BROADAXE PROJECT –WATERSHED REPORT

Regulatory Framework

Forest Plan Standards

The Idaho Panhandle National Forests Forest Plan outlines standards that meet Forest-wide goals and to meet or exceed State water quality standards (GR2, IPNF Forest Plan, p II-33). It requires implementation of project-level standards and guidelines for water quality contained in the Soil and Water Conservation Practices Handbook (FSH 2509.22), including those defined by State regulation or agreement between the State and Forest Service.

Forest-wide standards and guidelines for Management Areas 1, 6 and 9 are presented in the IPNF Forest Plan (GR2, IPNF Forest Plan, p. III-4 and III-30).

Clean Water Act

The intent of the Clean Water Act (CWA) of 1977 (33 U.S.C. 1323) was to "...restore and maintain the chemical, physical, and biological integrity..." of streams (US, 1988). The CWA also directed the States to administer the act and to develop an antidegradation policy (40 § 131.12).

Idaho Water Quality Law

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 through a Memorandum of Understanding with the State of Idaho (IDWR, 1993).

Other relevant management directives are presented in the project file document SW16.

Analysis Area

The Broadaxe analysis area is located in the upper middle portion of the St. Joe River watershed (USDA, 1997, An Assessment for the St. Joe Area, p. 13). Watershed resources (watershed condition, water quality and beneficial uses, water yield, and stream channel condition) are analyzed for the Broadaxe Project to the project area boundary, which includes the entire watershed area of Broadaxe Creek.

Cumulative Effects Area

Cumulative watershed effects are scale-dependent and the magnitude of change in water and sediment yield is inversely proportional to stream-order (Macdonald, 1989). Therefore detectable changes should be expected high in a watershed, where activities overlap in time and space. The scale of the Broadaxe area in relation to the much larger St. Joe River sub-basin would tend to render any effects beyond the temporal and spatial boundaries of the analysis area unmeasurable. Therefore, cumulative watershed effects will be analyzed from the Idaho-Montana stateline (Bitterroot Divide) to the mouth of Gold Creek (SW15).

Affected Environment

Analysis Methods

The water resource is assessed with respect to watershed condition, water quality (sediment levels, thermal modifications, etc.) and beneficial uses, water yield and peak flows, and stream channel conditions. Throughout the Water Resource section, areas were calculated using ARC GIS and were rounded off, which may cause slight discrepancies between resource analysis numbers.

Watershed Condition Model

A comparative analysis of existing watershed condition (status) based on GIS data was conducted in 2004 for the IPNF Forest Plan Revision effort at the 6th-code hydrologic unit level (SW18). Inherent sensitivity is defined in the model by the average annual precipitation, and the dominance of depositional stream reaches, sensitive landtypes, and sensitive snow zones in the watershed (SW18). The current watershed conditions were estimated based on the level of watershed disturbance as measured by road density, roads on sensitive landtypes, stream crossing frequency, equivalent clearcut area, and detrimental soil disturbance (SW18).

Field Review

Roads, particularly stream crossings and drainage structures, were inventoried during the 2001 to 2004 field seasons to assess erosional hazards and risks to the watershed resource (SW21). Information gathered on road-stream crossings included approximate fill volumes, culvert sizes, erosional features, and other observations.

Watershed monitoring of the late 1990s Beetlemania salvage project in 2002 included evaluation of BMP effectiveness and assessment of channel conditions at road-stream crossings that had been removed and recontoured on decommissioned and stored roads (SW9; GR18, IPNF 2002 Forest Plan Monitoring and Evaluation Report, p.36).

All reaches of named streams in the watershed cumulative effects analysis area were classified (Rosgen, 1994; Montgomery and Buffington, 1997) and channel conditions were assessed by the Avery hydrologist in 1993 (SW19). Channel and riparian conditions in Gold Creek, Broadaxe Creek and East Fork Gold were re-assessed in 2004 (SW19). In addition, segments of Gold and Broadaxe Creeks were surveyed and classified in 2004. The more recent surveys confirmed the assessment of the Avery Hydrologist and indicate that channel and riparian conditions have not measurably changed. This was as expected because only relatively low-impact management activities have occurred in the Broadaxe project area since 1993.

Peak Flow Calculations

Reference peak flows were estimated for the major streams in the project area using the procedures in Berenbrock's 2002 report, which has been automated on the USGS' StreamStats website.

WATSED Model

Vegetation changes and sediment and water yield modifications, relative to calculated natural background levels, due to previous and ongoing management in the analysis area (see Management History Report) were estimated using the WATSED computer model, which is calibrated for the Idaho Panhandle National Forests (USDA, 1981, R1/R4 Guide for Predicting Sediment Yields from

Forested Watersheds; Patten, 1989; SW20). The Regional database of past timber stand management activities and the GIS roads coverage determined from the Quartz Gold Roads Analysis Process were used as model input (SW30). No attempt was made to force the model to simulate the previous and ongoing lodgepole pine mortality and resultant sediment and water yield effects. WATSED spatially and temporally organizes typical watershed response relationships as a result of forest practices. Like any model, it simplifies extremely complex physical systems to generate specific quantitative values. These values cannot be assumed to represent actual in-stream sediment or flow levels. Therefore, model results are realistically limited to providing a means of comparison, not an absolute measure against verifiable standards (SW20).

Monitoring has shown that WATSED produces reasonable values for water yield and conservative (over-) estimates of sediment routing (GR16, IPNF 2000 Monitoring and Evaluation Report, pp. 26-27; GR19, IPNF 2003 Report pp. 41-44; SW20). Limitations of the WATSED model, as well as procedures that were used for running the model for this project are presented in the project file document SW20.

Rain-on-Snow Analysis

Calculated equivalent clearcut area for each previously harvested stand documented in the timber management database, including recovery since harvest, were used as to estimate the existing harvest openings in the sensitive snow zone.

Reference Condition

Watershed Condition

Broadaxe Creek is a third-order tributary to Gold Creek. Its watershed area is approximately 5.25 square miles. It receives 40 to 70 inches of precipitation annually. Approximately 14% of the drainage is within the 3000-4500 foot elevation “rain-on-snow” or “sensitive snow” zone (SW17). It is in the upper middle portion of the St. Joe River sub-basin. There are no mapped wetlands in the project area. Floodplains are limited because the stream channels are relatively confined.

Gold Creek is a fourth-order tributary of the St. Joe River with a 27.7 square mile drainage area. According to modeling conducted for the upcoming Forest Plan Revision, the Gold Creek watershed has a low sensitivity to disturbance (SW18). The lower 1.6 miles of Gold Creek, approximately 3.5 miles downstream of the mouth of Broadaxe Creek, may be inherently more sensitive than most of its watershed because it has a lower gradient and is less confined than the remainder of the drainage.

Over the course of its evolutionary history, a watershed may experience all vegetative conditions from high-intensity fire creating hydrophobic soil conditions and extreme runoff events to overstocked dense stands of timber that utilize most soil moisture and intercept much precipitation (especially snow) and reduce water yields to minimal levels. Every part of the project area may have had some disturbance over a long period of time, such that at any one time a variety of watershed conditions, from highly supportive of native species to unsupportive, might have been present across the Broadaxe area (USDA, 1997, An Assessment for the St. Joe Area).

