3

Affected Environment and Environmental Consequences

Changes in Chapter 3 Between Draft and Final EIS

Past, Present, and Reasonably Foreseeable Future Actions have been updated in Section 3.02, Table 3.02.3 displaying proposed activities on the north slope has been added and additional effects disclosed where appropriate in Chapter 3.

Tables and descriptions of water quality standards and past monitoring of water quality have been added under FEIS Section 3.1.3.2.

Table 3.1.7, water yield increases by subwatershed was added to the FEIS.

Effects under Forest Plan Guideline G9 have been added to FEIS Section 3.2.4.1

A clarification of effects on Humpy Creek has been made in FEIS Section 3.3.4.1.

The description of succession and effects of fire exclusion in spruce-fir stands is expanded in FEIS Section 3.4.3.1.

Identification of a sensitive plant species has been added to FEIS Section 3.4.3.6.

The description of effects of spruce beetles has been expanded in FEIS Section 3.4.3.7.

Effects of alternatives have been clarified in FEIS Sections 3.4.4.1 and 3.4.4.2.

Effects determinations have been added to Table 3.6.3.1.

Number of nesting bald eagles in Utah has been updated in FEIS Section 3.6.3.1.

Results of MIS monitoring have been updated with additional tables in FEIS Section 3.6.3.4.

Sections 3.6.4.01 and 3.6.4.02 with effects common to all species is added to the FEIS.

The description of effects on bald eagles has been expanded in FEIS Section 3.6.4.1.

Additional green-line transects have been included under cumulative effects of grazing in FEIS Sections 3.6.4.1 and 3.6.4.7.

Effects on northern goshawk under FEIS Section 3.6.4.2 have been clarified.

Effects on beaver under FEIS Section 3.6.4.4 have been clarified.

The description of effects on corridors has been expanded in FEIS Section 3.6.4.7.

CHAPTER 3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.01 Introduction

This Chapter summarizes the physical, biological, social, and economic environments of the project area and the effects of implementing each alternative on that environment. It also presents the scientific and analytical basis for the comparison of alternatives presented in the alternatives chapter. All significant or potentially significant effects, including direct, indirect and cumulative effects, are disclosed. Effects are quantified where possible, and qualitative discussions are also included. The means by which potential adverse effects will be reduced or mitigated are described (see also Chapter 2).

The discussions of resources and potential effects take advantage of existing information included in the Wasatch-Cache Forest Plan Revision FEIS, project-specific resource reports and related information, and other sources as indicated. Where applicable, such information is briefly summarized and referenced to minimize duplication. The project record for the West Bear Vegetation Management project includes all project-specific information, including resource reports, the watershed analysis, and other results of field investigations. The record also contains information resulting from public involvement efforts. The project record is located at the Evanston Ranger District Office in Evanston, Wyoming, and is available for review during regular business hours. Information from the record is available upon request.

3.02 Analyzing Effects

Environmental consequences are the effects of implementing an alternative on the physical, biological, social and economic environment. The Council on Environmental Quality (CEQ) regulations implementing the National Environmental Policy Act (NEPA) include a number of specific categories to use for the analysis of environmental consequences. Several are applicable to the analysis of the proposed project and alternatives, and form the basis of much of the analysis which follows. They are explained briefly here.

Direct, Indirect and Cumulative Effects

Direct environmental effects are those occurring at the same time and place as the initial cause or action. Indirect effects are those that occur later in time or are spatially removed from the activity. Cumulative effects result from incremental effects of a proposed action, when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative effects can result from individually minor, but collectively significant, actions taking place over a period of time. Direct, indirect and cumulative effects are discussed under each of the resource values analyzed in this document. Table 3.02.1 displays past timber harvest. Table 3.02.2 displays activities that were considered for cumulative effects and the section of the EIS where they are addressed. Table 3.02.3 displays planned projects on the north slope of the Uinta Mountains that have little or no effects on the resources in the West Bear analysis area due to their distance from the project area and the scope of the proposed projects.

Table 3.02.1. Past Timber Sale Units and Fires That May Contribute to Cumulative Effects in the West Bear Analysis Area

West Bear Subwatershed				
Year	**Acres**	**Prescription**	**Sale Name**	**Forest Type**
1949	53	Clearcut	Coyote Hollow	Lodgepole
1964	6	Clearcut	Unknown	Lodgepole
1965	51	Clearcut	Pass Creek	Mixed Conifer
1966	22	Clearcut	Pass Creek	Mixed Conifer

West Bear Subwatershed				
Year	**Acres**	**Prescription**	**Sale Name**	**Forest Type**
1967	5	Clearcut	Pass Creek	Mixed Conifer
1968	20	Clearcut	Pass Creek	Mixed Conifer
1972	42	Clearcut	Unknown	Lodgepole
1972	17	Clearcut	Whitney Road	Lodgepole
1972	41	Clearcut	Fat Chance	Lodgepole
1973	73	Clearcut	Fat Chance	Lodgepole
1980	141	Fire	Deer Creek Fire	Lodgepole
1982	3	Clearcut	Aspen	Aspen-conifer
1993	22	Clearcut	Whitney North	Mixed Conifer
1994	125	Selection	Whitney South	Mixed Conifer
1995	512	Selection	Meadow & Humpy	Spruce-fir
1996	3	Clearcut	Gold Hill	Mixed Conifer
Ongoing	245	Thinning	Coyote Road	Lodgepole
Total	1322			
Hayden Fork Subwatershed*				
Year	**Acres**	**Prescription**	**Sale Name**	**Forest Type**
1956	35	Fire	Gold Hill	Mixed Conifer
1956	44	Clearcut	Unknown	Mixed Conifer
1956	60	Selection	Unknown	Mixed Conifer
1964	33	Selection	Unknown	Mixed Conifer
1966	19	Clearcut	Gold Hill	Lodgepole
1972	5	Clearcut	Gold Hill	Lodgepole
1973	34	Clearcut	Gold Hill	Lodgepole
1982	8	Clearcut	Aspen	Aspen-conifer
1990	11	Clearcut	Aspen	Aspen
1994	52	Clearcut	Gold Hill	Lodgepole/aspen
1996	14	Clearcut	Gold Hill	Mixed Conifer/aspen
Total	315			

* This table includes only those past harvest units and fires that are in the portion of the Hayden Fork subwatershed that is within the general analysis area. There are an additional 326 acres of past harvest units in other portions of the Hayden Fork subwatershed that were included in the water yield analysis in EIS Section 3.1.3.5 and fire and fuel's analyses in EIS Section 3.5.4.

Table 3.02.2. Past, Present, and Reasonably Foreseeable Future Actions that May Contribute to Cumulative Effects in the West Bear Analysis Area

Activity	These Activities are Addressed Under the Following Sections of the EIS
Past Harvest (See Table 3.02.1)	3.1.3.5, 3.1.4.02, 3.1.4.3, 3.2.3.2, 3.2.4.1, 3.2.4.2, 3.4.3.3, 3.4.4.4, 3.6.4.02, 3.6.4.1, 3.6.4.2, 3.6.4.3, 3.6.4.4, 3.6.4.5, 3.7.4
Ongoing Harvest (See Table 3.02.1)	3.1.4.02, 3.1.4.3, 3.5.4.1, 3.6.3.1, 3.6.4.02, 3.6.4.1, 3.6.4.2, 3.6.4.3, 3.7.4, 3.8.4
Beetle Infestation (Primarily mountain pine beetles in the lodgepole pine cover type. See Maps #10 and #11.)	3.4.3.1, 3.4.3.4, 3.4.4.1, 3.4.4.2, 3.5.4.1, 3.6.4.1, 3.6.4.2, 3.6.4.4, 3.7.4, 3.8.4
Past Fires (Deer Creek and Gold Hill Fires. See Map #16)	3.4.4.4, 3.6.3.1, 3.6.4.7
Existing Roads (See Maps #15 and #16).	3.03, 3.1.3.1, 3.1.4.02, 3.1.4.1, 3.1.4.2, 3.2.4, 3.3.4.1,

Activity	These Activities are Addressed Under the Following Sections of the EIS
	3.3.4.4, 3.4.4.3, 3.6.4.02 3.6.4.1, 3.6.4.3, 3.6.4.5, 3.6.4.6, 3.6.4.7, 3.7.4.3, 3.8.4.1, 3.8.4.4
Grazing (Four sheep allotments including Meadow Cr., Gold Hill, Humpy Cr., and West Fork Bear.) See Range Report, 4/1/2005, (Zobell 2005a) and EIS Sec. 3.6.4.1	3.1.4.02, 3.2.4.1, 3.2.4.2, 3.3.3.3, 3.5.4.1, 3.6.4.1, 3.6.4.2, 3.6.4.3, 3.6.4.4, 3.6.4.5, 3.6.4.6, 3.6.4.7
Groomed Snow Trails (Hwy 150 and the Whitney Road from Hwy 150 to Whitney Reservoir.)	3.6.4.1, 3.6.4.2, 3.7.4
Dispersed Recreation (See Maps #14 and #15 and EIS Section 3.8)	3.1.4.02, 3.2.4.1, 3.2.4.2, 3.3.4.1, 3.3.4.4, 3.4.4.3, 3.6.4.02, 3.6.4.1, 3.6.4.2, 3.6.4.3, 3.6.4.6, 3.6.4.7, 3.7.4, 3.8.4
Whitney Reservoir Operations	3.1.3.1, 3.1.4.02, 3.3.4.1, 3.6.4.7
Fish Stocking (West Bear and Hayden Fork)	3.3.3.3, 3.3.4.1, 3.3.4.2, 3.3.4.3, 3.6.4.7
Main Fork Well (Being drilled in the Main Fork drainage about 1.5 miles east of the east boundary of the analysis area.)	3.6.4.7
Private Land Activity (Ongoing and potential subdivision and timber harvest north of the Forest Boundary. See EIS Section 3.6.4.7)	3.03, 3.6.4.4, 3.6.4.6, 3.6.4.7
Energy Development	3.6.4.7

Table 3.02.3. Proposed Activities on the North Slope of the Uinta Mountains That Do Not Contribute to Cumulative Effects in the West Bear Analysis Area

Activity	Location
Taylor Fork / Cedar Hollow ATV Access	Weber Drainage on Kamas District
Little Elk Lake ATV Loop	Mirror Lake Highway on Kamas District
Gourley Meadows Fuel Break	Smiths Fork Drainage, 25 Miles Northeast
Dahlgreen Aspen Treatment	Dahlgreen Drainage, 30 Miles East
Thunderbug Timber Sale	Gilbert Creek Drainage, 25 Miles Northeast
Lower Sage Aspen Treatment	Sage Creek Drainage, 30 Miles Northeast
Roadside Salvage Timber Sale	Kamas District, 10-20 Miles South
West Fork Blacks Fork Grazing Allotment	Blacks Fork Drainage, 10 Miles East

Unavoidable Adverse Effects

Implementation of any action alternative would cause some adverse environmental effects that cannot be effectively mitigated or avoided. Unavoidable adverse effects often result from managing the land for one resource at the expense of the use or condition of other resources. Many adverse effects can be reduced, mitigated or avoided by limiting the extent or duration of effects. The interdisciplinary procedure used to identify specific harvest units and roads was designed to eliminate or lessen the significant adverse consequences. The application of Forest Plan standards and guidelines, Best Management Practices, project-specific mitigation measures, and monitoring are all intended to further limit the extent, severity, and duration of potential effects. Such measures are discussed throughout this chapter. Regardless of the use of these measures, some adverse effects will occur. The pupose of this chapter is to fully disclose these effects.

Short-term Use and Long-term Productivity

Short-term uses, and their effects, are those that occur annually or within the first few years of project implementation. Long-term productivity refers to the capability of the land and resources to continue producing goods and services long after the project has been implemented. Under the Multiple-Use Sustained-Yield Act, and the National Forest Management Act, all renewable resources are to be managed in such a way that they are available for future generations. The harvesting and use of standing timber can be considered a short-term use of a renewable resource. As a renewable resource, trees can be reestablished and grown again if the long-term

productivity of the land is maintained. This long-term productivity is maintained through the application of the resource protection measures described in Chapter 2, in particular those applying to the soil and water resources.

Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species or the removal of mined ore. Irretrievable commitments are those that are lost for a period of time such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line rights-of-way or road. See Section 3.12 for a description of irreversible and irretrievable commitments of resources.

Available Information

Much of the Wasatch-Cache National Forest resource data resides in an electronic database formatted for a geographic information system (GIS). The Forest uses GIS software to assist in the analyses of these data. GIS data is available in tabular (numerical) format, and as plots displaying data in map format. For this EIS, all of the maps and much of the numerical analyses are based on GIS resource data.

There is less than complete knowledge about many of the relationships and conditions of wildlife, fish, forests, jobs and communities. The ecology, inventory and management of a large forest area is a complex and developing science. The biology of wildlife species prompts questions about population dynamics and habitat relationships. The interaction of resource supply, the economy, and communities is the subject matter of an inexact science. However, the basic data and central relationships are sufficiently well established in the respective sciences for the deciding official to make a reasoned choice between the alternatives, and to adequately assess and disclose the possible adverse environmental consequences. New or improved information would be very unlikely to reverse or nullify these understood relationships.

3.03 Other Resources

Several resources and uses of the project area are likely to remain unaffected by the proposed action or alternatives, or will not be affected to a significant degree. Even though significant effects are not anticipated, most of these resource are discussed in the sections of this chapter which follow the introduction, to the extent that measurable effects or differences between alternatives are present. Resources or uses for which no measurable effects were identified are discussed briefly here.

Air Quality

Both of the action alternatives will have limited, short-term effects on ambient air quality. Vehicle emissions and dust are likely to be indistinguishable from other local sources of airborne particulates, such as other motor vehicle emissions and dust from recreational traffic. Forest Service considerations for air quality usually relate to effects created by burning vegetative materials. Short-term negative effects to air quality can sometimes occur from prescribed burning projects, wildland fire use, or wildfires. For timber harvest and prescribed fire projects there can be short-term effects from burning slash and other vegetation. Prescribed fires are usually initiated when there is little if any risk of burning beyond what is intended.

The 1990 Clean Air Act provides legal direction for air quality. States were given a key role monitoring air quality so that it meets acceptable standards. National Forest lands in the State of Utah are classified as Class II attainment areas through application of the Clean Air Act. Forest Service burning activities associated with burning slash must comply with applicable federal, state and local standards for air quality, especially the standards of State of Utah, Division of Air Quality's Utah Smoke Management Plan. The Forest Service must coordinate slash burning with the state and burn when atmospheric conditions reduce potential risks of air quality degradation. While the State of Utah does not actively monitor air quality in most places on national forests there is no evidence that air quality in the project area is below standard. In general, air quality in the Rocky Mountains is considerably better than in most other areas of the continental United States. The project area is relatively remote and far from most air-polluting population or industrial centers.

Prescribed fire is proposed on approximately 523 acres with estimated 80% effectiveness resulting in 418 acres burned within the project area under alternative 2 and 40% effectiveness resulting in 209 acres burned under alternative 3. During the burning period, smoke would be produced that would be visible within the project area and could drift into surrounding communities. Burning could be expected to take place over several two or three day periods. Burning would be done in accordance with State of Utah Air Quality guidelines and smoke management plans, and under conditions that would disperse smoke and minimize drift into nearby communities, meeting Forest Plan Guideline G1 to minimize the amount and impact of smoke from "fire use" activities by identifying smoke-sensitive areas, using "best available control measures," monitoring smoke impacts, and following guidance in State smoke management plans. Considering the short time of burning, the limited area, and burning only under appropriate conditions, the effects on air quality are expected to be minimal. No other prescribed fire is scheduled for this analysis area or adjacent areas so cumulative effects are also expected to be minimal.

Alternatives 2 and 3 would also be expected to increase smoke and particulate matter during the time individual slash piles are being burned. These effects will be minimized through the use of air quality guidelines and timing of burning to coincide with conditions that will maximize dispersal and insure that smoke doesn't concentrate in the project area or adjacent communities. Because of compliance with Utah Air Quality guidelines, there will be no direct, indirect, or cumulative effects on air quality.

Heritage Resources

Forest Plan standards and guidelines for the identification and protection of heritage (cultural and historical) resources apply. The project area has been surveyed for cultural properties, and all project activities have been cleared with the State Historic Preservation Officer (Utah State 2004). No proposed activities are located in or near known cultural resource properties, or within areas of a high probability of such properties occurring.

Land Status

All of the land within the West Bear Vegetation Management analysis area with the exception of two 40 acre parcels and a portion of another small parcel of private land is under National Forest ownership. Some of the National Forest roads in the area are used for access to private property (USDA FS 2005a).

Minerals

There are no known mineral occurences of commercial value within the West Bear Vegetation Management general analysis area. The area may contain potential oil and gas resources, but there are no operating wells or development proposals at this time. The proposed action would have no direct or indirect impact on mineral resources.

Access Management

The Mountain View and Evanston Districts Travel Plan was completed in 2003 (USDA FS 2003a) so analysis of access needs and changes in access were made recently under that plan. Additional analysis for the West Bear Vegetation Management Project has been conducted using a science based project level roads analysis (USDA FS 2005a). No additional public access is proposed under any of the alternatives for this project. Surfacing at a crossing of Meadow Creek on road #80324 is currently being implemented with routine road maintenance. There are two other road segments that would not be used under the West Bear Vegetation Management alternatives that need spot surfacing, additional drainage, or partial relocation to reduce watershed and aquatic resource effects. They are road #80109 on Gold Hill and Road #80310 in upper Mill City Creek. This work can be accomplished with road maintenance.

3.04 Other Required Disclosures

NEPA at 40 CFR 1502.25(a) directs "to the fullest extent possible, agencies shall prepare draft environmental impact statements concurrently with and integrated with …other environmental review laws and executive orders."

The Forest Service has consulted with Utah State Historic Preservation Office (Utah State 2005) on this project and the State Historic Preservation Officer has concurred that no historical properties will be affected by this project.

The Forest Service has consulted with the U.S. Fish and Wildlife Service (USDI FWS 2005) in accordance with the Endangered Species Act implementing regulations for projects with threatened or endangered species.

