realm of natural conditions.

Stream channel transport processes are not expected to substantially change from the short-term estimated sediment increase because there would not be an appreciable shift in sediment size and aggradation is not expected to occur because there would not be a 100% increase in sediment (Megehan and King 2004 p. 217). There may be some short-term sediment storage as mentioned above, but overall there would be an estimated sediment reduction, that under the existing water yield regimen may increase transport capacity and perhaps mobilize some of the stored sediment. For streams in the project area, the stream channel processes of transport and storage are expected to remain in adjustment upon completion of activities associated with Alternative B.

Streambank Vegetation

No direct or indirect effect to streambank vegetation is expected because no management activities will occur to change vegetative composition or structure.

Temperature

No change in stream temperature is expected from the proposed activities because there would be no management induced change in vegetation within the RHCA buffers.

Road Influences

Stream Crossings

Table 15 displays the number of existing crossings, crossings removed, remaining crossings and potential short-term sediment after stream crossing removal work is completed under Alternative B (W-14, 18). One new crossing in Stevens Creek from proposed construction of a road previously decommissioned, would later be removed as part of timber sale activities. The number of stream crossings would be reduced 64% from the existing 168 down to 61 (W-14).

Table 15 – Stream Crossings and Potential Sediment

Stream	Existing Stream Crossings	Alt B Crossings Removed	Crossings Remaining	Potential short-term sediment (tons)
Haggerty Creek	12	9	3	0.016
Shady Creek	4	1	3	0.002
Tumbledown Creek	40	20	20	0.035
Bruin Creek	94	66	28	0.116
Stevens Creek	2	1	1	0.002
face drainages	16	10	6	0.018
total	168	107	61	0.189

Culvert Ability to Pass 100-year Stream Flow

Table 16 displays roads that would remain open or be closed with a gate (Rx A) or a barrier (Rx B) and have undersize culverts. The existing culvert and the recommended culvert size to pass a 100-year peak flow event (W-19) are shown. The existing culverts' sizes were identified from field surveys (W-8), and the recommend size for a 100-year event was calculated based on Barenbrock's (2002) regression equations and culvert nomographs. Table 16 also displays the stream name, the section where the culvert is found, the percentage of the culvert inlet that is blocked, and whether or not the culverts would be replaced for log haul. With Alternative B four undersized culverts would be left in place where the roads would not be used for hauling logs.

Table 16 - Undersize Culverts on Roads That Remain Open or Closed With Gate or Barrier

Road*	Drainage	Section	Existing size (inches)	Recommended size (inches)	% blocked	Proposed to be Replaced for Log Haul
3723	Haggerty	32	24	30	0%	No, no timber haul
1223	Tumbledown	28	24	36	0%	No, no timber haul
		34	18	24	0%	
		34	24	33	0%	
3350	Bruin	2 or 3	18	21	50%	Alternatives B & C
3399	Bruin	34	18	24	0%	Alternatives B & C
		34	18	30	0%	
		35	24	36	0%	
		35	18	24	0%	
1231	Bruin	36	18	21	0%	Alternatives B & C
		36	18	21	0%	
		36	18	24	95%	
		1	18	24	0%	Alternative B only; No timber haul for Alternative C
		1	18	21	0%	
		1	18	21	0%	
		1	18	24	30%	
		12	18	21	100%	

Road*	Drainage	Section	Existing size (inches)	Recommended size (inches)	% blocked	Proposed to be Replaced for Log Haul
		12	18	21	0%	

**Roads with culverts identified as undersize for 100-year event*

Roads Located Within 50 feet of Stream Channels

There would be a reduction of roads located within 50 feet of stream channels through road recontouring and stream crossing removals for Road Prescriptions C & D. This activity would remove approximately 120 road segments totaling about 2.7 miles. This is a reduction of 59% in number of segments and 58% in miles of road located within 50 feet of stream channels. Table 17 displays the road length and number of segments removed per drainage (from proposed stream crossing removal and recontouring) and the length and number remaining.

Table 17 – Road Segment Information After Road Storage and Decommissioning

Stream	Number of Segments Removed	Road length (miles) Removed	Number of Segments Remaining	Road Length (miles) Remaining
Haggerty Creek	10	0.23	3	0.06
Shady Creek	2	0.04	4	0.07
Tumbledown Creek	27	0.54	20	0.46
Bruin Creek	69	1.60	49	1.14
Stevens Creek	1	0.02	1	0.20
face drainages	11	0.24	7	.014
total	120	2.7	84	1.94

The proposed removal of stream crossings is not modeled by WATSED. Road segments removed within 50 feet of stream channels were accounted for in the WATSED model which shows substantial sediment reductions (see Table 13) for all drainages except Stevens Creek, which WATSED estimated as having a modest 0.3 t/yr reduction.

The stream crossing removals may have a short-term sediment increase ranging from 0.2 kg- 3.1 kg per crossing or an average of 1.4 kg/ crossing (Foltz 2008; W-14). Overall sediment addition from crossing removals is estimated at 0.002-0.116 tons (see Table 15). Some of the sediment generated from these crossing removals may be natural alluvium stored at the site below the crossing structure.

Hydrologic Connectivity and Proposed Activities

Hydrologic connectivity is: 1) longitudinal – up and downstream; 2) Lateral – riverine and floodplain interactions; 3) vertical – riverine and subsurface or groundwater interactions (Kondolf and others 2006 p. 1; Beechie and others 2006 p 125; Ward and others 2001 p 312-314).

No changes are expected in longitudinal hydrologic connectivity because no dams or diversions or change in base flow conditions are proposed (Stednick and Troendle 2004 p. 175).

Little change is expected in the current lateral hydrologic connectivity of the stream to any floodplain because frequency of inundation would not diminish from proposed activities, no levees are proposed, and no appreciable channel incision is expected because scour is not expected from the minor water yield increase (Kondolf and others 2006 p 2).

Wetlands

No wetlands have been identified within the project area, but design features would protect any wetland found during implementation of the proposed activity.

Water Quality/Beneficial Uses

Current beneficial uses are supported in the existing condition except for temperature, and there would be no change in stream temperature from the proposed activities. The short-term increases in water and sediment yields would not degrade the current beneficial use support because: the small increase in water yield is not outside the range of natural variability and would not be appreciable in peak flows stream channels historically experienced (1933 floods); the short-term increase in sediment is not substantial and is not likely to affect stream channel form or process as documented above; there would be an overall decrease in estimated sediment once all proposed activities are completed; there would be a reduction in potential pollutant entry points from the removal of 64% of existing stream crossings and reduction of 58% in road mileage within 50 feet of stream channels. The proposed activities are, overall, expected to increase beneficial use support.

Cumulative Effects of Alternative B

Past, present and reasonably foreseeable activities and their possible effects are included in Table 18.

As identified in Table 18, the following activities were modeled for cumulative effects: timber harvest, pre-commercial timber stand improvement (thinning), and road construction. The following activities may have some cumulative effects: road maintenance, Conrad Campground, trail maintenance, and in-stream fish habitat improvements. The large woody debris removal in Bruin Creek likely had an effect, but that effect is no longer believed to be present.

The stream channel form and processes discussed under the existing condition are the cumulative result of all past and present activities on the stream channel. The future activities identified in Table 18 with 'possible' cumulative effects are discussed below and are not expected to appreciably affect stream channel form or processes because of BMP implementation, dispersed activity location and timing, relatively low impact with minimal ground disturbance or no additional new ground disturbance.

Road Maintenance and Reconstruction

Road maintenance and reconstruction activities utilize BMPs. No substantial impacts are expected from road maintenance activities such as blading, drainage improvements, culvert maintenance and surfacing on existing dedicated roads when BMPs are utilized to minimize adverse effects on the aquatic environment. These activities are designed to prevent erosion and also prevent hydrologic connectivity of roads to the stream network. Utilizing BMPs to minimize adverse effects on the aquatic environment is consistent with the Clean Water Act (CFR 33 & CFR 44) and Idaho water quality standards (IDAPA 58.01.02.350 Rules Governing Nonpoint Source Activities).

Past Road-related Mass Failures

Two roads in the project area experienced mass-failure. Road 3310UA has two areas that slumped at an unknown time in the recent past (perhaps about 10-15 years ago) (W-8 photos). Road 1223 had fill erosion at mile 0.2 and a small debris flow at mile 0.08 from a storm event and/or runoff in 1997 (Act-7). The estimated size of the slumps on 3310UA is estimated at about 200 cubic yards (W-9). The fill erosion of Road 1223 is estimated at about 20 cubic yards and the debris flow at about 12 cubic yards (W-9). Some of the slump material from Road 3310UA made it to the channel of Haggerty Creek (W-9). The estimated fill erosion and some of the debris flow material was delivered to the Bruin Creek channel. See existing condition for description of effects from these mass failures. The stream has assimilated and adjusted to the delivery of sediment from this past event, and there is no current effect that would contribute cumulatively to the proposed activities.

Conrad Campground

Conrad Crossing Campground is located near the mouth of Stevens Creek at the eastern boundary of the project area. Future use of this campground is not expected to increase water or sediment yields, and the roadways within the campground and within the project area were modeled in WATSED. There is always the possibility of accidental or deliberate introduction of chemicals from vehicles or other sources. It is speculation to try and determine effects from any possible chemicals added to streams in the vicinity of the campground.

General Public Activities

Recreational activities are expected to increase over time and may contribute to localized, small-scale disturbances. Future small-scale disturbances or their effects are not estimated because these are impossible to predict and constitute speculation.

Trail Maintenance

Trail maintenance generally consists of clearing rocks, fallen logs or brush from the trail area. It also may include maintaining drainage features such as water bars or drainage dips. Trails in the project area do not parallel stream channels and are not located within the 50-foot buffer except Trail 5, which crosses Haggerty Creek and a small face drainage. Trail maintenance activities are not expected to have an appreciable effect on stream channel form or processes.

Instream Fish Habitat Improvement

Fish habitat improvement activities occurred in 1987 and 1993. There likely was minor sediment additions from these activities but their effects have dissipated and are not appreciable as a current cumulative effect.

Large Woody Debris (LWD) Removal

Removal of LWD from the Bruin Creek channel last occurred in 1987 when a log jam was removed. There had been some LWD removal previous to 1987. The removal of LWD increased the sediment transport capacity of the stream in the lower 4.4 mile reach that is accessible by road where the removal took place. The increased transport capacity means that sediment more easily moved through this reach when the wood was removed because wood stores sediment and wood increases hydraulic roughness which in turn reduces stream power and the ability to transport material. The removal of the wood did not introduce sediment into the channel but allowed stored sediment more freedom to move. The current LWD amounts (see existing condition) have likely returned the transport capacity to levels similar to those prior to the removal.

Eureka Mine

The Eureka Mine claim was staked prior to 1911 (Act-8). Major activity at this site likely occurred 75 to 100 years ago with an adit driven into the sidehill (Act-8). There is an area adjacent to the adit where waste rock was dumped. This dump encompasses approximately 360 cubic feet (Act-8). Effects from past mining activities are not affecting stream channels because the location is not proximate to any perennial or intermittent stream. Adit closure with a bat-friendly device is not expected to affect water quantity or quality because there is minimal disturbance and again the location is not proximate to any stream channel.

Table 18 - Past, Present, & Reasonably Foreseeable Actions Considered for Cumulative Effects

Action	Past	Present	Future	May Have Cumulative Effects	Explanation
Timber Harvest	X			Modeled	Modeled in WATSED
Tree Planting	X			Not likely	Usually hand work minimal ground disturbance
Precommercial Timber Stand Improvement	X			Modeled	Modeled in WATSED
Prescribed Burning for Site Preparation and fuels treatment	X			Modeled	Modeled in WATSED
Wildfires	X		**unknown**	Not likely	Effects likely dissipated because of time passage (Fire Report)
Fire Suppression	X	X	X	Not likely	Usually hand work; minimal ground disturbance

Action	Past	Present	Future	May Have Cumulative Effects	Explanation
Clearing Brush and Trees to Maintain Helispots	X	X	X	Not likely	Usually hand work; minimal ground disturbance
Wildlife Burns	X			Not likely	Minimal ground disturbance
Road Construction	X			Modeled	Modeled in WATSED
Road Decommissioning (3.6 mi)	X			Not likely	Previous work in mid-1990s; effects likely dissipated
Road Maintenance	X	X	X	Possible	Not likely because BMPs are used to control non-point pollution (per CFRs) and no additional new ground disturbance
Conrad Campground	X	X	X	Possible	Not likely except for accidental chemical discharges. No new ground disturbance
General Public Activities: firewood cutting, driving roads, camping, snowmobiling, hunting, hiking, berry picking, fishing, Christmas tree cutting	X	X	X	Possible	Not likely, not appreciable because of dispersed nature of activities and minimal ground disturbance
Trail Maintenance	X	X	X	Not likely	Because of trail location, BMPs used to control non-point pollution and no new ground disturbance
In-stream Fisheries Habitat Improvement Projects	X			Possible	Minor sediment addition for improved beneficial use support. Effects dissipated over time.
Spraying Herbicides to Control and Prevent Noxious Weeds Under the St. Joe Noxious Weed EIS	X	X	X	Not likely	Effects displayed in Weeds EIS, buffers to streams or wetlands required
Outfitting: • Simmons/Quartz Designated Outfitter Area: year-round operations; snowmobile use for hunting operations only on routes open to public; horseback tours; Whitetail Peak Spike Camp • Fishing in St. Joe River from Red Ives to Avery • Rafting in St. Joe River from Spruce Tree CG to Avery	X	X	X	Not likely	No appreciable increase in sediment or water yield is expected because of dispersed nature of activities and no to minimal level of ground disturbance
Baffling a culvert under FH 50 at Bruin Creek	X			Not likely	Improvement for beneficial use support, no change in water or sediment yield
Large woody debris removal from Bruin Creek	X			Likely	Increased sediment transport, may have recovered (see LWD discussions)
Eureka Mine hard rock mining	X			Not likely	
Installing bat-friendly barrier on Eureka Mine adit to block human access for safety			X	Not likely	

Cumulative Effects on Stream Channel Form and Process

Cumulative effects from proposed activities combined with past, present or foreseeable activities are not expected to appreciably affect stream channel form or processes because of the small changes in water and sediment yield over short time frames and the overall net reduction in sediment. Aggradation is not expected to occur unless there is a 100% increase in sediment (Megehan and King 2004 p 217). Road related mass failure sediment has been assimilated into the stream channels of Haggerty and Bruin Creeks, and these stream channels adjusted to this input in the same way as if these were natural mass failures. The stream channels have adjusted to their current water and sediment yield as evidenced by the relative stability of stream channels, the current riparian vegetation and the amount of large woody material present. Channel pattern and channel classification are not expected to change cumulatively from proposed activities when combined with past, present or foreseeable activities because of relatively stable cross-sections, the existing riparian vegetation, amounts of LWD and the confined nature of the stream channels.

