Cottonwood Creek
Total Maximum Daily Load (TMDL)

prepared for

Cottonwood Creek Watershed Advisory Group

First Revision
May 2000

Cottonwood Creek Total Maximum Daily Load
(TMDL)
Errata Sheet
June 2, 2000

This errata sheet serves as a replacement page for page 1-5, Section 1.5 of the Cottonwood Creek Total Maximum Daily Load dated May 2000. The text below replaces the information presently in the Cottonwood Creek TMDL.

Replacement Text:

The TMDL for ammonia involves comparing instream total ammonia concentrations to Idaho water quality criteria for cold water biota. The salmonid spawning criteria for ammonia are the same as those for cold water biota. The criteria are based on the toxic effects of ammonia to aquatic life and are pH and temperature dependent. The nutrient effect of ammonia is evaluated in the nutrient TMDL. The existing ,although limited, ammonia data shows that ammonia problems exist in Upper Cottonwood Creek sub-watershed during the months of November through March when the City of Cottonwood discharges. Ammonia concentration in this watershed increase in November and gradually decrease in March. For the Cottonwood Creek TMDL, the WLA for the City of Cottonwood during the critical time period (May - September) is 0lbs/day because the City does discharge during the this time period. Based on the available data, ammonia concentration increase during the time which the City of Cottonwood discharges (November - April). Thus the TMDL requires an 5% reduction in total ammonia from the City of Cottonwood during the November - April time period to ensure water quality standards are met.

Cottonwood Creek
Total Maximum Daily Load (TMDL)

Jointly Prepared by the:

Idaho Division of Environmental Quality
Nez Perce Tribe
Environmental Protection Agency

in consultation with the:
Cottonwood Creek Watershed Advisory Group

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May 2000

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This document was developed after numerous discussions to reach a clear understanding and a consensus of opinion on the relatively difficult issues associated with water quality protection and restoration by the following dedicated citizens living and working in the watershed and the federal, state and tribal staff members associated with the project.

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Members of the participating governmental agencies that worked with the Cottonwood Creek Watershed Advisory Group on the project are indebted to the commitment and sound advice provided by the Group. We wish to offer our sincere thanks for their efforts. They generously volunteered considerable time and effort and their knowledge of local conditions was invaluable.

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Acronyms/Abbreviations and Glossary

ACRONYM/ ABBREVIATION	FULL NAME
ACP	Alternative Conservation Program
BAG	Basin Advisory Group
bcfu	billion colony forming units
BMP or BMPs	Best Management Practice(s)
BOD or BOD5	Biological Oxygen Demand or 5-day Biological Oxygen
BURP	Beneficial Use Reconnaissance Project
°C	degrees celsius
CAFO	Confined Animal Feeding Operations
CBOD	Carbonaceous Biochemical Oxygen Demand
CFO	Confined Feeding Operations
CFR	Code of Federal Regulations
cfs	cubic feet per second
cfu	colony forming units
CWA	Clean Water Act
CSWCD	Clearwater Soil and Water Conservation District
DO	dissolved oxygen
DMR or DMRs	Discharge Monitoring Report (s)
E. coli	Escherichia coli
EPA	United States Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, Trichoptera Insect Orders
ESA	Endangered Species Act
FPA	Idaho Forest Practices Act
ft	feet
GIS	Geographic Information System
GPS	Global Positioning System
HI	Habitat Index
HUC or HUCs	Hydrologic Unit Code(s)
IDAPA	Idaho Administrative Procedures Act
IDEQ	Idaho Division of Environmental Quality

ACRONYM/ ABBREVIATION	FULL NAME
IDFG	Idaho Department of Fish and Game
IDHW	Idaho Department of Health and Welfare
IDL	Idaho Department of Lands
IDWR	Idaho Department of Water Resources
ISCC	Idaho Soil Conservation Commission
kg	kilogram
L	liter
LA	Load Allocation
lbs	pounds
LRO	Lewiston Regional Office
LC	Loading Capacity (which = TMDL = Assimilative Capacity)
MBI	Macroinvertebrate Biotic Index
MGD	million gallons per day
m	meter
mg	milligrams
mg/L	milligrams per liter
mL	milliliter
MOS	Margin of Safety
µg	microgram
µg/L	micrograms per liter
NPDES	National Pollutant Discharge Elimination System
NPS	nonpoint source
NPT	Nez Perce Tribe
NRCS	Natural Resources Conservation Service
NTU	nephelometric turbidity unit
SAWQP	State Agricultural Water Quality Program
SCC	Soil Conservation Commission
SCD or SCDs	Soil Conservation District(s)
SCS	Soil Conservation Service
SSOCs	Stream Segments of Concern
SWCD	Soil and Water Conservation District

ACRONYM/ ABBREVIATION	FULL NAME
SWPP	Storm Water Pollution Prevention Plan
T/yr	tons per year
TKN	total kjeldahl nitrogen
TMDL	Total Maximum Daily Load
TP	total phosphorus
TSS	total suspended solids
UAA	Use Attainability Assessment
USC	United States Code
U of I	University of Idaho
USDA	United States Department of Agriculture
U.S. EPA	United States Environmental Protection Agency
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WAG	Watershed Advisory Group
WBAG	Water Body Assessment Guidance
WLA	Waste Load Allocation
WQLS	Water Quality Limited Segment
WWTP	Wastewater Treatment Plant
yr	year

GLOSSARY

Alevin - Newly hatched salmonid still dependent on yolk sac; remains in stream bed gravel until yolk sac is absorbed.

Aeration - a process by which a water body secures oxygen directly from the atmosphere, the gas then enters into biochemical oxidation reactions in water.

Anadromous - Fishes, such as salmon and sea-run trout, that live part or the majority of their lives in the salt water but return to fresh water to spawn.

Aquifer - a water-bearing bed or stratum of permeable rock, sand, or gravel capable of yielding considerable quantities of water to wells or springs.

Adsorption - the adhesion of one substance to the surface of another; clays, for example, can adsorb phosphorus and organic molecules.

Aerobic - describes life or processes that require the presence of molecular oxygen.

Algae - small aquatic plants that occur as single cells, colonies, or filaments.

Alluvial - unconsolidated recent stream deposition.

Ambient - surrounding, external, or unconfined conditions.

Anaerobic - describes processes that occur in the absence of molecular oxygen.

Anoxia - the condition of oxygen deficiency.

Antidegradation - A federal regulation requiring the States to protect high quality waters. Waters standards may be lowered to allow important social or economic development only after adequate public participation. In all instances, the existing beneficial uses must be maintained.

Aquatic - growing, living, or frequenting water.

Assimilative Capacity - an estimate of the amount of pollutants that can be discharged to and processed by a waterbody and still meet the state water quality standards. It is the equivalent of the Loading Capacity which is the equivalent of the TMDL for the waterbody.

Basalt - a fine-grained, dark-colored extrusive igneous rock.

Bedload - material, generally of sand size or larger, carried by a stream on or immediately above (3") its bed.

Beneficial uses - any of the various uses which may be made of the water of an area, including, but not limited to, domestic water supplies, industrial water supplies, agricultural water supplies, navigation, recreation in and on the water, wildlife habitat, and aesthetics.

Benthic organic matter - the organic matter on the bottom of the river.

Benthic - pertaining to or living on the bottom or at the greatest depths of a body of water.

Benthos - macroscopic (seen without aid of a microscope) organisms living in and on the bottom sediments of lakes and streams. Originally, the term meant the lake bottom, but it is now applied almost uniformly to the animals associated with the substrate.

Best Management Practice (BMP) - a measure determined to be the most effective, practical means of preventing or reducing pollution inputs from point or nonpoint sources in order to achieve water quality goals.

Biochemical oxygen demand (BOD) - the rate of oxygen consumption by organisms and chemical reactions during the decomposition (= respiration) of organic matter, expressed as grams oxygen per cubic meter of water per hour.

Biomass - the weight of biological matter. Standing crop is the amount of biomass (e.g. fish or algae) in a body of water at a given time. Often measured in terms of grams per square meter of surface.

Biomass Accumulation - a measure of the density and lateral and downstream extent of plant growth across a waterbody.

Biota - All plant and animal species occurring in a specified area.

Cfs - cubic feet per second, a unit of measure for the rate of discharge of water. One cubic foot per second is the rate of flow of a stream with a cross section of one square foot which is flowing at a mean velocity of one foot per second. It is equal to 448.8 gallons per minute, 0.646 million gallons per day, or 1.98 acre-foot per day.

Coliform bacteria - a group of bacteria predominantly inhabiting the intestines of man and animal but also found in soil. Coliform bacteria are commonly used as indicators of the possible presence of pathogenic organisms.

Colluvium - material transported to a site by gravity.

Decomposition - the transformation of organic molecules (e.g. sugar) to inorganic molecules (e.g. carbon dioxide and water) through biological and non-biological processes.

Designated Beneficial Use or Designated Use - Those beneficial uses assigned to identified waters in Idaho Department of Health and Welfare Rules, Title 1, Chapter 2, "Water Quality Standards and Wastewater Treatment Requirements:, Sections 110. through 160. and 299., whether or not the uses are being attained."

Diel - A 24-hour period that includes a day and adjoining night.

Dissolved oxygen - commonly abbreviated DO, it is the amount of oxygen dispersed in water and is usually expressed as mg/L (ppm). The amount of oxygen dissolved in water is affected by temperature, elevation, and total dissolved solids.

Ecology - scientific study of relationships between organisms and their environment; also defined as the study of the structure and function of nature.

Ecosystem - a complex system composed of a community of flora and fauna taking into account the chemical and physical environment with which the system is interrelated; ecosystem is usually defined to include a body of water and its watershed.

Effluent - a discharge into the environment; often used to refer to discharge of untreated , partially treated, or treated pollutants into a receiving water body.

Environment - collectively, the surrounding conditions, influences, and living and inert matter that affect a particular organism or biological community.

Eolian - windblown.

Erosion - the wearing away of areas of the earth's surface by water, wind, ice, and other forces. **Culturally-induced erosion** is that caused by increased runoff or wind action due to the work of man in deforestation, cultivation of the land, overgrazing, and disturbance of the natural drainage; the excess of erosion over that normal for the area.

Eutrophic - from Greek for "well-nourished," describes a body of water of high photosynthetic activity and low transparency.

Eutrophication - the process of physical, chemical, and biological changes associated with nutrient, organic matter, and silt enrichment and sedimentation of a body of water. If the process is accelerated by man-made influences, it is termed cultural eutrophication. Eutrophication refers to natural addition of nutrients to waterbodies and to the effects of artificially added nutrients.

Existing Beneficial Use or Existing Use - Those beneficial uses actually attained in waters on or after November 28, 1975, whether or not they are designated for those waters in Idaho Department of Health and Welfare Rules, Title 1, Chapter 2, "Water Quality Standards ad Wastewater Treatment Requirements."

Fecal Streptococci - a species of spherical bacteria including pathogenic strains found in the intestines of warm blooded animals.

Feedback Loop - a component of a watershed management plan strategy that provides for accountability on targeted watershed goals.

Flow - the quantity of water that passes a given point in some time increment.

Gradient - the slope of the stream bed profile.

Granitic - derived from granite; coarse to medium grained intrusive igneous rock.

Groundwater - water found beneath the soil surface; saturates the stratum at which it is located; often connected to surface water.

Growth Rate - the amount of new plant tissue produced per a given time unit of time. It is also a measure of how quickly a plant will develop and grow.

Habitat - a specific type of place that is occupied by an organism, a population or a community.

Headwater - the origin or beginning of a stream.

Hydrologic basin - The area of land drained by a river system, a reach of a river and its tributaries in that reach, a closed basin, or a group of streams forming a drainage area. There are six basins described in the Nutrient Management Act (NMA) for Idaho -- Panhandle, Clearwater, Salmon, Southwest, Upper Snake, and the Bear Basins.

Hydrologic cycle - the circular flow or cycling of water from the atmosphere to the earth (precipitation) and back to the atmosphere (evaporation and plant transpiration). Runoff, surface water, groundwater, and water infiltrated in soils are all part of the hydrologic cycle.

Impervious - a surface, such as a pavement, that rain cannot penetrate.

Influent - the flow into a process, facility, or larger body of water.

Inorganic - materials not containing carbon and hydrogen, and not of biologic origin.

Irrigation return flow - surface and subsurface water which leaves the field following the application of irrigation water.

Land Application - a process or activity involving application of wastewater, surface water, or semi-liquid material to the land surface for the purpose of disposal, pollutant removal, or groundwater recharge.

Limiting factor - a chemical or physical condition that determines the growth potential of an organism, can result in less than maximum or complete inhibition of growth, typically results in less than maximum growth rates.

Limnology - scientific study of fresh water, especially the history, geology, biology, physics, and chemistry of lakes.

Load Allocation - The amount of pollutant that nonpoint sources can release to a waterbody.

Loading - the quantity of a substance entering a receiving stream, usually expressed in pounds (kilograms) per day or tons per month. Loading is calculated from flow (discharge) and concentration.

Loading Capacity - the maximum amount of pollutant a waterbody can safely assimilate without violating state water quality standards. It is also the equivalent of a TMDL.

Loam - moderately coarse, medium and moderately fine-textured soils that include such textural classes as sandy loam, fine sandy loam, very fine sandy loam, silt loam, silt, clay loam, sandy clay loam and silty clay loam.

Loess -is defined as a uniform eolian (wind-blown) deposit of silty material having an open structure and relatively high cohesion due to cementation by clay or calcareous material at the grain contacts.

Macroinvertebrates - aquatic insects, worms, clams, snails, and other animals visible without aid of a microscope, that may be associated with or live on substrates such as sediments and macrophytes. They supply a major portion of fish diets and consume detritus and algae.

Macrophytes - rooted and floating aquatic plants, commonly referred to as water weeds. These plants may flower and bear seed. Some forms, such as duckweed and coontail (*Ceratophyllum*), are free-floating forms without roots in the sediment.

Margin of safety - Commonly abbreviated MOS. An implicit or explicit component of water quality modeling that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving waterbody.

Mean - the **arithmetic mean** is the most common statistic familiar to most people. The mean is calculated by summing all the individual observations or items of a sample and dividing this sum by the number of items in the sample. The geometric mean is used to calculate bacterial numbers. The **geometric mean** is a back-transformed mean of the logarithmically transformed variables.

Meter - the basic metric unit of length; 1 meter = 39.37 inches or 3.28 feet.

Milligrams per liter (mg/L) - concentration equal to 0.001 grams in substance weight per liter capacity.

Million gallons per day (MGD) - a unit of measure for the rate of discharge of water, often used to measure flow at WWTPs. It is equal to 1.55 cubic feet per second.

Monitoring - the process of watching, observing, or checking (in this case water). The entire process of a water quality study including: planning, sampling, sample analyses, data analyses, and report writing and distribution.

Mouth - the location where a water body flows into a larger waterbody.

National Pollution Discharge Elimination System (NPDES) - a national program from the Clean Water Act for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits to discharge pollutants to waters of the United States, including pretreatment requirements.

Nitrogen - a nutrient essential to plant growth, often in more demand than available supply.

Nonpoint Source - A dispersed source of pollutants such as a geographical area on which pollutants are deposited or dissolved or suspended in water applied to or incident on that area, the resultant mixture being carried by runoff into the waters of the state. Nonpoint source activities include, but are not limited to irrigated and non-irrigated lands used for grazing, crop production and silviculture; log storage or rafting; urban areas; construction sites; recreation sites; and septic tank disposal fields.

Nuisance - anything which is injurious to the public health or an obstruction to the free use, in the customary manner, of any waters of the state.

Nutrient - an element or chemical essential to life, such as carbon, oxygen, nitrogen, and phosphorus.

Nutrient cycling - the flow of nutrients from one component of an ecosystem to another, as when macrophytes die and release nutrients that become available to algae (organic to inorganic phase and return).

Oligotrophic - "poorly nourished," from the Greek. Describes a body of water with low plant productivity and high transparency.

Organic matter - molecules manufactured by plants and animals and containing linked carbon atoms and elements such as hydrogen, oxygen, nitrogen, sulfur, and phosphorus.

Orthophosphate - a form of soluble inorganic phosphorus which is directly utilizable for algal growth.

Oxygen-demanding materials - those materials, usually organic, in a waterbody which consume oxygen during decomposition or transformation. Sediment can be an oxygen-demanding material.

Parameter - a variable quantity such as temperature, dissolved oxygen, or fish population, that is the subject of a survey or sampling routine.

Partitioning - the sharing of limited resources by different races or species; use of different parts of the habitat, or the same habitat at different times.

Pathogen- any disease-causing organism.

Periphyton - attached organisms, usually algae, growing on the bottom or other submersed substrates in a waterway.

pH - a measure of the concentration of hydrogen ions of a substance, which ranges from very acid (pH = 1) to very alkaline (pH = 14). pH 7 is neutral, and most lake waters range between 6 and 9. pH values less than 7 are considered acidic, and most life forms cannot survive at pH of 4.0 or lower.

Phased TMDL - A TMDL which identifies interim load allocations with further monitoring to gauge success of management actions in achieving load reduction goals and the effect of actual load reductions on the water quality of a waterbody. Under a phased TMDL, the TMDL has load allocations and wasteload allocations calculated with margins of safety to meet water quality standards.

Phosphorus - a nutrient essential to plant growth, typically in more demand than the available supply.

Phytoplankton - microscopic algae and microbes that float freely in open water of lakes and oceans.

Point source pollution - the type of water quality degradation resulting from the discharges into receiving waters from sewers and other identifiable "points." Common point sources of pollution are the discharges from industrial and municipal wastewater treatment plants.

Pretreatment - the reduction of the amount of pollutants, the elimination of pollutants, or the alteration of the nature of pollutant properties in wastewater prior to or in lieu of discharging or otherwise introducing such pollutants into a WWTP.

Primary productivity - the rate at which algae and macrophytes fix or convert light, water, and carbon dioxide to sugar in plant cells. Commonly measured as milligrams of carbon per square meter per hour.

Reach - a stream section with fairly homogenous characteristics.

Respiration - process by which organic matter is oxidized by organisms, including plants, animals, and bacteria. The process releases energy, carbon dioxide, and water.

Riffle - A shallow, gravelly area of stream bed with swift current.

Riparian - associated with aquatic (streams, rivers, lakes) habitats. Living or located on the bank of a waterbody.

Runoff - the portion of rainfall, melted snow, or irrigation water that flows across the surface or through underground zones and eventually runs into streams.

Sediment - bottom material in a body of water that has been deposited after the formation of the basin. It originates from remains of aquatic organism, chemical precipitation of dissolved minerals, and erosion of surrounding lands.

Settleable solids - the volume or weight of material that settles out of a liter of water in one hour.

Specific conductance - also known as specific conductivity. It is a numerical expression of the ability of an aqueous solution to carry electric current, expressed in μmhos/cm at 25°C. Conductivity is defined as the reciprocal of the resistivity normalized to a 1 cm cube of liquid at a specific temperature and is an indirect measure of dissolved solids.

Stagnation - the absence of mixing in a waterbody

Stochastic - of, or pertaining to, a process involving a randomly determined sequence of observations each of which is considered as a sample of one element from a probability distribution.

Stream Segments of Concern (SSOCs) - Stream segments nominated by the public and designated by a committee whose members are appointed by the Governor.

Storm water runoff - Surface water that washes off land after a rainstorm. In developed watersheds it flows off roofs and pavement into storm drains which may feed directly into the stream; often carries pollutants.

Subbasin: - Smaller geographic management areas within a hydrologic basin delineated for purposes of addressing site specific conditions.

Subwatershed - smaller geographic management areas within a watershed delineated for purposes of addressing site specific situations.

Suspended sediments - Fine mineral or soil particles that remain suspended by the current until deposited in areas of weaker current. They create turbidity and, when deposited, can cover fish eggs or alevins.

Thalweg - The center of the current.

Threatened species - a species, determined by the U.S. Fish and Wildlife Service, which are likely to become endangered within the foreseeable future throughout all or a significant portion of their range.

TMDL - Total Maximum Daily Load. TMDL = LA + WLA + MOS. A TMDL is the equivalent of the Loading Capacity which is the equivalent of the assimilative capacity of a waterbody.

Total suspended solids (TSS) - the material retained on a 2.0 micron filter after filtration.

Tributary - a stream feeding into a larger stream or lake.

Trophic state - level of growth or productivity of a lake as measured by phosphorus content, chlorophyll a concentrations, amount of aquatic vegetation, algal abundance, and water clarity.

Turbidity - a measure of the extent to which light passing through water is scattered due to suspended materials. Excessive turbidity may interfere with light penetration and minimize photosynthesis, thereby causing a decrease in primary productivity. It may alter water temperature and interfere directly with essential physiological functions of fish and other aquatic organisms, making it difficult for fish to locate a food source.

Vadose zone - The zone containing water under less pressure than that of the atmosphere, including soil water, intermediate vadose water, and capillary water. This zone is limited above by the land surface and below the surface of the zone of saturation, that is, the water table.

Wash Load - that part of the total sediment load composed of all particles finer than limiting size, which is normally washed into and through the reach under consideration without settling.

Waste Load Allocation (WLA) - a portion of receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. It specifies how much pollutant each point source can release to a waterbody.

Water column - water between the interface with the atmosphere at the surface and the interface with the sediment layer at the bottom. Idea derives from vertical series of measurements (oxygen, temperature, phosphorus) used to characterize water.

Water Pollution - Any alteration of the physical, thermal, chemical, biological, or radioactive properties of any waters of the state, or the discharge of any pollutant into the waters of the state, which will or is likely to create a nuisance or to render such waters harmful, detrimental or injurious to public health, safety or welfare, or to fish and wildlife, or to domestic, commercial, industrial, recreational, aesthetic, or other beneficial uses.

Water Quality Limited Segment (WQLS) - any water body, or definable portion of water body, where it is known that water quality does not meet applicable water quality standards, and/or is not expected to meet applicable water quality standards.

Water Quality Management Plan - a state or area-wide waste treatment management plan developed and updated in accordance with the provisions of the Clean Water Act.

Water quality modeling - the input of variable sets of water quality data to predict the response of a lake or stream.

Water table - the upper surface of groundwater; below this surface the ground is saturated with water.

Watershed - a drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation. The whole geographic region contributing to a water body.

Wetlands - lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. Wetlands must have the following three attributes: (1) at least periodically, the land supports predominately hydrophytes; (2) the substrate is predominately undrained hydric soil; and (3) the substrate is on soil and is saturated with water or covered by shallow water at some time during the growing season of each year.

1.0 EXECUTIVE SUMMARY

TMDL AT A GLANCE

Hydrologic Unit Code:	*South Fork of the Clearwater River #17060305*
§303(d) Listed Segments:	*Cottonwood Creek (source to mouth) #3288; Red Rock Creek #3289, South Fork Cottonwood #3290; Long Haul Creek #5221; Shebang Creek #5644; Stockney Creek #7288*
Water Quality Concerns:	*Sediment, Temperature, Nutrients, Dissolved Oxygen, Pathogens, Ammonia, Habitat and Flow Alteration*
Designated Beneficial Uses:	*Secondary Contact Recreation, Agricultural Water Supply, Cold Water Biota, Salmonid Spawning*
Sources Considered:	*Permitted Point Sources: Cottonwood WastewaterTreatment Plant* *Nonpoint Sources: Agriculture, Livestock, Timber Harvest, Storm water, Roads, Septic Systems*

Cottonwood Creek is a second order tributary of the South Fork Clearwater River located in Idaho County, Idaho. Cottonwood Creek flows from an elevation of 5,730 feet at Cottonwood Butte, east across the Camas Prairie, to an elevation of 1,332 feet at its confluence with the South Fork of the Clearwater River, near Stites, Idaho. It flows roughly from west to east and the mainstem is about 30 miles long. A waterfall approximately 9 miles upstream from the mouth of Cottonwood Creek restricts fish passage upstream. The 5 major tributaries to Cottonwood Creek are Stockney Creek, Shebang Creek, South Fork of Cottonwood Creek, Long Haul Creek, and Red Rock Creek.

The Cottonwood Creek watershed has an area of 124,439 acres. The topography of the watershed encompasses steep forested lands in the headwaters, rolling cropland associated the Camas Prairie, and deep canyons where Cottonwood Creek dissects the Camas Prairie in the eastern half of the watershed. Land uses consist of cropland (74%), pastureland (7%), rangeland (13%), forestland (6%), and urban/industrial (<1%). A small urban area of the City of Cottonwood and a small portion of the City of Grangeville are within the watershed.

Section §303(d) of the Federal Clean Water Act requires States to develop a Total Maximum Daily Load (TMDL) management plan for water bodies determined to be water quality limited. A TMDL documents the amount of a pollutant a water body can assimilate without violating a state's water quality standards and allocates that load capacity to known point sources and nonpoint sources. TMDLs are the sum of the individual waste load allocations for point sources and load allocations for nonpoint sources for nonpoint sources, including a margin of safety and natural background conditions.

In 1994, 1996, and 1998, Cottonwood Creek from its headwaters to the South Fork Clearwater was classified as a high priority water quality limited segment as a high priority water quality limited segment under §303(d) of the Clean Water Act. A TMDL was scheduled to be developed by the end of 1999. Pollutants of concern include: sediment, temperature, pathogens, nutrients, dissolved oxygen, ammonia, habitat alteration, and flow.

Three of the 5 tributaries to Cottonwood Creek were listed on the 1994 §303(d) list; the two others were added on the 1998 §303(d) list. The listed pollutants were a subset of those identified for the mainstem. Although the TMDLs for the tributaries are not due until 2001 or 2006, they are proactively addressed in the Cottonwood Creek TMDL as sources of pollutants to the mainstem.

The Idaho Water Quality Standards designate salmonid spawning, cold water biota, secondary contact recreation, and agricultural water supply as beneficial uses for Cottonwood Creek. 1995 and 1996 beneficial use studies indicated that Cottonwood Creek and its tributaries do not provide full support of beneficial uses because of macroinvertebrate population impairment and exceedances of water quality standards.

The primary nonpoint sources of pollutants in the Cottonwood Creek watershed are agricultural practices and runoff, livestock grazing, timber harvest activities, urban runoff, and land development activities. Storm water discharge systems, septic system failure and several other discrete sources are included with these nonpoint sources for loading analysis due to a lack of data and methodology for separate evaluation. The Cottonwood wastewater treatment plant is the only permitted point source. This plant is permitted to discharge to Cottonwood Creek November through March and land applies its wastewater during other times of the year.

Since portions of Cottonwood Creek lie within the Nez Perce Reservation, a Memorandum of Agreement was developed between the Nez Perce Indian Nation, the U.S. Environmental Protection Agency, and the State of Idaho Division of Environmental Quality to develop the TMDL, with the advice of the Cottonwood Creek Watershed Advisory Group WAG. In the Memorandum of Agreement, the parties agreed to utilize the State of Idaho's water quality standards for development of the TMDL.

This TMDL examines whether the estimated load capacities for pollutants in Cottonwood Creek are currently exceeded. Targets, loading analyses, and load allocations are presented for sediment, temperature, nutrients/dissolved oxygen, temperature, pathogens, and ammonia.

Water quality standards for the state of Idaho are intended to provide protection of designated beneficial uses. TMDL targets are based on these water quality standards. Numeric water quality criteria are used where they exist. Narrative water quality criteria have been interpreted and applied to Cottonwood Creek for sediment and nutrients. Load capacities reflect these water quality targets for Cottonwood Creek based on available or estimated instream flow data. Load allocations presented distribute the existing pollutant loading from both point and nonpoint sources within the watershed, based on available load capacity of Cottonwood Creek.

The following discussion explains how all the listed parameters were addressed in the TMDL. The Executive Summary Loading Table at the end of this Section summarizes pollutant and loading allocations.

1.1 Sediment

Both fine sediment and coarse sediment impair salmonid spawning and rearing in Cottonwood Creek. Therefore, both fine and coarse sediment TMDL analyses were conducted.

The fine sediment TMDL analysis shows that to meet the total suspended sediment at Lower Cottonwood Creek, the suspended sediment load needs to be reduced about 60% during the critical time period of January through May. Estimated load reductions for the 5 tributaries range from 60 to 95 percent.

Bedload modeling indicates that to stabilize the streambed at bankfull discharge, the streambed stability needs to be increased about 46%. Quantitative load allocations for the coarse sediment TMDL are not specified because there is not a direct linkage between the bed stability index and sediment load. A decreasing trend toward background sediment production, transport, and delivery by subwatershed is the goal of the coarse sediment load allocation scheme. Reducing coarse sediment delivery to Cottonwood Creek and timing of peak flood flows through best management practices will help improve the water quality of Cottonwood Creek. Future analysis of sediment sources and flow impacts will be used to help develop the sediment TMDL implementation plan.

1.2 Temperature

The Cottonwood Creek Total Maximum Daily Load (TMDL) was established to address thermal loading (heat) for the protection of steelhead salmon spawning and other cold water biota. Mainstem Cottonwood Creek from headwaters to mouth is protected for salmonid spawning (9^0C daily average, January 15 through July 15). Tributaries are required to meet cold water biota standards (19^0C daily average, year-round).

This TMDL establishes percent reduction targets (instream temperature) for non-point sources in each subwatershed. These percent reduction targets are linked to "Percent Increase in Shade" targets for each subwatershed, thereby reducing the overall rate of increase in instream temperature throughout the watershed. Management activities within a watershed, such as removing riparian shade trees, harvesting of the conifer overstory, grazing in riparian areas, and introducing bedload sediment which results in increased surface area, can increase the amount of solar radiation reaching the stream.

The amount of heat energy (i.e. loading capacity) which would meet State water quality temperature standards in the creek was determined by applying a modeling technique. Model results indicate that a 30 to 86% increase in shade is necessary in order to attain and maintain

State water quality standards, depending on stream reach. It is recognized that meeting the criteria will best be accomplished by additionally promoting channel restoration that leads to a narrower, deeper channel, colder water contributions from improved segments upstream, and/or increases in flow.

1.3 Nutrients/Dissolved Oxygen

Idaho's water quality criteria for nutrients states, "Surface waters of the State shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses." Impairment of recreational uses in the Cottonwood Creek watershed from excessive aquatic growth is not believed to be a problem due to low boating and swimming recreational use; however, impairment of aquatic life beneficial uses is considered to be a problem based on low dissolved oxygen levels observed in watershed streams.

The nutrient and dissolved oxygen TMDLs are combined. As part of these TMDLs, a key assumption is made that by meeting the instream nutrient target the dissolved oxygen water quality standard will be achieved as well. The TMDL establishes DO and percent saturation targets that are consistent with state water quality standards. The water quality standards states that for cold water biota, " a one day minimum of not less than 6.0 mg/L or 90% of saturation, which ever is greater." Both of these criteria are targets for Cottonwood Creek which is designated for cold water biota and salmonid spawning. The five major tributaries have not been specifically designated and are presumed to be protected for cold water biota; therefore, the DO criteria for cold water biota will be the target for these tributaries.

The nutrient TMDL used literature-derived targets for total inorganic nitrogen and total phosphorus. An averaging period of May through October was selected for estimating nutrient loading based on an assumption that this is when impairment is likely to occur and also that nutrients are not stored in the system. Since the City of Cottonwood wastewater treatment plant does not discharge during this time period, no waste load analysis and allocation was necessary. Using data collected from May 1997 through October 1997, nutrient loads and load capacities were estimated for the 5 major tributaries and lower Cottonwood Creek. Results consistently indicated significant reductions are necessary to meet the selected targets. Estimated phosphorus reductions ranged from 83 - 93%. Estimated nitrogen reductions ranged from 56 to 89%.

1.4 Pathogens

A BASINs nonpoint source modeling analysis was conducted for the pathogens TMDL using the State water quality criteria for fecal coliform bacteria. The mainstem of Cottonwood Creek and all tributaries were evaluated for secondary contact recreation. Red Rock was evaluated for primary contact recreation. This model estimates nonpoint souce loadings of bacteria for specific land uses in a watershed. Modeled instream bacteria concentrations were then calibrated with actual instream bacteria concentration data. Results indicated a needed load reduction ranging from 23 to 88% for the subwatershed streams. The Cottonwood WWTP is not a significant source of bacteria loading and therefore is given a WLA at its existing permitted limit. Significant sources appear to be runoff from animal wastes, septic tank failures, and cattle in streams.

1.5 Ammonia (Still Under Construction)

The TMDL for ammonia involved comparing total ammonia concentrations from samples collected between October 1996 and April 1998 to Idaho water quality criteria. The criteria for salmonid spawning and cold water biota are the same and vary depending upon pH and temperature conditions. Ammonia concentrations were first compared to stringent screening criteria based on worst-case temperature and pH conditions.

The existing ammonia data shows that problems exist in Upper Cottonwood Creek sub-watershed during the winter season. Ammonia concentration in this watershed increase in November and gradually decrease in March. For the Cottonwood Creek TMDL, the WLA for the Cottonwood WWTP during the critical time period (May - September) is 0lbs/day because the City of Cottonwood does discharge during the this time period. Based on the available data, ammonia concentration increase during the time which the Cottonwood Creek WWTP discharges (November - April). The TMDL requires an 5% reduction in total ammonia during the November - April time period to ensure water quality standards are met. The ammonia TMDL only addressed the toxicity effects of ammonia compounds; the nutrient effects of ammonia compounds are evaluated in the nutrient TMDL.

1.6 Flow and Habitat

Flow and habitat are identified on the §303(d) list as impairing uses in Jim Ford and Grasshopper Creeks. The TMDL does not address flow and habitat issues because these parameters are not currently required to be addressed under §303(d) of the Clean Water Act.

1.7 TMDL Implementation Plan

Within 18 months of approval of this TMDL, Cottonwood Creek WAG and supporting agencies will produce an implementation plan. This plan will specify projects and controls designed to improve Cottonwood Creek water quality by meeting the load allocations presented in this TMDL document. Implementation of best management practices within the watershed to reduce pollutant loading from nonpoint sources will be on a voluntary basis. Reductions from point sources will be addressed in revisions to discharge permits. This TMDL includes a Watershed Restoration Strategy that provides the framework for the implementation plan. It lists the types of best management practices the Cottonwood Creek WAG believes will best improve water quality. Example practices include prescribed grazing, alternate livestock water supplies, livestock exclusions, animal waste systems, tree and shrub planting, grassed waterways, streambank stabilization, conservation cropping and tillage practices, and protected riparian zones.

As additional information becomes available during the implementation of the TMDL, the targets, load capacity, and allocations may need to be changed. In the event that new data or information show that changes are warranted, TMDL revisions will be made with assistance of the Cottonwood Creek WAG. Because the targets, load capacity, and allocations will be re-examined and potentially revised in the future, the Cottonwood Creek TMDL is considered to be a phased TMDL. Although specific targets and allocations are identified in the TMDL, the ultimate success of the TMDL is not whether these targets and allocations are met, but whether beneficial uses and water quality standards are achieved.

Executive Summary Loading Table

Pollutant	Target	Subwatershed	Load	Load Capacity	Reduction Needed
Fine Sediment	50 mg/l TSS monthly average during critical time period (January - May)	Stockney	1,720 tons	206 tons	88%
		Upper Cottonwood	147 tons	59 tons	60%
		Shebang	401 tons	80 tons	80%
		SF Cottonwood	1,332 tons	67 tons	95%
		Long Haul	494 tons	74 tons	85%
		Red Rock	321 tons	116 tons	64%
		Lower Cottonwood	4,645 tons	1811 tons	61%
Coarse Sediment	Increase streambed stability about 46%	Bankfull width/depth ratio below 40 - 53% change			
		Pool frequency greater than 3 pools per 100 meters - 83% change			
		Increasing trend in residual pool volume			
		Depth fines of 5 year mean not to exceed 27 percent with no individual year to exceed 29 percent and subsurface fines <0.85 mm not to exceed 10 percent			

Pollutant	Target	Subwatershed	Frequently Occurring Temperature	Load Capacity	% Temperature reduction	% Shade Increase
Temperature	9°C/48°F during salmonid spawning period (January 15 - July 15) 19°C/66°F during other times of the year	Stockney	15°C/59°F	9°C/48°F	40%	47%
		Upper Cottonwood	18°C/64°F	9°C/48°F	25- 50%	44%
		Shebang	16°C/61°F	9°C/48°F	44%	76%
		SF Cottonwood	18°C/64°F	9°C/48°F	50%	44%
		Long Haul	19°C/66°F	9°C/48°F	53%	86%
		Red Rock	18°C/64°F	9°C/48°F	50%	75%
		Lower Cottonwood	21°C/70°F	9°C/48°F	50- 57%	30%

Pollutant	Target	Subwatershed	Load	Load Capacity	Reduction Needed
Total Inorganic Nitrogen	0.30 mg/l during growing season of April through October	Stockney	6,596 lbs/season	1,225 lbs/season	85%
		Upper Cottonwood	1,174 lb/season	637 lbs/season	56%
		Shebang	1,716 lbs/season	637 lbs/season	70%
		SF Cottonwood	2,527 lbs/season	752 lbs/season	76%
		Long Haul	1,682 lbs/season	752 lbs/season	64%
		Red Rock	6,412 lbs/season	836 lbs/season	89%
		Lower Cottonwood	32,441 lbs/season	6,470 lbs/season	91%

Pollutant	Target	Subwatershed	Load	Load Capacity	Reduction Needed
Total Phosphorus	0.10 mg/l during growing season of April through October	Stockney	1285 lbs/season	408 lbs/season	91%
		Upper Cottonwood	514 lbs/season	212 lbs/season	89%
		Shebang	436 lbs/season	212 lbs/season	87%
		SF Cottonwood	842 lbs/season	251 lbs/season	92%
		Long Haul	410 lbs/season	251 lbs/season	83%
		Red Rock	1,045 lbs/season	279 lbs/season	93%
		Lower Cottonwood	7,104 lbs/season	2,157 lbs/season	92%
Ammonia	IDAPA 16.01.02.250.02.c.iii 1.24 mg/l (November - April) 0.16 (May - October)	Upper Cottonwood City of Cottonwood (WLA)	784 lbs/season	742 lbs/season	5%
Bacteria	10% MOS in target Point Source (City of Cottonwood) remains at existing permit limit of 100 fcu/100ml Secondary Contact Recreation: 720 cfu/100 mL instantaneous and 180 cfu/100 mL 30-day geometric mean Primary Contact Recreation (Red Rock): 450 cfu/100 mL instantaneous and 45 cfu/100 mL 30-day geometric mean target	Stockney	72,200,000 bcfu/year	20,900,000 bcfu/year	71%
		Upper Cottonwood	28,000,000 bcfu/year	15,400,000 bcf/year	45%
		Shebang	107,000,000 bcfu/year	12,800,000 bcfu/year	88%
		SF Cottonwood	9,610,000 bcfu/year	7,400,000 bcfu/year	23%
		Long Haul	14,400,000 bcfu/year	8,930,000 bcfu/year	38%
		Red Rock	47,500,000 bcfu/year	15,700,000 bcfu/year	67%
		Lower Cottonwood	168,000,000 bcfu/year	82,300,000 bcfu/year	51%

cfu - colony forming units; bcfu - billion cfu/year; lbs - pounds; °C - degrees centigrade;
°F - degrees Fahrenheit; MOS - margin of safety

2.0 WATERSHED ASSESSMENT

The Cottonwood Creek Watershed Assessment (Sections 2.0 - 2.4) characterizes the natural features of the watershed and water quality concerns. Section 2.1 provides a general description of the watershed that covers climate, hydrology, geology, soils, fisheries, vegetation, land uses and land ownership. Section 2.2 documents studies related to beneficial use support and water quality. Sections 2.3 and 2.4 summarize pollutant sources and pollution control efforts.

The majority of text and statistics in Section 2.1 (Watershed Characterization) are taken directly from the Idaho County Soil and Water Conservation District's Cottonwood Creek State Agricultural Water Quality Planning Project Draft Final Report (ICSWCD 1999). Most of the data used in the TMDL and summarized in Section 2.2 are taken from the report on the monitoring phase of this project (Gilmore 1998). The Idaho Soil Conservation Commission (ISCC) provided the figures for this Assessment.

2.1 Watershed Characterization

2.1.1 General Description (ICSWCD 1999)

The Cottonwood Creek watershed, located in north central Idaho, begins at Cottonwood Butte in the northwest corner of Idaho County, west of the farming community of Cottonwood (Figure 1). From Cottonwood Butte (elevation 5,730 feet), Cottonwood Creek flows approximately 29 miles east through the Camas Prairie where it drains into the South Fork of the Clearwater River just above the town of Stites (elevation 1,319 feet) approximately 4 miles south of Kooskia, Idaho. Elevational differences are indicated on Figure 2. Cottonwood Creek drains a large portion of the Camas Prairie north of Grangeville. The topography of the watershed encompasses steep forested land in the headwaters, rolling cropland associated with the prairie, and deep canyons where Cottonwood Creek dissects the prairie in the eastern half of the watershed.

The size of the watershed is 124,439 acres covering approximately 192 square miles, all located in Idaho County. Approximately 58,373 acres or 47% of the watershed is within the Nez Perce Tribe (NPT) Reservation boundary. The 5 major tributaries of Cottonwood Creek are: Stockney, Shebang, Long Haul, South Fork Cottonwood and Red Rock Creeks (Figure 3). The watershed is broken into eight subwatersheds for the TMDL (Figure 3): Shebang Creek, Upper Cottonwood Creek, Stockney Creek, Red Rock Creek, Lower Cottonwood Creek, Middle Cottonwood Creek, South Fork Cottonwood Creek and Long Haul Creek. Table 1 indicates the acreage for each subwatershed.

Cottonwood Creek Watershed Location Map

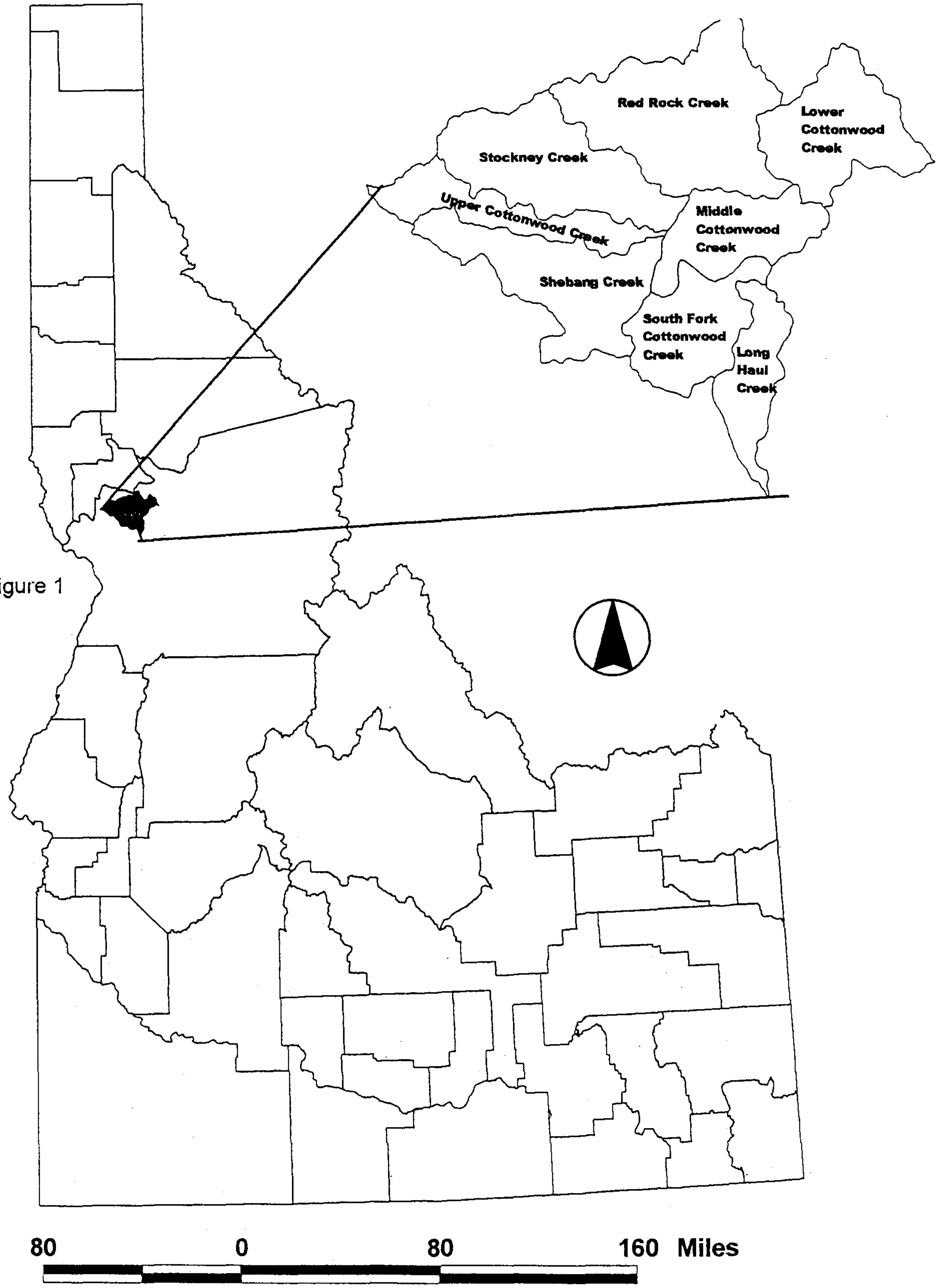
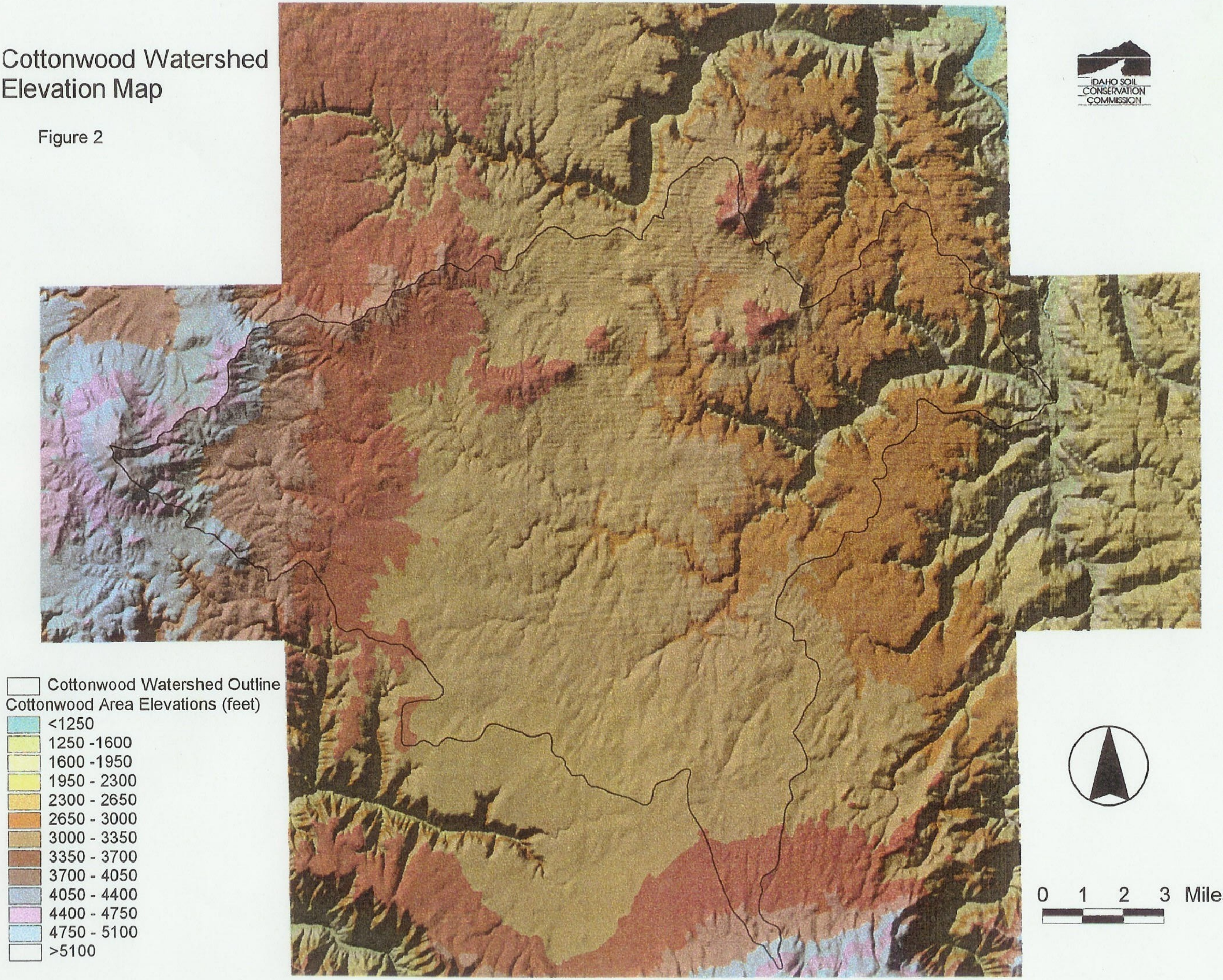


Figure 1

Cottonwood Watershed Elevation Map

Figure 2



Cottonwood Watershed Hydrology

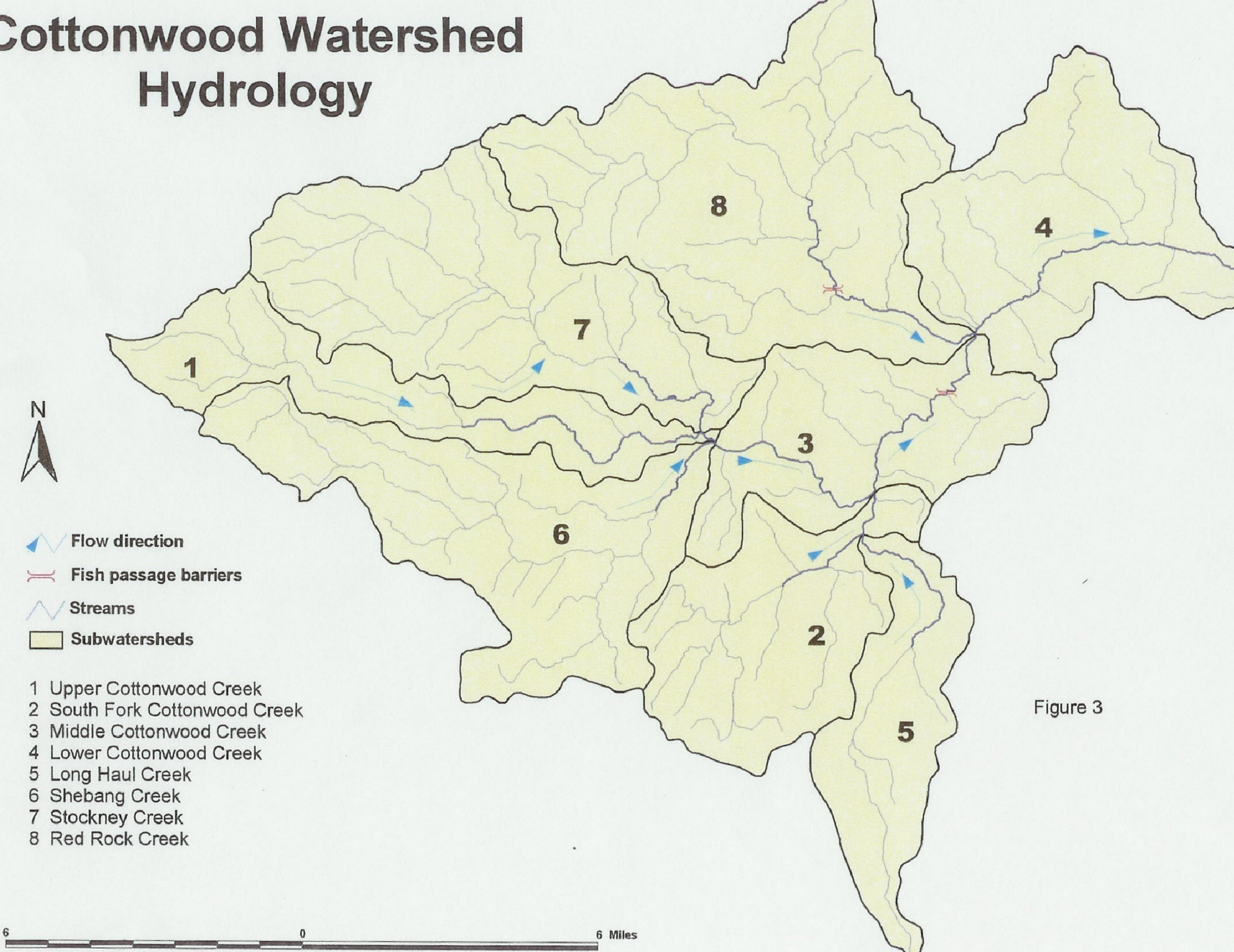


Figure 3

Table 1. Acreage of Cottonwood Creek Subwatersheds

Tributary	Acreage
Stockney Creek	19,917
Upper Cottonwood Creek	10,098
Shebang Creek	18,332
South Fork of Cottonwood Creek	12,557
Long Haul Creek	8,872
Red Rock Creek	26,482
Middle Cottonwood Creek	12,061
Lower Cottonwood Creek	16,120
TOTAL WATERSHED	124,439

2.1.2 Climate (ICSWCD 1999)

Climate in the Cottonwood Creek watershed is characterized as subhumid with cool moist winters and warm dry summers. Average summer high temperatures range from 90°F in Kooskia to 80°F across the Camas Prairie. Daily summer high temperatures can reach over 100°F, especially in the valley. A record high temperature of 114°F was recorded in Kooskia. January low temperatures average around 20°F. Temperatures below zero are common in the winter, and a record low -23°F was recorded in Cottonwood.