3.1 Water Resources

3.1.1 Assumptions and Methodology of Analysis

A key assumption for the analysis is that Riparian Habitat Conservation Areas (RHCA) will be in place along intermittent and perennial streams, and ponds and lakes and reservoirs and wetlands within the project area. The RHCAs will provide a buffer zone that will trap sediment that may move during project implementation and keep sediment from entering streams and water features. Documents that support the effectiveness of RHCAs include but are not limited to:

- Seyedbagheri (1996): Idaho Forestry best management practices: Compilation of research on their effectiveness. This publication cites a number of studies dealing with this BMP87—Rule 4.b.i. Design to leave areas of vegetation between roads and streams (first Alternative). Study results varied widely. Travel distances varied based on obstructions, slope, soil types, number of diversion structures, moisture accumulation and the number of cross drains. Travel distances ranged from no flows over 50 feet to no flows over 900 feet. The maximum travel distances were associated with drainage collection structures like culverts.
- Environmental Protection Agency (2005): National management measures to control nonpoint sources pollution from forestry. Streamside management area widths vary based on slope of adjacent lands. Maximum recommended widths identified as 200 feet on lands with a greater than 46% slope. Lands with no slope identify a maximum width of 50 feet. Maine Forest Service as cited in the above lists a maximum width of 165 feet. On lands with no slope the width is identified as 15 feet.

The analysis method is to present the desired conditions for water resources; described site-specific resource conditions related to water yield, water quality, wetlands, and floodplains in the analysis area; present research on potential effects of the treatments and then described specific impacts and effects of the alternatives on the water resources; describe irreversible and irretrievable commitment of resources for each alternative; and present mitigation measures that are used in the analysis. The analysis is quantified by using a water yield model for determining potential increases in water as a result of past timber harvest and of the proposed alternative treatments; presenting the slope gradient, distance from streams, and the amount of treatment area near streams and in riparian habitat conservation areas; describing the number of road crossings; and presenting the amount of wetlands affected by each alternative.

3.1.2 Existing Inventories, Monitoring, and Research Literature Review

Several sources of information are used to analyze the effects of the proposed project and alternatives. The West Fork Bear River Landscape Assessment (USDA Forest Service 2002) contains information on historic and present hydrologic cycles and stream conditions, and future desired hydrologic conditions. Field trips to the area to collect information and discuss aspects of the proposal were conducted on September 1997, October 2001, and November 2001; monitoring of timber harvest and prescribed fire use on the Wasatch-Cache NF were conducted between 2002 and 2005 in order to determine the effects on soil and water resources of timber treatments, prescribed fire use, and soil and water conservation measures that were implemented to reduce erosion and sedimentation. Riparian surveys were conducted along the West Fork Bear River in July 1993 and the streams were classified using Rosgen's classification system and stream stability surveys using Pfankuch method were conducted in August 1997. The dates of riparian, stream type and stream stability surveys and field trips related to the West Fork Bear Analysis area

are compiled in Water Resources Technical Reports (Condrat 2005; 2006). See Section 3.1.4.01 for a summary of research literature review.

3.1.3 Affected Environment

3.1.3.1. Water, Wetland, Floodplains and Riparian Features

The proposed action is located in two subwatersheds, West Fork Bear River and Hayden Fork with most of the treatment units in the West Fork Bear River subwatershed. See Map 6 in Appendix A. In the West Fork Bear River subwatershed, the proposed action treatment units are located in several drainages named Humpy Creek, Meadow Creek, upper West Fork Bear River, Lower Mill City Creek, Road and Coyote Hollow, and upper Mill City Creek. Two treatment units are located in a very small part of the Hayden Fork on the upper part of the east-facing slope on the shallow ridge between the Hayden Fork and West Fork Bear River.

The streams of the area are located in the headwater areas and the main perennial streams within the analysis area are Humpy Creek, Meadow Creek, and West Fork Bear River. The Hayden Fork stream channel is the east boundary of the general analysis area. These streams are moderately confined, gravel and cobble bed streams with willow and sedge vegetation along the stream banks. All of the streams have beaver in them and the West Fork Bear River has wide willow riparian complex with many beaver dams below Whitney reservoir. Most of the other streams in the project area are small intermittent and ephemeral streams with a few small perennial streams that are tributary to the main streams. Whitney Reservoir is a 188-acre, man-made impoundment located on the West Fork Bear River in the middle of the project area. The reservoir is used for irrigation water and the water elevation in the reservoir drops through the summer and fall seasons as irrigation water is used downstream.

Many wetlands occur in the analysis area. The main riverine wetlands occur along the West Fork Bear River below the Whitney Reservoir, along Humpy Creek, Meadow Creek, and Mill City Creek. The wetlands are mainly willow intermixed with sedges and are up to 1000 feet wide in the West Fork Bear River and several hundred feet wide in Meadow Creek. Small depressional wetlands occur in several of the drainages but mainly in the Mill City Creek drainage. Many of the depressions are 10 to 20 feet around and a few are small ponds several hundred feet in diameter. The wetlands are mostly undisturbed except at stream crossings. Just south of Unit 27, an existing road crosses about 800 feet of sedge-type wetland area and has several tracks side by side for about an average width of 24 feet. The wetland area affected by the road is about 0.44 acres in size.

Floodplains have been defined in various ways but for this analysis, these areas are defined as flat areas adjacent to streams that are composed of unconsolidated depositional material derived from sediments transported by the related stream, based on definitions contained in Fairbridge (1968). Most of the streams in the analysis area have no floodplains or very small areas adjacent to the stream where sediment may become deposited during high flows. This is because the stream gradients of most of the streams are moderate to steep and the stream channel is moderate to highly confined so that there is not much area for the streams to flow outside of their banks. In the analysis area, small floodplains occur in the low gradient meadows south of the main Whitney Road along West Fork Bear River, Meadow Creek, and Mill City Creek. The floodplains in the analysis area are not impacted except at stream crossings where fords cause some widening of the stream banks and culverts may restrict the ability to flood.

Riparian areas are found along all of the perennial streams, in wetland areas, and near small seeps and springs. Many of the riparian areas along the streams have willows and many beaver are present in the large drainages such as below Whitney Reservoir and along Meadow Creek. Most of the riparian areas are in good condition and are affected in the few places where roads cross the streams.

3.1.3.2 Water Quality

The State of Utah has designated the streams draining the Bear River watersheds above the National Forest boundary as Antidegradation Segments. This indicates that the existing water quality is better than the established standards for the designated beneficial uses. Water quality is required by state regulation to be maintained at this

level. The beneficial uses of streams within these watersheds, as designated by the Utah Department of Environmental Quality, Division of Water Quality, are:

- Class 2B – protected for recreation
- Class 3A – protected for cold water species of game fish and other cold water aquatic species
- Class 4 – protected for agricultural uses.

The numeric water quality standards can be found in Section R317-2, Utah Administrative Code, *Standards of Quality of Waters of the State* (State of Utah 2000).

In the most recent assessment of water quality, the State of Utah has determined that the waters within these watersheds that drain the West Fork Bear River analysis area fully support its beneficial uses (State of Utah 2002).

The Utah water quality standards and pollution indicators for selected parameters are shown in Table 3.1.1. Total phosphorus as P, total suspended solids, and Nitrate as N are pollution indicators for Class 2B beneficial use class. Total dissolved solids is a standard for Class 3B and Class 4 beneficial use classes.

Table 3.1.1. Water Quality Standards and Pollution Indicators for Selected Parameters.

	Acute Departure			Chronic Departure		
	3A	**2B**	**4**	**3A**	**2B**	**4**
Dissolved Oxygen (mg/l)	< 4.00			< 6.500		
Phosphorus as P (mg/l)	0.05	0.05		0.025	0.025	
Nitrate + Nitrite as N (mg/l)	4.00	4.00		4.000	4.000	
Dissolved Solids (mg/l)			1200			1200

Following Tables 3.1.2, 3.1.3, and 3.1.4 display water quality data, dissolved solids, and suspended sediments gathered over time at three sites within the analysis area. Water quality data include temperature, dissolved oxygen, nutrients (phosphorus and nitrogen) and these parameters are selected because they are indicators of disturbance in a watershed. For sediment load, dissolved solids and total suspended solids are summarized because no direct bed load sampling is known to have been conducted in the streams of the project area. Dissolved solids and total suspended solids give an indication of the dissolved ions and suspended material in the water draining the project area.

The sampling site on the Bear River was moved in 2002 from the Utah/Wyoming State Line up to a site below the confluence of the East Fork Bear River. The reason it was moved is because of easier access to the site after sampling frequency was changed from every three months to monthly. The Bear River below the East Fork Bear River sample site is an open, flowing reach composed of gravel, cobbles and boulders. Tables 3.1.2 and 3.1.3 below present data for the two sites on the Bear River. The Hayden Fork is tributary to the Bear Rive above this site. The data shows that since February 2003 no exceedances of Utah water quality standards or Pollution Indicators have occurred for all of the parameters shown in the tables. Temperature of the water ranges from 0 in the winter to 17 degrees C in the middle of the summer. Only one dissolved oxygen value was below the Utah water quality standard and this occurred in August 2002. All other dissolved oxygen values are good for cold-water fisheries. Nutrient levels are very low and are indicative of the quartzitic parent material and the young landscape of the Uinta Mountains. Dissolved solids are very low compared to the Utah standard of 1200 mg/l. Total suspended solids are low or not detected, and indicate low sedimentation of the Bear River in this area. Total suspended solids are low and no seasonal trend is seen in the data.

Table 3.1.2. Summary of Water Quality for Bear River at Utah/Wyoming State Line (STORET 4909500 Below the Confluence of the West and Main Forks of the Bear River).

Date	Temperature (degrees C)	Dissolved Oxygen (mg/l)	Phosphorus as P, Dissolved (mg/l)*	Phosphorus as P, Total (mg/l)*	Nitrogen, nitrite + nitrate as N, Dissolved (mg/l)*	Nitrogen, Nitrite + Nitrate as N, Total (mg/l)*	Solids, Dissolved (mg/l)	Solids, Total Suspended (mg/l)
4/1/1993	9.1	8.6	ND	0.022	0.049		128	0
9/15/1993	13.1	7.9	ND	0.011	ND		52	0
11/3/1993	0.4	10.9	ND	ND	0.065		86	0
10/17/1995	2.2	9.4	ND	ND	0.070		66	0
7/17/1998	14.9	7.0	ND	ND	ND		30	0
8/18/1998	11.5	8.1		ND		ND	24	0
9/24/1998	10.7			ND		ND	52	0
10/20/1998	0.6	10.5	ND	ND	ND		68	0
12/10/1998	0.0	10.3	ND	0.026**	0.138		78	0
2/25/1999	2.5	10.0	0.023	ND	0.178		98	0
3/30/1999	0.6	10.5	ND	0.033**	0.140		84	0
4/20/1999	1.5	10.8	0.023	0.024	0.106		80	0
5/4/1999	0.3	10.4	0.044	0.034**	ND		74	0
5/25/1999	2.3	10.9	0.023	0.022	ND		40	18
6/8/1999	4.1	10.6	ND	ND	ND		46	0
6/24/1999	11.9	8.3	ND	0.022	ND		22	4
9/29/1999	1.2	10.3		ND		0.100	62	0
3/20/2001				0.133***		0.170	116	0
10/16/2001	6.7	9.4		ND		0.130	84	24

* ND: Not detected.
** Chronic departure.
*** Acute departure.

Table 3.1.3. Summary of Water Quality for the Bear River Below the Confluence of the East and Main Forks (downstream from Hayden Fork, Main Fork and Stillwater Fork) of the Bear River (STORET 4909850).

Date	Temperature (degrees C)	Dissolved Oxygen (mg/l)	Phosphorus as P, Dissolved (mg/l)*	Phosphorus as P, Total (mg/l)*	Nitrogen, nitrite + nitrate as N, Dissolved (mg/l)*	Nitrogen, Nitrite + Nitrate as N, Total (mg/l)*	Solids, Dissolved (mg/l)	Solids, Total Suspended (mg/l)
7/17/2002	15.5			ND		ND	70	ND
8/13/2002	17.0	6.2**		ND		ND	74	7.6
9/15/2002			ND	0.032**	ND	ND	126	ND
9/18/2002	6.0	9.8		0.040**			56	ND
10/16/2002	7.0	8.9				ND	64	ND
2/24/2003	0.5			0.012		0.160	86	4.0
3/24/2003	0.5	10.7		ND		0.110	80	4.0
4/28/2003	2.0	11.0		ND		0.150	72	ND
5/27/2003	5.5	9.9		ND		ND	40	ND
6/23/2003	5.0	9.8		ND		ND	34	10.0
7/24/2003			ND	0.020	ND		46	6.0
8/20/2003			0.032	ND	ND		66	7.6
9/23/2003			ND	ND	0.100		70	ND
10/21/2003			ND	ND	ND		84	ND
11/18/2003			ND	ND	0.150		88	ND
1/27/2004	0.0	10.1		ND			104	ND
2/17/2004	0.0			ND			98	ND
3/23/2004	3.0	11.0		ND			84	ND
4/19/2004	1.0	12.7		ND		0.160	66	ND
5/18/2004	5.0	7.6	ND	ND	0.160		34	ND
6/29/2004	8.0	15.8	ND	ND	0.100		38	ND
7/6/2004	9.5	8.1	ND	ND	0.170	0.110	38	ND
8/2/2004	14.0	7.4		ND		ND	48	ND
9/7/2004	12.5	7.5		ND		ND	78	ND
10/7/2004	4.0	10.2		ND		0.150	72	ND
11/2/2004	0.0	9.7		ND		0.140	94	ND
12/6/2004	0.0	9.4		ND		0.170	68	ND

Date	Temperature (degrees C)	Dissolved Oxygen (mg/l)	Phosphorus as P, Dissolved (mg/l)*	Phosphorus as P, Total (mg/l)*	Nitrogen, nitrite + nitrate as N, Dissolved (mg/l)*	Nitrogen, Nitrite + Nitrate as N, Total (mg/l)*	Solids, Dissolved (mg/l)	Solids, Total Suspended (mg/l)
1/3/2005	0.0	8.6		ND		0.150	74	ND
3/14/2005	0.0	9.9		ND		0.150	88	7.6
4/11/2005	0.7	10.0		ND		0.150	94	10.4
5/9/2005	2.9	10.0		ND		0.190	66	4.8
6/7/2005	2.7	9.5		ND		0.130	40	ND
7/13/2005	9.9	7.0		ND		ND	14	ND
8/2/2005	10.9	8.6		ND		ND	18	ND
8/4/2005	16.3	7.0		ND	ND		20	ND
9/7/2005	10.7	7.5		ND		ND	48	ND
10/3/2005	6.3	8.2		ND		ND	68	ND
10/20/2005	6.4	10.0	ND	ND	0.130		64	ND
11/15/2005	0.0	10.2		ND		0.210	90	ND
12/14/2005	0.0	14.9						
1/18/2006	0.3	11.0						
2/8/2006	0.0							

* ND: Not detected.
** Chronic departure.

Most of the parameters meet Utah water quality standards or Pollution Indicators for water sampled at the West Fork Bear River below Whitney Reservoir. See Table 3.1.4 below. The range of values for temperature and dissolved oxygen values are good for cold-water fisheries and have no water standards exceedances. Since 1993, phosphorus values have exceeded water quality standards twice in June and once in January. The exceedances in June may be the result of sediment carried in the water during high spring runoff, especially since the stream flows through an extensive beaver complex that is located above the sampling site. Beaver complexes usually have areas of bare soil along and behind the dams. Nitrogen is very low and is indicative of the low nutrients in the quartzitic parent material. Total dissolved solids are low and are relatively constant throughout the year. Total suspended solids are low and no seasonal trend is seen in the data.

Table 3.1.4. Summary of Water Quality for the West Fork Bear River Below Whitney Reservoir (STORET 4909550).

Date	Temperature (degrees C)	Dissolved Oxygen (mg/l)	Phosphorus as P, Dissolved (mg/l)*	Phosphorus as P, Total (mg/l)*	Nitrogen, nitrite + nitrate as N, Dissolved (mg/l)*	Nitrogen, Nitrite + Nitrate as N, Total (mg/l)	Solids, Dissolved (mg/l)	Solids, Total Suspended (mg/l)
7/14/1993	9.5	9.1	ND	ND	0.105		118	0.0
9/1/1993	6.2	9.2	ND	0.012	0.223		160	3.0
2/16/1994	0.2	10.2	0.010	0.011	0.301		220	3.0
6/8/1994	5.4	8.7	ND	ND	0.179		176	0.0
2/28/1995	0.1	10.0	ND	0.014	0.217		196	3.0
6/22/1995	2.4	9.4	0.050	0.030**	0.510		130	28.0
8/23/1995	17.7	8.3	0.010	0.020	0.100		184	10.0
4/10/1996	1.1	9.3	0.010	0.020	0.350		206	6.0
6/26/1996	6.0	9.8	ND	0.010	0.250		178	4.4
10/16/1996	1.2	10.3	0.014	ND	0.070		184	0.0
7/8/1997	17.9	7.0	0.019		0.140		144	0.0
9/9/1997	14.0	9.0	0.040		ND		132	10.4
11/13/1997	0.2	10.2		ND	0.220		244	0.0
6/13/2000	9.2	8.7	ND	0.028**	0.100		150	0.0
7/12/2000	14.3	6.5	ND	ND	0.100		122	22.4
9/7/2000	11.9	9.3	ND	ND	ND		208	0.0
1/3/2005	0.0	7.5		0.031**		0.170	234	15.6
3/14/2005	0.0	8.4		ND		0.200	222	ND
4/11/2005	1.0	9.3		ND		0.170	232	ND
6/7/2005	3.6	8.8		0.018		0.200	136	14.8

* ND: Not detected.
** Chronic departure.

3.1.3.3 Hydrologic Characteristics

Snowmelt dominates the hydrology of the West Fork Bear River and Hayden Fork subwatersheds, although occasional summer thunderstorms occur in the area. The monthly mean water flow ranges from almost no flow to 28.4 cfs (cubic feet per second) in the West Fork Bear River just below Whitney Reservoir at USGS gauging station #1001200. The monthly mean water flow ranges from 11.2 to 195 cfs in the West Fork Bear River below Deer Creek at USGS gauging station #1001400 near the confluence with the main stem of the Bear River. Peak flows occur between May and July. The area has developed with a common genesis of landforms of older age glacial till and the bedrock geology is primarily of limestone, resulting in deep, fine-textured calcareous soils. Large beaver dam and willow complexes are found along many of the streams and these provide areas for sediment deposition. Groundwater flows are important with many springs and seeps occurring throughout the Whitney area. Deep water-bearing aquifers supply drinking water for wells located down stream. Most slope aspects are northerly and cool which tends to delay snowmelt. These slopes tend to be low energy resulting in low evapotranspiration rates and generally good soil moisture.