Downstream Cumulative Effects

Cumulative effects from estimated sediment levels associated with Alternative B are not expected to be appreciable in the St. Joe River immediately downstream from the project area streams because: 1) the estimated increase is small (Tables 10 & 12); 2) the short-term nature of the estimated increase; 3) some portion to all of the estimated sediment increase would be stored within the project area stream channels and floodplains; 4) the estimated increase will not cause aggradation (Megehan and King 2004 p 217) or likely be even measurable at a downstream location; 5) there would be a substantial overall estimated decrease in sediment (Table 14) once all activities are completed which would improve downstream conditions and downstream beneficial use support.

Temperature

No change in stream temperature is expected from the proposed activities because there would be no change in vegetation within the RHCA buffers. Stream temperature may become reduced from increased stream shade as vegetation continues to grow in RHCA areas adjacent to stream channels.

Wetlands

No wetlands have been identified within the project area, but design features would protect any wetland found during implementation of the proposed activity.

Water Quality/Beneficial Uses

Current beneficial uses are supported in the existing condition except for temperature and there will be no change in stream temperature from the proposed activities because of RHCA buffers. The short-term increases in water and sediment yields would not degrade the current beneficial use support because: the small increase in water yield is not outside the range of natural variability and would not be appreciable in peak flows stream channels historically experienced (1933 and 1996 floods); the short-term increase in sediment would not be substantial and is not likely to affect stream channel form or process as documented above; there would be an overall decrease in estimated sediment once all proposed activities are completed; there would be a reduction in potential pollutant entry points from the removal of 68% of existing stream crossings and reduction of 64% in road mileage within 50 feet of stream channels. The proposed activities are, overall, expected to increase beneficial use support.

Stream temperature may be reduced from increased stream shade as vegetation continues to grow in RHCA areas adjacent to stream channels.

Direct and Indirect Effects of Alternative C

Water Yield

Water Yield Increase

Water yield for Alternative C was estimated assuming proposed activities would result in 75% of the effects of Alternative B even though harvest activities are only 55% of, and road construction only 23% of that proposed for Alternative B. Table 19 displays the estimated increase in water yield for Alternative C.

Table 19 - Estimated Change in Water Yield from Proposed Activity

	Existing	Alternative C	
Drainage	Estimated Discharge (cfs)	Estimated Peak Increase (percent)	Estimated Peak Increase (cfs)
Haggerty/Shady/Face	26.4	1.5	26.8
Tumbledown Creek	29.1	1.5	29.5
Bruin Creek	40.4	1.5	41.0
Stevens Creek	2.5	0.8	2.5

Water Yield Recovery

Water yield recovery for Alternative C is not expected to be substantially different from that displayed in Table 11 for Alternative B. Water yield may recover in fewer years than Alternative B because there would be less harvest and less new road construction in Alternative C.

Sediment

Sediment Increase

The sediment yield for Alternative C is based on the proportion of harvest (55%) and road construction (23%) of Alternative C compared to Alternative B. Table 20 displays the estimated increase for Alternative C.

Table 20 – Alternative C Estimated Sediment Yield Increase from Proposed Harvest, Road Construction and Fuels Treatment (burning) Activities Occurring in 2010-2011

	1st-Year Sediment Increase From Roads			2nd-Year Sediment Increase From Roads, Harvest & Burning*			Total
Drainage	Natural Sediment (tons/yr)	Percent Increase	Sediment Increase (tons/yr)	Sediment Increase (tons/yr)	Percent Increase	Sediment Increase (tons/yr)	Percent Increase
Haggerty/Shady/face	25.0	0.2	0.06	0.25	2.7	0.68	2.9
Tumbledown Creek	15.9	1.2	0.18	0.80	2.7	0.43	3.9
Bruin Creek	16.5	0.5	0.08	0.33	2.7	0.45	3.2
Stevens Creek	24.7	0.2	0.06	0.25	0	0.00	0.2

**values include some second-year increase from roads*

Sediment Size

Road construction may increase the sand, silt or clay sediment particle size distribution because roads typically produce sediment in these size classes (MacDonald and Coe 2007 p 154; Burroughs and others 1983 p 216). The estimated sediment increase is not expected to be appreciable or measurable in project area streams. Sediment from harvest units is also expected to be fine-grained material (Megehan and King 2004 p 213). The estimated sediment volume would be reduced overall through road recontouring and storage that would reduce the amount of fine material delivered to stream channels.

Sediment Recovery

The sediment yield recovery for Alternative C would occur sooner or in about the same year as Alternative B as displayed in Table 13. Because road construction for Alternative C is only 23% of and most of that construction is located in the Tumbledown drainage only the Tumbledown drainage is expected to have an increase in sediment from road construction compared to the existing condition. WATSED estimated that there would be a 1% increase in sediment in Tumbledown and Stevens Creeks which is the same as Alternative B (Table 13).

Overall Sediment Reduction

Table 21 displays the estimated net sediment reduction for Alternative C from the proposed activities of road recontouring (Rx D) and storage (Rx C) when combined with proposed harvest, fuels treatment and road construction activities. Switalski and others (2004 p 27) identify reduced erosion and improved infiltration as some of the benefits of road removals.

Table 21 – Alternative C Estimated Net Sediment Yield Decrease after Completion of all Proposed Activities

Drainage	Existing sediment (ton/year)	Percent Decrease	Decreased Sediment (ton/year)
Haggerty/Shady/Face	52.8	22	11.6
Tumbledown Creek	19.4	11	2.1
Bruin Creek	32.5	53	17.2
Stevens Creek	29.9	2	0.6

Stream Crossings

Table 22 displays the existing crossings, crossings removed, remaining crossings and potential sediment from the crossing removals for Alternative C. Alternative C removes 8 more crossings than Alternative B because it includes storing part of Road 1223.

Table 16 displays roads with undersize culverts that would remain on open and gated roads. With Alternative C ten undersized culverts would be left in place, but those roads would not be used to haul timber.

Table 22 – Alternative C Stream Crossings and Potential Sediment

Stream	Existing Stream Crossings	Alt C Crossings Removed	Crossings Remaining	Potential short-term sediment (tons)
Haggerty Creek	12	9	3	0.016
Shady Creek	4	1	3	0.002
Tumbledown Creek	40	28	12	0.049
Bruin Creek	94	66	28	0.116
Stevens Creek	2	1	1	0.002
face drainages	16	10	6	0.018
total	168	115	53	0.203

Roads Located within 50 feet of Stream Channels

Table 23 displays the number of road segments and road mileage located within 50 feet of stream channels that would be removed and that would remain after implementation of Alternative C. Alternative C includes storing part of Road 1223 that is not included in Alternative B.

Table 23 –Road Segments within 50 feet of Steams After Road Storage and Decommissioning

Stream	Number of Segments Removed	Road length (miles) Removed	Number of Segments Remaining	Road Length (miles) Remaining
Haggerty Creek	10	0.23	3	0.06
Shady Creek	2	0.04	4	0.07
Tumbledown Creek	35	0.74	12	0.26
Bruin Creek	69	1.60	49	1.14
Stevens Creek	1	0.02	1	0.20
face drainages	11	0.24	7	.014
total	128	2.87	76	1.74

Roads

The proposed removal of stream crossings is not modeled by WATSED. Road segments removed within 50 feet of stream channels were accounted for in the WATSED model which shows substantial sediment reductions (see Table 14) for all drainages except Stevens Creek, which WATSED estimated as having a modest 0.3 tons/yr reduction.

The stream crossing removals may have a short-term sediment increase ranges from 0.2 kg-3.1 kg per crossing or an average of 1.6 kg/ crossing (Foltz 2008). Overall sediment addition from crossing removals is estimated at 0.002-0.116 tons (see Table 15). Table 15 is applicable to Alternative C also. Some of the sediment generated from these crossing removals may be natural alluvium stored at the site below the crossing structure.

Stream Channel Form

No appreciable effects to stream channel form are expected from changes in water yield from Alternative C because the magnitude of the estimated peak increase is small (0.5-0.7 cfs) (Table 19) and of short duration, returning to pre-activity levels within 4 to 11 years (W-3).

Stream channel form is not expected to be substantially affected by the estimated sediment increase from proposed activities in Alternative C because the short-term increase is of small magnitude; and there is an overall estimated decrease in sediment up to 53% once all activities are completed. There may be short-term storage of sediment within stream channels, on the stream bed, on channel margins, behind boulders and large woody debris and on adjacent floodplains, but because there is a large network of stream channels (Table 1) sediment storage is not expected to appreciably affect channel form at any given location because substantial aggradation is not expected. Aggradation is not expected to occur unless there is a 100% increase in sediment (Megehan and King 2004 p. 217). Channel pattern and channel classification are not expected to appreciably change from changed sediment yield and size because of relatively stable cross-sections, the existing riparian vegetation, amount of LWD and the confined nature of the stream channel.

Stream Channel Process

No substantial change is expected in the stream channel processes of storing and transporting material because the Alternative C estimated small increase in water yield would not substantially change stream flows outside the realm of natural conditions.

Stream channel transport processes are not expected to substantially change as a result of the short-term estimated sediment increase from Alternative C activities because there would not be an appreciable shift in sediment size and aggradation is not expected to occur because there is not a 100% increase in sediment (Megehan and King 2004 p. 217). There may be some sediment storage as mentioned above, but overall there would be an estimated sediment reduction, that under the existing water yield regimen may increase transport capacity and perhaps mobilize some of the stored sediment. For streams in the project area, the stream channel processes of transport and storage are expected to remain in adjustment upon completion of activities associated with Alternative C.

Temperature

No change in stream temperature is expected from the Alternative C activities because there would be no management induced change in vegetation within the RHCA buffers.

Hydrologic Connectivity and Proposed Activities

Hydrologic connectivity is: 1) longitudinal – up and downstream; 2) Lateral – riverine and floodplain interactions; 3) vertical – riverine and subsurface or groundwater interactions (Kondolf and others 2006 p. 1; Beechie and others 2006 p. 125; Ward and others 2001 pp. 312-314).

No changes are expected in longitudinal hydrologic connectivity because no dams or diversions or change in base flow conditions are proposed (Stednick and Troendle 2004 p. 175).

Little change is expected in the current lateral hydrologic connectivity of the stream to the floodplain because frequency of inundation would not diminish from Alternative C activities, no levees are proposed, and no appreciable channel incision is expected because scour is not expected from the minor water yield increase (Kondolf and others 2006 p. 2).

Wetlands

No wetlands have been identified within the project area, but design features would protect any wetland found during implementation of the proposed activity.

Water Quality/Beneficial Uses

Current beneficial uses are supported in the existing condition except for temperature, and there would be no change in stream temperature from the Alternative C activities. The short-term increases in water and sediment yields for Alternative C would not degrade the current beneficial use support because: the small increase in water yield is not outside the range of natural variability and would not be appreciable in peak flows stream channels historically experienced (1933, 1996 floods); the short-term increase in sediment is not substantial and is not likely to affect stream channel form or process as documented above; there is an overall decrease in estimated sediment once all proposed activities are completed; there is a reduction in potential pollutant entry points from the removal of 68% of existing stream crossings and reduction of 64% in road mileage within 50 feet of stream channels. The proposed activities are, overall, expected to increase beneficial use support.

Cumulative Effects of Alternative C

The cumulative effects of Alternative C are not substantially different than those discussed in the Cumulative Effects section for Alternative B, above, and displayed in Table 18. Overall effects are expected to be somewhat less than that of Alternative B because Alternative C would have 55% of the harvest and 23% of the new road construction compared to Alternative B.

Cumulative Effects on Stream Channel Form and Process

Cumulative effects from proposed activities combined with past, present or foreseeable activities are not expected to appreciably affect stream channel form or processes because of the small changes in water and sediment yield over short time frames and the overall net reduction in sediment. Aggradation is not expected to occur because it is estimated that there would be a short-term sediment increase of approximately 2.7%, and aggradation is not expected unless there is a 100% increase in sediment (Megehan and King 2004 p. 217). Road related mass failure sediment has been assimilated into the stream channels of Haggerty and Bruin Creeks, and these stream channels adjusted to this input in the same way as if there were natural mass failures. The stream channels have adjusted to their current water and sediment yield as evidenced by the relative stability of stream channels, the current riparian vegetation and the amount of large woody material present.