The average consecutive frost-free period (above 32°F) ranges from 115 days in Grangeville to 133 days in Kooskia. The average last frost (below 32°F) in the spring occurs in mid-May in Kooskia and in late May in the Camas Prairie area. The first frost in the fall occurs from mid- to late-September.

Average annual precipitation ranges from 20-25 inches across most of the basin with over 30 inches falling in the Cottonwood Butte area. Monthly precipitation averages are greatest March through June and the least during July. Monthly precipitation amounts range from 2-3 inches a month in the spring and 1-2 inches per month during the rest of the year.

Parts of Cottonwood Creek basin are periodically covered with an intermittent snowpack from November through March. The number of days per year with at least one-inch of snow on the ground ranges from 20 days in Kooskia to around 50 days in Grangeville. Higher elevation areas receive more snow and have a seasonal snowpack that may peak at around 8-10 inches of snow in March. Average annual snowfall amounts range from 22 inches per year in Kooskia to 50-60 inches across the Camas Prairie.

Table 2 presents precipitation records collected by volunteers during the State Agricultural Water Quality Project (SAWQP) conducted between October 1996 and April 1998. Water quality data from this project is the main source of data used for loading calculations presented in Sections 3.1 to 3.5. The SAWQP compared precipitation during this sampling period to historical conditions (Gilmore 1998). Precipitation for the 1997 water year (October 1996 through September 1997) was approximately 128% above average across the watershed. Precipitation was well above average for November and December 1996 and January 1997. Heavy snowpack in November and December melted rapidly due to warm chinook winds, which resulted in severe flooding conditions December 31, 1996 to January 1, 1997. Higher than normal precipitation continued throughout the spring of 1997 with March and April at 176% and 179% above normal, respectively. For the initial months of the 1998 water year (October 1997 through March 1998), precipitation was 58% below average.

2.1.3 Hydrology (ICSWCD 1999)

2.1.3.1 Surface Water Flows

There are no long-term stream gauging stations in the study area. Several temporary water level measurement stations were installed at seven locations in the watershed during the Cottonwood Creek SAWQP monitoring between October 1986 and April 1998 to estimate stream flows (Gilmore 1998). In addition the U.S. Geological Survey (USGS) has collected about 15 flow measurements in the early 1960s and in 1995 and 1996. That data, combined with other sporadic flow collection measurements from other studies, will be used in the TMDL to compare actual flow measurements to estimated flow measurements. In February 1999, the NPT installed a flow monitoring station at the mouth of Cottonwood Creek.

The majority of Cottonwood Creek streamflow comes from rain and snowmelt during the winter and spring. Because a large majority of the basin is below 4,000 feet, the basin is susceptible to winter rains and rain-on-snow runoff events. Based upon historic streamflow data from nearby gauging stations such as Lapwai Creek which have similar hydrologic flow characteristics, the February through May period may account for as much as 70 percent of the annual runoff streamflow.

Table 2. Precipitation Records from October 1996 - April 1998 (inches)

Month	Stockney Creek	Red Rock Creek	Lower Cottonwood Creek
Oct. 1996	1.04	1.42	1.85
Nov. 1996	2.44	3.05	3.45
Dec. 1996	3.40	4.22	2.79
Jan. 1997	1.71	2.36	2.83
Feb. 1997	0.91	0.66	1.20
Mar. 1997	2.67	2.74	4.89
April 1997	3.31	4.39	5.03
May 1997	1.32	2.74	3.33
June 1997	1.45	2.50	2.13
July 1997	2.91	3.35	3.90
Aug. 1997	0.54	0.37	0.40
Sept. 1997	2.27	2.24	2.41
Oct. 1997	1.66	1.09	1.39
Nov. 1997	1.07	0.59	1.41
Dec. 1997	0.54	0.92	0.95
Jan. 1998	1.12	1.16	1.80
Feb. 1998	0.32	0.50	1.48
Mar. 1998	1.25	1.32	1.29
TOTAL	29.93	35.62	42.53

Annual maximum peak flows in Cottonwood Creek are a result of winter or spring precipitation, rain-on-snow runoff events, or spring snowmelt. Rain accompanied by warm chinook winds is a common occurrence in the winter and early spring and often results in high and rapid runoff. During the winter, an intermittent snowpack may cover parts of the basin from November through March, providing additional runoff during rain events. These annual peaks may occur from December through May depending upon the duration and intensity of precipitation events.

At the nearby gauging station on Lapwai Creek, April is typically the peak discharge month, accounting for an average of 24 percent of the annual. A simulated hydrograph of Lower Cottonwood Creek indicates March to be the typical peak discharge month in Cottonwood Creek, where there is more mid-elevation area and less snow in higher forested area compared to Lapwai Creek. The lowest streamflow levels in Cottonwood Creek usually occur late summer or early fall before the fall rains begin. Appendix A provides a more detailed flow analysis that was used for TMDL flow estimates.

Rapid runoff and severe soil erosion may occur during winter precipitation events when the ground is frozen and bare of vegetation or stubble. Frozen soils may occur during the winter especially when snow cover is lacking. Soil temperature data in the nearby Craigmont area indicates the 4 inch soil temperature ranges from 28-36° F from December through February. The lowest minimum 4 inch temperature value recorded was 18°F in December 1991.

High intensity summer precipitation events may occur in the basin producing high and rapid runoff. The greatest one day precipitation event measured at the Cottonwood climatic station since 1977 was 2.10 inches in January 1982. However, localized, high intensity rainfall may occur at any time of the year producing high and rapid runoff. The majority of the annual maximum daily precipitation events occur in May and range from 1-2 inches.

Hydrology plays an important role in the overall effects on fisheries and other watershed uses. Land cover changes and subsequent management have resulted in dramatic changes to runoff and peak discharge from the watershed during storm events. The US Department of Agriculture Natural Resource Conservation Service (NRCS) Technical Release #20 (TR-20) computer model was used to simulate current and historic watershed conditions for Cottonwood Creek and the smaller tributaries (ICSWCD 1999). The peak streamflow discharge from a 25-year, 24-hour rainfall precipitation event under current conditions is 1.6 times, or 60 percent greater compared to historic conditions. Figure 4 illustrates the increase in peak discharge and total discharge from the historic watershed condition to the present watershed condition due to conversion of prairie to cropland. Similar results or ratios were obtained in comparing current to historic peaks for the 5 smaller tributaries and the entire Cottonwood Creek drainage basin.

Total volume for the 25-year, 24-hour runoff event was 40 percent more or 1.4 times greater under current than historic conditions. The relationship between current and historic runoff conditions for the 4 design storm events analyzed illustrates that both the peak runoff rates and total runoff volumes for the events are much greater under current conditions than historic conditions. Due to limitations of the hydrology model, data is displayed in a dimensionless hydrograph (ICSWCD 1999). The model serves for comparison purposes only and cannot be used to calculate or model actual flow.

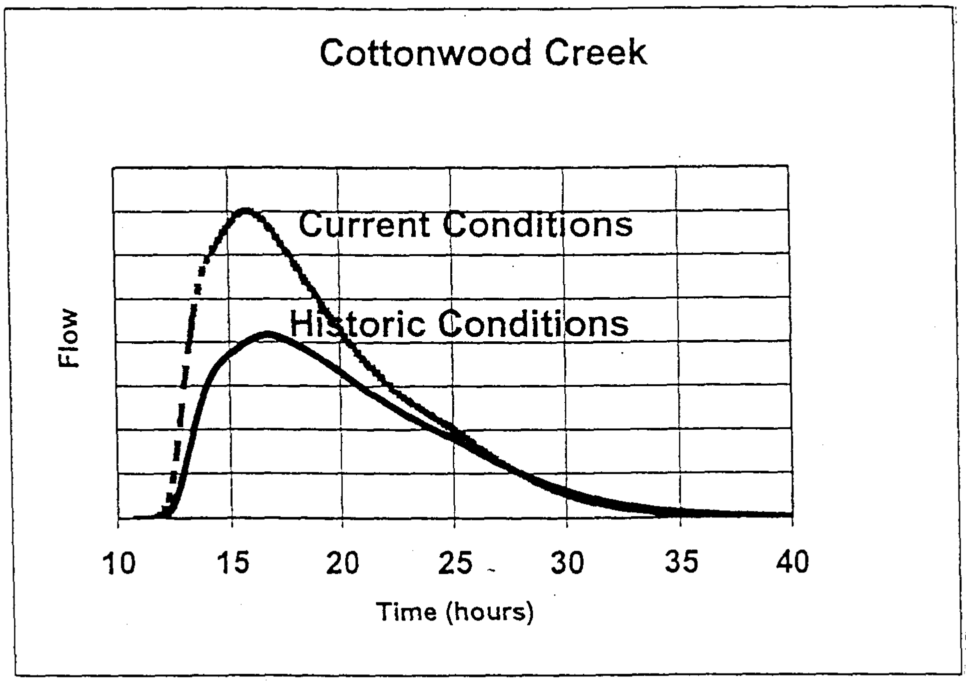


Figure 4. Dimensionless Hydrograph for a Modeled 25-year, 24-hour Rain-on-Snow Event for the Cottonwood Creek Watershed.

The TR-20 model illustrates the dramatic effect that land cover changes have had on the hydrology of the watershed. The model indicates that much less water is potentially stored in the current condition of the watershed than in the historic condition. Water moves more quickly through the watershed today producing higher peak flows and larger volumes as a result of the change in vegetation and ground cover in the basin. In addition, less water is retained or stored in the basin for base flow after runoff events. Higher peak flows may also impact stream channels by widening and scouring channels and provide the energy for transporting and moving larger substrate downstream.

2.1.3.2 Ground Water

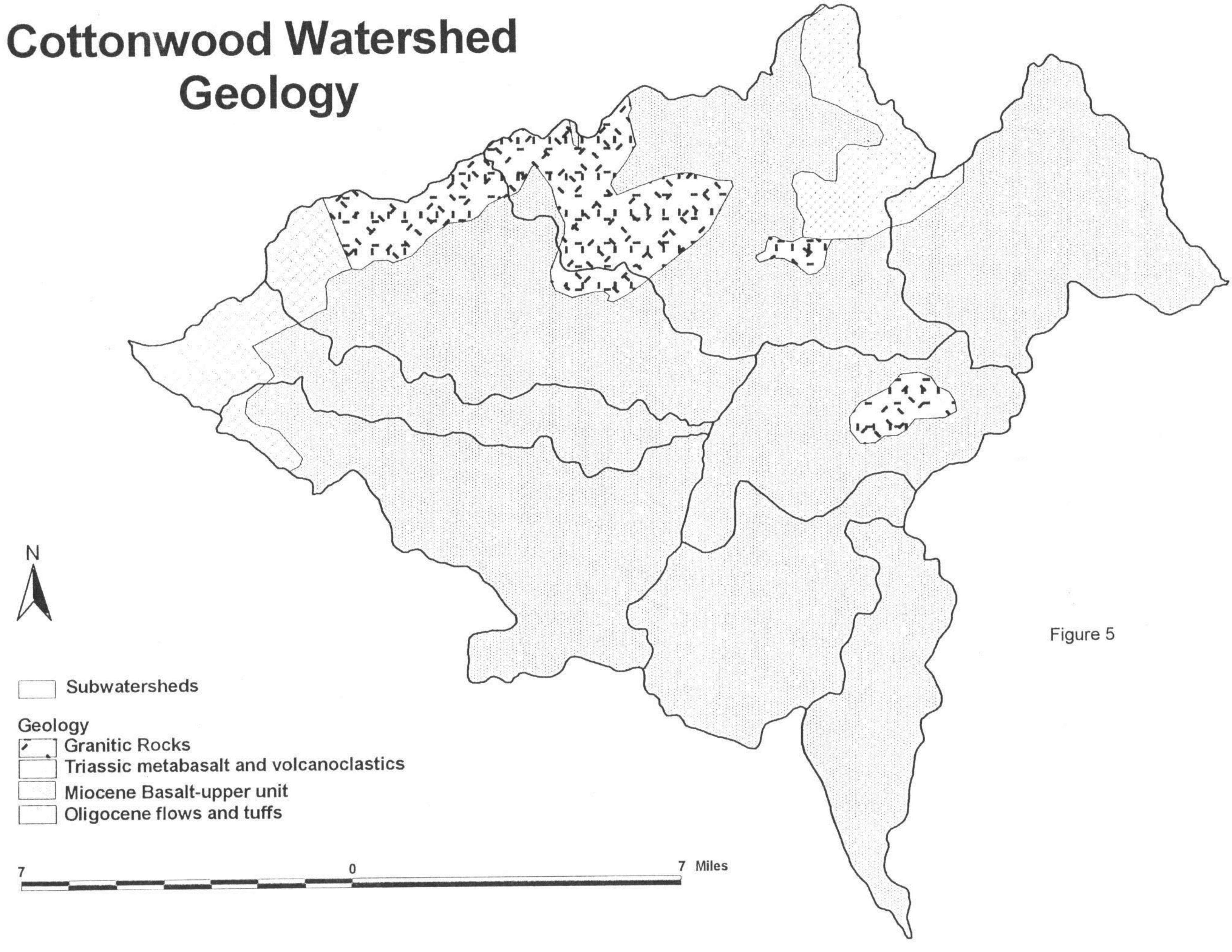
The Cottonwood Creek watershed overlies the Clearwater Plateau ground water system. The aquifer is recharged by the area's streams where permeable basalts are exposed to stream channels and by precipitation percolating through fractured bedrock in upland areas.

The quality of ground water within the Clearwater Plateau flow system is reported as suitable for domestic use, though levels of dissolved cadmium and lead occasionally exceed primary drinking water criteria and concentrations of dissolved manganese sometimes exceed the recommended level (ICSWCD 1999). Recent ground water studies in the Cottonwood and Camas Prairie areas have indicated levels of nitrate exceeding the state criteria in some monitoring and domestic wells (refer to Section 2.2.5).

This ground water system is prioritized as 10th within Idaho with the following potential agricultural contamination sources: feed lots, hazardous material handling, pesticide handling and use, surface runoff, fertilizer application, septic tank systems, domestic wells, and silvicultural activities (IDWR 1981).

2.1.4 Geology (ICSWCD 1999)

Figure 5 indicates the general geology of the Cottonwood Creek watershed. The watershed is in the Columbia Plateau Geomorphic Province. Bedrock predominantly consists of Tertiary Age Columbia River Basalt. Cottonwood Butte on the west edge of the watershed is formed in Permian-Triassic Age Seven Devils Volcanics - metamorphosed volcanic and sedimentary rocks. Isolated areas along the north edge of the area and a section of the main stem Cottonwood Creek downstream from the South Fork Cottonwood Creek confluence are formed in Cretaceous Age disintegrating granitic rock of the Idaho batholith. The watershed area is typified by gently sloping upland plateaus which drain into deep, narrow canyon streams, indicating watershed development in a rolling, dissected basalt plateau. The upper plateau area is partially mantled by Quaternary Age Palouse loess.



Cottonwood Watershed
Geology
N
Subwatersheds
Geology
Granitic Rocks
Triassic metabasalt and volcanoclastics
Miocene Basalt-upper unit
Oligocene flows and tuffs
7
0
7 Miles

Figure 5

2.1.5 Soils (ICSWCD 1999)

The types of soils in the watershed affect many aspects of surface water quality and quantity, particularly the quantity of sediment in the streams. Soils in the Cottonwood Creek watershed are cut-over forest and prairie soils derived primarily from wind-blown silt loess, with alluvium and colluvium. The soil map units in this watershed have been grouped into 7 soil groups (Figure 6). These groupings are based on landform, depth of soil, drainage class, erosion hazard, and the potential pesticide loss due to leaching and surface loss. The 7 soil groups include the following:

1) Westlake-Wilkins Silt Loam (soil type 1); Nearly level to gently sloping, very deep, somewhat poorly drained soils formed in alluvium derived primarily from loess, and occurring on bottomlands and drainageways.

2) Nez Perce Silt Loam (soil type 2); Gently sloping to moderately steep, very deep, and moderately well drained to well drained soils formed in loess, occurring on plateaus on south facing prairie slopes.

3) Uhlorn Silt Loam (soil type 2); Gently sloping to sloping, very deep, well drained soils formed in loess and occurring on plateaus on north facing prairie slopes.

6) Ferdinand-Bluesprin-Riggins Complex (soil type 3); Strongly sloping to very steep, very shallow to very deep, well drained soils, formed in loess colluvium and residuum from basalt, andesite, and granite on south-facing slideslopes and shoulders.

7) Klickson-Suloaf Association (soil type 4); Strongly sloping to extremely steep, shallow to very steep, well drained soils formed in loess, colluvium and residuum from basalt, andesite and granite on moderately high plateaus, mountains and north-facing canyon sides.

Table 3 provides a summary of the hydrologic characteristics, runoff and erosion potential of these major soil groupings. A more detailed description of soil characteristics is also provided in Appendix A of the SAWQP report (ICSWCD 1999).

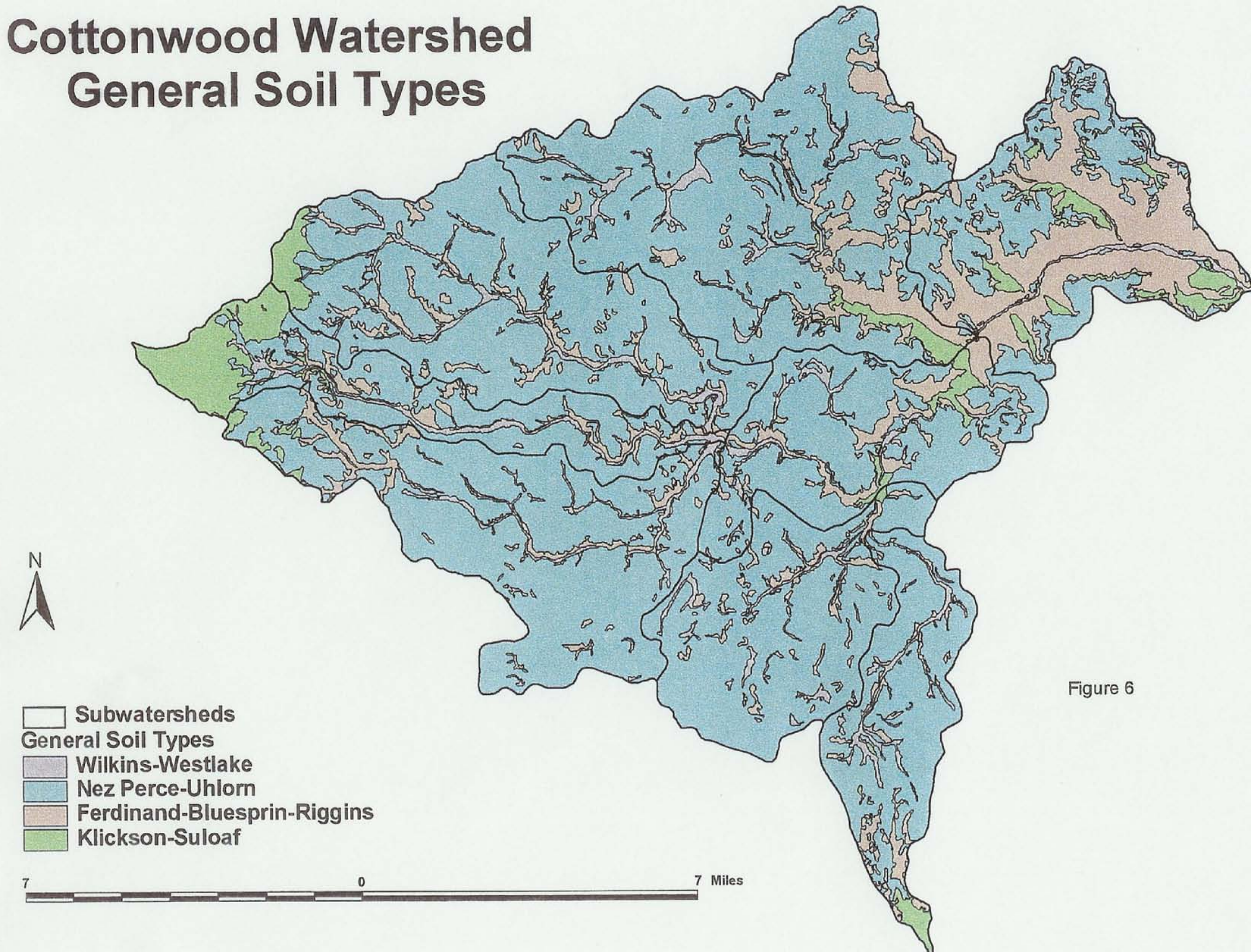

Cottonwood Watershed
General Soil Types
N
Subwatersheds
General Soil Types
Wilkins-Westlake
Nez Perce-Uhlorn
Ferdinand-Bluesprin-Riggins
Klickson-Suloaf
7
0
7 Miles
Figure 6

Table 3. Hydrologic Characteristics, Runoff, and Erosion Potential of Major Soil Groupings

Soil	Soil Group	Hydrologic Group	Flood Hazard	Season Water Table	Permea-bility	Run off Potential	Erosion Potential	Soil Leaching Potential
Wilkins Silt Loam	1	D	Yes	Yes	Slow	Slow	None/ slight	Nominal
Westlake Silt Loam	1	C	Yes	Yes	Moderately slow	Very slow	None/ slight	Nominal
Nez Perce Silt Loam	2	C	No	Yes	Moderately slow	Medium rapid	Moderate severe	Nominal
Uhlorn Silt Loam	2	C	No	No	Moderately slow	Medium rapid	Moderate	Nominal
Meland Silt Loam	2	C	No	No	Moderately slow	Rapid	Severe	Nominal
Ferdinand	3	C	No	No	Slow	Very rapid	Very severe	Nominal
Bluesprin	3	B	No	No	Slow	Very rapid	Very severe	Nominal
Riggins	3	C	No	No	Slow	Very rapid	Very severe	Nominal
Klickson	4	B	No	No	Moderate	Very rapid	Very severe	Inter-mediate
Suloaf	4	B	No	No	Moderate	Very Rapid	Very severe	Nominal

2.1.6 Fisheries

Documented fish occurrences have been recorded by a variety of sources; including Bureau of Land Management, NPT, Idaho Department of Fish & Game, and Idaho Division of Environmental Quality.

Cottonwood Creek provides spawning and rearing habitat for rainbow/steelhead trout. Steelhead trout were federally listed as a threatened species on October 17, 1997. A full passage barrier at all flows for anadromous fish occurs at stream mile 9.0. The lower reaches of Cottonwood Creek lack good riparian cover and shade. The primary limiting factors to aquatic life include lack of good quality pools, lack of instream cover, elevated water temperatures, wide/shallow stream channels, and flood scoured stream channel/banks.

Aggradation of the South Fork Clearwater River associated with bedload transport is occurring at its confluence with Cottonwood Creek (river mile 4.7) and other Camas Prairie tributaries. The net result is a channel that is wider, more shallow, and likely containing fewer large pools than existed under natural conditions. In addition, much of the lower South Fork Clearwater becomes unsuitable for cold water salmonids due to warm temperatures and elevated sediment yields.

This habitat loss in the mainstem South Fork Clearwater River has reduced connectivity for migrating adults and juveniles in addition to rearing capability (USFS 1998).

Red Rock Creek flows into Cottonwood Creek at stream mile 7.0. Red Rock Creek provides fish habitat although it has a full/partial passage barrier (possible fish passage at the right flow but doubtful) for anadromous fish occurring at stream mile 3.6. Common channel types below the barrier consist of A and B channels. Primary limiting factors include lack of good quality pools, lack of instream cover, deposited sediment, elevated water temperatures, and flood scoured stream channels.

Documented Fish Species on mainstem Cottonwood Creek **below** the fish migration barrier include:

Steelhead trout	*Oncorhynchus mykiss*
Resident rainbow trout	*Oncorhynchus mykiss*
Mountain whitefish	*Prosopium williamsoni*
Northern squawfish	*Ptychocheilus oregonensis*
Chiselmouth	*Acrocheilus alutaceus*
Bridgelip sucker	*Catostomus columbianus*
Sculpin	*Cottus sp.*

Fish species found on mainstem Cottonwood Creek and tributaries **above** fish migration barrier include:

Black bullhead	*Ictalurus melas*
Pumpkinseed	*Lepomis gibbosus*
Redside shiner[1]	*Richardsonius balteatus*
Speckled dace[1]	*Rhinichthys osculus*

The mouth area and lower reaches of Cottonwood Creek have the potential to be used by other fish species found in the South Fork Clearwater River. Consequently, it could be expected that spring/summer chinook salmon potentially could be found in the lower segment of Cottonwood Creek (juvenile rearing only) although it is not documented. Snake River chinook salmon (stream and ocean types) were listed under the Endangered Species Act in 1992. Spring chinook salmon in the Clearwater River were exempted from the listing because of uncertainty associated with the genetic integrity of this stock. Genetic integrity was questioned because the construction of the Lewiston Dam in the early 1900s allegedly eliminated all runs of native spring chinook salmon into the Clearwater basin. Those currently found in the basin are exclusively of hatchery origin, although they may be naturally reproducing (USFS 1998).

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[1]Denotes fish found above and below fish migration barrier

Bull trout (*Salvelinus confluentus*), which are found in the South Fork of the Clearwater River, are federally listed as a threatened species. Bull trout have not been documented in Cottonwood Creek although the lower reaches may supply suitable habitat for adult and sub-adult rearing when water flows and temperatures are suitable (i.e. fall, winter, spring).

Steelhead are widely distributed across the South Fork Clearwater River basin. Abundance varies by year, and is partially correlated with numbers of returning adults. Other factors affecting abundance include habitat quality, hatchery supplementation, and fishing pressure. To accomplish restoration of mainstem South Fork Clearwater River conditions, all watersheds in the subbasin should be considered (USFS 1998). Steelhead begin migrating up the Columbia River in July and usually arrive at the Clearwater River in September and remain in its large pools during the winter. They move into lower elevation tributaries such as Cottonwood Creek in the spring to spawn, with fry typically emerging no later than mid-June (Johnson 1999a). Steelhead were documented migrating up lower Cottonwood Creek in March and April 1999 (NPT 1999a). Juveniles rear for 2-3 years in natal streams before migrating to the ocean. A considerable number of steelhead do not migrate to the ocean; instead, these fish remain as resident rainbow trout in fresh water.

The following descriptions of the various fish species documented in Cottonwood Creek is taken from *Fishes of Idaho* (Simpson and Wallace 1982).

Mountain whitefish prefer cold mountain streams with deep pools. These fish mature in 3 years and are fall spawners (October through November) with the eggs laid in riffles hatching in March. Desired spawning substrate is gravel and small rubble with an adequate current to keep silt removed from the eggs. Their food consists primarily of aquatic and terrestrial insects.

Squawfish prefer to spawn in shallow water over a gravel bottom in late May to early July. Eggs are deposited randomly. Squawfish eat aquatic invertebrates, but fish are the bulk of their diet.

The sculpin has been used as an indicator of waters of high quality having high dissolved oxygen, cool temperatures, and low levels of pollution. Generally sculpin spawn in May and early June with adhesive eggs deposited in rock crevices and under rocks. The nest usually is protected by a single male until the eggs hatch after 30 days at 50°F. Sculpin eat insects and small fish. Sculpin serve as an important food source for trout.

Chiselmouth spawning occurs in spring and early summer when water temperatures reach 60°F. Spawning occurs in streams over gravel or small rubble. Adults feed exclusively on algae although the young will feed on the surface and do consume insects.

Bridgelip suckers prefer the colder water of small, fast flowing rivers with gravel to rocky bottoms. Spawning occurs in late May to June.

Speckled dace will live in a variety of habitats, but normally prefer shallow, cool and quiet waters. Little is known of the spawning habits of this fish in Idaho, except that it spawns in the spring. Stomach analyses indicate that it is an omnivorous feeder.

The redside shiner prefers lakes, ponds, or rivers with slow-moving currents. Spawning occurs in June or July with adults moving into spawning areas when the water temperatures reaches at least 50°F. The eggs are adhesive and settle to the bottom attaching to the substrate or submerged vegetation. The fry feed on small planktonic organisms but switch to a diet of insects, mostly terrestrial, by the second year of life. They will also eat eggs, often their own.

Pumpkinseeds reproduce in the spring when water temperatures reach approximately 65°F. Nests are built on the bottom in fine gravel or sand. These fish eat mainly snails and aquatic insects although small fish, larval frogs and salamanders may also be consumed.

The black bullhead has a high tolerance for silty water with low oxygen and warm temperatures as high as 85°F. Spring spawning occurs when water temperatures reach 65°F. Food is composed of snails, aquatic insects, crustaceans, and plant material.

It should be noted that the fish species present above the Cottonwood Creek fish migration barrier appear to be well suited to warmer, lower velocity waters, with small bottom substrate and assumable higher turbidity.

2.1.7 Wetlands (ICSWCD 1999)

Wetlands in watershed are closely associated with Cottonwood Creek and tributaries. Most wetland areas within the watershed occur near streams and seeps associated with valley bottom areas. Historically, few wetlands occurred on upland areas away from the valley bottoms. According to the Cowardin classification system, major wetland types in the watershed include riverine and palustrine emergent. Hydrology regimes include open water, seasonally flooded, temporarily flooded and saturated. Hydrophytic vegetation associated with riverine wetlands include reed canary grass, willow species, hawthorn, rose, cottonwood and alder. Palustrine emergent wetlands vegetation is dominated by reed canary grass with smaller amounts of sedge species, rush species, bulrush and cattails.

2.1.8 Land Uses and Ownership

2.1.8.1 Past Land Uses and Ownership

Since time immemorial, the NPT had utilized the Camas Prairie for a variety of uses, including subsitence gathering activities such as camas digging. From the early 1700's when the Nez Perce obtained horses, the prairie also provided excellent summer pasture for their herds (Josephy 1965).

This description of the area comes from *The Journals of Lewis and Clark.* On May 9, 1806 Captain Lewis wrote (Bergon 1989):

"our rout lay through a level rich country similar to that of yesterday [Camas Prairie, Idaho]...the country is level extreemly fertile and in many parts covered with a tall and open growth of the longleafed pine [Ponderosa pine], near the watercourses the hills are steep and lofty tho' [they] are covered with a good soil not remarkably stony and possess more timber than the level country, the bottom lands on the watercou[r]ses are reather narrow and confined tho' fertile & seldom inundated. this country would form an extensive settlement; the climate appears quite as mild as that of similar latitude on the Atlantic coast if not more so and it cannot be otherwise than healthy; it possesses a fine dry pure air. the grass and many plants are now upwards of knee high. I have no doubt but this tract of country if cultivated would produce in great abundance every article essentially necessary to the comfort and subsistence of civilized man. ...nature...has distributed a great variety of esculent plants over the face of the country..."

In the 1860's supplies for mining camps in Florence were packed along trails across the prairie. Settlement began along these trails. In 1862 several way stations sprang up along the trail including one at Cottonwood, built along the south bank of Cottonwood Creek (Elsensohn 1978). In volume one of *Pioneer Days in Idaho County* Elsensohn states, "A beautiful grove of cottonwood trees once lined the banks of the creek a short distance below the town. From these...the town got its name. It is said...[the trees] were cut...for use in the construction of a combination store, saloon, hotel and stage station."

Along with rapid settlement, agriculture began on the Camas Prairie in the late 1800's. Elsensohn quotes pioneer Loyal P. Brown who said, in an 1888 address to the Idaho County Pioneer Association:

"In spring of 1863...grain was sowed, and I think the first timothy ever grown in Idaho was planted...Settlers continued to come, and we find today nearly all the public lands taken up and occupied for homes...Small fruits [apples, pears, plums and cherries] were...cultivated and we find good orchards all over the Prairie...we can also boast of well cultivated farms producing grain and vegetables,...It is generally conceded that no section of the northwest produces better than our Camas Prairie. Oats and barley often exceed one hundred bushels per acre, with wheat from thirty to sixty bushels. Truly, this is the land of homes, a good climate, rich and productive soil, fine pasturage for the stock grower."

Elsensohn states that during this same period stockmen brought herds of cattle and sheep to "fatten on the luscious bunchgrass that covered the [Camas Prairie]."

In the late 1800's numerous sawmills were built in the area. By the mid 1890's there were seven sawmills within a five or six mile radius of Keuterville alone. The capacity of these early mills ranged anywhere from 500 to 15,000 feet per day (Elsensohn 1978).

In 1908 a railway was established across the prairie which helped to boost growth in the region. By 1914 Cottonwood was recognized as the largest grain and stock shipping point on the Grangeville extensions of the Northern Pacific Railroad (Elsensohn 1978).

Populations on the Camas Prairie continued to steadily grow to the present. Advances in machinery in the early 1900's enabled farmers to work larger parcels of land. Many, then, sold out to their neighbors. Therefore as farm sizes increased, populations of some of the smaller towns decreased (Craigmont High School 1963).

2.1.8.2 Cultural Resources

The NPT has utilized this watershed since time immemorial. Resources of significance include camps, villages, and other areas of significant cultural and religious value. Prehistoric and historic cultural resources have been identified in the watershed. Historic resources include farmsteads, stores, and cabins. Resources of significance include camps, villages, and areas of traditional cultural value. An oral history manuscript depicting historical and cultural uses of lands by the NPT (University of Idaho 1977) indicates historic trails in watershed areas covered by the Keuterville, Cottonwood, Nez Perce SW, and Nez Perce SE topographic USGS quadrangle maps. The Nez Perce have and continue to use the canyon as a corridor. Although cultural resources are undocumented, they are likely present along Cottonwood Creek.

2.1.8.3 Present Land Uses (ISCWD 1999)

The area in the Cottonwood Creek watershed is predominately rural with an economy based on agriculture. The entire City of Cottonwood, population of 835 (1990 Census) and a portion of the City of Grangeville, population of 3,400, are within the watershed. Grangeville is the Idaho County seat and the watershed comprises 2.3% of the total area of Idaho County. The population, based on 1995 estimates, is 14,789.

Land uses in the Cottonwood Creek watershed are shown in Figure 7 and summarized by subwatershed in Table 4. Cropland comprises 74% of the land use in the watershed; pastureland 7%; rangeland 13%; forestland 6% and urban/industrial < 1%.

Table 4. Land Use by Subwatershed

Subwatershed	**Cropland**	**Pastureland**	**Rangeland**	**Forestland**	**Urban/ Industrial**	**Total Acres**
Stockney Creek	16,364	897	2,094	558	4	19,917
Upper Cottonwood	5,689	1,578	405	2,062	364	10,098
Shebang	15,790	1,408	754	318	62	18,332
South Fork Cottonwood	10,989	1,091	452	16	9	12,557
Long Haul Creek	6,940	905	100	250	677	8,872
Red Rock Creek	20,889	944	3,777	833	29	26,482
Middle Cottonwood	8,929	689	1,597	846	0	12,061
Lower Cottonwood	6,188	993	6,755	2,184	0	16,120
Total Acres	91,788 74%	8,505 7%	15,934 13%	7,067 6%	1,145 <1%	124,43 9

There are 5 dairies, 11 hog producers, and approximately 160 winter feeding operations in the watershed. The size of these winter feeding operations vary from 0.10 acres to 30+ acres. Approximately 1/4 of these operations have large amounts of animals confined to small acreage with direct access to the creek and are considered critical areas for Best Management Practice (BMP) implementation (ICSWCD 1999). Table 5 provides a breakdown of the location of these facilities by subwatershed.

Cottonwood Watershed Landuses

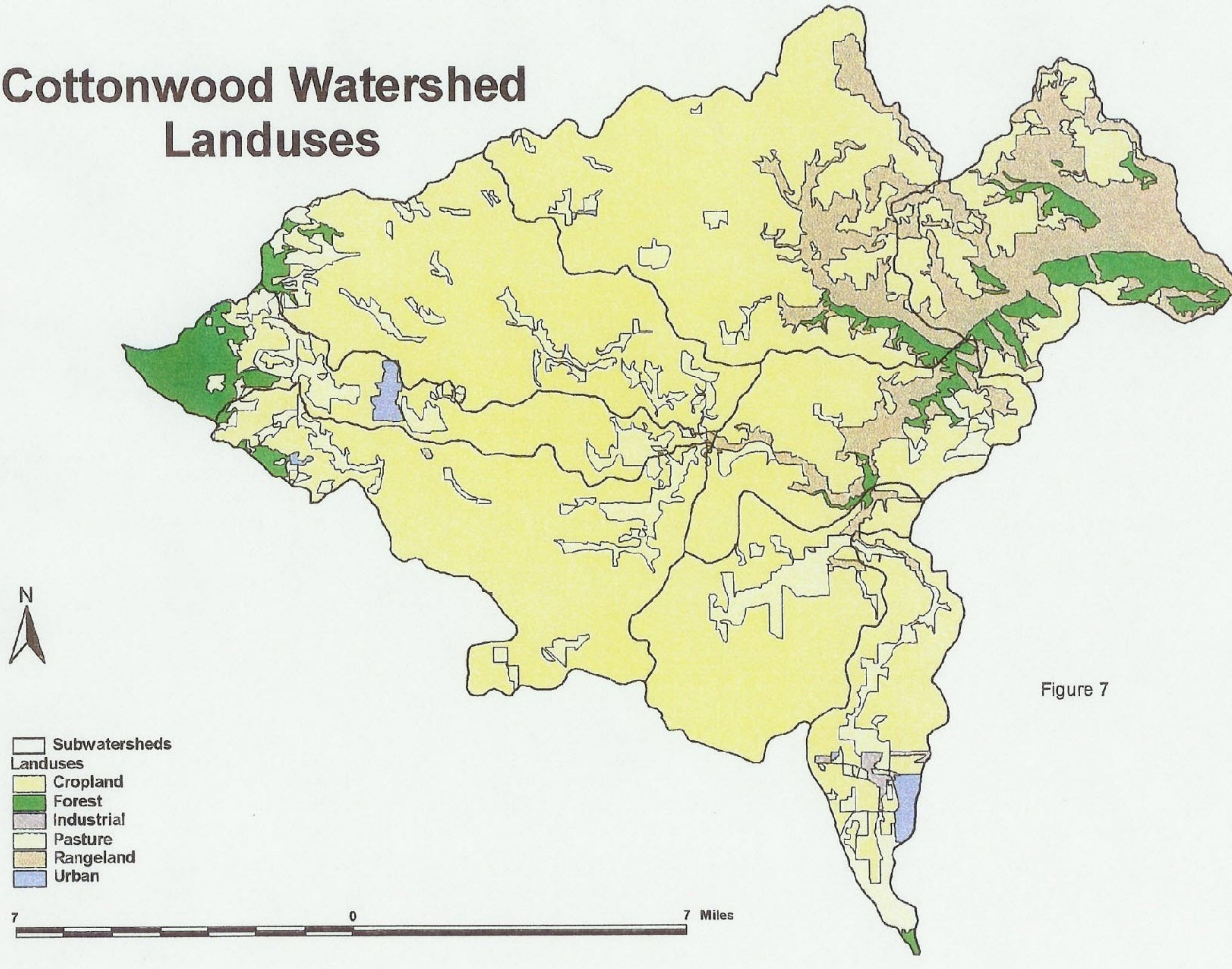


Figure 7

Table 5. Livestock Facilities

Subwatersheds	Animal Feeding Units	Hog Producers	Dairies
Shebang Creek	27	2	0
Upper Cottonwood Creek	11	1	3
Stockney Creek	29	5	2
Red Rock Creek	34	3	0
Lower Cottonwood Creek	7	0	0
Middle Cottonwood Creek	34	0	0
South Fork Cottonwood Creek	6	0	0
Long Haul Creek	12	0	0
Total	160	11	5

The following is general land use summary; a more detailed description is available in the Cottonwood Creek SAWQP report (ICSWCD 1999).

Cropland: The majority of the cropland which constitutes 74% of the land use occurs on gently sloping to moderately steep slopes. Most cropland occurs on plateaus in very deep, moderately well to well drained soils formed in loess. The major crops grown within the watershed are winter wheat, spring barley, and spring wheat. Other important crops that are grown are spring peas, oats, lentils, rape, and canola. Hay and bluegrass are grown in rotation with small grains. Potential erosion is greater with a summer fallow rotation, which represented approximately 15% of the cropland acreage in 1998 (Spencer 1999).

Rangeland: The majority of the rangeland (13% of the land use) within the watershed is located on the east end of the watershed. The largest concentration of rangeland occurs on steep south facing slopes in the lower end of the watershed. Slopes range between 20 to 90 %. The 15,934 acres of rangeland is in fair to poor condition with the less favorable conditions expected over time due to widespread invasion of noxious weeds such as yellow star thistle in these areas. Most grazing is limited to early spring and late fall.

Pastureland: There is approximately 8,505 acres (7% of the land use) of pastureland within the watershed. Slopes and aspects are quite variable. Soils include patterned ground along with some good loamy soils and transitional soils. The better soils were probably farmed at some point in the past, but they are now better suited to pasture. With the large variability in soils and sites comes a big difference in production and species makeup. Most of the farm operations in the watershed include some sort of livestock operation. These pasturelands are used for spring, summer and fall pasture.

Forestland: There are approximately 7,067 acres of forested lands (6% of land use) within the watershed. The watershed topography and climate changes from hot, dry, and extremely steep dissected canyon timberlands near the mouth of Cottonwood Creek to more gently sloping, and more moist forest in the headwaters of the drainage. In the lower zones the forested areas tend to occur on the north and east aspects, where more favorable microclimates are found. Forest cover in the upper zones is more extensive across the landscape because moisture limitations are reduced. Predominate forest habitat types include ponderosa pine/snowberry in the warm, dry areas, progressing to grand fir/queencup beadlilly vegetation representations in upper elevations. Limited areas of spruce can be found as well along wet, cool bottomlands. Most forest riparian zones are found in the upper portion of the watershed where streams have more gentle gradients, typically along a wider alluvial bottomland setting. Livestock grazing occurs in most of the forested areas of the watershed. An estimated 16.5 million board feet of timber has been harvested in the watershed since 1989 (Talbott 1999).

Mining: The Cottonwood Creek watershed has limited mining activities. The Idaho Department of Lands (IDL) land inventory system has 4 recorded surface mining applications. These records indicate mining operations, which have filed a mine reclamation plan with IDL. They represent sand and gravel extraction sites. These recorded sites are located in the Long Haul Creek (T30N R3E Sec. 19), Shebang Creek (T31N R 1E Sec.7), South Fork of Cottonwood Creek (T31N R2E Sec. 26) and Middle Cottonwood Creek (T31N R3E Sec.18) subwatersheds. Other similar type mining operations may exist that are not on file at IDL. A gold mining operation located 4 to 5 miles northwest of the City of Cottonwood in the Stockney Creek subwatershed is inactive and will be fully reclaimed in 1999.

Roads: There are approximately 288 miles of roads within the watershed excluding urban streets (Figure 8). Included in this total are the following:

Primary Highway (U.S. 95)	16 miles
Improved Blacktop	38 miles
Improved Dirt	181 miles
Unimproved Dirt	53 mile

Cottonwood Watershed Roads

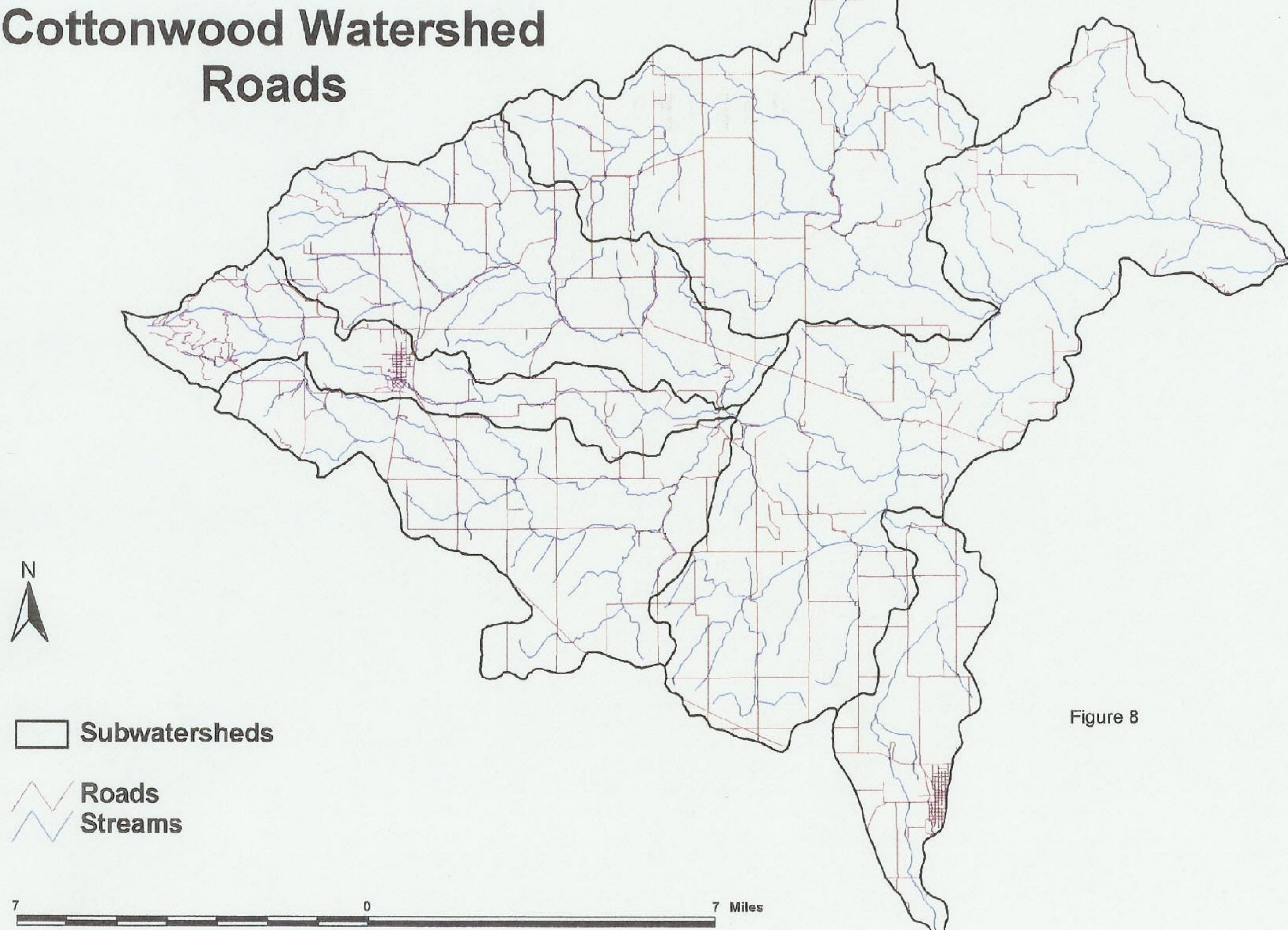


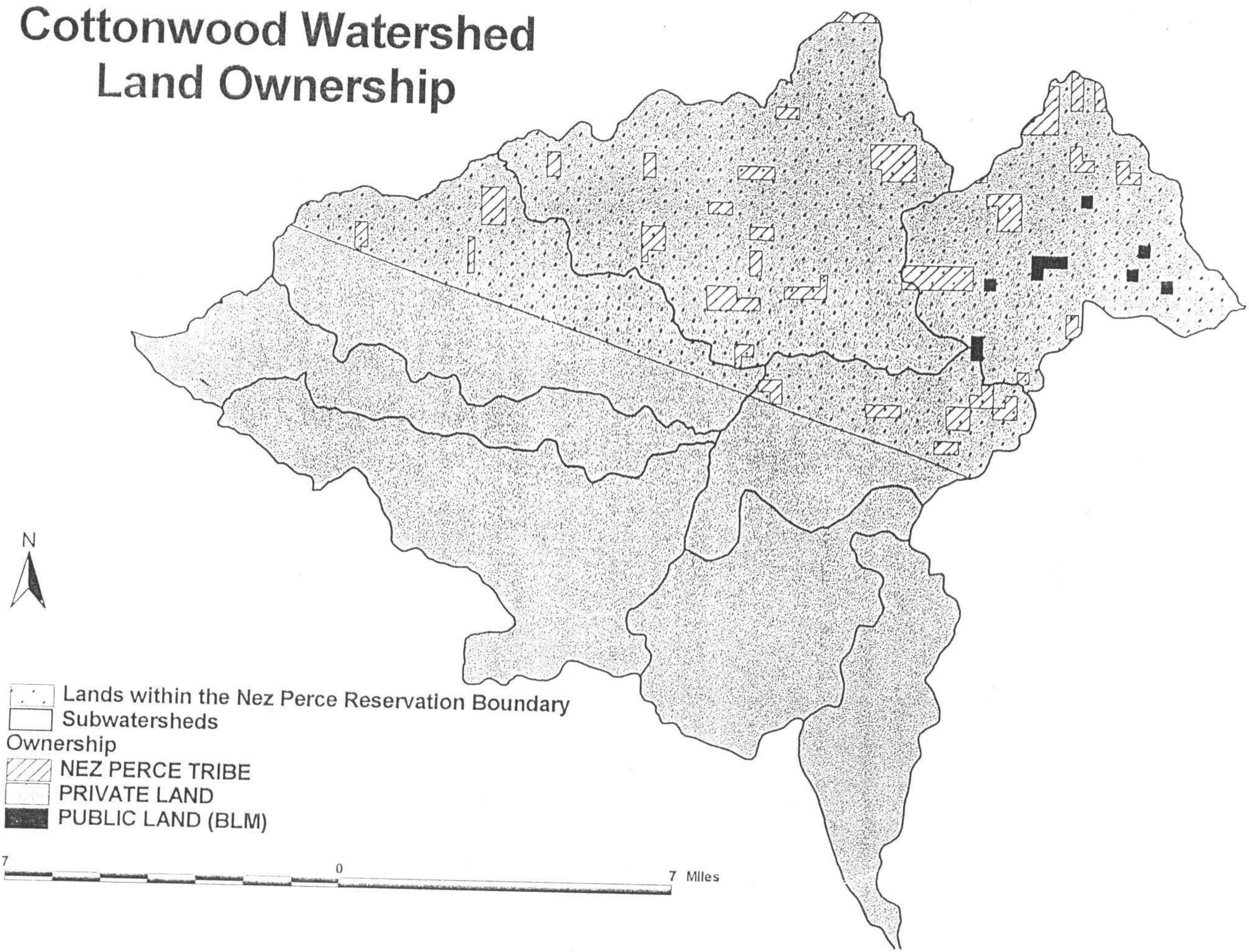
Figure 8

2.1.8.4 Present Land Ownership

Figure 9 indicates land ownership in the watershed and Table 6 summarizes land ownership by subwatershed. The majority of land is privately owned. There are approximately 275 farm operations within the watershed. The majority of the cropland owned by the NPT is leased to non-tribal members. The average farm size exceeds 1000 acres.