3.1.3.4 Water Features in Relation to Proposed Treatment Units and Road

Some of the proposed treatment units have small water features and some of the proposed temporary and intermittent roads cross streams as noted in the remarks column in Table 3.1.1.

Table 3.1.5. Summary of water features related to proposed treatment units and roads.

Harvest Unit				Distance to Stream (feet)	Remarks
Unit #	Alt 2 Area (acres)	Alt 3 Area (acres)	Slope (%) Gradient		
Humpy Creek drainage					
2	19	---	20-40	300	1,200’ of north edge of unit borders the 300 foot buffer of the Humpy Creek RHCA (category 1 RHCA).
3	44	---	12-38	300	1,100’ of north edge of unit borders the 300 foot buffer of the Humpy Creek RHCA 1.
5	18	---	4-28	100	Intermittent streams (category 4 RHCA) are located southeast and northwest of unit 5. Three small areas (total of 200’ long) border the 100 foot buffer of the stream RHCA. There would be two intermittent service road crossings of an intermittent stream on the southwest end of Unit 5.
6	21	---	3-19	100	200’ of north edge of unit borders the 300 foot buffer of the Humpy Creek RHCA 1 and 1,000’ of southeast edge of unit borders the 150 foot buffer of the stream RHCA 2 of a perennial tributary of Humpy Creek. This tributary also has an intermittent service road crossing.
Meadow Creek					
7	28	28	21	400	Unit not adjacent to RHCA.
8	16	16	22	500	Unit not adjacent to RHCA.
9	13	13	9-35	150	200’ of east edge borders the 150 foot buffer of the stream RHCA of perennial tributary (category 2 RHCA) to Meadow Creek. 100’ buffer (category 4 RHCA) adjacent to pond .

Harvest Unit				Distance to Stream (feet)	Remarks
Unit #	Alt 2 Area (acres)	Alt 3 Area (acres)	Slope (%) Gradient		
10	16	16	10	150	600' of north edge of unit borders the 300 foot buffer of the RHCA of Meadow Creek (category 1 RHCA) and 300' of east edge borders the 150 foot buffer of the stream RHCA of perennial tributary (category 2 RHCA) to Meadow Creek.
11	169	149	17-46	150	800' of northwest edge of unit borders the 150 foot buffer of the stream RHCA (category 2 RHCA) of perennial tributary to Meadow Creek. Under Alternative 2, the north part of Unit 11 has seeps that surfaces and creates moist soil conditions. Under Alternative 3, this area is taken out of the unit.
12	57	57	11-25	350	Maintain 100' intermittent stream buffer (category 4 RHCA) on east side. North of Unit 12, an existing maintenance level 2 road fords 3 small intermittent streams (category 4 RHCA).
13	11	11	8-19	100	Unit adjacent to 100' buffer of intermittent RHCA (category 4 RHCA).
14	8	8	11-17	450	Unit not adjacent to RHCA. North of Unit 14, an existing maintenance level 2 road fords a small intermittent stream (category 4 RHCA).
15	25	25	16-24	1000	Unit not adjacent to RHCA.
16	8	8	4-36	100	Unit not adjacent to RHCA. Southeast of Unit 16, an existing maintenance level 2 road fords a small, wet area at the head of an intermittent stream (category 4 RHCA).
26	14	---	5-20	100	1,250' of north edge of unit borders the 300 foot buffer of the stream RHCA (category 1 RHCA) of Meadow Creek and 200' of east edge of unit borders the 100 foot buffer of the stream RHCA of intermittent tributary (category 4 RHCA) to Meadow Creek.
Whitney (West Fork Bear River)					
17	21	21	10-40	500	South edge of unit is about 150 feet from3 small ponds (category 4 RHCA).
18	22	---	15	100	200' of northeast edge of unit borders the 100 foot buffer of the stream RHCA of intermittent tributary (category 4 RHCA) to Meadow Creek.
19	6	---	13	100	About 200' of the north edge borders the 100 foot buffer of the intermittent stream RHCA (category 4 RHCA).
20	42	42	32	300	900' of east edge of unit borders the 300' RHCA buffer of perennial fish-bearing tributary (category 1 RHCA) to Whitney Reservoir. South of Unit 20, the maintenance level 2 road that is along the north side of Beaver Lake (category 3 RHCA) is very rutted and is within a wetland area.
21	6	6	5	300	50' of southeast edge of unit borders the 300' RHCA buffer of perennial fish-bearing tributary (category 1) to Whitney Reservoir.
22	10	10	15	300	900' of north edge of unit borders the 300' RHCA buffer of perennial fish-bearing tributary (category 1) to Whitney Reservoir.

Harvest Unit				Distance to Stream (feet)	Remarks
Unit #	Alt 2 Area (acres)	Alt 3 Area (acres)	Slope (%) Gradient		
23	7	7	6	200	Unit not adjacent to RHCA.
24	80	54	5-38	100	Southeast corner adjacent to intermittent RHCA (category 3 RHCA).
25	53	45	5-38	100	North side adjacent to intermittent tributary (category 4 RHCA).
27	22	---	6-37	300	Maintain 100' RHCA north of unit. South of Unit 27, the maintenance level 2 road is very rutted with many tire tracks side-by-side and is within a wetland area (category 4 RHCA).
33	60	60	10-15	700	Unit not adjacent to RHCA.
34	41	41	24	1,300	Unit not adjacent to RHCA.
35	161	104	9-42	1,700	Unit not adjacent to RHCA.
Lower Mill City Creek/ Road Hollow/ Coyote Hollow					
29	---	19	10-35	150	Portions of east side adjacent to intermittent RHCA (category 4 RHCA).
30	47	43	9-18	100	Portions of east side adjacent to intermittent RHCA (category 4 RHCA).
31	19	19	23	200	Unit not adjacent to RHCA.
32	65	28	12-24	150	Portions of east side adjacent to intermittent RHCA (category 4 RHCA).
36	56	56	9-29	700	Unit not adjacent to RHCA.
37	19	19	11-18	700	Unit not adjacent to RHCA.
Mill City Creek/ Hayden Fork					
41	43	65	8-20	300	Unit not adjacent to RHCA.
42	47	417	0-17	5,000	Unit adjacent to pond (category 4 RHCA buffer applies).
43	75	---	0-15	2,000	Unit not adjacent to RHCA.
Hayden Fork					
44	120	---	0-30	1,200	Unit not adjacent to RHCA.
Note: Slope gradient was determined by measuring contour lines on topographic maps. The symbol "---" denotes that no treatment is occurring in the unit.					

3.1.3.5 Past Timber Harvest Water Yield Increases

Estimates of water yield increase are made for the past treatments and the alternatives for subwatersheds in the analysis area (See Table 3.02.1). For past harvest within the analysis area, the initial amount of water yield increase from clearcut harvest, partial cut, and prescribed fire use is estimated to be 3.0 inches. Using these values as the amount of increase expected from the proposed harvest treatments in Alternatives 2 and 3, an estimate of the amount of annual water yield increase are shown in Table 3.1.3.

Past timber harvest has increased water yields from the West Fork Bear River and Hayden Fork subwatersheds and estimates of increased water yield has been modeled for these subwatersheds. As shown in Table 3.1.3, a small amount of the West Fork Bear River, the area that drains into Whitney Reservoir, and the Hayden Fork, have had timber harvest and estimates for the percent increases of the total water yield for the three basins from past timber harvest are 0.6, 0.2, and 0.03 respectively.

Table 3.1.6. Water yield increases for past harvest by drainage (See Appendix A, Map #16).

Drainage	Area (acres)	Annual Discharge[1] (acre-feet/year)	1) Water yield increase in 2005 (acre-feet) 2) Percent of water yield from drainage basin 3) Treatment area (acres) 4) Percent of treatment area within drainage basin	
			Past Harvest	
West Fork Bear River Subwatershed	36,479	34,991	1) acre-ft	194
			2) %	0.6
			3) acres	1322
			4) %	3.6
West Fork Bear River above Whitney Reservoir	4,347	6,171	1) acre-ft	10.6
			2) %	0.2
			3) acres	91
			4) %	2.1
Hayden Fork Subwatershed	16,407	30,713[1]	1) acre-ft	83
			2) %	0.3
			3) acres	621
			4) %	3.8

[1] Data is summarized from USGS gage stations #10011400, #10011200 with the exception of Hayden Fork. Since no stream gage is on the Hayden Fork, this value was determined by proportioning using the area of the subwatersheds and the amount of annual discharge from the East Fork Bear subwatershed.

3.1.4 Environmental Consequences

This section describes the potential effects of timber harvest, road construction, and prescribed fire including the direct, indirect, and cumulative effects for each alternative for runoff quantity, timing, and peak flow; water quality; and wetlands and floodplains. The analysis area for these effects on water resources is expanded from the general analysis area to include the entire West Bear and Hayden Fork subwatersheds. The method of analysis is a description and an assessment of the likelihood of the direct and indirect effects on water resources and their cumulative effects in combination with past, ongoing, and reasonably foreseeable future actions. The analysis includes a description of the individual harvest units and their proximity to water resources, an assessment of the rates of sedimentation; and recommended mitigation measures that are expected to reduce sedimentation.

3.1.4.01 Review of Research on the Potential Effects to Water Resources from Timber Harvest, Road Construction, and Prescribed Fire

Timber Harvest has the potential to affect water resources in several ways. It can cause changes in runoff quantity, timing, and peak flow, and changes in water quality, particularly sediment, temperature, dissolved oxygen, and chemical concentrations.

In snow-dominated regions, increases in water yield due to forest harvest occur on the rising limb of the hydrograph consistently in May and sometimes in June with no detectable changes in the rest of the runoff season. The largest runoff occurs during the wettest years and while smallest increases occur in the drier years (Troendle and Nankervis 2000).

For this analysis, it is thought that using water yield increase values from research studies would give a better estimate of the amount of water increase that may occur instead of using a specific model to indicate the potential increase. This analysis will not include an ECA analysis because there are other factors that should be considered in assessing affects of water yield on streams and research (Bettinger and Johnson 1998) indicates that ECA analysis may not be a good proxy for predicting sediment and that several factors need to be considered in assessing cumulative effects of timber harvest.

Troendle and Nankervis (2000) reviewed the current state of the art knowledge on the effects of forest disturbance water yield for the Central Rocky Mountain Region. They state that research has shown that in the snow zone, forest removal results in greater snow pack accumulation; reduction in interception loss by the forest canopy; reduced evapotranspiration; less soil-water depletion on site; changes on stream flow with greater flow occurring on the rising limb of the runoff hydrograph, only consistently occurring in May and sometimes in June with no detectable change in the balance of the season; and the largest seasonal increases occurring in wettest years while the smallest increases occurring in dry years (Troendle and Nankervis 2000). Research has shown that water yield increase for small clearcuts is consistently about 3.0 inches across most experimental watersheds (Troendle and Nankervis 2000). Research by Troendle (1987) on a 100-acre experimental watershed in Colorado indicates that about 3.5 inch increase in water yield was realized from a partial cut over a three-year period (average about 1.2 inches per year) with over half of the increased flow attributed to increased snowpack accumulation (Troendle and Nankervis 2000).

USEPA researchers (Fulton and West 2002) reviewed the impacts of forestry activities on water quality and several key points were made. Researchers have concluded "there is the potential for forestry operations to adversely affect water quality if best management practices (BMP) are poorly implemented. ... Sediment concentrations can increase due to accelerated erosion, water temperatures can increase due to removal of overstory riparian shade, slash and other organic debris can accumulate in water bodies depleting dissolved oxygen, and organic and inorganic chemical concentrations can increase due to harvesting and pesticide applications. … These potential increases in contaminants are usually proportional to the severity of site disturbance … Impacts of silvicultural non-point source pollution depend on site characteristics, climatic conditions, and the forest practices employed."

Temporary roads have the potential to modify natural drainage networks and accelerate erosion processes that may result in increased stream sedimentation, degraded aquatic habitats and altered channel morphology. Road impacts increase as they become more hydrologically connected to the natural channel network (Jones and Grant 1996). Roads and their drainage systems typically act to intercept surface and subsurface runoff and route excess runoff into the channel system (Hauge et al. 1979; Megahan 1972), resulting in both increased stream flows (Harr et al. 1975) and increased sediment delivery to streams (Wemple et al. 1996). Especially in steep terrain, roads increase the rate of hill slope failures and soil mass wasting (Swanston and Swanston 1976; Swanston 1991). Fine sediments can be delivered to natural streams by erosion of road surfaces as well as from non-vegetated road cut and fill surfaces (Reid and Dunn 1984). Roads impact aquatic habitats by limiting fish passage through culverts at road-stream crossings (Furniss et al. 1991) and increasing fine sediment in spawning gravels which in turn reduces dissolved oxygen levels and sub-surface stream flow and results in reduced spawning success by salmonids (Bjornn et al. 1991; Phillips et al. 1975). Some of the effects of roads can be mitigated by design changes that disperse, rather than concentrate road runoff by gravel surfacing (Burroughs and King 1989; Furniss et al. 1991), seasonal road closures to protect roads without gravel surfaces from use during adverse weather, or by designating undisturbed protective buffers along streams to allow filtering of fine sediments (Roby et al. 1977). The effectiveness of streamside buffers generally increases with width, but the impacts of large-scale or chronic disturbances can still impact streams, even with relatively wide and intact buffer strips.

Researchers (Fulton and West 2002) also reviewed the effects of prescribed fire on water quality and several conclusions were reached. They found that "prescribed fire can impact water quality by heating the soil and killing soil organisms, thereby altering nutrient transformation rates and bioavailability. These impacts depend upon the severity and intensity of the fire. Prescribed burning of slash can increase erosion and sediment delivery to streams by eliminating protective cover and altering soil properties. …The degree of erosion after a prescribed burn depends on soil erodibility; slope; precipitation timing, volume, and intensity; fire severity; cover remaining on the soil; and speed of revegetation." They also stated "the following management measures were identified as ways to reduce the magnitude of the effects of fire on water quality: (1) limit fire severity, (2) avoid burning on steep slopes, and (3) limit burning on sandy or water repellent soils."

3.1.4.02 Effects and Mitigation Common to Action Alternatives

Several potential effects from timber harvest, construction and use of temporary roads, skid trails, and landings and prescribed fire use could occur as described in the review of research above. Research (Fulton and West 2002) has shown that the amount of adverse effects to water quality can be influenced by:

1. Amount of soil disturbance
2. Amount of ground cover on the soil
3. Amount buffer that exists to act as a filter between upland areas and water bodies (stream channels, lakes, and ponds)
4. Amount of accumulation of slash and organic debris in water bodies
5. Removal of overstory riparian shade
6. Introduction of organic and inorganic chemicals from harvesting and pesticide applications.

Several of these influences listed above are mitigated by the type of harvest and standard operating procedures that are used for harvest operations, road construction and maintenance, and prescribed fire use. The influences that are mitigated are the amount of soil disturbance, amount of ground cover on the soil, amount of accumulation of slash and organic debris in water bodies, and the introduction of organic and inorganic chemicals from harvesting and pesticide applications. These are mitigated because under selective harvesting the amount of soil disturbance low; branches and leaves of cut trees are spread on the harvest unit to provide ground cover protection; slash is not left in stream channels and no pesticides or herbicides are used; and prescribed fire will occur when soils are moist, under higher relative humidity, and the topography of prescribed fire areas is not steep.

Monitoring on the Wasatch-Cache NF of timber harvest and prescribed fire has shown that these activities can be accomplished with very little effect on soil and water resources. Timber harvest that took place in the West Fork Bear River subwatershed was monitored in October 2001 near Humpy Creek and in July 2004 in Coyote Hollow showed that skid trails and intermittent roads had dense vegetation growing on them and no signs of erosion or sediment movement. These areas were treated similar to those that are in this timber treatment proposal. Another timber harvest area was monitored in Slideout Canyon east of Logan, Utah. This timber treatment was a clearcut and an intermittent service road was built in the canyon. Monitoring showed that slash was scattered across the harvest units as a best management practice to provide ground cover; the skid trails have revegetated quickly; no sign of erosion has been seen on the skid trails or across the harvest units; the drainage dips in the road were working properly to remove flowing water from the road and the road has remained in very good condition for several years; and no sediment movement to stream channels has been observed.

Monitoring of prescribed fires at Rock Creek and along Highway 150 near Samak, Utah in 2003 and 2004 showed that very little erosion and sedimentation occurred from these fires. The places where erosion and sedimentation did occur were in areas of steep slopes and high burn severity. A wildfire that occurred in Shepard Canyon in late October burned in a manner that would have been in a prescription for a prescribed fire. The results of monitoring showed that the following year showed that most of the burned area was low to moderate burn severity and vegetation grew back quickly. The only evidence of accelerated erosion and poor vegetative recovery was in a small area of high burn severity on a moderately-steep hillslope.

Cumulative Effects – Cumulatively, there is not expected to be a measurable effect to water quantity or quality from Alternatives 2 or 3 in combination with past and ongoing timber harvest and road construction because the amount of additional water yield is not expected to be measurable, the amount of sedimentation of streams or other water bodies is expected to be very low and segments of existing roads with poor drainage or poor locations are being improved or relocated. The other activities in the analysis area that may affect water quality include private land development, grazing, Whitney Reservoir operations, and recreation uses such as ATV use, camping, fishing, and hiking.

A subdivision is being developed north of the Forest Boundary and adjacent to the general analysis area in the Hayden Fork subwatershed near its confluence with the Stillwater Fork. Cumulative effects from this development would include a very slight increase in water yield. It is uncertain how much clearing will be done in this

development, but assuming 10 acre per lot with 31 lots, there could be about 310 acres of clearing. Each lot has a designated 10 acre building site. The effects of this on water yield would be an additional 0.3% for a total of 0.7% water yield increase in the Hayden Fork, which would be immeasurable. Effects on water quality are also expected to be minimal. Summit County has been very involved in the subdivision and would be responsible for ensuring acceptable septic siting.