Water Quality and Beneficial Uses

Designated beneficial uses for the St. Joe River are domestic water supply, salmonid spawning, cold-water biota, primary contact recreation, and special resource water (IDAPA 58.01.02.110.11; IDEQ,

2003, p. 18). Tributaries are undesignated surface waters. Existing beneficial uses in these tributaries are aquatic life (cold-water biota) and primary or secondary contact recreation (IDAPA 58.01.02.101.01.a). Wildlife habitat (IDAPA 58.01.02.100.04) and aesthetics (IDAPA 58.01.02.100.05) are designated as beneficial uses of all waters of the state.

These beneficial uses were designated by Idaho Department of Environmental Quality (IDEQ) based upon assessment of the historic and current value of the water in each stream segment as a function of nutrients, bacteria, pH, dissolved gas, toxic substances, dissolved oxygen, temperature, ammonia, habitat, sediment, and turbidity. The reference condition for water quality in the streams in the analysis area is that they were fully supportive of cold-water uses. The only major aspect of beneficial uses that cannot be assessed based on water quality elements is aquatic habitat. Gold Creek is considered high-value fisheries stream at the Forest level (GR2, IPNF Forest Plan, p. II-30).

Natural Sediment Production and Delivery to Streams

Disturbances such as fire and extreme runoff events are distinct in time and space and can occur anywhere across the landscape. Random sediment inputs from such disturbances to stream channels occur as a complex series of pulses that are delivered and stored within low order, high gradient stream channels (Benda and Dunne, 1997). Sediment may accumulate for centuries in these channels before being transported or "flushed" downstream by episodic events with large increases in water yield (Kirchner et al., 2001).

Following any erosional event, large volumes of sediment are concentrated in different sections of the stream channel, near tributary junctions along the larger order, lower gradient sections or above natural debris accumulations. The stream channel transports bed material downstream from these storage sites at different rates. The bed material travels slowly, creating temporary patterns of sediment transport, sediment storage, and channel morphology throughout the stream channel (Benda and Dunne, 1997). The WATSED model estimates of natural background sediment production and sediment routed to streams in the Broadaxe area is displayed in Table 1 below.

Water Yield

Water yield is primarily a function of precipitation, landtype, vegetative cover, and drainage area. Natural disturbances such as fire would tend to increase water yields by reducing canopy cover and plant uptake of subsurface flows and by producing hydrophobic soils after severe burns (USDA, 2002b, West Gold Final EIS, IPNF, pp. III-8 - III-11); whereas dense, immature regeneration stands would tend to decrease surface and subsurface flows. As stated for other resource indicators, a range of water yield conditions would probably have been present in the Broadaxe area through space and over time. The WATSED model estimates of natural water yield are displayed in the project file document SW22.

The mean annual precipitation over the Broadaxe drainage is 61 inches, producing an average bankfull flow of 155 cubic feet per second (cfs) (Berenbrock, 2002; SW23). The mean annual precipitation in the Gold Creek drainage is 51 inches, with an average bankfull flow of 617 cfs (SW23). The biannually recurring peak flow is approximately representative of the average bankfull or channel-forming flow (Hortness and Berenbrock, 2004). Regional data shows that peak flows with return intervals of 50 to 100 years can be 2 to 3 times higher than normal bankfull flows in the vicinity of the project area (SW23). So it can be assumed that streams in the analysis area have been subjected to much higher flows than the calculated bankfull flow.

Many peak flows in northern Idaho are associated with mid-winter rain-on-snow events and rain-on-spring-snow events with peaks that are usually higher and of shorter duration than normal spring high flows (MacDonald and Hoffman, 1995). Models cannot predict peak flows resulting from these events because their frequencies are random. They do not occur on an annual basis; and they are dependent on certain climatic conditions such as air temperature, intensity and duration of precipitation, rain-on-snow elevations and snowpack characteristics (Berris and Harr, 1987). Although the bankfull flow tends to be the main channel-forming flow, these higher peaks can induce significant channel changes, particularly if they are accompanied by mass failures.

Stream Channels

Based on geomorphological characteristics such as valley slope and type, upper Gold Creek and its tributaries, including Broadaxe Creek, should primarily have Rosgen type "A" channels (Rosgen, 1996). Below its confluence with Broadaxe Creek, Gold Creek may be expected to have a "B" channel. These channel types are relatively confined and are capable of transporting moderate increases in water and sediment from their drainage areas without changing their dimension, pattern or profile.

In Montgomery and Buffington's (1997) classification scheme, upper Gold Creek and Broadaxe Creek and their tributaries are expected to include colluvial, bedrock, cascade, and step pool morphologies. Gold Creek below Broadaxe Creek would tend toward step pool, pool riffle, and plane bed morphologies. Cascade, bedrock, and step-pool channels tend to transport sediment. In contrast, pool riffle, plane bed and colluvial channels tend to be more responsive to altered sediment supply. Response-type channels may have more significant and lingering impacts due to sediment and water yield disturbances (Montgomery and Buffington, 1997).

Existing Condition

The existing condition was assessed to provide a basis for comparing the effects of the proposed management activities and alternatives. All previous and ongoing activities in the project area are included in the analysis of existing conditions (SW30, see Management History Report).

Watershed Condition

Broadaxe Creek was part of the Quartz Gold landscape analysis area for the St. Joe Geographic Assessment (USDA, 1997, An Assessment for the St. Joe Area). The Quartz Gold area was rated in poor condition with a static trend in the aquatics analysis. Modeling for the IPNF Forest Plan revision indicates that Gold Creek has impaired watershed conditions, due the level of management that has previously occurred (SW18). The St. Joe River, downstream of the cumulative effects analysis area, is designated Special Resource Water (SRW) by the State of Idaho a (IDAPA 58.01.02.110.11). Point source discharges to SRW are restricted (IDAPA 58.01.02.056.03). There are no point sources of any pollutants in the project or cumulative effects analysis area.

Human disturbances that have affected basin hydrology include vegetative treatments, road building, fire, and fire suppression. The current vegetative condition in the Broadaxe area is not considered to estimate historic or natural conditions (USDA, 1997, An Assessment for the St. Joe Area). This is due in part to fire exclusion and harvest practices that tend to reduce patch size. Since the fires of 1889 and 1910 (see Fire/Fuels report), stands dominated by lodgepole pine have been allowed to mature in the upper Broadaxe Creek drainage (see Vegetation report). This has resulted in a large

area susceptible to mortality from mountain pine beetle attacks. The current condition results in a "press"-type disturbance, whereby disturbed conditions are spread over the entire area and through time, rather than being more concentrated as in historic conditions. In addition, there are approximately 100 roaded acres in the project area (SW24). These roads vary from unvegetated, to completely overgrown with alder, to partially or fully recovered due to active decommissioning and/or natural regeneration.

Water Quality and Beneficial Uses

The St. Joe River is designated as a Special Resource Water (SRW) of the State (IDAPA 58.01.02.110.11). Point sources of discharge to SRW are restricted (IDAPA 58.01.02.056.03). There are no point sources for any pollutant in Broadaxe or Gold Creek.