Table 6. Land Ownership in the Cottonwood Creek Watershed

Subwatershed	Private	BLM	Nez Perce Tribe	Total
Stockney Creek	19,516	0	401	19,917
Upper Cottonwood Creek	10,094	4	0	10,098
Shebang Creek	18,332	0	0	18,332
South Fork Cottonwood Creek	12,557	0	0	12,557
Long Haul Creek	8,872	0	0	8,872
Red Rock Creek	24,586	0	1,896	26,482
Middle Cottonwood Creek	11,298	44	719	12,061
Lower Cottonwood Creek	14,121	399	1,600	16,120
Total	119,376 96%	447 <1%	4,616 4%	124,439


Cottonwood Watershed
Land Ownership
N
Lands within the Nez Perce Reservation Boundary
Subwatersheds
Ownership
NEZ PERCE TRIBE
PRIVATE LAND
PUBLIC LAND (BLM)
7
0
7 Miles

2.2 WATER QUALITY CONCERNS

2.2.1 Federal Requirements for Water Quality Limited Waters

The Federal Clean Water Act (CWA) requires restoration and maintenance of the chemical, physical, and biological integrity of the nation's waters (33 USC §§1251-1387). States and tribes, pursuant to §318 of the CWA, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the water whenever attainable. Section 303(d) of CWA establishes requirements for states and tribes to identify and prioritize waterbodies which are water quality limited (i.e. waterbodies which do not meet water quality standards). States and tribes must publish a priority list of impaired waters every two years. For waters identified on this list, states and tribes must develop a TMDL set at a level to achieve water quality standards.

In 1976 and 1977 an intensive survey of Cottonwood Creek found adverse effects on the water quality from nonpoint source activities in combination with waste water discharges from the City of Cottonwood (IDEQ 1978). In 1983, Cottonwood and Stockney Creek were designated as first priority stream segments through the State's Agricultural Pollution Abatement Plan. A State of Idaho Water Quality Status Report designated Cottonwood Creek as water quality limited from the headwaters to the South Fork Clearwater River confluence (IDEQ 1986). In 1994, 1996, and 1998, Cottonwood Creek was classified as a high priority water quality limited segment on Idaho's §303(d) list and a TMDL was scheduled to be developed by the end of 1999. Three of the 5 tributaries to Cottonwood Creek were listed on the 1994 §303(d) list; the two others were added on the 1998 §303(d) list. Table 7 summarizes the dates of listing, listed pollutants, and TMDL deadlines for Cottonwood Creek and its tributaries. Although the TMDLs for the tributaries are not due until 2001 and 2006, they are proactively being addressed along with the mainstem because the tributaries are sources of pollutants to the mainstem.

Table 7. Summary of §303(d) Listed Stream Segments in the Cottonwood Creek watershed.

Stream Segment	Boundaries	Pollutants on §303(d) List	§303(d) Listing Dates	TMDL Deadline on §303(d)
Cottonwood Creek	source to mouth	nutrients, sediment, dissolve oxygen, temperature, ammonia, pathogens, habitat and flow alteration	1994 1996 1998	1999
Stockney Creek	source to mouth	pathogens, sediment	1994 1996	2001
Shebang Creek	source to mouth	unknown	1998	2006
SF Cottonwood Creek	source to mouth	pathogens, habitat alteration, nutrients, temperature	1994 1996	2001
Long Haul Creek	source to mouth	unknown	1998	2006
Red Rock Creek	source to mouth	sediment	1994 1996	2001

2.2.2 Designated Beneficial Uses of Cottonwood Creek

Surface water beneficial use classifications are intended to protect the various uses of surface water bodies. Idaho waterbodies which have designated beneficial uses are listed in Idaho's Water Quality Standards and Wastewater Treatment Requirements (IDHW 1996). They are comprised of five categories: aquatic life, recreation, water supply, wildlife habitat, and aesthetics.

Aquatic life classifications are for water bodies which are suitable, or intended to be made suitable, for viable communities of aquatic organisms and populations of significant aquatic species. Aquatic life classifications include cold water biota, warm water biota, and salmonid spawning.

Recreation classifications are for water bodies which are suitable, or intended to be made suitable, for primary contact recreation and secondary contact recreation. Primary contact recreation depicts prolonged and intimate contact by humans where ingestion is likely to occur.

Secondary contact recreation depicts recreational uses where ingestion of raw water is not probable.

Water supply classifications are for water bodies which are suitable, or intended to be made suitable, for agriculture, domestic, and industrial uses. Wildlife habitat waters are those which are suitable, or intended to be made suitable, for wildlife habitat. Aesthetics are applied to all waters.

Designated beneficial uses listed for the mainstem of Cottonwood Creek include salmonid spawning, cold water biota, secondary contact recreation, and agricultural water supply (IDAPA 16.01.02.120). The beneficial uses of the five major tributaries have not been designated; therefore, for these tributaries, the presumed beneficial use for aquatic life is cold water biota and the presumed beneficial use for recreation is primary or secondary contact recreation (IDAPA 16.01.02.101).

2.2.3 Water Quality Criteria

Appendix B details the applicable surface water quality criteria for Cottonwood Creek that are summarized in Table 8. Idaho water quality standards include criteria necessary to protect designated beneficial uses. The standards are divided into three sections: General Surface Water Criteria; Surface Water Quality Criteria for Use Classifications; and Site-Specific Surface Water Quality Criteria (IDHW 1996). The numeric criteria that exist in these rules for fecal coliform bacteria, temperature, ammonia, and dissolved oxygen will be used in the TMDL. The criteria for nutrients and sediment are narrative criteria that indicate levels of these pollutants cannot exceed quantities that impair beneficial uses. Because these pollutants do not have numeric criteria, surrogate numeric targets are proposed in the TMDL (Sections 3.1 and 3.3).

These water quality criteria pertain to those times and locations where stream flow is non-intermittent. Idaho rule (IDAPA 16.01.02.003.50) defines an intermittent stream as: "A stream which has a period of zero flow for at least one week during most years. Where flow records are available, a stream with a 7Q2 hydrologic-based design flow of less than one-tenth (0.1) cfs is considered intermittent. Streams with perennial pools which create significant aquatic life uses are not intermittent." Stream segments of zero flow occur between perennial pools within the upper portions of the Cottonwood Creek watershed. Therefore, these Idaho water quality criteria may or may not apply to some of the upper portions of the watershed <u>during low flow times of the year</u>.

Idaho state water quality standards pertaining to point source discharges stipulate that if a designated mixing zone exists in a flowing receiving water "the mixing zone is not to include more than twenty five percent (25%) of the volume of the stream (IDAPA

16.01.02.060.01.e.iv)." In recognition that Cottonwood Creek flow volumes are not large enough to support an adequate mixing zone during the low flow seasons of the year, the current National Pollution Discharge Elimination System (NPDES) permit states that the Cottonwood Wastewater Treatment Plant (WWTP) may only discharge into Cottonwood Creek when there is available dilution (October 31 to April 1). TMDL targets and allocations (Sections 3.1 to 3.5) for the WWTP take both the flow and pollutant concentrations present within Cottonwood Creek into consideration. Also, in the case of permitted point source discharges, additional stipulations for the mixing of wastewater discharge may be applied (IDAPA 16.01.02.401.03). These and other considerations specific to the WWTP point source discharge will be determined by the local IDEQ permitting engineer during §401 permit certification.

Table 8. Summary of Cottonwood Creek Surface Water Criteria

Pollutant	**Statement in Idaho Code 16.01.02**
Sediment	Idaho State criteria for Sediment and Turbidity - Sediment shall not exceed quantities which impair beneficial uses Turbidity standard for Cold Water Biota - turbidity not to exceed background by more than 50 NTU instantaneously or 25 NTU for more than 10 consecutive days.
Temperature	Idaho State criteria for Cold Water Biota and Salmonid Spawning - Cold Water Biota: 22°C (72°F) daily maximum at any time; 19°C (66°F) daily average. Salmonid Spawning: 13°C (55°F) daily maximum and 9°C (48°F) daily average. These criteria apply only during actual spawning period for salmonid species present in watershed. The default or assumed spawning period is from Feb. 1 to July 15 for steelhead trout and Jan. 15 to July 15 for rainbow trout.
Nutrients	Idaho State criteria for excess Nutrients - Surface waters shall be free from excess nutrients that can cause visible slime growth or other nuisance
Pathogens	Idaho State criteria for Primary and Secondary Recreation - Secondary (October through April): Monthly geometric mean fecal coliform concentrations not to exceed 200 colony forming units (cfu)/100 ML at any time; or 800 cfu/100 ML instantaneous; or 400 cfu/100 mL in more than 10% of samples taken over a 30 day period. Primary (May through September): Monthly geometric mean fecal coliform not to exceed 50 cfu/100 mL; or 500 cfu/100 mL instantaneous; or 200 cfu/100 mL in more than 10% of samples taken over a 30 day period.

Pollutant	Statement in Idaho Code 16.01.02
Ammonia	Idaho State criteria for Cold Water Biota and Salmonid Spawning - As defined in tables in 16.01.02.250.c.iii (1) and (2); pH and temperature dependent.
Dissolved Oxygen	Idaho State Criteria for Cold Water Biota and Salmonid Spawning - Dissolved oxygen at 6 mg/L or greater at all times. Idaho State Criteria for Salmonid Spawning: Intergravel dissolved oxygen of 6 mg/L or greater weekly mean and 5 mg/L or greater daily minimum.
Oil and Grease	Idaho General Water Quality Criteria - Concentrations must be less than those found to impair beneficial uses.

2.2.4 Beneficial Use Support Studies

IDAPA 16.01.02.053 establishes a procedure to determine whether a water body fully supports designated and existing beneficial uses, relying heavily upon aquatic habitat and biological parameters, as outlined in the Water Body Assessment Guidance (IDEQ 1996). IDAPA 16.01.02.054 outlines procedures for identifying water quality limited waters which require TMDL development, publishing lists of Water Quality Limited waterbodies, prioritizing waterbodies for TMDL development, and establishing management restrictions which apply to water quality limited waterbodies until TMDLs are developed.

The appropriateness of the salmonid spawning as a beneficial use became an important issue after 1986 when sampling below the WWTP (IDEQ 1986) indicated non-compliance of the plant with permitting requirements and also questioned the appropriateness of this beneficial use for the upper reaches of Cottonwood Creek. The question of which beneficial uses were appropriate for Cottonwood Creek prompted IDEQ to conduct a "Use Suitability Assessment" on the reach near the WWTP (Mann 1990). The results and conclusions indicated that the designated uses for the headwater reaches should be changed because of low or nonexistent flows, degraded water quality, poor channel stability, and the "probability of continued poor land management practices in the watershed." Based on comments received, IDEQ withdrew a proposed rulemaking effort for this use modification proposal in order to conduct a more detailed evaluation of the beneficial uses of Cottonwood Creek through a Use Attainability Assessment (UAA).

In 1992 IDEQ conducted a UAA for Cottonwood Creek (IDEQ 1993) to specifically address the appropriateness of aquatic life (salmonid spawning and cold water biota) and contact recreation (secondary) beneficial uses. The UAA determined whether salmonid spawning was attainable according to the following decision tree process. If the presence of salmonids were documented, then salmonid spawning was considered attainable. Salmonids were only detected in the sample location below the waterfall at stream mile 9.0. If salmonids were not documented, then the question of attainability of salmonid spawning hinged on the answers to two questions: 1) Is there a significant occurrence of cold water biota?; and 2) Is the stream capable of supporting salmonid spawning, excluding human caused pollution? The presence of mayflies (*Ephemeroptera*), caddisflies (*Plecoptera*), or stoneflies (*Trichoptera*) (EPT) insects was used as an indication of significant occurrence of cold water biota. Best professional judgment of the survey staff was used to determine whether a site was capable of supporting salmonid spawning if the site was allowed to recover. Historical evidence of spawning conditions was not available.

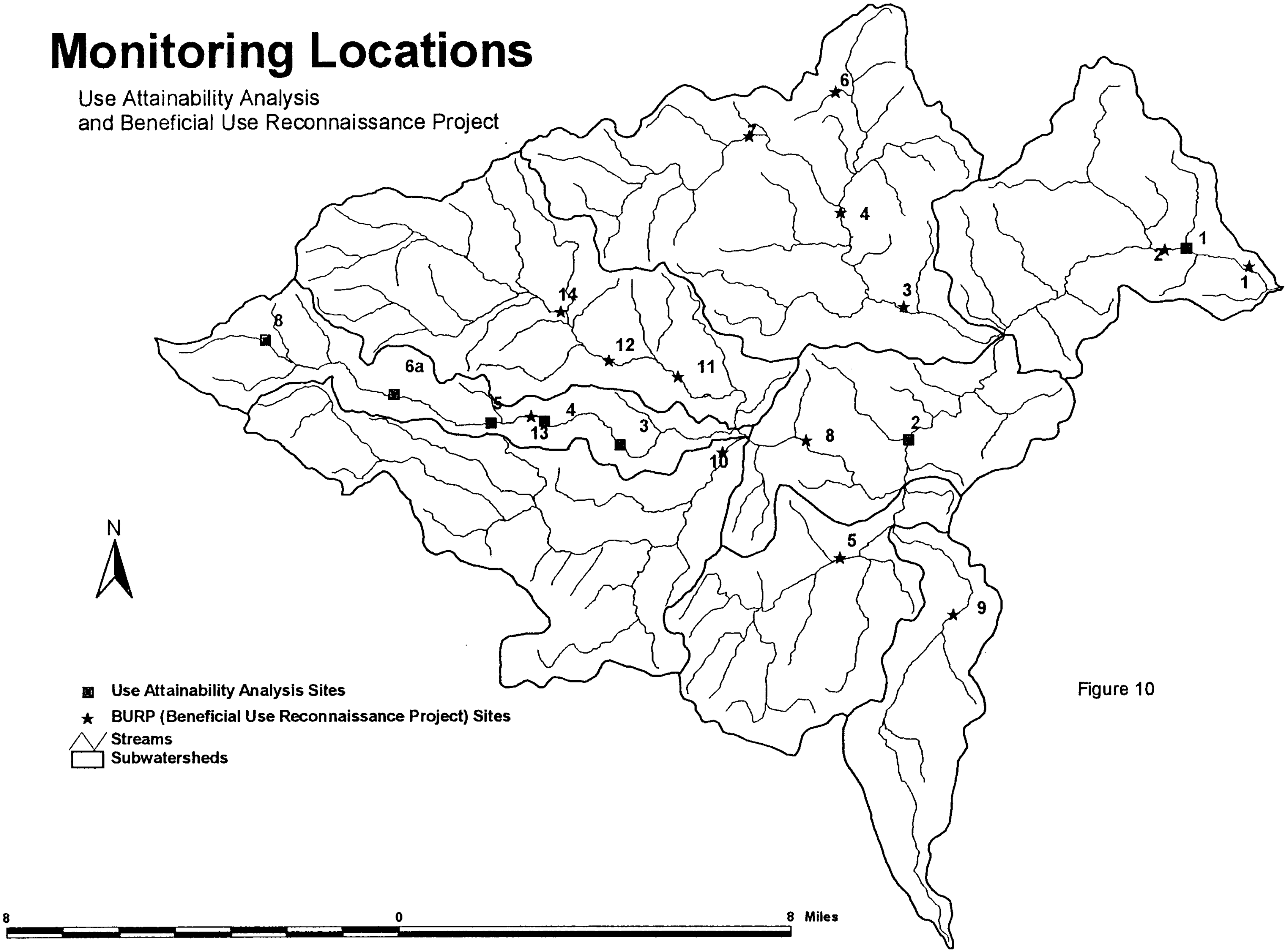
For the 5 sample locations where macroinvertebrate data was collected above the waterfall, all stations had cold water biota present except for the station below the Cottonwood WWTP (Figure 10). The only station at which high water quality taxa were documented was the station near Cottonwood Butte; the taxa documented at other stations were indicative of medium to poor water quality. The UAA concluded that the designated beneficial uses of salmonid spawning and cold water biota (as well as secondary contact recreation and agricultural water supply) were appropriate and attainable for Cottonwood Creek from its source to mouth. The reported habitat assessment scores indicated serious problems with water quality and the riparian zones. The UAA recommended the Cottonwood WWTP upgrade to a level that will support beneficial uses in Cottonwood Creek.

IDEQ Beneficial Use Reconnaissance Project (BURP) survey was conducted on Cottonwood Creek in 1995. BURP surveys were also conducted on tributaries to Cottonwood Creek including the South Fork Cottonwood Creek, Shebang Creek, Long Haul Creek, and Stockney Creek in 1995 and 1996. BURP surveys collect data on fish, macroinvertebrates and habitat to determine presence of beneficial uses and the support status of those uses for Idaho State Water Quality Standards (IDEQ 1995 and 1996).

BURP data collected on an upper and a lower site along Cottonwood Creek indicated that the beneficial uses were not fully supported. Additionally, BURP data collected on the four tributaries showed that the beneficial uses within these water bodies also did not have full support. These determinations were made using the Water Body Assessment Guidance (WBAG) document (IDEQ 1996). The status of not full support was primarily due to the low macroinvertebrate index scores, which were in the impaired range for all the sampling locations except for Long Haul Creek. The score for Long Haul where the score fell between the "supported" and "not supported" range and thus is treated as not full support for TMDL purposes.

Monitoring Locations

Use Attainability Analysis
and Beneficial Use Reconnaissance Project



■ Use Attainability Analysis Sites

★ BURP (Beneficial Use Reconnaissance Project) Sites

Streams

Subwatersheds

Figure 10

In 1997, NPT conducted a BURP survey on Red Rock Creek. In 1998, the NPT conducted BURP surveys at three locations on Red Rock Creek, one location on Stockney Creek, and two stations on Cottonwood Creek. The results from these surveys have not been evaluated for beneficial use support due to the pending revisions of the WBAG (IDEQ 1996). In addition, macroinvertebrate results are not available for the 1997 and 1998 BURP samples.

Appendix C contains a summary of all the BURP surveys, including a comparison of results to literature reference conditions for salmonid spawning and rearing.

In 1999, the U.S. Bureau of Land Management (BLM) completed a biological assessment of Cottonwood Creek as part of its biological assessment of ongoing and proposed BLM activities on listed salmonids in the Lower South Fork Clearwater Rivers and Tributaries (Johnson 1999b). Results are contained in Appendix D. For most of the criteria evaluated, conditions in Cottonwood Creek for support of salmonids were suboptimal.

2.2.5 Other Water Quality Studies

Historically, numerous water quality related studies were completed for Cottonwood Creek. The following summary of these studies is principally from IDEQ (IDEQ 1992) and the Cottonwood Creek Agricultural Planning Project (ICSWCD 1999). Studies related to beneficial use support are summarized in the previous section.

In 1962, the Idaho Department of Fish and Game (IDFG) identified low flows and high temperature as problems on Cottonwood Creek (IDFG 1962). In 1974, the IDFG studied the lower 9 miles of Cottonwood Creek for salmonid spawning potential (Mallet 1974). Although no spawning sites were identified, the lower reach was found suitable for spawning. Steelhead, rainbow trout and whitefish were identified in the stream.

In 1983, the Idaho Pollution Abatement Plan listed Cottonwood Creek and Stockney Creek as Agricultural Nonpoint Source Water Quality Priority Streams.

In 1984, the BLM performed a riparian assessment on the lower reach of Cottonwood Creek. The assessment rated all habitat parameters as poor (BLM 1984), due mainly to lack of riparian vegetation and degraded stream banks.

In 1985 and 1986, the ICSWCD sponsored an agricultural water quality planning project funded by IDEQ to study water quality on Stockney Creek, a tributary of Cottonwood Creek (IDEQ 1986a). The beneficial uses of agricultural water quality supply and secondary contact recreation were documented as impaired by suspended sediment, nutrient and bacteria contamination. Livestock were considered as the probable source of the bacteria contamination. Study recommendations included reduction of animal wastes entering the creek and implementation of agricultural BMPs.

The NPT conducted two studies during the 1980s as part of a biological and physical inventory of streams located on the Nez Perce Indian Reservation. In 1984, redside shiners, speckled dace, sculpin, bridgelip sucker, northern squawfish and chisel mouth were identified (Fuller et al. 1984). Study findings indicated the Cottonwood Creek fishery is influenced by habitat deficiencies such as low summer flows, high summer stream temperatures, sedimentation and lack of instream cover. Nutrients and fecal coliform bacteria impacted water quality. The Cottonwood Creek watershed was characterized by excessive high flows of short duration during spring runoff, intensive precipitation periods, and low flows during dry summer and fall periods (Fuller et al. 1985). Both the 1984 and 1985 studies recommended riparian enhancement along the entire length of Cottonwood Creek and instream structures in the lower reach of the creek in order to enhance the fisheries potential.

A summary report by the NPT (Kucera 1986), describes relationships between physical stream habitat and juvenile steelhead trout abundance for tributaries in the lower Clearwater River Basin, including Cottonwood Creek. Biological information included density, biomass, production, and migration of juvenile summer steelhead trout. Physical habitat information included available instream cover, stream discharge, stream velocity, water temperature, bottom substrate, embeddedness, and stream width and depth. The study identified lack of perennial flow in the middle to upper sections, lack of yearling habitat, low stream flow, elevated water temperatures, and extreme variations in annual stream flow as limiting factors for enhancing the anadromous fishery.

In 1986, IDEQ conducted a study that determined the Cottonwood WWTP were not in compliance with the NPDES permit (IDEQ 1986). The study determined the discharge from the lagoons significantly impacted Cottonwood Creek in respect to pH, Biochemical Oxygen Demand (BOD), nitrogen, phosphorus, bacteria, and total suspended solids. The results of this study questioned the appropriateness of salmonid spawning and cold water biota as beneficial uses for the upper portion of Cottonwood Creek.

In 1987, the BLM identified significant numbers of cold water biota (BLM 1987) in the lower reaches of Cottonwood Creek. Although the biota were primarily of the pollution tolerant taxa and the diversity was low, the numbers were sufficient to provide nutrients for salmonids should the substrate conditions improve.

In 1991, the USDA Soil Conservation Service (SCS) conducted a Preliminary Assessment of Cottonwood Creek. The report identified agricultural chemicals, sediment from all land masses, bacteria from livestock operations, municipal wastewater, a gold mining operation and the lumber mill in Grangeville as potential pollution sources.[2]

In 1992, the IDEQ conducted fish electroshocking at a location above and below the fish migration barrier (IDEQ 1993). Results indicated the presence of steelhead trout, northern squawfish, speckled dace, and chiselmouth below the fish barrier and abundant populations of speckled dace and redside shiner above the fish barrier.

In the years 1994 to 1996, the NPT monitored water quality parameters at 2 stations along Cottonwood Creek (NPT 1996). One station was near the mouth of Cottonwood Creek and the other was approximately 2.5 miles above the confluence with Red Rock Creek at Columbia Crossing. Parameters measured were flow, temperature, dissolved oxygen, pH, turbidity, dissolved solids and conductivity. Temperature monitoring on Red Rock Creel indicated exceedance of the cold water biota standard during the summer months in 1995 but not 1994. Dissolved oxygen concentrations ranged from 4.0 mg/L to 10 mg/L, and dipped below the State standard of 6 mg/L in September 1994. Turbidity levels ranged from 0 to 1,000 Nephelometric Turbidity Units (NTU) and were consistently higher than 50 NTU. This data is considered qualified due to lack of instrument calibration; however, the trends observed are considered accurate (Wren 1999).

Between the fall of 1996 and spring of 1998, the ICSWCD implemented a water quality monitoring program in the Cottonwood Creek drainage. The goal of the program was to provide current baseline monitoring data necessary to determine water quality status within the Cottonwood Creek watershed. The program objectives were to: 1) determine the status of the beneficial uses in the watershed, which was completed through IDEQ and NPT BURP sampling activities; and 2) evaluate suspended sediment, nutrients, bacteria loading, and water temperature within the Cottonwood Creek watershed to prioritize critical watersheds. Annual stream flows were estimated using water level data from automatic samplers that recorded fluctuations in creek levels once every hour. Stream stage was recorded, water velocity was estimated using Manning's formula (Grant 1991), and a formula for stage-to-flow conversion was developed. Precipitation was collected throughout the watershed through a coordinated volunteer program. Samples were collected at or near the mouth of all the major tributaries to Cottonwood Creek as well as at the mouth of Cottonwood Creek. Figure 11 indicates the sampling locations.

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[2]The gold mining operation is inactive and will be fully reclaimed in 1999.

Monitoring Locations

Temperature and SAWQP

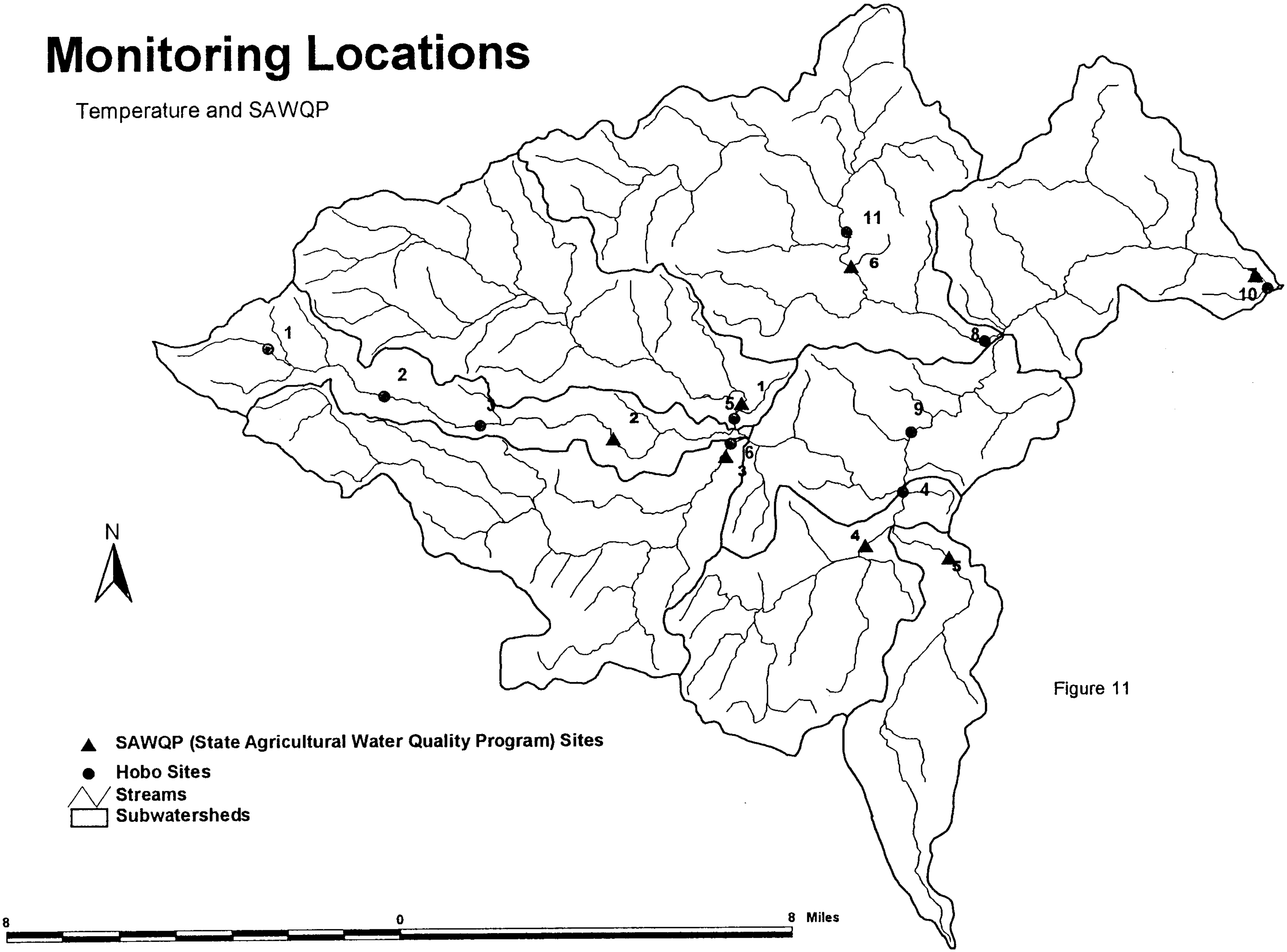


Figure 11

Results indicated significant exceedances of Idaho criteria for temperature and fecal coliform bacteria. Although there are no State numeric criteria for nutrients, levels at all stations for total phosphorus and nitrogen compounds were at levels conducive to algae growth based on literature values. Although there are no numeric criteria for total suspended solids, the levels at all stations exceeded levels shown to impair aquatic life based on literature guidance. Ammonia levels at all stations exceeded the U.S. EPA Gold Book (U.S. EPA 1986) criteria for salmonid and non-salmonid fish species at all stations; however, exceedances of State ammonia criteria were not evaluated. Results of this study are described in more detail in Section 2.2.6.

The effectiveness of the Cottonwood hybrid poplar land application system was evaluated between from July 1996 through December 1997 (Teasdale and Funk 1998). Water samples from Cottonwood Creek were taken upstream and downstream of the Cottonwood WWTP and upstream and downstream of the effluent discharge point. Other sample locations included wastewater influent and effluent and 6 shallow monitoring wells within the hybrid poplar plantation. Concentrations of BOD were consistently low at all sampling stations. No consistent increase in total suspended solids occurred throughout the land application area. No strong trends were seen in phosphorus concentrations through the site; a slight increase immediately below the wastewater lagoons was negated by the time the flow reached the discharge point. The percentage of soluble reactive phosphorus of total phosphorus levels averaged 60% in samples collected below the effluent discharge. Some impact on the water quality of Cottonwood Creek was detected during low flow periods but was believed to attributable to seepage from the unlined wastewater lagoons.

Nitrogen concentrations in Cottonwood Creek exhibited a seasonal pattern. Concentrations upstream of the wastewater lagoons were greater during higher flow periods in the fall and spring, possibly due to increased nitrogen transport and a reduction of biological uptake associated with cooler temperatures and less solar radiation than during the summer. Nitrogen levels increased downstream of the WWTP during the effluent discharge period. During the summer low flow periods a significant increase in nitrogen was detected immediately below the wastewater lagoons. Nitrogen levels reduced to near upstream levels by the time flow reached the lowest monitoring point below the effluent discharge. This decrease was attributed to biological uptake and ground water dilution. Chloride levels increased below the wastewater lagoons during low stream flow, further supporting the likelihood that seepage from the wastewater lagoons affects water quality at low flows.

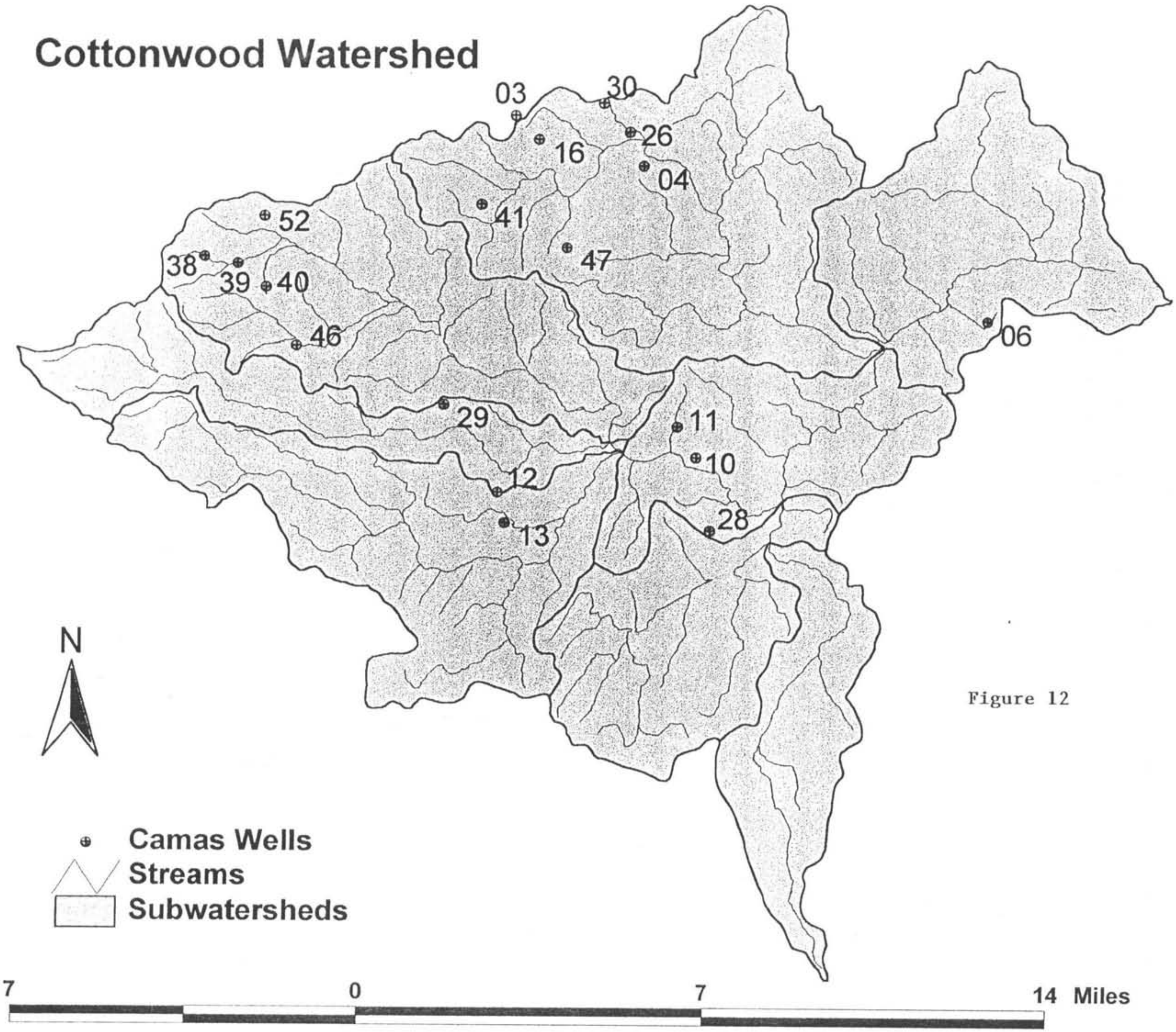
The land application study also involved ground water monitoring above and below the WWTP. Relatively high concentrations of nitrate were detected in samples collected from monitoring wells in sampled between December 1996 and July 1997. Some levels exceeded the state drinking water standard of 10 mg/L.

The study noted 3 sources of nonpoint source impacts in the vicinity of the WWTP. Sampling data from upgradient shallow monitoring wells indicated that ground water inflow from upgradient agricultural fields carried a significant concentration of nitrate during wet spring periods. The study also noted possible contribution from pastureland north of the facility where cattle had direct access upstream of discharge sampling points during the study. The third source was seepage from the unlined wastewater lagoons as discussed previously. The study concluded that water quality impacts from the operation of the hybrid poplar plantation land application system on Cottonwood Creek were minimal.

The land application study results for the site below the discharge point were compared to data from the SAWQP study taken on upper Cottonwood Creek 6.5 miles below the Cottonwood WWTP (Teasdale and Funk 1998) In general, the SAWQP data exhibited a wider range of variability and supported the seasonal trends seen in the WWTP data. Concentrations on nitrogen and phosphorus compounds generally increased below the WWTP, presumably due to nonpoint source contribution.

In summer 1998, IDEQ conducted water temperature monitoring at 9 stations within the watershed (Figure 11). Data indicated exceedances of both the salmonid spawning criteria and cold water biota criteria for locations along Cottonwood Creek above and below the falls. Exceedances of the cold water biota temperature criteria occurred at stations on all the tributaries.

In summer 1998, IDEQ conducted a study of nitrite plus nitrate concentrations of shallow and deep aquifers underlying the Camas Prairie and the larger Clearwater Plateau (IDEQ 1998). Sampling results suggested that Camas Prairie aquifers have elevated nitrate levels, particularly the wells in the surficial water bearing zones. Twenty five percent of the private drinking water wells exceeding the drinking water standard of 10 mg/L. Seventy five percent of the wells sampled had nitrate concentrations exceeding a background level of 2 mg/L. Figure 12 indicates the locations of wells sampled in the Cottonwood watershed. Table 9 displays the nitrate results for these wells.



Cottonwood Watershed
03
30
26
16
04
52
41
38
39
40
47
46
06
29
11
10
12
13
28
N
Camas Wells
Streams
Subwatersheds
7
0
7
14 Miles

Figure 12

Table 9. 1998 Ground Water Sampling Results for Cottonwood Area Wells (locations indicated on figure 12)

Well #	Well Depth(ft)	Nitrate (mg/L)	Well #	Well Depth (ft.)	Nitrate (mg/L)
3	402	36.80	4	275	19.30
6	358	5.48	10	100	12.20
11	240	< 0.01	12	215	< 0.01
13	90	9.46	16	640	0.97
26	135	3.77	28	182	17.50
29	200	2.20	30	255	2.66
30	255	2.66	38	325	3.62
39	400	3.12	40	200	2.29
41	327	3.17	46	500	2.72
47	103	< 0.01	52	80	14.50

In May 1999 the Idaho Department of Lands (IDL) performed a Cumulative Watershed Effects (CWE) analysis of the Cottonwood Creek watershed using the standard procedures of the Forest Practices Cumulative Watershed Effects Process for Idaho (IDL 1995). The CWE methodology is designed to examine conditions of the forested lands in the watershed in and around a stream. It then attempts to identify the causes of any adverse conditions. Finally, it helps identify actions that will correct any identified adverse conditions. The CWE process consists of seven specific assessments: erosion hazard, canopy closure/stream temperature, hydrologic risk, sediment delivery, channel stability, nutrients, and beneficial use/fine sediment. The following summarizes results of the CWE analysis, which are further described in Appendix E.

Forested land covers 6880 acres or about 5% of the Cottonwood Creek watershed, distributed in the headwaters above the town of Cottonwood and along the lower canyon, mostly on north-facing canyon walls. From the point of view of CWE hazard ratings for forest practices, these lands overall have a low mass failure hazard rating and low surface erosion hazard rating. Within this forested land area, there are about 59 miles of roads that are identified as forest practice roads. Many of these roads were assessed using CWE on the ground and resulted in a (very) low road sediment delivery rating. Evidence of erosion from skid trails was minimal, and no mass failures originating on FPA land were identified. Therefore, the overall sediment delivery rating for the forested parts of the watershed is low.

Of the 6880 acres of forested land, CWE determined that about 1175 effective acres, or 17%, of canopy have been removed. The Hydrologic Risk Rating of canopy removal is determined by plotting canopy removal against the stream channel stability rating. The stream channel stability rating for Cottonwood Creek was determined to be 54, in the moderate range, which resulted in a low CWE Hydrologic Risk Rating.

The main area of concern raised by the CWE assessment is the lack of shading over the stream to maintain stream temperatures. Of 22 segments laid out onthe Class I portions of the stream, 9 of these have inadequate canopy cover and shading to maintain stream temperatures. These nine segments occur at the lower elevations of the stream, in the canyon, where heat loading is most extreme. Further analysis will be required under Idaho Forest Practices Act to determine whether this condition in the lower canyon is natural, or a function of forest practices, in which case it will need to be addressed.

2.2.6 Overview of Water Quality Problems

As indicated in Table 7, the 1994, 1996 and 1998 §303(d) lists for the State of Idaho indicate 8 parameters of concern for Cottonwood Creek from the headwaters to South Fork of the Clearwater: sediment, temperature, pathogens, nutrients, dissolved oxygen, ammonia, habitat and flow alteration. The 1994, 1996, and 1998 §303(d) also lists the following parameters of concern for Cottonwood Creek tributaries: Red Rock Creek - sediment; Stockney Creek - pathogens, sediment; South Fork Cottonwood Creek - pathogens, habitat alteration, nutrients, and temperature. Long Haul Creek and Shebang Creek were added to the 1998 §303(d) list, but the parameters of concern are indicated as unknown on that list. However, SAWQP monitoring results indicated exceedances of State numeric criteria in Long Haul and Shebang Creek for temperature and fecal coliform bacteria, and of literature reference criteria for nutrients, ammonia, and sediment.

High temperatures, excessive sediment, nutrients, ammonia, and low dissolved oxygen can lead to eutrophic conditions or other impacts to cold water biota, salmonid spawning, and contact recreation. This section describes sources and negative effects of these pollutants on beneficial uses and provides trends exhibited in recent sampling for these pollutants relative to exceedance of criteria or specific problem areas within the watershed.

Changes in habitat and flow can also impact beneficial uses. This section summarizes types of habitat and flow alterations that have occurred in the Cottonwood watershed. Because habitat and flow parameters are not pollutants, they have no criteria, and they are not suitable for estimation of load capacity or load allocations. Therefore, TMDLs will be not developed for these parameters. Actions taken to address pollutants of concern such as sediment, temperature, and nutrients, may address flow and habitat alteration as well.

2.2.6.1 Sediment

Management activities in the watershed have increased the magnitude and frequency of peak flows resulting in greater sediment transport and deposition within the watershed. The following are general observations of erosion and sedimentation problems in the watershed provided for the the SAWQP (Stevenson 1998):

"The extensive rolling uplands and steep canyon slopes contribute to moderate volume and velocity runoff, and sediment yield directly to the stream channels. The upper plateau slopes act as recharge zones for the ground water system and part of the water received as precipitation on these upper slopes infiltrates in fractured and decomposed bedrock. Ground water discharges as springs and base flow in the lower basalt canyons. Narrow, steep canyon drainages in the upper parts of the canyons (Red Rock and main Cottonwood Creeks) and steep stream gradients result in little deposition of sediment load in any surface runoff from canyon slopes which reaches the stream channels in these sections. The lower 7 miles of the Cottonwood Creek canyon exhibit a more developed floodplain with flatter stream gradients and a wider valley floor. This section is subject to deposition and channel instability resulting from high sediment and bedloads and high volume water runoff events.

Erosion of coarse-grained materials from forest and rangeland on the canyon slopes occurs in response to storm events and human activity. Accelerated erosion also occurs in response to agricultural activities on crop and pastureland on basalt plateaus. Sediment eroding from canyon slopes is predominantly coarser-grained and a higher percentage deposits as gravel-cobble bedload along stream corridors and on short alluvial/colluvial fan slopes as overland flows reach the canyon floor and gradients decrease. Fine-grained sediment is contributed to the drainage system from eroding upland meadow stream banks and riparian pasture areas as well as from cropland. Sediment transported by the streams is either deposited in the upper watershed or delivered in a high percentage to the lower 7 miles of Cottonwood Creek and the outlet at the Clearwater River. In the upland areas sediment can be deposited in well-vegetated riparian zones during overbank flooding events, or in response to gradient changes and associated decreases in carrying capacity of the streams. Due to the steep stream gradient and lack of functioning riparian zones, fine-grained sediment and organic matter delivered to the streams is generally delivered in a high percentage to the lower main Cottonwood Creek channel and the South Fork of the Clearwater. The proportion of sloping land to relatively level land is very high, resulting in higher sediment delivery rates.

Field observations indicate the main resource problem in the upper watershed is soil erosion from cropland and roads. Sediment transported downstream and high peak flow runoff, especially during peak flows in the spring, are the main resource problems in the lower sections of the watershed, impacting water quality and beneficial uses in Cottonwood Creek. Practices which increase infiltration throughout the watershed and decrease soil erosion from cropland and roads during the spring flush will have the greatest impact on downstream water-quality and habitat from this watershed.

In summary, two types of sediment problems occur in Cottonwood Creek watershed: 1) fine sediment, which is mainly derived from the Camas Prairie soils, is eroded through surface erosion, is delivered by annual overland flows, and is routed as suspended load; and 2) coarse bedload, which is mainly derived in the lower canyon lands, is eroded through mass failure and bank erosion, delivered, and routed as bedload by annual flood events. The first is highly dependent on soil types, whereas the latter is more dependent on geology. In addition, both types of sediment are influenced by the fact that flood magnitude and frequency have been increased as a result of land conversion."

The sediment standard in the State of Idaho Code is a narrative standard that states sediment shall not exceed, "...in the absence of specific sediment criteria, quantities which impair designated beneficial uses." Such impairment is determined through water quality monitoring, fisheries studies, and habitat assessments. There are many indicators of sediment impacts to water quality: 1) water column sediment indicators such as total suspended solids (TSS) and turbidity that measure fine sediment; 2) streambed sediment indicators such as percentage of fine particles less than a certain critical size or cobble embeddedness; 3) other channel indicators such as width/depth ratio or pool/riffle ratio; 4) biological indicators such as those based on fish or aquatic insect numbers and diversity; and 5) riparian habitat or hillslope indicators such as bank stability or amount of large woody debris. The Cottonwood Creek SAWQP monitoring project (Gilmore 1998) involved collecting turbidity and TSS data. Data on some of the other types of indicators is available through past studies such as the BURP data and the SAWQP riparian assessment (ICSWCD 1999).

2.2.6.1.1 Water Column Indicators of Sediment

Sediment suspended in the water column can adversely affect aquatic life. Many fish species are adapted to high suspended sediment levels for short durations that commonly occur during natural spring runoff events. However, longer durations of exposure can interfere with feeding behavior, damage gills, reduce available food, reduce growth rates, smother eggs and fry in the substrate, damage habitat and induce mortality. Eggs, fry and juveniles are particularly sensitive to suspended sediment, although at high enough concentrations adult fish are affected as well.

Turbidity is a measure of the extent to which light passing through water is scattered due to suspended materials. The Idaho turbidity standard states that turbidity shall not exceed background by more than 50 NTU instantaneously or 25 NTU for more than 10 consecutive days. Fourteen turbidity samples were taken from September 1997 to April 1998 at the mouth of

Cottonwood Creek as part of the SAWQP monitoring project; results are presented in Table 10. Although some samples exceeded 50 NTU during the January, February, and April, without background samples exceedances of the State criteria cannot be assessed. Turbidity samples collected by the NPT during July 1998 BURP surveys on Red Rock Creek and near the mouth of Cottonwood Creek exceeded 50 NTU; however, background levels were not available for comparison to evaluate criteria exceedances. Turbidity samples taken at Columbia Crossing and Lower Cottonwood Creek by ISCC and NPT personnel approximately once a week throughout the summer of 1999 were all below 50 NTU except for one sample taken on 8/16/99 at Cottonwood Creek that measured 72.6 NTU.

Table 10. Turbidity Data for Lower Cottonwood Creek (Gilmore 1998)

Sampling Date	Turbidity (NTU)	Sample Date	Turbidity (NTU)
9/27/97	.68	10/14/97	1.02
11/3/97	5.86	11/24/97	4.02
12/11/97	2.10	1/19/98	165.00
1/26/97	84.00	2/10/98	48.00
2/16/98	39.40	3/2/98	9.30
3/16/98	5.70	4/4/98	4.00
4/20/98	40.00	Average	31.47

Total suspended solids (TSS) concentrations include the amount of solids suspended in the water, whether mineral (such as soil particles) or organic (such as algae). The TSS test measures an actual weight of material per volume of water. A comprehensive review of TSS criteria conducted by IDEQ and U.S. EPA (IDEQ 1999) suggests that 25 mg/L is a highly protective threshold for salmonids. This threshold can be variable but likely ranges from about 25 mg/L to 80 mg/L, depending on duration. Table 11 presents the estimated mean daily TSS concentrations at the mouth Cottonwood Creek and near the mouth of its tributaries; all means exceeded ranges of values indicated above as protective of aquatic life. The highest concentrations were observed on the South Fork of Cottonwood. Using flow and TSS data, Gilmore (1998) calculated total pounds discharged for each tributary sampling location from October 1996 through April 1998. Of the tributaries to Cottonwood Creek, the South Fork of Cottonwood and Stockney Creeks contributed the highest sediment load.

Table 11. Estimated Mean Daily TSS (Gilmore 1998)

Sampling Station	Mean TSS mg/L
Stockney Creek	658
Upper Cottonwood Creek	117
Shebang Creek	255
South Fork of Cottonwood	823
Long Haul Creek	354
Red Rock Creek	186
Lower Cottonwood Creek	233

2.2.6.1.2 Other Indicators of Sediment

Bedload is material generally of sand size or larger that is carried by the stream on or immediately above its bed. Excessive bedload causes the loss of spawning and rearing habitat (i.e. cobble embeddedness, filling of pools, bed aggradation) and can lead to changes in channel width that then increases temperature and also reduces aquatic habitat. It is believed that excessive bedload is impairing beneficial uses in the Cottonwood Creek watershed; however, bedload sampling data is not available.

As part of the IDEQ BURP surveys, a Wolman pebble count is conducted to estimate particle size distribution of streambed sediment. These counts entail sampling at least 50 sediment particles per transect at each of 3 riffles per site. The percentage of small gravel and finer particles less than 6.35 mm is often used as an indicator of habitat quality for salmonid fishes. Deposition of fine sediments in spawning substrate have been shown to be a major cause of embryo and larval mortality. Survival is high only if the eggs receive an adequate supply of dissolved oxygen, an adequate flow of water through the gravel to supply this oxygen, and necessary flows to remove metabolic wastes (Beschta and Platts 1986). Percent emergence of swim-up fry has also been shown to be reduced by fine sediment by a number of researchers. When particle sizes less than 6.35 mm reach 20-25% of the total substrate, embryo survival and emergence of swim-up fry is reduced by 50% (Bjornn and Reiser 1991).

Results indicated percentages of fine particles (< 6.35mm) were below the 20-25% range cited in Bjornn and Reiser (1991) in samples collected on Cottonwood Creek mainstem below the waterfall at Site 1 (stream mile 1.8; Rosgen's[3] channel type C) and Site 2 (stream mile 4.0; Rosgen's channel type. High percentages (48- 94%) were found on Cottonwood Creek at sites above the waterfall and in the 5 major tributaries, with the exception of Site 4 (near the confluence of the East Fork and West Fork of Red Rock Creek) that contained 17% fines (Rosgen's channel type G). The gradient of all these stream reaches was 2% or less and 10 of the 12 reaches were classified as Rosgen's C channels. For more details on percent fine results and interpretation of those results, refer to Appendix C.