A rangeland report (Zobell 2005a) discloses results of seven monitoring studies of ground cover conditions that have been established within the analysis area. Three of the six monitoring studies indicate that ground cover conditions are meeting the Forest Plan standard (S7). Of the remaining four studies, three indicate a trend towards the standard. No trend is indicated for one study not meeting Forest Plan standard (S7). A greenline transect established on Mill City Creek in 1999 shows a very high (99.6%) late seral species composition. Additional greenline transects were added in Meadow Creek Study #15-11 (with 92.4% late seral species and Meadow Creek Study #15-14 (with 93% late seral species) in 2005. A greenline transect (Study #15-25 with 98% late seral species) was established on the West Fork Bear River and Study #15-26, (photo points on Beaver Lake outlet stream with estimated 98% late seral species) were added in the West Fork of the Bear River subwatershed in 2006. The action alternatives do not include any treatment in riparian habitat conservation areas, so the effects of grazing have little if any interaction with the alternatives.

There are no irrigation ditches within the analysis area. Water stored in Whitney Reservoir is managed for irrigation after peak runoff in late June and July. The riparian corridor along the West Bear remains intact on the Forest except for the area occupied by Whitney Reservoir and two road crossings. This reservoir has little impact on downstream water quality and serves to settle out some sediment during spring runoff.

ATV use has significantly increased over the past 10 years, creating additional problems as people travel off designated routes. Enforcement of the recently implemented Mountain View and Evanston Travel Plan should reduce the effects of this use.

Water quality monitoring conducted since 1993 has shown that water from the West Fork Bear River subwatershed fully meets its beneficial uses for drinking water, cold-water fishery and aquatic life, and livestock use. Water quality is not expected to be adversely affected by these alternatives and the water in this area is expected to continue to meet state water quality standards and not be degraded.

Irretrievable and Irreversible Commitment of Water Resources – No irretrievable and irreversible commitment of water resources is expected because water would be protected from sedimentation and temperature changes through best management practices such as establishment of buffer zones and installing proper road drainage.

3.1.4.1 Wetlands and Floodplains

Alternative 1 – No Action

There would be no change to wetland conditions from those described in the existing conditions. There would be no change to conditions of the floodplains in the analysis area.

Alternative 2 – Proposed Action

Most wetlands would not be affected by Alternative 2 and improvements to wetlands would occur from road realignment. The wetland area south of Unit 27 would be improved by rerouting the road along a hillside north of the wetland and rehabilitating about 800 feet of road that is currently within a wetland. Several tracks are side-by-side for an average width of about 24 feet and the amount of wetland improved would be about 0.44 acres. There would be no change to conditions of the floodplains in the analysis area.

Cumulative Effects

Cumulatively, a small improvement in wetland condition within the West Fork Bear River subwatershed is expected since many wetlands occur in the watershed, no adverse effects are expected to wetlands as a result of the

treatments, and wetlands south of Unit 27 will be improved by rerouting an existing road out of the wetlands. No wetlands are affected in the Hayden Fork subwatershed.

Alternative 3 – Reduced Roads

There would be no direct or indirect effects to wetland conditions from those described in the existing conditions because they will be avoided by equipment during treatment operations and mitigation to control sedimentation such as leaving adequate amounts of slash on the ground will minimize erosion and sediment movement. No improvement to wetlands would occur for the wetland area south of Unit 27. There would be no change from the existing conditions of the floodplains since no road crossings are expected to cross floodplains in the analysis area.

Cumulative Effects

Cumulatively, there would be no change to the amount and condition of wetlands. There are no other projects known that would change the amount or condition of existing wetlands in the analysis area. No wetlands would be affected in Humpy Creek and no improvements to wetlands along the road south of unit 27 would occur since funding of a project to realign the road south of unit 27 would not be generated from this project. No wetlands are affected in the Hayden Fork subwatershed.

3.1.4.2 Water Quality

Alternative 1 – No Action

Water quality is expected to meet State standards as it has since regular water quality monitoring in cooperation with the Utah Division of Water Quality began in 1993. No changes in sedimentation, stream temperatures, dissolved oxygen, or organic and inorganic chemical concentrations are expected since no changes in management are expected.

Alternative 2 – Proposed Action

Several factors are important for comparing the potential for adverse effects to water quality. These are:

- the potential sediment movement of the soil
- the amount of exposed soil at the ground surface
- the amount of buffer between the areas of soil disturbance and water bodies
- the amount of riparian and wetland area directly affecting the project
- the number of roads crossing streams.

Sediment modeling using the Forest Service WEPP sediment model was completed for the project area and is presented in the Soils Technical Report. The results of modeling 30-year return frequency events show a small amount (about 1 ton) of sediment delivery to streams could occur from harvest activities that occur on soil type 506 (See Table 3.2.1). This soil type occurs in many of the RHCA zones that were proposed to be harvested as part of the proposed action. After further discussion, the interdisciplinary team decided to limit treatment to areas outside of RHCAs. Adjusting the model parameters to include a 100-foot wide exclusion buffer zone between the stream and harvesting activity showed that predicted sediment delivery rates would be reduced to nothing. All harvest units will be located to meet RHCA guidelines. Therefore, very little sediment yield is expected.

The amount of exposed soil in the treatment units is analyzed by reviewing past harvest operations and prescribed fire use on the WCNF and interpreting this information in the context of the proposed action. See Soils Technical Report (Flood 2005). Field trips to similar types of projects in Dahlgreen Creek took place on June 4, 2002 and March 23, 2004. The field trips showed that, after treatment, vegetation protected the ground and no accelerated erosion was seen in the area. Reviews of other similar harvest activities in Slideout Canyon on 07/02/2003 and 08/04/2004 and at West Duck Timber Sale on the East Fork Blacks Fork on 07/28/2004 showed that skid roads

revegetate quickly and slash left on the ground provides very good ground cover for protecting soil. Review of prescribed burns along Highway 150 east of Kamas, Utah and in Rock Creek show that vegetation quickly recover and protect the site in areas that had a low to moderate burn severity. No sediment movement was seen in the prescribed fire areas in the low to moderate burn severity areas. Most of the soil in the prescribed fire use areas that have been monitored have revegetated by the following spring after the area was treated. The same response is expected to occur from the proposed project.

In considering the amount of buffer between areas of soil disturbance and water bodies, the Riparian Habitat Conservation Area is used as an indicator of an adequate buffer to protect stream conditions, provide shade for streams, and to provide a filter for sediment. All unit boundaries in the proposed action will be located to meet RHCA guidelines.

In Alternative 2, two intermittent stream and one perennial stream intermittent service road crossing would be constructed near Units 5 and 6 located south of Humpy Creek. Along the road south of Meadow Creek, five small intermittent streams would have culverts put in place, the road surface would be improved, and proper drainage installed.

In summary, a small amount of sediment may reach perennial stream channels along Humpy Creek and Meadow Creek and west side of Whitney Reservoir because the treatment units are close to the streams. Only a small amount of soil disturbance is expected because of use of BMPs such as planning treatments to avoid water quality problems, avoiding steep slopes, use of designated skid trails; based on monitoring of past recent harvest treatments, adequate ground cover will remain on the treatment sites and minimize soil erosion. As a standard operating practice, no slash or organic debris will be left in any water bodies. No organic or inorganic chemicals are expected to enter any water body because USFS best management practices allow no refueling near streams, slash is not left in water bodies, and no pesticides will be used in the treatments. In the short term, a small amount of sediment may occur from installing culverts across the five intermittent streams. Installation of these culverts will take a short amount of time and will occur when no precipitation is falling. The amount of sedimentation during installation is expected to be very small. Sediment from roads will be controlled through installing proper drainage that will direct sediment into buffer areas and not directly into a stream. Field reviews of timber access roads in Slideout Canyon show that properly constructed road drainage directs sediment to areas that capture the sediment and no sedimentation of stream channels occur.

With implementation of recommended mitigation measures, no adverse effects to water quality are expected since a minimum buffer of 100 feet is expected to catch sediment, if any that may move from the treatment unit and the buffer will leave vegetation in place, which will keep stream temperatures the same as existing conditions.

Cumulative Effects

A slight increase in sediment produced by stream crossings in Humpy Creek, Meadow Creek and west side of Whitney Reservoir is expected. Neither of the existing roads in the Humpy Creek drainage crosses stream channels so existing sediment production is at a low level. The realignment and improvement of drainages in the Meadow Creek and West Bear drainages should result in overall less sediment production in the West Bear drainage as a whole. There are no new stream crossings proposed in the Hayden Fork subwatershed.

Alternative 3 – Reduced Roads

In Alternative 3, adverse effects to water quality will be similar to Alternative 2, except the potential to deliver sediment to a channel, increase stream channel temperatures, lower dissolved oxygen in streams, and increase organic and inorganic chemical concentrations in streams is reduced because the potential disturbance adjacent to RHCAs is smaller. The only areas where treatment units are adjacent to RHCAs along Humpy Creek and Meadow Creek would be in RHCA Category 1 areas adjacent to unit 9 and RHCA Category 2 areas adjacent to units 9, 10 and 11. In the Whitney Reservoir drainage, only treatment units 20 and 21 would be adjacent to RHCA Category 1 areas. No adverse direct or indirect effects are expected since there will be an adequate buffer to capture any sediment that may move from the treatment areas.

Cumulative Effects

Cumulatively, there would be little change in water quality. No wetlands would be affected in Humpy Creek, but the road realignment south of units 20 and 27 would not be accomplished without a separate funding source. There are no new stream crossings proposed in the Hayden Fork subwatershed.

3.1.4.3 Runoff Quantity, Timing, and Peak Flow

Alternative 1 – No Action

The increases in water yield that have occurred from past timber activities by subwatershed are shown in Table 3.1.6. Very little change has occurred to the runoff quantity, timing and peak flow volumes because of the small amount of timber harvest that has occurred in the drainage basins. The existing water yield increase that has occurred from past timber harvest activities is expected to decrease slowly due to the regrowth of previously harvested timber stands and return to preharvest water yields in about 55 years after the last harvest.

Alternative 2 – Proposed Action

Estimates of increases in water yield are shown by subwatershed in Table 3.1.7. About 0.5 percent water yield increase over existing conditions is expected from the proposed treatments in the 36,479 acre West Bear drainage and the increase is spread over several smaller drainages within the main drainage. A small amount (0.2 percent) of increase in water yield above existing conditions is expected in the area that drains into Whitney Reservoir. This is because only 2.5 percent of the 4,347 acre area that would drain into the reservoir would be treated. Very little increase (39 acre-feet/year) in water yield over existing conditions would occur in the Hayden Fork subwatershed because the amount of treatment area is small in comparison with the subwatershed basin size of 16,407 acres.

The increases are well below the amount of increase that would be able to be measured at a gage at the mouths of the drainages. Research by Troendle and Nankervis (2000) shows that on small drainages of 100 to 193 acres, increases could be measured but in the entire drainage of 667 acres increases in water yield were not detectable. Their conclusion is that water yield does increase but at larger scales the increases become less detectable.

The timing of the increased runoff would be expected to occur in May or early June. Only a slight increase in peak flow is expected because the percent of increase in water yield for the drainages is small and the water yield is distributed in many, small drainages within the larger West Fork Bear River subwatershed and one small portion of the Hayden Fork subwatershed.

Cumulative Effects

In the West Fork Bear River subwatershed, the total water yield increase from past harvest (including the ongoing Coyote Road Hollow Timber Sale) and this alternative is estimated to be about 1.1 percent which will be immeasurable. In the Hayden Fork subwatershed, the total water yield increase from past harvest, 310 acres of private land clearing, and this alternative is estimated to be about 0.7 percent which will be immeasurable. This meets Forest Plan Guideline G5 to not allow activities that could result in water yield increases that would degrade water quality and impact beneficial uses.

Alternative 3 – Reduced Roads

For each drainage area, estimates for increases in water yield are shown in Table 3.1.3. Effects to runoff quantity, timing, and peak flow are expected to be similar to Alternative 2 except they would be slightly smaller in the West Fork Bear River drainage. In the Hayden Fork drainage, effects would be the same as in Alternative 2. In drainages that flow into Whitney Reservoir, Alternative 3 would have about 25 percent less area treated than Alternative 2 which would result in a similar decrease in the water yield increase from the treatments.

Cumulative Effects

In the West Fork Bear River subwatershed, the total water yield increase from past harvest (including the ongoing Coyote Road Hollow Timber Sale) and this alternative would be about 1.0% and would be immeasurable. In the Hayden Fork subwatershed, the total water yield increase from past harvest, 310 acres of private land clearing, and this alternative is estimated to be about 0.7% which would be immeasurable. This meets Forest Plan Guideline G5 to not allow activities that could result in water yield increases that would degrade water quality and impact beneficial uses.

Table 3.1.7. Water yield increases by subwatershed (See Appendix A, Map #s 1, 2, and 16).

Drainage	Area (acres)	Annual Discharge[1] (acre-feet/year)	1) Water yield increase in 2005 (acre-feet) 2) Percent of water yield from drainage basin 3) Treatment area (acres) 4) Percent of treatment area within drainage basin				
				Past Harvest	Private Land Clearing	Alt 2	Alt3
West Fork Bear River Subwatershed	36,479	34,991	1) acre-ft	194	0	164	149
			2) %	0.6	0	0.5	0.4
			3) acres	1,322	0	1,431	1,191
			4) %	3.6	0	3.9	3.3
West Fork Bear River above Whitney Reservoir	4,347	6,171	1) acre-ft	10.6	0	12.9	9.5
			2) %	0.2	0	0.2	0.2
			3) acres	91	0	107.4	79
			4) %	2.1	0	2.5	1.8
Hayden Fork Subwatershed	16,407	30,713[1]	1) acre-ft	83	107	39	39
			2) %	0.3	0.3	0.1	0.1
			3) acres	621	310	195	195
			4) %	3.8	1.9	1.2	1.2

[1] Data is summarized from USGS gage stations #10011400, #10011200 with the exception of Hayden Fork. Since no stream gage is on the Hayden Fork, this value was determined by proportioning using the area of the subwatersheds and the amount of annual discharge from the East Fork Bear subwatershed.

3.2 Soils

3.2.1 Assumptions and Methodology of Analysis

An erosion and sediment delivery predictive model (Flood 2005a) titled FSWEPP was used to estimate the potential detrimental effects on soils from displacement due to water erosion. A worst-case erosion scenario was modeled for a slope containing 10 foot wide designated skid trails, spaced at 100 foot intervals along the contour of the slope. Skid trail surface modeled was native forest soil with 20% rock content. Because of lower post treatment bare soil amounts, areas treated with prescribed fire are assumed to have lower erosion rates, for similar soil types, than areas containing mechanical harvest skid trails. Model runs were made for each soil type that occurs in the harvest units. Soil texture and slope characteristics were varied according to the information contained in the mapping unit description for each soil type (USDA FS 1995a). Detrimental soil erosion was considered to have occurred when predicted erosion rates, from a 6 year return period rain storm, exceeds the soil loss tolerance value (T Value) for each soil type. Soil loss tolerance values for each soil type found in the project activity areas was calculated using guidance from the National Soil Survey Handbook (USDA NRCS 2004).

Detrimental soil compaction was assumed to have occurred only on the designated skid trails, and only on soil types determined to be susceptible to soil compaction. Detrimental soil compaction was assumed to have occurred on all designated log landings regardless of soil type.

Potentially heavy amounts of woody fuels that, if burned, could result in detrimental severe soil heating, were assumed to occur only in proposed harvest units 41, 42, 43, and 44.

The effects of management activities on soil resources can be minimized by management practices and mitigation measures. Post project monitoring of the implementation of practices or measures will determine how many acres and what percent of the project are actually totally committed.

3.2.2 Existing Inventories, Monitoring, and Research Literature Review

Available soil resource information for this project area can be found in an unpublished soil resource inventory for the North Slope of the Uinta Mountains (USDA FS 1995a). See Maps 8 and 9 in Appendix A. This information was supplemented with documentation obtained by the Forest Soil Scientist during field visits to proposed harvest units and road locations and to completed harvest units from the Humpy Creek Timber Sale in August of 2004.

Several sources of material are used to analyze the effects of the proposed project and alternatives. A comprehensive listing of field trips to the area to collect information and discuss aspects of the proposal can be found on page 3 of the Water Resources Technical Report (Condrat 2005). Table 3.1.1 displays a summary of those findings. In particular, monitoring of past timber harvest activities in the area was conducted in August 2004 in order to determine the effects of the timber treatment and soil and water conservation measures that were implemented to reduce erosion and sedimentation. See Section 3.2.4.01 for a summary of research literature review.

3.2.3 Affected Environment

3.2.3.1. Soil Features

Information on specific soil types and associated properties that occur within the cutting blocks of the proposed action and its alternatives can be found in Tables 3.2.1 and 3.2.2 below.