The St. Joe Sub-basin Assessment and TMDL (Total Maximum Daily Load) Report (IDEQ, 2003) provided EPA-approved information on beneficial uses and attainment of water quality standards required by the Clean Water Act. Beneficial uses are currently un-supported in Gold Creek due to temperature exceedences (SW26). A temperature TMDL was developed for the Upper St. Joe River and its tributaries (IDEQ, 2003, pp. 89-94).

The mainstem of Gold Creek from the confluence with the East Fork Gold Creek to the St. Joe River (1.6 miles) had previously been determined to be water quality limited (IDEQ, 1999). Pollutants of concern in 1998 were sediment, nutrients, habitat alteration, and temperature (IDEQ, 2003, p. 16). A final determination of the status of Gold Creek was made by the State (SW25) and approved by EPA in August 2003 (SW26). It was found to be non-supportive of beneficial uses and a temperature TMDL was developed and approved by EPA. Although, the assessment indicated that cold-water aquatic life and use are supported (IDEQ, 2003, p. 27 and 44), temperature was found to exceed the current standards in Gold Creek (IDEQ, 2003, p. 25). A target canopy cover was established for this stream and its tributaries (IDEQ, 2003, pp. 103-105 and 127; SW25) to help achieve a thermal load reduction. IDEQ recommended delisting Gold Creek for sediment and nutrients (IDEQ, 2003, pp. xvi and 43-44); therefore, there are no sediment or nutrient load reduction requirements for Gold Creek. Habitat alteration cannot be addressed by TMDLs (IDEQ, 2003, p. xvi). Aquatic habitat is addressed in the Fisheries Report for this project.

Previous restoration activities in the Gold Creek watershed have been undertaken to improve watershed conditions as a result of concerns raised at the District and Forest level. These have primarily been road storage and obliteration treatments that have been implemented in the last five to ten years (SW27, SW21). They have included removal of culverts and channel restoration (at least 50 sites, 3 in Broadaxe), full and partial recontouring of road prisms, or decompaction and/or revegatation of roadbeds (approximately 50 miles, 3.3 miles in Broadaxe). Riparian shrubs were planted in the late 1990s at many of the road-stream crossings that were removed. Fisheries habitat improvements in Gold Creek were implemented in 1989 and 1994 (see Fisheries report)

Idaho's Antidegradation regulations make a specific provision for water quality limited segments for which no approved TMDL yet exists (IDAPA 58.01.02.054.04). For these or medium to low priority waters (which is the status for Gold Creek because IDEQ is not scheduled to complete a TMDL pending delisting for sediment and nutrients), there is only the requirement to use best management practices for non-point sources deemed necessary to prohibit further impairment of the designated or existing beneficial uses.

No other TMDLs were developed for streams in the project area. Therefore, there are no load reduction requirements for any other streams in the project area. EPA approved the St. Joe Sub-basin Assessment and TMDLs in 2003, and no new TMDLs are expected to be developed before the 2004 list is developed (SW29).

Existing Sediment Production and Delivery to Streams

Although there are no point sources for sediment in the watershed cumulative effects area, excess sediment has been found to be the primary constituent that affects water quality in the middle St. Joe River and its tributaries (USDA, 1997, An Assessment for the St. Joe Area). Forest Plan monitoring has shown that managed watersheds may be more responsive to extreme runoff events based on sediment yield data collected in Bird and Skookum Creeks (GR17, IPNF, 2001 Forest Plan Monitoring and Evaluation Report, p. 27-31), which are downstream of the project area in the middle St. Joe zone. In addition, research has shown that forest roads are usually the leading contributor of sediment to stream channels (Gucinski et al., 2001; Bilby et al., 1989; Duncan et al., 1987). There are approximately 23 miles of road in the Broadaxe drainage. However, sediment has been determined not to be a pollutant in Gold Creek or its tributaries (IDEQ, 2003, p. xvi and 44) and neither sediment levels nor turbidity were identified as a concern for the fisheries resource.

There is no sediment monitoring data for Gold Creek or its tributaries to indicate current vs. natural loading and transport rates. Therefore, the WATSED model was used to estimate the natural background and existing condition due to management activities for sediment yield in the project area. Table 1 displays the model results for the major streams in the project area.

Table 1. WATSED Model Output for Natural and Existing Sediment Yields

Watershed(s)	*Total Sediment (tons/square mile)	*Routed Sediment (tons/square mile)	*Existing Increase (tons/square mile)
Broadaxe Creek	126	17.9	7.88
**Gold Creek	647	13.0	10.66

*Total sediment is natural background sediment delivered annually to all stream channels in the watershed. Routed sediment is natural background sediment routed annually to the critical reach of the drainage (SW33). Existing increase is the modeled management-induced inputs to the critical reach for the year 2005.
**Results Gold Creek incorporates inputs from its tributaries (including Broadaxe Creek).

The existing sediment increases in Broadaxe and Gold Creeks estimated in Table 1 are as low as they can ever recede, because WATSED assumes forest roads remain open in perpetuity. Therefore, this is the baseline against which the proposed action will be compared. Experience with the WATSED model in this area indicates that sediment increases cannot be lower than 20% unless all streamside roads are removed. There are no roads encroaching within 50 feet of stream channels in the Broadaxe project area except at 17 stream crossings. In addition, approximately 0.8 miles of the Road 1218 are within the INFS buffer (300 feet) of lower Broadaxe Creek itself. In Gold Creek, Forest Highway 50 and several other roads encroach on stream channels.

Sediment modeling cannot predict the individual effects of stochastic events such as rain-on-snow-induced fill failures. There are approximately 4 miles of existing road in the Broadaxe area that lie within the normal rain-on-snow elevation of 3,000 to 4,500 feet above sea level. None of these roads are likely to be used in the Broadaxe salvage project. The combination of unstable road fills

and extreme runoff events such as those caused by the rapid melt-offs that are likely in this zone can result in catastrophic failures and associated sediment delivery to streams. Most large failures of road fills in northern Idaho have been associated with rain-on-snow events, particularly at stream crossings (SW31).

Water Yield

Equivalent clearcut area in the Broadaxe drainage, as calculated by the WATSED model, is currently approximately 8% and in Gold Creek overall, 11%. Vegetation changes due to natural processes, such as insect-caused mortality, cannot be modeled. Therefore, the WATSED model was used to predict water yield, peak flow, and peak flow duration increases due only to past management activities that have changed canopy cover (see Management History Report, SW30).

Table 2. WATSED Model Outputs for Existing Water Yield and Peak Flows

Watershed(s)	*% Annual Water Yield Increase	*% Peak Flow Increase	*Peak Flow Duration Increase (days)
Broadaxe Creek	4	4	4
**Gold Creek	5	6	5

*Annual water yield increase is the current increase over the average annual discharge for the watershed. Peak flow increase is the increase in the annual mean water yield over the watershed's peak flow month. Peak flow duration increase is the number of days over natural background that flows are predicted to be in the top 25-percentile of the watershed's peak flow month (SW33).
**Results for Gold Creek incorporate inputs from its tributaries, including Broadaxe Creek.