When fine sediment is in excess of transport capacity, coarser particles on the stream substrate tend to become surrounded or partially buried by fine sediment in streams with large amounts of sand and silt. Embeddedness quantitatively measures the extent to which the larger particles are embedded or buried by fine sediment. Areas with high embeddedness have very little space for invertebrates or juvenile fish to hide or seek protection from the current. Research has noted lower aquatic insect and salmonid fish densities with high levels of cobble embeddedness. Levels above 30% are considered to indicate low habitat condition in the Clearwater Basin (NMFS et al. 1998).

The NPT collected cobble embeddedness data at stream miles 1.0 and 6.0 in 1984 (Fuller et al. 1984). Measurement of 25% taken at both stations were evaluated as probably not limiting to salmonid protection.

For the SAWQP, percent embeddedness was evaluated for each surveyed habitat unit by estimating the percentage of particle surface area surrounded by fine particles (<6.33 mm) in the stream substrate (ICSWCD 1999). Four to 5 rocks were sampled in each habitat unit. Mean cobble embeddedness values summarized for all channel types are shown in Table 12.

[3]Channel typing according to Rosgen (1994)

Table 12. Mean Percent Cobble Embeddedness for All Channel Gradients (ICSWCD 1999)

Subwatershed	Mean % Cobble Embeddedness
Long Haul Creek	predominantly free particles
Shebang Creek	32
South Fork Cottonwood Creek	21
Stockney Creek	67
Upper Cottonwood Creek	40
Red Rock Creek	33
Lower Cottonwood Creek	28

Cobble embeddedness data at this level of precision is difficult to use as a diagnostic tool and is best used as a "red flag" for potential problems. Within the Cottonwood Creek drainage, low cobble embeddedness was mostly associated with high gradient stream reaches and not necessarily changes in land use or streambank stability. Those streams with the highest gradient such as Red Rock Creek, the lower end of Long Haul, South Fork of Cottonwood and the lower reaches of Cottonwood Creek all have moderate to high gradients and low cobble embeddedness. This is probably due to the streams' higher transport capacity and ability to scour stream substrate at peak flows. Also, though cobble embeddedness is a measure of salmonid spawning habitat suitability or quality, it is not necessarily an indication of a departure from natural conditions.

2.2.6.2 Stream Temperature

The temperature of stream water usually varies on seasonal and daily time scales, and differs by location according to climate, elevation, extent of streamside vegetation and the relative importance of ground water inputs. Other factors affecting stream temperatures include: solar radiation, cloud cover, evaporation, humidity, air temperature, wind, inflow of tributaries, and width to depth ratio. Diel temperature fluctuations are common in small streams, especially if unshaded, due to day versus night changes in air temperature and absorption of solar radiation during the day.

Aquatic species are restricted in distribution to a certain temperature range, and many respond to the magnitude of temperature variations and amount of time spent at a particular temperature rather than an average value (MacDonald et al. 1991). Although species have adapted to cooler and warmer extremes of most natural waters, few taxa are able to tolerate very high temperatures.

Reduced oxygen solubility at high water temperatures can compound the stress on fish caused by marginal dissolved oxygen concentrations.

Stream temperatures measured within the Cottonwood Creek watershed often exceed Idaho water quality criteria for salmonid spawning and cold water biota (provided in Table 8) during the low flow period of the year. Generally, temperatures were exceeded beginning in early July and persisting to early August. Temperatures recorded by thermograph in 1998 show most sites within the watershed exceeding temperature criteria. For the sites on Cottonwood Creek, the standard for salmonid spawning was marginally exceeded near Cottonwood Butte. Exceedances of salmonid spawning were of greater magnitude and duration at sites in lower reaches. Exceedances of the cold water biota occurred at every sampling station on Cottonwood Creek except the one near Cottonwood Butte. Temperatures monitored in the other tributaries all exceed the standard for cold water biota during summer months. The tributaries with exceedances of greatest magnitude and duration were Shebang and Red Rock Creeks. Monitoring at Yellow Bull Springs (located in the Red Rock watershed) indicated a constant temperature between August and October 1998 of 13°C.

Temperatures throughout the watershed in 1996 and 1997 also exceeded the salmonid spawning and cold water biota criteria as shown in Tables 13 and 14. In assessing full support of beneficial uses, U.S. EPA guidance on temperature classifies fully supporting when criteria is exceeded in less than ten percent of measurements.

Table 13. Temperature Exceedances For Mainstem Cottonwood Creek (Gilmore 1998)

	Frequency > 13° C before July 15 (% of total readings)		**Frequency > 22° C after July 15 (% of total readings)**	
	1996	1997	1996	1997
Upper Cottonwood Creek	100	74	1	16
Lower Cottonwood Creek	100	85	18	19

Table 14. Temperature Exceedance for Cottonwood Creek Tributaries (Gilmore 1998)

Tributary	**Number of readings > 22° C**		**Frequency > 22° C (% of total readings)**	
	1996	**1997**	**1996**	**1997**
Stockney Creek	16	12	3.6	1.3
Tributary	**Number of readings > 22° C**		**Frequency > 22° C (% of total readings)**	
	1996	**1997**	**1996**	**1997**
SF Cottonwood Creek	4	113	1.0	12
Long Haul Creek	No data	179	No data	19
Red Rock Creek	101	184	23.0	20

The NPT conducted additional temperature monitoring in summer 1999. Results are summarized in Section 3.2.

2.2.6.3 Nutrients

Nuisance aquatic growth can adversely impact aquatic life and recreation. Algae of various types grow in the water and on the bed of Cottonwood Creek. Algae provide a food source for many aquatic insects, which in turn serve as food for fish. Algae grow where substrate is suitable and sufficient nutrients (nitrogen and phosphorus) are available to support growth. Flows, temperatures, and sunlight penetration into the water all must combine with nutrient availability to produce conditions suitable for photosynthetic growth. When nutrients exceed the quantities needed to support primary productivity, algae blooms may develop. Subsequent death and decay of algae creates an oxygen demand. If the demand is high enough because of an algae bloom, dissolved oxygen (DO) concentrations in the water body may decline to low levels that harm fish. Algae blooms and excessive rooted aquatic macrophytes can also physically interfere with recreational activities such as swimming and wading and directly change fish habitat. Also, decomposing algae can create objectionable odors and some species produce toxins that impair agricultural water supply.

Idaho's criteria for nutrients states: "Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses (IDAPA 16.01.02.200.06)." Nutrient limitation occurs when a nutrient, usually phosphorus or nitrogen, is below the levels needed for algal growth in the water column. Influxes of these nutrients will stimulate algal growth if other factors are conducive to growth (e.g. light, temperature, flow). Alternatively, a system can have high enough levels of nutrients that it is limited by other factors besides nutrients, and nutrient levels must be decreased to limiting levels to have an effect on algal biomass.

2.2.6.3.1 Phosphorus Compounds

For prevention of plant nuisances, levels of total phosphorus in a stream should not exceed 0.1 mg/L (U.S. EPA 1986). As indicated in Table 15, total phosphorus levels in samples collected from the October 1986 to April 1998 SAWQP monitoring project within Cottonwood Creek and its tributaries ranged from 0.05 mg/L to 2.56 mg/L. In 94% of the samples collected, the recommended criteria of 0.10 mg/L was exceeded. Concentrations of soluble reactive phosphorus were not measured in this study.

In the Cottonwood WWTP study (Teasdale and Funk 1998), concentrations of total phosphorus in Cottonwood Creek immediately below the WWTP ranged from 0.016 to 0.560 mg/L and averaged 0.258 mg/L. Soluble reactive phosphorus concentrations ranged from .007 to 0.586 mg/L and averaged 0.152 mg/L. On average, soluble reactive phosphorus concentrations were approximately 60% of total phosphorus concentrations at this sampling station.

Phosphorous levels measured within Cottonwood Creek and its tributaries are conducive to algae growth, which in turn, can reduce the available dissolved oxygen. High stream temperatures and ample sunlight during the low flow season also act to stimulate algae growth within the watershed.

Table 15. Percent of Incidents Exceeding 0.10 mg/L Total Phosphorus and Range of Results from October 1996 - April 1998

Tributary	Percentage with TP above 0.1 mg/L	Range of Results	
		High (mg/L TP)	Low (mg/L TP)
Stockney Creek	94%	2.56	.07
Upper Cottonwood Creek	97%	0.99	.08
Shebang Creek	86%	1.35	.05
South Fork Cottonwood Creek	94%	2.29	.05
Long Haul Creek	92%	1.59	.07
Red Rock Creek	94%	2.04	.06
Lower Cottonwood	100%	1.93	.13

2.2.6.3.2 Nitrogen Compounds

In surface waters, nitrogen occurs as nitrate (NO_3), nitrite (NO_2), ammonia, and organic nitrogen. The SAWQP project involved monitoring of: 1) NO_3 plus NO_2, which covers most of the nitrogen available in surface waters; 2) ammonia, which is also available for plant uptake; and 3) total Kjeldahl nitrogen, which is the fraction of total nitrogen that in unusable for growth or bound up in the organic form. Upon decomposition, organic nitrogen can be converted to inorganic nitrogen and become available in the inorganic forms available for plant growth. Sample results indicated that the available nitrogen levels represented 47 to 75% of the total nitrogen levels and the average available nitrogen was 60% of the total nitrogen levels.

For prevention of nuisance algae growth, a stream should not exceed 0.3 mg/L NO_3 (U.S. EPA 1993). Table 16 shows the range and average NO_2 plus NO_3 levels found in samples collected for the SAWQP monitoring project from October 1986 to April 1998 within Cottonwood Creek and its tributaries. Since separate results are not available for NO_3 only, levels of NO_2 plus NO_3 were compared to the 0.30 mg/L NO_3 reference criteria. Nearly every sample, or 85% of the total samples collected, exceeded this criteria, with the highest percentage of exceedances occurring in samples from Red Rock Creek. This comparison of NO_2 plus NO_3 results to a NO_3 reference criteria is considered to accurately reflect water quality problems associated with excess nitrogen compounds since most of the nitrogen is likely in the nitrate form in aerobic waters. Only under anaerobic conditions will nitrogen likely exist in the nitrite form.

Table 16. Results Exceeding 0.30 mg/L Nitrate/Nitrite from October 1996 - April 1998

Station	% of Samples Above 0.3 mg/L $NO_2 + NO_3$	Range of Results	
		High (mg/L $NO_2 + NO_3$)	Low (mg/L $NO_2 + NO_3$)
Stockney Creek	89%	10.20	0.00
Upper Cottonwood Creek	83%	7.20	0.00
Shebang Creek	83%	16.90	0.00
South Fork of Cottonwood Creek	83%	32.70	0.00
Long Haul Creek	83%	13.70	0.00
Red Rock Creek	97%	12.40	0.10
Lower Cottonwood Creek	78%	10.00	0.00
Average of all Stations	85%		

Total nitrogen is composed of inorganic and organic nitrogen. Inorganic nitrogen constitutes the form of nitrogen available for plant uptake or "available nitrogen" and is the sum of nitrate plus nitrite plus total ammonia. Table 17 provides a comparison of inorganic nitrogen to total nitrogen levels for all samples collected in the 1996 - 1998 SAWQP monitoring study. Red Rock Creek had the highest percentage of available nitrogen at 77%. Average percent available nitrogen from all samples was 68%.

Table 17. Comparison of Inorganic to Organic Nitrogen

Station	Percentage Inorganic Nitrogen of Total Nitrogen
Stockney Creek	72%
Upper Cottonwood Creek	62%
Shebang Creek	61%
South Fork of Cottonwood Creek	72%
Long Haul Creek	63%
Red Rock Creek	77%
Lower Cottonwood Creek	68%

2.2.6.3.3 Algae

Attached stream algae is part of the periphyton assemblage in streams which consist of algae, bacteria, fungi, and meiofauna. Algae growths were observed and samples were collected for algae identification at sites in the upper portions of the watershed in summer 1998. Results are summarized in Table 18. At a site on Long Haul Creek near the mouth, the sample was dominated by at least four genera of filamentous green algae (Chlorophyta). In addition, several types of motile and non-motile colonial green algae were abundant. Some species of blue-green algae (Cyanophyta) were present in low numbers; the species found are not known to fix nitrogen. Yellow green algae were the dominant algae at the three other sampling stations on Shebang, Stockney, and Upper Cottonwood creeks. Some species of blue-green algae were present in low numbers in samples from Stockney and Upper Cottonwood Creeks; the species found are not known to fix nitrogen.

A single cell bloom of green algae can indicate nutrient influx. At these sites the presence of filamentous green algae can indicate long term nitrogen levels high enough to support filamentous algae growth. Some of the algae species (*Spriogyra* spp., *Oscillatoria* spp., *Gomphonema* spp.,

Lyngbya spp.) documented at sites in the upper watershed are indicator species of polluted water (American Public Health Association et al. 1975).

2.2.6.4 Dissolved Oxygen

The standard of dissolved oxygen (DO) in the water column for cold water biota and salmonid spawning is DO is a one-day minimum of not less than 6.0 mg/L or 90% of saturation, whichever is greater. The state standard for intergravel DO for salmonid spawning is 6 mg/L or greater weekly mean and 5 mg/L or greater daily minimum.

Limited DO data is available for the Cottonwood Creek watershed; trend data is lacking. DO levels measured once in August 1998 were 8.3 mg/L near the mouth of Cottonwood Creek and 5.7 mg/L near the Cottonwood WWTP. Levels measured in IDEQ studies 1976 and 1986 (IDEQ 1978 and IDEQ 1986b) above and below the WWTP indicated low levels below the WWTP (4-6 mg/L and 3-5 mg/L), but these studies occurred before the WWTP switched to land application during the low flow season. Decreased DO levels in this stream appear to be dependent upon excessive nutrient loading and consequent algal growth (increased BOD). It is probable that if nutrient levels and resultant excessive algae growth is addressed, DO levels will remain in a healthy range.

Table 18. Types of Algae Identified (IDEQ 1998)

Sampling Location	Algae Identification Results
Near Mouth of Long Haul Creek	Filamentous Green Algae - Division Chlorophyta: *Ulothrix* spp., *Rizoclonium* spp., *Microspora* spp., and *Spriogyra* spp.
	Non-motile Green Algae - *Chlorococcales* spp.: *Scenedesmus* and *Pediastrum* spp.
	Blue Green Algae - Division Cyanophyta (in low numbers): *Merismopedia* spp., *Oscillatoria* spp., and *Lyngbya* spp.
	Yellow Green Algae - Division Chrysophyta: Benthic diatoms present in high numbers, *Gomphonema* spp.
Near Mouth of Shebang Creek	Yellow Green Algae - Division Chrysophyta: *Billeria/Tribonema* spp. dominated this sample; benthic diatoms also present (*Gomphonema* spp.)
Stockney Creek	Yellow Green Algae - Division *Chrysophyta*: *Billeria/Tribonema* spp. dominated this sample; benthic diatoms also present (*Gomphonema* spp.)
	Blue Green Algae - Division Cyanophyta: *Oscillatoria* spp. present in low numbers
Upper Cottonwood Creek	Yellow Green Algae - Division Chrysophyta: *Billeria/Tribonema* species dominated this sample; benthic diatoms also present (*Gyrosigma* spp.)
	Blue Green Algae - Division Cyanophyta: *Oscillatoria* spp. present in low numbers

2.2.6.5 Pathogens

Pathogens are a small subset of microorganisms (e.g. certain bacteria, viruses, and protozoa) which if taken into the body through contaminated water or food can cause sickness or even death. Some pathogens are also able to cause illness by entering the body through the skin or mucous membranes.

Direct measurement of pathogen levels in surface water is difficult because they usually occur in very low numbers and analysis methods are unreliable and expensive. Consequently, non-pathogenic bacteria which are often associated with pathogens, but which typically occur in higher concentrations and are thus more easily measured, are therefore measured. Fecal coliform bacteria are a commonly used indicator organism, although they are not pathogenic themselves in most instances. Fecal coliforms grow in the intestinal tract of warm blooded animals, so their presence indicates recent fecal contamination either from animals or humans. However, the test used to detect fecal coliform also detects, and thus reports, certain non-fecal organisms as well.

Fecal coliform concentrations found in the 1998 SAWQP monitoring project exceeded the Idaho state water quality criteria for primary and secondary recreation at all sampling locations. Table 19 provides the frequency of exceedances of both the geometric mean and the instantaneous criteria. The tributaries with the greatest exceedances of state criteria were Red Rock Creek, Shebang Creek, and Lower Cottonwood Creek.

IDEQ is conducting a negotiated rulemaking process that would change the primary and secondary contact recreation standard based on fecal coliform to one based on *Escherichia coli* (*E. coli*). No *E. coli* sampling results are available for Cottonwood Creek; limited data collected activities will be conducted in summer 1999 to determine whether a correlation exists between *E. coli* and fecal coliform results. *E. coli* bacteria are a subset of fecal coliform bacteria and considered to be a better indicator of pathogenic microorganisms. The test for *E. coli* are less likely to give false positive, and are more closely related to incidence of gastro-intestinal distress in swimmers.

2.2.6.6 Ammonia

Ammonia can be both toxic to aquatic animal life and a source of nutrients to plants. Ammonia exists in equilibrium in water in three different forms - dissolved ammonia gas commonly referred to as un-ionized ammonia (NH_3), ammonium hydroxide (NH_4OH), and ammonium ion (NH_4+). The proportions of these forms in water are dependent upon pH and temperature. As pH and temperature increase, the percentage of total ammonia that exists as unionized ammonia increases, which is the principal toxic form of ammonia. Much of the ammonia present in water bodies is generated by bacteria as an end product in the anaerobic decomposition of organic matter. Ammonia is also an oxygen-demanding substance. Oxygen is consumed when bacteria convert ammonia to nitrate (NO_3) through the process of nitrification.

Idaho water quality criteria for ammonia are intended to protect cold water biota and salmonid spawning. These criteria are the same and are based on calculations that take into account water temperature and pH. No numeric criteria are available in Idaho rules related to the "nutrient" effect of ammonia - excess concentrations that cause nuisance aquatic growths that impair beneficial uses.

Table 19. Fecal Coliform Results Compared to Criteria (Gilmore 1998)

Station	Primary Contact Recreation		Secondary Contact Recreation	
	% of samples > 500 cfu/100 mL	% of samples with mean > 50 cfu/100 mL	% of samples with > 800 cfu/100 mL	% of samples with mean > 200 cfu/100 mL
Stockney Creek	19	86	8	29
Upper Cottonwood Creek	11	71	8	29
Shebang Creek	30	100	16	57
South Fork Cottonwood Creek	11	57	11	14
Long Haul Creek	22	86	11	43
Red Rock Creek	38	100	32	71
Lower Cottonwood Creek	22	100	14	43
Average % all stations	22	86	14	41

To judge whether ammonia levels in the SAWQP study are high enough to impact beneficial uses, levels were compared to criteria established by U.S. EPA for salmonids and non-salmonid fish species (Gilmore 1998). Ammonia is reported to be acutely toxic to non-salmonids from 0.14 to 4.6 mg/L and to salmonids from 0.083 to 1.09 mg/L. Table 20 indicates the number of samples exceeding the lowest reference criteria in these ranges. An average of 41% and 77% of the results exceeded the 0.14 mg/L criteria for non-salmonids and 0.083 mg/L for salmonids, respectively. A more detailed comparison to the State criteria that are dependent on pH and temperature will be performed as part of the TMDL loading analyses in Section 3.5. The criteria for salmonids of 0.083 mg/L is close to the state standard for a temperature of 28°C and a pH of 9.0, which are worst case conditions for the Cottonwood Creek watershed. Thus the percentage of exceedances of state criteria will be lower then the percentages of exceedances compared to the conservative U.S. EPA criteria for salmonids.

Table 20. Percent of Incidents Exceeding U.S. EPA Ammonia Criteria

Station	% of samples exceeding 0.14 mg/L non-salmonid criteria	% of samples exceeding 0.083 mg/L salmonid criteria
Stockney	44%	78%
Upper Cottonwood	64%	78%
Shebang	44%	75%
SF of Cottonwood	36%	81%
Long Haul	31%	81%
Red Rock	39%	69%
Lower Cottonwood	31%	76%
average for all stations	41%	77%

2.2.6.7 Habitat Alteration (ICSWCD 1999)

Riparian areas are located immediately adjacent to water sources such as streams, springs, rivers, and ponds. A healthy riparian system provides the following functions: sediment filtering, bank stabilization, water storage and release, and aquifer recharge. As part of the SAWQP, a riparian assessment was conducted for the Cottonwood Creek watershed. Assessment techniques evaluated both biological and physical aspects of the streams in the watershed and their associated riparian areas. General conclusions were that channel straigthening and incision of the stream into the valley floor, along with the removal of trees and loss of woody debris from the channel, has resulted in the degradation of aquatic habitat and loss of stream channel function. The establishment and dominance of reed canary grass *(Phalaris arundinacea)* and continued channel maintenance has prevented recovery over time to normal stream channel functions. The lack of normal channel evolution processes (i.e. erosion and depositional processes) have led to a decrease in habitat diversity and complexity throughout the watershed.

Most all tributaries to and including Cottonwood Creek suffer from the lack of aquatic habitat diversity particularly in the upper reaches of the drainage. Upper reaches of Stockney Creek have been channelized and vegetation changed from what was most likely willow dominated to dominance by reed canary grass. The majority of Upper Cottonwood reaches have either been channelized or become incised in the valley floor with vegetation dominated by reed canary grass. The upper reaches of Shebang Creek were in relatively good condition but the lower reaches had noted problems of channelization, streambank tramping and removal of riparian vegetation, and dominance of reed canary grass. These same problems were noted for the upper reaches of Long Haul and Red Rock Creeks and all of reaches in the South Fork of Cottonwood Creek. Loss of a cottonwood forest in the floodplain was noted as a problem in the Lower Cottonwood Creek subwatershed.

Reed canary grass can stabilize stream banks and thus prevent erosion of stream channels. However, stream channels evolve over time and their diverse habitat and productivity is in part due to the stream's ability to migrate across valley bottoms. The tenacious nature of reed canary grass may prevent this movement of the stream channel and stop or slow channel evolution process. Also, reed canary grass does not allow more desirable species, such as sedges and willows, to invade once it has become well established.

It is unlikely that soil and water conditions at many riparian sites in the lower watershed will remain stable. Erosion resistance is characterized by vegetation condition as it relates to soil and substrate stability and texture. Vulnerability of the area or susceptibility to change may be influenced by external activities. The riparian area has been subject to extreme hydraulic events as well as intensive grazing and forest harvesting activities. Grazing activities contribute to removal of streamside vegetation, removal of vegetation along stock trails, and streambank instability.

Many wetland areas are dominated by reed canary grass limiting their habitat value. Wetlands have been impacted from past and present management. Subsurface tile, ditching and woody vegetation removal have been the typical conversion activities in the watershed. Sediment deposition in wetland areas has also reduced the functions and values of the wetlands.

2.2.6.8 Flow Alteration

The SAWQP (ICSWCD 1999) provided a modelling analysis of how land cover changes affected the hyrodology of the watershed; the results of this model are summarized in Section 2.1.3. Those effects are primarily that: 1) water runs off of the watershed at an accelerated rate resulting in higher peak flows; and 2) more water leaves the watershed leaving less water going to deep percolation for the maintenance of late summer flows. Higher peak flows can result in slowed steambank building processes, increased streambank erosion and increased bedload. In the upper portions of the watershed streambank erosion does not seem to have been accelerated due to high peak flows, however there are few streambank-building processes taking place. It is theorized that the stream experiences scouring flows each year and the channel is still making adjustments to that new flow regime (Blew 1999). Significant bank erosion and channel scour have been observed in the lower reach (Fitzgerald 1999). The implications of reduced summer flow include but are not limited to higher water temperature, decreased oxygen content, and decreased flow depth.

2.2.7 TMDL Data Sources and Data Gaps

The two of the water quality data sets highlighted in Section 2.2.5 that comprised the major data set used in conducting the TMDL analyses (Sections 3.1 to 3.5) were: 1) The monitoring data collected as part of the SAWQP project (Gilmore 1998); and, 2) the monitoring data from July of 1996 to December 1997 collected as part of the land application effectiveness study of the Cottonwood WWTP (Teasdale and Funk 1998). These studies were collected during periods of higher than normal precipitation and some rain-of-snow events that lead to excessive runoff. Data from limited sampling activities conducted in the 1999 field season will also be used for TMDL analyses.

This assessment has identified several data gaps that limit full assessment of the effects of §303(d) listed pollutants on beneficial uses as outlined in Table 21. Some of data gaps will be filled with 1999 sampling efforts. As part of the TMDL implementation phase, a long-term monitoring plan that will address the other data gaps will be developed. Data limitations are also indicated in the TMDL loading analyses (Sections 3.1 to 3.5). As a phased TMDL, when more comprehensive trend data becomes available, the TMDL analyses can be revisited and revised based on better information.

Table 21. Data Gaps

Pollutant or Other Factor	Data Gap
Flow	continuous flow data desired at the mouth
	flow data from above and below the Cottonwood WWTP
	flow data for subtributaries
	ground water flow data
Bacteria	data to help determine contributions from various non-point sources (e.g. from septic tanks vs. from grazing) such as data on current livestock populations and manure management practices
	Comprehensive *E. coli* trend and peak data in preparation for change in standard
Sediment/Habitat	turbidity/TSS data at the mouth to determine correlation*
	bedload data
	McNeil Core Dediment Data
	substrate and water column particle size data in lower reaches
	channel cross sections in lower reaches
	intergravel dissolved oxygen data
Temperature	data at the mouth of every tributary during critical periods
	data to evaluate correlation between water and air temperatures
Point Source Contributions	data for all §303(d) pollutants that helps determine contribution from point sources and non-point sources
Nutrients/Dissolved Oxygen	periphyton biomass data
	dissolved vs. total phosphorus data
	background surface water and ground water nutrient levels
	data on nutrient storage and release
	data on algae growing season
	data to distinguish contribution of various nonpoint sources
	diurnal dissolved oxygen data

2.3 Pollutant Source Summary

This section summarizes point source and nonpoint sources of pollutants in the Cottonwood Creek Watershed. It incorporates information form 1998 and 1999 sampling studies regarding what are major contributors of loading of these pollutants to the creek.

2.3.1 Nonpoint Sources

The primary nonpoint pollution sources in the Cottonwood Creek watershed are agriculture, grazing, forestry, storm water, county roads, and septic tanks. Agricultural related nonpoint source pollution is caused by conventional tillage practices and confined livestock management. Potential impacts to water quality also stem from livestock grazing. Forestry related nonpoint source pollution is caused by forest roads, skid trails, stream crossings, and loss of stream shade within riparian areas.

Storm water related nonpoint pollution is caused by construction activities, resident and business activities, roadways, and parking lots. Discrete facilities within the watershed such as a mill or gravel pit also contribute to storm water runoff. Because these sites are not currently managed under U.S. EPA's NPDES Storm Water Program, the TMDL pollutant loads and allocations have been grouped with nonpoint storm water discharge activities.

The Idaho County Health Department estimated one-third of existing septic systems within the Cottonwood Creek Watershed are not functioning properly and contributing to degradation of water quality in Cottonwood Creek (ICSWCD 1999). However, this is a rough estimate due to the lack of records on on-site septic systems prior to the 1980's and further evaluation of septic system contribution to loads in the Cottonwood Creek is needed. Storm water discharge systems, septic system failure and several other discrete sources are included with these nonpoint sources for TMDL loading analysis due to a lack of data and methodology for separate evaluation.

2.3.2 Point Sources

The Cottonwood WWTP is the only point source currently managed under U.S. EPA's NPDES program in the watershed. The WWTP discharges most of the pollutants listed on the §303(d) list for Cottonwood Creek (nutrients, bacteria, sediment, ammonia and BOD materials); consequently, the TMDL determines a waste load allocation for these pollutants. The TMDL also evaluates the effect of the discharge, if any, on the temperature of Cottonwood Creek.

Two other small wastewater lagoons exist in the Cottonwood Creek watershed, one in the Shebang Creek subwatershed and the other in the Long Haul watershed. Insufficient information is available to conduct a load analysis for these facilities. Any pollutant loads from these facilities are considered part of the nonpoint source load in this TMDL. If these wastewater lagoons or any other lagoons are determined to be point sources by U.S. EPA that require a permit in the future, then the TMDL should be revised to provide a separate waste load allocation for these facilities.

Pollutant sources within each subwatershed to be addressed in this TMDL are listed in Table 22.

Table 22. Pollutant Source Inventory

Pollutant Sources	Upper Cot. Creek	Lower Cot. Creek	Stockney Creek	SF Cot. Creek	Red Rock Creek	Long Haul Creek	Shebang Creek
Agriculture	x	x	x	x	x	x	x
Livestock	x	x	x	x	x	x	x
Urban	x	None	None	None	None	x	None
Forestry	x	x	x	x	x	x	x
Storm water	x	x	x	x	x	x	x
Mining	None	x	None	x	None	x	x
Septic Systems	x	x	x	x	x	x	x
Roads	x	x	x	x	x	x	x
Point Source	x	None	None	None	None	None	None

2.3.3 Pollutant Specific Sources

This section indicates how nonpoint and point sources contribute to specific pollutant loads in the Cottonwood Creek watershed.

2.3.3.1 Sediment

Sediment enters Cottonwood Creek and its tributaries largely from nonpoint sources. Although the Cottonwood WWTP is permitted to discharge total suspended solids, the measured levels in the discharge of the Cottonwood WWTP are considered to be low and do not impact beneficial uses. Nonpoint sediment sources along Cottonwood Creek and its tributaries include runoff from agricultural, grazing, timber harvest and construction activities; unstable stream banks; runoff from the City of Cottonwood and a small portion (less than 5%) of the City of Grangeville; and runoff from roads.

2.3.3.2 Temperature

Stream temperature in the Cottonwood Creek watershed is regulated by climate, elevation and solar radiation. Thermal loading from the WWTP is not considered significant, since the plant typically discontinues discharge by the end of April. Management activities including timber harvest in proximity of the stream, grazing in riparian areas, channelization, and alteration of total vegetative cover have contributed to increased solar radiation entering the stream. Excess sediment supplied to the channel from nonpoint sources including agriculture, roads, and bank erosion has increased bedload, and resulted in a wider, shallower channel in many areas. This has increased the surface area of water exposed to solar radiation and heat absorption by the stream. Channelization of the stream associated with land use activities in the upper watershed has resulted in increased flow velocities, and channel downcutting leading to additional sediment loading and bank erosion.

2.3.3.3 Nutrients/Ammonia

Sources of nutrients (i.e. nitrate, ammonia, phosphorus) within the Cottonwood Creek watershed include both point and nonpoint sources. The Cottonwood WWTP discharge contains elevated concentrations of nutrient compounds; however, the plant does not discharge during the low flow season. Nonpoint sources include storm water runoff, septic and animal wastes, runoff from agricultural, grazing, timber harvest activities, and construction activities, and fertilizer applications. Phosphorus is usually associated with soil particles, and practices that increase soil erosion cause increases in phosphorus in receiving surface waters.

2.3.3.4 Pathogens/Bacteria

The major sources of pathogens in the watershed are non-point sources. Although the Cottonwood WWTP plant effluent contains bacteria, the levels of bacteria in the discharge are restricted to State water quality criteria. The City treats the discharge with chlorine to control bacteria. Nonpoint sources of bacteria within the watershed include failing septic systems and animal wastes. An estimated 1/3 of the septic systems in the watershed are failing (ICSWCD 1999). Animals dependent on a stream as a water source often add large amounts of waste to the stream system. Compaction in adjacent areas to the stream has also been found to increase near-bank surface runoff, which in turn carries additional animal wastes into the stream. Fecal coliform counts typically increase in response to storm and runoff events. Fecal coliforms survive for long periods in cow feces (up to year) (U.S. EPA 1993); therefore, bacterial numbers may be influenced by past activities. Bottom sediments are a significant reservoir for fecal coliforms that may be resuspended by streamflow or animal disturbance.

2.4 Pollution Control Efforts

2.4.1 Previous Point Source Pollution Control Efforts

The original Cottonwood sewage treatment facilities consisting of a 5 cell municipal wastewater treatment lagoon system were constructed in 1955. Studies by IDEQ (IDEQ 1986b) determined the discharge from the lagoons significantly impacted Cottonwood Creek with respect to pH, BOD, nitrogen compounds, phosphorus, bacteria, and TSS. Pollutant limits were sometimes exceeded.

The City of Cottonwood developed a facility improvement plan in 1993 that examined several enhanced treatment options. The City of Cottonwood selected the hybrid poplar plantation because it eliminated effluent discharge during periods of low stream flow and had potential to produce marketable fuel wood and fiber. The plantation and irrigation system were completed in 1995. The wastewater treatment system now includes an influent flow measurement manhole, five connected facultative treatment pond cells, a chlorine disinfection basin, irrigation pumps, a spray irrigation system, 40 acre hybrid-poplar planation, effluent overflow cells, an underdrain collection system, a dechlorination chemical contact chamber, and an effluent discharge pipe.

As discussed in Section 2.2.5, a recent study of the effectiveness of the poplar plantation concluded water quality impacts of the operation of the hybrid poplar plantation land application system on Cottonwood Creek were minimal. The sampling parameters between the studies conducted before (IDEQ 1986b) and after (Teasdale and Funk 1998) the WWTP upgrade were not all the same. However, based on comparing the total phosphorus levels in Cottonwood Creek below the WWTP during the low flow season, an order of magnitude reduction in instream phosphorus concentrations occurred, indicating substantial improvement in water quality as a result of the upgrade. The study recommended sealing the bypass manhole located at the WWTP ponds to reduce seepage from those unlined ponds that was believed to be the cause of increased nitrogen concentrations below the ponds.

2.4.2 Previous Nonpoint Pollution Control Efforts

2.4.2.1 Agriculture BMP implementation

No records have been routinely kept on the implementation of BMPs in the Cottonwood Creek watershed. At this time estimates are available based on the best professional judgement of local NRCS and ISCC staff familiar with agricultural activities in the watershed. Table 23 provides these estimates. Some of the programs used to implement these practices include Agriculture Conservation Practices, Resource Conservation and Development projects, Long-term Agreements and Farm Service Agency Highly Erodible Ground regulations which require management components such as conservation cropping sequence and contour farming. As part of the TMDL implementation plan and follow-up work on the SAWQP project, a system to inventory the construction and the effectiveness of BMPs in the watershed will be developed.

2.4.2.2. Dairies

In 1995 a Memorandum of Understanding (MOU) between the U.S. EPA, IDEQ and Idaho Department of Agriculture (IDA) was signed to provide IDA authority to oversee the waste management at dairies statewide. This MOU has provided an enforcement mechanism to assure dairies adequately manage animal waste. Idaho Code 37-401 covers the procedures for review and approval of dairy animal waste management systems. IDA conducts routine inspections of those systems. Idaho rules governing dairy waste (IDAPA 02 Title 04 Chapter 14) require a dairy waste system to be in place and/or operated consistently with the Idaho Waste Management Guidelines for Confined Feeding Operations. Non-compliance with these rules for control of dairy wastes may result in revocation of authority to sell milk for human consumption.

Table 23. Rough Estimates of BMPs Implemented

Best Management Practice	**Estimated Implementation**	**Best Management Practice**	**Estimated Implementation**
Grass Hay	5400 acres	No Till	8000 acres
Continuous No Till	700 acres	Strips	300 acres
Gully Plug	1	Sediment Basin	12
Terrace	35000 feet	Grass Waterway	25 acres
Conservation Reserve Program	2500 acres	Ponds	125
Waste Management Systems	2	Farmstead Windbreak	10 acres
Water Development Projects	31	Conservation Tillage	Not estimated
Fence	Not estimated	Riparian Buffers	Not estimated

2.4.2.3 Forestry

Application of conservation applications on private forested lands has been accomplished with BMPs applied under the authority of the Idaho Forest Practice Act (FPA). Forest application is required when forest management occurs, and is administered by IDL.

2.4.3 Future Pollution Control Efforts

2.4.3.1 Agriculture

The ICSWCD recognizes the need for a pro-active approach to resource management and protection. Because cropland is the major land use in the District, a principal concern of the ISWCD is to support the voluntary status of the agriculture industry. The ICSWCD supports the philosophy of an active approach to resource management by farmers and ranchers without imposing unnecessary regulations.

The ICSWCD was concerned with the potential effect of cropland production activities to both on-site soil productivity and off-site resource impacts. The SAWQP and associated monitoring initiated in 1996 and completed in 1999 was designed to evaluate the current status of the watershed's resources. The goal of this planning project was to develop a resource assessment for the Cottonwood Creek Watershed.

The SAWQP documented the priorities for BMP implementation in the watershed so that efforts can focus on the greatest sources of nonpoint source pollution from agricultural land uses. The SAWQP report (ICSWCD 1999) will serve as the basis for developing a detailed TMDL implementation plan. The District will next assess the desired level of participation among landowners within the watershed. That assessment, combined with the analysis of best treatment alternatives and associated costs provided in the SAWQP report, will be used to prepare funding proposals aimed at BMP implementation in the watershed.

2.4.3.2 Forestry

The IDL implements the Idaho FPA and the rules (IDAPA 20.02.01) pertaining to the FPA that apply to state and private forestry activities in the watershed. The rules identify BMPs that apply to any single instance of timber harvesting, reforestation, road construction and maintenance, chemical application, or slashing management. Forested activities on BLM lands must comply with BLM's management guidelines (USDA-USDA 1995).

The NPT follows forest practice guidelines on reservation lands, as described in the NPT Forest Management Plan (NPT 1999c). These guidelines apply to all aspects of forest management including those mentioned above. The NPT has adopted BMP guidelines which are used to develop site-specific BMP's on Tribal forests. An interdisciplinary approach to land management with input from foresters, hydrologists, fisheries and wildlife biologists, and soil, range, and cultural resource professionals is used when developing site-specific management plans.

2.4.4 Reasonable Assurance

For watersheds that have a combination of point and nonpoint sources where pollution reduction goals can only be achieved by including some nonpoint source reduction, the TMDL must incorporate reasonable assurance that nonpoint source reductions will be implemented and effective in achieving the load allocation (U.S. EPA 1991a). If appropriate load reductions are not achieved from nonpoint sources through existing regulatory and voluntary programs, then reductions must come from point sources. In the Cottonwood Creek TMDL, reductions from both point and nonpoint sources are needed for nutrients.

Nonpoint source reductions listed in the Cottonwood Creek TMDL will be achieved through the combination of authorities the State, NPT and U.S. EPA possesses; through on-going efforts to reduce nonpoint pollution; and through the commitment of the Cottonwood Creek watershed advisory group and other watershed landowners to future nonpoint source pollution control efforts. This section discusses how reasonable assurance is provided both on a programmatic and watershed specific basis for the Cottonwood Creek watershed.

2.4.4.1. Regulatory Authorities for Nonpoint Source Pollution Control

The State, NPT, and U.S. EPA have responsibilities under §§ 401, 402 and 404 of the Clean Water Act to provide water quality certification within this watershed. Under this authority, the State, Tribe, and U.S. EPA review dredge and fill, stream channel alteration and NPDES permits to ensure that the proposed actions will meet all water quality standards. These activities are on-going and will continue in the future.

Due to data limitations, storm water runoff is addressed as a nonpoint pollution source in this TMDL. However, U.S. EPA regulates storm water runoff under its NPDES permitting regulations and program. The State, NPT, and U.S. EPA provide nonpoint source pollution prevention education and technical assistance/support to cities/counties, and watershed advisory groups throughout the state. Guidance is available from U.S. EPA, the Tribe, and the State of Idaho on BMPs for storm water runoff controls that includes educational activities, construction site runoff, and on site detention of runoff.

Under §319 of the Clean Water Act, each state or tribe is required to develop and submit a nonpoint source management plan. U.S. EPA has approved the current Idaho Nonpoint Source Management Plan (Bauer 1989) as meeting the intent of §319 of the Clean Water Act. The Plan identifies programs to achieve implementation of BMPs, includes a schedule for program milestones, and identifies available funding sources. The State attorney general has certified that adequate State authorities exist to implement the Plan. The Idaho Nonpoint Source Management Program coordinates the development and execution of this Plan. The NPT is currently developing its nonpoint source management plan.

Idaho Water Quality Standards and Wastewater Treatment Requirements (IDAPA 16.01.02) refer to existing authorities to control nonpoint pollution sources in Idaho and list designated agencies responsible for reviewing and revising nonpoint source BMPs. Designated agencies are IDL for timber harvest activities, oil and gas exploration and development and mining activities; the ISCC for grazing and agricultural activities; the Idaho Transportation Department (ITD) for public road construction; the DOA for aquaculture; and IDEQ for all other activities (IDAPA 16.01.02.003). Table 24 lists the existing state rules covering approved best management practices pertinent to existing and possible future nonpoint sources in the Cottonwood Creek watershed. The U.S., through the various agencies including U.S. EPA and NRCS, and the NPT retain authority to control nonpoint pollution problems within the Nez Perce Reservation.

The State of Idaho initially uses a voluntary approach to control agricultural nonpoint sources. However, regulatory authority can be found in the water quality standards (IDAPA 16.01.02.350.01 through 16.01.02.350.03). IDAPA 16.01.02.054.07 refers to the Idaho Agricultural Pollution Abatement Plan (IDHW and ISCC 1993) which provides direction to the agricultural community on approved BMPs. A portion of the Ag Plan outlines responsible agencies or elected groups, Soil Conservation Districts (SCDs), that will take the lead if nonpoint source pollution problems need to be addressed. For agricultural activity, it assigns the local SCDs to assist the landowner/operator with developing and implementing BMPs to abate nonpoint pollution associated with the land use. If a voluntary approach does not succeed in abating the pollutant problem, the State may seek various administrative and civil remedies, including without limitation injunctive relief, for those situations that may be determined to be an imminent and substantial danger to public health or environment (IDAPA 16.01.02.350.02.a and b).

Table 24. Approved best management practices in Idaho rules.

Authority	IDAPA Citation	Responsible Agency
Idaho Forest Practice Rules	16.01.02.350.03(a) or IDAPA 20.02.01	Idaho Department of Lands
Rules Governing Solid Waste Management	16.01.02.350.03(b) or Title 1, Chapter 6	Idaho Department of Health and Welfare
Rules Governing Subsurface and Individual Sewage Disposal Systems	16.01.02.350.02 or Title 1, Chapter 3	Idaho Department of Health and Welfare
Rules and Standards for Sream-channel Alteration	16.01.02.350.03(d)	Idaho Department of Water Resources
Rules Governing Exploration and Surface Mining Operations in Idaho	16.01.02.350.03(f)	Idaho Department Lands
Rules Governing Placer and Dredge Mining in Idaho	16.01.02.350.03(g)	Idaho Department of Lands
Rules Governing Dairy Waste	16.01.02.350.03(h) or IDAPA 02.04.14	Idaho Department of Agriculture

The Idaho water quality rules also specify if water quality monitoring indicates that water quality standards are not being met, even with the use of BMPs or knowledgeable and reasonable practices, the state may request that the designated agency evaluate and/or modify the BMPs to protect beneficial uses. If necessary the state may seek injunctive or other administrative or judicial relief against the operator of a nonpoint source activity in accordance with the Director of the Department of Health and Welfare's authority provided in Section 39-108, Idaho Code (IDAPA 16.01.02.350).

2.4.4.2 Cottonwood Creek Implementation Plan

The Idaho Water Quality Standards directs appointed watershed advisory groups to recommend specific action needed to control point and nonpoint sources affecting water quality limited waterbodies. Upon issuance of this TMDL, the Cottonwood Creek Watershed Advisory Group (WAG), with the assistance of appropriate federal, state, and tribal agencies, will begin development of an implementation plan. The Cottonwood Creek watershed restoration strategy (Appendix H) provides the framework for the implementation plan. It lists the types of BMPs the WAG believes will best improve water quality. The restoration strategy focuses on reduction of thermal load, sediment, bacteria, and nutrients.

The implementation plan will provide details of the actions needed to achieve load reductions, a schedule of those actions, and specific monitoring needed to document action and progress toward meeting water quality standards. The implementation plan:

- bases pollutant control actions on the load allocations in the TMDL;
- sets a time by which water quality standards are expected to be met, including interim goals or milestones as deemed appropriate;
- schedules the what, where, and when of actions that are to take place;
- identifies who will be responsible for undertaking planned actions;
- specifies how completion of actions will be tracked;
- includes a follow-up monitoring plan to address data gaps, and how data will be evaluated and used to recommend revisions to the TMDL; and
- describes monitoring to document attainment of water quality standards, including evaluation and reporting of results. This monitoring will evaluate both BMP effectiveness and applications.

2.4.4.3 Potential Funding Sources

Table 25 provides a summary of the types of funding sources available for control of nonpoint pollution sources. Some of these funding sources have been used for past projects. The Cottonwood Creek WAG and the TMDL implementing agencies are committed to seeking funding for water quality improvement projects from these funding sources as well as other new funding sources that become available.

Table 25. Potential Sources of Funding for Nonpoint Source Control Activities

Program	Lead Agency	Land Use Coverage	Typical Cost Share
Federal Programs			
Public Law 566	NRCS	Cropland, Pasture, Riparian, Range	65%
Environmental Quality Incentives Program (EQIP)	NRCS	Cropland, Pasture, Riparian, Range	75%
Wildlife Incentives Program	NRCS	Wildlife Habitat Improvements	75%
Forestry Incentives Program	NRCS	Timber Planting, Reforestation, Forest Roads	50-75%

Program	Lead Agency	Land Use Coverage	Typical Cost Share
Conservation Reserve Program (CRP)	FSA	Cropland, Reforestation	50% + rental based on soil type
Continuous CRP	FSA	Grassed waterways Filter/buffer strips, Riparian Forest Buffer Strips	50% + rental based on soil type + 20% incentive
Wetlands Reserve	NRCS	Cropland	easement for protecting wetlands
Resource Conservation & Development	NRCS	Land Conservation, Water Mgt. Community Development	requires funding sources based on specific project
319	U.S. EPA/IDEQ	Cropland, Riparian, Rangeland, Roads, Urban Areas, Forest Roads	prioritized through BAGS/WAGS recommendations
State Programs			
Habitat Improvement Program	IDFG	Upland Habitat Improvements	50%-75%
Resource Conservation & Rangeland Development	ISCC	Riparian, Rangeland, Cropland	low interest loans and grants
State Income Tax Credit	ISCC	Riparian, Rangeland, Cropland	50% $2,000 max state tax credit/yr upon prior approval
State Agricultural Water Quality Project	ISCC	Riparian, Rangeland, Cropland	up to 90%
Other Programs			
Bonneville Power Administration	FOCUS ISCC/NPT	Aquatic, Riparian, Upland Restoration	variable
U.S. Fish & Wildlife Service (USFWS)	USFWS	Wetland/Riparian Improvements	unknown
National Marine Fisheries Service (NMFS)	NMFS	Wetland/Riparian/Instream Improvements	50% in-kind non-federal match
Army Corps of Engineers (ACOE)	ACOE	Instream to Enhance Wildlife/Protect Resources	unknown

NPT = Nez Perce Tribe
NRCS = Natural Resources Conservation Service
FSA = Farm Services Agency
U.S. EPA = U.S. Environmental Protection Agency
IDEQ = Division of Environmental Quality
IDFG - Idaho Dept of Fish & Game
ISCC = Idaho Soil Conservation Commission

3.0 COTTONWOOD CREEK LOADING ANALYSES AND ALLOCATIONS

Cottonwood Creek is listed on Idaho's 1994, 1996, and 1998 §303(d) lists for 8 parameters of concern: sediment, nutrients, thermal modification, dissolved oxygen, flow and habitat alteration, pathogens, and ammonia (refer to Table 7). Pollutant targets, pollutant loads, pollutant allocations and pollutant load capacities are presented for sediment, temperature, nutrients/dissolved oxygen, bacteria, and ammonia in this section.

Flow and habitat alteration are identified on the §303(d) list as impairing uses in Cottonwood Creek. Flow and habitat do not let themselves to mass/time pollutant loading as defined by U.S. EPA guidance on TMDL development. The Cottonwood Creek TMDL does not address flow and habitat issues because these parameters are not currently required to be addressed under §303(d) of the Clean Water Act. If the U.S. EPA determines that TMDLs are required for water quality problems caused by flow and habitat modification, TMDLs will be developed. Flow and habitat modifications may be addressed through activities needed to implement TMDLs for other listed parameters.

Loading capacity is effectively synonymous with the TMDL for a water body. TMDL is defined as mass per unit time (e.g. pounds per day) of pollutant allowed. The TMDL is the amount of pollutant that can enter the creek without exceeding water quality standards. Although the TMDL is defined in pounds per day or equivalent measurement, in practice, compliance is measured as a concentration of pollutant in the creek (the water quality target) usually expressed in mg/L.

In a conventional approach to TMDLs there are two basic steps to loading analysis: 1) determining or predicting existing loads; and 2) determining the load capacity. The difference of the two provides the necessary load reductions that need to be achieved in order to meet water quality standards. Most simply, load is a product of a concentration and flow data. Existing loads can be calculated directly from instream concentration and flow data, but often need to be estimated for flows or times other than those monitored. Load capacity is similarly calculated, but with a water quality criteria or concentration target instead of instream concentrations and flows based on the critical loading condition. While this sounds simple, it often does not work out so simply and unconventional approaches are often needed to some degree mainly due to data limitations.

Wasteload allocations (WLA) are established for point sources and load allocations (LA) are determined for other sources. Load allocations are best estimates of the portion of the total load that can be contributed by nonpoint sources or by natural sources. When uncertainty exists about the pollutant to water quality relationship (this is almost always the case), federal law requires a margin of safety (MOS) be included in the calculations. The MOS may be explicitly incorporated into the TMDL or may be incorporated in conservative assumptions used to establish the TMDL. The MOS is intended to insure that water quality goals will be met even though uncertainty in the loading capacity exists. The TMDL is the sum of the individual waste load allocations for point sources (WLA), the load allocation for nonpoint sources and natural background (LA) plus a margin of safety.

For the TMDLs developed, pollutant targets are based on numeric water quality standards where they exist, or interpretation of narrative water quality standards in the case of nutrients and sediment. Pollutant load allocations are presented as a function of available flow and allowable pollutant concentration based on the pollutant targets. Where the point sources and nonpoint sources contribute to loading of the same pollutant, the estimated load capacity is divided among the point sources and nonpoint sources. The source, quality and quantity of data used in determining each pollutant target, load, and allocation is discussed in relation to each pollutant within the following sections.

TMDLs were developed for both Cottonwood Creek and its tributaries even though the TMDLs for the tributaries are not due until 2001 or 2006. The tributaries were proactively addressed along with the Cottonwood Creek mainstem because the tributaries are sources of pollutants to the mainstem.

An implementation plan will be developed by the Cottonwood Creek WAG and supporting agencies to specify controls designed to improve water quality in the Cottonwood Creek watershed by meeting the load allocations contained in this TMDL document. During implementation, additional water quality information is expected to be generated. This information may indicate that targets, load capacities, and load allocations may need to be changed. In the event that data show changes are warranted, TMDL revisions will be made with assistance from the Cottonwood Creek WAG. Because the targets, load capacity, and allocations will be re-examined and potentially revised in the future, the Cottonwood Creek watershed TMDL is considered to be a phased TMDL.