Table 3.2.1. Soil Types in Proposed Harvest Units

Acres by Harvest Unit and Landtype Association Code (Alt 2 Acres/Alt 3 Acres)										
Harvest Unit	206 Fourmile & Senchert		207 Fourmile & Apco fine		226 Duchesne & Mirror Lake		491 Hoodle, Namon Dry & Namon		506 ACO Fine, ACO C-sk, MCA C-sk	
	Alt 2	Alt 3	Alt 2	Alt 3	Alt 2	Alt 3	Alt 2	Alt 3	Alt 2	Alt 3
2							16		3	
3							36		7	
5							14		4	
6							13		8	
7			1	1	27	27				
8			1	1	15	15				
9									13	13
10									16	16
11							140	121	29	29
12	1	1					43	43	13	13
13							8	8	3	3
14							7	6	1	1
15	1	1							24	24
16	3	3							5	5
17	7	7							14	14

Acres by Harvest Unit and Landtype Association Code (Alt 2 Acres/Alt 3 Acres)										
Harvest Unit	206		207		226		491		506	
	Fourmile & Senchert		Fourmile & Apco fine		Duchesne & Mirror Lake		Hoodle, Namon Dry & Namon		ACO Fine, ACO C-sk, MCA C-sk	
	Alt 2	Alt 3	Alt 2	Alt 3	Alt 2	Alt 3	Alt 2	Alt 3	Alt 2	Alt 3
18									22	
19									6	
20							28	28	14	14
21									6	6
22	1	1							9	9
23	7	7								
24	2	1	2	2			76	51		
25	4	1	3				48	42		
26	1						13			
27									22	
29						12		7		
30							47	43		
31					4	4	15	16		
32					37	19	28	9		
33	1	1					59	59		
34							41	41		
35							159	104		
36							56	56		
37							19	19		
41	2	2			41	63				
42					47	417				
43					75					
44					120					
Burn Only					197					

Table 3.2.2. Soil Properties

Land Type Association	Composition[1]	T- Value[2] (tons/ac/yr)	Slope %	Erosion (tons/ac/yr)				% Compactable
				30 yr	15 yr	6 yr	3yr	
206 Fourmile	0.66	2	0 to10	0	0	0	0	0
206 Senchert	0.33	5	0 to10	0	0	0	0	0
207 Fourmile	0.57	2	0 to 30	0	0	0	0	0
207 Apco fine	0.43	5	0 to 30	0	0	0	0	43
226 Duchesne	0.66	5	10 to 40	2.36	1.12	0	0	0
226 Mirror lake	0.33	2	10 to 40	2.36	1.12	0	0	0
491 Hoodle	0.55	5	4 to 30	0	0	0	0	55
491 Namon Dry	0.28	5	10 to 30	0.39	0	0	0	0
491 Namon	0.17	5	30 to 60[3]	7.83	7.66	4.87	1.44	0
506 ACO Fine	0.50	5	10 to 40	1.07	0.49	0.03	0	0
506 ACO C-sk	0.30	5	10 to 40	0	0	0	0	0
506 MCA C-sk	0.20	3	10 to 40	0	0	0	0	0

[1] Soil Map Unit Composition - The makeup of a given delineation within a soil map, in terms of different soil types that normally occur within it. Map units have one major dominant component and one or more minor components. The composition of a map unit also includes a very small amount of soil type inclusions that are not described or otherwise considered in the interpretation of the map unit.

[2] Soil Loss Tolerance Value ("T" Factor) - The maximum rate of annual soil erosion that will permit plant productivity to be sustained economically and indefinitely.
[3] No skidding will be done on slopes over 40% in this land type.

This section will summarize soil properties found in the project area in terms of the detrimental disturbances commonly associated with silvicultural practices. Detrimental soil disturbances are those processes which can alter or destroy the ability of soils to support communities of native plants, and consist of the compaction, puddling, and displacement (erosion) of mineral soil, and the displacement or destruction of litter, duff, and large woody debris.

In general, soils within the project area originated from glacial activity, and reflect the limestone and quartzite makeup of the parent rocks exposed in the upper elevations of the Whitney area. The most erodible soil types are the Mirror Lake, Duchesne, and Namon soil types with sandy loam and loam surface textures. For these soil types, inherent erodibility is primarily a function of the steeply sloping landforms that they occur upon. The soil types most prone to compaction from mechanized harvesting equipment are the Apco fine and Hoodle units (USDA Forest Service 1995b). The extent, location, and distribution of these specific soil types within the proposed cutting blocks can be found in Tables 2 and 4 in Appendix A of this report.

3.2.3.2 Detrimental Soil Effects from Past Timber Harvest Activities

Based upon recent monitoring of past timber harvest activities in the Meadow Creek and Humpy Creek drainages (See Map #16 and Table 3.02.1), very little (less than 6%) of the areas actually treated show detrimental effects to soil quality from either erosion or compaction (Flood 2004).

On August 3, 2005, the forest soil scientist conducted a field monitoring assessment of the effectiveness of required mitigation measures for the Humpy Creek timber sale harvested in 1995. Specifically, the assessment measured the aerial extent of detrimental soil disturbances associated with designated skid trails used for harvest activities. The results of that assessment are reported here in the following table:

Table 3.2.3. Humpy Creek Skid Trail Effects Monitoring

Skid Trail #	Length (paces)	Compaction (paces)	Rutting (paces)	Erosion (paces)
1	15	2	0	0
2	20	2	0	0
3	30	1	0	0
4	35	2	0	0
5	20	0	0	0

Within the monitored areas, detrimental disturbance occurred on 7 out of 120 total paces sampled. This calculates to a Total Detrimental Disturbance (TDD) of about 6% of the area.

3.2.4 Environmental Consequences

This section describes the potential effects of timber harvest, road construction, and prescribed fire and then describes the direct, indirect and cumulative effects to soil resources from each of the alternatives. The soils analysis area is the activity areas (harvest units and temporary roads) within the general analysis area. The method of analysis is a description and an assessment of the likelihood of the direct and indirect effects of detrimental disturbances to soil quality. The analysis includes an assessment of the likelihood and magnitude of detrimental soil disturbances and recommended mitigation measures that are expected to reduce or minimize the potential effects.

The analysis of the soils related effects from the proposed action and its alternatives will be done in terms of the disclosure of Total Detrimental Disturbance (TDD). The assessment of TDD considers the direct, indirect and cumulative effects of the proposed management activity, excluding the effects on the soil resource of system roads constructed as part of the proposed action (USDA FS 2003). TDD will be evaluated in terms of Forest Plan

guideline G4, which allows no more than 15% of an activity area, excluding system roads, to have detrimental soil disturbances (USDA FS 2003).

The main issues for soil resources are reductions to long-term soil productivity from detrimental soil disturbances such as erosion, compaction, and severe burning. Direct effects occur at essentially the same time and place as the activities causing them. Direct effects can reduce soil productivity by altering the physical and chemical properties that influence biologic and hydrologic functions. This can indirectly affect the ability of vegetative communities to reestablish following disturbance and to maintain growth over time. Direct effects on physical soil properties and their indirect effects on plant growth can be persistent, and therefore accumulate both temporally and spatially as future vegetation management practices occur.

The potential for soil erosion to occur as a result of proposed harvest activities has been calculated for each of the soil types in the project area using the FSWEPP soil erosion and sediment delivery modeling program. Modeling results can be found in Appendix A, "FSWEPP Modeling Results", of the soils specialist report. The potential for soil compaction to occur as a result of proposed harvest activities was interpreted for each of the soil types in the project area using known soil properties such as soil texture, organic matter content, and surface rock fragment content (USDA Forest Service 1995b). Soil compaction ratings can be found in Tables 1 and 3 of Appendix B, "West Fork Bear Timber Sale Soil Features," of the soils specialist report. The potential for severe soil burning to occur as a result of prescribed fire activities was interpreted for units with proposed burning using known soil properties such as organic matter content and topsoil thickness (USDA Forest Service. 1995c).

The activity area for the FEIS analysis of soil effects will be the timber sale treatment units. This position is supported in the R4 Soils Quality Handbook, which specifically mentions that the activity area for timber sales would be the treatment units themselves.

The proposed action project area contains harvest units that encompass, in total, about 1489 acres and prescribed burning on about 197 additional acres of National Forest System lands on the Evanston Ranger District. This will be the analysis area for the disclosure of all direct, indirect, and cumulative effects to the soil resource from the proposed action and its alternatives. Cumulative effects are limited to the treatment areas since the alternatives would have no cumulative effects on soils outside of treatment areas.

3.2.4.01 Review of Research on the Potential Effects to Soil Resources from Timber Harvest, Road Construction, and Prescribed Fire

Timber harvest practices can cause short-term reductions on soil productivity by reducing or displacing surface organic matter and large woody debris, and by displacing (eroding) and compacting mineral soils.

Research has shown that vegetation management activities such as timber harvesting and site preparation activities can have a major impact on soil physical, chemical and biological processes and functions (Harvey et al. 1987; Jurgensen et al. 1997). It has been noted that substantial losses in site productivity for 15 to 25 years following clear cutting can occur, due in part to soil compaction and displacement (Jurgensen et al. 1997). The level of disturbance to the soil will depend in part on: (1) the intensity of the treatment, (2) the type of equipment used, (3) the time of year in which the activity occurs, and (4) the amount of woody debris remaining on site following activities. Site preparation methods that increase the organic matter content in the surface soil layer can improve the physical and chemical functions and processes of the soil. Over the long term, this can increase site productivity 63 to 70 percent. Harvey et al. (1987) also recognized the importance of maintaining organic matter and other above and below ground woody material in retaining soil moisture, nitrogen fixation and ectomycorrhizal organisms, for long-term productivity and soil health.

Soil compaction is the densification of soil particles when subjected to wheel or track loading by vehicles, equipment, animals, or humans. The surface area that is driven upon during a typical harvesting operation varies with topography, with flatter terrain having a proportionately larger area driven upon at least once. Minimizing tractor traffic in harvest units can reduce the aerial extent of compaction (Alexander and Poff 1985). Alexander and Poff (1985) found that if skid trails for conventional ground-based harvesting were 100 feet apart, 11% of the harvest area would be disturbed. If skid trails are 150 feet apart, only 7% of the harvest area would be disturbed, and

if they are 250 feet apart, only 4% is disturbed. Soil compaction has been found to have no detrimental effects on soil microbial populations (Shestak and Busse 2005).

Prescribed fire can physically destroy surface organic matter. The USEPA found that prescribed fire can impact soil quality by heating the soil and killing soil organisms, thereby altering nutrient transformation rates and bio-availability. Prescribed burning of slash can increase erosion by eliminating protective cover and altering soil properties. These impacts depend upon the severity and intensity of the fire. The degree of erosion after a prescribed burn depends on soil erodibility; slope; precipitation timing, volume and intensity; fire severity; cover remaining on the soil; and speed of revegetation (Fulton and West 2002).

3.2.4.02 Effects and Mitigation Common to the Action Alternatives

Surface organic matter, such as litter and duff, provides a protective cover for mineral soil from the impact of raindrops, and also provides a porous sponge like cover that absorbs and transmits incipient water to the underlying mineral soil material. In sufficient amounts, surface organic matter can reduce both detachment of soil due to erosion, and the displacement of soil through runoff.

Large woody material is a primary source of surface organic matter in forested ecosystems. It supplies food, water, and cover for soil macro and microorganisms. These organisms contribute directly and indirectly to long-term soil productivity.

Organic matter displacement and removal occurs when litter, duff, and large woody debris is either destroyed or redistributed as a result of vegetation treatments, including prescribed fire.

Surface organic matter and large woody debris can be destroyed in a timber harvest activity area by removal of overstory trees and by slash treatment with prescribed fire. Overstory trees provide a source of shade that cools the forest floor. Removal of the overstory increases the temperature of the forest floor, increasing the activity of microorganisms that feed on and decompose surface organic matter. Overstory trees are also a source of twigs, branches, and boles that make up large woody debris. Removal of the overstory can reduce the amount of woody material available for long-term recruitment as debris.

Because prescribed fire will occur when soils are moist and under higher relative humidity, and because the topography of prescribed fire areas is not steep, none of the units proposed for this treatment will be subject to severe soil burning on a widespread basis. Small concentrations of heavy fuels are likely to occur in some portions of units 41, 42, 43 and 44 that could cause hydrophobic soil conditions under the pockets, but this effect would be temporary (2 or 3 years) and would not be likely to affect more than 1% of the activity area.

Displacement of surface organic matter and large woody debris can occur in a timber harvest area when harvest equipment turns or spins, when logging debris and slash piled for prescribed burning and site preparation, when the forest floor is removed during road, trail, and land construction, and when slash is concentrated in processing piles at log landings.

Susceptibility of a soil to litter and duff removals depends upon inherent soil fertility as a function of existing amounts of organic matter. Within the project area, all soil types have comparatively high amounts of surface organic matter and good inherent fertility. Consequently, there are no soil types with susceptibility to displacement or destruction of litter and duff. Susceptibility of soils to removal of large woody debris is somewhat independent of inherent soil properties and depends more upon the potential of specific silvicultural practices to remove woody debris from a site.

Mineral soil displacement occurs when the ground is gouged, rutted, or scraped off by timber harvest vehicles or logs during road and trail construction and yarding operations. By disturbing effective litter and plant cover, this exposes mineral soils to erosive forces such as wind and water. FSWEPP modeling results show that there would be no soil erosion on any of the soil types occurring within the proposed action harvest units, for the type of storms most likely to occur during the span of the project (6 years or less return frequency). FSWEPP modeling of 30 year return frequency storm events does show that soil erosion could occur, as a result of proposed harvest activities, on the Mirror Lake and Duchesne soils found within soil type 226. Because these kinds of storms are not likely to occur

within the time frame of harvest activity, and none of the erosion rates exceed soil loss tolerance values, and none of the units containing these soil types are within 300 feet of any stream channels, no specific erosion control practices will be needed to mitigate this effect.

Soil compaction results in a change in soil structure and pore-size distribution. Compaction reduces macroscopic pore space in the soil, reducing water infiltration and percolation. In addition, the air capacities of the soil are reduced and shear strength increased. These changes hinder root formation and establishment, which can directly reduce forest productivity. Susceptibility to compaction is most common in moist and/or medium textured soils with small amounts of surface rock.

The soil types most prone to compaction from mechanized harvesting equipment are the Apco fine and Hoodle soils found within the 207 and 491 soil types. These soil types can be found in many of the harvest units within the action alternatives. Because of the potential for widespread detrimental soil compaction to occur as a result of the proposed action, it is my recommendation that appropriate mitigation will be required to minimize the effects on long-term soil productivity. For these soil types, restricting harvest activities to the normal dry season alone will not be effective in mitigating potential soil compaction. In addition to restricting harvest to the dry season, main tractor skid roads (those receiving 3 or more passes by skidding equipment) on these soil types should be no less than 100 feet apart, except where converging.

3.2.4.1 Soil Erosion, Compaction

Alternative 1 – No Action

Direct and Indirect Effects

Based upon recent monitoring of past timber harvest activities in the Meadow Creek and Humpy Creek drainages, very little (less than 6%) of the areas actually treated show detrimental effects to soil quality from either erosion or compaction (Flood 2004). There would be no other direct disturbance of soil from silvicultural treatments or practices.

This alternative would result in very little additional detrimental soil disturbance or total soil resource commitment of the soil resource. Natural soil productivity would be maintained on at least 85% of the analysis area. Significant indirect effects from soil damage or disturbance on the ability of native vegetation communities to establish and maintain themselves would not occur as a result of this alternative.

Alternative 2 – Proposed Action

Direct and Indirect Effects

Erosion rates that exceed soil loss tolerance values were not predicted to occur on any harvest units as a result of a 6 year return period rain storm under this alternative. Erosion rates that exceed soil loss tolerance values were predicted to occur on harvest units containing the steeply sloping (40 to 60% slope gradients) Namon soils found within soil type 491. However, Forest Plan standard S1 specifically prohibits the use of ground based skidding on slopes with gradients steeper than 40%, so this level of erosion would not be seen as a result of proposed activities (USDA FS 2003). Also, because this alternative avoids ground based skidding on the steep, erosive, and unstable slopes of soil type 491, Forest Plan guideline G9 is being met. Soil erosion rates exceeding soil tolerance values could occur under this alternative, as a result of a 30 year return interval heavy thunderstorm event, in proposed harvest units 7, 8, 31, 41, 42, 43, and 44, or about 22% of the activity area (Flood 2005a). Because these kinds of storms are not likely to occur within the time frame of harvest activity, the probability of detrimental soil erosion actually occurring in these units, as a result of proposed activities, is very low. Also, because this alternative avoids ground based skidding on the steep, erosive, and unstable slopes of soil type 491, Forest Plan guideline G9 is being met. Consequently no specific erosion control practices will be needed to mitigate this effect.

Soil types that are susceptible to the effects of compaction are listed in Table 3.2.4, under this alternative (Flood 2005b). For these soil types, restricting mechanized harvest to a designated system of timber skidding trails will

reduce unmitigated detrimental soil compaction to about 13% percent of each of the 20 activity areas that contain these soil types. See Treatment Unit Disturbance Table for Alt. 2 below. Normal requirements for skidding during the normal operating season or on frozen soils are adequate protection for those landtype associations that have units not listed in Table 3.2.4. Under this alternative, because units with prescribed fire treatments will only be burned during the fall when soils are damp, none will be subject to severe soil burning.

Table 3.2.4. Treatment Unit Disturbance Table for Alt. 2

Unit #	Acres in Unit	Skid trails acres	Landings acres	% Activity Area Left Disturbed	
2	19	2.1	0.4	13	13
3	43	4.8	0.9	13	13
5	18	2.0	0.4	13	13
6	21	2.3	0.4	13	13
11	169	18.6	3.4	13	13
12	57	6.3	1.1	13	13
13	11	1.2	0.2	13	13
14	8	0.9	0.2	13	13
20	42	4.6	0.8	13	13
24	80	8.8	1.6	13	13
25	55	6.0	1.1	13	13
26	14	1.5	0.3	13	13
30	47	5.2	0.9	13	13
31	19	2.1	0.4	13	13
32	65	7.1	1.3	13	13
33	60	6.6	1.2	13	13
34	41	4.5	0.8	13	13
35	159	17.5	3.2	12	12
36	56	6.2	1.1	13	13
37	19	2.1	0.4	13	13

The proposed action would result in very little additional detrimental soil disturbance or total soil resource commitment of the soil resource. Natural soil productivity would be maintained on at least 85% of the activity area. Significant indirect effects from soil damage or disturbance on the ability of native vegetation communities to establish and maintain themselves would not occur as a result of this alternative.

Cumulative Effects

The small amount of soil disturbance and damage that would occur as a result of silvicultural activities proposed in this alternative would be cumulative to the effects of other present and reasonably foreseeable activities that have occurred, or might occur, within the harvest units proposed under this alternative. These effects include soil erosion and compaction that could occur as a result of livestock grazing and dispersed recreation activities such as camping or off road vehicle use. Based upon recent monitoring of past timber harvest activities in the Meadow Creek and Humpy Creek drainages, very little (less than 6%) of the areas actually treated show detrimental effects to soil quality from either erosion or compaction (Flood 2004). No additional timber sales in this area are scheduled in this planning period, assumed for the purpose of this analysis to run through the end of all lodgepole pine treatments (approximately 20 years).