Peak flow or water yield increases of <5% and the effects of such increases are unlikely to be measurable (SW34). However, natural climatic variations in can result in peak flows several times greater than the calculated increase of 6% in Gold Creek (USDA, 2002b, West Gold Final EIS). WATSED estimates the natural background peak flow duration in the Broadaxe area to be 39 days, with existing management-induced increases ≤15%. Peak duration increases of less than 20% are not expected to cause significant effects (Patten, 1989).

Rain-on-Snow Peaks

Table 3 shows the estimated existing canopy openings in the sensitive snow zone in the project and cumulative effects analysis areas (SW17). Canopy openings in this zone can increase sensitivity to extreme weather events due to decreased evapotranspiration, and increased snow accumulation, ablation, and melt with the result being an altered hydrograph with higher peak flows due to a "flashier" response to climatic events, reduced base flows, and overall increased water yield.

Table 3. Existing Canopy Openings in the Rain-on-Snow Zone

Watershed(s)	Openings in the Sensitive Snow Zone (acres)
Broadaxe Creek	75
Gold Creek	619

Increased openings in the sensitive snow zone can result in higher rain-on-snow flood peaks (Kappesser, 1991). Gold Creek has had more previous harvest in the area of sensitive snowpack than Broadaxe. Because Broadaxe Creek has a higher average elevation than the majority of the Gold Creek watershed, it is inherently less susceptible to rain-on-snow events and their effects. Total

canopy openings in Broadaxe Creek and Gold Creek are relatively low; therefore, existing rain-on-snow effects would tend to be minimal.

Stream Channel Conditions

Broadaxe Creek has a steep, transport-type channel (Montgomery-Buffington step-pool, Rosgen A) and, as such, may be expected to be more resistant to degradation due to management-induced changes in sediment and water yield. Its tributaries are colluvial, A-type channels, which store sediment until it is flushed by extreme runoff events. There are shifting patterns of sediment storage and transport in the mainstem of Broadaxe Creek primarily due to steps forced by natural wood debris in the channel. Most of the channel of Broadaxe Creek is currently relatively unaffected by roads and logging (SW19). However, approximately 0.7 miles of the riparian area in the lower 1.2 miles of the stream valley was harvested in the 1960s and 1970s. This lowermost reach of Broadaxe Creek has a lack of overstory as a result of the riparian harvest and channel substrate may be slightly more mobile than would be expected for the channel type (SW19). In addition, the Beetlemania salvage project in the late 1990s resulted in 2 openings (49 and 74 acres) on the south-facing ridges and slopes in the lower part of the Broadaxe drainage. Roads constructed for the Beetlemania salvage were temporary (SW9). The Beetlemania project activities do not appear to have affected channel conditions in Broadaxe Creek (SW19) or headwater tributaries (SW9; GR18, IPNF 2002 Forest Plan Monitoring and Evaluation Report, p.36).

At the cumulative effects scale, Gold Creek was identified in the St. Joe GA analysis (SW36) as having unstable and encroaching roads. In addition, its channel was determined to be out of equilibrium (SW36). Problems in Gold Creek include modifications of channel geometry due to encroachment of Forest Highway 50; causing increased sediment loading, bank destabilization, aggradation in lower gradient sections. Timber management-related water yield increases may have induced some degradation in harvested tributaries where channels are confined. Extensive gravel and cobble deposits along the channel of Gold Creek near the mouth of the East Fork Gold Creek may be due in part to turn-of-the-century mining (Sims, 1998). The trend is static as the channel continues to adjust to modifications.

Environmental Consequences

Hydrologic response to vegetative change is highly variable and dependent on numerous site factors such as elevation, aspect, slope, soils, landforms, flow regimes, channel type, etc. It is important to examine hydrologic changes within the context of those factors and then translate them into potential changes to water yield, erosion, water quality, and aquatic habitat.

Analysis Methods

Effects of proposed activities on the water resource will be assessed with respect to watershed condition, water quality (sediment levels, thermal modifications, etc.) and beneficial uses, water yield and peak flows, and stream channel conditions. Throughout the Water Resource section, areas were calculated using ARCINFO GIS and were rounded off, which may cause slight discrepancies between resource analysis numbers.

Equivalent Clearcut Area

Equivalent clearcut area (ECA) is a measure of the total amount of forest canopy reduction in a watershed due to management activities such as harvesting and road building. The WATSED model output for ECA will be used as a relative indicator of watershed condition and the potential for significant in-stream effects as a result of the proposed vegetative and fuels treatments and temporary road construction. The Regional database of past timber stand management activities, the GIS roads coverage determined from the Quartz Gold Roads Analysis Process, and the proposed salvage harvest and associated openings and temporary roads were used as model input (SW30). ECA is one of the variables in the model that was used to estimate the current watershed conditions across the IPNF (see *Watershed Condition Model* above).

Water and Sediment Yield Modifications

Cumulative sediment and water yield modifications were predicted using the WATSED model, which is calibrated for the Idaho Panhandle National Forests (USDA, 1981, R1/R4 Guide for Predicting Sediment Yields from Forested Watersheds; Patten, 1989). Previous and proposed management activities were used as input to the model (see Management History Report, SW30). WATSED spatially and temporally organizes typical watershed response relationships as a result of forest practices such as harvesting and road building. Like any model, it simplifies extremely complex physical systems to generate specific quantitative values. Therefore, model results are realistically limited to providing a means of comparison, not an absolute measure against verifiable standards (SW20). Therefore, model results were used only for comparison between the existing condition and the effects of the proposed action. Limitations, as well as procedures that were used for running the WATSED model, are presented in project file document SW20.

The model estimates of sediment and water yield and peak flows reflect how watersheds with similar climates and landtypes have responded over time to a similar history of disturbance. WATSED is not intended nor designed to model event-based processes and functions, or specific in-channel responses. It does, however, incorporate the results of those processes in its driving coefficients (SW20).

Stream Channel Conditions

The effects of the alternatives will be assessed based on the existing condition of project area streams. The existing condition of the streams determined from recent field surveys (SW19) will allow interpretation of modeled vegetation changes and sediment and water yields due to project activities versus natural losses of lodgepole pine.

Direct & Indirect Effects of Current and Reasonably Foreseeable Actions

Table 4 displays the effects of current and reasonably foreseeable activities that are common to the No-Action Alternative and all of the action alternatives. These activities and their effects were incorporated into the cumulative effects analysis of the alternatives.