3.1 Sediment

This section describes the Cottonwood Creek coarse sediment TMDL components. The sediment targets and load capacity, load analysis and allocation, and margin of safety and critical conditions are described below. For simplicity, the technical details of the analyses are not included in this section and are provided in Appendix F.

3.1.1 Sediment Targets and Load Capacity

This section describes the Cottonwood Creek TAG's interpretation of the State of Idaho narrative sediment standard (IDAPA 16.01.02.200.08), and the linkage between the sediment targets and load capacity. The sediment TMDL sets sediment reductions for suspended sediment load and bedload mobility.

The State of Idaho narrative sediment standard (IDAPA 16.01.02.200.08) states that sediment must not be present at levels which impairs beneficial uses. Anthropogenic water and sediment inputs to Cottonwood Creek have elevated the suspended sediment load and helped destabilize low gradient reaches. These impacts have resulted in sediment laden water, widening and shallowing of the stream, a loss of pools and pool volume, and an increase of fines at depth. All of these impacts have adversely effected coldwater biota and salmonid spawning uses by significantly increasing suspended sediment, reducing critical pool habitat, and increasing the temperature of the stream due to its wide/shallow nature. To address these beneficial use impairments, the TMDL establishes a numeric target for suspended sediment and a set of surrogate targets, discussed in greater detail below, which are expected to lead to full support of the salmonid spawning and coldwater biota uses and attainment of the narrative sediment standard.

3.1.1.1 Fine Sediment

This TMDL establishes a quantitative fine sediment target using the total suspended sediment (TSS)[1] water quality parameter. The fine sediment target is an average daily TSS concentration of 50 mg/l or less. This target was selected based on IDEQ sediment TMDL guidance (IDEQ 1999e) and is intended to account for the acute and chronic effects of suspended sediment on the various life stages of salmonids. Inherently, this target attempts to account for fine sediment resulting from natural and anthropogenic sources. The TSS load capacity, which is the product of the target TSS concentration and stream discharge, is set at the 84th percentile suspended sediment load during the critical time period (i.e. January through May). The 84th percentile is chosen as a conservative value and is factored into the fine sediment TMDL as a margin of safety.

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[1] In this TMDL, total suspended solids data is used as an indicator of total suspended sediment. Refer to Appendix F regarding the correlation between these two water column sediment parameters.

3.1.1.2 Coarse Sediment

This TMDL establishes quantitative coarse sediment targets using surrogate measures. Measures of channel geometry and substrate conditions are used to include: 1) bankfull width to depth ratio; 2) pool frequency; 3) residual pool volume; and 4) depth fines. The existing and desired target levels and references are summarized in Table 26. Appendix F provides more details on surrogate target selection.

Table 26. Coarse Sediment TMDL Targets for Critical Reach of Lower Cottonwood Creek

Target	Existing Condition	Desired Condition (reference)	Percent Change
Bankfull width/depth ratio	86	< 40 (NMFS et al. 1998)	53
Pool frequency (pool/100 meters)	0.5	3 (Montgomery and Buffington 1993)	83
Residual pool volume (m^3)	11	increasing trend (refer to Appendix F)	?
Depth fines	Data Gap	5-year mean not to exceed 27 percent with no individual year to exceed 29 percent, and subsurface fines < 0.85 mm not exceed 10 percent (IDEQ 1999)	?

As stated above, the coarse sediment targets are a numerical interpretation of the narrative sediment standard. Because these targets are not traditional mass-per-unit-time loading values, an inferential link between the coarse sediment targets and load is used to develop the sediment load capacity.

At this time a direct empirical link between the targets and the sediment load capacity cannot be established. As a result, a linkage analysis is completed which shows how numeric targets and the load analysis results relate to each other, and how they combine to yield estimates of sediment load capacity (EPA, 1999). For lower Cottowood Creek, the present status of instream sediment targets are a function of the sediment and water inputs, however, there is not a linear relationship between the percent change in the target and sediment load.

This TMDL makes an inferential link between instream sediment targets and bedload mobility by assuming that by reducing the bedload transport rate of lower Cottonwood Creek, the stability of the channel will increase, and by improving the channel stability, the bankfull width to depth ratio will decrease, pool frequency and residual pool volume will increase, and the volume of depth fines will decrease. Based on this premise, it follows that by increasing the channel stability by about 46% (see below), the coarse sediment targets and water quality standards will be achieved.

3.1.2 Sediment Load Analysis and Allocation

This section describes the fine and coarse sediment load analysis results and allocation scheme. Sediment load reductions are established and allocated to the subwatersheds of Cottonwood Creek. The sediment source analysis shows that the majority of the fine and coarse sediments are from nonpoint sources. There is one permitted point source (ie, city of Cottonwood's WWTP) within the Upper Cottonwood Creek subwatershed which receives a waste load allocation for TSS.

3.1.2.1 Fine Sediment

The fine sediment TMDL analysis shows that to meet the TSS target at Lower Cottonwood Creek, the suspended sediment load needs to be reduced about 60% during the critical time period (i.e. January through May) (Table 27). However, the percent reduction varies by month with the greatest reduction of 80% during April and the smallest reduction of 30% during January (see Appendix F for details). The fine sediment production rate per unit drainage area is 0.16 tons/day/mi^2. Because these are estimates of the actual sediment load, this TMDL sets a 60% reduction for Lower Cottonwood Creek as an interim goal where new stream discharge and TSS data will be used to revise this estimate over time.

Table 27. Lower Cottonwood Creek Fine Sediment TMDL Summary (units in tons per day)

Critical Period	Load Capacity	Existing Load Estimate	Load Allocation*	Load Reduction	Percent Reduction
January through May	14	47	14	33	60

* = no waste load allocation required

There are six subwatersheds within the Cottonwood Creek catchment that require fine sediment TMDLs. All six subwatersheds need at least a 60% TSS load reduction (Table 28a). According to the TSS data, the subwatersheds with the highest TSS load are: 1) South Fork Cottonwood Creek; 2) Stockney Creek; 3) Long Haul Creek; and 4) Shebang Creek. Normalizing the existing TSS load by drainage area shows that the subwatersheds producing the most fine sediment are: 1) South Fork Cottonwood Creek; 2) Long Haul Creek; and 3) Stockney Creek (Table 28b). Fine sediment production from these three watersheds is greater than the remaining three by a factor of at least two, and is greater than Lower Cottonwood by an order of magnitude (ie, factor of 10). In addition, the results show clearly that South Ford Cottonwood Creek is the single largest contributor of fine sediment to Lower Cottonwood Creek.

TSS load reductions are set for each of these subwatersheds for the same critical time period as Lower Cottonwood Creek. These load reductions are set so that the TSS target is met at the mouth of each subwatershed, and they do not consider the reduction needed at Lower Cottonwood Creek. However, this analysis assumes that actions taken to reduce the suspended sediment load of the subwatersheds will effectively reduce the load of Lower Cottonwood Creek. As a result, the suspended sediment load allocation scheme accounts for the needed reductions at

Lower Cottonwood Creek as well as individually listed segments nested within the watershed (Table 28).

There is one permitted point source (ie, city of Cottonwood's WWTP) within the Upper Cottonwood Creek subwatershed which receives a waste load allocation for TSS at the present permit level of 70 mg/L. TSS data, collected above and below the WWTP, show no significant significant increase in fine sediment (Teasdale and Funk 1998): therefore, the Cottonwood WWTP receives no new TSS reductions as a result of this TMDL.

Table 28a. Subwatershed Fine Sediment TMDL Summary (units in tons per day).

Site Number	Subwatershed	Load Capacity	Existing Load Estimate	Load Allocation	Load Reduction	Percent Reduction
1	Stockney Creek	6	47	6	41	88
2	Upper Cottonwood Creek*	3	8	3	5	60
3	Shebang Creek	3	15	3	12	80
4	South Fork Cottonwood Creek	4	80	4	76	95
5	Long Haul Creek	4	24	4	20	85
6	Red Rock Creek	4	11	4	7	64

* = City of Cottonwood WWTP receives a waste load allocation at present permit levels and does not require TSS load reductions.

Table 28b. Subwatershed Fine Sediment Load Summary by Subwatershed

Site Number	Subwatershed	Drainage Area (mi^2)	Existing Load (tons/day)	Unit Existing Load (tons/day/mi^2)
1	Stockney Creek	31.1	47	1.5
2	Upper Cottonwood Creek	15.8	8	0.5
3	Shebang Creek	28.6	15	0.5
4	South Fork Cottonwood Creek	19.6	80	4.1
5	Long Haul Creek	13.9	24	1.7
6	Red Rock Creek	39.8	11	0.3

3.1.2.2 Coarse Sediment

Bedload modeling indicates that to stabilize the streambed at bankfull discharge, the streambed stability needs to be increased about 46%. In other words, to reduce the mobility of the median substrate particle size, the boundary shear stress at bankfull flow needs to be reduced. This can be accomplished several ways: 1) increase the roughness of the stream channel (e.g. large woody debris); 2) reduce the magnitude of bankfull discharges so that water is retained on the land longer; and 3) reduce the hillslope and instream production of coarse sediment. In combination, these actions will help stabilize the lower reaches of Cottonwood Creek.

As stated above, because these coarse sediment allocations are not traditional mass-per-unit-time loading values, an inferential link between the targets and sediment loading is used to develop the sediment load capacity. Instead of the traditional load allocation, this analysis uses the "other appropriate measure" tool to meet the TMDL requirements.

Coarse sediment sources are characterized and prioritized by subwatershed. A decreasing trend toward background sediment production, transport, and delivery by subwatershed is the goal of the coarse sediment load allocation scheme. It is assumed that beneficial use support will be achieved at some point between the current and natural bedload transport rates. However, other actions need to be implemented to improve Lower Cottonwood Creek (ie, large woody debris and peak flow alteration).

In the interim, the coarse sediment source analysis relies on the NRCS SAWQP sediment budget for Cottonwood Creek to prioritize coarse sediment sources (ICSWCD 1999). Further source assessment will be completed as part of the TMDL implementation plan development.

3.1.3 Margin of Safety and Critical Conditions

An explicit and implicit margin of safety is used to develop the fine and coarse sediment TMDLs. The explicit MOS is factored into the fine sediment load analysis where the 84^{th} percentile TSS load is used to establish the existing TSS load. This is a conservative approach to setting the needed load reductions given the available TSS and stream discharge data.

The implicit MOS is equated into the coarse sediment targets and load analysis. The coarse sediment targets are established using conservative values derived from theoretical thresholds and regional reference conditions (see Appendix F for details). For the coarse sediment loading analysis bedload mobility is measured relative to the d_{50} particle size rather than the d_{84} particle size which provides a conservative measure of channel stability.

The critical conditions considered for beneficial use support and target attainment include: 1) channel geometry; 2) seasonal sediment load trends; 3) timing of steelhead migration; and 4) long-term salmonid spawning and rearing needs.

All of the flow and sediment analyses, to include the streambed stability analysis, have built in assumptions that attempt to account for critical conditions: for example, the use of bankfull discharge as the flow that maintains the stream channel over the long-term. Other specific assumptions and factors that account for critical conditions are described in detail in Appendix F.

3.2 Stream Temperature

The Cottonwood Creek temperature TMDL was established to address thermal loading (heat) for the protection of salmonid spawning and other cold water biota. The TMDL establishes percent reduction targets (instream temperature) for nonpoint sources in each subwatershed. These percent reduction targets are linked to "Percent Increase in Shade" targets for each sub-watershed, thereby reducing the overall rate of increase in instream temperature throughout the watershed. For point source activities, no wasteload allocations were given to the Cottonwood WWTP because the facility is not a source of thermal loading during the interval when temperature violations occur in the upper watershed.

3.2.1 Targets

Mainstem Cottonwood Creek is protected for salmonid spawning (IDAPA 16.01.02.120 (cc. CB-1322)). Use designations have not been established for the 5 major tributaries flowing into Cottonwood Creek; therefore, the default designation is cold water biota (IDAPA 16.01.02.101.01). This TMDL addresses fisheries concerns resulting from impairments due to water temperature increases. The State of Idaho temperature criteria protects several species of fish in Cottonwood Creek as described in Section 2.1.6. The temperature targets for Cottonwood Creek are shown in Table 29.

Table 29. Designated Beneficial Use and Applicable Temperature Criteria

Beneficial Use	Criteria	Where Standard Applies
Salmonid Spawning	Water temperature of thirteen (13°C/55°F) or less with a maximum daily average no greater than nine (9°C/48°F) IDAPA 16.01.02.250.02.d.(ii)	Cottonwood Creek
Cold Water Biota	Water temperatures of twenty-two (22°C/72°F) or less with a maximum daily average no greater that nineteen (19°C/66°F) IDAPA 16.01.02.250.02.c(ii)	Tributaries flowing into Cottonwood Creek: Red Rock Creek Long Haul Creek South Fork Cottonwood Creek Stockney Creek Shebang Creek

3.2.2 Condition Assessment

3.2.2.1 Thermograph Location

Continuously recording thermographs were strategically placed throughout the watershed, June through September in 1996 (7), 1997 (7), 1998 (10), and 1999 (11). Stream temperatures were evaluated for each subwatershed. See Appendix G for sub-watershed and thermograph locations. Sites included: main stem Cottonwood Creek (including the mouth), all major tributaries, and one spring in Red Rock Creek Watershed.

Stream temperature in a watershed is driven by the interaction of many instream variables described in Section 2.2.6.2. Energy exchange may involve solar radiation, longwave radiation, evaporative heat transfer, convective heat transfer, conduction, and advection, interacting with channel characteristics.

3.2.2.2 Temperature Patterns

Stream temperatures in 1998 and 1999 often exceeded the Idaho temperature criteria during the low flow period of the year. As seen in Figures 13 and 14, stream temperatures in Cottonwood Creek were cooler in the headwater areas and warmer on the prairie. Stream temperature increased (approximately 5 °C) from the headwaters of Cottonwood Creek to the City of Cottonwood. No significant change in temperature was observed between the thermographs located upstream and downstream of the Cottonwood WWTP. From the City of Cottonwood to it's confluence with the South Fork Clearwater River, the mainstem temperature gradually increases by approximately 6 °C. Temperatures fluctuate about 3 degrees with inflowing tributaries.

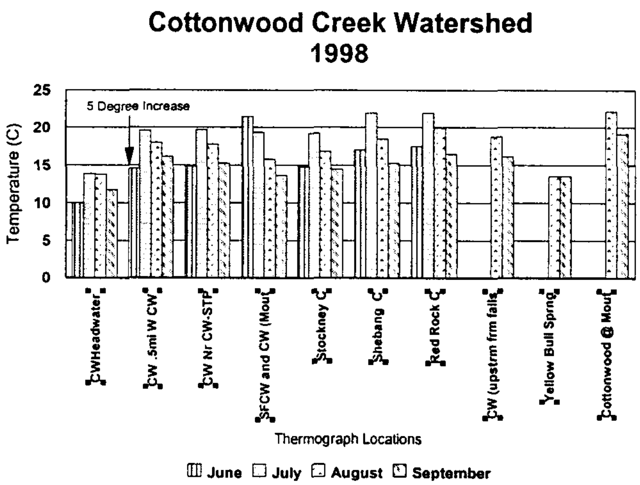

Figure 13 - Monthly Daily Average Temperature (1998)

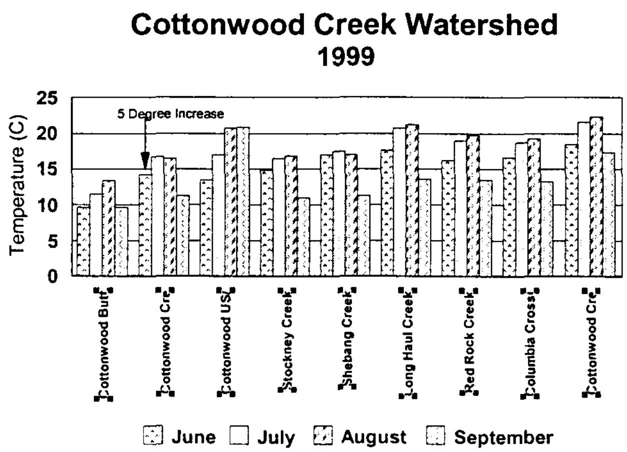

Figure 14 - Monthly Daily Average Temperature (1999)

Table 30. Number of Temperature Exceedances in Cottonwood Watershed (1998)

Location	June[1]	July 1st - 15th[1]	July 16 - 31st[2]	August[2]	September[2]
Number of Days Sampled (N)	21	15	16	31	30
Cottonwood Creek Headwaters (1)	18	15	0	0	0
Cottonwood Creek 0.5 mile west of City of Cottonwood (2)	21	15	16	8	4
Cottonwood downstream of WWTP (3)	21	15	16	10	1
South Fork Cottonwood Creek (Mouth) (4)	12	15	5	0	0
Stockney Creek (5)	12	15	16	6	0
Shebang Creek (6)	12	15	16	15	1
Red Rock Creek (7)	12	15	16	18	6
Cottonwood Creek (upsteam from falls) (8)				10	2
Yellow Bull Springs				0	0
Cottonwood Creek at Mouth				25	18

1 Criteria Applied is Salmonid Spawning Criteria of 9°C.
2.Criteria Applied is Cold Water Biota Criteria of 19°C

Exceedances of the daily average temperature criteria were noted throughout the watershed (Table 30). Stream temperatures in 1999 were cooler than 1998, and temperature patterns were vastly different. Peak stream temperatures in 1998 occurred in mid-June, while in 1999, peak temperatures occurred in mid-August (Appendix G, thermograph plots).

Frequency of recurring stream temperatures was evaluated for each subwatershed. Based on the 1998 and 1999 thermographs, the highest frequently occurring temperature during the warmest time period (June 1 through July 15) was 18°C/64°F and the coolest frequently occurring temperature was 12°C/54°F. Temperature frequencies are summarized by subwatersheds in Appendix G.

The Cottonwood Watershed generally has suboptimal amounts of riparian vegetation to provide stream shading, in addition to areas of increased soil compaction, accelerated bank erosion, and channel downcutting. These impacts have increased the water surface area available for heating, resulting in stream temperature criteria exceedances.

The Cottonwood Creek TMDL proposes increases in stream shading in order to meet the temperature criteria.

3.2.2.3 Stream Shade

Timber harvest, grazing, and agricultural activities within the riparian zone can have a significant effect on canopy closure. Canopy cover contributes to the rate of increase in instream temperature. Without riparian shade trees, most incoming solar radiation energy is available to heat the stream. Riparian vegetation effectively reduces excess solar radiation loading. In the Cottonwood Creek watershed, existing riparian shade conditions were evaluated by ISCC (Appendix G). Average shade values are presented in Table 31.

Table 31. Average Existing Shade Condition in the Cottonwood Creek Watershed

Riparian Vegetative Shade Conditions	
Subwatersheds	**Average Existing Shade Condition**
Upper Cottonwood Creek - Headwaters	70%
Upper Cottonwood Creek	37%
Stockney Creek	48%
Shebang Creek	19%
South Fork Cottonwood Creek	13%
Long Haul Creek	2%
Red Rock Creek	19%
Lower Cottonwood Creek	16%

3.2.3 Evaluation of the Critical Time Period (Exceedance Period)

The designated use for Cottonwood Creek (source to mouth) is salmonid spawning. Therefore, Idaho water quality criteria of 9°C/48°F for salmonid spawning is applicable for this reach January15-July 15. The "critical time period", or time of warmest instream temperatures during this interval was used for model calibration to climate and instream conditions.

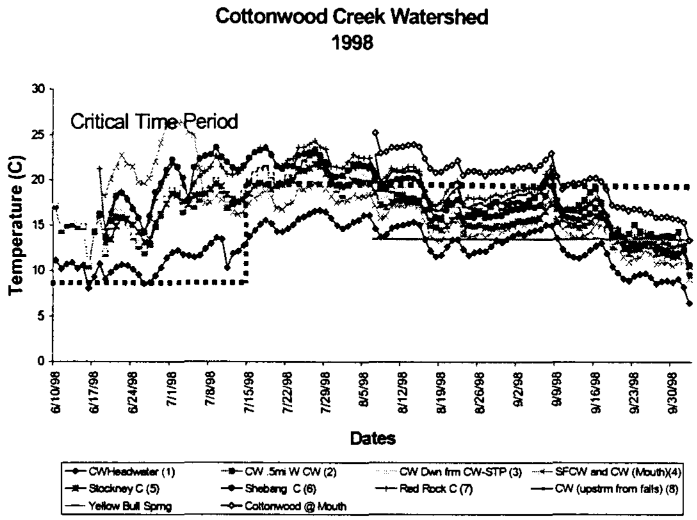

Figure 15 - Critical Time Period in Cottonwood Creek 1998

The salmonid spawning beneficial use requires that Cottonwood Creek and tributaries at their confluence with the mainstem meet the daily average temperature criteria of 9°C/48°F. The 1998 thermographs were collectively evaluated to establish the critical time period. Based on this evaluation, the critical time was defined as June 1 through July 15 (Figure 15). During this time interval, no thermal assimilative capacity was available and daily average stream temperatures exceeded the salmonid spawning criteria. The headwaters of Cottonwood Creek had relatively few exceedances compared to sites located on the prairies. Many tributaries in Upper Cottonwood Creek also failed to meet the Idaho salmonid spawning criteria during this time period in both 1998 and 1999 (Figures 15 and 16). Data presented in Figures 15 and 16 also show that some violations of the cold water biota criteria also occur outside of the salmonid spawning time period. Proper management activities, such as riparian shading and changes in land management practices, necessary for reducing instream temperature should be effective extending into September.

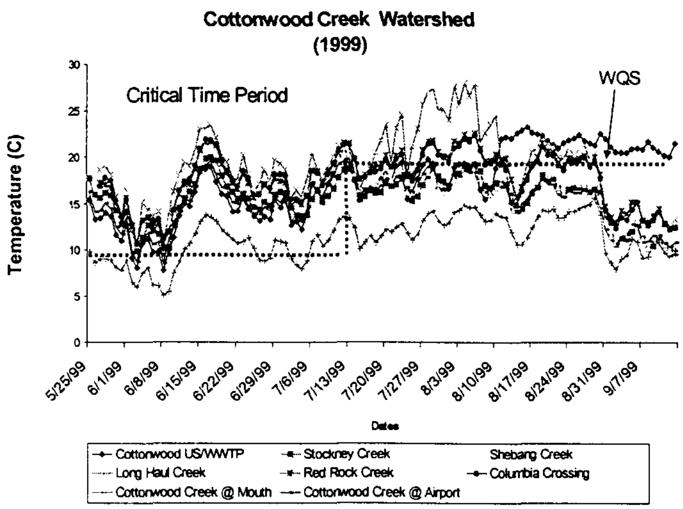

Figure 16 - Cottonwood Creek Critical Time Period 1999

Annual shifts in stream temperature are climatologically related. Conditions at the time of this study are discussed below. The Pacific Northwest saw radical weather shifts during the summer of 1998, when western North America transitioned from the second strongest El

Nino event of the 20th century, with a dry, warm winter to a moderate-strong La Nina event with a cold, wet winter.

May 1998 for the Clearwater Region was anomalously very wet, 3.8 - 7.0" (130% - 290% of normal), but had near normal temperatures. June 1998 was wet but only at the mid- to- high elevations. Lower elevations (i.e. Lewiston) were fairly dry. Temperatures stayed 1-2 degrees below normal with late spring showers carrying over to the first week of July. Strong convective storms with abundant showers occurred the last few days of July. Precipitation totals for July varied from 1.2 - 3.9 " (110% - 160% of normal). Intense thermal ridging in July brought scorching, hot conditions across the region, culminating with many high temperature records broken on July 26th. July 1998 was the hottest month in historical record and the (in-direct) proxy record going back a thousand years for much of the United States. This thermal ridging continued into August, and very little precipitation fell across the region. Temperatures exceeded 3 °F above normal for both months.

In 1999, spring in the Clearwater Basin was very cold with near-normal (90% - 110%) snow-packs. May was dry and cold (3-4 degrees below normal). June had near-normal moisture and cold temperatures (3 degrees below normal). July was very dry with cold temperatures (2 - 3 degrees below normal). August had above normal (110-130% of normal) moisture and temperatures one degree above normal (Martin 1999).

3.2.4 Load Capacity and TMDL Allocations

TMDLs may be expressed in terms of mass per unit time, toxicity, or other appropriate measures (40 CFR 130.2(i)0). As an "*other appropriate measure*" for the TMDL, a percent reduction target in instream temperature has been set for each subwatershed to meet the prescribed loading capacities. This TMDL focuses on temperature reductions during the critical time period, the warmest interval when criteria are exceeded. Percent reduction targets will be linked to "Percent Increase in Shade" targets for each subwatershed to meet the Idaho temperature criteria.

3.2.4.1 Load Capacity

The load capacity for Cottonwood Creek watershed is the Idaho water quality criterion of 9 °C/48 °F. The achievement of the loading capacity in Cottonwood Creek will rely on watershed-wide reductions in thermal loading. Improved conditions upstream (i.e. lower channel width/depth ratios, increased shade, and increased flow) will result in lower temperatures downstream.

3.2.4.2 TMDL Waste Load Allocation

The Cottonwood WWTP, the only permitted point source in the watershed, is currently permitted to discharge to Upper Cottonwood Creek only between October 31 and April 1 of each year, although discharges have also occurred during April and May under emergency provisions (IDEQ 1999c). Between April 30 and October 16 the WWTP is permitted to land apply wastewater onto a hybrid poplar tree plantation operated by the City of Cottonwood. As the WWTP does not discharge during the exceedance time being addressed by the TMDL, it will not receive a wasteload allocation for temperature (heat).

3.2.4.3 Percent Reduction Targets

Percent reduction targets throughout the Cottonwood Creek watershed were established to ensure attainment of the mean daily Idaho temperature criteria of 9°C/48°F. Targets were established using frequency distribution charts of 1998 instream temperature, for each subwatershed (Appendix G), representing most frequently occurring instream temperatures during the critical time period (June 1 through July 15). The year 1998 was used to establish the percent reduction targets in order to provide a conservative estimate representing warmest conditions. This provides assurance that prescribed targets will be effective during worst case conditions, as well as, outside of the salmonid spawning period. Table 32 identifies the most frequent instream temperature and the corresponding percent reduction needed to meet the Idaho temperature criteria. Methods for calculating percent reductions are identified in Appendix G.

3.2.4.4 Development of Corresponding Shade Targets

The percent temperature reduction target for each subwatershed may be translated into corresponding subwatershed shade targets. These provide baseline goals for the Cottonwood Creek Watershed Restoration Strategy (WRS) (Appendix H). It would be desirable to increase these percentages voluntarily at the Cottonwood Creek WAG's discretion, in areas where shade increases are minimal or unnecessary to meet criteria. Improving stream conditions and shade levels in all subwatersheds, headwater areas, and low-order tributaries will aid in lowering downstream temperatures. The WRS, as further developed by the Cottonwood Creek WAG, will promote the attainment of water quality criteria through watershed improvement projects, restoration activities and best management practices. The success of the WRS relies heavily on the cooperation of landowners in the watershed.

Table 32 - TMDL / Allocation and Percent Reduction Target

Subwatershed	Frequently Occuring Temperature (°C)	Load Capacity (°C)	Reduction in Stream Temperature (%)
Upper Cottonwood Creek (Headwaters of Cottonwood Creek to Cottonwood City Limits)			
Upper Cottonwood Creek(1)	12°C/54°F	9°C/48°F	25
Upper Cottonwood Creek - (From City Limits to confluence with Stockney Creek)			
Upper Cottonwood Creek(2)	18°C/64°F	9°C	50
Upper Cottonwood Creek(3)	18°C	9°C	50
Stockney Creek			
Stockney Creek	15°C/59°F	9°C	40
Shebang Creek			
Shebang Creek	16°C/61°F	9°C	44
South Fork Cottonwood Creek			
South Fork Cottonwood Creek	18°C/64°F	9°C	50
Long Haul Creek			
Long Haul Creek	19°C/66°F	9°C	53
Red Rock Creek			
Red Rock Creek	18°C	9°C	50
Lower Cottonwood Creek			
Cottonwood Creek Reservation Line	18°C	9°C	50
Lower Cottonwood Creek. @ Mouth	21°C/70°F	9°C	57

Note:
Upper Cottonwood (1) - Upper Cottonwood (Butte) Headwaters,
Upper Cottonwood (2) - Upper Cottonwood .5 mi. US from City of Cottonwood
Upper Cottonwood (3) - Upper Cottonwood near WWTP

The Stream Segment Temperature Model (SSTEMP) was used to develop the shade target for each subwatershed. Calibration of the model for each subwatershed relied on stream temperature data, estimated streamflow data and climatic information for the identified critical time periods.

The Stream Segment Shade Model (SSHADE), a sub-component of SSTEMP was used to estimate existing and desired riparian shade for specific channel widths. The Stream Segment Solar Model (SSSOLAR) was used to estimate solar radiation available to increase instream temperature at a given time of year. Parameters for SSSOLAR and SSSHADE included: streamflow; relative humidity; wind speed; cloud cover; vegetative characteristics (site potential characteristics); and air temperature. Air temperature data was available for three weather stations: Cottonwood, Grangeville, and Kooskia. Location and elevation of the subwatershed determined choice of air temperature station for use in the model. Relative humidity, wind speed and cloud cover estimations were made using the NOAA Climatic Atlas (see Sec. 3.2.5). Estimated relative humidity was corrected for changes in elevation within each subwatershed (Appendix G). Daily average streamflow, a critical factor in the model calibration exercise, was limited to estimations based on Regional USGS curves (Appendix A). Additional streamflow data should be collected to more fully characterize this watershed.

Each watershed was calibrated using available thermographs. Appendix G shows thermograph locations. Results of calibration showed that the degree difference between the modeled stream temperature and the observed stream temperature was 0.5°C - 2°C (Appendix G). This suggests that the model can predict mean daily stream temperature within a reasonable range given the data deficiencies.

Climax vegetative species were identified by local land management agencies to develop shade targets for each subwatershed (Blew 1999b) (Table 33). Riparian vegetative characteristics, including range of height, were identified for three sub-regions (Figure 17). A solar angle of 60° (June through September), the height of mature, riparian vegetation required to shade the middle of the stream channel, stream orientation, topographic altitude, and time of year were used to calculate shade needed within each subwatershed for temperature improvement. Average vegetative height for each sub-region is shown in Table 33. Final shade targets, summarized in Table 34, represent increases required to meet the percent reduction targets and water quality criteria. These shade targets were not allocated to non-point source categories (i.e., agricultural, forestry, etc.) because site specific shade data by landuse was not available. Monitoring will be an integral part of the strategy as criteria attainment will occur overtime, and adjustments incorporated in a phased TMDL approach. As the stream recovers, other factors may work to decrease temperatures, including narrowing and deepening of the channel, colder water contributions from improved segments upstream, or increased flow from possible flow alterations.

Table 33. Potential Vegetative Heights Within Each Subwatershed

Sub-regions	**Subwatershed**	**Vegetative climax species**	**Potential height (ft)**
Upper Cottonwood Creek Headwaters	Upper Cottonwood Creek	Conifer, Douglass Fir, Grand Fir, Cedar	123
Upper Cottonwood Creek Prairie, immediately downstream from headwaters	Upper Cottonwood Creek, Shebang Creek, Stockney Creek	Alder, Willow, Ponderosa Pine, Camas, Lodgepole Pine, Orchid Grass, Sedges and Rushes, Cottonwood	50
Lower Cottonwood Creek to mouth	Lower Cottonwood Creek, Red Rock Creek, Long Haul Creek, South Fork Cottonwood Creek	Alder, Willow, Ponderosa Pine, Camas, Lodgepole Pine, Orchid Grass, Sedges and Rushes, Cottonwood	50

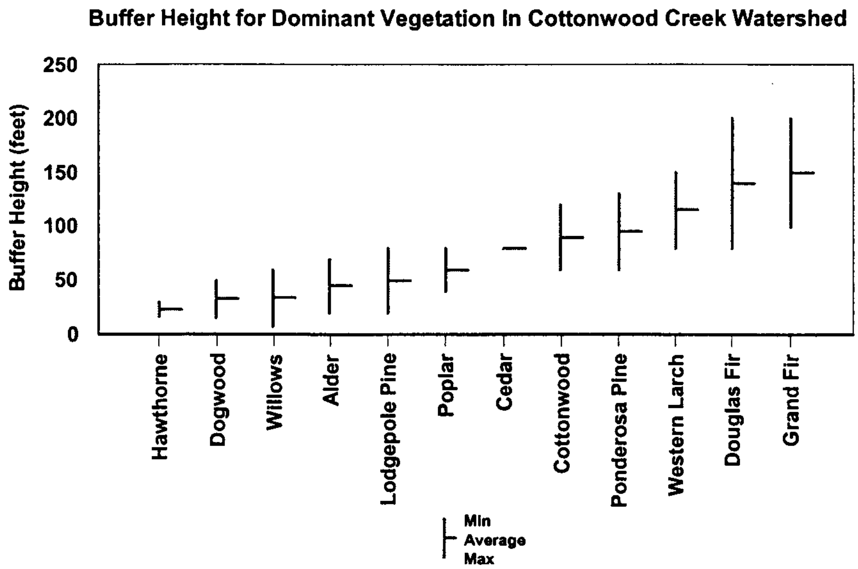

Figure 21 - Dominant Vegetation Types and Heights in the Cottonwood Creek Watershed

Table 34. TMDL / Allocation and Percent Increase in Shade Needed for Cottonwood Creek

Subwatershed	**Frequently Occurring Temperature (°C)**	**Load Capacity (°C)**	**Reduction in Stream Temperature (%)**	**Percent Increase in Shade to Meet TMDL Target (%)**
Upper Cottonwood Creek (Headwaters of Cottonwood Creek - Cottonwood City Limits)				
Upper Cottonwood Creek(1)	12°C/54°F	9°C/48°F	25	20*
Upper Cottonwood Creek - (From City Limits to confluence with Stockney Creek)				
Upper Cottonwood Creek(2)	18°C/64°F	9°C	50	44
Upper Cottonwood Creek (3)	18°C	9°C	50	
Stockney Creek				
Stockney Creek	15°C/59°F	9°C	40	47
Shebang Creek				
Shebang Creek	16°C/61°F	9°C	44	76
South Fork Cottonwood Creek				
SF Cottonwood Creek	18°C	9°C	50	44
Long Haul Creek				
Long Haul Creek	19°C/66°F	9°C	53	86
Red Rock Creek				
Red Rock Creek	18°C	9°C	50	75
Lower Cottonwood Creek				
Cottonwood Creek Reservation Line	18°C	9°C	50	30
Lower Cottonwood Creek.@ Mouth	21°C/70°F	9°C	57	

Note:
Upper Cottonwood (1) - Upper Cottonwood (Butte) Headwaters
Upper Cottonwood (2) - Upper Cottonwood 0.5 mi. US from City of Cottonwood
Upper Cottonwood (3) - Upper Cottonwood near WWTP
* Shade needed in area directly above the City limits, but below Cottonwood Butte

Due to the lack of site specific information regarding the heat load contribution from various nonpoint sources categories in the watershed, shade allocation/percent reduction targets were for each sub-watershed. Achievement of 9°C/48°F temperature criteria in the Cottonwood Creek should occur overtime as a result of improvements throughout the watershed. It is recognized that while the model is restricted to developing shade targets, meeting the criteria will best be accomplished by also promoting channel restoration that leads to a narrower, deeper channel, colder water contributions from improved segments upstream, and/or increases in flow from changes in water yield patterns. Restoration of beneficial uses for steelhead in the watershed requires temperatures within preferred levels for steelhead, 10 - 13°C (50 - 55°F) (Bjornn and Reiser 1991). Monitoring will assess effects of restoration activities on temperature and targets may be adjusted with improvement. The State of Idaho and U.S. EPA Region 10 are currently conducting temperature studies which could result in changes in the temperature criteria and trigger revision of the TMDL. Per the State of Idaho's TMDL guidance and concurrence of U.S. EPA and the NPT, the ultimate measure of TMDL success is beneficial use support.

3.2.5 Margin of Safety and Seasonality

3.2.5.1 Adaptive Management

The Cottonwood Creek Watershed Restoration Strategy (Appendix H) developed with assistance from the Cottonwood Creek WAG identifies restoration activities and best management practices which will ensure progress toward criteria attainment. This strategy provides the framework for the implementation plan which will include a high level of project detail. The Cottonwood Creek TMDL is intended to adapt to implementation, allowing for future changes to the loading capacity and surrogate measures (allocations) in the event that data collection illustrates needed adjustments. The Cottonwood Creek WAG may initiate changes in implementation strategies based on progress toward meeting the beneficial uses and water quality criteria in consultation with the governmental agencies jointly developing the TMDL.

3.2.5.2 Assumptions

A margin of safety is factored into the temperature simulation methodology. Conservative estimates of streamflow, wind speed, relative humidity, and cloud cover were used in calibrating SSSOLAR and SSTEMP, and in developing the "Percent Increase in Shade" targets for each sub-watershed. A list of assumptions and documented data sources used in calibrating and running the SSTEMP Model for each subwatershed within Cottonwood Creek are shown in Table 35.

Table 35. SSTEMP parameters

PARAMETER	ASSUMPTIONS/DATA SOURCE
Relative humidity	Range from 20% - 40% depending upon Elevation/ *NOAA Climatic Atlas*, CRITFC
Wind speed	8 mph / *NOAA Climatic Atlas*
Streamflow	Regional USGS curves
Percent possible sun (cloud cover)	80% / *NOAA Climatic Atlas*

3.2.5.3 Seasonal Variation

Section 303(d)(1) requires TMDLs to be "established at a level necessary to implement the applicable water quality criteria with seasonal variations." Both stream temperature and streamflow vary seasonally from year to year. Water temperatures are coolest in the winter and early spring months. Stream temperatures in this watershed exceed the Idaho water quality criteria primarily in mid-summer (June through August). Warmest stream temperatures correspond to areas with prolonged solar radiation exposure, warm air temperature and low flow conditions. These conditions occur during mid-summer and lead to the warmest seasonal instream temperatures. The analysis presented in this TMDL represents mid-summer conditions when the controlling factors for stream temperature are most critical.

3.3 Nutrients/Dissolved Oxygen

3.3.1 Instream Nutrient and Dissolved Oxygen Targets

Idaho's water quality criteria for nutrients states, "Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses (IDAPA 16.01.02.200.06)." Section 2.2.6.4 describes how nutrients can impair aquatic and recreational beneficial uses. Impairment of recreational uses in the Cottonwood Creek watershed from excessive aquatic growth is not believed to be a problem due to low boating and swimming recreational use; however, impairment of aquatic life beneficial uses is considered to be a problem. Excess nutrients can adversely impact aquatic life beneficial uses by stimulating aquatic plant growth which, upon decay, decreases DO; such growths can also directly change fish habitat.

Of the many elements required by aquatic plants, nitrogen and phosphorus are typically the two elements in shortest supply in natural water relative to the needs of plants. As a result, aquatic plant growth is often controlled by the availability of nitrogen or phosphorus, or both, in the water column. Other factors that influence aquatic plant growth in waterbodies include, but are not limited to, the type of plant life, stream flow patterns and bed scour, water temperature and velocity, light intensity, and grazing by aquatic insects. From a management standpoint, factors others than nutrients, stream flow patterns, and bed scour are difficult to control.

The goal of a nutrient TMDL is to determine the load entering a system at which nutrient and algal biomass levels remain low enough such that excessive diurnal fluctuations of DO concentrations and pH levels will not occur. Idaho's water quality criteria do not specify numeric nutrient limits. Stream systems vary greatly in terms of other factors mentioned above, this in turn changes the amount of nutrients that can lead to excessive aquatic growth. The level of a nutrient that causes impairment in one water body may not in another.

To address excess nutrients, surrogate targets are sometimes used, for example chlorophyll *a*. The use of chlorophyll *a* is based on the biomass conditions associated with low DO conditions. However, chlorophyl *a* or biomass data is not available for Cottonwood. Nor is it known what level of biomass would lead to DO problems in Cottonwood Creek.

Recent phosphorus and nitrogen data are available from the SAWQP. Therefore, instream targets for phosphorus and nitrogen concentrations are developed using these data. However, once sufficient data is obtained, these nutrient targets can be revised to be site specific. Targets are developed for both nitrogen and phosphorus compounds because both are found at concentrations well above saturation levels; that is neither nutrient is at low enough levels to limit plant growth.

Due to a lack of sufficient data from which to construct a relationship between nutrient levels and DO in Cottonwood Creek and tributaries, a DO loading analysis has not been developed. Instead, this TMDL makes the critical presumption that nutrients are a reasonable surrogates for DO, and by reducing nutrient concentrations the DO criteria will be achieved. Follow-up monitoring as part of TMDL implementation will help track DO levels and progress in meeting the State DO criteria.

3.3.1.1 Instream Nitrogen Target

Total nitrogen includes both inorganic and organic forms of nitrogen. Total inorganic nitrogen (TIN) is the sum of nitrate plus nitrite (as nitrogen) and total ammonia (as nitrogen). These are the forms of nitrogen directly available for plant uptake, and data to calculate TIN is available from the SAWQP. Therefore, TIN will be used for the instream nitrogen target.

Since it is unknown what level of nitrogen could cause excessive aquatic growths sufficient to impair beneficial uses in the Cottonwood Creek watershed, a review was conducted of available criteria in federal or state guidance or literature studies and levels used in other TMDLs.[1] Based upon that review, a TIN level of 0.300 mg/L was selected as the target. This is primarily based on the recommendation of Bauer and Burton (1993) of 0.300 mg/L nitrate-nitrogen, which follows the work of Muller (1953). Expressing the target as TIN instead of nitrate-nitrogen is a conservative approach as TIN will always be greater than or equal to its nitrate-nitrogen fraction. Use of TIN provides a more conservative measure and thus a margin of safety.

3.3.1.2 Instream Phosphorus Target

Total phosphorus (TP) consists of both particulate and dissolved fractions of both organic and inorganic phosphorus compounds. Dissolved phosphorus consists of all forms of phosphorus in solution, whether organic or inorganic. Phosphorus in solution in surface waters occurs almost solely as phosphates. Orthophosphate (PO_4^{-3}) is the form which plants can use, and thus best correlates to short term stimulation of growth. The chemical test for soluble reactive phosphorus comes closest to measuring orthophosphate[2].

All the Cottonwood SAWQP data is for total phosphorus, consequently the target will be for total phosphorus. Only a portion of the total phosphorus is orthophosphate. For the limited data

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[1]For more details on how nitrogen and phosphorus targets were selected, please refer to the 6/21/99 Cottonwood Creek Nutrient and Ammonia Target Issue Paper, available from DEQ-LRO.

[2]For simplification, orthophosphate will be used as the term for soluble reactive phosphorus results in this TMDL.

available, the ratio of orthophosphate to total phosphorus averaged 70 percent.[3] Once sufficient data is available for both total and soluble reactive phosphorus testing, the proportion will be better known and the target will then be reevaluated.

Like nitrogen, the level of phosphorus that could cause excessive aquatic growths sufficient to impair beneficial uses in Cottonwood Creek is also unknown. Therefore, a review was conducted of available criteria in federal or state guidance or literature studies and levels used in other TMDLs.[1] A TP level of 0.100 mg/L was selected for the target. This is primarily based on the recommendation in U.S. EPA water quality criteria document (U.S. EPA 1986), referencing the work of Mackenthun (1973), that TP not exceed 0.100 mg/L to prevent plant nuisances.

3.3.1.3 Instream Dissolved Oxygen Target

Minimum concentrations of DO set forth in current State of Idaho water quality criteria for waters designated for cold water biota is one day minimum of not less than 6.0 mg/L or 90% of saturation, which ever is greater. For waters designated for salmonid spawning, the weekly mean intergravel DO concentrations must be >= 6.0 mg/L, and greater than 5.0 mg/L at all times (see also Appendix B). Both of these criteria are targets for Cottonwood Creek which is designated for cold water biota and salmonid spawning. The five major tributaries have not been specifically designated and are presumed to be protected for cold water biota; therefore, the DO criteria for cold water biota will be the target for these tributaries. The numeric dissolved oxygen criteria applicable to cold water biota and salmonid spawning beneficial uses of Cottonwood Creek are found at IDPA 16.01.02.250.02.c and d.(see Appendix A for Water Quality Standards). These criteria are established as targets for the dissolved oxygen TMDL.

The cause-and-effect relationship between nutrients, water temperature, plant growth and decomposition, and low dissolved oxygen levels is well established. As a result, it is expected that the substantial reductions in water temperature and nutrient concentrations of Jim Ford Creek, which will result from meeting the TMDL targets, will result in increased dissolved oxygen levels. Since there is inadequate information at present to establish a quantitative relationship between the nutrient targets and dissolved oxygen, it is necessary to make a key assumption that the prescribed nutrient reductions will result in meeting the dissolved oxygen targets.

Limited DO data from 1998 and 1999 sampling shows levels that meet the state water quality criteria. However, almost all this data was collected during the daylight hours when photosynthesis is occurring. Summer 1999 diurnal sampling at the Columbia Crossing location above the canyon portion of the watershed indicates DO levels do go well below the DO water quality criterion during early morning hours (Figure 18). Twenty-four hour DO levels averaged

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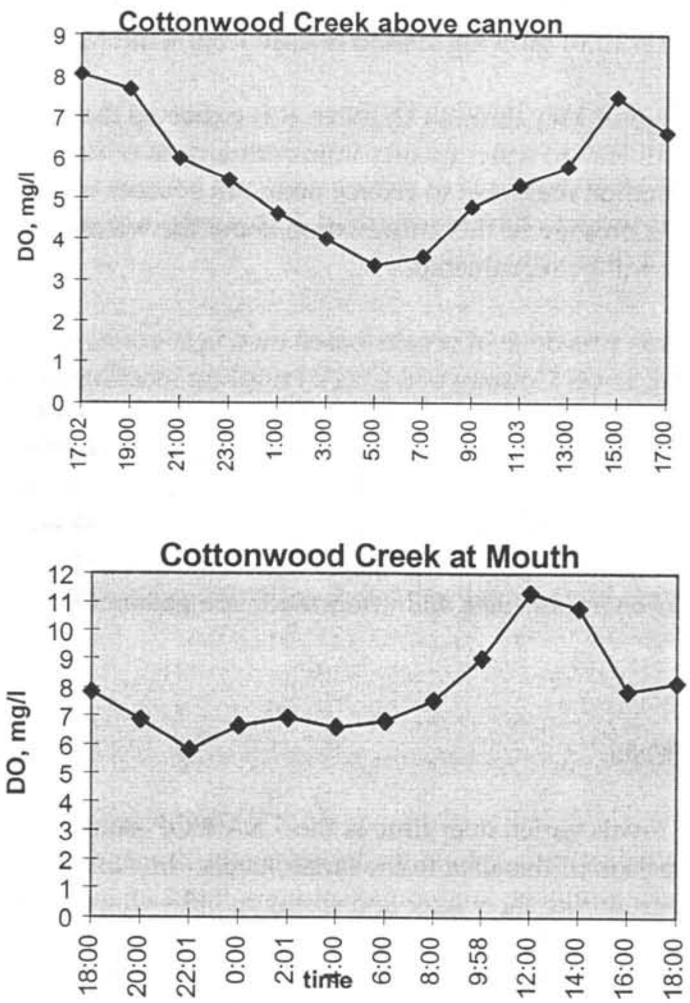
[3]From Teasdale and Funk (1998), this ratio was 60% in Upper Cottonwood Creek. From DEQ 1999 samples collected at Cottonwood Butte and Lower Cottonwood Creek, the ratio was 60% and 80%, respectively.

5.6 mg/L. Diurnal sampling at the mouth of Cottonwood Creek during the same 24-hour period indicated DO levels were higher overall than at Columbia Crossing, averaging 7.9 mg/L, and only briefly fell below the criterion in the early evening hours (Figure 19). Although limited, this data suggests that low DO conditions are occurring mostly in the upper portion of the watershed, where lower flow and higher temperatures are more conducive to aquatic growth, than in the lower watershed.



Figures 18 and 19. Diurnal Dissolved Oxygen (DO) at Columbia Crossing and Mouth of Cottonwood Creek on August 2 & 3, 1999

3.3.1.4 Target Averaging Periods and Critical Conditions

This TMDL uses a seasonal averaging period for both nitrogen and phosphorus compounds. The TMDL load, load reduction, and load capacity calculations are based on concentration and flow conditions that occur during the time when low DO conditions are likely to occur - mainly the months when algae growth is active. Specifically, May through October has been selected as the averaging period for estimating critical system loading and determining necessary load reductions. Even though concentrations of nutrients are generally higher in the winter/spring months, critical loading is tied to when impairment of beneficial uses occur in the watershed, which is during the low flow, summer months as aquatic growth limits DO levels. This proposal is based on the assumption that while nutrients enter watershed year-round, significant storage of nutrients does not occur in Cottonwood Creek. This assumption is made because phosphorus is primarily associated with the "washload." Also, seasonal measurements would capture increased phosphorus loading if such did occur as a result of growing season release from winter storage.

Though load reductions are based on the period May through October, it is expected that reductions based on the growing season will lead to water quality improvements at other times of the year. It is also expected that implementation measures to reduce nonpoint sources will be effective year round. As more years of data provide further information about the watershed, the averaging period used to calculate loading will be reevaluated.

As part of the TMDL analyses, a comparison was done of results based on a year-round and seasonal averaging period for the upper and lower Cottonwood Creek sampling locations. The results were very close and are presented in Section 3.3.3.3. Table 20 (Section 2.2.7) provides monitoring recommendations aimed at providing more certainty in selecting targets and averaging periods, and in assessing overall nutrient conditions in the watershed (such as nutrient storage and background contributions). Per EPA guidance, most TMDL components can be revised using monitoring feedback and new information. Thus the Cottonwood Creek nutrient targets and averaging period may be modified as new data and information are gathered.

3.3.2 Condition Assessment

3.3.2.1 Instream Flow and Concentration Data

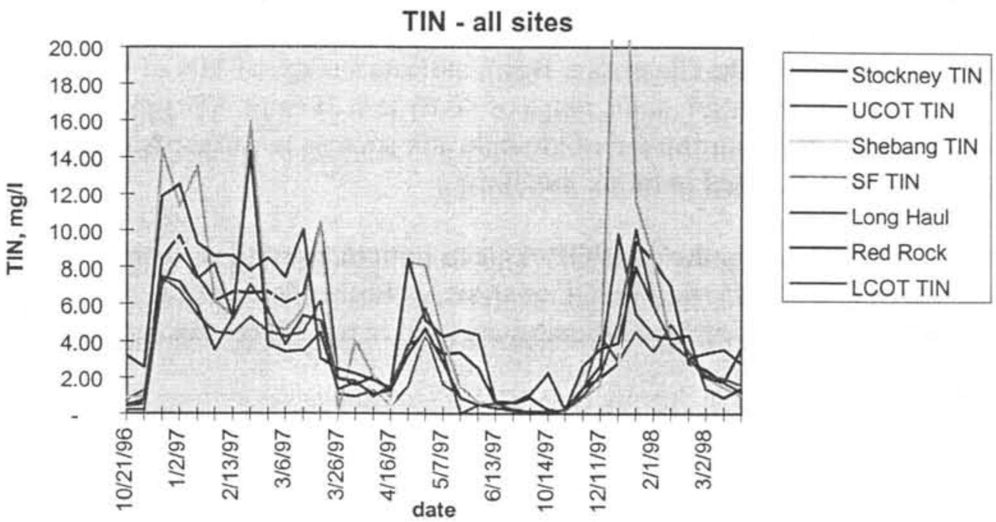
Figures 20 and 21 show how TIN and TP levels varied over time at the 7 SAWQP sampling locations. Section 2.2.6.4 provides comparison of this data to the target levels. In general, nitrogen and phosphorus levels were highest during the winter and spring months when higher flows occurred and lowest in the low flow months, although less data was collected in the summertime. The levels of phosphorus in winter and spring of 1997 were much higher than those in the winter and spring of 1998. This is attributed to the higher than normal precipitation that occurred in winter and spring 1997.