Downstream Cumulative Effects

Cumulative effects from estimated sediment levels associated with Alternative C are not expected to be appreciable in the St. Joe River immediately downstream from the project area streams because: 1) the estimated increase is small (Tables 19 & 20); 2) the short-term nature of the estimated increase; 3) some portion to all of the estimated sediment increase would be stored within the project area stream channels and floodplains; 4) the estimated increase is not substantial or likely even measurable at a downstream location; 5) there would be a substantial overall estimated decrease in sediment once all activities are completed which would improve downstream conditions and downstream beneficial use support.

Temperature

No change in stream temperature is expected from the proposed activities because there would be no change in vegetation within the RHCA buffers. Stream temperature may become reduced from increased stream shade as vegetation continues to grow in RHCA areas adjacent to stream channels.

Wetlands

No wetlands have been identified within the project area, but design features would protect any wetland found during implementation of the proposed activity.

Water Quality/Beneficial Uses

Current beneficial uses are supported in the existing condition except for temperature, and there would be no change in stream temperature from the proposed activities because of RHCA buffers. The short-term increases in water and sediment yields would not degrade the current beneficial use support because: the small increase in water yield is not outside the range of natural variability and would not be appreciable in peak flows stream channels historically experienced (1933 and 1996 floods); the short-term increase in sediment would not be substantial and is not likely to affect stream channel form or process as documented above; there would be an overall decrease in estimated sediment once all proposed activities are completed; potential pollutant entry points would be reduced from the removal of 68% of existing stream crossings and reduction of 64% in road mileage within 50 feet of stream channels. The proposed activities are, overall, expected to increase beneficial use support.

Stream temperature may be reduced from increased stream shade as vegetation continues to grow in RHCA areas adjacent to stream channels.

Regulatory Consistency

<u>Alternative A</u>

Forest Plan

Alternative A is consistent with the Forest Plan goals and standards because management activities would not appreciably change water quality or stream channel form or processes.

Clean Water Act

Alternative A is consistent with the goals and objectives of the Clean Water Act because management activities would not appreciably change water quality or stream channel form or processes.

State Water Quality Laws and Regulations

Alternative A is consistent with Idaho State Water Quality Standards because management activities would not appreciably change water quality or stream channel form or processes.

Executive Orders 11988 & 11990

Alternative A is consistent with the Executive Orders 11988 and 11990 because management activities would not affect floodplains or wetlands.

Alternatives B and C

Forest Plan

Alternative B and Alternative C are consistent with the Forest Plan goals and standards because management activities would implement BMPs; RHCA buffers would be implemented to protect water quality; and proposed activities would not appreciably change water quality or stream channel form or processes.

Clean Water Act

Alternative B and Alternative C are consistent with the goals and objectives of the Clean Water Act because management activities would not appreciably change the physical processes of storage and transport of material delivered to stream channels. Stream channel form and processes are not expected to appreciably change from management activities because of relatively stable cross-sections, riparian vegetation, amount of LWD and confined nature of the stream channels. The biological integrity of waters within the project area are not expected to appreciably change from management activities because temperature and organic inputs would not change because of RHCA buffers; the short-term small estimated sediment increase would not cause aggradation; and effects from proposed activities are not outside the range of natural variability. The biological integrity of waters within the project area should improve once all activities are complete and the overall sediment yield is reduced. No change is expected to the chemical composition of waters within the project area because no chemical additives are proposed; no change in riparian vegetation within RHCAs; and the risk of contamination would be reduced because of the reduction in the number of road/stream crossings and the reduction in the amount of road mileage within 50 feet of stream channels.

State Water Quality Laws and Regulations

Alternative B and Alternative C are consistent with Idaho State Water Quality Standards because non-point source pollution would be managed through the use of BMPs in completing management activities. No appreciably change to water quality and beneficial use support is expected from the estimated short-term water or sediment yields; the long-term reduction in sediment would improve water quality and beneficial use support. No change in stream temperatures is expected because of RHCA buffers. Stream channel form and processes are not expected to appreciably change from management activities.

Executive Orders 11988 & 11990

Alternative B and Alternative C are consistent with the Executive Orders 11988 and 11990 because management activities would not affect floodplains or wetlands.

NFMA

Alternative B and Alternative C are consistent with NFMA because watersheds will not be irreversibly harmed and the implementation of RHCA buffers will protect the water resource and not adversely affect water conditions as documented above.

Definitions

Water yield

Water yield is the amount of water that is delivered from a landscape. Typically the landscape is a watershed or some contributing area of a watershed. A watershed is all land and water within a drainage divide (SCSA 1982 p 186).

Water yield is measured in various ways: an acre-foot is the amount of water that would cover an acre one-foot deep; a miner's inch is the flow required to place an inch of water into a miner's sluice. Discharge is the rate of flow in terms of volume of fluid passing a given cross section per unit time (Leopold and others 1964 p 155). Discharge is typically expressed in cubic feet per second (cfs) or cubic meters per second ($m^3 s^{-1}$).

Water yield can also be discussed as instantaneous peak flow (maximum flow) or base flow (how much water during low flow periods). Water yield can also be measured as water stage (the elevation of the water surface above an arbitrary datum at a designated point or area). Water stage is typically used for identifying and predicting flood conditions, and for estimating discharge (using a rating curve, which is measured discharge plotted against the corresponding elevation of the water surface (Dunne and Leopold 1978 p 594)).

Instantaneous peak flow is analyzed as water yield for the Fallen Bear Project.

Water Quality

Water quality addresses the chemical, physical and biologic components of a water body (lakes, streams, groundwater aquifers) as it relates to human assigned values or beneficial uses. Typically water quality includes components like temperature, turbidity, dissolved oxygen, pH, other chemical constituents, streamflow, etc.

Stream temperature: the temperature of water flowing in a stream.

Stream chemistry: the chemical make-up of water flowing in a stream.

Turbidity: a measurement of the suspended solids in a liquid (SCSA 1982 p. 179).

Channel form

Channel form consists of the channel slope, shape of the channel cross-section and the channel pattern (as viewed on a map or from the sky). The form of any stream channel is related to both hydraulic and physical features. There are eight interrelated variables involved in the downstream changes in river slope and channel form: width, depth, velocity, slope, sediment load, size of sediment debris, hydraulic roughness, and discharge (Leopold and others 1964 p 268).

Channel cross-section (width, depth, discharge, sediment yield): The shape of a cross-section of a river channel is a function of the flow, the quantity and character of the sediment in movement through the section, and the character or composition of the materials making up the bed and banks of the channel (Leopold and others 1964 p 198).

Channel pattern (slope, discharge, sediment yield, Beechie and others 2006 p. 130 Fig. 4 p 137): Rivers display a continuum of patterns from straight to highly sinuous (Schuum 1977 p 113). Beechie and others (2006) identify four channel patterns in forested mountainous areas, straight, meandering, island-braided and braided for interpreting the dynamics of river-floodplain ecosystems.

Channel Pattern	Definition
Straight	Primarily single thread channel, sinuosity <1.5
Meandering	Primarily single thread channel, sinuosity >1.5

Island-braided	Multiple channels, mainly separated by vegetated islands
Braided	Multiple channels, mainly separated by unvegetated gravel bars

Table from: *Beechie and others 200, p 128*

Sinuosity: Sinuosity is defined as the ratio of channel length to valley length (Rosgen 1996 p 2-8). A straight channel pattern has low sinuosity compared to a meandering channel, which has higher sinuosity.

Sediment yield (sediment load, size of sediment debris): Sediment yield is defined as the total sediment outflow from a catchment over some unit of time (Gordon and others 1992 p 336). Sediment load is the amount of sediment moving in stream channels (Leopold and others, 1964 p 169). Sediment is material from bedrock or from the earth's soil mantle that is displaced and then deposited on slopes or in stream channels [Solid material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by the forces of air, water, gravity or ice and has come to rest on the earths surface either above or below sea level (SCSA 1982 p 142).]

Pebble count (size of sediment debris, hydraulic roughness): Sediment can range in size from fine sand, silt and clay (0.002 mm to 2.0 mm, (SCSA 1982 p 159)) to very large boulders (4096 mm (Gordon and others 1992 p 195)). Typically there is a differentiation between finer-grained material that is suspended in the water column (suspended solids) and larger material that is not usually suspended (bedload) (Leopold and others 1964 p 180).

Channel processes (physical)

A channel's physical process is to convey the water, sediment (Schumm 1977 p 104-105) and wood (Montgomery and others 2003 p 21) delivered to it from adjacent areas; also, wood may be stored (Grunell 2003 p 75) and sediment deposited (Gordon and others 1992 p 319) or stored (Gregory 2003 p 2) in the stream system. Stream morphology (dimensions, patterns and profile, Rosgen 1996 p xvi) both responds to and develops under the amount of water, sediment and wood delivered to it. "[T]he upland channel is formed and maintained by the flow of water and sediment that it carries and is thus the creator of its own geometrical properties" (Leopold and others 1964 p 272).

"The ability of flowing water to carve a channel, transport debris, and thus ultimately to degrade [to lower a land surface by erosion] the landscape, depends on these forces – gravitational impelling force, and the resistances offered it. The effects of lithology [the structure and composition of rock formations] and topography on the ability of flowing water to carve and transport are exerted principally through their relation to the resisting forces" (Leopold and others 1964 p 153).

Dynamic Equilibrium (stream)

"True stability does not exist in streams": "In all natural systems, change is the rule": "…dynamic equilibrium …signif[ies] that a stream in this condition can adjust rather quickly to changes and attain a new dynamic equilibrium" (Heede and Rinne (1990) p 252).

Schumm (1977 p 9) states that a stream is in equilibrium when there is a balance between its transporting capacity and the amount of material supplied to it. And further (citing Mackin 1948 p 471) that a change in any controlling factors [that determine stream characteristics] will cause a displacement of the equilibrium in a direction that will tend to absorb the effect of the change.

Heede (1992 p 6) states that dynamic equilibrium does not imply absolute equilibrium conditions, but that a stream can adjust to a new hydraulic situation within a relatively short time, perhaps a few years. And also states (1992 p 6) that in geologic time spans, dynamic eqjuilibrium has no place, because land denudation is the long-term process.

Hydrologic connectivity

Hydrologic connectivity is: 1) longitudinal – up and downstream; 2) Lateral – riverine and floodplain interactions; 3) vertical – riverine and subsurface or groundwater interactions (Kondolf and others 2006 p 1; Beechie and others 2006 p. 125; Ward and others 2001 p 312-314).

Soil productivity

Soil productivity is the capacity of a soil in its normal environment to produce a specified plant or sequence of plants under a specified system of management (SCSA 1982).

Mass failure

Mass failure or slope debris movement is the transport of material in a coherent mass as opposed to movement of individual soil particles. There are three primary types of mass failure: slides, flows and heaves. Mass failures will only occur when driving forces (shear stress) exceed resisting forces (shear strength) (Ritter 1978 pp143-144).

Nomograph

A nomograph is a set of scales for the variables in a problem which are so distorted and so placed that a straight line connecting the known values on some scales will provide the unknown values at its intersection with the other scales (Webster's 1972 p 966).

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Fallen Bear Water Resources Report Appendix A: Applicable BMPs & Soil and Water Conservation Practices

Introduction

The Clean Water Act, as amended, (33 U.S.C. 1323) directs the Forest Service to meet state, interstate and local substantive as well as procedural requirements respecting control and abatement of pollution in the same manner, and of the same extent as any non-government entity.

The Forest Service has the statutory authority to regulate, permit and enforce land-use activities on the National Forest System lands that affect water quality.

As the designated management agency, the Forest Service is responsible for implementing 1) nonpoint source (NPS) pollution control; and 2) the Idaho State Water Quality Standards on National Forest System lands. The Forest Service's water quality policy is to: 1) promote the improvement, protection, restoration and maintenance of water quality to support beneficial uses on all National Forest Service waters; 2) promote and apply approved Best Management Practices (BMPs) to all management activities as the method for control of NPS pollution; 3) comply with established state or national water quality goals; and 4) design monitoring programs for specific activities and practices that may affect or have the potential to affect in-stream beneficial uses on National Forest System lands.

The Forest Service also coordinates all water quality programs, on National Forest System lands within its jurisdiction, with the local, state and federal agencies, affected public lands users, adjoining land owners, and other affected interests.[1]

The Idaho Panhandle National Forest Plan states (Chapter II, p. 27) that the Forest will "maintain high quality water to protect fisheries habitat, water based recreation, public water supplies and be within state water quality standards." The State's water quality standards regulate nonpoint source pollution from timber management and road construction activities through application of Best Management Practices (BMPs). The BMPs are developed under authority of the Clean Water Act to ensure that Idaho's waters do not contain pollutants in concentrations which adversely affect water quality or impair a designated use. State recognized BMPs that will be used during project design and implementation are contained in these documents:

a. Rules and Regulations Pertaining to the Idaho Forest Practices Act, (IFPA), as adopted by the Idaho Land Board; and

b. Rules and Regulations and Minimum Standards for Stream Channel Alterations, as adopted by the Idaho Water Resources Board under authority of the Idaho Stream Channel Protection Act (ISCPA).

Many of the rules and regulations for stream channel alterations are contained, in slightly different forms, in two Memorandum of Understandings (MOU) between the USFS and the State of Idaho. These MOUs are incorporated into the Forest Manual and R-1 Supplement 31, contains provisions which are not currently state recognized BMPs.