Because of this, and the fact that none of the harvest units proposed under this alternative have been previously harvested, cumulative detrimental soil disturbances would be less than about 13% of the activity area, well within Forest Plan guidelines for Soil Quality

Alternative 3 – Reduced Roads

Direct and Indirect Effects

Under this alternative, erosion rates that exceed soil loss tolerance values were not predicted to occur on any harvest units as a result of a 6 year return period rain storm. This is because the alternative avoids placing soil disturbing timber harvest practices on any of the steep, erosive and unstable slopes that occur in the analysis area. This allows the alternative to meet direction provided under Forest Plan Standard S1 and Guideline G9. Soil erosion rates exceeding soil tolerance values could occur under this alternative, as a result of a 30 year return interval heavy thunderstorm event, in proposed harvest units 7, 8, 29, 31, and 32, or about 8% of the activity area (Flood 2005a). Because these kinds of storms are not likely to occur within the time frame of harvest activity, the probability of detrimental soil erosion actually occurring in these units, as a result of proposed activities, is very low. Consequently no specific erosion control practices will be needed to mitigate this effect.

Also under this alternative, soil erosion rates exceeding soil loss tolerance values were predicted to occur, as a result of a 30 year return period rain storm, in proposed harvest units containing the Mirror Lake and Duchesne soils found within soil type 226 (Flood 2005a). Because these kinds of storms are not likely to occur within the time frame of harvest activity, the probability of detrimental soil erosion actually occurring in these units, as a result of proposed activities, is very low. Consequently no specific erosion control practices will be needed to mitigate this effect. Soil types that are susceptible to the effects of compaction are listed in Table 3.2.5, below, under this alternative (Flood 2005b). For these soil types, restricting mechanized harvest to a designated system of timber skidding trails will reduce unmitigated detrimental soil compaction to about 13% percent of each of the 14 activity areas that contain these soil types. See Treatment Unit Disturbance Table for Alt. 3 below.

Table 3.2.5. Treatment Unit Disturbance Table for Alt. 3

Unit #	Acres in Unit	Skid trails acres	Landings acres	% Activity Area Left Disturbed	
11	150	16.5	3.0	13	13
12	57	6.3	1.1	13	13
13	11	1.2	0.2	13	13
14	7	0.8	0.1	13	13
20	42	4.6	0.8	13	13
24	54	5.9	1.1	13	13
25	43	4.7	0.9	13	13
30	43	4.7	0.9	13	13
31	20	2.2	0.4	13	13
32	28	3.1	0.6	13	13
33	60	6.6	1.2	13	13
35	104	11.4	2.1	13	13
36	56	6.2	1.1	13	13
37	19	2.1	0.4	13	13

This alternative would result in very little additional detrimental soil disturbance. Natural soil productivity would be maintained on at least 85% of the analysis area. Significant indirect effects from soil damage or disturbance on the ability of native vegetation communities to establish and maintain themselves would not occur as a result of this alternative.

Under this alternative, because the units are proposed for prescribed fire treatments only during the fall, none will be subject to severe soil burning.

Cumulative Effects

The small amount of soil disturbance and damage that would occur as a result of silvicultural activities proposed in this alternative would be cumulative to the effects of other past, present and reasonably foreseeable activities that

have occurred, or might occur, within the harvest units proposed under this alternative. These effects include soil erosion and compaction that have occurred, or could occur as a result of past harvest activities, livestock grazing and dispersed recreation activities such as camping or off road vehicle use. Based upon recent monitoring of past timber harvest activities in the Meadow Creek and Humpy Creek drainages, very little (less than 6%) of the areas actually treated show detrimental effects to soil quality from either erosion or compaction (Flood 2004). No additional timber sales in this area are scheduled in this planning period, assumed for the purpose of this analysis to run through the end of all lodgepole pine treatments (approximately 20 years).

Because of this, and the fact that none of the harvest units proposed under this alternative have been previously harvested, cumulative detrimental soil disturbances would be less than about 13% of the activity area, well within FP guidelines for Soil Quality.

3.2.4.2 Severe Soil Burning

Alternative 1 – No Action

Direct and Indirect Effects

While Alternative 1 limits direct disturbances to soils from silvicultural activities, natural disturbances will still occur. In particular, wildfires may result in direct detrimental effects to soil by removing vegetation and exposing barren soils to erosion. Also, heat from fire can physically consume or damage productive top soils. Within the spruce stands of the analysis area under average climatic conditions, wildfires are most likely to occur in small patches and as part of a larger mosaic of lightly burned and unburned areas. Under this scenario, widespread severely burned or damaged soils are not anticipated.

Alternative 2 – Proposed Action

Under this alternative, none of the units with proposed prescribed fire treatment during the fall will be subject to severe soil burning.

Alternative 3 – Reduced Roads

Under this alternative, none of the units proposed prescribed fire treatment during the spring or fall will be subject to severe soil burning.

Cumulative Effects

The small amount of soil damage that could occur as a result of future wildfires in the area would be cumulative to the effects from present activities, but is unpredictable.

3.3 Aquatics

3.3.1 Assumptions and Methodology of Analysis

A key assumption for the analysis is that Riparian Habitat Conservation Areas (RHCA) will be in place along intermittent and perennial streams within the project area. The RHCAs will provide a buffer zone that will trap sediment that may move during project implementation and keep sediment from entering streams and water features.

The analysis method is to present the desired conditions for aquatic resources (See Chapter 1.5.1.1 and 1.5.1.6) described site-specific resource conditions related to aquatic habitat in the analysis area; present research on potential effects of the treatments and then described specific impacts and effects of the alternatives on the aquatic resources; describe irreversible and irretrievable commitment of resources for each alternative; and present

mitigation measures that are used in the analysis (See Chapter 2.1.4 and 2.1.5). The analysis is partially dependent on preceding water and soil resource analysis (sediment delivered to streams and ponds from soil erosion) to determine effects of the alternatives on aquatic species. Past inventories of aquatic species are used to characterize the quantity and quality of habitat as well as fish populations.

3.3.2 Existing Inventories, Monitoring, and Research Literature Review

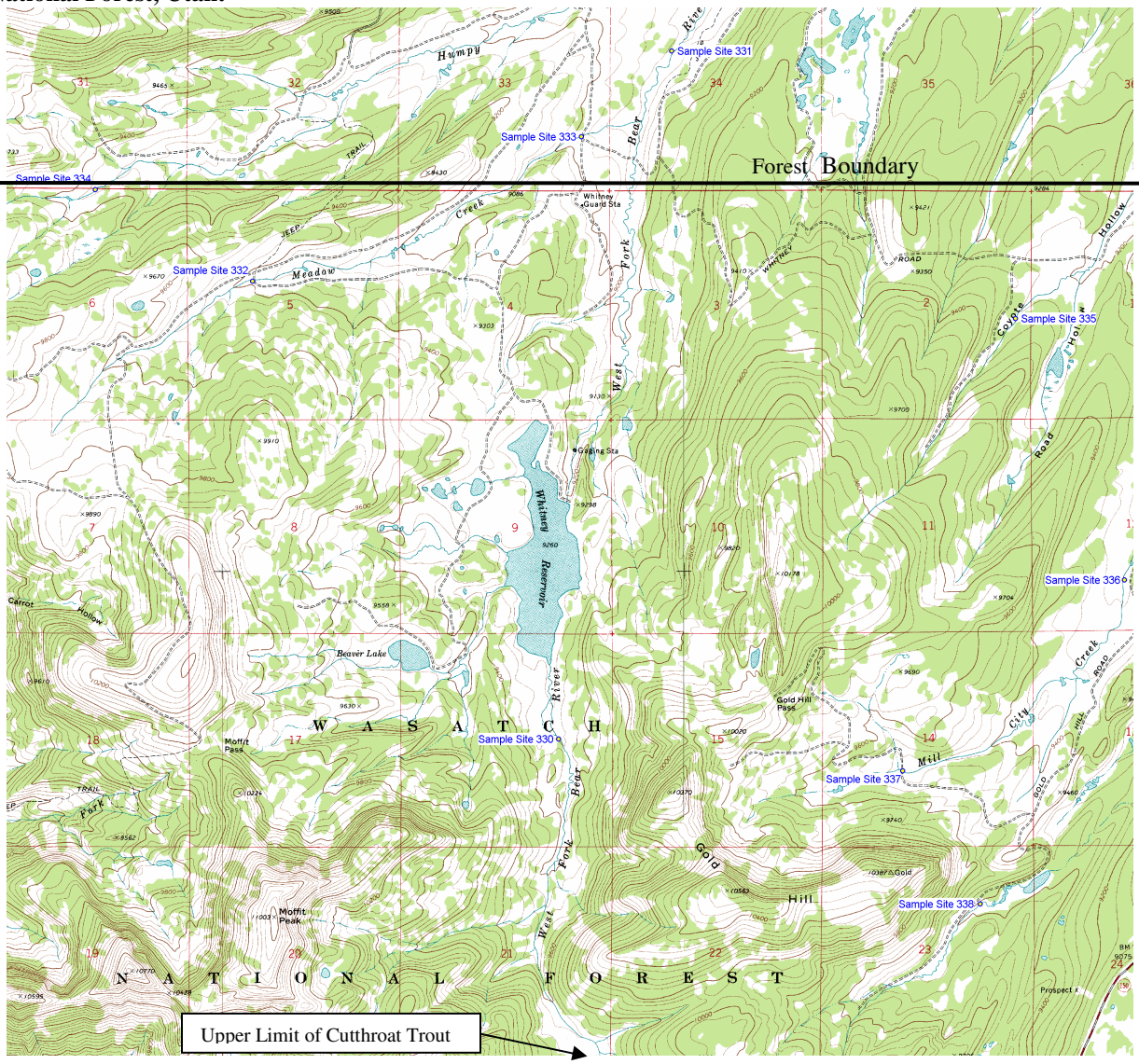
Several sources of information are used to analyze the effects of the proposed project and alternatives. Fish surveys were conducted in 1993 and 1994 in the West Bear subwatershed and an extensive survey of the Bear River drainage including the West Fork of the Bear River was conducted in 2003. Interdisciplinary site visits to look at existing conditions and opportunities were conducted in the West Bear area in 2001, 2002, and 2004. Monitoring of past management activities to determine effects of soil disturbing activities has been done in a variety of locations across the forest (See Section 3.1.2). Riparian surveys were conducted along the West Fork Bear River in July 1993 and the streams were classified using Rosgen's classification system and stream stability surveys using Pfankuch method were conducted in August 1997. Riparian, stream type and stream stability survey data and field trips related to the West Fork Bear Analysis area are described by Condrat (2005). Literature relevant to the analysis is cited throughout the following sections of the aquatic resources analysis.

3.3.3 Affected Environment

3.3.3.1 Habitat

The West Fork of the Bear River subwatershed has and continues to provide important conservation areas for Bonneville cutthroat throat. In 1993 and 1994 a habitat survey was conducted on the West Fork of the Bear River above Whitney Reservoir. Cutthroat trout were found upstream to where the stream splits into three smaller tributaries (Figure 3.3.1). A portion of the stream had dried up during the survey. The upper part of the drainage consisted of a series of riffles and small pools. The portion of the tributary from the reservoir upstream to the first conifers (approximately 3/4 of a mile) consisted of a number of beaver ponds and shallow riffles. Cutthroat trout appear to be coming out of the reservoir and moving upstream to spawn during the spring. Young-of-the-year cutthroat trout were seen throughout the stream.

Figure 3.3.1. Map of West Fork Bear River project area with fish sample sites identified, Wasatch-Cache National Forest, Utah.



The West Fork of the Bear River was divided into 5 stream reaches for the 1993-94 surveys. Habitat surveys were not conducted on the stream below Whitney Reservoir. The survey above the reservoir started at the reservoir and went upstream. Much of this area is composed of willow, sagebrush and conifers.

Reach one starts at the reservoir and goes upstream 726 meters. This reach has an average width of 2.9m and average depth of 0.4m. Reach 1 consists of 5% glide habitat, 48% pool habitat and 46% riffle habitat. The dominant substrate type is cobble with the subdominant substrate being gravel. No woody material was found within the reach. There is one ford within the reach, which needs to be corrected to prevent additional sedimentation from silting in spawning areas. There are a number of beaver dams in this reach of stream.

Reach two starts where conifers first reach the stream and goes upstream 1,401 meters to where a dry channel enters the stream channel. Water in this section ends 34m below a small dry channel enters from the left facing upstream. In 1994 this 34 meter section and an additional 495 meters above the dry tributary were also dry. Reach 2, excluding the dry section has an average width of 1.7m and average depth of 0.2m. Reach 2 consists of 49% glide

habitat, 14% pool habitat and 37% riffle habitat. The dominant substrate type is gravel. Woody material consisted of 2.4 small pieces per mile and 21.4 brush piles per mile.

Reach three starts at the dry tributary and goes upstream 945 meters of which the lower 495m were again dry in 1994. Reach 3, excluding the dry section has average width of 1.7m and average depth of 0.2m. Reach 3 consists of 37% glide habitat, 5% pool habitat and 58% riffle habitat. The dominant substrate type is cobble with gravel being subdominant. Woody material consisted of 3.6 small pieces per mile.

Reach four starts at the upstream end of reach three and goes on up for 1078m. Reach 4, had average width of 1.6m and average depth of 0.2m. Reach 4 consists of 50% glide habitat, 8% pool habitat and 42% riffle habitat. The dominant substrate type is cobble with gravel being subdominant. No woody material was found in this reach. Reach 4 has average width of 4.8m and average depth of 0.2m.

Reach five consists of 7% glide habitat, 31% pool habitat and 62% riffle habitat. The dominant substrate type is cobble with gravel being subdominant. Woody material consisted of 248 large pieces, 381 small pieces and 38 brush per mile. It should be remembered that this reach was only 88.7 meters long with an average width of 0.9m and an average maximum depth of 0.2m.

3.3.3.2 Fish Population, Species and Condition

There were eight sample sites located in the West Fork of the Bear River subwatershed on the Wasatch-Cache National Forest. Two sample sites were on the mainstem, two in Meadow Creek, one in Humpy Creek, one in Coyote Hollow, and two in Mill City Creek. Spot sampling was also conducted on the three side tributaries of Whitney Reservoir. Utah Division of Wildlife Resources also found brook trout in Road Hollow in 2004 (Personal Communication, Paul Thompson, Regional Fish Biologist, 14 July 2004).

West Fork Bear River

The West Fork Bear River was surveyed in two locations. The first location is where Forest Road 032 crosses over the stream below Whitney Reservoir. The upper section was located approximately 0.6km above Whitney Reservoir where conifers begin to make up the riparian zone. Both sections were 100 meters in length. The West Fork Bear River drains to the north and is located on the north slope of the Uinta Mountains. Activities occurring within the drainage include hunting, fishing, camping, ATV travel, grazing, and timber harvest. The Utah Division of Wildlife Resources, (Thompson 2003) sampled the mainstem West Fork Bear River approximately 12km downstream of the lower West Fork Bear River Sampling site during 2003.

The lower West Fork Bear River (sample site 331) was sampled on the 30 of June 2003 (Figure 3.3.1 and Photo 3.3.1). This was the third time this station has been sampled over the past 10 years. In total, 17 cutthroat trout, 1 brook trout, and 51 sculpin were collected (Table 3.3.1). The water temperature was 18^{o}C and the stream width was 4.3m wide and 0.17m deep. The cutthroat trout population, fish 100mm or larger, was estimated at 151 fish/km ±34. The brook trout population, fish 100mm or larger, was estimated at 10 fish/km. No brook trout were captured during the second pass so no range in the population is calculated. Sculpin were found to be abundant.

Table 3.3.1. Fish species, the number per kilometer, weight per hectare, mean total length with range, mean total weight with range and mean condition factor (K) collected for fish collected in the lower West Fork Bear River, Summit County, Utah, 2003. Mean total length (TL) and mean weight (WT) is for all fish captured not just those over 99mm in length.

Year	Species	#/km (#/mile)	Kg/ha (lb/acre)	Mean TL (mm) Range	Mean WT (g) Range	Mean K
2003	>99mm BCT	151 (243)	21 (19)	190 (79-274)	55 (4-190)	1.04
	>99mm BKT_1	10 (16)	3 (3)	216	146	1.45
	SCS	abundant				

Year	Species	#/km (#/mile)	Kg/ha (lb/acre)	Mean TL (mm) Range	Mean WT (g) Range	Mean K
2001	>99mm BCT SCS	329 (529) abundant	28 (25)	131 (42-307)	31 (1-320)	0.85
1994[2]	>99mm BCT Sculpin	682 (1,097) abundant	37 (33)	117 (41-240)	20 (1-162)	0.99

BCT= Bonneville cutthroat trout
BKT= Brook trout
SCS= Sculpin
[1]Only 1 brook trout was captured.
[2]The 2003 stream width was used to calculate a total mass for the section reach. This may or may not reflect the width during the 1994 sample.

Populations in the lower West Fork Bear River section appear to fluctuate greatly over the years, ranging from 151 BCT/km in early July 2003 to 682 BCT in 1994. This may be reflective of the dam operation on Whitney Reservoir and the release of water through this section or the difference in timing of the samples from early July to early September 2001. Fish condition looked above average in the 2003 sample with the estimated population size. Sculpin continued to be abundant. Brook trout, for the first time were found in this section in 2003. They were also found approximately 12 km downstream in UDWR survey section for the first time this year (Thompson 2003). Fertile brook trout, cutthroat trout and rainbow trout have been stocked in Whitney Reservoir by UDWR to provide for the sport fishery in the past. During the last two years (2004-2005), the UDWR has shifted to stocking sterile rainbow and tiger trout (brown/brook trout hybrid) to minimized potential impacts. This is a concern with the predatory nature of the brook and tiger trout and the size advantage they have over similar age class cutthroat trout. The difference in total production may also reflect low water years that have occurred over the past 4 years.

Photo 3.3.1. Looking downstream through the sample site for the lower West Fork Bear River, Summit County, Utah, 2003.

The upper survey section (Sample Site 330) was also sampled on the 30 of June 2003 (Figure 3.3.1). This was the second time this station has been sampled over the past 10 years. In total, 13 cutthroat trout, 2 brook trout, 9 rainbow trout and 25 sculpin were collected in the section on (Table 3.3.2). The water temperature was 10^{o}C and the stream width was 0.8m wide and 0.15m deep. The cutthroat trout population, fish 100mm or larger, was estimated at 98 fish/km ±28. The brook trout population, fish 100mm or larger, was estimated at 20 fish/km. One brook trout was captured during each pass so no range in the population is calculated. These were treated as if both were collected during the first pass to generate a population estimate per kilometer. The rainbow trout population, fish 100mm or larger, was estimated at 101 fish/km ±20. Sculpin were found to be common.