Table 4. Summary of Effects of Current and Reasonably Foreseeable Actions

Activity	Direct/Indirect Effects	Comments
Quartz Wildlife Burn	minimal	One brushfield would be burned at the mouth of Gold Creek, minimal canopy may be lost, stream would be buffered from ignition, these prescribed burns are required to occur only in controlled conditions and have been shown in the past to have minimal effects on erosion and runoff (SW39)
Permitted Outfitting	minimal	Practices protective of in-stream habitat documented in Outfitter Guide Programmatic BA (USDA, 2004, Outfitter and Guide Programmatic Biological Assessment) are sufficient to protect water quality
Whitetail Trail Construction and Reconstruction	minimal	The Whitetail trail system originates in Stevens Creek, downstream of the cumulative effects analysis area, only short segments may traverse the ridge into the lower Gold Creek drainage; however, no effects are anticipated because the trail is high on the ridge and does not cross or encroach on any stream channels
Dispersed Campsite Use	minimal	One campsite encroaches on Gold Creek near the mouth of Berge Creek and another encroaches on a small perennial tributary of Gold Creek upstream of Broadaxe Creek, these will continue to impair channel conditions in these reaches
Fire Suppression	minimal to none	Practices protective of bull trout habitat documented in the St. Joe River/North Fork Clearwater Basins BA (USDA, 1998b) are sufficient to protect water quality
Recreational Uses	minimal	Primarily due to influence of roads, this is considered in the WATSED modeling
Miscellaneous gathering of forest products	minimal	Primarily due to influence of roads, this is considered in the WATSED modeling
Noxious Weeds Suppression Activities	none	Covered by St. Joe Noxious Weeds EIS (USDA, 1999)
Road Maintenance	minimal, long-term benefit	BMPs (see Watershed Appendix) for roads have been shown to be protective of water quality and beneficial uses (Seyedbagheri, 1996; Burroughs and King, 1989); culvert upgrades to comply with INFS would involve in-stream work, the direct sediment effects have been found to be minimal (SW37)
Helispot Maintenance	minimal	Helispots are usually 1 acre openings located along roads, which are modeled in WATSED and on ridgetops where effects to water resources will be minimal to none
Data Gathering	none	No associated ground- or channel-disturbing activities
Road Waste Disposal	yes	There is one road waste site located within a RHCA in the Float Creek drainage that is currently being used, new road waste sites will be located to avoid riparian areas and sensitive landtypes
Limited Timber Harvest and Fuels Treatment under CEs	minimal	Federal Rules for CEs require that activities have minimal and acceptable effects on all resources
Upper St. Joe Temperature TMDL Implementation	benefit	Target shade canopies were established for 8 upper St. Joe tributaries, including Gold Creek and its tributaries. USFS is a co-operator with IDL for Forest practices that affect stream canopy. TMDL implementation will help achieve the bull trout temperature standard.

Direct, Indirect & Cumulative Effects of No Action

It is assumed that with no action in the project area lodgepole pine mortality will continue, resulting in a substantial loss of the lodgepole pine component in the proposed action stands (see Vegetation report). The dead trees would exacerbate the negative watershed effects of a wildfire, should a start occur (see Fire/Fuels and Soils reports).

Watershed Condition

Because the current trend is static, with no action, watershed conditions would remain impaired due to past, current, and reasonably foreseeable activities in the project area. Ongoing loss of crown closure due to the mountain pine beetle infestation would continue, primarily in lodgepole stands. The watersheds in the Gold Creek area evolved within a disturbance regime of periodic catastrophic wildfires (see Fire/Fuels report). Therefore, over the long term, the watershed would adjust to a potential severe fire event as they have in the past. Cumulative watershed effects of the no-action alternative are discussed in comparison to the proposed action in the sections below.

Water Quality and Beneficial Uses

With no action in the project area, water quality would probably be maintained in the project area. Stream temperatures would probably remain in the range of previous measurements. Vegetative recovery from past management would benefit in-stream habitat over the very long term except in areas with streamside roads. Chronic sediment inputs would decrease slightly relative to the existing condition as unused roads become overgrown. Potential loss of canopy due to beetle kill could degrade water quality over the short term due to elevated water yield and thermal and/or sediment inputs (Robichaud and Brown, 1999). Cumulative effects of the no-action alternative are discussed in comparison to the proposed action in the sections below.

Water Yield

Water yield and peak flows could recover to more natural levels as stands that have been harvested in the past continue to grow and increase canopy. However, significant loss of crown closure in untreated stands due to the pine beetle infestation could contribute to increased water yield and peak flows. Tree mortality in this case could also increase fuel loading and heighten the risk of severe fires, should a fire start occur. A large, severe fire would further increase water yields, with recovery back to existing conditions likely within 20 years (Legleiter et al., 2002). Cumulative water yield effects of the No-Action Alternative are discussed in comparison to the proposed action in the sections below.

Stream Channel Conditions

The channels of Broadaxe Creek and its tributaries and Gold Creek would likely remain in essentially the same conditions as they are currently. The streams in the Gold Creek drainage evolved within a disturbance regime of periodic wildfires and, therefore, would adjust over the long term to a potential severe fire event as they have in the past. However, such an event would perpetuate the existing, impaired watershed condition, further degrading channel and in-stream habitat conditions in the Gold Creek drainage over the short term. This could have significant effects on aquatic habitat.

Direct, Indirect & Cumulative Effects of the Proposed Action

The cumulative effects of these activities in each alternative are considered in the following sections.

Table 5. Summary of Effects of Proposed Action

Activity	Direct/Indirect Effects	Comments
Temporary Road Construction and Decommissioning	minimal	The temporary roads are proposed for upper slopes and do not cross streams. Their service life is expected to be ≤4 years. Direct effects are discussed in the soils section. Indirect and cumulative effects are modeled in WATSED.
Salvage Harvest	minimal	The proposed action would remove dead, dying, and high-risk lodgepole pine, most of which would be lost to mountain pine beetles with no action. Indirect and cumulative effects are modeled in WATSED.
Fuels Reduction and Site Preparation	minimal to none	Monitoring of similar projects reported that there were no detrimental impacts to channels (SW39). These activities are covered by INFS RHCAs and RMOs.
Reforestation	benefit	Openings >2 acres in salvaged stands would be reforested with early seral species, would trend watersheds toward desired conditions.

Direct, indirect, and cumulative effects of the proposed action are discussed with respect to watershed condition, water quality and beneficial uses, water yield, and stream channel conditions. These effects are displayed in a simplified tabular format in project file document SW40.

Watershed Condition

The proposed action would directly affect the vegetative condition of the area in the relative short term by removing lodgepole pines trees and in most cases by converting from a high-risk stand to a younger, more vigorous stand. Temporary road construction would also decrease canopy cover, in addition to altering hillslope morphology and hydrologic functioning over the short term. Indirect effects of canopy reductions could be slightly elevated water yields over the short term with recovery to existing condition within 20 years (see *Water Yield* below). However, based upon modeling of historic wildfires on the IPNF and in the Northern Rocky Mountains, the proposed level of vegetative change and resulting water yield would be well within the historic range of variation (USDA, 2002b, West Gold Final EIS, IPNF, pp. III-8 - III-11; McCaughey et al., 1997).

Table 6 displays cumulative equivalent clearcut area (ECA) as calculated by WATSED for several scenarios. The existing condition was modeled solely as the result of all previous harvest and existing roads for the year 2005. The no action condition was modeled to estimate the existing mortality and expected lodgepole pine losses over the next 10 years in the proposed action stands only. The proposed action was modeled as if road construction, salvage harvesting and fuels treatment/site preparation were completely implemented in 2005 and recovery was modeled as if temporary roads had recovered hydrologic function the following year (SW32).