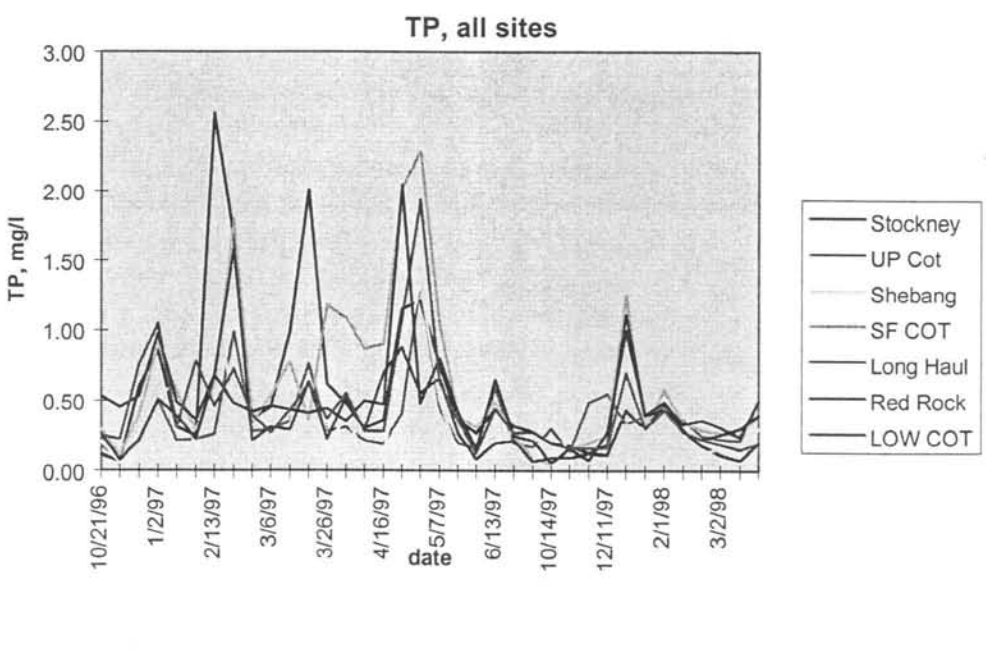
Pollutant loading needs to consider the background contribution from sources that cannot be managed. Background estimates can be generated from the literature, reference conditions, or modeling, and ideally are watershed specific. All the SAWQP sampling locations were at the mouths of the tributaries of Cottonwood Creek and its mouth and are not representative of background. In order to get an idea of background nutrient levels in the Cottonwood Creek watershed, in June 1999 a sample was collected from Upper Cottonwood Creek on the Butte in an area of limited land management use. The TP measured 0.070 mg/L, 30% of the level measured on the same day at the mouth of Cottonwood Creek. The TIN measured 0.028 mg/L, 5% of the level measured at the mouth. These levels are used to represent background in this TMDL analysis. Future monitoring should include periodic sampling of background areas under varying flow conditions to better assess background contributions.

Samples were collected in September 1998 at Yellow Bull Springs, a significant spring in the Red Rock drainage. Results for orthophosphate were 0.070 mg/L, similar to levels of total phosphorus at the Butte. Results for nitrate-nitrite (as nitrogen) were 0.94 mg/L, which is higher than level observed on the Butte and also higher than the target of 0.30 mg/L. A survey of groundwater monitoring results in the Clearwater Basin indicate a range of TIN of <0.07 mg/L to 19.3 mg/L with a median of 0.400 mg/L and a range of <0.01 to 0.28 mg/L TP with a median of 0.05 mg/L (Crockett 1995). The contribution of groundwater sources to surface water loading are data gaps that should be addressed in future monitoring.

Flow estimates were obtained during the SAWQP. Due to limitations of those estimates, alternate estimates were generated for this TMDL analysis, as further described in Appendix A. For comparison purposes, both sets of flow estimates are used in the TMDL load analysis.

Figures 20 and 21. TIN and TP Concentrations Measured During SAWQP





The relationship between nutrient and flow was examined by regression analyses. The TP concentrations and flow were significantly and positively correlated (i.e. as flow increases, TP concentrations increase), with r^2 varying from 0.12 to 0.553 for the 7 SAWQP sampling location, as summarized in Table 36. TIN and flow were positively and significantly correlated at all sites but Long Haul, but with less correlation than TP and flow; the r^2 varied from 0.15 to 0.45 at the other 6 sites, as summarized in Table 37. TP concentrations also correlated positively and significantly with TSS concentrations (r^2 = .62), which is consistent with the flow: TP relationship.

Table 36. Summary Regression Statistics for Flow and TP

Subwatershed	**Regression Equation**	**r^2**	**F statistic**
Stockney Creek	y = 0.005x - 0.706	0.55	< 0.05
Upper Cottonwood Creek	y = 0.0053x + .285	0.12	0.05
Shebang Creek	y = 0.197x + 0.194	0.26	< 0.05
South Fork Cottonwood Creek	y = 0.060x - 0.383	0.23	< .05
Long Haul Creek	y = 0.011x + 0.287	0.14	< .05
Red Rock Creek	y = 0.012x + 0.209	0.45	< .05
Lower Cottonwood Creek	y = 0.003x + 0.214	0.44	< .05

Table 37. Summary Regression Statistics for Flow and TIN

Subwatershed	**Regression Equation**	**r^2**	**F statistic**
Stockney Creek	y = 0.223x + 0.785	0.29	< 0.05
Upper Cottonwood Creek	y = 0.508x + 1.788	0.15	< 0.05
Shebang Creek	y = 0.216x + 2.006	0.19	< 0.05
South Fork Cottonwood Creek	y = 0.819x - 5.187	0.15	< 0.05
Long Haul Creek	y = 0.084x + 2.118	0.08	0.10
Red Rock Creek	y = 0.091x + 2.450	0.32	< 0.05
Lower Cottonwood Creek	ln(y) = 0.7244x - 2.08	0.37	< 0.05

3.3.2.2 Point Source Concentration and Flow Data

The 1996-97 study of the Cottonwood land application unit (Teasdale and Funk 1998) involved collecting once a month grab samples of the discharge and irrigation effluent between July 1996 and December 1997. Results for the months when effluent was discharged to the creek are presented in Table 38. No other recent nutrient data is available for the WWTP. For point source discharge measurements, daily discharge measurements taken during the land application study are used. Monthly averages are presented in Table 38, and the average discharge and 95% percentile discharge averages based on these data are also provided.

Table 38. Cottonwood WWTP Flow and Nutrient Data

Month/Year	**Monthly Average flow, cfs**	**TP in Effluent, mg/L (once a month grab sample)**	**TIN in Effluent, mg/L (once a month grab sample)**
November 1996	0.57	1.67	5.9
December 1996	0.59	0.779	5.11
January 1997	0.72	1.1	4.22
February 1997	0.96	1.42	3.33
March 1997	1.1	0.82	5.92
April 1997	0.6	2.89	4.43
May 1997	0.65	2.35	0.59
November 1997	0.32	0.247	7.82
December 1997	0.34	0.387	7.38
Average Discharge	0.74	1.58	4.21
95% Discharge	1.06	2.73	5.91

3.3.3 Instream Load Analyses

This section describes the approach and results of load, load capacity, and load reduction calculations. All these calculations are based on instream nutrient and flow data described in the previous section.

3.3.3.1 Assumptions

1) Existing load estimates are based on instream measurements. This can underestimate the load to the stream since assimilation or processing of pollutant loads usually occurs between the point

of entry to the water and the point its quality is monitored. This bias is immaterial if future progress in load reductions is measured comparably.

2) Because daily flow measurements were not available, stream flow was estimated using USGS regional regression equations (see Appendix A for details). It is assumed that these measurements are representative of a range of flow conditions. Resulting loads can either be underestimates (if actual flows are higher than represented by these flow estimates) or overestimates (if the actual flows are lower than the estimates).

3) It was assumed conditions represented by the May 1997 through October 1997 sampling period are representative of the general nutrient concentrations and locations in the watershed over time during low flow conditions. Since nutrient concentrations and flow will vary greatly dependent upon short and long term weather patterns, land use practices, and point source discharges that all can vary greatly, loading analyses based on such a limited time frame can either be an overestimate or underestimate.

4) It was assumed that concentrations of composite samples (taken over a minimum of 6 and maximum of 18 days) accurately represent daily concentrations during the compositing period and that daily concentrations were accurately estimated by collection of samples once every 8 hours during the day.

5) The concentrations of one sample measured at the headwaters of the drainage on Cottonwood Butte (0.70 mg/L TP and 0.028 mg/L TIN) are representative of background conditions. This means that no variation in background concentration is assumed; which is unlikely the case but the only available data to rely on.

All these assumptions point out limitations of the data which can only be addressed with additional long-term monitoring. The present conclusions of the Cottonwood Creek TMDL are a reasonable synthesis of our current knowledge of the watershed and its water quality. These conclusions will need to be re-evaluated based upon monitoring feedback and availability of new information.

3.3.3.2 Methodology

1) Daily concentrations were estimated using the results of the composite nutrient samples. For example, if total phosphorus in the composite sample collected between 5/23/97 and 6/13/97 was 0.030 mg/L, then it was assumed that this was the concentration of each day in that sampling period. Since no samples were collected in July and August 1997, the average of the results from the last sample date in June (6/27/97) and the first sample date in September (9/29/97) were averaged and this average was used as the daily concentration estimate for July and August.

2) For daily flow estimates, the simulated hydrograph generated by the MOVE.1 technique (see Appendix A for details) was used for Lower Cottonwood Creek. For the tributaries, the 50^{th}

percentile stream flow estimates for mean daily monthly flow generated through regional regression were used. Results using these flows were compared to those using flow estimates generated by the SAWQP.

3) Daily load estimates were calculated by multiplying daily flow estimates generated as described in step 2 by the daily concentration estimates generated as described in step 1 times a conversion factor using the formula below. Estimated loads were summed for the averaging period and a daily average load was also calculated.

Nutrient concentration (mg/L) x flow (cfs) x 28.3 liter/ft^3 x 60sec/min x 60min/hr x 24hr/day x 1g/1000mg x 1 lb/453.59grams = load (pounds per day or lb/day) or

load (lb/day) = nutrient concentration (mg/L) x flow (cfs) x 5.39

4) Load capacities were estimated using the same procedures except target concentrations were used in place of measured concentrations.

5) Background load was estimated using the same procedures in steps 1-3 except that background concentrations measured in June 1999 on Cottonwood Butte were used.

6) An explicit 10% MOS was factored in by subtracting an additional 10% of the load capacity minus background.

7) For comparison purposes, a load analysis using the same procedures above but a year-round averaging period (April 1997 through March 1998) was conducted for Upper and Lower Cottonwood Creek sampling sites.

3.3.3.3 Results

Tables 39 and 40 present TP and TIN loading analyses results, respectively. The tables provide the estimated total load, background load, margin of safety load allocation, and available load capacity during the averaging period. Estimated percentage reductions are calculated by determining the percentage difference between the available load capacity and the estimated load minus background.

Table 39. TIN Loading Analysis Results

Location	Total Load Capacity (lbs/season)	Background (lbs/season)	MOS - (lbs/ season)	Available Load Capacity to Allocate (lbs/season)	Estimated Load (minus background (lbs/season)	Estimated Load Reduction (%)
Stockney Creek[1]	1,225	122	110	993	6,596	85%
Upper Cottonwood Creek[1]	637	64	57	516	1,174	56%
Shebang Creek[1]	637	64	57	516	1,716	70%
South Fork Cottonwood Creek[1]	752	75	68	609	2,527	76%
Long Haul Creek[1]	752	75	68	609	1,682	64
Red Rock Creek[1]	836	84	75	677	6,412	89%
Lower Cottonwood Creek[2]	6,470	647	582	5,241	32,441	84%

[1] With flows generated 0.50 probability flow estimate from regional regression

[2] With flows generated by MOVE.1 analysis based on 22 year regression with Lapwai Creek

Table 40. TP Loading Analysis Results

Location	Total Load Capacity (lbs/season)	Background (lbs/season)	MOS (lbs/ season)	Available Load Capacity to Allocate (lbs/season)	Estimated Load (minus background (lbs/season)	Estimated Load Reduction (%)
Stockney Creek[1]	408	286	12	110	1,285	91%
Upper Cottonwood Creek[1]	212	149	6	57	514	89%
Shebang Creek[1]	212	149	6	57	436	87%
South Fork Cottonwood Creek[1]	251	175	8	68	842	92%
Long Haul Creek[1]	251	175	8	68	410	83%
Red Rock Creek[1]	279	195	8	76	1,045	93%
Lower Cottonwood Creek[2]	2,157	1,510	65	582	7,104	92%

[1] With flows generated using 0.50 probability regional regression flow estimates
[2] With flows generated by MOVE.1 analysis based on 22 year regression with Lapwai Creek

3.3.4 Load Allocation and Waste Load Allocation

The Cottonwood WWTP is not permitted to discharge in the selected aquatic growing season of May 1 to October 31. Therefore, a waste load analysis and allocation is not necessary based on the assumption that the WWTP continues not to discharge in this time period. However, great uncertainty exists with the selection of the aquatic plant growing season as explained in Section 3.3.1 and Appendix J. Further study and monitoring of this issue is planned as explained in Appendix J that could require a waste load allocation in a revised TMDL.

Since no waste load analyses and allocation is needed, all estimated reductions are allocated to nonpoint sources as provided in Tables 39 and 40.

3.3.5 Seasonal Variations and Margin of Safety

Section 303(d)(1) requires TMDLs to be "established at a level necessary to implement the applicable water quality standards with seasonal variations." Thus, the analysis must be conservatively based to address seasonal peaks, if any, that might occur in pollutant concentrations or impairment of uses. This TMDL addresses seasonality by basing the load and load capacity on the growing season, the time when impairment of beneficial uses due to aquatic plant growth can occur. This is also period when load capacity is at its lowest due to low flows.

Uncertainties inherent in developing the nutrient TMDL include: 1) lack of specific data on contribution of background and various nonpoint sources of nutrients as well as groundwater input; 2) lack of comprehensive flow and nutrient concentration data including data on nutrient storage in the system; 3) lack of comprehensive nutrient concentration data of WWTP discharge and data related to contribution of seepage from unlined ponds; and 4) lack of comprehensive data on algae biomass and DO conditions.

An implicit margin of safety occurs in the choice of a TIN target based on acceptable total nitrate as nitrogen levels in guidance. In addition, an explicit 10% MOS was included by decreasing the available load capacity by 10% for both TIN and TP.

3.4 Pathogens/Bacteria

3.4.1 Targets

The Cottonwood Creek modeling effort uses the current State of Idaho fecal coliform criteria shown below for the basis of evaluation. A negotiated rulemaking process is underway that involves changing the recreational contact criteria from one based on fecal coliform to one based on Escherichia coli (E. coli). Because this rule is not final, the existing fecal coliform criteria must be used for this TMDL. Also, E. coli data for the Cottonwood watershed is limited and insufficient for a loading analysis. Samples were recently collected for E. coli analysis in summer 1999 but results are not yet available.

The State of Idaho has set water quality criteria for surface waters for primary and secondary contact uses as reflected in Table 41. Primary contact recreation occurs between May 1 and September 30.

Table 41. State of Idaho Fecal Coliform Water Quality Criteria

Idaho Fecal Coliform Water Quality Criteria	**Not to Exceed at Any time:** and	**No Greater than:** in 10% Samples taken within 30 days and	**Not to Exceed a Geometric Mean of:** Based on min. 5 samples within 30 days
Primary Contact Recreation	500 cfu/100 mL	200 cfu/100 mL	50 cfu/100 mL
Secondary Contact Recreation	800 cfu/100 mL	400 cfu/100 mL	200 cfu/100 mL

The mainstem of Cottonwood Creek is designated for secondary contact recreation use. For the undesignated tributaries, the presumed designated use is primary or secondary contact recreation, so a choice exists as to which criteria to use for the loading analysis (IDAPA 16.01.02.101.01) Therefore the government entities developing the TMDL agreed that secondary contact recreation criteria was appropriate for all the tributaries except for Red Rock, which will be evaluated using primary contact recreation criteria.

3.4.2 Assessment of Point Sources

The Cottonwood WWTP is the only point source in the Cottonwood Creek watershed permitted through U.S. EPA's NPDES program. The Cottonwood WWTP is designed to serve a population of 800, discharges to Upper Cottonwood Creek, and is permitted to discharge bacteria, sediment, ammonia and BOD material. The Cottonwood WWTP was upgraded in 1995-96 and currently consists of a series of five connected treatment ponds, a chlorine disinfection basin, and a 40 acre hybrid poplar tree plantation (IDEQ 1999a).

The Cottonwood WWTP is currently permitted to discharge to Upper Cottonwood Creek only between October 31 and April 1 of each year although discharges have also occurred during April and May under emergency provisions (IDEQ 1999c). Between April 30 and October 16 the WWTP is permitted to land apply wastewater onto a hybrid poplar tree plantation operated by the City of Cottonwood.

The current permit effluent limitations for the WWTP for fecal coliform discharge to Cottonwood Creek is:

Pollutant	Monthly Average	Weekly Average
Fecal Coliform	100 cfu/100 mL	200 cfu/100mL

(Teasdale and Funk 1998)

The permit limitations for spray-irrigated wastewater (April 30 to October 16) are:

Maximum Total Coliform count:	Maximum Volume Allowed per year:
2.2 organisms/100 mL	42.6 mgal

(Teasdale and Funk 1998)

The City of Cottonwood has requested changes to their current permit. The City wants allowable creek discharge to be based on available dilution flows in Cottonwood Creek instead of being based on a specified time frame discharge. The City also wants to eliminate treating the tile drain leachate with chlorine if bacteria are below a minimum level (IDEQ 1999d). Daily flow data and monthly fecal coliform monitoring data from the WWTP was used as input to the watershed model (Cottonwood 1999).

3.4.3 Assessment of Fecal Coliform Loading from Nonpoint Sources Activities

IDEQ has identified the primary nonpoint sources in the Cottonwood Creek watershed as agriculture, grazing, timber harvest, storm water, county roads, and septic tanks. The principal sources of nonpoint bacterial loading are believed to be agriculture, grazing, and septic systems (IDEQ 1999a). Approximately 74% of the land in the watershed is used for cropland, 7% for pastureland, and 13% for rangeland. Sources of bacteria from agriculture and grazing practices include runoff from small confined feeding operations, manure applications to fields, and direct contamination from animals with access to the streams. Sections 3.4.3.1 through 3.4.3.5 provide estimates of both animal concentration (i.e., number of animal per subwatershed) and fecal loading for each subwatershed. This information will then be used to run the Nonpoint Source Model (NPSM) for the Cottonwood Creek watershed.

3.4.3.1 Livestock Estimates

Since manure from livestock can be a potential source of fecal coliform bacteria, it is necessary to roughly estimate the number of animals in a watershed, the amount of manure produced, and how it can reach the creeks and streams. The number of animals, land use, and amount of rain fall, are all important factors in estimating the loading from animal manure.

Based on input provided by Cottonwood WAG and TAG members and ICSWCD representatives, IDEQ recommended using 35-40 average cows per animal feeding unit and 55 cows per dairy (IDEQ 1999b). The estimate for beef cattle was reduced to 20 cows per feeding unit based on comments at the 10/28/99 WAG meeting. Estimated number of hogs were producers were provided by the NRCS District Conservationist (Spencer 1999). Table 42 provides the livestock estimates for each of the subwatersheds.

Table 42. Livestock Estimation by Subwatershed

Subwatersheds	Animal Feeding Units	Feed Lot Cows[1] (Est.)	Dairies	Dairy Cows (Est.)	Total Cows (Est.)	Hog Producers	Total Hogs (Est.)
Stockney Creek	29	580	2	110	1,270	5	355
Upper Cottonwood Creek	11	220	3	165	605	1	139
Shebang Creek	27	540	0	0	1,080	2	782
South Fork Cottonwood Creek	6	120	0	0	240	0	0
Long Haul Creek	12	240	0	0	480	0	0
Red Rock Creek	34	680	0	0	1,360	3	1,058
Middle Cottonwood	34	680	0	0	1,360	0[2]	0
Lower Cottonwood	7	140	0	0	280	0	0
Totals	160	6,400	5	275	6,675	11	2,334

[1]These estimates were revised down by a factor of two based on comments received at 10/28/99 WAG meeting.

[2]Revised from April 1999 draft data (IDEQ 1999a and IDEQ 1999b).

3.4.3.2 Manure Loading Estimates

Estimating the fecal coliform loading from manure included application of hog and cow manure to cropland, manure application and direct loadings to pastureland, and fecal coliform accumulation and wash-off from build-up areas. The modeling took into account the following considerations:

- Subwatershed land use (the acreage of each land use in each of the subwatersheds)
- Estimated number of beef and dairy cows, and swine per subwatershed
- Fraction of time beef cattle confined per month
- Percentage of manure applied to cropland or pastureland per month
- Assumed number of wildlife per square mile
- Population served by septic systems
- Number of failing septic systems

Based on these inputs, estimated monthly fecal coliform accumulation rates were determined for each subwatershed by land use. Following are the assumptions used for cattle and hogs, much of which was derived from the 10/28/99 WAG meeting.

- Hogs: Hog manure is applied to cropland at a rate of 2% of annual production every month except for July, August, and September, when it's applied at a rate of 27.33%. It's assumed that no hog manure is applied to pasturelands.

- Poultry: It was assumed there is no poultry production in the watershed and no litter applied to the fields in the watershed.

- Dairy Cattle: Dairy cattle are confined in feedlots so all their waste is used for manure application to cropland and pastureland. The manure is stored from November to March, and is applied to cropland, pastureland, and rangeland at the rate of 22.22% (of annual production) during April, May, and June. Dairy cow manure is applied as generated (1/12 or 8.33%) during July through October.

- Beef Cattle: Beef cattle can be in either feedlots or allowed to graze. When grazing a small percentage, in some subwatersheds, are assumed to have direct access to the streams. It's assumed that no grazing occurs from December through February. Waste from beef cattle in feeding lots is applied to rangeland and pastureland. The direct contribution of fecal coliform to a stream by cattle was represented as a point source in 4 subwatersheds in the model (Section 3.4.4.2).

3.4.3.3 Wildlife Contribution:

An average of 6 deer per square mile throughout the entire watershed was assumed, except for forested land, in which deer were assumed to be at a higher density of 10 deer per square mile. A total elk population in the watershed of 60 was assumed (Richards 1999). This translates to about 0.31 elk per square mile. Assuming elk produce 3 times the amount of fecal coliform as deer, they were accounted for in the model as deer, making a total of 7 deer per square mile in all but forested land, and 11 deer per square mile in forested land. Table 43 provides the estimated deer per subwatershed and land use. It's assumed that there are no deer in urban areas.

Table 43. Wildlife Estimates by Subwatershed

Subwatersheds	Cropland	Forest	Pasture	Subtotals
Stockney Creek	186	7	25	218
Upper Cottonwood Creek	61	36	24	121
Shebang Creek	174	5	24	203
Long Haul Creek	64	1	24	8
South Fork Cottonwood Creek	119	1	20	140
Red Rock Creek	230	9	53	292
Lower Cottonwood	152	47	113	312
Subtotals	986	106	283	1,375

3.4.3.4 Direct Fecal Coliform Loading Source(s)

In order to get the NPSM model output to provide a good fit for the observed data, animals directly contaminating Upper Cottonwood, Stockney, Red Rock, and South Fork of Cottonwood Creek watershed were modeled as a "point source" during April and May. A significant fecal coliform load was added directly to creek water in the model since fecal coliform concentrations in some creeks were higher during periods of no rain. This scenario is indicative of a significant direct source(s) of fecal coliform loading to these waters. This source (modeled as a point source) was added only for those stream (and months) where concentrations were high during periods of no rain. Whether or not cattle were the source of fecal loading in these streams and these months is uncertain and a subject of dispute. The loads in question occurred only during late Spring (April and May) and not in summer. Red Rock Creek was particularly odd because the fit for 1998 required a point source starting in February. Further investigation is needed to determine the direct source of fecal coliform loads and possibilities include but are not limited to cattle in the streams, migrating birds and resuspension of fecal material in the water column. Table 44 summaries the assumptions for unknown point source.

Table 44. Assumption for Direct Fecal Coliform Loading Sources

Subwatershed	Bacteria Load (cfu/hr)
S.F. Cottonwood	6.0E9
Red Rock (4/97-5/97)	1.3E10
Red Rock (2/98-4/98)	6.5E9
Upper Cottonwood (4/97-5/97) (4/98-5/98)	 1.5E9 5.0E8
Stockney (4/97-5/97) (4/98-5/98)	 6.5E9 3.0E9

3.4.3.5 Septic Systems

Since private septic systems can also be a source of fecal coliform bacteria, it is necessary to roughly estimate the number of failing systems in a watershed. The North Central District Health Department personnel estimated that one-third of the systems in the watershed were failing (IDEQ 1999a and 1999c). To estimate the amount of fecal coliform being contributed by failing septic systems, the rural population was estimated, then the number of rural households, the number of septic systems and then the number of failing systems were tabulated.

Here is an example for Shebang Creek subwatershed:

233 people in watershed (estimated from 1990 Census block data)
2.66 people per household (County average from 1995 Idaho County population data)
233 people ÷ 2.66 people per household ≅ 88 households
88 households x 1 system per household = 88 septic systems
88 systems x 1/3 systems failing = 29 septic systems failing

Table 45 summarizes the estimated rural population, number of households, number of septic systems, and estimated system failures for each subwatershed.

Table 45. Estimated Rural Population, Households and Number of Septic Systems

Subwatershed	Estimated Rural Population[a]	Estimated Number of Failed Septic Systems
Stockney Creek	230	29
Upper Cottonwood Creek	120	15
Shebang Creek	233	29
South Fork Cottonwood Creek	58	7
Long Haul Creek	186	23
Red Rock Creek	196	25
Middle Cottonwood Creek[b]	43	5
Lower Cottonwood Creek[b]	39	5

[a] Population estimates based on U.S. Census data (ESRI 1999);Population and household calculations exclude the cities of Cottonwood and Grangeville
[b] Lower and Middle Cottonwood Creek watersheds were combined for the septic system calculations and modeling;

3.4.4 BASINS Nonpoint Source Model (NPSM) and Input Data

The Nonpoint Source Model (NPSM) estimates non-point loadings of selected pollutants for specific land uses in a watershed. NPSM allows a user to simulate the routing and flow through a network of streams, rivers, lakes and reservoirs. NPSM can also simulate point sources to represent the flow and concentration of a pollutant from a facility or discharger. Below is a summary of the data sets and their sources that were used for the Geographic Information System (GIS) component of BASINS and the modeling of the Cottonwood Creek watershed:

- Land Use/Land Cover Data - ISCC, 1999
- Watershed Boundaries - ISCC, 1999
- Stream Geometry/Cross Sections - Gilmore, 1998
- Elevation Data and River Reach Network - U.S. EPA, 1999
- Soils Data - ISCC, 1999
- Weather Data - principally from Cottonwood weather station, supplemented by data from Fenn and Lewiston stations - NOAA, 1999

3.4.4.1 Hydrology Calibration

The principal steps in the hydrology calibration processes were:

- Develop an overall water mass balance compared with the monitoring data by adjusting overall gains and losses of water in the watershed from precipitation, evapotranspiration, and loss to deep groundwater;

- Adjust the high-flow/low-flow distribution to match the monitoring data by adjusting the rates at which water percolates through the soil, enters groundwater, and recharges streams;

- Match peak storm volumes and reproduce the number of days required for flow to return to normal levels; and

- Fit the seasonal distribution of flows taking into account seasonal variation in evapotranspiration, soil moisture, and changes in groundwater recharge to streams.

The final hydrology calibration (Figure 22) shows an excellent fit to the stream gage data.

NPSM Hydrology Calibration

Cottonwood Creek - 10/96 - 5/98

Simulated vs. Observed

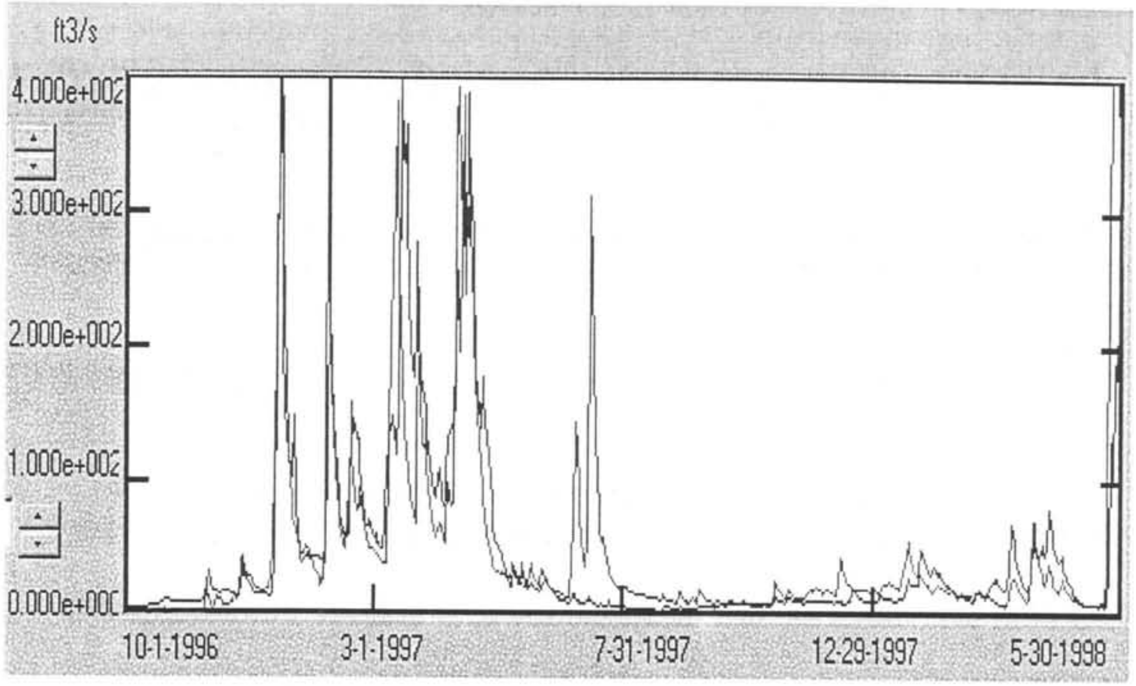


Figure 22. Hydrology Calibration at Lower Cottonwood Creek Gage Station

3.4.4.2 Bacteria Calibration

The bacteria calibration required adjustments to the estimated unknown point source manure loading rate, some monthly manure application rates, as well as the concentration of assumed fecal coliform in groundwater. Figure 23 demonstrates the comparison of the fecal coliform

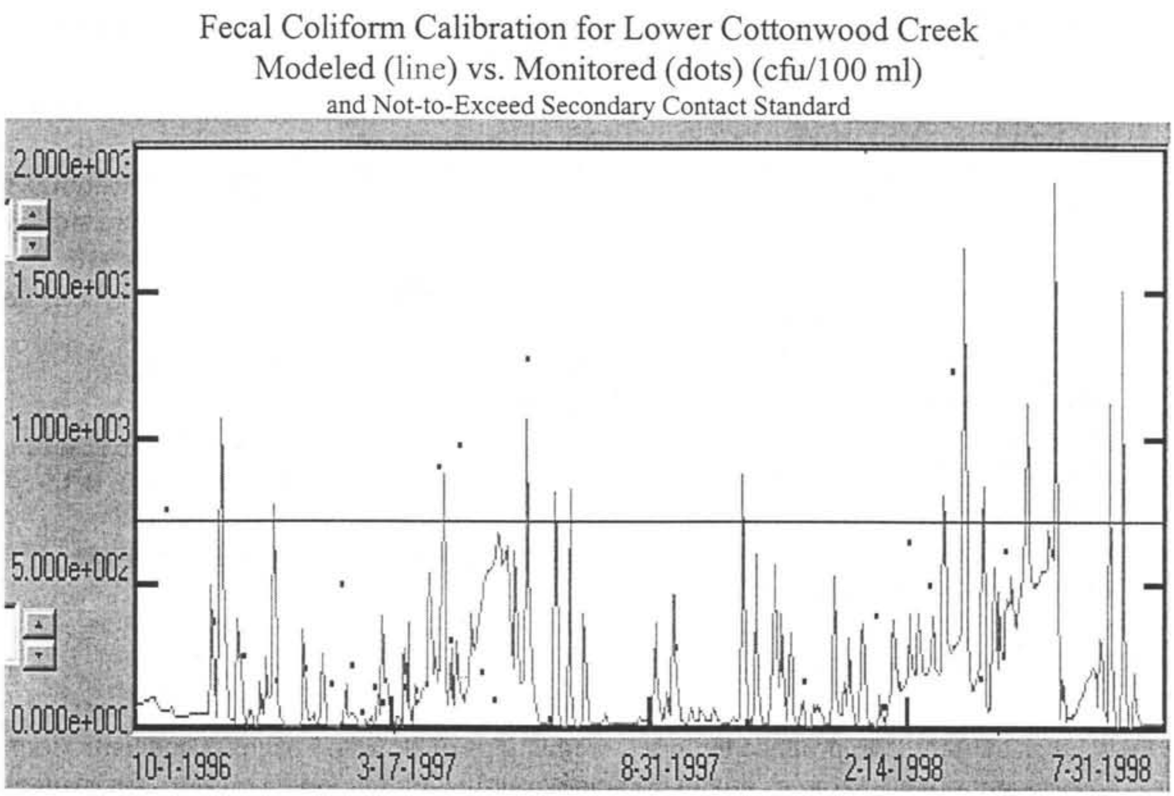


Figure 23. Fecal Coliform Baseline Calibration for Lower Cottonwood Creek

monitoring data to the bacteria modeling for Lower Cottonwood Creek. The bacteria calibration shows a good fit to the monitoring data. Appendix I contains the calibration adjustment graphs for the other subwatersheds.

The bacteria calibration was performed in the following order: 1) start with South Fork Cottonwood and Long Haul Creeks since they have beef cattle only; 2) then calibrate subwatersheds with both beef cattle and hogs - i.e. Shebang and Red Rock Creeks; 3) then calibrate subwatersheds with beef cattle, hogs, and dairies - Upper Cottonwood and Stockney Creeks; and 4) finally to Lower Cottonwood which gets loads from all six of the previous subwatersheds.

The following are notes regarding the addition of a point source - referenced below as "unknown point source" and the addition of higher accumulation and maximum storage rates (of fecal coliform). Point sources were introduced in the calibration only when it was clear that high bacteria loads were occurring during periods of dry weather, and where existing model point sources (i.e. Cottonwood WWTP and septic systems in each subwatershed) did not account for the high concentrations. Higher accumulation and maximum storage rates were added to improve the calibration when unexplained high bacteria concentrations corresponded with wet weather. Table 44 provides a breakdown for the unknown point source assumptions.

- *South Fork Cottonwood:* Increased number of beef cows back to original 240 from 120. Added cows in stream from mid-April to mid-June (6E9 #/hr).
- *Long Haul:* Increased accumulation rate 2 times from June to November to 3E10 and maximum storage to 4.5E10 for Rangeland and Pastureland.
- *Shebang:* Increased accumulation rate in May/June to 2.7E11 (and maximum storage to 4.05E11) - factor of 10 increase. Also found a good fit by increasing maximum storage only to 4.23E11 for April/May/June - this could be explained as bacteria regrowth.
- *Red Rock:* Added "unknown point source" for April and May, 1997 (1.3E10 cfu/hr) and Feb-April, 1998 (6.5E9 cfu/hr).
- *Upper Cottonwood:* Used "unknown point source" of 1.5E9 cfu/hr for April to May,1997, and 5E8 cfu/hr for April to May,1998.
- *Stockney:* Used "unknown point source" load of 6.5E9 cfu/hr for mid-April to end of May,1997 and 3E9 cfu/hr for mid-April to end of May,1998 and started load in 4/15 instead of 4/1.
- *Lower Cottonwood:* Increased accumulation to 3.62E10 and maximum storage to 5.43E10 for April, May, and June.

3.4.5 Margin of Safety and Seasonality

The model was calibrated to produce unbiased simulations of flow and bacteria concentrations though some water quality samples do not coincide exactly with the model output. An explicit 10% Margin of Safety (MOS) was added to both primary and secondary recreational contact criteria to account for model variance from observed. Considerable effort was put into working with the Cottonwood Creek WAG and TAG to derive representative assumptions regarding animal populations, and manure management in the watershed; these assumptions are thought to provide a substantial backing to this MOS level.

Uncertainties

- Bottom sediments, thought to have the potential to store and later release (during a storm) fecal coliform do not appear to be of great significance in this watershed since the model appears to predict in-stream bacteria concentration well despite neglecting to describe this sedimentation/resuspension process.

- Seasonal stream temperature variations, and their effect on fecal coliform in-stream degradation rates, were not taken into account in this model. Limited sensitivity analysis shows water temperature variation to have little impact on model results, particularly relative to the uncertainty in the assumed manure application rates.

- Bacteria regeneration, i.e. the regrowth of bacteria after some decay in the bacteria population has already occurred, is not explicitly considered in this model. Regeneration, however, can be thought of as being part of the dynamic equilibrium between loss and regrowth, which still results in stable maximum storage and can be thought of as being included implicitly. The increased rates of fecal coliform accumulation and storage that were necessary for Shebang (May through June) and Lower Cottonwood (April through June) could also be explained in the model by simply increasing the maximum storage. Bacteria regeneration, were it to take place on the land surface, would result in a larger ratio of accumulation rate to maximum storage. The combination of wet and warm weather in late spring may be ideal conditions for bacteria regeneration, and plausibly explains the higher accumulation and storage rates required for Shebang and Lower Cottonwood Creeks during the model calibration.

Section 303(d)(1) requires TMDLs to be "established at a level necessary to implement the applicable water quality standards with seasonal variations." Thus, the analysis must be conservatively based to address seasonal peaks, if any, that might occur in pollutant concentrations. This TMDL addresses seasonality by the use of a continuous simulation model.

Section 3.4.6 Loading Estimates and TMDL Allocations

Relative stream loadings from each subwatershed, based on the baseline model calibration, are shown in Table 46.

Table 46. Stream Loading by Source (Billions fecal Coliform per year (Bfc/year))

Subwatershed	**Septic System Load (Bfc/year)**	**Unknown Point Source Load [2] (Bfc/year)**	**Cottonwood WWTP Load (1997/Max[3]) (Bfc/year)**	**Manure Application, Grazing Cattle (Bfc/year)**
Shebang Creek	757	-	-	107,000,000
Upper Cottonwood	392	1,440	120/829	28,000,000
Stockney Creek	757	5,130	-	72,200,000
Red Rock Creek	653	16,370	-	47,500,000
Lower Cottonwood[1]	261	-	-	168,000,000
South Fork	183	8,640	-	9,610,000
Long Haul Creek	601	-	-	14,400,000

1 - Loads from Middle and Lower Cottonwood subwatersheds were combined for theseestimates.
2 - 0.0, 0.2, 1.0, 2.1, 0.0, 1.3, and 0.0 cattle per creek, respectively.
3 - Based on continuous 600,000 GPD flow and 100 cfu/100 ml concentration.

Load Allocations

Table 47 lists the fecal coliform load (in Bcfu/yr) for the current loading (based on the baseline model calibration), the load capacity for each subwatershed, and the percent reduction in the current load that this new load represents. Finally, Table 47 shows the Load allocation for each subwatershed, which is based on the model simulation in which water quality standards were achieved in each subwatershed.

Table 47. Load Estimates and Allocations

Subwatershed	Current Estimated Load (bcfu/year)	Loading Capacity (bcfu/year)	% Reduction	Load Allocation
Stockney Creek	72,200,000	20,900,000[1]	71	20,900,000[1]
Upper Cottonwood Creek	28,000,000	15,400,000[2]	45	WLA - 829
				LA - 15,400,000[2]
Shebang Creek	107,000,000	12,800,000[3]	88	12,800,000[3]
Long Haul Creek	14,400,000	8,930,000[2]	38	8,930,000[2]
South Fork Cottonwood Creek	9,610,000	7,400,000[3]	23	7,400,000[3]
Red Rock Creek - Secondary Red Rock Creek - Primary	47,500,000 47,500,000	25,200,000[3] 15,700,000[4]	47 67	25,200,000[3] 15,700,000[4]
Lower Cottonwood Creek*	168,000,000	82,300,000[2]	51	82,300,000[2]

*Load to Lower Cottonwood Creek includes load to Middle Cottonwood Creek.
1 - Includes reduction in current "unknown point source" and faulty septic system loads by 80%.
2 - Includes reduction in current faulty septic system loads by 80%.
3 - Includes reduction in current "unknown point source" load by 95%, and reduction in current fault septic system loads by 80%.
4 - Includes reduction in current "unknown point source" load by 100%, and reduction in current fault septic system loads by 90%.

Wasteload Allocation (WLA)

The WLA City of Cottonwood will be the existing permit limit of 100 cfu/100 mL. Because bacteria allocations in Cottonwood Creek are apportioned to both point and non-point sources, the TMDL must incorporate reasonable assurance that the nonpoint sources reductions will be implemented to meet the prescribed load allocations. For the Cottonwood Creek TMDL, bacteria load reductions from nonpoint sources will be achieved through a combination of future efforts being proposed by State of Idaho, Nez Perce Tribe and Cottonwood Creek Watershed Advisory Group as detail in Section 2.4.4.

3.4.7 Modeling Control Scenarios

In this section, control scenarios are provided that illustrate the modeled outcome for example control scenarios. During the TMDL implementation phase, the Cottonwood Creek WAG will direct how reductions will be accomplished in the watershed. These model scenarios serve as tools to help the WAG plan those reductions. All control scenarios were compared against the applicable water quality criteria, reduced by 10% for the MOS. The percent of the time the MOS-adjusted criteria is expected to be exceeded is summarized in Table 48 for the baseline (existing) and each of the control scenarios.

Scenario A - Deleting unknown point source
Deleting the unknown point source that could be cattle in streams or other source was the first control scenario. This scenario, depending on the current conditions and management practices in the watershed, would be implemented by methods such as fencing the stream bank to prevent direct access, and/or by providing a source of water away from the stream itself. Since cattle in the stream were included in the baseline (existing) bacteria calibration as point source dischargers, cattle were removed from the model simply by applying a 0.0 multiplier to both the flow and fecal coliform load. This control scenario had a clear and dramatic effect on the bacteria concentration graph, reducing the "not-to-exceed" standard exceedance rate to less than 5% for all creeks with a "unknown point source" point source. This control scenario also reduced the geometric-mean criteria exceedance rate to zero for three subwatersheds (Upper Cottonwood, South Fork Cottonwood, and Lower Cottonwood Creek). The resulting primary contact standard exceedance rates for Red Rock Creek were still quite high: 3.3% and 54.0%, for the "not-to-exceed" and geometric mean criteria, respectively. The model results indicate that additional controls would be necessary to meet standards.

Scenario B - Delayed Dairy Manure Application with Composting, and Deleting Unknown Point Source: This scenario assumed that instead of 22.22% of the dairy manure application taking place in April, May, and June, it is composted instead; resulting in an 80% reduction in fecal coliform concentration and the compost is applied in July, August, and September. Additionally, the " unknown point sources" were removed as in Scenario A.

Scenario C - Zero Hog Manure, WWTP at Permit, and Deleting Unknown Point Source:
In this scenario, hog manure impact was reduced to zero in the watershed to test the relative impact of the current hog manure management practices as represented in the model. The Cottonwood WWTP was set to a constant discharge of 0.4642 cfs (or 300,000 GPD) and 100 cfu/100mL for the months of October through the end of March. Additionally, the "unknown point source" point sources were removed as in Scenario A.

Scenario D - Zero Beef Manure, WWTP at Permit, and Deleting Unknown Point Source
In this scenario, the beef cattle manure impact was reduced to zero in the watershed to test the relative impact of the current beef cattle manure management practices as represented in the model. Additionally, WWTP was set at its permitted level, and the "unknown point source" were removed as in Scenario A.

Scenario E - Zero Beef Manure, WWTP at Permit, Deleting Unknown Point Source, and Zero Septic Load: This scenario is Scenario D, with the additional loss of the septic system load in each subwatershed. This scenario demonstrates that septic systems may be significantly impacting the watershed.

Scenario F - Zero Dairy Cow Manure, WWTP at Permit, and Deleting Unknown Point Source
In this scenario, the dairy cattle manure impact was reduced to zero in the watershed to test the relative impact of the current dairy cattle manure management practices as represented in the model. Additionally, WWTP was set at its permitted level, and the "unknown point sources" were removed as in Scenario A.

Additional model runs

An additional model run was performed to evaluate the impact of the Cottonwood WWTP. The WWTP load was set to zero and resulted in no significant reductions in water quality standard exceedances.

A model run was also performed to evaluate the simple moving of the dairy cow manure application (22.22% rate) from April/May/June to July/August/September. The rate of water quality standard exceedances remained essentially the same. Exceedances in spring were only traded for exceedances in summer.

Table 48. Comparison of Modeling Scenarios

	Scenario 0		Scenario A		Scenario B		Scenario C		Scenario D		Scenario E		Scenario F	
	Calibration (Baseline-Existing)		No Point Source		Delayed Dairy Manure Application with Composting, and No Point Source		Zero Hog Manure, WWTP at Permit, and No Point Source		Zero Beef Cow Manure, WWTP at Permit, and No Point Source		Zero Beef Cow Manure, WWTP at Permit, and No Point Source, and Zero Septic Load		Zero Dairy Cow Manure, WWTP at Permit, and No Point Source	
	% Exceedance Secondary Standard[a]		% Exceedance Secondary Standard[a]		% Exceedance Secondary Standard[a]		% Exceedance Secondary Standard[a]		% Exceedance Secondary Standard[a]		% Exceedance Secondary Standard[a]		% Exceedance Secondary Standard[a]	
Reach	Any time (720 cfu /100mL)	30-day Geo. Mean (180 cfu /100mL)	Any time (720 cfu /100mL)	30-day Geo. Mean (180 cfu /100mL)	Any time (720 cfu /100mL)	30-day Geo. Mean (180 cfu /100mL)	Any time (720 cfu /100mL)	30-day Geo. Mean (180 cfu /100mL)	Any time (720 cfu /100mL)	30-day Geo. Mean (180 cfu /100mL)	Any time (720 cfu /100mL)	30-day Geo. Mean (180 cfu /100mL)	Any time (720 cfu /100mL)	30-day Geo. Mean (180 cfu /100mL)
Stockney	10.9	17.2	4.2	4.5	3.4	4.5	3.7	4.5	0.2	4.3	0.2	0.0	3.0	4.5
Upper Cottonwood	6.3	18.5	1.1	0.0	0.6	0.0	1.2	6.0	0.3	6.0	0.2	0.0	0.3	6.0
Shebang	5.5	9.0	5.5	9.0	5.5	9.0	5.1	8.1	0.0	3.0	0.0	0.0	2.2	4.8
South Fork Cottonwood	13.8	19.3	0.5	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.0
Long Haul	1.8	13.2	1.8	13.2	1.8	13.2	1.8	13.2	0.6	8.2	0.0	0.0	1.1	11.1
Red Rock	20.0	29.0	1.5	4.3	1.5	4.3	1.2	4.3	0.0	4.3	0.0	0.0	1.5	4.3
Lower Cottonwood	3.0	24.7	2.2	0.0	2.2	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.5	0.0
	% Exceedence [b] Primary Standard		% Exceedence [b] Primary Standard		% Exceedence [b] Primary Standard		% Exceedence [b] Primary Standard		% Exceedence [b] Primary Standard		% Exceedence [b] Primary Standard		% Exceedence [b] Primary Standard	
	Any time (450 cfu /100 mL)	30-day Geo. Mean (45 cfu /100mL)	Any time (450 cfu /100 mL)	30-day Geo. Mean (45 cfu /100mL)	Any time (450 cfu /100 mL)	30-day Geo. Mean (45 cfu /100mL)	Any time (450 cfu /100 mL)	30-day Geo. Mean (45 cfu /100mL)	Any time (450 cfu /100 mL)	30-day Geo. Mean (45 cfu /100mL)	Any time (450 cfu /100 mL)	30-day Geo. Mean (45 cfu /100mL)	Any time (450 cfu /100 mL)	30-day Geo. Mean (45 cfu /100mL)
Red Rock	15.0	61.7	4.2	41.6	4.2	41.6	2.7	38.1	0.0	7.2	0.0	0.0	4.2	41.6

[a]Percentage determined based on year-round comparison
[b]Percentage based on comparison with May to September period (period in which primary contact criteria apply)

3.4.8 Conclusions

- The Cottonwood WWTP is not a significant source of fecal coliform loadings in Upper and Lower Cottonwood Creeks.

- A direct loading to the creek from various unknown point sources appears to be a significant source of fecal coliform loadings, in some subwatersheds, particularly during periods of dry weather.

- Accumulation of fecal coliform on land surfaces, due to both grazing/pasturing of cattle and manure spreading from animal feeding operations, appears to be a significant of fecal coliform loading, particularly during wet weather events.

- Faulty septic systems appear to be a significant contributor to exceedances of the fecal coliform criteria in Cottonwood Creek watershed.

- A viable implementation plan to achieve fecal coliform criteria would require reductions from a combination of the four main fecal coliform source categories in the watershed: hog manure, dairy cow manure, beef cattle manure, and faulty septic systems.

3.4.9 Recommendations

The following recommendations, derived during the course of this modeling effort, are intended to inform stakeholders of studies or investigations that could be used in future watershed studies or to develop and effective implementation plan.

- *Collect Additional Data on Current Manure Management Methods in the Watershed* - This will be essential in deriving an effective implementation plan.

- *Additional Bacteria Sampling* - Despite the not-to-exceed value being the key comparison point for the secondary contact standard, sample results rarely corresponded with modeled peak concentrations, and were instead typically on the modeled storm concentration downslope.

- *Collect Reliable Flow Data for Each Subwatershed* - The collection of additional flow data would allow modeling of land use-specific hydrology and fecal coliform loads.

3.5 Ammonia

The TMDL for ammonia involves comparing instream total ammonia concentrations to Idaho water quality criteria for cold water biota. The salmonid spawning criteria for ammonia are the same as those for cold water biota. The criteria are based on the toxic effects of ammonia to aquatic life and are pH and temperature dependent. The nutrient effect of ammonia is evaluated in the nutrient TMDL. The existing ,although limited, ammonia data shows that ammonia problems exist in Upper Cottonwood Creek sub-watershed during the winter season. Ammonia concentration in this watershed increase in November and gradually decrease in March. For the Cottonwood Creek TMDL, the WLA for the Cottonwood WWTP during the critical time period (May - September) is 0lbs/day because the City does discharge during the this time period. Based on the available data, ammonia concentration increase during the time which the Cottonwood Creek WWTP discharges (November - April). The TMDL requires an 5% reduction in total ammonia during the November - April time period to ensure water quality standards are met.