The practices described herein are tiered to Forest Service Handbook FSH 2509.22. They are developed as part of the NEPA process, with interdisciplinary involvement, and are designed to meet state and Forest water quality objectives. The purpose of this appendix is to: 1) establish the connection between the Soil and Water Conservation Practice (SWCP) employed by the Forest Service and BMPs identified in

[1]Memorandum of Understanding Implementing the Nonpoint Source Water Quality Program in the State of Idaho, signed by USEPA, Idaho Departments of Agriculture, Water Resources, and Division of Environment; BLM; and US Forest Service, Regions 1 and 6. 1994

Idaho Water Quality Standards (IDAPA 16.01.2300.05) and 2) identify how the SWCP Standard Specifications for the Construction of Roads, and the Timber Sale Contract provisions meet or exceed the Rules and Regulations pertaining to the Idaho Forest Practices Act, Title 38, Chapter 13, Idaho Code. The relevant portions of the Rules and Regulations developed under the Idaho Stream Protection Act are also covered.

The objective of this appendix is to provide conservation practices for use on National Forest Lands to minimize the effects of management activities on soil and water resources. The conservation practices were compiled from Forest Service manuals, handbooks, contract and permit provisions, to directly or indirectly improve water quality, reduce losses in soil productivity and erosion, and abate or mitigate management effects, while meeting other resource goals and objectives. They are of three basic forms: administrative, preventive and corrective. These practices are neither detailed prescriptions nor solutions for specific problems. They are purposely broad. These practices are action initiating process mechanisms which call for the development of requirements and considerations to be addressed prior to and during the formulation of alternatives for land management actions. They serve as checkpoints which are considered in formulating a plan, a program and/or a project.

Although some environmental impacts may be characteristic of a management activity, the actual effects on soil and water resources will vary considerably. The extent of these management effects on soil and water resources is a function of:

1. The physical, meteorological and hydrologic environment where the activity takes place (topography, physiography, precipitation, channel density, geology, sol type, vegetative cover, etc.).
2. The type of activity imposed on a given environment (recreation, mineral exploration, timber management, etc.) and its extent and magnitude.
3. The method of application and the duration of the activity (grazing system used, types of silvicultural practice used, constant vs. seasonal use, recurrent application or onetime application, etc.).
4. The season of the year that the activity occurs or is applied.

These factors vary within the National Forests in the Northern Region and from site to site. It follows then that the extent and kind of impacts are variable, as are the abatement and mitigation measures. No solution prescription, method, or technique is best for all circumstances. Thus the management practices presented in the following include such phrases as "according to the design", "as prescribed," "suitable for," "within acceptable limits," and similar qualifiers. The actual prescriptions, specifications, and designs are the result of evaluation and development by professional personnel through interdisciplinary involvement in the NEPA process. This results in specific conservation practices that are tailored to meet site specific resource requirements and needs.

BMP Implementation Process

In cooperation with the States, the USDA Forest Service's primary strategy for the control of nonpoint sources is based on the implementation of BMPs determined necessary for the protection of the identified beneficial uses. The Forest Service Nonpoint Source Management System consists of:

1. BMP selection and design based on site-specific conditions; technical, economic and institutional feasibility; and the designated beneficial uses of the streams.
2. BMP Application
3. BMP monitoring to ensure that they are being implemented and are effective in protecting designated beneficial uses.
4. Evaluation of BMP monitoring results.
5. Feeding back the results into current/future activities and BMP design.

The District Ranger is responsible for insuring that this BMP feedback loop is implemented on all projects. The Practices described herein are tiered to the practices in the R1/R4 FSH 2509.22. They were developed as part of the NEPA process, with interdisciplinary involvement, and meet State and Forest water quality objectives. The purpose of this appendix document is to: 1) establish the connection between the SWCP employed by the Forest Service and BMPs identified in Idaho Water Quality Standards (IDAHO APT 16.01.2300.05) and 2) identify how the SWCP, Standard Specifications for the Construction of Roads, and the Timber Sale Contract provisions meet or exceed the Rules and Regulations Pertaining to the Idaho Forest Practices Act, Title 38, Chapter 13, Idaho Code (BMPs). The relevant portions of the Rules and Regulations developed under the Idaho Stream Protection Act are also included.

FORMAT OF THE BMPS

Each Soil and Water Conservation Practice (SWCP) is described as follows:

Title: Includes the sequential number of the SWCP and a brief title.

Objective: Describes the SWCP objective(s) and the desired results for protecting water quality.

Effectiveness: Provides a qualitative assessment of expected effectiveness that the implemented BMP will have on preventing or reducing impacts on water quality. The SWCP effectiveness rating is based on: 1) literature and research (must be applicable to area 2) administrative studies (local or within similar ecosystem); and 3) professional experience (judgment of an expert by education and/or experience). The expected effectiveness of the SWCP is rated either High, Moderate or Low.

High: Practice is highly effective (>90%) and one or more of the following types of documentation are available:

a) Literature/Research - must be applicable to area

b) Administrative studies - local or within similar ecosystem

c) Experience - judgment of an expert by education and/or experience.

d) Fact - obvious by reasoned (logical response

Moderate: Documentation shows that the practice is effective less than 90% of the time, but at least 75% of the time.

Or

Logic indicates that this practice is highly effective, but there is little or no documentation to back it up.

Or

Implementation and effectiveness of this practice will be monitored and the practice will be modified if necessary to achieve the objective of the BMP.

Low: Effectiveness unknown or unverified, and there is little to no documentation

Or

Applied logic is uncertain in this case, or the practice is estimated to be less than 75% effective.

Or

This practice is speculative and needs both effectiveness and validation monitoring.

The effectiveness estimates given here are general, given the range of conditions throughout the Forest. More specific estimates are made at the project level when the BMPs are actually prescribed.

Compliance: Provides a qualitative assessment of how the implementation of the specific measures will meet the Forest Practice Act Roles and Regulations pertaining to water quality.

Implementation: This section identifies: (1) the site-specific water quality protection measures to be implemented and (2) how the practices are expected to be applied and incorporated into the Timber Sale Contract.

ITEMS COMMON TO ALL SOIL AND WATER CONSERVATION PRACTICES

Responsibility For Implementation: The District Ranger (through the Presale Forester) is responsible for insuring the factors identified in the following SWCPs are incorporated into: Timber Sale Contracts through the inclusion of proper B and/or C provisions; or Public Works Contracts through the inclusion of specific contract clauses.

The Contracting Officer, through his/her official representative (Sale Administrator and/or Engineering Representatives for timber sale contracts; and Contracting Officers Representative for public works contracts) is responsible for insuring that the provisions are properly administered on the ground.

Monitoring: Implementation and effectiveness of water quality mitigation measures are also monitored annually. This includes routine monitoring by timber sale administrators, road construction inspectors, and resource specialists which is documented in diaries and project files. Basically, water quality monitoring is a review of BMP implementation and a visual evaluation BMP effectiveness. Any necessary corrective action is taken immediately. Such action may include modification of the BMP, modification of the project, termination of the project, or modification of the state water quality standards.

Abbreviations

TSC = Timber Sale Contract	SAM = Sale Area Map
TSA = Timber Sale Administrator	COR = Contracting Officer Representative
PWC = Public Works Contract	(I)FPA = (Idaho) Forest Practices Act
SCA = Stream Channel Alteration Act	SWCP= Soil and Water Conservation Practices
BMP = Best Management Practices	EPA = Environmental Protection Agency
SPS = Special Project Specifications	INFISH = Inland Native Fish Strategy
CFR = Code of Federal Regulations	RHCA = Riparian Habitat Conservation Area

There is a **Glossary of Terms** located at the back of this document

KEY SOIL AND WATER CONSERVATION PRACTICES

* **CLASSES OF SWCP (BMP)**

A = Administrative G = Ground Disturbance Reduction

E = Erosion Reduction W = Water Quality Protection

S = Stream Channel Protection/Stream Sediment Reduction

Class * Soil and Water Conservation Practice (FSH 2509.22)

11 WATERSHED MANAGEMENT

W 11.07 Oil and Hazardous Substance Spill Contingency Planning

W 11.09 Management by Closure to Use

W 11.11 Petroleum Storage & Delivery Facilities & Mgt

13 VEGETATION MANIPULATION

G 13.02 Slope Limitations for Tractor Operation

G 13.03 Tractor Operation Excluded from Wetlands, Bogs, and Wet Meadows

E 13.04 Revegetation of Surface Disturbed Areas

E 13.05 Soil Protection During and After Slash Windrowing

E 13.06 Soil Moisture Limitations for Tractor Operation
W 13.07 - Pesticide Use Planning
W 13.08 - Apply Pesticides According to Label and EPA Registration Directions
W 13.09 - Pesticide Application Monitoring and Evaluation
W 13.10 - Pesticide Spill Contingency Planning
W 13.11 - Cleaning and Disposal of Pesticide Containers and Equipment
W 13.12 - Protection of Water, Wetlands, and Riparian Areas During Pesticide Spraying

14 TIMBER

A 14.02 Timber Harvest Unit Design
A 14.03 Use of Sale Area Maps for Designating Soil and Water Protection Needs
A 14.04 Limiting the Operating Period of Timber Sale Activities
E 14.05 Protection of Unstable Areas
A 14.06 Riparian Area Designation
G 14.07 Determining Tractor Loggable Ground
E 14.08 Tractor Skidding Design
E 14.09 Suspended Log Yarding in Timber Harvesting
A 14.10 Log Landing Location and Design
E 14.11 Log Landing Erosion Prevention and Control
E 14.12 Erosion Prevention and Control Measures During Timber Sale Operations
E 14.13 Special Erosion Prevention Measures on Areas Disturbed by Harvest Activities
E 14.14 Revegetation of Areas Disturbed by Harvest Activities
E 14.15 Erosion Control on Skid Trails
E 14.16 Meadow Protection During Timber Harvesting
S 14.17 Stream Course Protection (Implementation and Enforcement
E 14.18 Erosion Control Structure Maintenance
A 14.19 Acceptance of Timber Sale Erosion Control Measures Before Sale Closure
E 14.20 Slash Treatment in Sensitive Areas
A 14.22 Modification of the Timber Sale Contract

15 ROADS AND TRAILS

A 15.02 General Guidelines for Road Location/Design
E 15.03 Road and Trail Erosion Control Plan
E 15.04 Timing of Construction Activities
E 15.05 Slope Stabilization and Prevention of Mass Failures
E 15.06 Mitigation of Surface Erosion and Stabilization of Slopes
E 15.07 Control of Permanent Road Drainage
E 15.08 Pioneer Road Construction
E 15.09 Timely Erosion Control Measures on Incomplete Road and Stream Crossing Projects
E 15.10 Control of Road Construction Excavation & Sidecast Material

S 15.11 Servicing and Refueling of Equipment

S 15.12 Control of Construction In Riparian Areas

S 15.13 Controlling In-Channel Excavation

S 15.14 Diversion of Flows Around Construction Sites

S 15.15 Stream Crossings on Temporary Roads

S 15.16 Bridge & Culvert Installation (Disposition of Surplus Material and Protection of Fisheries)

E. 15.17 Regulation of Borrow Pits, Gravel Sources, and Quarries

E 15.18 Disposal of Right-of-Way and Roadside Debris

S 15.19 Streambank Protection

E 15.21 Maintenance of Roads

E 15.22 Road Surface Treatment to Prevent Loss of Materials

E 15.23 Traffic Control During Wet Periods

G 15.24 Snow Removal Controls

E 15.25 Obliteration of Temporary Roads

E 15.27 Trail Maintenance and Rehabilitation

18 FUELS MANAGEMENT

E 18.02 Formulation of Fire Prescriptions

E 18.03 Protection of Soil and Water from Prescribed Burning Effects

BEST MANAGEMENT PRACTICES

PRACTICE 11.07 - Oil and Hazardous Substance Contingency Planning

PRACTICE 11.11 - Petroleum Storage and Delivery Facilities and Management

PRACTICE 15.11 - Servicing and Refueling of Equipment

OBJECTIVE: To prevent contamination of waters from accidental spills of fuels, lubricants, bitumens, raw sewage, wastewater and other harmful materials by prior planning and development of Spill Prevention Control and Countermeasure Plans.

EFFECTIVENESS: Although SPCC Plans cannot eliminate the risk of materials being spilled and escaping into waters, they can, if followed, be effective at reducing adverse effects to tolerable levels. Depending on the location and quantity of a spill, a properly implemented Plan can provide for up to 100 percent containment of a spill.

COMPLIANCE: Meets FPA Rules

IMPLEMENTATION: The TSC holds the Purchaser responsible for taking appropriate preventative measures to insure that any spill of oil or oil products does not enter any stream or other waters of the United States. If the total oil or oil products storage exceeds 1,320 gallons, or if any single container exceeds the capacity of 660 gallon, the Purchaser will prepare a Spill Prevention Control and Countermeasure Plan. The plan shall meet EPA requirements including certification by a registered professional engineer. If necessary, specific requirements for transporting oil to be used in conjunction with the contract will be specified in the contract.

The Forest Service will designate the location, size and allowable uses of service and refueling areas. The criteria below will be followed at a minimum:

1. Petroleum product storage containers with capacities of more than 200 gallons, stationary or mobile, will be located no closer than 100 feet from stream, water course, or area of open water. Dikes, berms, or embankments will be constructed to contain the volume of petroleum products stored within the tanks. Diked areas will be sufficiently impervious and of adequate capacity to contain spilled petroleum products.

2. Transferring petroleum products: During fueling operations or petroleum product transfer to other containers, there shall be a person attending such operations at all times.

3. Equipment used for transportation or storage of petroleum products shall be maintained in a leak-proof condition. If the Forest Service Representative determines there is evidence of petroleum product leakage or spillage, he/she shall have the authority to suspend the further use of such equipment until the deficiency has been corrected.