Table 6. Equivalent Clearcut Area Predicted by WATSED

Watershed	Existing Condition	No Action	Proposed Action	Recovery from Proposed Action*	Year of Water Yield Recovery*
Broadaxe Creek	8.3%	15.7%	16.5%	9.4%	2024
Gold Creek	11.2%	12.4%	12.5%	11.3%	2009

*Recovery was assumed to occur when model output for water yield and peak flows both returned to their existing (pre-Broadaxe salvage) levels.

No riparian areas would have new entry because the RHCA buffers for priority watersheds would be imposed; therefore, non-lodgepole pine canopy would be retained and would continue to mature to provide stream shading and in-stream woody debris recruitment (see *Water Quality and Beneficial Uses* below). Stream channels in the analysis area are primarily transport-type and are therefore unlikely to be adversely affected by the minor, short-term predicted water yield increases (see *Water Yield* below).

The model output is somewhat speculative for all scenarios because canopy loss due to lodgepole pine mortality across the drainage could not be accurately predicted, nor could potential natural canopy recovery due to forest succession. Finally, the potential loss of additional stands due to a wildfire event is not predictable. Nevertheless, ECA less than 15% is considered low for the IPNF (SW18) and canopy openings (ECA) less than 20% are unlikely to result in measurable water yield changes (Stednick, 1995). Therefore no measureable direct, indirect or cumulative watershed effects are anticipated. No measurable effects on low flows are expected because Keppeler (1998) found that changes in base flows occurred during the late summer season only after 50% or more of a drainage was harvested.

The vegetative and fuels treatments would reduce the risk of severe wildfire effects in the Broadaxe drainage (see Vegetation and Fire/Fuels reports). This would reduce the risk of further degradation of the condition of the Gold Creek watershed. However, the proposed action would not change the Forest characterization of Gold Creek as “not properly functioning.”

Water Quality and Beneficial Uses

The proposed action is designed to maintain water quality and beneficial uses. Appropriate INFS buffers (see Design Features) and BMPs (Watershed Appendix, FSH2509.22) would be implemented to prevent sediment generation or movement from proposed activities into streams. The overall effectiveness for all BMPs is expected to be high (Lynch and Corbett, 1989 & 1990; Seyedbagheri, 1996; Burroughs and King, 1989; USDA, 2002a, Best Management Practices Effectiveness Monitoring Report). Road BMPs (IDAPA 20.02.01.040) appear to be effective in controlling sediment (rated little or no sediment) on 94% of the 144 miles assessed in Idaho in 2000 (IDEQ, 2001). Therefore, no measurable effects on water quality and beneficial uses from project activities are anticipated. No new point sources of discharge would be created and the characteristics that resulted in designation of the St. Joe River as an SRW would continue to be protected.

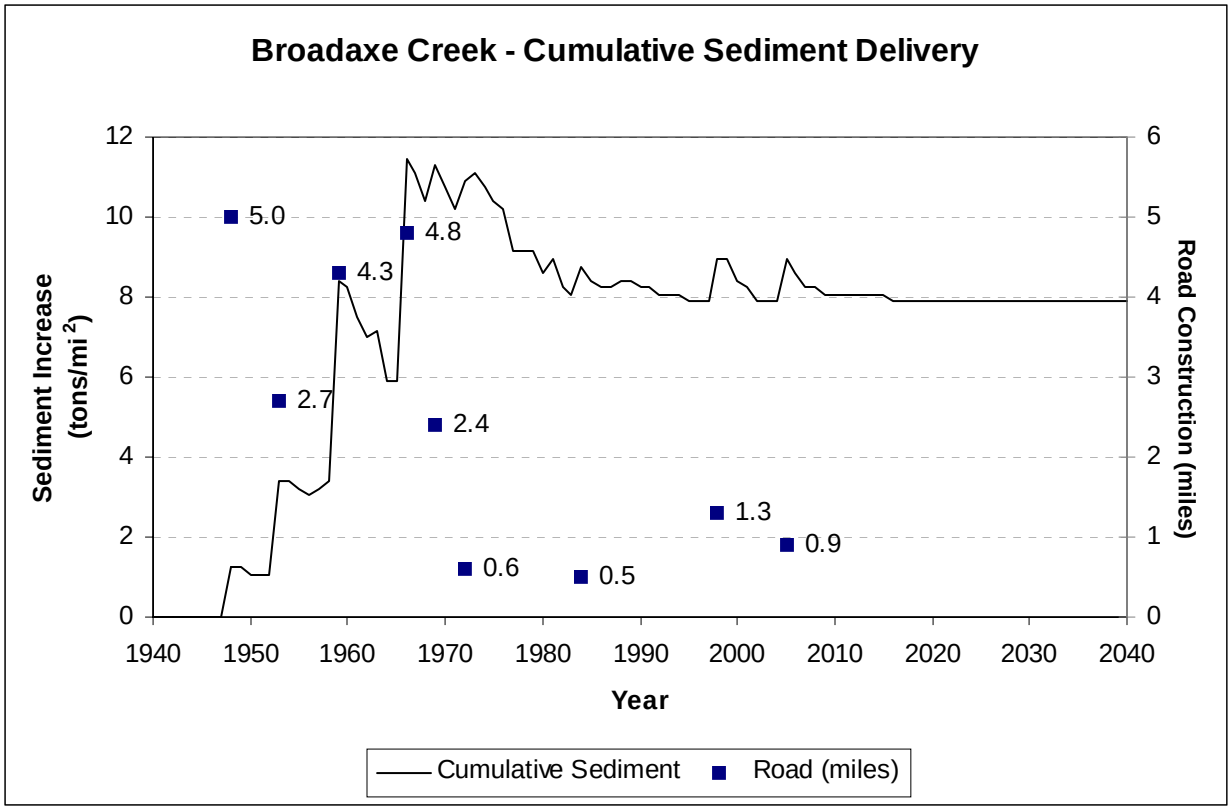
Stream Water Temperatures

The Upper St. Joe River temperature TMDL applies to 8 tributary streams (IDEQ, 2003, pp. 89-96) including Gold Creek. The TMDL is intended to lower water temperatures in these critical fisheries streams, by requiring increased stream canopy, and result in a net benefit to the St. Joe River. The proposed action would not affect the temperature TMDL or the listing of Gold Creek for thermal modifications. INFS buffers for priority watersheds would be imposed on project activities. Thermal buffering of runoff could increase, assuming no large, severe wildfires, as trees and shrubs in riparian areas continue to grow and provide shade. No project activities would occur in riparian areas; therefore, Broadaxe and Gold Creeks would be allowed to move toward their target canopy covers and support of beneficial uses. Consequently, water temperature in the St. Joe River downstream of the project area would not be affected by project activities.

Cumulative Sediment Delivery to Broadaxe Creek

The WATSED model was used to predict sediment increases to streams over natural background levels (SW22) due to previous, ongoing, and proposed management activities, assuming full implementation of vegetative and fuels treatments and temporary road construction and decommissioning. The model attributes most sediment production and sediment delivery to roads on the landscape. Therefore, there is a short spike in sediment predicted due to 0.9 miles of temporary road construction for the proposed action. The results presented in Figure 1 are cumulative from past management plus project activities.