Table 3.3.2. Fish species, the number per kilometer, weight per hectare, mean total length with range, mean total weight with range and mean condition factor (K) collected for fish collected in the upper West Fork Bear River, Summit County, Utah, 2003. Mean total length (TL) and mean weight (WT) is for all fish captured not just those over 99mm in length.

Year	Species	#/km (#/mile)	Kg/ha (lb/acre)	Mean TL (mm) Range	Mean WT (g) Range	Mean K
2003	>99mm BCT	98 (158)	164 (146)	172 (54-410)	101 (2-570)	0.94
	>99mm BKT	20 (32)	22 (19)	213 (198-228)	87 (80-94)	0.91
	>99mm RBT	101 (163)	325 (290)	305 (276-334)	260 (158-338)	0.91
	SCS	common				
1994	>99mm BCT	30 (48)	3 (2)	111 (28-120)	13 (1-17)	0.91
	sculpin	sparse				

BCT= Bonneville cutthroat trout
BKT=brook trout
RBT=rainbow trout
SCS=sculpin

Populations in the upper West Fork Bear River section appear to fluctuate greatly over the years ranging from 30 BCT/km in early September 1994 to 151 BCT in 2003. This may reflect the time of year the collection was made. Fish condition look above average in the 2003 sample with the estimated population size. Sculpin were common. Brook trout and rainbow trout, for the first time, were found in this section. Brook trout and rainbow trout have been stocked in Whitney Reservoir by UDWR to provide for the sport fishery. This is a concern with the predatory nature of the brook trout and the size advantage they have over similar age class cutthroat trout. Rainbow trout are also a concern as they can crossbreed with cutthroat trout.

Meadow Creek

Meadow Creek (Sample Site 332) upper site was sampled at 9:30am on 2 July 2003. The site is located where forest road 324 crosses over Meadow Creek (Figure 3.3.1, Photo 3.3.2). The average depth was recorded at 0.1m. This was the first time this station has been sampled. In total, 13 cutthroat trout were collected in the section on the 2 of July 2003 (Table 3.3.3). The cutthroat trout population, fish 100mm or larger, was estimated at 107 fish/km ±28.

Table 3.3.3. Fish species, the number per kilometer, weight per hectare, mean total length with range, mean total weight with range and mean condition factor (K) collected for fish collected in the Meadow Creek, Summit County, Utah, 2003. Mean total length (TL) and mean weight (WT) is for all fish captured not just those over 99mm in length.

Year	Species	#/km (#/mile)	Kg/ha (lb/acre)	Mean TL (mm) Range	Mean WT (g) Range	Mean K
Upper site						
2003[1]	>99mm BCT	107 (172)	2521 (22)	151 (81-238)	46 (6-115)	1.13
Lower site						
2003[2]	>99mm BCT	123 (97)	42 (38)	174 (73-327)	81 (4-310)	1.00
	Sculpin	common				

BCT= Bonneville cutthroat trout
[1] Upper Section
[2] Lower Section

Photo 3.3.2. Survey reach for the upper section in Meadow Creek, Wasatch-Cache National Forest, Utah, 2003.

A lower site of Meadow Creek (Sample Site 333) was also sampled on 2 July 2003. The sample site is located where forest road 032 crosses over Meadow Creek and goes upstream 100m (Figure 3.3.1). A beaver dam was located within the reach sampled. The pond behind the beaver dam was approximately 1 meter deep. Also several washed out beaver dams were found within the reach. The water was 12°C during the time of sampling. The water temperature at the time of sampling was 7°C. The average stream width was measured to be 2.4m. The average depth was recorded at 0.1m. This was the first time this station has been sampled. In total, 14 cutthroat trout were collected (Table 3.3.3). The cutthroat trout population, fish 100mm or larger, was estimated at 123 fish/km ±34.

Humpy Creek

Humpy Creek (Sample Site 334) was sampled at 9:30am on 01 July 2003. The site is just where the stream leaves National Forest System land (Figure 3.3.1, Photo 3.3.3). The average stream width was measured to be 3.8m. The average depth was recorded at 0.12m. This was the first time this station has been sampled. In total, 7 cutthroat trout and 45 sculpin were collected (Table 3.3.4). The cutthroat trout population, fish 100mm or larger, was estimated at 50 fish/km. No range in population size has been calculated because no cutthroat trout were collected during the second pass.

Table 3.3.4. Fish species, the number per kilometer, weight per hectare, mean total length with range, mean total weight with range and mean condition factor (K) collected for fish collected in the Humpy Creek, Summit County, Utah, 2003. Mean total length (TL) and mean weight (WT) is for all fish captured not just those over 99mm in length.

Year	Species	#/km (#/mile)	Kg/ha (lb/acre)	Mean TL (mm) Range	Mean WT (g) Range	Mean K
2003	>99mm BCT SCS	50 (80) common	31 (28)	168 (42-269)	75 (1-184)	0.96

BCT= Bonneville cutthroat trout
SCS=Sculpin

Photo 3.3.3. Sample section on Humpy Creek that was surveyed in 2003, Wasatch-Cache National Forest, Utah.

Coyote Hollow

The stream that drains from Coyote Hollow (Sample Site 335, here after referred to as Coyote Hollow Creek, Figure 3.3.1) was sampled on 01 July 2003. The site is at the bottom end of the first meadow that the road passes through after you leave the Whitney Road (Photo 3.3.4). The average stream width was measured to be 0.4m. The average depth was recorded at 0.11m. This was the first time this station has been sampled. Eight cutthroat trout were collected with 4 being over 99mm (Table 3.3.5). The cutthroat trout population, fish 100mm or larger, was estimated at 40 fish/km. No range in population size has been calculated because no cutthroat trout were collected during the second pass.

Table 3.3.5. Fish species, the number per kilometer, weight per hectare, mean total length with range, mean total weight with range and mean condition factor (K) collected for fish collected in the Coyote Hollow Creek, Summit County, Utah, 2003. Mean total length (TL) and mean weight (WT) is for all fish captured not just those over 99mm in length.

Year	Species	#/km (#/mile)	Kg/ha (lb/acre)	Mean TL (mm) Range	Mean WT (g) Range	Mean K
2003	>99mm BCT	40 (64)	68 (60)	126 (59-219)	35 (2-87)	1.08

BCT= Bonneville cutthroat trout

Photo 3.3.4. A photo of the access road going down to the sample site on Coyote Hollow Creek that was surveyed in 2003, Wasatch-Cache National Forest, Utah.

Mill City Creek

Mill City Creek, a tributary to the West Fork Bear River, was surveyed in 1994. Cutthroat trout are found in a series of beaver ponds located in the upper drainage.

Information was collected from two sample sites on Mill City Creek in 2003 (Sample sites 336 and 337, Figure 3.3.1). These samples were taken on the 7 July 2003. The lower sample (Sample Site 336) was located where the Gold Hill Road joined with the Mill City Road. No fish were collected at this site. This may reflect the intermittent nature of Mill City Creek.

The upper site (Sample site 337) was sampled on the 7 July 2003 (Photo 3.3.5). The site where Forest Road 160 crosses over Mill City Creek and goes downstream 100 meters. The average stream width was measured to be 1.9m. The average depth was recorded at 0.07m. This was the first time this station has been sampled. In total, 16 cutthroat trout and 2 sculpin were collected (Table 3.3.6). A population estimate was not made because of failure to document the number of fish collected during each of the two passes. If all of the fish had been collected on the first pass the estimate would have been 130 fish/km. This would be a good lower bound estimate for the population and will be reflected in the table below. No range in population size was made.

Table 3.3.6. Fish species, the number per kilometer, weight per hectare, mean total length with range, mean total weight with range and mean condition factor (K) collected for fish collected in the upper section of Mill City Creek, Summit County, Utah, 2003. Mean total length (TL) and mean weight (WT) is for all fish captured not just those over 99mm in length.

Year	Species	#/km (#/mile)	Kg/ha (lb/acre)	Mean TL (mm) Range	Mean WT (g) Range	Mean K
2003	>99mm BCT SCS	130 (209) sparse	121 (108)	144 (59-229)	39 (1-106)	1.08

BCT= Bonneville cutthroat trout
SCS=Sculpin

Photo 3.3.5. Photos of the sample site on Mill City Creek that was surveyed in 2003, Wasatch-Cache National Forest, Utah. Left photo looks upstream to culvert and road crossing. Right photo looks downstream (north) through the survey reach.

Hayden Fork Subwatershed

Five sample sites were located in the Hayden Fork Subwatershed. Two were located on the mainstem itself. One sample site was on an unnamed tributary from Gold Hill (hereafter referred to as the Gold Hill Creek). Two other sample sites were located on an unnamed tributary from Teal Lake (hereafter referred to as Teal Lake Creek).

Gold Hill Creek

Gold Hill Creek (Sample Site 338) was sampled on 7 July 2003 (Figure 3.3.1). The site is upstream where a major campsite is located next to a large pond on Gold Hill Road (Photo 3.3.6). The average stream width was measured to be 1.1m. The average depth was recorded at 0.12m. This was the first time this station has been sampled. Five cutthroat trout were collected (Table 3.3.7). The cutthroat trout population, fish 100mm or larger, was estimated at 20 fish/km. No range in population size has been calculated because no cutthroat trout were collected during the second pass.

Table 3.3.7. Fish species, the number per kilometer, weight per hectare, mean total length with range, mean total weight with range and mean condition factor (K) collected for fish collected in the Gold Hill Creek, Summit County, Utah, 2003. Mean total length (TL) and mean weight (WT) is for all fish captured not just those over 99mm in length.

Year	Species	#/km (#/mile)	Kg/ha (lb/acre)	Mean TL (mm) Range	Mean WT (g) Range	Mean K
2003	>99mm BCT	20 (32)	46 (41)	100 (59-150)	17 (2-50)	1.36

BCT= Bonneville cutthroat trout

Photo 3.3.6. Photo of the sample site on Gold Hill Creek, looking north from the top of the section downstream, that was surveyed in 2003, Wasatch-Cache National Forest, Utah.

3.3.3.3. Sensitive Species

Bonneville cutthroat trout are a Forest Service Sensitive Species. Surveys for Bonneville cutthroat trout have been completed for all streams within the Project Area and all of the perennial streams have been found to contain cutthroat trout except the stream up Road Hollow which contains brook trout. It is believed that the Bear River populations of Bonneville cutthroat trout on the Wasatch-Cache National Forest will persist over the next 100 years

(Wasatch-Cache Revised Forest Plan FEIS, Appendix B). The primary concerns in the drainage are the non-native fish and some habitat impacts from historic timber harvest and grazing. Overall, Bonneville cutthroat trout population trends appear to be stable throughout the Bear River Drainage with the exception of the Hayden Fork where non-native fish competition and loss of habitat complexity from historic tie hacking have occurred.

A key policy for the long-term conservation of native species on the Wasatch-Cache National Forest (Page B3-71, USDA FS 2003b) is the State of Utah's Fish Stocking and Transfer Procedures (Utah Division of Wildlife Resources 1997). The policy statement reads: "Fish stocking and transfer is an integral and important component of fish management in Utah. It will only be conducted in a manner that does not adversely affect the long-term viability of native aquatic species or their habitat, aids native species conservation, enhances fish populations in existing aquatic habitats, and aids the efficient and effective management of recreational fisheries to provide angling diversity and participation." The Wasatch-Cache National Forest supports this policy.

The West Fork of the Bear River populations are identified as pure in the Conservation Agreement and Strategy for Bonneville Cutthroat Trout in the State of Utah (Lentsch et al. 1997). The Status Review conducted by the U.S Fish and Wildlife Service in 2001 (United States Department of Interior 2001) identifies the West Fork Bear River as a management population because of the desire to maintain the sport fishery in the drainage. Generally fish conditions have remained relatively stable in the West Bear drainage. Biomass production has gone down in the lower mainstem (possibly due fluctuations in reservoir outflow) and is stable for those other populations with comparative samples.

One of the disturbing results in this drainage is finding non-native brook trout moving upstream and downstream (Thompson 2003) out of Whitney Reservoir. Rainbow trout were also found moving upstream into the tributaries that drain into Whitney Reservoir. Historically these fish were stocked into the reservoir to meet public demand of the sport fishery. Brook trout were found approximately 3 and 10 miles (Thompson 2003) below Whitney Reservoir. It is unclear whether these fish came up from the mainstem Bear River, 12 miles below Whitney Reservoir or down from the Reservoir. It is clear that they are found in the reach now. The movement of brook and rainbow trout above the Reservoir is clearer. They have moved up out of the reservoir and now inhabit all of the tributaries of the reservoir in limited numbers. These species threaten the native fish found in the drainage through competition and interbreeding.

Thompson (2003) lists conservation efforts for the headwaters of the Bear River. These include ". . . 1) identifying streams/stream reaches where non-native salmonid control would be feasible, 2) continuing the program of stocking sterile rainbow trout where there is a public demand for this salmonid, 3) developing a sterile brook trout source for stocking where there is a public demand for this salmonid, 4) establishing Bonneville cutthroat trout monitoring stations in a representative portion of the stream in this subunit, and 5) completing the genetic testing of Bonneville cutthroat trout in this subunit." The stocking of only sterile, nonnative fish in the reservoir appears to be consistent with the conservation strategy and the UDWR's Fish Stocking and Transfer Procedures' Policy. In the other drainages, Humpy Creek, Meadow Creek, Coyote Hollow and Mill City Creek, non-native fish were not collected at the survey sites and do not appear to be present. Maintaining high quality habitat should continue to be emphasized.

3.3.3.4 Amphibians

A number of amphibians are believed to exist within the project area. These include: tiger salamander, boreal chorus frogs, boreal toads, and Great Basin spadefoot toad, woodhouse toad, Northern Leopard Frog (Stebbins 1985; Lentsch et al. 1995). Spotted frogs are not found in the project area (Stebbings 1985; Lentsch et al. 1995; Thompson et al. 2003).

Boreal Toads

Boreal Toads are known to exist in the project area. They have been found in the Mill City Creek Drainage, in Road Hollow, West Fork Bear River Drainage adjacent to Whitney Reservoir and in the Gold Hill Creek Drainage (Thompson 2003; Paul Thompson Personal Communication July 14, 2004). They have generally been found in close proximity to water during the spring surveys.

Chorus Frogs

Chorus frogs are also known to exist in the project area. They have been found in Coyote Hollow, Meadow Creek and the Humpy Creek drainages. They are believe to exist in other locations throughout the drainage but have not been found during surveys.

3.3.3.5 Management Indicator Species

Bonneville and Colorado River cutthroat trout are management indicator species for aquatic habitat under the Revised Wasatch-Cache Forest Plan. Bonneville cutthroat trout are native to the West Bear subwatershed, but Colorado River cutthroat trout are not. Most streams across the Wasatch-Cache National Forest have been surveyed for cutthroat trout. It is believed that the Bear River populations of Bonneville cutthroat trout on the Wasatch-Cache National Forest will persist over the next 100 years under the Wasatch-Cache Revised Forest Plan FEIS, Appendix B (USDA FS 2003). Generally fish conditions have remained relatively stable in the West Bear subwatershed. Biomass production has gone down in the lower mainstem (possibly due to fluctuations in reservoir outflow) and is stable for those other populations with comparative samples. A recently updated Management Indicator Species Report (USDA FS 2006a) provides information on monitoring accomplished since the Forest Plan was revised in 2003. The overall trend of the Whitney Reservoir metapopulation is up while the West Fork Bear metapopulation is flat. The Mill City population trend is flat (USDA FS2006a). The cutthroat trout in the Hayden Fork is part of the Upper Bear River Metapopulation, which includes East Fork Bear River, Stillwater and the Hayden Fork. This population's trend is flat (USDA FS2006a).

3.3.4 Environmental Consequences

This section describes the direct, indirect and cumulative effects to aquatic and semiaquatic species. The primary issues for aquatic and semiaquatic species are the effects to streams, lakes and ponds from timber harvest and haul and their associated road locations. For each alternative the impacts to riparian habitat conservation areas and in-channel habitat was considered. Haul routes and the number of stream crossings were also considered.

This section describes the potential effects of timber harvest, road construction, and prescribed fire and then describes the direct, indirect, and cumulative effects for each alternative for runoff quantity, timing, and peak flow; water quality; and wetlands and floodplains. The analysis area for these effects on water resources is expanded from the general analysis area to include the entire West Bear and Hayden Fork subwatersheds. The method of analysis is a description and an assessment of the likelihood of the direct and indirect effects of sedimentation on water resources and their cumulative effects in combination with past, ongoing, and reasonably foreseeable future actions. The analysis includes a description of the individual harvest units and their proximity to water resources, an assessment of the rates of sedimentation; and recommended mitigation measures that are expected to reduce sedimentation.

3.3.4.1 Habitat

The location, planning and construction of temporary roads and skid trails can alter the sediment expected to enter the stream channels causing direct and indirect effects to fish and amphibians. Other factors that affect sedimentation are the distance and the ground cover condition of the area between the erosion source and the water feature. The longer the distance and the denser the ground cover, the potential to trap sediment before it reaches a water feature increases.

Mitigation measures were developed to reduce the potential for sediment from reaching streams or ponds where aquatic species may be impacted. The primary mitigation measure used to protect aquatic and semi-aquatics species was prohibiting logging operations within riparian habitat conservation areas adjacent to water bodies. This is supported by Minshall (2003) and provides for recruitment of large woody material into the stream channel and prevents disturbance of the flood plain and riparian vegetation. Large wood provides shade, instream cover and resting areas for fish. Many of these stream channels lack large wood because of the historic tie hacking that took place in the 1900s. Other mitigation measures such as limiting skidding operations on slopes over 40% would slow

runoff, increase water infiltration, and enhance revegetation, helping to reduce runoff into the streams and small ponds.

The primary direct effect on fish and amphibians, from sediment coming from the harvest areas or roads used for harvest, is the smothering eggs and swim-up fry in the spawning areas. The ability of fish and amphibians' to uptake oxygen through their gills is also impacted as sediment is suspended in the water column. Harvest of trees in riparian zones can also reduce overhead and instream cover for fish and amphibians. The potential for large trees to be recruited into the channel was also considered in setting no harvest areas adjacent to streams.