In the event any leakage or spillage enters any stream, water course or area of open water, the operator will immediately notify the Forest Service who will be required to follow the actions to be taken in case of hazardous spill, as outlined in the Forest Hazardous Substance Spill Contingency Plan.

PRACTICE 11:09 - Management by Closure to Use

PRACTICE 15:23 - Traffic Control During Wet Periods

OBJECTIVE: To reduce the potential for road surface disturbance during wet weather and to reduce sedimentation probability by excluding activities that could result in damage to facilities or degradation of soil and water resources.

EFFECTIVENESS: Moderate

COMPLIANCE: Meets FPA Rules

IMPLEMENTATION: Closures (seasonal, temporary, or permanent) are made when the responsible line officer determines that a particular resource or facility needs protection from use. Specific guidelines for closure of roads during the period of the contract and at the end of the Purchaser's operations will be spelled out in the TSC.

Roads that must be used during wet periods should have a stable surface and sufficient drainage to allow such use with a minimum of resource impact. Rocking, paving and armoring are measures that may be necessary to protect the road surface and reduce erosion potential. Roads not constructed for all weather use should be closed during the wet season. Where winter field operations are planned, roads may need to be upgraded and maintenance intensified to handle the traffic without creating excessive erosion and damage to the road surface.

PRACTICE 13.02 - Slope Limitations for Tractor Operation

PRACTICE 14.07 - Determining Tractor Loggable Ground

OBJECTIVE: To reduce gully and sheet erosion and associated sediment production by restricting tractor operation to slopes where corrective measures for proper drainage are easily installed and effective.

EFFECTIVENESS: In general, the less the slope percentage, the less are the chances of rilling, gullying, or soil displacement as a consequence of tracked or wheeled skidding.

COMPLIANCE: Meets FPA Rules

IMPLEMENTATION: The TSC requires that the location of all skid trails and landings must be agreed upon before construction. Specific criteria that will be addressed during sale-layout and pre-work with the operator will include:

General:

1. All new or reconstructed landings, skidtrails, and fire trails shall be located on stable areas outside riparian areas. Sidecasting will be held to a minimum.

2. Tractor or wheel skidding will not normally be conducted on slopes over 35 percent. Incidental tractor skidding on slopes greater than this my be allowed when determined by a hydrologist or soils scientist that to do so is preferable to other options (i.e. Building additional road) and that accelerated erosion will not occur.

Skid Trails:

1. Skid trails shall be kept to the minimum feasible width and number.
2. Locate skid trails to avoid concentrating runoff and provide breaks in grade and waterbars.
3. Skidding equipment will be restricted to approved skid trails.

Landings:

1. Landing sizes will be the minimum necessary for safe, economical operation.
2. Landings and log decks will not be located within Riparian Areas.
3. Landings, log decks and/or burn piles will be located a minimum of 300 feet from streams, far enough away that direct (unfiltered) entry of sediment, bark, or ash and burning products will not occur.

PRACTICE 13.04 - Revegetation of Surface Disturbed Areas

PRACTICE 14.14 - Revegetation of Areas Disturbed by Harvest Activities

OBJECTIVE: To protect soil productivity and water quality by minimizing soil erosion.

EFFECTIVENESS: Revegetation can be moderately effective at reducing surface erosion after one growing season, following disturbance, and highly effective in later years. Effectiveness has been shown to vary from 10 percent on 3/4:1 slopes to 36 percent on 1:1 slopes to 97 percent on 1:1 slopes in later years (King, John G. and E. Burroughs. Reduction of Soil Erosion on Forest Roads. Intermountain Research Station General Technical Report, 1988).

COMPLIANCE: Meets FPA rules.

IMPLEMENTATION: As determined necessary, temporary roads, landings, skid trails, and anywhere else soil has been severely disturbed by Purchaser's harvesting operations will be seeded within one year after harvesting is completed. Seed mixes (consisting of native species) and fertilizer specifications will be incorporated into TSC provisions. The TSC will also include specifications for scarification/ripping of compacted landing and closed roads where this is deemed necessary by the IDT.

PRACTICE 13.05 - Soil Protection During and Following Slash Windrowing

OBJECTIVE: To prevent removal or severe disruption of the productive surface soil and minimize losses from erosion.

EFFECTIVENESS: Moderate

COMPLIANCE: Meets FPA rules.

IMPLEMENTATION: Windrowing or piling of slash with tractor or grapple piling machine is a common method of fire hazard abatement and site preparation. Potential for damage to soils and water are high. On slopes, windrows should be contoured as much as possible to act as a filter barrier which catches sediment and detains water runoff. Such piling would only be conducted on slopes greater than 50 percent upon the recommendation of a soils scientist or hydrologist. Care must be taken to minimize disturbance to the surface soil layer during these operations. Equipment would be prohibited from operating within 50 feet of streamcourses except at designated crossing areas. Areas where such slash disposal operations are acceptable will be identified in the TSC, where site specific specifications will be included.

Practice 13.06 - Soil Moisture Limitations for Tractor Operation

OBJECTIVE: To minimize soil compaction, puddling, rutting, and gullying with resultant sediment production and loss of soil productivity by ensuring that activities are done when ground conditions are such that erosion and sedimentation can be controlled .

EFFECTIVENESS: Responsible implementation and enforcement are required for high effectiveness.

COMPLIANCE: No Related FPA rules.

IMPLEMENTATION: Tractor operations will be limited to periods when the soil moisture content is 18 percent or less, the ground is frozen, or there is at least 18 inches of snow depth. Tractor operations will only be allowed outside of these specifications through the sue of designated skid trails. These requirements will be incorporated into provision of the TSC.

PRACTICE: <u>13.07</u> - <u>Pesticide Use Planning</u>

OBJECTIVE: To incorporate water quality and hydrologic considerations into the Pesticide Use Planning Process.

EXPLANATION: The pesticide use planning process will be used to identify problem areas and the objectives of the project, establish the administrative controls, identify treatments and preventive measures, and incorporates the hydrologic considerations contained in SWCP 13.08 through 13.13. The NEPA process addresses these considerations in terms of impacts, mitigation measures, and alternative treatment measures. Project work and safety plans specify management direction.

Factors considered in pesticide selection are: purpose of the project, application methods available, target species, timing of treatment, pest locations, size of treatment area, and need for repeated treatment. Practicability of application considers: registration restrictions, form and method of application, topographic relief and areas to be avoided, and social acceptance of the project. The degree of risk considers: hazard to humans, method of application, transportation and handling hazards, carriers needed, and chemical persistence.

IMPLEMENTATION: The interdisciplinary team evaluates the project in terms of potential site response, potential social and environmental impacts, mitigating measures needed to protect water quality, and the need and intensity of monitoring and evaluation. The responsible Line Officer then prepares the necessary NEPA documentation, Project Plan, and Safety Plan. Depending on the pesticide use, (FSM 2151.04) the Forest pesticide-use coordinator or Integrated pest Management Working Group or Regional IPMWG reviews the documents along with the Pesticide-Use Proposal, form FS-2100-2, and makes recommendations for or against approval of the project.

REFERENCES: NFMA; NEPA; FSM 2150 and 2323; State Hazardous Waste Management Plans; see references in "Best Management Practice" Definition (05--2 and 3).

PRACTICE: <u>13.08</u> - <u>Apply Pesticides According to Label and EPA Registration Directions</u>

OBJECTIVE: To avoid water contamination by complying with all label instruction and restrictions.

EXPLANATION: Label directions for each pesticide are detailed and specific, and include legal requirements for use.

IMPLEMENTATION: Constraints identified on the label and other legal requirements of application are incorporated into project plans and contracts. Responsibility for ensuring that label directions and other applicable requirements are followed rests with the Forest Supervisor or a designate such as the Forest Pesticide Use Coordinator. For contracted projects, it is the responsibility of the Contracting Officer to ensure that label directions and all other requirements are followed.

REFERENCES: FSM 2150; see references in "Best Management Practice" Definition (05--2 and 3).

PRACTICE: 13.09 - Pesticide Application Monitoring and Evaluation

OBJECTIVE: To determine and document that pesticides have been applied safely and to provide an early warning for any contamination of water or non-target areas or resources.

EXPLANATION: This practice provides feedback on the placement accuracy, application amount, and any water contamination that might occur from pesticide use, so as to minimize or eliminate hazards to non-target areas or resources. Monitoring and evaluation methods include spray cards, dye tracing, and direct measurement of pesticide in or near water. Type of pesticide, equipment, application difficulty, public concern, beneficial uses, monitoring difficulty, availability of competent laboratory analysis and applicable Federal, State, and local laws and regulations are factors considered when determining the monitoring and evaluation needs.

IMPLEMENTATION: The monitoring and evaluation of pesticide application is a component of SWCP 11.02. The need for a monitoring plan is identified during the Pesticide Use Planning Process/NEPA process. If determined necessary, this monitoring and evaluation plan will consider the same items as in SWCP 11.02. A technical staff familiar in pesticide monitoring will evaluate and interpret the monitoring results in terms of compliance, State water quality standards and adequacy of project specifications.

REFERENCES: FSM 2150; see references in "Best Management Practice" Definition (05--2 and 3).

PRACTICE: 13.10 - Pesticide Spill Contingency Planning

OBJECTIVE: To reduce contamination of water from accidental pesticide spills.

EXPLANATION: A contingency plan that contains a predetermined organization and immediate actions to be implemented in the event of a hazardous substance spill will be prepared. The plan lists notification requirements, time requirements for the notification, how spills will be handled, and who will be responsible for clean-up. Factors considered for each spill are: specific substance spilled, quantity, toxicity, proximity of spill to waters, and the hazard to life, property, and the environment.

IMPLEMENTATION: The Pesticide Spill Contingency Plan will be incorporated into the Project Safety Plan. The NEPA process will provide the means for including public and other agency involvement in plan preparation. The plan will list the responsible authorities.

REFERENCES: SWCP 11.07; FSH 2109.12, Pesticide Storage, Transportation, Spills, and Disposal Handbook; FSM 6740, 7442, 7442, and 7460; Oil and Hazardous Substances Pollution Contingency Plan for EPA Regions 8 and 10, 7/26/85; R-1 and R-4 Emergency and Disaster Plan; see references in "Best Management Practice" Definition (05--2 and 3).

PRACTICE: **13.11** **- Cleaning and Disposal of Pesticide Containers and Equipment**

OBJECTIVE: To prevent water contamination and risk to humans from cleaning and disposal of pesticide containers.

EXPLANATION: The cleaning and disposal of pesticide containers and equipment must be done in accordance with Federal, State, and local laws, regulations, and directives, and in a manner which will safeguard public health, the beneficial uses of water, aquatic organisms and wildlife. Containers are rinsed three times, the rinse water applied on the project area as soon as practical, and the containers taken to the designated disposal site. Application equipment is also rinsed and rinse water applied to the project site before the equipment is moved from the project area.

IMPLEMENTATION: When the pesticide is applied by In-Service personnel, the Forest or District Pesticide Use coordinator will locate proper rinsing and disposal sites, and will arrange for container disposal in an approved disposal site. When the pesticide is applied by a contractor, the contractor is responsible for proper clean-up and container disposal in accordance with label directions and Federal, State, and local laws.

The Project Contracting Officer will document that the proper disposal methods were followed.

REFERENCES: FSM 2150; FSH 2109.12, Pesticide Storage, Transportation, Spills, and Disposal Handbook; FSH 6709.11, Health and Safety Code Handbook; FSH 6709.12, Safety and Health Program Handbook; SWCP 11.07 and 11.08; see references in "Best Management Practice" Definition (05--2 and 3).

PRACTICE: **13.12** **- Protection of Water, Wetlands, and Riparian Areas During Pesticide Spraying**

OBJECTIVE: To minimize the risk of a pesticide entering surface or subsurface waters or affecting riparian areas, wetlands, and other non-target areas.

EXPLANATION: When applying pesticides, an untreated buffer strip will be left alongside surface waters, wetlands, and riparian areas. Factors considered in establishing buffer strip widths beyond minimums established by FSM and NEPA documents are: beneficial water uses, adjacent land use, rainfall, temperature, wind speed, wind directions, terrain, slope, soils and geology, vegetative type, and aquatic life. Other considerations include: persistence, mobility, toxicity, and formulation of the pesticide, method of applications, equipment used, spray patterns, droplet size, application heights, and application pattern.

IMPLEMENTATION: Protected areas will be identified and mapped by an interdisciplinary team and the Forest Pesticide Use Coordinator during the NEPA process. Protection of untreated areas is the responsibility of the project supervisor for In-Service projects and the Contracting Officer for contracted projects. The certified commercial applicators are briefed about location of protection areas. These areas are flagged or otherwise marked when necessary to aid in boundary identification.

REFERENCES: FSM 2526, 2527, 2245, AND 2150; see references in "Best Management practice" Definition (05--2 and 3).

PRACTICE 14.02 - Timber Harvest Unit Design

PRACTICE 14.07 - Determining Tractor Loggable Ground

PRACTICE 14.08 - Tractor Skidding Design

PRACTICE 14.09 - Suspended Log Yarding

PRACTICE 14.10 - Log Landing Location and Design

OBJECTIVE: To insure that timber harvest unit design will maintain water quality and soil productivity by utilizing the appropriate harvest systems and by locating/designing landings and skidding patterns to best fit the terrain and avoid soil erosion.

EFFECTIVENESS: Moderate

COMPLIANCE: Meets FPA rules.