3.5.1 Target and Load Capacity

Ammonia exists in equilbrium in water in 3 different forms: dissolved ammonia gas commonly referred to as un-ionized ammonia (NH_3), ammonium hydroxide (NH_4OH), and ammonium ion (NH_4^+). The proportions of these forms in water depend on pH and temperature. Un-ionized ammonia is the principal toxic form of ammonia. As pH and temperature increase, the percentage of total ammonia that exists as un-ionized ammonia increases.

Ammonia criteria are listed in Tables III and IV of IDAPA 16.01.02.250.02.c.iii. Criteria are provided for both one-hour and four-day averages of un-ionized ammonia and total ammonia under different temperature and pH conditions. The total ammonia criteria are used in this TMDL since all the SAWQP data is for total ammonia, not un-ionized ammonia. The 4-day criteria are used instead of the one-hour criteria because the SAWQP data was composited over a period ranging from 6 to 18 days, so the data is more representative of daily averages. This is a conservative step, since the 4-day criteria are lower than the one-hour criteria.

The target selected for the critical April - October time period and used in this TMDL analyses is 0.16 mg/L, the criteria in Idaho rule for 28°C and a pH of 8.6. The target selected for the October to April time period, is the 1.24 mg/l the criteria in Idaho rule for 16°C and a pH of 8.0. These targets are conservative since they are based on higher temperature and pH conditions than observed in sampling data on average, as further detailed in the following two sections.

3.5.2 Condition Assessment

3.5.2.1 Ammonia Data

Figure 24 shows how ammonia levels varied over time at the 7 SAWQP sampling locations. In general, levels were higher during the winter and spring months when higher flows occurred and lower in the low flow months. Given the difference in criteria tied to temperature conditions, the data was categorized into two periods for analysis - November through March and April through October. The Cottonwood WWTP is permitted to discharge to the Creek between October 31 and April 1; however, the plant discharged in April and May 1997 due to storage limitations, so point source discharge contributions are considered in both time periods.

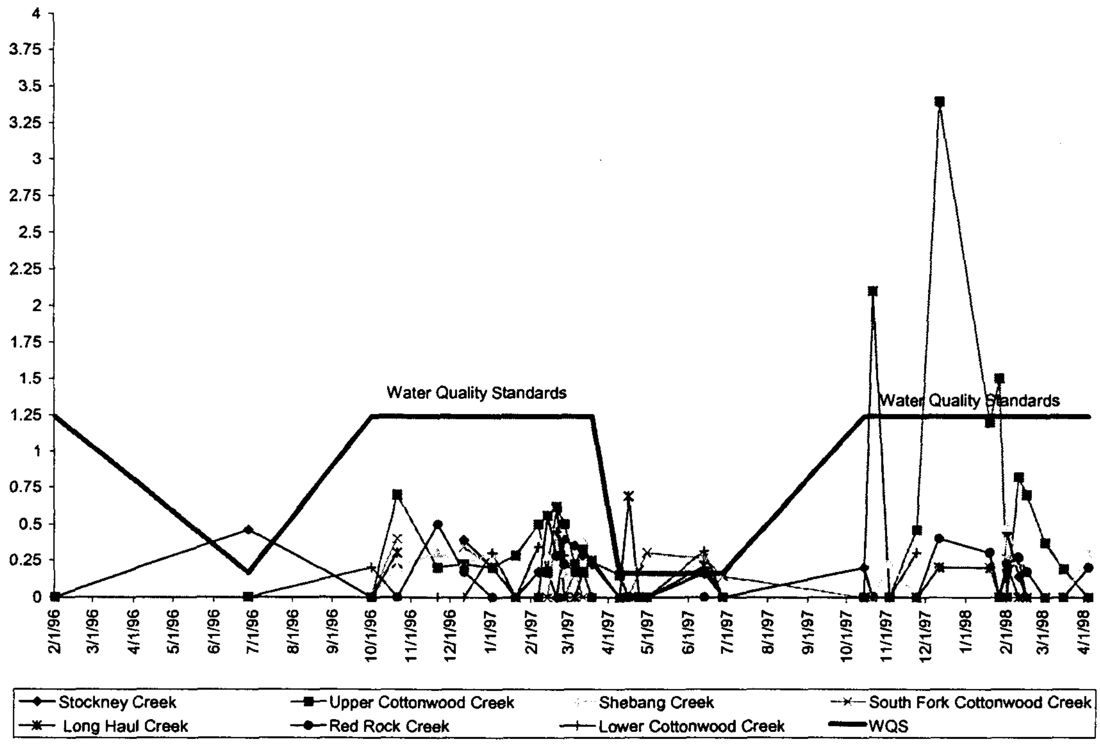


Figure 24. SAWQP Ammonia Results

3.5.2.2 pH Data

The SAWQP study did not involve collection of pH data; consequently, pH trends were examined from field data collected by the NPT at BURP sites in 1998, field data collected by the NPT and other agencies in 1999; and data collected by Teasdale in 1996 and 1997 (Teasdale and Funk 1998). Table 49 presents a summary of available pH data.

Of the 38 pH measurements during the April through October period, the average was 8.18 and 95% of the data was 7.98 or below. Consequently, 8.6 was used as a conservative pH for deriving the ammonia criteria to be used for the loading analysis during this time period. Measurements of pH during the colder months of November through March were limited to only those collected once a month in 1996 and 1997 by Teasdale (Teasdale and Funk 1998). Those measurements averaged 7.6; therefore, 8.0 was used a conservative pH for deriving the ammonia criteria used for the loading analysis during this time period.

Table 49. Cottonwood Creek pH Data

Date	Location	pH	Source
11/96 - 3/97	Upper COT	7.56 average of once a month sample	Teasdale and Funk (1998)
4/97 - 10/97	Upper COT	8.62 average of once a month sample	Teasdale and Funk (1998)
11/97 & 12/97	Upper COT	7.62 average of once a month sample	Teasdale and Funk (1998)
7/9/98	Red Rock	8.76	NPT BURP
7/8/98	Red Rock	8.10	NPT BURP
8/17/98	Lower COT	7.98	NPT BURP
7/7/98	Red Rock	8.68	NPT BURP
7/14/98	Lower COT	7.87	NPT BURP
7/13/98	Stockney	7.97	NPT BURP
8/18/98	Lower COT	7.40	BLM
8/18/98	Upper COT	7.20	BLM
6/14/99	COT Butte	7.90	DEQ
6/14/99	Lower COT	8.66	DEQ
8/2 & 8/3/99	Lower COT	8.19 diurnal average	DEQ
8/2 & 8/3/99	Middle COT	7.71 diurnal average	DEQ
6/23/99	Middle COT	8.10	NPT
6/28/99	Middle COT	8.33	SCC
7/6/99	Middle COT	8.44	SCC
7/12/99	Middle COT	8.75	SCC
7/19/99	Middle COT	8.48	NPT
7/21/99	Middle COT	8.15	NPT
8/2/99	Middle COT	8.17	SCC
8/10/99	Middle COT	8.42	SCC

Date	Location	pH	Source
8/23/99	Middle COT	8.04	SCC
8/30/99	Middle COT	8.14	SCC
6/23/99	Lower COT	8.12	NPT
6/28/99	Lower COT	8.28	SCC
7/6/99	Lower COT	8.45	SCC
7/12/99	Lower COT	8.38	SCC
7/21/99	Lower COT	8.54	NPT
8/2/99	Lower COT	8.33	SCC
8/10/99	Lower COT	8.67	SCC
8/16/99	Lower COT	7.91	SCC
8/23/99	Lower COT	8.30	SCC
8/30/99	Lower COT	8.20	SCC
8/18/99	Long Haul	7.97	NPT
8/3/99	Red Rock	8.78	NPT
8/19/99	Shebang	7.48	NPT
8/18/99	SF COT	7.86	NPT
8/19/99	Stockney	7.78	NPT

3.5.2.3 Temperature Data

Temperature data was collected several times daily in September 1996 and between late May and mid-September of 1997 during the SAWQP and also between mid-June and early October 1998 (IDEQ 1998). To determine the temperature to be used for the initial comparison of ammonia levels to criteria, temperature averages were calculated for July 1997 and 1998, which were the months with the highest stream temperatures in those years. Temperature averages were calculated for September 1997 and 1998 as conservative estimates of temperatures during the November - March time frame since no data is available for these months. Table 50 presents these temperature averages.

Table 50. Summary of Temperature Averages for Ammonia Screening Criteria Evaluation

Location	July 1998	July 1997	Sept/Oct. 1998	Sept. 1997	Sept. 1996
Stockney Creek	19.3	17.3	12.1	15.7	13
Upper Cottonwood Creek	19.7	18.9	13.6	16.5	13
Shebang Creek	22.0	19.8	12.5	17.0	21
SF Cottonwood Creek	19.3	19.8	11.1	16.4	11.1
Long Haul Creek	NA[1]	20.3	NA[1]	17.1	NA[1]
Red Rock Creek	21.9	19.3	13.1	17.1	15.8
Lower Cottonwood Creek	22.2	20.6	15.6	18.5	15.3
Watershed Average	20.8	19.4	15.3	16.9	16.1

[1] NA - Not Available

3.5.2.4 Comparison to Criteria

In comparing the potential ammonia concentrations to the 4-day ammonia criterion, data/information from sections 3.5.2.2 and 3.5.2.3 were used. The SAWQP ammonia was used initially and was compared to a conservative criteria of 0.16 mg/L for a pH of 8.6 and temperature of 28°C for the months of April through October and conservative criteria of 1.24 mg/L for a pH of 8.0 and temperature of 16°C for the months of November through March. Based on this data, the initial screening for potential exceedences shows that April through October were the months when potential ammonia violations occurred. During the November through March time frame, Upper Cottonwood Creek also shows the potential for exeedences. The previous section explains why these choices are considered conservative. Table 51 summarizes the number and percentage exceedances for the SAWQP data.

Table 51. Initial Screening of Ammonia Results for Exceedences Based on Conservative Criteria

Location	Nov. - March (total ammonia greater than 1.24 mg/L)	April - Oct. (Total ammonia greater than 0.16 mg/L)
Stockney Creek	0	3 (21%)
Upper Cottonwood Creek	3 (13%)	2 (14%)
Shebang Creek	0	3 (21%)
SF Cottonwood Creek	0	4 (29%)
Long Haul Creek	0	4 (29%)
Red Rock Creek	0	2 (14%)
Lower Cottonwood Creek	0	1 (7%)

3.5.2.5 Critical Loading Condition

The critical loading condition occurs when water quality criteria begin to be exceeded at too great a frequency. In analyzing the SAWQP data, the exceedances of conservative ammonia screening criteria almost all occur during the low flow, summer months. This is primarily because the criteria are lower pH and temperature increase, which happens during this period. Although the highest concentrations of ammonia generally occurred during the winter months and spring runoff period, the critical loading condition is during hotter, low flow months.

3.5.2.6 TMDL Allocation

The WLA for the Cottonwood WWTP during the critical time period (May - September) is 0lbs/day because the City does discharge during the this time period. The TMDL also requires a 18% reduction in total ammonia during the October - April time period to ensure water quality standards are attained.

3.5.3 Seasonal Variations and Margin of Safety

Section 303(d)(1) requires TMDLs to be "established at a level necessary to implement the applicable water quality standards with seasonal variations." Thus, the analysis must be conservatively based to address seasonal peaks, if any, that might occur in pollutant concentrations. This TMDL addresses seasonality by basing the load and load capacity during two critical loading condition (April - October; November - March).

Uncertainties inherent in developing the ammonia TMDL include: 1) lack of specific data on contribution of various nonpoint sources of ammonia; 2)lack of comprehensive flow and ammonia concentration data representing long-term trends; and 3) lack of pH and temperature data during fall, winter, and spring periods.

4.0 PUBLIC PARTICIPATION

4.1 Cottonwood Creek Watershed Advisory Group

Idaho Code IDAPA 16.01.02.052 provides requirements for public participation in water quality decisions. Basin Advisory Groups (BAGs) and Watershed Advisory Groups (WAGs) recommend pollution control activities and advise the State on priority impaired waterbodies and management of impaired watersheds. The Cottonwood Creek WAG was appointed by the Administrator of IDEQ in August 1997 to fulfill the public participation requirements of Idaho Code 39-3601 et seq. Members selected for the WAG were recommended by the Clearwater BAG from nominations obtained from the local community to represent specific stakeholder groups within the watershed. In fall 1998, when IDEQ entered into a Memorandum of Agreement with the NPT and U.S. EPA, the NPT selected additional tribal representatives for the WAG, whom were then appointed to the WAG.

The Cottonwood Creek WAG has been successful in assisting governmental agencies in the development of the Cottonwood Creek TMDL. Since fall 1997, the group has met twelve times. The meetings were held in the BLM office in Cottonwood and were open to the public.

The Cottonwood Creek WAG has provided the community's perspective of appropriate watershed management actions though cooperative discussions of issues, recommendations and advice. The Cottonwood Creek WAG is committed to improving water quality conditions in Cottonwood Creek and its tributaries. Although the Cottonwood Creek TMDL estimates pollutant reductions needed to support beneficial uses, the WAG would like to reiterate their belief and observations that current watershed conditions and land management practices are better than historic conditions and practices. The WAG offers the following summary comments/concerns regarding the Cottonwood Creek TMDL:

WAG Comments on Recreation Contact Use: The mainstem Cottonwood Creek is designated secondary contact recreation. The undesignated tributaries can be considered as either primary or secondary contact recreation until they are designated one or the other through rulemaking. The WAG believes the appropriate use classification for all tributaries is secondary contact and would like the governmental agencies developing the TMDL to reconsider use of the primary contact criteria in the bacteria TMDL for Red Rock Creek.

WAG Comments on Switch from Fecal Coliform to *E. coli* Criteria: The State has proposed changing the current bacteria water quality criteria from one based on fecal coliform levels to one based on *E. coli* levels. The WAG supports this criteria change since *E. coli* bacteria is more indicative of pathogenic microorganisms than fecal coliform bacteria.

WAG Comments on Designation of Salmonid Spawning Beneficial Use: Currently in Idaho Code, the designated beneficial use for aquatic life on Cottonwood Creek from its source to its mouth is salmonid spawning. The WAG believes this designation should be confined to the segment of Cottonwood Creek below the waterfall at stream mile 9.0 because this waterfall provides a full barrier to fish passage. The WAG requests that the appropriate regulatory agencies initiate the regulatory process to accomplish this redesignation.

WAG Comments on Salmonid Spawning Time Frame: The expert fisheries biologist for the Cottonwood Creek watershed has indicated that steelhead move into lower elevation tributaries such as Cottonwood Creek from the South Fork of the Clearwater River in the spring to spawn, with fry typically emerging no later than mid-June (Johnson 1999a). Currently, the default spawning time frame in Idaho Code is February 1st through July 15th, which is the time frame used in the temperature TMDL analysis. Having the period extend through mid-July instead of mid-June increases the estimates of needed heat reduction/increased shade in the TMDL. The WAG supports the proposed State rulemaking that deletes the default salmonid time frame table and allows for consideration of site specific spawning conditions. Should this time frame be made site specific, then the temperature TMDL should be revised accordingly.

WAG Comments on State Temperature Water Quality Criteria: The WAG does not believe that the current State salmonid spawning criteria is attainable no matter what practices are implemented in the watershed to try to achieve it. Temperature data from the headwaters and Yellow Bull Springs of the watershed support this belief. They also doubt this criteria was ever met historically. The WAG supports the current efforts of the State to evaluate the suitability of its temperature criteria.

WAG Comments on Septic Failure: The WAG believes the assumption that 1/3 of the septics in the watershed are failing may be an underestimate. The WAG supports efforts to better delineate the proportionate load contributions among the various nonpoint sources in the watershed.

WAG Comments on Nutrient Targets: The selected nutrient targets were based on literature references. The WAG believes nutrient levels in the watershed can be reduced with implementation of appropriate BMPs. However, the WAG does not believe that the significant reductions predicted to be necessary to meet these targets can be achieved. Further data collection, study and development of targets based on watershed specific conditions is encouraged.

4.2 Public Comments

The Cottonwood Creek draft TMDL is available for public review and comment from Monday, December 6, 1999 through Tuesday, January 4, 2000. Notification to the general public of the opportunity to comment on the draft TMDL was made in the *Cottonwood Chronicle* (12/9/99), the *Idaho County Free Press* (12/8/99), and the *Lewiston Tribune* (12/6/99). Copies of the TMDL were sent to each of the Cottonwood Creek WAG members, members of the Clearwater BAG, and members of the Cottonwood Creek TAG. In addition, copies of the draft TMDL were available for review at the following locations: IDEQ Lewiston Office, IDEQ Grangeville Office, NPT Water Resources Division Lapwai Office, U.S. EPA Boise Office, Cottonwood City Hall, Idaho County Soil and Water Conservation District Grangeville Office, and Cottonwood City Library.

Two public comment meetings were held--one on December 9, 1999 at the Clearwater Basin Advisory Group meeting in Lewiston and the other on December 15, 1999 at Cottonwood City Hall.

Appendix J provides a summary of the comments received during the public comment period and responses to those comments that identify changes made in the draft TMDL as a result of public comment.

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APPENDIX A COTTONWOOD CREEK FLOW ANALYSIS

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Introduction

The purpose of this narrative is to document the methods and data used to estimate daily and monthly stream discharge at various sites within the Cottonwood Creek watershed. Daily stream flow is estimated at the mouth of Cottonwood Creek near the South Fork of the Clearwater River using the Maintenance of Variance Extension, Type 1 (MOVE.1). Mean daily discharge for each month of the water year is estimated at eight sites within the Cottonwood Creek watershed using U.S. Geological Survey (USGS) regional regression equations (Kjelstrom 1998).

The objective of the Cottonwood Creek flow analysis is to provide reliable stream discharge data for TMDL pollutant loading calculations. The pre-existing stream discharge data are not considered reliable. SAWQP monitoring of Cottonwood Creek from 1994 to 1996 provides water quality data used in the loading calculations. Unfortunately, this monitoring did not measure stream discharge directly. Instead, stream stage was recorded and water velocity was estimated using Manning's. The reported stream discharge values from this monitoring, especially near the mouth, are over and under-estimates of actual low and high flows, respectively.

MOVE.1 Technique

The hydrograph of lower Cottonwood Creek is extended using the MOVE.1 technique (Hirsch 1982). Stream discharge measurements were taken periodically at the lower Cottonwood Creek site from 1994 through 1999 by the USGS, BLM, IDEQ, ICSWCD, and Nez Perce Tribe. Raw flow data are reported in Table A-1. The stream flow data (ungaged site) are regressed against continuous data from USGS Lapwai Creek near Lapwai, Idaho (13342450) stream gage (gaged site), and a synthetic hydrograph is estimated for water years 1975 through 1997 using the MOVE.1 technique.

A statistically significant linear relationship exists between the ungaged and gaged sites. This curve is significant at the 0.05 probability level, however, Hirsch (1982) points out bias which can result from using simple linear regression. Consequently, the MOVE.1 technique is applied which is shown to reduce model bias and improve the accuracy of flow estimates (Hirsch 1982). The MOVE.1 equation is defined as follows:

Yi = m(y) + ((S(y)/S(x))*(Xi - m(x)))

where:

Yi = predicted stream flow of ungaged site
m(y) = mean of ungaged site data
S(y) = standard deviation of ungaged site

Xi = measured stream flow of gaged site
m(x) = mean of gaged site data
S(x) = standard deviation of gaged site

The extended hydrograph is predicted using the following values:

m(y) = 1.34
m(x) = 1.77
S(y) = 0.78
S(x) = 0.79

Regional Regression

The mean daily discharge for each month at 8 monitoring sites is estimated using the USGS regional regression equations (Figure A-1) (Kjelstrom 1998). For each site, estimates of mean monthly discharge from Lipscomb (1998) are used in this analysis. These values are adjusted using factors reported in Kjelstrom (1998), and the 20th, 50th, and 80th percentile mean daily flows are estimated.

Kjelstrom (1998) subdivides central Idaho into regions which produced the best coefficients of determination from regression analyses. According to his map, Cottonwood Creek is in Region 4. Based on the hydrologic characteristics of the watershed, and the index gage used to estimate mean monthly discharge (i.e. Lawyers Creek near Nez Perce, Idaho (13338800)), the decision was made to use Region 5 factors instead. According to Lipscomb (1999), the regional boundaries are not precise, and since Cottonwood Creek is near a boundary it is likely appropriate to use Region 5. A comparison of Region 4 versus Region 5 flow values found less than a 10% difference for low flows and up to 50% difference for high flows.

The results of this analysis are reported in Table A-2.

Table A-1. Stream Discharge Measurements Used in MOVE.1 Equation

Date	Agency*	Cottonwood Q (cfs)
7/25/94	IDEQ	0.8
3/31/95	BLM	23.4
5/16/95	USGS	76.2
6/15/95	IDEQ	3.9
6/16/95	USGS	8.2
7/18/95	USGS	7.5
8/15/95	USGS	3.2
9/14/95	USGS	2.1
10/16/95	USGS	7.3
11/22/95	USGS	14.2
12/12/95	USGS	152.0
1/25/96	USGS	51.1
2/14/96	USGS	133.0
3/13/96	USGS	112.0
4/16/96	USGS	688.0
8/17/98	NPT	2.3
8/18/98	NPT	2.4
2/19/99	NPT	78.2
3/29/99	NPT	65.8
4/8/99	NPT	101.2
4/16/99	NPT	69.7
4/21/99	NPT	74.3

* IDEQ - Idaho Division of Environmental Quality; NPT - Nez Perce Tribe; USGS - U.S. Geological Survey; BLM - Bureau of Land Management

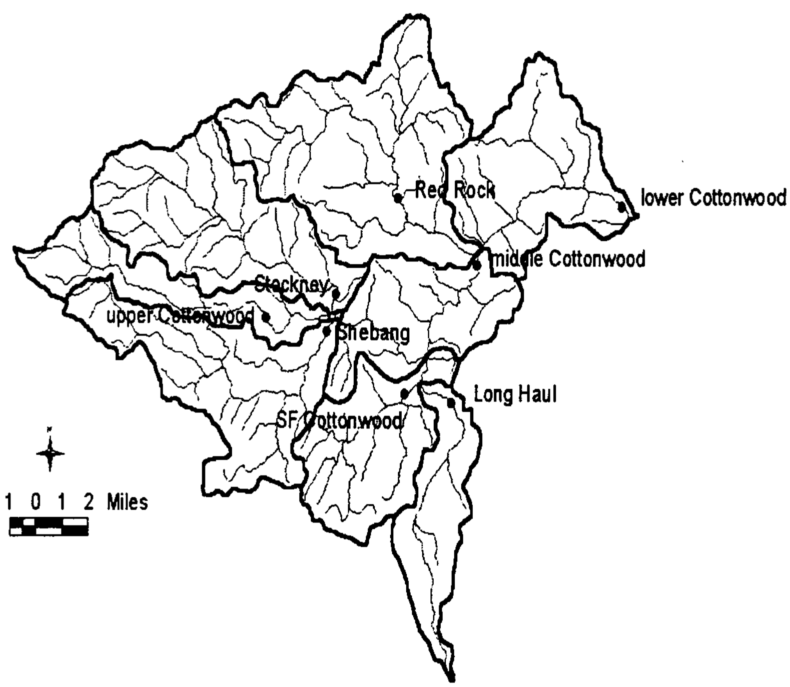

Figure A-1. Map Showing Sites Where Stream Discharge is Estimated Using USGS Regional Equations

Table A-2. Estimated Mean Daily Monthly Discharge for the 20th, 50th and 80th Percentiles

Subwatershed	SAWQP Station	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
20th percentile													
Stockney	1.0	3.2	7.1	8.2	55.0	38.6	108.0	90.9	29.4	11.0	2.9	1.5	2.1
Upper Cottonwood	2.0	1.7	3.7	4.2	28.2	19.9	55.5	46.2	15.4	5.7	1.5	0.7	1.1
Shebang	3.0	1.7	3.7	4.2	28.2	19.9	55.5	46.2	15.4	5.7	1.5	0.7	1.1
SF Cottonwood	4.0	2.0	4.3	4.9	33.8	23.4	65.7	55.4	18.2	6.6	1.8	1.0	1.2
Long Haul	5.0	2.0	4.3	4.9	33.8	23.4	65.7	55.4	18.2	6.6	1.8	1.0	1.2
Red Rock	6.0	2.3	4.9	5.6	38.1	26.9	74.5	63.1	19.6	7.5	2.1	1.0	1.5
L Cott	7.0	15.6	32.9	37.4	253.8	175.5	496.4	415.8	133.0	50.2	13.6	6.9	9.8
M Cott		8.0	17.1	20.0	136.1	95.9	262.8	223.3	70.7	26.7	7.2	3.6	5.2
50th percentile													
Stockney	1.0	2.4	5.0	4.6	15.2	18.5	43.7	28.3	14.1	4.2	1.8	0.9	1.2
Upper Cottonwood	2.0	1.2	2.6	2.4	7.8	9.5	22.4	14.4	7.4	2.2	0.9	0.4	0.7
Shebang	3.0	1.2	2.6	2.4	7.8	9.5	22.4	14.4	7.4	2.2	0.9	0.4	0.7
SF Cottonwood	4.0	1.5	3.0	2.8	9.4	11.2	26.6	17.3	8.7	2.5	1.1	0.6	0.7
Long Haul	5.0	1.5	3.0	2.8	9.4	11.2	26.6	17.3	8.7	2.5	1.1	0.6	0.7
Red Rock	6.0	1.7	3.5	3.2	10.5	12.9	30.1	19.7	9.4	2.9	1.3	0.6	0.9
L Cott	7.0	11.4	23.5	21.1	70.2	84.0	200.6	129.6	63.7	19.2	8.4	4.2	5.9
M Cott		5.9	12.2	11.3	37.6	45.9	106.2	69.6	33.8	10.2	4.5	2.2	3.1
80th percentile													
Stockney	1.0	1.5	3.7	3.1	10.1	8.6	22.2	13.6	7.1	2.7	0.9	0.5	0.9
Upper Cottonwood	2.0	0.8	1.9	1.6	5.2	4.4	11.4	6.9	3.7	1.4	0.5	0.2	0.5
Shebang	3.0	0.8	1.9	1.6	5.2	4.4	11.4	6.9	3.7	1.4	0.5	0.2	0.5
SF Cottonwood	4.0	1.0	2.2	1.9	6.2	5.2	13.5	8.3	4.4	1.6	0.6	0.3	0.5
Long Haul	5.0	1.0	2.2	1.9	6.2	5.2	13.5	8.3	4.4	1.6	0.6	0.3	0.5
Red Rock	6.0	1.1	2.5	2.1	7.0	6.0	15.3	9.4	4.8	1.9	0.6	0.3	0.6
L Cott	7.0	7.4	17.0	14.1	46.8	39.0	102.0	62.1	32.3	12.5	4.3	2.4	4.1
M Cott		3.8	8.8	7.5	25.1	21.3	54.0	33.4	17.2	6.6	2.3	1.2	2.2

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APPENDIX B IDAHO SURFACE WATER QUALITY STANDARDS

The following water quality criteria are applicable to the beneficial uses within the Jim Ford Creek watershed for the pollutants of concern listed on the 1994, 1996, and 1998 Section 303(d) lists:

IDAPA 16.01.02.200.02
Toxic Substances. Surface waters of the state shall be free of toxic substances in concentrations that impair beneficial uses. These materials do not include suspended sediment produced as a result of nonpoint source activities.

IDAPA 16.01.02.200.03
Deleterious Materials. Surface waters of the state shall be free from deleterious materials in concentrations that may impair designated beneficial use.

IDAPA 16.01.02.200.05
Floating, Suspended, or Submerged Matter. Surface waters of the state shall be free from floating, suspended, or submerged matter of any kind in concentrations causing nuisance or objectionable conditions or that may impair designated beneficial uses. This matter does not include suspended sediment produced as a result of nonpoint source activities.

IDAPA 16.01.02.200.06
Excess Nutrients. Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses.

IDAPA 16.01.02.200.07
Oxygen-Demanding Materials. Surface waters of the state shall be free from oxygen demanding materials in concentrations that would result in an anaerobic water condition.

IDAPA 16.01.02.200.08
Sediment. Sediment shall not exceed quantities specified in Section 250, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses. Determinations of impairment shall be based on water quality monitoring and surveillance and the information utilized as described in Subsection 350.02.b. Subsection 350.02.b generally describes the BMP feedback loop for nonpoint source activities.

IDAPA 16.01.01.250.01.a
Primary Contact Recreation: between May 1 and September 30 of each calendar year, waters designated for primary contact recreation are not to contain fecal coliform bacteria significant to the public health in concentrations exceeding:

i. 500 colony forming units per 100 mL at any time; and

ii. 200/100 colony forming units/100 mL in more than ten percent of the total samples taken over a thirty day period; and

iii. A geometric mean of 50 colony forming units/100 mL based on a minimum of five samples taken over a thirty day period.

IDAPA 16.01.01.250.01.b
Secondary Contact Recreation: waters designated for secondary contact recreation are not to contain fecal coliform bacteria significant to the public health in concentrations exceeding:

i. 800/100 colony forming units/100 mL at any time; and

ii. 400/100 colony forming units/100 mL in more than ten percent of the total samples taken over a thirty day period; and

iii. A geometric mean of 200 colony forming units/100 mL based on a minimum of five samples taken over a thirty day period.

IDAPA 16.01.01.250.01.c
Primary and Secondary Contact Recreation: All toxic substance criteria set forth in 40 CFR 131.36(b)(1), Column D2, revised as of December 22, 1992, effective February 5, 1993 (57 FR 60848, December 22, 1992). 40 CFR 131.36(b) (1) is hereby incorporated by reference in the manner provided in subsection 250.07; provided, however, that standard for arsenic shall be 6.2 ug/L for Column D2 (which constitutes a recalculation to reflect an appropriate bioconcentration factor for fresh water).

IDAPA 16.01.01.250.02.c
Cold Water Biota: waters designated for cold water biota are to exhibit the following characteristics:

i. Dissolved oxygen concentrations exceeding 6 mg/L at all times.

ii. Water temperatures of 22 °C or less with a maximum daily average of no greater than 19 °C.

iii. Ammonia - refer to rules that provide formula and tables for one-hour and four-day criteria that are pH and temperature dependent.

iv. Turbidity below any applicable mixing zone set by the Department, shall not exceed background turbidity by more than 50 NTU instantaneously or more than 25 NTU for more than ten consecutive days.

IDAPA 16.01.01.250.02.d
Salmonid spawning: waters designated for salmonid spawning are to exhibit the following characteristics:

I. Dissolved Oxygen.

(1) Intergravel Dissolved Oxygen.

(a) One day minimum of not less than five point zero (5.0) mg/L.

(b) Seven day average of not less than six point zero (6.0) mg/L.

(2) Water-Column Dissolved Oxygen.

(a) One day minimum of not less than six point zero (6.0) mg/L or ninety percent of saturation, whichever is greater.

ii. Water temperatures of 13 °C or less with a maximum daily average no greater then 9 °C.

iii. Ammonia.

(1) One hour average concentration on un-ionized ammonia is not to exceed the criteria defined at Idaho Department of Health and Welfare Rules Section 250.02.c.iii.(1).

(2) Four day average concentration of un-ionized ammonia is not to exceed the criteria defined at Idaho Department of Health and Welfare Rules Section 250.02.c.iii.(2).

iv. Unless modified for site-specific conditions, the time periods for salmonid spawning and incubation in Table 2 apply for the indicated species.

Table 2: Annual Time Periods for Salmonid Spawning and Incubation

Fish Species	Time Period
Chinook salmon (spring)	Aug 1 - Apr 1
Chinook salmon (summer)	Aug 15 - June 15
Sockeye salmon (fall)	Sept 15 - Apr 15
Sockeye salmon	Oct 1 - June 1
Steelhead trout	Feb 1 - July 15
Redband trout	Mar 1 - July 15
Cutthroat trout	Apr 1 - Aug 1
Sunapee trout	Sept 15 - June 10
Bull trout	Sept 1 - Apr 1
Golden trout	June 15 - Aug 15
Kokanee	Aug 1 - June 1
Rainbow trout	Jan 15 - July 15
Mountain whitefish	Oct 15 - Mar 15
Brown trout	Oct 1 - Apr 1
Brook trout	Oct 1 - June 1
Lake trout	Oct 1 - Apr 1
Arctic grayling	Apr 1 - July 1

IDAPA 16.01.01.250.03.a
Water Supplies.
Domestic: waters designated for domestic water supplies are to exhibit the following characteristics:

I.. All toxic criteria set forth in 40 CFR 131.36(b)(1), Column D1, revised as of December 22, 1992, effective February 5, 1993 (57 FR 60848, December 22,1992). 40 CFR 131.36(b)(1) is hereby incorporated by reference in the manner provided in Subsection 250.07 provided, however, the standard for arsenic shall be point zero two (0.02) ug/L for Column D1 (which constitutes a recalculation to reflect an appropriate bioconcentration factor for fresh water).

ii. Radioactive materials or radioactivity not to exceed concentrations specified in Idaho Department of Health and Welfare Rules, IDAPA 16, Title 01, Chapter 08, "Rules Governing Public Drinking Water Systems."

APPENDIX C SUMMARY OF BURP DATA

Prepared by:
Carol Fox and Sarah Young, IDEQ LRO
Ann Storrar, NPT Water Resources

The following tables summarize the BURP data collected by IDEQ and NPT. The following explains the significance of the BURP parameters measured in Cottonwood Creek and its tributaries. Comparisons to regional references are also provided for some of the BURP parameters. For most of the criteria evaluated, conditions in Cottonwood Creek for support of salmonids and cold water biota were suboptiminal.

Large Woody Debris: Woody debris and root wads create habitat diversity by forming pools and waterfalls, trapping sediment, and enhancing channel and bank stability. Research has shown a direct relationship between the amount of wood and salmonid production, and wood removal has been shown to reduce fish populations.

Canopy Cover: Trees provide shade to keep streams cool, as well as hold soil on steep slopes and stabilize streambanks. Well-vegetated hillsides catch the rain and release it slowly. Removing vegetation makes slopes unstable and causes more rapid runoff, which increases soil erosion and carries more sediment to streams.

Pool-Riffle Ratio: The pool / riffle ratio may be used to predict the streams capability of providing resting and feeding pools for fish and riffles to produce their food and support their spawning. Riffles are the most productive portion of the channel for generating food, especially insects for fish. Salmon and trout use riffles for spawning because embryo and juvenile survival require the specific hydraulic conditions.

Percent Fines: Sediment introduced to streams from erosion increases turbidity, clogs spawning gravels, reduces habitat available for aquatic insects, and fills in pools. Fine sediment hinders the flow of water and oxygen to embryos and, ultimately suffocates them. As streams become wide and shallow, they are more susceptible to summer heating, winter icing, and bank erosion.

Fish Density: Fish populations are a result of the physical, biological, and chemical factors surrounding them, and through their link to the food chain levels below them, provide understanding of stream functioning. Size, structure, and growth rates of fish populations allow insight into the habitat conditions that existed in the past 2 to 10 years.

Width to Depth: Sediment accumulation in stream channels reduces stream depth. Large width to depth ratios are often a result of erosion due to increased peak flow, increased sediment availability, and bank erosion due to loss of streamside vegetation. Streams that are wide and shallow have fewer high quality pools, and less shade, reducing suitable habitat for salmonids.

Pool Frequency: Pools are the major stream habitat of most fish. Although pools of all shapes, sizes, and quality are needed to support different age classes, deep, slow-velocity pools with large amounts of overhanging vegetation support the largest and most stable fish populations. Frequency and size of pools is dependent on stream size, gradient, confinement, flow, sediment load, and large woody debris.

Bank Stability: Eroding streambanks deliver sediment directly to the channel. Steeper banks are subject to more erosion and failure, and streams with poor banks will often have poor instream habitat. Protection from erosion is provided by plant root systems as well as by boulder, cobble, or gravel material. Channels with banks and riparian vegetation in good condition, handle flooding with less habitat damage. Channel bank conditions are closely linked to the quality of fish habitat.

Macroinvertebrates: Macroinvertebrates have several major roles in aquatic ecosystems. They graze on periphyton (attached algae) and feed on organic matter which enters streams. They effect nutrient cycling, and productivity, in addition to constituting an important food source for fish.

Several characteristics make macroinvertebrates useful indicators of water quality, including: their abundance in most streams, their range of responses to environmental stresses; their sedentary nature which allows site specific analysis of pollutant or disturbance effects; and their life span of several months to a few years which allows them to be used as indicators of past environmental conditions. In addition, the sensitivity of aquatic insects to habitat changes and water quality changes have shown them to be effective indicators of stream impairment.

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Cottonwood Creek Data Summary

12/30/1998

Cottonwood Creek--14 sites--Beneficial Use Reconnaissance Data NPT and IDEQ
Site # based on distance from the mouth of Cottonwood Creek.

Site	Stream Mi.	Site ID	Survey Date	Location	Legal Description	Elevation (ft)	Dischg (cfs)	Rch lngth (m)	Grad (%)
1	1.8	1998RNPTA019	08/17/1998	Cottonwood Ck.	32N04ESec30	1400	2.30	115.3	1.0
2	4.0	1998RNPTA008	07/14/1998	Cottonwood Ck.	32N03ESec24	1590	17.13	189	2.0
3	12.2	1998RNPTA005	07/08/1998	Red Rock Ck.	32N02ESec26	2200	1.09	109	2.0
4	17.0	97NCIROZ12	07/23/1997	Red Rock Ck.	32N02ESec23	2830	1.68	100	2.0
5	18.8	95NCIROA10	06/28/1995	S.F. Cttnwd Ck.	31N02ESec26	2950	0.25	125	1.0
6	21.0	1998RNPTA006	07/09/1998	Red Rock Ck.	32N02ESec02	3040	0.008	109	2.0
7	21.0	1998RNPTA004	07/07/1998	Red Rock Ck.	32N02ESec09	3080	0.36	117	1.0
8	21.8	95NCIROA05	06/15/1995	Lower Cttnwd Ck.	31N02ESec15	2930	3.94	115	0.2
9	23.2	96NCIROA37	08/23/1996	Long Haul Ck.	31N03ESec31	2980	0.00	100	0.05
10	25.0	96NCIROA38	08/23/1996	Shebang Ck.	31N02ESec16	2980	0.00	100	0.5
11	28.0	95NCIROA02	06/18/1995	Lower Stockney Ck.	31N03ESec06	3100	2.90	160	0.9
12	30.2	95NCIROA01	06/13/1995	Stockney Ck.	31N01ESec01	3160	1.82	100	0.7
13	30.8	95NCIROA06	06/22/1995	Upper Cttnwd Ck.	31N01ESec11	3300	3.67	100	1.1
14	31.0	1998RNPTA007	07/13/1998	Stockney Ck.	32N01ESec35	3100	3.01	111.7	2

Site	Location	Rosgen	Mean width (m)	Width/Depth Ratio (wetted) Mean depth (m)	Mean w/d
1	Cottonwood Ck.	C	5	0.1162	43.0
2	Cottonwood Ck.	B	8.07	0.16	51.5
3	Red Rock Ck.	B	2.95	0.302	9.8
4	Red Rock Ck.	G	3.17	0.097	32.5
5	S.F. Cttnwd Ck.	C	1.94	0.44	4.4
6	Red Rock Ck.	C	1.77	0.03	66.3
7	Red Rock Ck.	C	1.57	0.087	18.1
8	Lower Cttnwd Ck.	C	3.51	0.56	6.3
9	Long Haul Ck.	C			
10	Shebang Ck.	C			
11	Lower Stockney Ck.	C	3.78	0.26	14.5
12	Stockney Ck.	C	2.26	0.45	5.0
13	Upper Cttnwd Ck.	C	1.55	0.33	4.7
14	Stockney Ck.	B	2.03	0.20	10.3

Site	Location	Pool (m)	Riffle (m)	Pool / Riffle Ratio P/R Ratio	Canopy Cover Mean % cover
1	Cottonwood Ck.	2.3	113	0.02	20
2	Cottonwood Ck.	0	189	0.00	6
3	Red Rock Ck.	25.4	83.6	0.30	16
4	Red Rock Ck.	0	100	0.00	10
5	S.F. Cttnwd Ck.	87	38.6	2.25	5
6	Red Rock Ck.	0	109	0.00	0
7	Red Rock Ck.	3.4	113.6	0.03	0
8	Lower Cttnwd Ck.	18	95	0.19	5
9	Long Haul Ck.	91	9	10.11	0
10	Shebang Ck.	70	30	2.33	7
11	Lower Stockney Ck.	41.5	119	0.35	43
12	Stockney Ck.	27.3	74.3	0.37	39
13	Upper Cttnwd Ck.	18	82	0.22	55
14	Stockney Ck.	0	111.7	0.00	0

Site	Location	Wetted width	# pools	Pool Frequency Reach Length (m)	# Pools / 100 m	Large Woody Debris # pieces*	Min. Vol.(m^3)
1	Cottonwood Ck.	5	1	115.3	0.87	0	0.00
2	Cottonwood Ck.	8.07	0	189	0.00	0	0.00
3	Red Rock Ck.	2.95	4	109	3.67	0	0.00
4	Red Rock Ck.	3.17	0	100	0.00	0	0.00
5	S.F. Cttnwd Ck.	1.94	4	125	3.20	0	0.00
6	Red Rock Ck.	1.77	0	109	0.00	0	0.00
7	Red Rock Ck.	1.57	1	117	0.85	0	0.00
8	Lower Cttnwd Ck.	3.51	2	115	1.74	0	0.00
9	Long Haul Ck.		1	100	1.00	0	0.00
10	Shebang Ck.		1	100	1.00	0	0.00
11	Lower Stockney Ck.	3.78	3	160	1.88	5	0.04
12	Stockney Ck.	2.26	2	100	2.00	5	0.04
13	Upper Cttnwd Ck.	1.55	3	100	3.00	1	0.01
14	Stockney Ck.	2.03	0	111.7	0.00	0	0.00

* # of pieces >10 cm diameter and 1 m in length

Residual Pool Depth (m)

Site	Location	Pool 1	Pool 2	Pool 3	Pool 4	Pool 5	Pool 6
1	Cottonwood Ck.	0.15	0.14	0.37	0.17		
2	Cottonwood Ck.	nd					
3	Red Rock Ck.	0.3	0.32	0.35	0.35		
4	Red Rock Ck.	nd					
5	S.F. Cttnwd Ck.	nd					
6	Red Rock Ck.	nd					
7	Red Rock Ck.	0.15					
8	Lower Cttnwd Ck.	nd					
9	Long Haul Ck.	0.19	0.13				
10	Shebang Ck.	0.35	0.3	0.2			
11	Lower Stockney Ck.	nd					
12	Stockney Ck.	nd					
13	Upper Cttnwd Ck.	nd					
14	Stockney Ck.	nd					

Residual Pool Volume (m^3)

Site	Location	Pool 1	Pool 2	Pool 3	Pool 4	Pool 5	Pool 6
1	Cottonwood Ck.	1.31	13.83	23.2	3.5		
2	Cottonwood Ck.	nd					
3	Red Rock Ck.	5.58	8.04	3.15	10.64		
4	Red Rock Ck.	nd					
5	S.F. Cttnwd Ck.	nd					
6	Red Rock Ck.	nd					
7	Red Rock Ck.	0.82					
8	Lower Cttnwd Ck.	nd					
9	Long Haul Ck.	1.9	2.05				
10	Shebang Ck.	19.25	7.2	7.8			
11	Lower Stockney Ck.	nd					
12	Stockney Ck.	nd					
13	Upper Cttnwd Ck.	nd					
14	Stockney Ck.	nd					

ıites LHD #of pools were less than PQI # of pools. So more pools shown in residual pool depth than in the pool frequency section.

Bank Stability (% stable veg. and unveg)

Site	Location	Left Bank	Right Bank
1	Cottonwood Ck.	0	0
2	Cottonwood Ck.	100	100
3	Red Rock Ck.	80	65
4	Red Rock Ck.	0	100
5	S.F. Cttnwd Ck.	5	95
6	Red Rock Ck.	30	50
7	Red Rock Ck.	60	50
8	Lower Cttnwd Ck.	10	10
9	Long Haul Ck.	50	0
10	Shebang Ck.	85	100
11	Lower Stockney Ck.	10	60
12	Stockney Ck.	70	80
13	Upper Cttnwd Ck.	100	100
14	Stockney Ck.	0	0

Substrate Composition (mean %)

Site	0-1 mm	1-2.5 mm	2.5-6 mm	6-15 mm	15-31 mm	31-64 mm	64-128 mm	128-256 mm	256-512 mm	512-1024 mm	1024&> mm	D50 (mm)	% Tot fines <6mm
1	0.00	0.00	0.00	0.04	0.07	0.37	0.44	0.06	0.00	0.00	0.00	64-128	0
2	0.11	0.01	0.00	0.00	0.08	0.17	0.36	0.21	0.05	0.00	0.00	64-128	12
3	0.39	0.13	0.17	0.08	0.08	0.09	0.03	0.01	0.00	0.00	0.00	1-2.5	69
4	0.05	0.02	0.10	0.04	0.08	0.20	0.30	0.16	0.05	0.00	0.00	64-128	17
5	0.47	0.15	0.09	0.03	0.08	0.08	0.09	0.01	0.01	0.02	0.00	1-2.5	71
6	0.91	0.00	0.03	0.00	0.00	0.03	0.02	0.01	0.00	0.00	0.00	0-1	94
7	0.46	0.20	0.10	0.10	0.08	0.07	0.01	0.01	0.00	0.00	0.00	1-2.5	76
8	0.55	0.04	0.00	0.06	0.12	0.11	0.09	0.01	0.01	0.00	0.01	0-1	59
9	0.27	0.20	0.13	0.08	0.09	0.10	0.10	0.01	0.03	0.00	0.00	2.5-6	60
10	0.15	0.26	0.10	0.05	0.06	0.23	0.16	0.00	0.00	0.00	0.00	2.5-6	51
11	0.65	0.14	0.03	0.02	0.01	0.01	0.01	0.03	0.04	0.00	0.06	0-1	82
12	0.59	0.12	0.01	0.06	0.08	0.10	0.02	0.00	0.01	0.00	0.00	0-1	72
13	0.33	0.14	0.01	0.08	0.10	0.10	0.04	0.01	0.01	0.01	0.18	6-15	48
14	0.68	0.00	0.11	0.02	0.10	0.05	0.02	0.00	0.00	0.00	0.00	0-1	79

Stds.: Bjornn and Reiser 1991:

Species	% Fines < 6.35 mm	% Embryo Survival
Cutthroat	20	50
Rainbow	30	50
Kokanee	33	50
Cutthroat	10	75
Rainbow	20	75
Kokanee	25	75

Macroinvertebrates

Site	Location	% EPT	HBI	%SCR	EPT Index	Taxa Rich	% Dom	Shan H	MBI
N Rock Std		94	0.5	85	38	29	26	1.06	
1	Cottonwood Ck.	nd							
2	Cottonwood Ck.	nd							
3	Red Rock Ck.	nd							
4	Red Rock Ck.	nd							
5	S.F. Cttnwd Ck.	3.00	4.80	2.00	4.00	17.00	56.00	0.61	1.99
6	Red Rock Ck.	nd							
7	Red Rock Ck.	nd							
8	Lower Cttnwd Ck.	26.00	5.70	5.00	4.00	14.00	54.00	0.73	2.22
9	Long Haul Ck.	1.00	6.20	31.00	1.00	17.00	48.00	0.79	2.71
10	Shebang Ck.	9.00	6.50	6.00	4.00	21.00	44.00	0.69	2.46
11	Lower Stockney Ck.	25.00	5.50	10.00	6.00	16.00	46.00	0.73	2.47
12	Stockney Ck.	68.00	3.50	1.00	3.00	10.00	43.00	0.73	2.87
13	Upper Cttnwd Ck.	3.00	5.80	1.00	4.00	12.00	49.00	0.58	1.83
14	Stockney Ck.	nd							

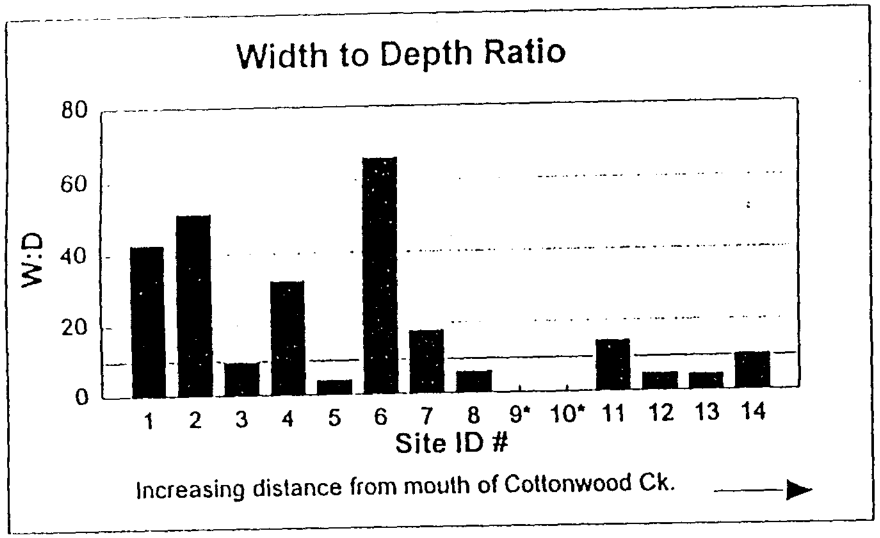
Fish

Site	Location	< 100 mm	100-200 mm	200-300 mm	Seconds	Approx.Density	Add'l Species
1	Cottonwood Ck.	no e fish data					
2	Cottonwood Ck.	104 sucker, 9 sculpin, 24 shiner, 212 dace, 4 chiselmouth	4 sucker		461		
3	Red Rock Ck.	11 dace	1 dace		181		
4	Red Rock Ck.	no e fish data					
5	S.F. Cttnwd Ck.	6 dace	1 sunfish		not timed		
6	Red Rock Ck.	no e fish data					
7	Red Rock Ck.	no e fish data					
8	Lower Cttnwd Ck.	23 dace, 79 shiner	1 shiner, 6 bullhead		not timed		
9	Long Haul Ck.	no e fish collected					
10	Shebang Ck.	49 dace					
11	Lower Stockney Ck.	no e fish collected					
12	Stockney Ck.	82 dace			not timed		
13	Upper Cttnwd Ck.	no e fish collected					
14	Stockney Ck.	169 dace	1 dace		238		

IDFG 1991 River and Stream Investigations:

wild trout densities within individual sampling sites in Regions 5 and 6 as estimated by electrofishing. All streams less than 10 meters wide.