Alternative 1 – No Action

Aquatic and semiaquatic species habitat is expected to remain constant. No changes in riparian vegetation, sedimentation, stream temperature or organic and inorganic concentrations are expected since no change in management is expected. Large woody debris would continue to be recruited at a natural rate. The only exception to this would be in the case of a wildfire in which the entire stand could be lost and sediment significantly increased. Existing problems with road stream crossings, location, and drainage would continue to be problems.

Alternative 2 – Proposed Action

A detailed description of the alternative can be found in Section 2.1.2. Descriptions of unit and road locations and roads on poor locations or with poor drainage in proximity to stream channels can be found in Table 3.1.5. This includes all units and their associated intermittent service, temporary roads and the three roads being relocated.

Native cutthroat trout have been found in Humpy Creek so although the management prescription for the Humpy Creek streamside area is 6.1 under the Forest plan, the RHCA width is 300 feet on either side of the fish bearing stream and the emphasis for management is aquatic habitat. The Interdisciplinary Team originally proposed management to reduce the likelihood of beetle infestations within RHCA's in the West Bear analysis area. After a number of field trips and discussions of the potential benefits versus effects on RHCA's, the Interdisciplinary Team recommended and it has been decided to leave these areas out of Alternatives 2 (Proposed Action) and 3 (Reduced Roads). Unit layout on-the-ground under both alternatives would maintain the category 1 RHCA buffers of 300 feet along all streams with native fisheries, including Humpy Creek. Using best management practices including removing the culverts and fills on the intermittent stream crossings in the Humpy Creek drainage following harvest, and maintaining intact RHCAs would result in a few small and temporary sources of sediment from road stream crossings.

There would be no effect on riparian and stream channel shading or woody debris recruitment because no trees would be removed within category 1 or 2 RHCA's (Table 3.3.8). Direct and indirect effects on in channel aquatic habitat should therefore be minor with little impact to aquatic species. Impacts to RHCAs is greater as new roads and their associated stream crossings are constructed, existing fords are replaced with culverts and sections of roads are relocated to allow for the restoration of RHCA.

<u>New Stream Crossings</u>
Alternative 2 includes the construction of four new stream crossings. Three are over intermittent tributaries to Humpy Creek (Category 4 RHCA) and a forth is over an unnamed tributary to Meadow Creek (Category 4 RHCA). It is estimated that each crossing would impact an area of approximately 30 feet wide and go across the category 4 RHCA on both sides of the stream for a total impacted area of 0.6 acres.

<u>Existing Stream Crossings</u>
Alternative 2 also includes the replacement of four fords with culverts. These are primarily located parallel to Meadow Creek and just below Beaver Lake. The road base and surface will be strengthened to provide for truck traffic, which should also reduce sediment runoff. All of these crossings are over category 4 RHCAs. It is assumed that with each crossing approximately 0.1 acre of adjacent RHCA will be benefited because vehicles stay to a single stream crossing and less sediment is washed down the channel as fords are replaced with culverts.

Road Relocations

There are three road relocations in the proposed action. The first relocation is on an unnamed tributary to Meadow Creek. This relocation is 0.1 miles in length and includes the removal of an old ford and the installation of a new stream crossing (this is included in the new stream crossings listed above). This replacement is the same under both Alternative 2 and 3 and moves the road up on dryer ground. The existing location would be restored under both alternatives. This would require the restoration of about a 30 foot long strip through the 100 foot long category 4 RHCA on both sides of the stream for a total of 0.1 acres restored.

The second location is on the east side of Beaver Lake where the road parallels the lake shore is proposed to be removed and relocated outside of the RHCA. There are no stream crossings and it is estimated that this relocation will improve approximately 0.2 acres of category 3 RHCA. This relocation is only proposed under Alternative 2.

The third relocation is southwest of Beaver Lake adjacent to unit 27. It is estimated that this relocation will restore approximately 1 acre of category 4 RHCA. This relocation is only proposed under Alternative 2. The new road is outside of the RHCA boundary.

Table 3.3.8. The proposed stream crossing impacts and improvements with respective acres of RHCA habitat.

	New Stream Crossings (1)	RHCA Acres negatively impacted from new crossings	Existing Fords Replaced with Culverts (2)	RHCA Acres Impacted (negatively short term, positively long term)	Acres restored to RHCA function (3)	Total Acres Improved (4)	Net Acres of Improved Function of RHCA.
Alternative 1							
WF Bear River	0	0	0	0	0	0	0
Hayden Fork	0	0	0	0	0	0	0
Alternative 2							
WF Bear River							
Category 1 and 2	0	0	0	0	0	0	0
Category 3	0	0	0	0	0.2	0.2	0.2
Category 4	4	0.6	4	0.4	1.1	1.5	0.9
Hayden Fork	0	0	0	0	0	0	0
Alternative 3							
WF Bear River							
Category 1, 2, and 3	0	0	0	0	0	0	0
Category 4	1	0.1	3	0.3	0.1	0.4	0.3
Hayden Fork	0	0	0	0	0	0	0

(1) New Crossings are expected to be 30 feet wide and the RHCA is 100 on both sides of the intermittent channel. Additional clearing is expected at the new installation sites increasing the width of impact over existing fords.

(2) Culverts would replace fords and road work would occur to provide a road base with sufficient strength to carry equipment and logs to and from the units. It is assumed that this would benefit a strip of vegetation on both sides of the road and through the crossing as traffic is held to the road surface and vegetation is allowed to recover. It is assumed that the total size of the area restored is approximately 0.1 acre per crossing.

(3) Area adjacent to Beaver Lake approximately 500 feet with a width of 20 feet from upslope edge of road to lake (.2 acres).

(4) It is assumed that the relocation of the road going to unit 27 would improve approximately 1 acre of category 4 RHCA

Cumulative Effects

Overall, there would be a slight decrease in cumulative impacts to the fish populations in the West Fork of the Bear River Drainage (HUC- 160101010104) from this proposal. There should be no change in the Hayden Fork Drainage. The impact to the riparian habitat from roads within 300 feet of the stream would decrease slightly from its current percent of 0.59% (Wasatch-Cache National Forest 2003 Table B-3-10, Appendix B3 page 48) with the relocation of existing problem areas and even with the construction of the new roads over the tributaries to Humpy Creek. Existing threats would be further reduced as sections of existing roads are relocated further away from aquatic systems near Beaver Lake and its tributaries (See Photo 3.3.3.7).

There should be no additional impact to the Hayden Fork from the proposal. No RHCA's should be directly or indirectly impacted from the proposal. Cumulative impacts will increase as recreation and dispersed camping occurs along the Hayden Fork.

Other uses that will continue to impact RHCAs and aquatic species and their habitat area:

Timber Harvest: No additional impacts are expected in the foreseeable future as RHCAs are maintained and BMP are used to meet riparian management objectives.

Grazing: Sheep grazing will continue in all of the drainages. The densities will continue at 453 sheep head months per mile of accessible water. This continues to be well below the Forest median of 1,046 sheep headmonths per mile of accessible water. Sheep grazing directly impacts fish as eggs are in the gravel from mid may through mid August. Indirect impacts include increase nitrification, streambank destabilization at crossing points and reduced overhanging vegetation.

Existing Roads and Authorized Trails. In the West Fork Bear River 0.59 percent of the area within 300 feet of the stream has been impacted by roads and trails (Wasatch-Cache National Forest 2003 Table B-3-10, Appendix B3 page 48). This alternative should decrease the impacts to RHCA's as roads are relocated and fords are converted to culverts. Unauthorized use of all-terrain vehicles have significantly increased over the past 10 years, creating additional problems as people travel off designated routes (See Photo 3.3.3.8. Enforcement of the recently approved Travel Plan should reduce off-road travel in the future.

Developed and Dispersed Recreation: Campgrounds and their use will continue to impact 1.8 percent of category 1 RHCA along the Hayden Fork. There are no developed recreational facilities in the West Fork Bear River Drainage. Dispersed Recreation will also continue to impact an even larger percent of the RHCA throughout the two drainages. This will include both legal uses and illegal off-route uses by expanding ATV riders as this activity becomes more popular.

Non-native Species: The expansion of non-native species in the West Fork Bear River and the Hayden Fork will continue to be a concern. Activities are currently in place for removing non-native brook trout and rainbow trout from the tributaries above Whitney Reservoir Dam. This is very time intensive and in many locations has proven unsuccessful. The Division of Wildlife Resources has recently shifted to sterile fish to reduce the potential of interbreeding and reproduction of non-native species. The Forest has been working closely with the Division in moving in this direction.

Photo 3.3.3.7 Road on edge of Beaver Lake.

Photo 3.3.3.8. User Created Trail in Coyote Hollow Stream Channel.

Alternative 3 – Reduced Roads

This alternative drops units 2-6, 18, 19, 26, and 27 and reduces the size of units 11, 24, 25, 30, 32, and 35. In the Gold Hill area, Units 41 and 42 would be burned without conifer harvest, but the total acreage treated is the same as the area treated in Alternative 2. A total of 1,387 acres are treated in the project area with 1,047 acres being found in West Fork Bear River and 340 acres being treated in the Hayden Fork. Alternatives 3 also eliminate the fords across the tributaries of Meadow Creek and eliminates the eastern most ford and relocates the road. This should improve riparian and in-water habitats. This alternative eliminates potential effects to aquatic species in the Humpy Creek Drainage by eliminating the units and roads in the drainage. It also drops the relocation of the roads around Beaver Lake out of the RHCAs.

There would be no effect on riparian and stream channel shading or woody debris recruitment because no trees would be removed within category 1 or 2 RHCA's (Table 3.3.8). Direct and indirect effects on in channel aquatic habitat should therefore be minor with little impact to aquatic species. Impacts to RHCAs is greater as new roads and their associated stream crossings are constructed, existing fords are replaced with culverts and sections of roads are relocated to allow for the restoration of RHCA.

<u>New Stream Crossings</u>

Alternative 3 includes the construction of one new stream crossing. This is over an unnamed tributary to Meadow Creek (Category 4 RHCA). It is estimated that this crossing would impact an area of approximately 30 feet wide and go across the category 4 RHCA on both sides of the stream for a total impacted area of 0.1 acres.

Existing Stream Crossings
Alternative 3 also include the replacement of three fords with culverts. These are located parallel to Meadow Creek. The road base and surface will be strengthened to provide for truck traffic, which should also reduce sediment runoff. All of these crossings are over category 4 RHCAs. It is assumed that with each crossing approximately 0.1 acre of adjacent RHCA will be benefited was vehicles stay to a single stream crossing and less sediment is washed down the channel as fords are replaced with culverts.

Road Relocations
There is only one road relocation in the proposed action. This relocation is on an unnamed tributary to Meadow Creek. This relocation, 0.1 miles in length and includes the removal of an old ford and the installation of a new stream crossing (this is included in the new stream crossings listed above). This replacement is the same under both Alternative 2 and 3 and moves the road up on dryer ground. The existing location would be restored under both alternatives. This would require the restoration of about a 30 foot long strip through the 100 foot long category 4 RHCA on both sides of the stream for a total of 0.1 acres restored.

Cumulative Effects

Overall, there would be a slight decrease in cumulative impacts from roads and timber harvest to the fish populations in the West Fork of the Bear River Drainage (HUC- 160101010104) from this proposal. Existing impacts would be reduced and/or eliminated as fords are replaced with culverts and roads brought up to maintenance standards as part of the proposed action and three sections of road are relocated. The impact to the riparian habitat from roads within 300 feet of the stream would decrease slightly from its current percent of 0.59% (Wasatch-Cache National Forest 2003 Table B-3-10, Appendix B3 page 48) with the relocation of the road that parallels Meadow Creek. No new access would be provided in the Humpy Creek Drainage.

Other uses that will continue to impact RHCAs and aquatic species and their habitat area:

Timber Harvest: No additional impacts are expected in the foreseeable future as RHCAs are maintained and BMP are used to meet riparian management objectives.

Grazing: Sheep grazing will continue in all of the drainages. The densities will continue at 453 sheep head months per mile of accessible water. This continues to be well below the Forest median of 1,046 sheep headmonths per mile of accessible water. Sheep grazing directly impacts fish as eggs are in the gravel from mid may through mid August. Indirect impacts include increase nitrification, streambank destabilization at crossing points and reduced overhanging vegetation.

Existing Roads and Authorized Trails. In the West Fork Bear River 0.59 percent of the area within 300 feet of the stream has been impacted by roads and trails (Wasatch-Cache National Forest 2003 Table B-3-10, Appendix B3 page 48). This proposal will not change this percent even with the relocation of the road in lower Meadow Creek. Unauthorized use of all-terrain vehicles have significantly increased over the past 10 years, creating additional problems as people travel off designated routes (See Photo 3.3.3.8. Enforcement of the recently approved Travel Plan should reduce off-road travel in the future.

Developed and Dispersed Recreation: Campgrounds and their use will continue to impact 1.8 percent of category 1 RHCA along the Hayden Fork. There is no developed recreational facilities in the West Fork Bear River Drainage. Dispersed Recreation will also continue to impact an even larger percent of the RHCA throughout the two drainages. This will include both legal uses and illegal off-route uses by expanding ATV riders as this activity becomes more popular.

Non-native Species: The expansion of non-native species in the West Fork Bear River and the Hayden Fork will continue to be a concern. Activities are currently in place for removing non-native brook trout and rainbow trout from the tributaries above Whitney Reservoir Dam. This is very time intensive and in many locations has proven unsuccessful. The Division of Wildlife Resources has recently shifted to sterile fish to reduce the potential of interbreeding and reproduction of non-native species. The Forest has been working closely with the Division in moving in this direction.

3.3.4.2 Fish Population, Species and Condition

Fish populations and condition are directly related to quality of available habitat and can be affected to some extent by heavy recreational fishing pressure. The species of fish occupying the habitat are also affected by habitat conditions as species that can exist in sediment rich or warm water environments will tend to replace cold, clear water fish if habitat conditions become degraded. The species of fish are also affected by fish stocking programs. Effects of alternatives on habitat are discussed in Sections 3.3.4.1. The alternatives have no effect on fish stocking programs or expansion of non-native trout populations, which are outside of the scope of this analysis.

3.3.4.3. Sensitive Species

Alternative 1 – No Action

There would be no direct, indirect or cumulative effects on Bonneville cutthroat trout other than those potential effects on habitat described in Section 3.3.4.1. Concerns exist for continued expansion of non-native trout in the main stem of the West Fork of the Bear River. These concerns are not affected by the alternatives.

Determination

This alternative of the proposed West Fork Bear Vegetation Management Project will have “no impact" to the Bonneville cutthroat trout population on the Forest.

Alternative 2 – Proposed Action

There would be no direct, and potentially minor indirect or cumulative effects on Bonneville cutthroat trout and their habitat. These are described in Section 3.3.4.1. Concerns exist for continued expansion of non-native trout in the main stem of the West Fork of the Bear River. These concerns are not affected by the alternatives.

Determination

The proposed West Fork Bear Vegetation Management Project "**may impact individuals**, but is not likely to cause a trend toward federal listing or a loss of viability" to the Bonneville cutthroat trout population on the Forest.

Alternative 3 – Reduced Roads

There would be no direct, and potentially minor indirect or cumulative effects on Bonneville cutthroat trout and their habitat. These are described in Section 3.3.4.1. Concerns exist for continued expansion of non-native trout in the main stem of the West Fork of the Bear River. These concerns are not affected by the alternatives.

Determination

Alternative 3 of the proposed West Fork Bear Vegetation Management Project "**may impact individuals**, but is not likely to cause a trend toward federal listing or a loss of viability" to the Bonneville cutthroat trout population on the Forest.

3.3.4.4 Amphibians

Alternative 1 – No Action

There would be no direct, indirect or cumulative effects on amphibians unless a stand replacing fire occurs or some other natural event.

Alternative 2 – Proposed Action

Maintenance of Riparian Habitat Conservation Areas around ponds and along streamside riparian areas and maintenance of a partial forest canopy and down logs in forest patches near ponds and streams would maintain quality habitat for amphibians. There should be no direct, indirect or cumulative effects on amphibians under this alternative other than minor effects of temporary road crossings of riparian areas. These effects are well offset by favorable effects of relocating portions of existing roads away from water bodies and outside of riparian areas.

Cumulative Effects

Cumulative impacts to the riparian habitat from roads within 300 feet of the stream would decrease slightly or remain steady below its current percent of 0.59% with the relocation of road segments with existing problems and construction of the new roads over the tributaries to Humpy Creek. Existing threats would be further slightly reduced as sections of existing roads are relocated further away from aquatic systems near Beaver Lake and its tributaries. All terrain vehicles have significantly increased over the past 10 years, creating additional problems as people travel off designated routes. Enforcement of the recently approved Travel Plan will reduce off-road travel in the future. Private land development in an area that includes numerous ponds and is adjacent to the northeast corner of the general analysis area may affect amphibian habitat. However, since the action alternative under the West Bear project are not treating riparian habitat conservation areas surrounding ponds, there is little or no interaction between the alternatives and private land development effects on ponds. Offsetting favorable and adverse cumulative impacts are therefore acceptable.

Alternative 3 – Reduced Roads

Maintenance of Riparian Habitat Conservation Areas around ponds and along streamside riparian areas and maintenance of a partial forest canopy and down logs in forest patches near ponds and streams would maintain quality habitat for amphibians. The only direct, indirect or cumulative effects on amphibians under this alternative should be the minor effects of temporary road crossings of riparian areas. There would be fewer crossings under this alternative but relocation of existing roads in the Beaver Lake area would not be done.

Cumulative Effects

Cumulative impacts to the amphibian populations in the analysis area from road construction under this proposal would be less than alternative 2. However, the existing impact to the riparian habitat from roads located near Beaver Lake and its tributaries would not change so cumulative impacts under this alternative would be about the same as those under Alternative 2. Cumulative impacts are therefore minor.

3.3.4.5 Management Indicator Species

The cutthroat trout populations within the project area are West Fork Bear River, Whitney Reservoir, Upper Bear River and Mill City Creek. The implementation of the best management practices and mitigation measures in Tables 2.1.7 and 2.1.8 should reduce and or eliminate sedimentation from the travel routes. The potential of having sediment reach fish bearing streams from the harvest units is precluded as harvest is not allowed in the riparian habitat conservation areas (RHCAs).

The implementation of any of the alternatives identified in this project should not affect the trend of the cutthroat trout populations identified for the Forest (Cowley 2005).