IMPLEMENTATION: Based upon site-specific environmental factors and the physical limitations of equipment, the IDT will determine appropriate harvest methods for each harvest unit and this method will be specified in the TSC. During the presale operation, harvest units will be designed to fit selected harvest methods. During contract administration, the location of landings, skid trails, temporary roads, and skyline corridors will be determined keeping in mind that:

1. Machinery may not operate within 50 feet of any stream except when crossing at designated crossings.
2. Full suspension of logs is required across any stream except at approved crossings.
3. One end suspension may be required in certain soils and situations as specified in the EIS.
4. Landings may not be located within 300 feet of any creek unless approved by a hydrologist.
5. Skid trails will be located and designed to minimize soil disturbance.
6. Skid trails will be located so as to avoid concentrating runoff.

PRACTICE 14.03 - Use of Sale Area Maps for Designating Soil and Water Protection Needs

OBJECTIVE: To delineate the location of protection areas and special treatment areas, to insure their recognition, proper consideration, and protection on the ground.

EFFECTIVENESS: High

COMPLIANCE: No related FPA rule

IMPLEMENTATION: The following features will be designated on the Sale Area Map:

a. Stream courses will be excluded from harvest and fuels activites according to standard INFISH buffers as shown on the Alternative maps in this EIS.

b. Wetlands (meadows, lakes, potholes, etc.) are to be protected per the timber sale contract clauses.

These features will be reviewed on the ground by the Purchaser and the Sale Administrator prior to harvesting.

A Watershed Specialist (Forest or District) will work with the Presale Forester to insure that the above features have been designated on the Sale Area Map during contract development.

PRACTICE 14.04 - Limiting the Operating Period of Timber Sale Activities

PRACTICE 15.04 - Timing of Construction Activities

OBJECTIVE: To minimize soil erosion, sedimentation and loss in soil productivity by insuring that the Purchaser conducts his operations, including erosion control work, road maintenance, etc., in a timely manner, within the time period specified in the TSC.

EFFECTIVENESS: Moderate

COMPLIANCE: Meets FPA Rules

IMPLEMENTATION: Limited operating periods are identified and recommended during the environmental analysis by the Interdisciplinary Team. Contract language specifies contract termination date and operating periods within that contract. Purchaser's plans must show intent to operate within these time frames prior to approval to commence work. Extensions of time (except for contract term adjustments) and waiver of specified operating periods should be granted only after IDT review.

PRACTICE 14.06 - Riparian Designation

OBJECTIVE: To minimize the adverse effects on Riparian Areas with prescriptions that manage nearby logging and related land disturbance activities.

EFFECTIVENESS: Moderate

COMPLIANCE: Meets FPA rules

IMPLEMENTATION: The Riparian Habitat Conservation Areas are identified during the environmental analysis by the interdisciplinary team. The timber sale project is designed to include site specific (INFISH) Standards and Guidelines for the prevention of sedimentation and other stream damage from logging activities. The environmental analysis will provide for planning of harvests to insure long-term health and revegetation of the Riparian Areas, while meeting shading, debris recruitment, and other management objectives. As appropriate, monitoring and evaluation will be identified in the environmental analysis documentation. The Presale Forester is responsible for the inclusion of Riparian Area protection measures in the Timber Sale Contract and on the Sale Map Area. The Sale Administrator is responsible for contract compliance during harvest operations.

PRACTICE: 14.11 - Log Landing Erosion Prevention and Control

PRACTICE: 14.12 - Erosion Prevention and Control During Timber Sale Operations

PRACTICE: 14.15 - Erosion Control on Skid Trails.

OBJECTIVE: To protect water quality by minimizing erosion and subsequent sedimentation derived from log landings and skid trails.

EFFECTIVENESS: Moderate

COMPLIANCE: Meets FPA rules

IMPLEMENTATION: The following minimum criteria will be used in controlling erosion and restoring landings and skid trails so as to minimize erosion:

General:

1. Deposit waste material from construction or maintenance of landings and skid and fire trails in geologically stable locations at least 100 feet outside of the appropriate Stream Protection Zone.
2. Seeding will be done with a seed/fertilizer mix specified in the contract.

Landings:

1. During period of use, landing will be maintained in such a manner that debris and sediment are not delivered to any streams.
2. Landings shall be reshaped as needed to facilitate drainage prior to fall and spring runoff. Landings shall be stabilized by establishing ground cover or by some other means within one year after harvesting is completed.
3. Landings will drain in a direction and manner that will minimize erosion and will preclude sediment delivery to any stream.

Skid Trails:

1. Skid trails and fire trails shall be stabilized whenever they are subject to erosion, by waterbarring, cross draining, outsloping, scarifying, seeding, or other suitable means. This work shall be kept current to prevent erosion prior to fall and spring runoff.

2. Spacing of water bars on skid trails will be based on guides for controlling sediment from secondary logging roads (no date). If necessary, additional water bars will be prescribed by the sale administrator and/or watershed specialist.

PRACTICE 14.17 - Stream Channel Protection (Implementation and Enforcement)

PRACTICE 15.19 - Streambank Protection

OBJECTIVES: To protect stream beds and streamside vegetation, during and after forest practice operations and road construction, by (1) maintained unobstructed passage of stormflows; (2) reducing sediment and other pollutants from entering streams; and (3) restoring the natural course of any stream, as soon as practical, if the stream is diverted as a result of timber management activities.

EFFECTIVENESS: High

COMPLIANCE: Meets FPA rules

IMPLEMENTATION: Protecting stream channels during timber harvesting is accomplished by contract clause incorporated into the sale contracts. This is normally accomplished by designating particular streams as protected streamcourses and limiting or restoring timber management operations in streamside zones. There is substantial overlap between timber sale provisions to protect stream channels, and regulations that govern road construction and other practices.

The intent of the regulations and clauses is to protect the integrity of stream channels and minimize adverse impacts to the channel and downstream resources and beneficial uses. The following items are a minimum that will be incorporated into the TSC specifically to govern channel protection in the project area.

1. Purchaser shall repair all damage to a streamcourse if the Purchaser is negligent in their operations, including damage to banks and channel, to an acceptable condition as specified by the Forest Service.

2. All project debris shall be removed from streamcourse, in an agreed manner that will cause the least disturbance. Specifically:

   Whenever possible trees shall be felled, bucked, and limbed in such a manner that the tree or any part thereof will fall away from any streams. Within 24 hours, slash and other debris that enters streams as a result of harvesting operations shall be removed. If the slash would be beneficial (i.e. provide sediment filtering) then the Sale Administrator may allow the Purchaser to leave the slash in place below culverts.

3. Location and method of stream crossing will be designed and agreed to prior to construction.

4. Wheeled or track laying equipment shall not be permitted to operate within 50 feet slope distance of the streams except at approved crossings.

5. On perennial streams, dewatering with filter fabric and/or diversion shall be considered prior to excavation for culvert placement.

6. Filter cloth, erosion control blankets, plastic, straw bales, and rip- rap will be used as appropriate to keep live water from contacting new fill during culvert installations.

7. When dewatering of a stream crossing is required, a non-erodible conduit, flex pipe or geotextile fabric will be used on all crossings. Silt fences shall be constructed below the stream crossing(s) prior to any streambank disturbance.

8. The construction activities in or adjacent to the stream may be limited to specific times to protect beneficial water uses.

9. Logs will be end-lined out of streamside and Riparian Areas. Equipment is permitted to enter streamside areas only at locations and times agreed by the Forest Service.

10. Material from temporary road and skid trail stream crossings will be removed and streambanks restored to an acceptable condition.

11. When cable yarding across or inside the riparian areas is necessary logs should be fully suspended across a stream and immediately above streambanks. Yarding shall be done in such a manner as to minimize streambank channel disturbance.

12. Construction equipment may cross, operate in or operate near streamcourses only where so agreed to and designated by the Forest Service prior to construction. Crossing of perennial stream channels will be done in compliance with the specifications included in the contract.

13. On perennial streams, stream channel alteration specifications will include the following:

a. Ford the stream only at one location.

b. Any cofferdams or temporary crossings should be designed to handle high streamflows.

c. Protect streambank vegetation as much as possible.

d. All fill materials shall be placed and compacted in horizontal lifts.

e. If rip rap is used, it shall extend at least one foot above anticipated high water mark, and meet minimum size criteria.

f. Rip rap shall extend far enough upstream and downstream to reach stable areas.

15. If the channel is damaged during construction, it will be restored as nearly as possible to its original configuration without causing additional damage to the channel.

16. Construction methods shall provide for eliminating or minimizing discharges of turbidity, sediment, organic matter or toxic materials. A settling basin may be required for this purpose.

PRACTICE 14.18 - Erosion Control Structure Maintenance

OBJECTIVE: To ensure that construction erosion control structures are stabilized and working effectively.

EFFECTIVENESS: High

IMPLEMENTATION: The TSC requires that during the period of the contract, the Purchaser shall provide maintenance of soil erosion control structures constructed by the Purchaser until they become stabilized, but not for more than one year after their construction. After 1 year, any erosion control work needed is accomplished through the Forest Service funding.

The TSC also requires the Purchaser to maintain the erosion control structures concurrently with his operations under the sale, and in any case, not later than 15 days after completion of skidding each unit or subdivision.

PRACTICE 14.19 - Acceptance of Timber Sale Erosion Control Measures Before Sale Closure

OBJECTIVE: To assure the adequacy of required erosion control work on timber sales.

EFFECTIVENESS: High

COMPLIANCE: No directly related FPA rule.

IMPLEMENTATION: The TSC requires that upon the Purchaser's written request and assurance that work has been completed the Forest Service shall perform an inspection. In evaluating acceptance the following definition will be used by the Forest Service: "Acceptable" erosion control means only minor deviation from established standards, provided no major or lasting impact is caused to soil and water resources. The Forest Service will not accept as complete, erosion control measures which fail to meet this criteria.

PRACTICE 14.20 - Slash Treatment in Sensitive Areas

OBJECTIVE: To protect water quality by protecting sensitive tributary areas from degradation which would result from using mechanized equipment for slash disposal.

EFFECTIVENESS: Moderate

COMPLIANCE: No directly related FPA rule.

IMPLEMENTATION: Sensitive areas needing special protection are identified by the IDT in the Timber Sale Planning Process. Results are documented and identified in the slash treatment plan. The TSC is prepared to incorporate provisions to provide the level of protection prescribed.

PRACTICE 14.22 - Modification of the Timber Sale Contract

OBJECTIVE: To modify the Timber Sale Contract if new circumstances or conditions indicate that the timber sale will cause irreversible damage to soil, water, or watershed values.

EFFECTIVENESS: High

COMPLIANCE: No directly related FPA rules.

IMPLEMENTATION: If evidence indicates that unacceptable impacts would occur to soil and water resource if the sale was harvested as planned, the Forest Service Representative will request the Contracting Officer to gain Regional Forester advice and approval to proceed with a resource environmental modification, mutual cancellation, or unilateral cancellation of the Timber Sale Contract as allowed by the TSC.

PRACTICE 15.02 - General Guidelines for the Location and Design of Roads and Trails

OBJECTIVE: To locate and design roads and trails with minimal soil and water resource impact while considering all design criteria.

EFFECTIVENESS: Moderate

COMPLIANCE: Exceeds FPA rules

IMPLEMENTATION: As the TSC is assembled, road location and design criteria are assembled from several volumes of standards, and optional specifications and guidelines. Specific roads and road segments often have specifications that are unique to the road or road segment. The following listed items, however, are general road location and design guidelines for minimizing impacts on water quality.

1. Fit the road to the topography - Use natural benches, follow contours, avoid long, steep road grades. Balance cut/fill where possible to avoid waste areas.
2. Locate on stable topography. Whenever possible, avoid slumps and slide prone areas and steep side hills.
3. Locate roads a safe distance away from streams and other water bodies, and provide an adequate buffer zone to trap sediment before it enters into any water body.
4. Minimize the number of stream crossings and choose stable sites. Structures will be designed (sized) for long-term stability, generally for the Q100 and will provide for fish passage, if present.
5. Locate and design roads to drain naturally by appropriate use of outsloping and insloping with cross drainage and grade changes, where possible. Cross drains will be installed to 1) carry interpreted flow across constructed areas; 2) to relieve the length undrained ditch; and 3) to reduce disruption of normal drainage patterns. Road and trail drainage should be channeled to effective buffer areas, either natural or manmade, to maximize sediment deposition prior to entry into live water.

6. Ditch lines and road grades will be designed to minimize unfiltered flow into streams. A rolling dip, relief culvert or similar structure will be installed as close as practical to crossings to minimize direct sediment and/or water input directly into streams. The drainage will be routed through buffer strips or other sediment settling structures where possible.
7. At a minimum, windrows will be installed 100 feet on both sides of perennial stream crossings and where installation will minimize sediment delivery to nearby streams or channels. Windrows will also be installed where fill slope erosion is possible, or where road derived erosion may be delivered; (i.e. outflow area of culverts or rolling dips, etc).
8. Design to the standard necessary to accomplish anticipated use and equipment needs safely, while providing for long-term protection of the soils and water.
9. Seeding and fertilization of erodible surfaces exposed during construction will be accomplished. Next season seeding will be done where original treatment is not fully successful.
10. Road construction occurring outside the normal operating season will have additional restrictions on the amount of pioneered road and additional erosion control measures.

PRACTICE 15.03 - Road and Trail Erosion Control Plan

OBJECTIVE: To prevent, limit, and mitigate erosion, sedimentation, and resulting water quality degradation through timely implementation of erosion control practice.