Figure 1. WATSED Model Output for Sediment Delivery



Periods of road building coincided with timber harvests. The WATSED estimates indicate that the vast majority of existing sediment delivery to streams is the result of previous management activities in the drainage. The proposed action may cause up to a 6% increase in sediment delivered to Broadaxe Creek over the existing condition in the first few years after implementation. This indirect effect is similar to the effects of the Beetlemania salvage in 1998, which was had no effect on Broadaxe Creek (SW9 and SW27). It is predicted to abate within 11 years. WATSED also predicts a 1% increase in sediment delivery to Gold Creek following implementation of the proposed action compared to the existing condition. This indirect sediment delivery to Gold Creek is predicted to then abate to existing, minimum levels within 2 years of implementation. No direct, indirect, or cumulative sediment effects due to the proposed activities in the St. Joe River are anticipated.

The model input includes only proposed removal of lodgepole pine and associated openings and not the total natural losses that might be occurring (see Vegetation report) across the cumulative effects area. It is expected that with no action, natural canopy losses may induce slightly increased sediment levels as a result of increased water yields. Without treatment, potential wildfire effects in the dead lodgepole stands (see Fire/Fuels report) would be expected to induce significantly more erosion and sediment delivery than either the proposed salvage or unmanaged mortality alone (Robichaud and Brown, 1999).

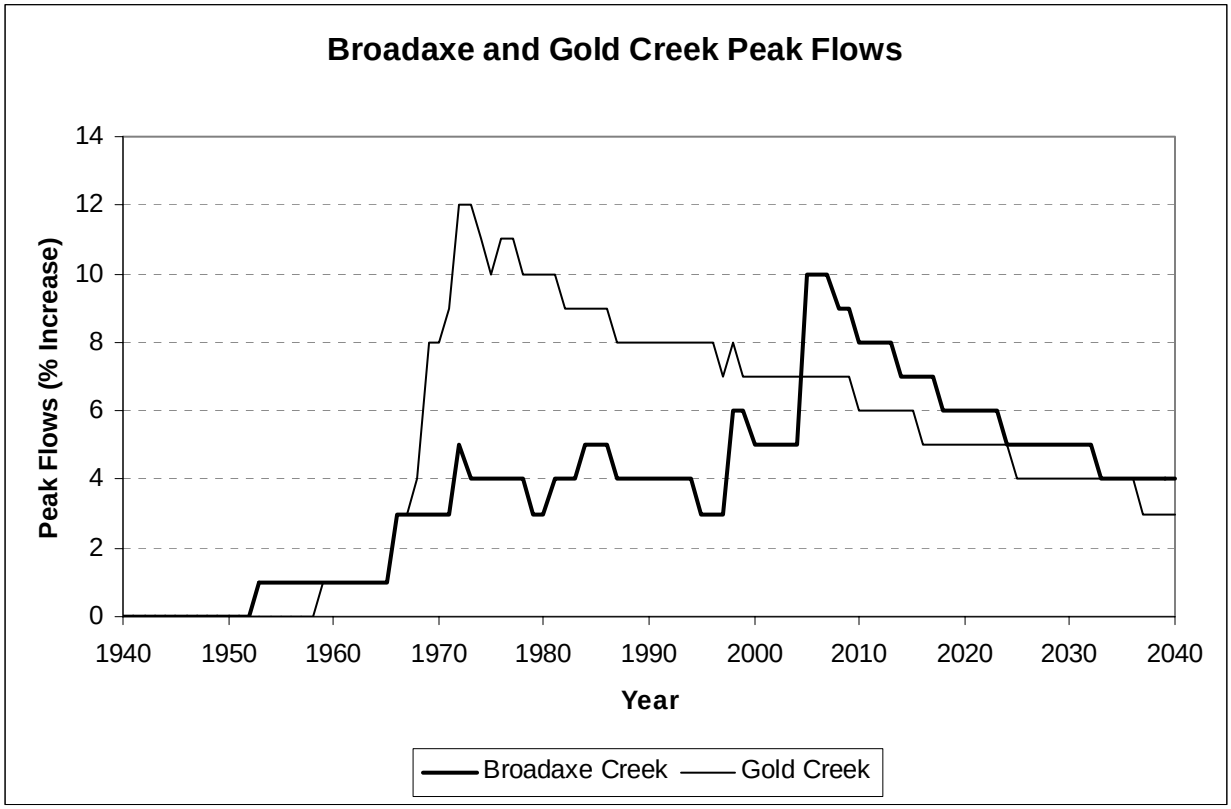
Because WATSED is a deterministic model, any harvest, fire, or road will generate and deliver sediment. Also the model has no recovery component for unused forest roads, so sediment levels will never decrease to natural background levels while there are roads on the landscape, whether they are closed, completely overgrown forest roads or open dirt roads. Based on experience with the WATSED model in this area, all riparian roads must be removed to achieve sediment levels less than 20% above background. It should be noted, however, that Forest Plan monitoring has shown that WATSED outputs for sediment delivery are consistently higher than measured suspended and bedload sediment (GR16, IPNF 2000 Forest Plan Monitoring and Evaluation Report, p. 26-27).

Research has shown unchannelized sediment rarely travels more than 300 feet (GR3, InFish EA/DN/FONSI, p. A-5). In addition, standard practices for timber harvesting and roads have been shown to be moderately to highly effective in conserving soil and water quality (Seyedbagheri, 1996; IDEQ, 2001). Ground-based harvest and temporary road construction would not occur within 300 feet of any perennial or intermittent stream channel. Monitoring shows that hydrologic recovery from these types of ground-disturbance occurs within three to five years (Hickenbottom, 2001; Redente et al., 1994). Therefore, even though onsite erosion rates may increase over the short term in 1% of the drainage (see Soils report), no detectable additional contribution of sediment to streams due to harvest-related ground disturbance is anticipated.

There are no sediment load reduction requirements for any upper St. Joe streams (IDEQ, 2003, pp. 134-135). Twelve miles of county-administered FH 50 run through the watershed cumulative effects area. The highway was included in the WATSED modeling and therefore cumulative effects from county activities have been considered. It is expected that highway maintenance activities will continue to be in compliance with state roads rules, Army Corps of Engineers permitting of roads activities, and state water quality standards, and that beneficial uses will continue to be supported in the St. Joe River.

Water Yield

The WATSED model was used to predict cumulative water yield, peak flow, and peak flow duration increases due to past and present management plus complete implementation of proposed project activities (SW30). The proposed salvage was modeled to represent the predicted openings plus intermediate removals not anticipated to create openings. Figure 2 shows the model results for peak flows in Broadaxe and Gold Creek. The water yield effects of lodgepole pine mortality with no action or a potential severe wildfire could not be realistically modeled.



With implementation of the proposed action, peak flow increases over the short term could be 5% higher than the existing condition in Broadaxe Creek. However, natural climate variations can result in flows 50% greater than the cumulative increases predicted for this project (SW23). In addition, Stednick (1995) found that canopy openings greater than 20% were required to produce measurable water yield increases. Cumulative ECA is a conservative over-estimate of canopy openings, because partial canopy removals are included. Management-induced ECA would not exceed 17% (Table 6, SW32); therefore, no detectable water yield increases due to project activities are anticipated.