EFFECTIVENESS: Moderate

COMPLIANCE: No related FPA rule

IMPLEMENTATION: Prior to the start of construction, the Purchaser shall submit a schedule for proposed erosion control work as required in the Standard Specifications. The schedule shall include all erosion control items identified in the specifications. Erosion control work to be done by the Purchaser will be defined in Standard Specification 204 and/or in the Drawings. The schedule shall consider erosion control necessary for all phases of the project. The Purchaser's construction schedule and plan of operation will be reviewed in conjunction with the erosion control plan by the TSA, District Watershed Specialist, and Engineering to insure their compatibility before any schedules area approved. The Engineer will certify that the Purchaser's Erosion Control Plan meets the specifications.

PRACTICES: <u>15.05</u> - <u>Slope Stabilization and Prevention of Mass Failures</u>

OBJECTIVES: To reduce sedimentation by minimizing the chances for road-related mass failures, including landslides and embankment slumps.

EXPLANATION: Road construction in mountainous terrain requires cutting and loading natural slopes which may lead to landslides and/or embankment failures depending on the soil strength, geology, vegetation, aspect, and groundwater regime. Landslides and embankment failures are undesirable because they interrupt traffic, are costly to repair, visually unacceptable, and generate large quantities of erosion and sedimentation.

Roadways may drastically change the subsurface drainage characteristics of a slope. Since the angle and height of cut and fill slopes increase the risk of instability, it is often necessary to provide subsurface drainage to avoid moisture saturation and subsequent slope failure. Where it is necessary, horizontal drains, drainage trenches, or drainage blankets may be used to lower the subsurface water levels and to prevent groundwater from entering embankments.

In areas with high landslide potential, the composition and characteristics of embankments may be controlled since they are essentially engineered structures. Care must be taken to prevent the incorporation of construction slash or other organic material and the embankment material should be placed by one of the following methods.

a. Layer placement.

b. Controlled compaction.

c. Controlled compaction using density controlled strips.

d. Compaction controlled with a special project specification.

IMPLEMENTATION: In areas with intrinsic slope stability problems, appropriate technical resource staffs must be involved in an interdisciplinary approach to route location. Sufficient subsurface investigation and laboratory testing must be performed to general design parameters and mitigating features which will meet the constraints and requirements developed through the NEPA process.

In contracted projects, compliance with environmental analysis requirements and controls which have been provided for in the specifications is assured by enforcement of the Timber Sale Contract Provisions by the Contracting Officer and/or Engineering Representative.

REFERENCES: FSM 7706.11, 7706.12, 7710, and 7720; Standard Specifications 203, 212, 605, 613, 619, 630, and 631; Timber Sale Contract Provisions B6.31, B6.62, C5.2, C5.4, and C6.36; FSH 7709.11, Transportation Engineering Handbook and FSH 7709.56b, Drainage Structures Handbook; see references in "Best Management Practice" Definition (05--2 and 3); In R-4: R-4 Technical Guide - Erosion prevention and Control on Timber Sale Areas, May 1981.

PRACTICE 15.06 - Mitigation of Surface Erosion and Stabilization of the Slopes

OBJECTIVE: To minimize soil erosion from road cutslopes, fillslopes and travelway.

EFFECTIVENESS: Moderate

COMPLIANCE: Meets FPA Rule

IMPLEMENTATION: Areas requiring mitigation of surface erosion may occur anytime during the life of the timber sale contract. When these are found, the following provisions will be implemented.

a. All disturbed areas associated with road construction and reconstruction will be seeded. The first seeding will be applied as soon as practical after cuts and fills are brought to grade within seeding seasons as established in the TSC. A second seeding in the fall or spring season following road construction will be required where original seeding did not adequately revegetate exposed soil areas.

b. Where surface erosion is occurring because of inadequate vegetative cover, additional seeding and re-fertilization will occur using recommended seed and fertilizer mixes. If the Purchaser has done his required seeding, or bare spots are not caused by the Purchaser, seeding will be done by the Forest Service.

c. Where ditches are carrying erosion products into stream channels, straw bale and erosion cloth ditch blocks will be installed to "short-circuit" the delivery. Seeding of the eroding surfaces and seeding of the stored sediment in the ditch will also be accomplished.

d. Where either straw bale/erosion cloth structures are not felt to be effective, underdrains or other measures will be installed to drain the ditches onto suitable ground, or at least reduce erosion impacts to the stream.

e. Slumping of cutslopes will require a combination of both mechanical and vegetative controls. If/when this problem is found, a solution will be determined in consultation with Engineers, geotechnical and resource specialists and appropriate actions taken to remedy the situation or minimize adverse impacts.

f. Additional underdrains (e.g. French drains) will be constructed where intercepted moisture is encountered on incised stream approaches. Erosion control blankets and straw bales will be used to dissipate ditch scour and stabilize fill slopes.

g. At ditch relief culvert locations, or at culvert locations in dry or intermittent wet draws, the piles shall not be broken but shall be placed a minimum of 20 feet below the culvert outlet. At culvert locations in live streams, piles shall not be broken but shall be continued at the toe of the embankment over the top of the culvert. No slash shall be allowed to restrict the flow of water from the culvert.

Unless caused by the Purchaser during his maintenance operations, or known before sale award and included in TSC, these items (a-g) will be beyond the scope of Purchaser responsibility. Repair and/or improvement would be then handled by contract modification or by the Forest Service.

PRACTICE 15.07 - Control of Permanent Road Drainage

OBJECTIVE: To minimize the erosive effects of concentrated water and the degradation of water quality by proper design and construction of road drainage systems and drainage control structures.

EFFECTIVENESS: Moderate

COMPLIANCE: Meets FPA rules

IMPLEMENTATION: The following items will be included in the identified road contract specifications or drawings.

1. *For New Construction and Reconstruction* - During and following operations on out sloped roads, retain out slope drainage and remove berms on the outside except those intentionally constructed for protection of road grade fills.
2. *For New Construction* - The following criteria will be incorporated into new road design:

   a. Construct cross drains and relief culverts to minimize erosion of embankments. Minimize the time between construction and installation of erosion control devices. Use riprap, vegetative matter, downspouts and similar devices to minimize erosion of the fill.

   b. Prior to fall or spring runoff, install drainage structures or cross drain uncompleted roads which are subject to erosion.

   c. Install relief culverts at a minimum grade of 1 percent greater than road gradient.

3. *For Existing Roads* - At a minimum, the following items will be added to or improved in the existing road system that will be used for purposed timber haul:

   a. Energy dissipaters or downspouts will be placed below problem culvert outlets (Reconstruction item).

   b. In all areas where ditch erosion is significant at this time, relief culverts that drain onto suitable areas will be installed (Reconstruction item).

   c. Roads restricted after use will also have erosion control measures in place prior to final pull-out.

   d. For all native surface roads to be restricted after use, the travelway will be seeded and fertilized: and will have the surface roughened to accept seed germination and vegetative establishment where necessary and beneficial.

PRACTICE 15.08 - Pioneer Road Construction

OBJECTIVE: To minimize sediment production and mass wasting associated with pioneer road construction.

EFFECTIVENESS: Moderate

COMPLIANCE: No directly related FPA rule.

IMPLEMENTATION: The following contract specifications will be required:

a. Construction of pioneer roads shall be confined to the roadway limits unless otherwise approved by the Contracting Officer.

b. Pioneering shall be conducted so as to prevent undercutting of the designated final cut slope, and to prevent avoidable deposition of materials outside the designated roadway limits.

c. Erosion control work will be completed concurrent with construction activity or prior to the wet season. During the wet and winter season, no more that 1,000 feet of road can be in the pioneer state without the required erosion control work completed.

d. Permanent culverts will be installed during the pioneer phase unless positive control of sediment can be accomplished during installation, use, and removal of the temporary structure.

PRACTICE 15.09 - **Timely Erosion Control Measures on Incomplete Road and Stream Crossing Projects:**

OBJECTIVE: To minimize erosion of and sedimentation from disturbed ground on incomplete projects.

EFFECTIVENESS: Moderate

COMPLIANCE: Meets FPA rules

IMPLEMENTATION: The following measures will be implemented during projects:

1. Temporary culverts, side drains, flumes, cross drains, diversion ditches, energy dissipaters, dips, sediment basins, berms, debris racks, or other facilities needed to control erosion will be installed as necessary. The removal of temporary culverts, culvert plugs, diversion dams, or elevated streamcrossing causeways will be completed as soon as practical.
2. Removal of debris, obstruction, and spoil material from channels and floodplains.
3. Seeding with native species to minimize erosion.
4. Installation of drainage structures or cross draining uncompleted roads which are subject to erosion prior to fall or spring runoff.

Erosion control measures must be kept current with ground disturbance, to the extent that the affects area can be rapidly "closed" if weather conditions deteriorate. Areas must not be abandoned for the winter with remedial measures incomplete.

PRACTICE 15.10 - Control of Road Construction Excavation and Sidecast Material

PRACTICE 15.18 - Disposal of Right-of-Way and Roadside Debris

Objective: To measure that unconsolidated excavated and sidecast material, construction slash, and roadside debris generated during road construction is kept out of streams, and to prevent slash and debris from subsequently obstructing channels.

Effectiveness: High

Compliance: Meets FPA rules

Implementation: In the construction of road fills near streams, compact the material to reduce the entry of water, and minimize the amount of snow, ice, or frozen soil buried in the embankment. No significant amount of woody material shall be incorporated into fills. Slash and debris may be windrowed along the toe of the fill, but in such a manner as to avoid entry into a stream and culvert blockage.

Where slash windrows are not desirable or practical, other methods of erosion control such as erosion mats, mulch, and straw bale or fabric sediment fences will be used. Where exposed material (excavation, embankment, borrow pits, waste piles, etc.) is potentially erodible, and where sediments would enter streams, the material will be stabilized prior to fall or spring runoff by seeding, compacting, rip-rapping, benching, mulching or other suitable means.

PRACTICE 15.13 - Controlling In Channel Excavation

OBJECTIVE: To minimize downstream sedimentation by insuring that all in-channel excavations are carefully planned.

EFFECTIVENESS: High

COMPLIANCE: Meets SCA rules

IMPLEMENTATION: Location and method of stream crossings will be designed and agreed to prior to construction. The following items highlight some of the principal provisions which can be incorporated into the TSC that will govern channel protection:

1. Construction equipment may cross, operate in, or operate near stream courses only where so agreed to and designed by the Forest Service prior to construction.
2. No construction equipment shall be operated below the existing water surface except that fording the stream at one location only will be permitted, and work below the water level that is necessary for culvert bedding or footing installations will be permitted to the extent that it does not create unnecessary turbidity or stream channel disturbance.
3. Construction of any hydraulic structures in stream channels will be in compliance with TSC specifications.

PRACTICE 15.14 - Diversion of Flows Around Construction Sites

OBJECTIVE: To minimize downstream sedimentation by insuring that all stream diversions are carefully planned.

EFFECTIVENESS: High

COMPLIANCE: Meets SCA Rules

IMPLEMENTATION: Flow in streamcourses may only be diverted if the Forest Service deems it necessary for the contractor to meet contractual specifications. Such a diverted flow shall be restored to the natural streamcourse as soon as practicable. Stream channels impacted by construction activity will be restored to their natural grade, condition, and alignment.

PRACTICE 15.15 - Stream Crossings on Temporary Roads

OBJECTIVE: To keep temporary roads from unduly damaging streams, disturbing channels, or obstructing fish passage.

EFFECTIVENESS: Moderate

COMPLIANCE: Meets SCA Rules

IMPLEMENTATION: The following preventive measures will be included in contract specifications for such installations:

a. Divert stream flow through or around project sites during construction when that will minimize downstream sedimentation. Active streams will be de-watered or diverted during culvert installations only at the direction of the Forest Service.

b. Erodible material shall not be deposited into live streams.

c. Any material stockpiled on floodplains shall be removed before rising water reach the stockpiled material.

d. During excavation in or near the streamcourse, it may be necessary to use suitable coffer dams, caissons, cribs of sheet piling. This will usually be the case where groundwater is contributing a significant amount of water to the immediate excavation area. If any of the aforementioned devices are used, they will be practically watertight and no excavation will be made immediately outside of them.

e. Water pumped form foundation excavation shall not be discharged directly into live streams, but shall be pumped into settling ponds or into locations where water will not re-enter stream.

PRACTICE 15.17 - Regulation of Borrow pits, Gravel Sources and Quarries

OBJECTIVE: To minimize sediment production form borrow pits, gravel sources, and quarries, and limit channel disturbances in those gravel sources suitable for development in floodplains.

EFFECTIVENESS: High

COMPLIANCE: No Related FPA RULE

IMPLEMENTATION: Minimize opportunities for erosion from borrow pits and gravel sources from entering streams.

1. Complete any crushing and/or screening of excavating bedload away from any active stream channels and minimize future opportunities for waste materials to enter area streams, even under flood conditions.
2. Identify and implement opportunities to minimize erosion from existing borrow pits within the drainage.
3. If development of new rock sources are needed within the watershed, complete a pit development plan or rock source development plan which outlines all mitigation measures needed to control future erosion of the rock source.

PRACTICE 15.18 - Disposal of Right-of-Way and Roadside Debris

OBJECTIVE: To insure that debris generated during road construction is kept out of streams and to prevent slash and debris from subsequently obstructing channels.

Also see Practice 15.10

EFFECTIVENESS: High

COMPLIANCE: Meets FPA Rules

IMPLEMENTATION: Disposal of Right-of-Way and roadside slash be accomplished with one or more of the following practices.

1. Windrowing
2. Scattering
3. Chipping
4. Piling and Burning
5. Removal to previously agreed to locations.

Solid cull logs may be bucked into manageable lengths and piled alongside the road for fuelwood. No wood may obstruct flow in ditchlines or culverts.

PRACTICE 15.19 Streambank Protection

OBJECTIVE: To minimize sediment production form streambanks and structural abutments in natural waterways.

EFFECTIVENESS: Moderate

COMPLIANCE: Meets FPA Rules

IMPLEMENTATION: To reduce sediment and channel bank degradation at sites disturbed by construction of stream crossing or roadway fill, it may be necessary to incorporate "armoring" in the design of a structure to allow the water course to stabilize after construction. Riprap, gabion structures, and other measures are commonly used to armor stream banks and drainage ways form the erosive forces of the flowing water. These measures must be sized and installed in such a way that they effectively resist erosive water velocities. Stone use for riprap should be free from weakly structured rock, soil, organic material and materials of insufficient size, all of which are not resistant to stream flow and would only serve as sediment sources. Outlets for drainage facilities in erodible soils commonly require rip-rapping for energy dissipation. See conservation practice 14.17 for additional measures.

PRACTICE 15.21 - Maintenance of Roads

OBJECTIVE: To conduct regular preventive maintenance operations to avoid deterioration of the roadway surface and minimize disturbance and damage to water quality, and fish habitat.

EFFECTIVENESS: Moderate

COMPLIANCE: Meets FPA Rules

IMPLEMENTATION: For roads in active timber sale areas standard TSC provisions require the Purchaser to perform or pay for road maintenance work commensurate with the Purchaser's use. Purchaser's maintenance responsibility shall cover the before, during and after operations period during any year when operations and road use are performed under the terms of the Timber Sale Contract. All maintenance work shall be done concurrently, as necessary, at least to the following minimum standards:

1. Culverts and ditches shall be kept functional.
2. During and upon completion of seasonal operations, the road surface shall be crowned, out-sloped, in-sloped or waterbarred, and berms removed from the outside edge except those intentionally constructed for protection of fills.
3. The road surface shall be maintained as necessary to minimize erosion of the subgrade and to provide proper drainage.
4. If road oil or other surface stabilizing materials are used, apply them in such a manner as to prevent their entry into streams.
5. Sidecast of all material associated with road maintenance will be done in a manner to prevent its entry into streams.
6. Slumps, slides and other erosion features causing stream sedimentation will be kept repaired and stabilized.

PRACTICE 15.22 - Road Surface Treatment to Prevent Loss of Materials

OBJECTIVE: To minimize the erosion of road surface materials and consequently reduce the likelihood of sediment production.

EFFECTIVENESS: High

COMPLIANCE: No directly related FPA Rule

IMPLEMENTATION: On timber sale roads, the Purchaser shall undertake measures to prevent excessive loss of road material if the need for such action has been identified by the IDT. Road surface treatments may include: watering, applying magnesium chloride, sealing, aggregate surfacing, chipsealing, or paving.

PRACTICE 15.24 - Snow Removal Controls

OBJECTIVE: To minimize the impact of snow melt on road surfaces and embankments and to reduce the probability of sediment production resulting from snow removal operations.

EFFECTIVENESS: Moderate

COMPLIANCE: No directly related FPA Rule

IMPLEMENTATION:

1. The Purchaser is responsible for snow removal in a manner which will protect roads and adjacent resources.
2. Rocking or other special surfacing and/or drainage measures may be necessary, before the operator is allowed to use the roads.
3. During snow removal operations, banks shall not be undercut nor shall gravel or other selected surfacing material be bladed off the roadway surface. Ditches and culverts shall be kept functional during and following roadway use. If the road surface is damaged, the Purchaser shall replace lost surface material with similar quality material and repair structures damaged in blading operations.
4. Snow berms shall not be left on the road surface or shall be placed to avoid channelization or concentration of melt water on the road or erosive slopes. Berms left on the shoulder of the road shall be removed and/or drainage holes opened at the end of winter operations and before spring breakup. Drainage holes shall be spaced as required to obtain satisfactory surface drainage without discharge on erodible fills. On in slopped roads, drainage holes shall also be provided on the ditch side, but care taken to insure that culvert inlets are not damaged.

PRACTICE: 15.27 - Trail Maintenance and Rehabilitation

OBJECTIVE: to minimize soil erosion and water quality problems resulting from trail erosion.

EXPLANATION: Trails often have erosion problems due to poor location, improper maintenance, and the amount or type of use. This deterioration can often be minimized by proper maintenance, restriction of certain types of use, and/or relocation. Mainline and heavy use trails should have a functional drainage systems (waterbars, culverts at small stream crossings, corduroy, puncheon or boardwalks in boggy areas). Additional measures (lateral ditching, trail relocation, reconstruction, and so forth) may be required in heavy sue or problem areas.

IMPLEMENTATION: Each District will develop a trail maintenance plan which determines level, timing and frequency of maintenance. The need for closures will be identified through Forest Transportation Planning. Closure is done by authority of the Forest Supervisor (SWCP 11.09).

REFERENCES: SWCP 11.03, 11.09, 15.01, 15.02, and 15.03; FSH 7709.56b, Drainage Structures Handbook; see references in "Best Management Practice" Definition (05--2 and 3).

PRACTICE 18.02 - Formulation of Fire Prescriptions

PRACTICE 18.03 - Protection of Soil and Water form Prescribed Burning

OBJECTIVE: To maintain soil productivity, minimize erosion, and prevent ash, sediment, nutrients and debris from entering surface water.

EFFECTIVENESS: High

COMPLIANCE: No Related FPA Rule

IMPLEMENTATION: The prescription elements are defined by the interdisciplinary team during the environmental analysis. Field investigations are conducted to identify site specific conditions which may affect the prescription. Both the optimum and tolerable limits for soil and water resource needs should be established. Prescription elements will include such factors as fire, weather, slope aspect, soil moisture and fuel moisture which influence the fire intensity. These elements have a direct effect on whether or not a litter layer remains after burning and whether or not a water repellent layer is formed. The amount of remaining litter significantly affects erosion rates, water quality and runoff volumes.

Glossary of Soil and Water Conservation Practices Terms

Area Transportation Plan. A plan that identifies the transportation facilities needed to manage the lands and resources for a given area.

Armoring. Protective coverings or structures used to displace the erosive force of water. Rip-rapping is a type of armoring.

Baseline Data. Data representative of a particular base period or concurrent control sample. Normally representative of the undisturbed, undeveloped state.

Best Management Practice (BMP). A practice or a combination of practices, that is determined by a State (or designated area-wide planning agency) after problem assessment, examination of alternative practices, and appropriate public participation to be the most effective, practical (including technological, economic, and institutional considerations) means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality goals (40 CFR 130.2(q)).

Contract Provisions. Controls constraints, and/or general direction included in Contracts offered by the Forest Service.

Cross Drain/Ditch. A man made ditch or channel constructed to intercept surface water runoff and divert it before the runoff concentrates to erosive volumes and velocities.

Crowning. Forming a convex road surface which allows runoff to drain from the running surface to both sides of the road prism.

Cumulative Effect. The impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agency or person undertakes such other action (40 CFR 1508.7).

Degraded Watershed. A basin which has suffered environmental damage, resulting in accelerated soil or vegetative loss or chemical contamination to the quantifiable detriment of other resources.

Designated Streams. A stream or portion of a stream identified as warranting special consideration in management decisions and project activities. See also Stream or Streamcourse.

Floodplain. The lowland and relatively flat areas during adjoining inland waters that are covered by its waters during flooding.

Hazardous Substance. Materials which by their nature are toxic or dangerous to handle or dispose of, such as radioactive materials, petroleum products, pesticides, chemicals and biological wastes.

In-Service. Pertains to activities, actions or personnel within the USDA Forest Service.

Interdisciplinary Team (IDT). A group of two or more individuals, with different training or skills, assembled to solve a problem or perform a task. The team is assembled out of recognition that no one scientific discipline is sufficiently broad to adequately solve the problem. The members of the team proceed to solution with frequent interaction, so that each discipline may provide insights to any stage of the problem and disciplines may combine to provide new solutions. This is different from a multidisciplinary team, where each specialist is assigned a portion of the problem and their partial solutions are linked together at the end to provide the final solution. The forming of the team, the data collection and analysis, team discussions, interactive evaluation, and joint resolution of the problem in the Interdisciplinary Process.

Line Officer. Management personnel within the Forest Service Organization consisting of: Secretary of Agriculture, Chief of Forest Service, Regional Foresters, Forest Supervisors, and District Rangers. Refers to the line of authority and responsibility.

Log Landing. An area where logs are skidded or yarded prior to loading and transportation to a mill.

Mitigate. To offset or lessen real or potential impacts of effects through the application of additional controls or actions. Counter measures are employed to reduce or eliminate undesirable or unwanted results.

Monitoring. The periodic evaluation or resources or activities on a representative sample basis to establish long-term trends, assess the impacts of land management activities, determine how well objectives have been met, and check compliance against established standards.

Nonpoint Source (NPS) Pollution. Diffuse sources of water pollution that originate from many indefinable sources and normally include agricultural and urban runoff, runoff from construction activities, etc. In practical terms, nonpoint sources do not discharge at a specific, single location (such as a single pipe). Nonpoint source pollutants are generally carried over or through the soil and ground cover via stormflow processes. Unlike point sources of pollution (such as industrial and municipal effluent discharge pipes), nonpoint sources are diffuse and can come from any land area. It must be kept in mind that this definition is necessarily general: legal and regulatory decisions have sometimes resulted in certain sources being assigned to either the point or nonpoint source categories because of consideration other than their manner of discharge (for example, irrigation return flows are designated as "nonpoint sources" by law, even though the discharge is through a discrete conveyance).

Normal Operating Season. A portions of a year when normal timber harvesting operations are expected to take place uninterrupted by adverse weather conditions.

Outsloping. Shaping a road to cause drainage to flow toward the outside shoulder (generally the fill slope), as opposed to insloping which encourages drainage to flow to the inside shoulder (generally the cut slope). Emphasis is on avoiding concentrated water flow.

Permittee. Individual or entity that has received a grazing or Special Use Permit from the Forest Service.

Pesticide. A general term applied to a variety of chemical materials including insecticides, herbicides, fungicides and rodenticides.

Point Source. Originating from a discrete identifiable source or conveyance.

Purchaser. The entity which is awarded a USDA Forest Service contract after bidding, usually with competition. As used in timber, the entity which has purchased timber as identified in a timber sale contract.

Reforestation. A renewal of forest cover by seeding, planting or natural means.

Revegetation. The replacement of vegetative cover which has been harvested or lost due to natural occurrences. Accomplished either through planting or nursery stock or seeding, or through natural processes.

Riparian Habitat Conservation Area (RHCA). Areas with distinctive resource values and characteristics that are comprised of an aquatic ecosystem and adjacent upland areas that have direct relationships with the aquatic system (riparian ecosystems). This includes wetlands and all areas within a given horizontal distance from the normal high water line of a stream, or from the shoreline of a standing body of water (INFISH 1991). An RHCA is not a zone of exclusion, but an area of closely managed activity. RHCAs act as an effective filter and absorptive zone for sediment; maintains shade; protects aquatics and terrestrial riparian habitats; protecst channel and streambeds; and promotes floodplain stability.

Rip Rapping. The use of a large rock, boulders, concrete chunks or similar non-erosive, heavy objects as an armoring device.

Road Maintenance Plan. A document schedule and program for upkeep of roads to provide a level of service for the user and protection of resources. There are five levels of maintenance; Level I being the least intense and Level V being the most intensive.

Rocking. The application of aggregate to a roadbed to provide strength and a more stable erosion resistant surface.

Sale Area Map. A map of suitable scale and detail to be legible which part of a timber sale contract. The map identifies sale area boundaries and contract requirements specific to the sale.

Significant Disturbance. Disturbance of surface resources, including soil, water and vegetation, which has the potential to degrade water quality to a level requiring corrective action.

Site Preparation. A general term for removing unwanted vegetation, slash and even roots and stones from a site before reforestation. It is generally accomplished bye either mechanical, chemical, or biological means, or controlled fire.

Site Specific. Pertains to a discernible, definable area of point on the ground where a project or activity will (or is proposed) to occur.

Soil and Water Conservation Practice (SWCP). The set of practices which, when applied during implementation of a project, ensures that soil productivity is maintained, soil loss and water quality impacts are minimized, and water related beneficial uses are protected. These practices can take several forms. Some are defined by state regulation or Memoranda of Understanding between the Forest Service and the States and thus are recognized as Best Management Practices (BMPs). Others are defined by the Forest Service interdisciplinary teams or described in FS Handbooks for application Forest-wide. Both kinds of SWCP are included in the Forest Plan as Forest-wide standards or are referenced in the plans. A third kind of SWCP is identified by the interdisciplinary team for application to specific management areas; these are included as Management Area Standards in the appropriate management areas in the Forest Plan. A fourth kind, project level SWCPs, are based on site specific evaluations and represent the most effective and practical means of accomplishing the soil and water resource goals of the specific area involved in the project. These project level conservation practices can either supplement or replace the Forest Plan for specific projects. This handbook will aid in the development of the fourth kind of SWCP.

Soil Productivity. The capacity of the soil to produce a specific crop such as fiber and forage, under defined levels of management. It is generally dependent on available soil moisture and nutrients and length of growing season.

Specified Road. A forest development transportation system road that is identified in and to be constructed or reconstructed under a Forest Service contract.

Wetlands. Those areas that are inundated by surface or groundwater with a frequency sufficient, under normal circumstances, to support a prevalence of vegetation or aquatic life that requires saturated or seasonally saturated solid conditions for growth and reproduction. Wetlands included marshes, bogs, sloughs, potholes, wet meadows, river overflows, mud flats, seeps and springs.

Windrowing. To pile slash or debris is a row along the contour of the slope.