In Gold Creek, no significant increase in water yield or peak flows was predicted, however recovery of peak flows to minimal levels from the existing 7% above background could be delayed several years by project activities (SW32). WATSED predicts recovery in both Broadaxe and Gold Creek to ≤5% above background for annual water yield within 13 years, and for peak flows within 19 years, of project activities. At that level, watershed effects due to management activities would be highly unlikely (SW34). WATSED predicts peak duration increases due to proposed activities ≤20%

(SW32); therefore, no negative effects due to extended peak flows are expected (Patten, 1989). No water yield effects are expected in the St. Joe River downstream of the project area.

In the no action alternative, losses of lodgepole pine to beetle kill would result in conditions similar to the live tree density and canopy cover estimated for the proposed action. Therefore, natural changes in the no action alternative would likely result in indirect water yield increases at least one half as high as those predicted for the proposed action. Finally, periodic wildfires that were common in northern Idaho forests over long timeframes may have resulted in peak flow increases almost twice as high as those predicted for the cumulative effects of this project (USDA, 2002b, West Gold Final EIS, IPNF, pp. III-8 - III-11). Broadaxe Creek has resilient channel types and high transport capacities, therefore, in-stream effects from changed water yields and peak flows in either case, except a large, severe wildfire, are expected to be inconsequential (see *Stream Channels* below).

Rain-on-Snow Peaks

The proposed salvage units and temporary road are all well above the sensitive snow zone. In addition, the openings created by the proposed action would not be significantly different than the openings anticipated due to beetle kill in the no action alternative. Therefore, no direct or indirect effects from rain-on-snow events are anticipated due to project activities. Cumulative effects in the sensitive snow zone under either alternative could change due to canopy recovery from past and proposed harvest, canopy loss due to lodgepole pine mortality, canopy recovery due to vegetative succession, and potential additional losses due to wildfire.

Stream Channels

RHCA buffers on project activities would ensure that riparian areas and stream channels are not subjected to any direct effects from harvest or fuels treatment activities. Indirect effects would also be substantially moderated by the presence of these buffers. Channels in the project area are inherently likely to accommodate minor fluctuations in sediment and water yield (Rosgen, 1997, pages 4-6; Montgomery and Buffington, 1997). The level of vegetative treatment proposed in the project area would result in small estimated magnitudes of water and sediment increases relative to those induced by the local climatic fluctuations (and related natural disturbances, such as severe wildfires) under which these channels evolved (MacDonald and Hoffman, 1995) and which would continue to occur with or without implementation of the proposed salvage. Therefore, there would be very little difference between the effects of the proposed action and no action, particularly in the event of a sever wildfire.

Despite the previous watershed-scale management, Broadaxe Creek has remained relatively stable (SW19). The proposed project is higher in the drainage and is more restricted than most previous management. Therefore, no measurable change is expected in the channel of Broadaxe Creek. The predicted changes in water and sediment yield could alter flow regimes in Broadaxe Creek. However, these changes are unlikely to decrease channel stability (Patten, 1989, p. 27) or to measurably impact existing stream channel conditions in the project area (Schumm, 1977, p. 129; Leopold et al, 1964, pp. 80-94 and 248; Gordon, 1992, pp. 298-301, 334-339; Gordon, 1995, p. 24). It is unlikely that short-term peak flow increases from harvest would be sufficient to increase in-channel erosion or decrease existing pool volumes because sediment supply would not likely exceed transport capacity (Montgomery and Buffington, 1997). Spring and mid-winter floods due to climate fluctuations (temperature and precipitation) are more likely to cause channel changes than

management effects. Project activities would not occur in the sensitive-snow zone, therefore flood levels should not be measurably affected by implementation.

At the cumulative effects scale, a short-term, 1% increase in total sediment and a delay in water yield recovery in Gold Creek are highly unlikely to affect the channel. The lower 1.6-mile reach of Gold Creek is already impacted by gravel aggradation and is inherently more sensitive to disturbance. Given that total water yield modifications in Gold Creek are substantially less than model estimates for previous years (12% peak increases in the 1970s) and that the channel substrate is primarily coarse material, it is unlikely that the channel in this reach would change from its existing condition with implementation of the proposed action. Because cumulative in-stream effects would be negligible, no impacts to Gold Creek or the St. Joe River due to proposed activities are anticipated.

Consistency with Forest Plan and Other Laws and Regulations

IPNF Forest Plan Standards

State Water Quality Standards protective of beneficial uses and long-term watershed productivity would be maintained with implementation of any alternative.

State standards for sediment and chemical constituents would continue to be met.

Idaho Forest Practices Rules (IDAPA 20.02.01) would be incorporated into any activities in the project area (Watershed Appendix, FSH 2509.22).

In-stream flows would be maintained with any alternative.

There are no public water systems that would be affected by any project activities.

Physical integrity of streams and existing biota would be maintained or improved with any alternative.

Models have been used in conjunction with field data, monitoring results, research, and professional judgment to refine estimated effects of proposed activities and to make recommendations for management alternatives, design criteria, and mitigation measures.

INFS Standards and Guidelines and RHCA buffers would be implemented with any alternative and would limit ground disturbance on floodplains and in riparian areas. Unmapped channels would be buffered 100 feet from project activities during sale layout.

INFS requirements for flood passage would be implemented with any action alternative.

Project activities are consistent with management area direction to implement Best Management Practices.

Wild & Scenic Rivers Act

All alternatives comply with requirements of the Wild and Scenic Rivers Act for “Recreational Rivers.”

Clean Water Act & State of Idaho Implementation

The no action and proposed action alternatives would maintain the chemical, physical, and biological integrity of the streams in the project area, in adherence with 33 U.S.C. §1251. The proposed action would not impact the 1998 303(d) listing of Gold Creek for sediment, temperature, nutrients or habitat alteration.

Sediment: There are no sediment load reductions required in the Gold Creek drainage. Indirect, short-term sediment generated by project activities in Broadaxe Creek would not reduce water quality or impair beneficial uses in Gold Creek (Idaho Code § 39-3601; 40 CFR 131.12).

Temperature: In compliance with TMDL requirements (IDEQ, 2003, p. 94-96), thermal modifications in the Upper St. Joe River sub-basin would not be exacerbated. RHCA buffers on salvage units would allow riparian corridor canopies to recover to levels established for Gold Creek and its tributaries.

Nutrients: There are no nutrient load reductions required in the Gold Creek drainage. Nutrient levels in Gold Creek and its tributaries would be unaffected by project activities.

Habitat Alteration: Aquatic habitat conditions would not change in Broadaxe or Gold Creek with implementation of the proposed action.

The proposed action would comply with the Idaho Water Quality Standards (IDAPA 58.01.02) for Special Resource Waters and would adhere to the Antidegradation Policy to provide water quality protective of existing uses (IDAPA 58.01.02.051).

Executive Order No. 11988 and 11990, Floodplain and Wetland Protection

Project activities would not adversely affect floodplains or wetlands. No activities are proposed on floodplains. Streams that could have floodplains are buffered from activities by >300 feet. There are no mapped wetlands in the project area. Unmapped, smaller wetlands would have 100-foot RHCA buffers delineated in unit layout.

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