# of streams	Density (fish / 100m2)
20	0-5
29	5.1-10
21	10.1-15
18	15.1-20
13	20.1-25
8	25.1-30
4	30.1-35
5	35.1-40
3	40.1-45
1	70.1-75
1	75.1-80
1	85.1-90

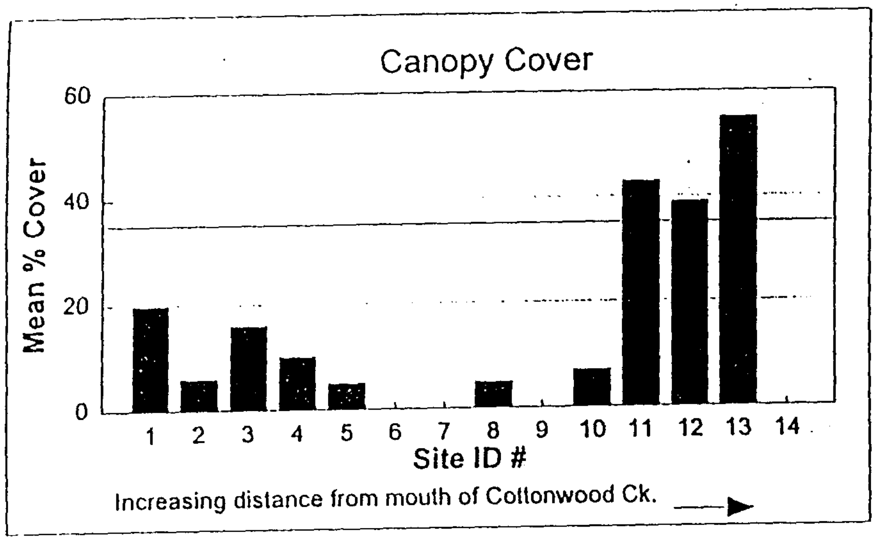


Standards:
INFISH: <10
IDEQ: (1996)
Optimal: <7
Suboptimal: 8-15
Marginal: 15-25
Poor: >25

Conclusions:
Sites 1, 2, 4, and 6 are all high.
Higher W:D found in lower end of drainage

* no data available

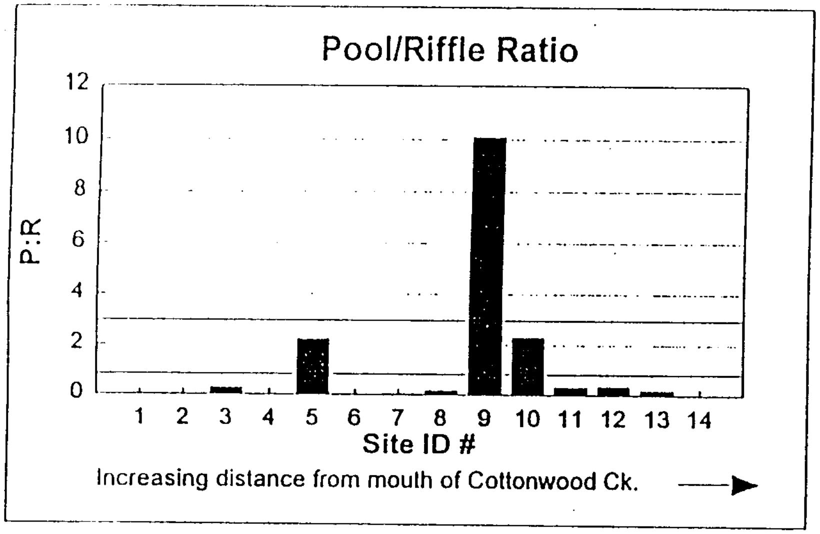
Site	Stream Mi.	Location
1	1.8	Cottonwood Ck.
2	4.0	Cottonwood Ck.
3	12.2	Red Rock Ck.
4	17.0	Red Rock Ck.
5	18.8	S.F. Cttnwd Ck.
6	21.0	Red Rock Ck.
7	21.0	Red Rock Ck.
8	21.8	Lower Cttnwd Ck.
9	23.2	Long Haul Ck.
10	25.0	Shebang Ck.
11	28.0	Lower Stockney Ck.
12	30.2	Stockney Ck.
13	30.8	Upper Cttnwd Ck.
14	31.0	Stockney Ck.



Standards:
Plafkin et al., 1989:
Optimal: 36-65%
Sub-Optimal: 20-35%
Marginal: 65-100%
Poor: <20%

Conclusions:
Sites 11, 12, & 13 are in optimal range.
All others are generally poor.

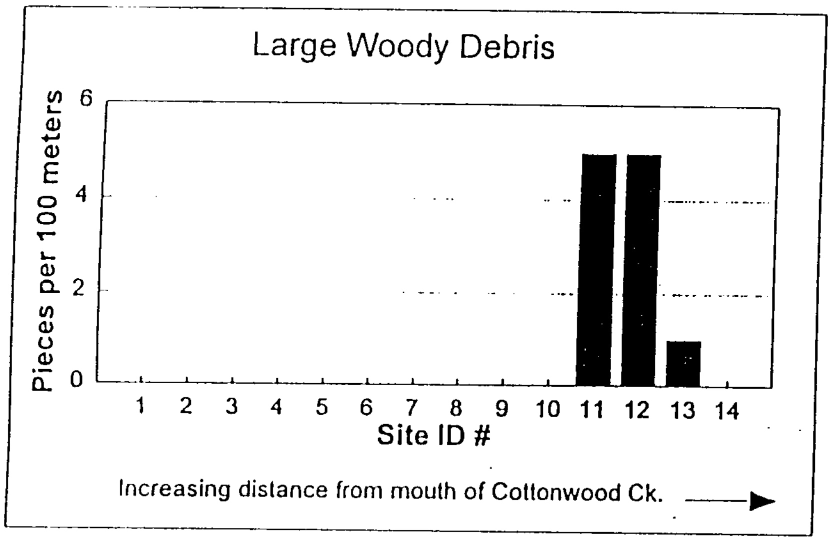
*unless otherwise indicated, all blanks equal readings of zero.



Standards:
1 MacDonald et al. (1991)
IDEQ WBAG 1996 Guidance:
Optimal: 1-3
Suboptimal: 4-9
marginal 10-20

Conclusions:
Most sites show a shortage or lack of pools.
5 and 10 are in the optimal range
Site 9 shows a shortage of riffles.

Site	Stream Mi.	Location
1	1.8	Cottonwood Ck.
2	4.0	Cottonwood Ck.
3	12.2	Red Rock Ck.
4	17.0	Red Rock Ck.
5	18.8	S.F. Cttnwd Ck.
6	21.0	Red Rock Ck.
7	21.0	Red Rock Ck.
8	21.8	Lower Cttnwd Ck.
9	23.2	Long Haul Ck.
10	25.0	Shebang Ck.
11	28.0	Lower Stockney C
12	30.2	Stockney Ck.
13	30.8	Upper Cttnwd Ck.
14	31.0	Stockney Ck.

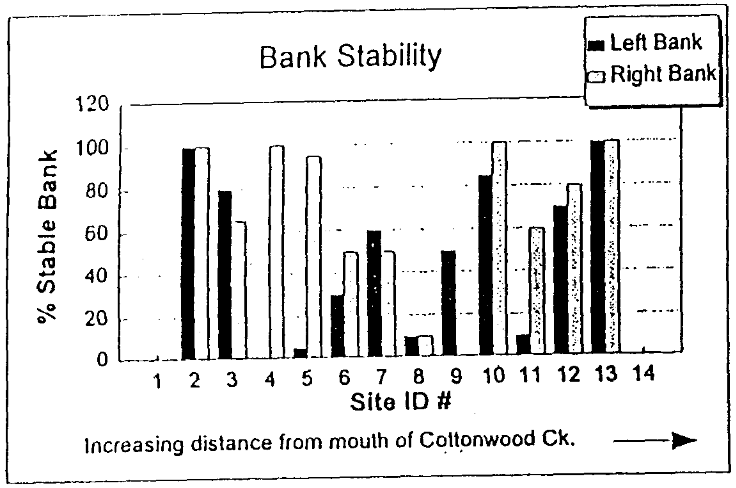


Standards:
Varies w/ channel width, type and geology.
See Overton et al. (1995) for comparison.

Note: LWD are defined as pieces >10 cm in diameter and >1 m in length.

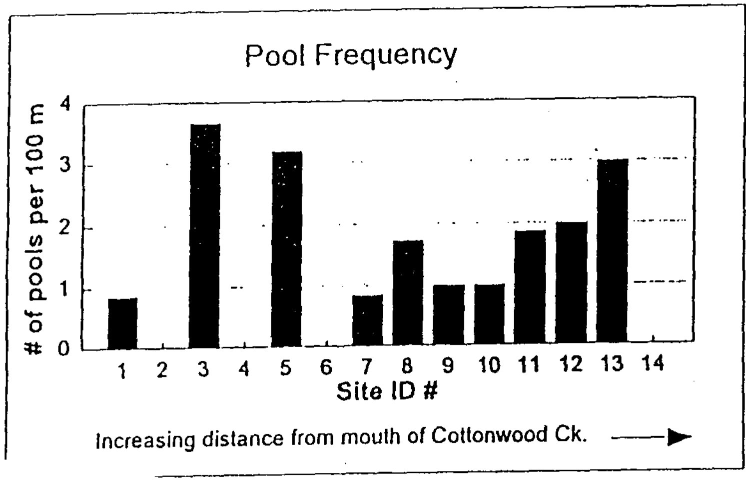
*unless otherwise indicated, all blanks equal readings of zero.

Site	Stream Mi.	Location
1	1.8	Cottonwood Ck.
2	4.0	Cottonwood Ck.
3	12.2	Red Rock Ck.
4	17.0	Red Rock Ck.
5	18.8	S.F. Cttnwd Ck.
6	21.0	Red Rock Ck.
7	21.0	Red Rock Ck.
8	21.8	Lower Cttnwd Ck.
9	23.2	Long Haul Ck.
10	25.0	Shebang Ck.
11	28.0	Lower Stockney C
12	30.2	Stockney Ck.
13	30.8	Upper Cttnwd Ck.
14	31.0	Stockney Ck.



Standards:
INFISH & Platts et.al.(1983)
80% = excellent

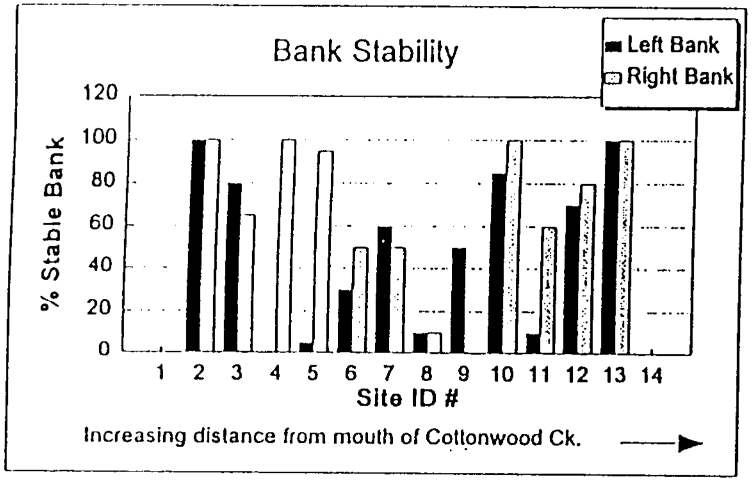
Conclusions:
Generally lft banks are less stable than rt banks.
Sites 2, 10, & 13 - both lrt and rt banks are stable.
Sites 1, 8, and 14 show little or no stable bank.
More than half the sites have at least one bank below 50%.



Standards:
Varies w/ channel width, type and geology.
See Overton and INFISH for comparison.

Conclusions:
All sites are suboptimal based on INFISH.
Sites are also low compared to Winchester Lake proposed surrogate target of 6 to 8 pools per 100 m.
Data has not yet been compared to Overton natural conditions.

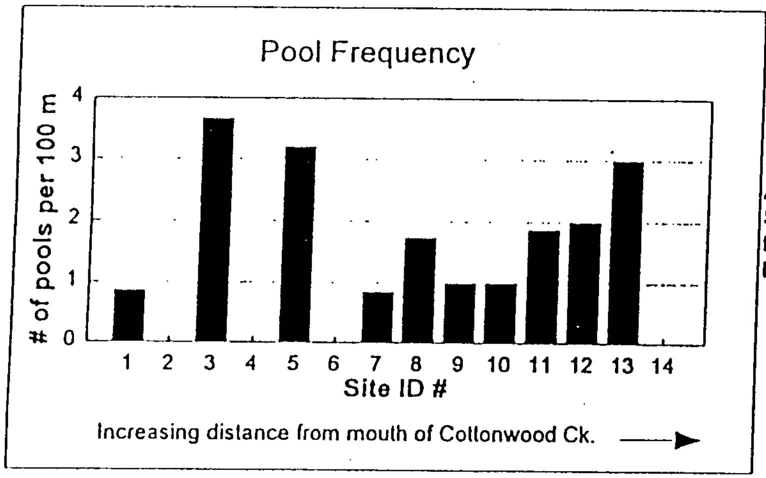
*unless otherwise indicated, all blanks equal readings of zero.



Standards:
INFISH and Platts: 80% = excellent

Conclusions:
Generally lft banks are less stable than rt banks.
Sites 2, 10, & 13 - both lrt and rt banks are stable.
Sites 1, 8, and 14 show little or no stable bank.
More than half the sites have at least one bank below 50%.

Site	Stream Mi.	Location
1	1.8	Cottonwood Ck.
2	4.0	Cottonwood Ck.
3	12.2	Red Rock Ck.
4	17.0	Red Rock Ck.
5	18.8	S.F. Cltnwd Ck.
6	21.0	Red Rock Ck.
7	21.0	Red Rock Ck.
8	21.8	Lower Cltnwd Ck.
9	23.2	Long Haul Ck.
10	25.0	Shebang Ck.
11	28.0	Lower Stockney C
12	30.2	Stockney Ck.
13	30.8	Upper Cltnwd Ck.
14	31.0	Stockney Ck.



Standards:
Varies w/ channel width, type and geology.
See Overton and INFISH for comparison.

Conclusions:
All sites are suboptimal based on INFISH.
Sites are also low compared to Winchester Lake proposed surrogate target of 6 to 8 pools per 100 m.
Data has not yet been compared to Overton natural conditions.

*unless otherwise indicated, all blanks equal readings of zero.

APPENDIX D BLM BIOLOGICAL ASSESSMENT

The attached ranking matrix is the April 1999 Cottonwood Creek Biological Asessment prepared by Craig Johnson of the BLM Cottonwood Resource Area Office (Johnson 1999b). This assessment is from pp. 37-46 of the "Biological Assessment of Ongoing and Proposed Bureau of Land Managment Activities on Listed Fall Chinook Salmon, Steelhead, and Bull Trout in the Lower South Fork Clearwater River and Tributaries (also includes Westslope Cutthroat Trout and Spring/Summer Chinook Salmon)," which is contained in the April 1999 South Fork of the Clearwater Biological Assessment (Nez Perce National Forest, Grangeville, Idaho).

SCREENING PROCESS

A. Watershed Conditions

1. Watershed Road Density

a. Environmental Baseline=Moderate. Estimated to be 1-3 miles/square mile.

b. Effect of Actions=Maintain. No new roads are proposed to be constructed on BLM lands.

2. Streamside Road Density

a. Environmental Baseline=Low. Estimated to be larger 3 miles/square mile.

b. Effect of Actions=Maintain. No new roads are proposed to be constructed on BLM lands within streamside areas (RHCAs).

3. Landslide Road Density

a. Environmental Baseline=Low. Estimated to be <1 mile/square mile.

b. Effect of Actions=Maintain. No new roads are proposed to be constructed on BLM lands within landslide prone areas.

4. Riparian Vegetation Condition

a. Environmental Baseline=Low. The stream bottom area, floodplain, and stream channel has been severely scoured by past flood events. The riparian area is lacking shrubs and trees (i.e. cottonwood).

b, Effect of Actions=Maintain. No change is expected to occur to riparian vegetation from ongoing and/or proposed actions. Grazing levels and use will be at same levels and riparian conditions and trends are expected to continue.

5. Change in Peak/Base Flow

a. Environmental Baseline=Low. Cottonwood Creek and tributaries have pronounced changes in peak flow, base flow, and flow timing characteristics comparable to a watershed functioning within its natural disturbance regime. The larger tributaries within the watershed are very "flashy" and have experienced some flood damage also.

b. Effect of Actions=Maintain. No timber harvest or road construction is proposed to occur on BLM lands which would affect changes in peak/base flows. No other BLM activities would either degrade or improve this indicator. BLM lands comprise a very small percentage of the entire subbasin and/or tributary watersheds and have negligible ability to change peak/base flow conditions.

6. Water Yield (ECA)

a. Environmental Baseline=Low. The majority of the Cottonwood Creek watershed is agriculture (dryland farming) or rangeland, consequently ECA is estimated to be less than <10 percent. However, because most timbered areas have been logged and the large amount of farmland, the drainage is not within its natural stream flow regimes.

b. Effects of Actions=Maintain. No timber harvest is proposed to occur on BLM lands within the analysis area. BLM lands comprise a very small percentage of the entire subbasin and/or tributary watersheds and have a negligible ability to change water yield.

7. Sediment Yield

a. Environmental Baseline=Low. During spring run-off or high precipitation events, Cottonwood Creek and tributaries have elevated levels of sediment. It is predicted that current chronic sediment yield is larger than 15 percent over natural base

b. Effects of Actions=Maintain. No timber harvest or road construction is proposed to occur on BLM lands. BLM lands comprise a very small percentage of the entire subbasin and/or tributary watersheds and have a negligible ability to change sediment yield.

B. <u>Channel Conditions and Dynamics</u>

1. Width/Depth Ratio
a. Environmental Baseline=Low. Flood scouring of floodplains, riparian areas, and stream channels has resulted in wider and shallower stream channels. Some stream reaches within the drainage have been impacted by grazing.

b. Effects of Actions=Maintain. No BLM actions will change the width/depth ratio for fish bearing tributaries..

2. Streambank Stability
a. Environmental Baseline=Low. It is estimated that over 15 - 30 percent of the streambank of lower Cottonwood Creek are rated unstable, primarily attributed to flood scouring.

b. Effects of Actions=Maintain. Current BLM activities and grazing levels are expected to maintain existing streambank stability.

3. Floodplain Connectivity
a. Environmental Baseline=Low. Severe floodplain degradation (flood events) has reduced floodplain connectivity.

b. Effects of Actions=Maintain. Current BLM actions will maintain floodplain connectivity.

C. Water Quality
1. Temperature - Steelhead
a. Environmental Baseline=Low (spawning); Low (rearing). The seven day running average maximum temperature for rearing is large than 20 degrees C.

b. Environmental Baseline=Maintain. No timber harvest or road construction is proposed within RHCAs and exiting grazing levels are within acceptable thresholds. Current BLM activities will maintain water temperatures.

2. Temperature - Bull Trout
a. Environmental Baseline= Low (rearing). No bull trout spawning occurs in Cottonwood Creek. The seven day running average maximum temperature for rearing is >20 degrees C.

b. Environmental Baseline=Maintain. No timber harvest or road construction is proposed within analysis area and existing grazing levels are within acceptable thresholds and expected to continue. Current BLM activities will maintain water temperatures

4. Suspended Sediment
a. Environmental Baseline=Low. Suspended sediment levels are at elevated levels. No long term measured data is available, however, suspended sediment is estimated to be >= 11 days >=80 mg/l in Cottonwood Creek..

b. Environmental Baseline=Maintain. No timber harvest or road construction is proposed within analysis area and existing grazing levels are within acceptable thresholds and expected to continue. Current BLM activities will maintain suspended sediment levels.

5. Chemical Contamination/Nutrients
a. Environmental Baseline=Moderate. Moderate levels of chemical contamination from agricultural, grazing, and other sources, some excess nutrients. Agriculture is a significant land use within the drainage.

b. Environmental Baseline=Maintain. Current BLM activities are expected to maintain chemical contamination/nutrients levels.

D. Habitat Access
a. Environmental Baseline=High. No man made barriers exist in lower Cottonwood Creek.

b. Environmental Baseline=Maintain. Current BLM activities will not affect fish passage in Cottonwood Creek.

E. Habitat Elements
1. Cobble Embeddedness
a. Environmental Baseline=Low - Moderate. Periodic severe flood scouring has flushed out fines in lower watershed, however, bedload movement is very significant. Tributary streams located upstream have elevated cobble embeddedness levels.

b. Environmental Baseline=Maintain. No timber harvest or road construction is proposed within analysis area and existing grazing levels are within acceptable thresholds and expected to continue. Current BLM activities will maintain cobble embeddedness levels. BLM lands comprise a very small percentage of the entire subbasin and/or tributary watersheds and have negligible potential to change cobble embeddedness.

2. Percent Surface Fines
a. Environmental Baseline=Low - Moderate. Periodic severe flood scouring has flushed out fines in lower watershed, however, bedload movement is very significant. Tributary streams located upstream have elevated surface fines.

b. Environmental Baseline=Maintain. No timber harvest or road construction is proposed within analysis area and existing grazing levels are within acceptable thresholds and expected to continue. Current BLM activities will maintain surface fine levels. BLM lands comprise a very small percentage of the watershed and have negligible potential to change surface fines levels.

3. Percent Fines by Depth
a. Environmental Baseline=Low. No core sampling of spawning gravels available. Because of severe flood scouring, probably the best gravels are located in deposition area, which would have elevated percent fines by depth.

b. Environmental Baseline=Maintain. No timber harvest or road construction is proposed within analysis area and existing grazing levels are within acceptable thresholds and expected to continue. Current BLM activities will maintain percent fines by depth of spawning gravels in the Cottonwood Creek. BLM lands comprise a very small percentage of the entire subbasin and/or tributary watersheds and have negligible potential to change percent fines by depth of spawning gravels.

4. Large Woody Debris
a. Environmental Baseline=Low. Both acting and potential levels of LWD are below near-natural levels. Recent flooding (1996) has flushed most LWD downstream. LWD provides a critical function in these streams.

b. Environmental Baseline=Maintain. No timber harvest or road construction is proposed in RHCAs occurring on BLM lands. Existing levels of LWD will be maintained with BLM ongoing and proposed actions.

5. Pool Frequency
a. Environmental Baseline=Low. Pools are lacking in lower Cottonwood Creek, primarily riffles and run type habitats.

b. Environmental Baseline=Maintain. Activities not expected to result in increases in fine sediment deposition sufficient to further decrease number, size, and quality of pools. Existing levels of pool frequency will be maintained with BLM ongoing and proposed actions.

6. Pool Quality
a. Environmental Baseline=Low. Existing pool quality is rated low, lack of LWD and instream cover for creek.

b. Environmental Baseline=Maintain. Activities not expected to result in increases in fine sediment deposition sufficient to further decrease number, size, and quality of pools. Existing levels of pool quality will be maintained with BLM ongoing and proposed actions.

7. Off-Channel Habitat
a. Environmental Baseline=Low. Few backwater and off-channel areas occur.

b. Environmental Baseline=Maintain. Existing levels of off-channel habitat will be maintained with BLM ongoing and proposed actions.

8. Habitat Refugia
a. Environmental Baseline=Low. Inadequate habitat refugia exists within the Lower Clearwater River subbasin for all listed species. Tributary streams have been degraded and provide poor fish habitat for special status species.

b. Environmental Baseline=Maintain. Existing levels of habitat refugia will be maintained with BLM ongoing and proposed actions. BLM lands comprise a very small percentage of the entire subbasin and/or tributary watersheds and have negligible potential to provide significantly impacts habitat refugia conditions. Within the entire South Fork Clearwater River drainage, streams providing habitat refugia include Johns Creek and Mill Creek (Forest Service).

F. <u>Take</u>
1. Harassment, Redd Disturbance, Juvenile Harvest
a. Environmental Baseline=Moderate - Harassment and Redd Disturbance; High- Juvenile/Adult Harvest. Livestock grazing is considered to have low potential for harassment and redd disturbance to listed fish. The lower Cottonwood Creek streambottom is sensitive to livestock grazing. However, overall cattle related harassment and redd disturbance is considered to be low risk. Currently, steelhead use of the drainage is considered low and no "key" spawning areas have been identified. Juvenile and adult harvest (poaching and incidental mortality) could occur from recreational fishing activity, however, the lower stream reaches provide little or no recreational fishing.

b. Environmental Baseline=Maintain. Low risk and low potential for harassment or redd disturbance will occur from livestock grazing adjacent to streams.

G. Bull Trout Subpopulation Characteristics and Habitat Integration
a. Environmental Baseline=Low. Environmental baseline for the Lower South Fork Clearwater River and tributaries has a low condition for subpopulation size, growth and survival, life history diversity and isolation, persistence and genetic integrity, and habitat conditions. No tributaries within the lower South Fork Clearwater River subbasin provide spawning and early rearing for bull trout. The Lower Clearwater River is used by fluvial bull trout for migration, over-wintering, and adult/subadult rearing. Population levels are low and tributary streams have degraded habitats which provide poor quality habitat for bull trout.

TABLE 10: COTTONWOOD CREEK EFFECT SUMMARY FOR INDIVIDUAL PROJECT(S)/ACTIVITIES

Indicators	Grazing Allotments (4)				
Watershed Road Density					
Streamside Road Density					
Landslide Prone Road Density					
Riparian Vegetation Condition	-1				
Peak/Base Flow					
Water Yield (ECA)					
Width/Depth Ratio					
Sediment Yield	-1				
Streambank Stability	-1				
Floodplain Connectivity					
Temperature Spawning	-1				
Temp. - Rearing and Migration	-1				
Turbidity or Suspended Sediment	-1				
Chem. Contaminants - Nutrients					
Physical Barriers - Adults					
Physical Barriers - Juvenile					
Cobble Embeddedness					
Percent Surface Fines					
Percent Fines by Depth					
Large Woody Debris					
Pool Frequency					
Pool Quality					
Off-Channel Habitat					
Habitat Refugia					
Harassment	-1				
Redd Disturbance	-1				
Juvenile Harvest					

P = Proposed Project; ST = Short Term Effects; NBE = Net Beneficial Effect; "+" = Beneficial Effect; "-" = Negative Effect

Pot. Effect	Probability of Effect: None	Very Low	Low	Moderate	High
None	0	0	0	0	0
Very Low	0	1	1	1	1
Low	0	1	1	2	2
Moderate	0	2	3	3	4
High	0	3	4	4	4

TABLE 11: DOCUMENTATION OF ENVIRONMENTAL BASELINE AND EFFECTS OF ACTION(S) ON RELEVANT INDICATORS

WATERSHED NAME: Cottonwood Creek SUBBASIN NAME: Lower South Fork Clearwater River
ACTION(S): Ongoing and/or Proposed and Programmatic Actions
SPECIES/LIFE STAGE: Steelhead Trout, Bull Trout, Sp/Su Chinook Salmon, Rainbow/Redband Trout, and Pacific Lamprey

PATHWAYS	ENVIRONMENTAL BASELINE 1/			EFFECTS OF THE ACTION		
Indicators	High	Moderate	Low	Restore 2/	Maintain 3/	Degrade 4/
WATERSHED CONDITIONS 1. Watershed Road Density			x		x	
2. Streamside Road Density			x		x	
3. Landslideprone Road Dens.	x				x	
4. Riparian Vegetation Cond.			x		x	
5. Peak/Base Flow			x		x	
6. Water Yield (ECA)			x		x	
7. Sediment Yield			x		x	
CHANNEL COND.&DYNAMICS 1. Width/Depth Ratio			x		x	
2. Streambank Stability			x.		x	
3. Floodplain Connectivity			x		x	
WATER QUALITY 1. Temp.-Spawn.			x		x	
2. Temp.-Rear/Migration			x		x	
3. Temp. - Bull Trout			x		x	
4. Suspended Sediment			x		x	
5. Chem. Contam./Nutrients		x			x	
HABITAT ACCESS 1. Physical Barriers - Adult	x				x	
2. Physical Barriers - Juvenile	x				x	

1/ Indicators of high, moderate, or low habitat condition. Refer to specific subbasin/watershed BEs for river and stream environmental baseline information.

2/ For the purposes of this checklist, "restore" means to change the function of an indicator for the better, or that the rate of restoration rate is increased.

3/ For the purposed of this checklist, "maintain" means that the function of an indicator will not be degraded and that the natural rate of restoration for this indicator will not be retarded.

4/ For the purposed of this checklist, "degrade" means to change the function of an indicator for the worse, or that the natural rate of restoration for this indicator is retarded. In some cases, a "not properly functioning" indicator may be further worsened, and this should be noted.

TABLE 11 CONTINUED: DOCUMENTATION OF ENVIRONMENTAL BASELINE AND EFFECTS OF ACTION(S) ON RELEVANT INDICATORS

WATERSHED NAME: Cottonwood Creek SUBBASIN NAME: Lower South Fork Clearwater River
ACTION: Ongoing and/or Proposed Projects and Programmatic Actions
SPECIES/LIFE STAGE: Steelhead Trout, Bull Trout, Sp/Su Chinook Salmon, Rainbow/Redband Trout, and Pacific Lamprey

PATHWAYS	ENVIRONMENTAL BASELINE 1/			EFFECTS OF THE ACTION		
Indicators	High	Moderate	Low	Restore 2/	Maintain 3/	Degrade 4/
HABITAT ELEMENTS 1. Cobble Embeddedness			x		x	
2. Percent Surface Fines			x		x	
3. Percent Fines By Depth			x		x	
4. Large Woody Debris			x		x	
5. Pool Frequency			x		x	
6. Pool Quality			x		x	
7. Off-Channel Habitat			x		x	
8. Habitat Refugia			x		x	
TAKE 1. Harassment	x				x	
2. Redd Disturbance		x			x	
3. Juvenile/Adult Harvest	x				x	
BULL TROUT SUBPOP. CHAR. AND HABITAT INTEGRATION 1. Subpopulation Size			x		x	
2. Growth and Survival			x		x	
3. Life History Diversity, Isolation			x		x	
4. Persist. & Genetic Integrity			x		x	
5. Integr. of Species & Habitat Condition			x		x	

1/ SCH=Spring/Summer Chinook Salmon; SH=Steelhead Trout; BT=Bull Trout

APPENDIX E COTTONWOOD CREEK CUMULATIVE WATERSHED EFFECTS ASSESSMENT

Assessment conducted under the auspices of the

Idaho Forest Practices Act

Report prepared by
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Idaho Department of Lands
Coeur d'Alene, Idaho

January 2000

I. INTRODUCTION

A. Watershed Description

Cottonwood Creek is a 124,352-acre, 5th-order watershed in north central Idaho used primarily for agriculture and grazing. It contains the town of Cottonwood, Idaho and a few other small residential areas (Figure 1). Grangeville lies on the southern border of the watershed, and Stites is just downstream from the confluence of Cottonwood Creek with the South Fork of the Clearwater River. This document pertains to the few remaining forested areas throughout the watershed, comprising about 6,880 acres in total – no effort is made to stratify by 6th order subwatershed as is normal for a Cumulataive Watershed Effects (CWE) assessment of forest practices. The 6th order subwatersheds are listed in Table 1 and shown in Figure 1.

Table 1. Cottonwood Creek subwatersheds

Basin No.	Creek Name	Subwatershed No.	Acres
17060305	Cottonwood Cr.	1307	9733
17060305	Cottonwood Cr. Sidewalls	1310	28015
17060305	Red Rock Cr.	1313	26403
17060305	Stockney Cr.	1308	20410
17060305	Shebang Cr.	1305	17827
17060305	South Fork Cottonwood Cr.	1309	21965

Cottonwood Creek flows through the town of Cottonwood, Idaho. The drainage empties into the South Fork of the Clearwater River ½ mile south of Stites, in Idaho County, Idaho (Figure 1). Land ownership is primarily private individuals and corporations, with smaller ownerships of the Nez Perce Tribe and the Bureau of Land Management. The northern edge of the watershed is within the boundary of the Nez Perce Tribal Reservation.

Cottonwood Creek is a fourth order tributary to the South Fork of the Clearwater River. The drainage is oriented in an easterly direction with the Cottonwood Creek mainstem generally flowing from west to east. Elevation in the watershed ranges from 1332 feet where Cottonwood Creek empties into the South Fork of the Clearwater to 5730 feet at the Keuterville Radio Facility on Cottonwood Butte. The landscape has three distinct elements: a large undulating basalt plateau area used mostly for agriculture, steep canyons where the creek has cut down through the basalt to the Clearwater River, and a small hilly area in the west around Cottonwood Butte. Forested lands addressed in this report occur on the north and east facing slopes in the canyonlands and on the hills around Cottonwood Butte and south of Grangeville.

The dominant bedrock type in the Cottonwood drainage is Columbia River basalt, underlying some 80% of the watershed, including all the canyonlands. The far west part on Cottonwood Butte is metabasalts similar to the Seven Devils formation. A few highly weathered granitic intrusions occur along the northern border of the watershed (Figure 2a). Most of the drainage is covered by a thin layer of loess.

The area is characterized by warm, dry summers and cold winters, with an average annual precipitation ranging from 20 inches at the lower elevations to near 40 inches at the higher elevations. The majority of precipitation occurs as winter snowfall and spring rain. High-volume runoff occurs during spring snowmelt and major rain-on-snow events.

Vegetation varies with elevation and aspect. Strong south to west facing slopes at the lower elevations support forbs and grasses and areas of Ponderosa Pine savannah. On north facing slopes and with increasing elevation, forest stands become more dense with a greater diversity of conifer species. The presence of Douglas fir, grand fir, and larch increases with increasing elevation and effective precipitation. Essentially all of the basalt plateau land has been converted to agricultural uses. A significant portion of the area is used for rangeland and portions of the valley bottomlands have been converted to ranches.

B. Beneficial Uses

The USEPA determined that sediment and temperature threaten Cottonwood Creek's beneficial uses [U.S. Environmental Protection Agency (USEPA), Region 10: 303(D) list for Idaho, Appendix C, October 7, 1994]. As a result of this 303(d) listing, the Idaho Division of Environmental Quality (DEQ) conducted a Beneficial Use Reconnaissance Project (BURP) analysis in June 1995. It was determined that beneficial uses are not fully supported in Cottonwood Creek.

C. Goals of this Assessment

At the request of the Idaho Division of Environmental Quality (DEQ) and in response to the USEPA 303(d) listing, a Cumulative Watershed Effects (CWE) assessment of the forested portions of Cottonwood Creek was conducted by IDL and other interested parties to: 1) develop an understanding of the inherent hazards of the landscape within the Cottonwood Creek watershed, 2) document the current conditions within the forested portions of the watershed relevant to hydrologic processes and the disturbance history, and 3) develop a control process that will ensure that the forested portion of the watershed is managed to protect water quality so that beneficial uses are supported.

II. CUMULATIVE WATERSHED EFFECTS METHODOLOGY

Complete CWE assessments of the Cottonwood Creek watershed were conducted in 1999 by personnel from IDL, DEQ, and the Nez Perce Tribe. The Cottonwood Creek CWE assessment followed the standard procedures of the Forest Practices Cumulative Watershed Effects Process for Idaho (Idaho Department of Lands, April 1995). Since the CWE assessment covered only those lands used for forestry, and since forested land is widely scattered throughout the watershed, the 6879-acre study area reported herein is of the conglomerate forestland.

Idaho Code Section 38-1303 (17) defines cumulative watershed effects as "...the impact on water quality and/or beneficial uses which result from the incremental impact of two (2) or more forest practices. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time." The CWE methodology is designed first to examine conditions in the watershed surrounding a stream, and in the stream itself. It then attempts to identify the causes of any adverse conditions. Finally, it helps identify actions that will correct any identified adverse conditions.

As described in the Forest Practices Cumulative Watershed Effects Process for Idaho (Idaho

Department of Lands, April 1995), the CWE process consists of seven specific assessments: A) Erosion Hazard, B) Canopy Closure/Stream Temperature, C) Hydrologic, D) Sediment Delivery, E) Channel Stability, F) Nutrients, and G) Beneficial Uses/Fine Sediment.

The CWE "Adverse Conditions Assessment " method was applied to analyze whether significant adverse effects occur in the forested portions of Cottonwood Creek drainage. Adverse condition assessments were conducted for stream temperature, hydrology, and beneficial uses/fine sediment. The adverse condition assessment results are presented in Section IV.

Finally, the CWE process provides guidance to help forest landowners design management practices to alleviate any adverse conditions and prevent problems from future forest practices. These prescriptions and recommendations are presented in Section V.

III. CUMULATIVE WATERSHED EFFECTS ASSESSMENT RESULTS

A. Erosion and Mass Failure Hazard Assessment

The erosion and mass failure hazards for forestry within the CWE process are based on geologic type and percent slope. The two geologic types occurring in the Cottonwood Creek watershed are highly weathered granitics and basalts. Figure 2a shows the distribution of geologic types in the watershed based on the State of Idaho 1:500,000 scale map. Table 2a presents the CWE hazard rating for each geologic type by slope class. Figures 2b shows the geographic extent of the forestry hazard rating classes for both surface erosion and mass failures, since they have the same ratings. The forested portions of the Cottonwood Creek watershed have an overall low surface erosion hazard rating and a low mass failure hazard rating.

Table 2a. Surface Erosion and Mass Failure Hazard Ratings by Geology and Slope

	Surface Erosion Hazards			Mass Failure Hazards		
Geologic Material	**0 – 30% Slope**	**31 – 60% Slope**	**>60% Slope**	**0 – 30% Slope**	**31 – 60% Slope**	**>60% Slope**
Granitics Highly Weathered	Mod	High	High	Mod	High	High
Basalts	Low	Mod	High	Low	Mod	High

Table 2b. CWE Surface Erosion Hazard Rating Analysis for Cottonwood Creek

TOTAL FORESTED ACRES	ACRES LOW SURFACE EROSION HAZARD	ACRES MODERATE SURFACE EROSION HAZARD	ACRES HIGH SURFACE EROSION HAZARD	% LOW SURFACE EROSION HAZARD	%MODERATE SURFACE EROSION HAZARD	%HIGH SURFACE EROSION HAZARD	CWE SURFACE EROSION HAZARD RATING
6880	4123	2033	723	60.0 %	29.5 %	10.5 %	Low

Table 2c. CWE Mass Failure Hazard Analysis for Cottonwood Creek

TOTAL WATERSHED ACRES	ACRES LOW MASS FAILURE HAZARD	ACRES MODERATE MASS FAILURE HAZARD	ACRES HIGH MASS FAILURE HAZARD	PERCENT LOW MASS FAILURE HAZARD	PERCENT MODERATE MASS FAILURE HAZARD	PERCENT HIGH MASS FAILURE HAZARD	CWE MASS FAILURE HAZARD RATING
6880	4123	2033	723	60.0 %	29.5 %	10.5 %	Low

It is noted that the slope maps of the forested areas were derived from USGS DEMs. The literature identifies a problem with this procedure in that it underestimates the amount of high slope area. On-site assessments should use actual slopes and the hazard ratings presented in Table 2a.

B. Canopy Closure/Stream Temperature Assessment

Class I streams and Class II streams contributing at least 20% of the flow within Cottonwood and Red Rock Creeks were divided into segments at intervals determined by land use and 200-ft elevational change per segment (Figure 3). The other subwatersheds were not assessed because they lack forested land. Percent shading over each segment was estimated from aerial photos and verified with field measurements. Table 3 presents the comparison of the measured results with target shade requirements.

Table 3. Canopy closure/stream temperature ratings by stream reach.

Stream Segment Number	Existing Canopy Cover (%)	Target Canopy Cover (%)	Chinook or Bull Trout Present (Y or N)	Other Salmonids Present (Y or N)	Evidence of Forest Practices Upslope (Y or N)	Canopy Closure/ Temperature Rating (H or L)
1	0-20	Non-FPA	N	Y	Non-FPA	Non-FPA
2	21-40	100	N	Y	Y	H
3	71-90	100	N	Y	Y	H
4	71-90	100	N	Y	Y	H
5	71-90	100	N	Y	Y	H
6	21-40	16	N	N	Y	L
7	21-40	Non-FPA	N	N	Non-FPA	Non-FPA
8	0-20	Non-FPA	N	N	Non-FPA	Non-FPA
9	0-20	Non-FPA	N	N	Non-FPA	Non-FPA
10	0-20	Non-FPA	N	N	Non-FPA	Non-FPA
11	0-20	Non-FPA	N	N	Non-FPA	Non-FPA
12	0-20	Min-FPA	N	N	Y	L
13	41-70	15	N	Y	Y	L
14	41-70	6	N	Y	Y	L
15	71-90	Min-FPA	N	Y	Y	L
16	41-70-	100	N	Y	Y	H
17	41-70	100	N	Y	Y	H
18	71-90	100	N	Y	Y	H
19	71-90	92	N	Y	Y	H
20	21-40	Non-FPA	N	N	Non-FPA	Non-FPA

21	0-20	Non-FPA	N	N	Non-FPA	Non-FPA

The Canopy Closure/Stream Temperature rating is determined only for those segments associated with forest practices. A high rating indicates that there is a high likelihood that vegetative cover is inadequate to maintain stream temperature within the standard.

Of the segments sampled, 8 are non-FPA, 8 have high ratings, and 5 have low ratings. Essentially all the segments in the forested portions of the lower canyons of Cottonwood Creek and Red Rock Creek have high ratings (Figure 3), indicating inadequate canopy shading over the stream in all forested segments in the lower end. The segments on Cottonwood Butte have low ratings.

C. Hydrologic Risk Assessment

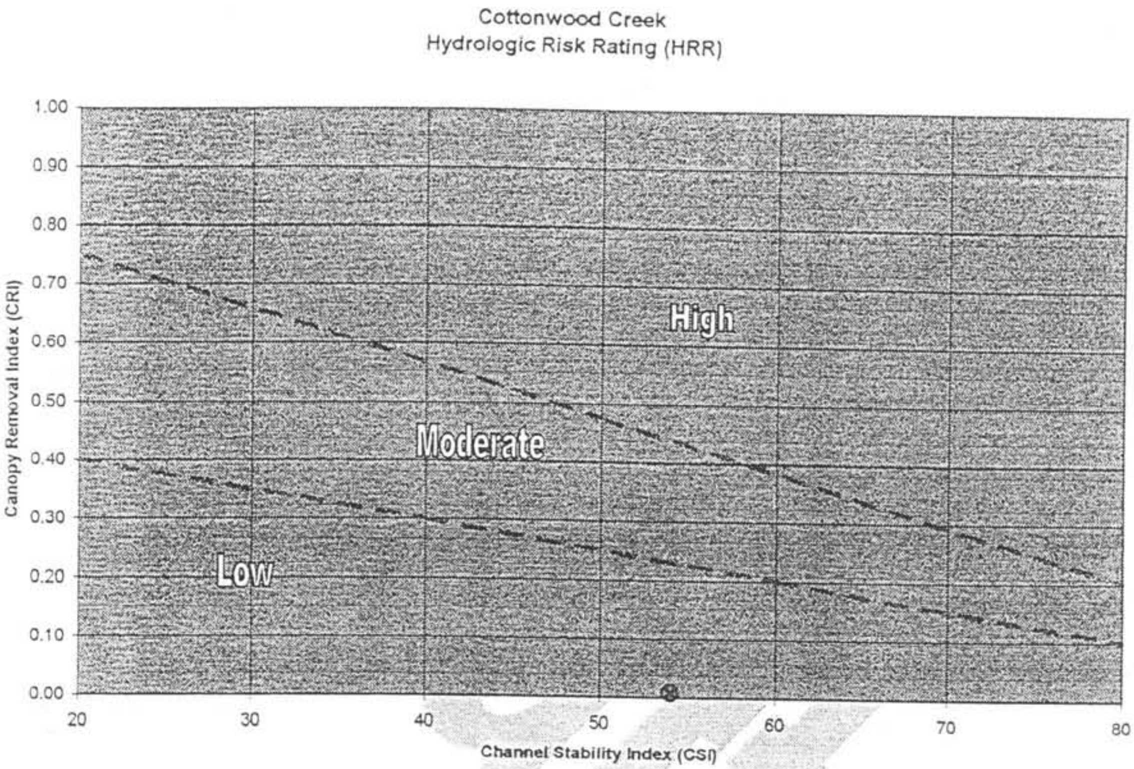
Forestry is currently practiced on 6,880 acres or approximately 5% of the Cottonwood Creek watershed. The equivalent area of canopy removed through timber harvest and road construction is about 1104.4 acres (equivalent acres of canopy removed is the summation of each forested acre times its percent canopy removed), for a Canopy Removal Index (CRI) of 0.15. Figure 4 shows the current land use and canopy removal condition. Since the forested portion of Cottonwood Creek is so small, the Canopy Removal Index in this report is calculated for those acres still being managed for forestry. (Normally the CRI is calculated by dividing the equivalent removal acres by the total acres in a watershed, not just the acres under forestry.)

The Canopy Removal Index is coupled with the Channel Stability Index (from Section E below) to produce a hydrologic risk rating (HRR). The HRRs for Cottonwood Creek sampled for Channel Stability are shown in Chart 1 (next page). The HRR Chart reflects the calculation using the total watershed acres resulting in a CRI of 0.009. The HRR for the Cottonwood Creek is low. If the chart were plotted using the CRI 0.15, the HRR would still be in the low range.

D. Sediment Delivery Assessment

Sediment generated from roads, skid trails, and mass wasting was evaluated for delivery to streams. In order to provide more detailed data, the road and mass failure data were collected for the Cottonwood Creek on a site-specific basis. Roads were divided into segments with uniform cut slope, fill slope, road surface, road drainage, road type, sediment production, and sediment delivery characteristics such that one CWE "road sediment delivery score" could be calculated for each segment. The intent of this segmentation is to provide a data set with specific road segments for which sediment delivery scores are available. From these segment scores, a single road sediment delivery score for the subwatershed was calculated for all the forested land using a weighted average based on segment lengths and total length of roads sampled. Similarly for mass failures, each was recorded for location, volume of material moved, and percent delivery to a waterway. The mass failure sediment delivery score was calculated based on the average mass failure frequency, size, and delivery. Much of the data collected in 1999 were recorded using a Geographical Positioning System (GPS) data dictionary, and were entered into a Geographical Information System (GIS) for the analysis.

Chart 1. Hydrologic Risk Rating for Upper Cottonwood Creek.



1. Roads

The whole Cottonwood Creek drainage contains approximately 339 miles of roads and trails (Figure 5). A GIS analysis determined that about 18.4 miles of the roads are within forestry land use areas. Approximately 14.8 miles of the roads were assessed using the CWE road assessment. The road sample was skewed towards roads close to streams and those considered as having high potential to impact water quality.

CWE road scores ranged from 10 to 30, all in the low range. The weighted average CWE road score for the forested portion of the watershed is 12.1.

2. Skid Trails

Most historic harvest activity used ground-based tractor skidding and some of this occurred in stream protection zones. These skid trails have recovered substantially and cannot be used in the future under current FPA rules. New skid trails are outside stream protection zones, resulting in very little delivery of sediment to stream channels (Table 4).

Sediment delivery ratings from skid trails for Cottonwood are low. (Table 4).

Table 4. Sediment Delivery Score Summary for Cottonwood Creek

Sediment Source	CWE Score	CWE Rating
Roads	12.1	Low
Skid Trails	2	Low
Mass Wasting	9	Low
Total	23.1	Low

Total Sediment Delivery scores: Low; < 66, Moderate; 66 – 105, High; > 105

3. Mass Wasting

There were no instances of mass wasting identified in the Cottonwood Creek drainage. However several debris torrents, some quite large leaving raw banks over six feet high, were observed by crews during channel stability evaluations. These debris torrents originated on agriculture or rangeland above FPA lands and are not considered as part of the CWE analysis.

4. Total Sediment Delivery Ratings
5.

Total Sediment Delivery Rating for Cottonwood Creek is low (Table 4).

E. Channel Stability

Three 1000 ft stream reaches in the Cottonwood Creek drainage (Figure 6) were evaluated for channel stability in May, 1999 when stream flows were relatively low. The results are summarized in Table 5.

Table 5. Channel Stability Assessment rating for Cottonwood Creek.

Reach No.	CWE Score	CWE Rating
1 – Lower Cottonwood	54	Moderate
2 – Red Rock	38	Moderate
3 – Upper Cottonwood	37	Moderate

Channel Stability Index (CSI) Total score: < 36 = Low; 36 - 58 = Moderate; > 58 = High

The overall Channel Stability Index is Moderate for Cottonwood Creek. CWE found bank sloughing, poor vegetative bank protection, little bank rock content, little or no large organic debris, channel bottom movement, channel bottom rock shape/ roundness and channel bottom rock brightness all contributing to the problems in several reaches. The channel stability segments in the lower canyon showed considerable impact from livestock grazing and debris torrents coming down the canyon sidewalls.

E. Nutrient Assessment

Since the Cottonwood Creek watershed does not contain or empty into a lake or reservoir a nutrient assessment was not conducted.

F. Beneficial Use Attainability and Status

Based on an evaluation of 1998 Beneficial Use Reconnaissance Project (BURP) data for Cottonwood Creek using the associated 1996 Water Body Assessment Guidance, DEQ categorized Cottonwood Creek as not having full support of beneficial uses. The DEQ BURP results, with a Habitat Index score of 99 and a Macroinvertebrate Biotic Index score of 1.83, demonstrate that beneficial uses are not fully supported.

IV. ADVERSE CONDITION ANALYSIS

Table 6 presents the summary results from all the assessments. These results are used to determine whether an adverse condition exists. If no adverse condition exists, then standard Best Management Practices (BMPs) as specified in the Idaho Forest Practices Act should continue to be applied. If an adverse condition exits, then Cumulative Watershed Effects Management Prescriptions (CWEMPs), that will ultimately be Site Specific BMPs (SSBMPs), must be developed and implemented, or if the problem is not clear, further analysis may be called for.

Table 6. CWE Assessment Summary for Cottonwood Creek.

Assessment	CWE Rating
Surface Erosion Hazard	Low
Mass Failure Hazard	Low
Canopy Closure/Stream Temperature	High
Hydrologic Rise	Low
Road Sediment Delivery	Low
Skid Trail Sediment Delivery	Low
Mass Failure Sediment Delivery	Low
Total Sediment Delivery	Low
Channel Stability Index	Moderate
Nutrients	N/A
Beneficial Uses/Fine Sediment	NFS

A. Beneficial Use/Fine Sediment Adverse Condition – Additional Analysis Required.

Wherever the beneficial uses are not fully supported, CWE requires an analysis of the condition. The DEQ BURP results, with a Habitat Index score of 99 and a Macroinvertebrate Biotic Index score of 1.83, demonstrate that beneficial uses are not fully supported. The CWE total sediment delivery ratings for he drainage is low and will require additional analysis, as seen by the shaded blocks in Table 7.

Table 7. Beneficial use/Fine sediment adverse condition key1.

Sediment Delivery Rating	Beneficial Use Condition	Management Direction
Low	Supported	Standard BMPs
	Not Supported	Additional Analysis
Medium	Supported	CWEMPs
	Not Supported	CWEMPs Additional Analysis
High	Supported	CWEMPs

1 Shaded blocks show conditions for Cottonwood Creek Watershed.

Based upon these CWE results, however, it is concluded that the adverse conditions with respect to fine sediment in Cottonwood Creek are not the result of forest practices. The very low CWE sediment scores, the small percentage of forested land in the watershed, and our observations about sediment from the major land uses in the watershed leads to the conclusion forestry operations should continue to implement standard BMPs.

B. Stream Temperature Adverse Condition – Adverse Conditions Exist.

An adverse condition exists for the Cottonwood Creek drainage because of the High Canopy Cover/Stream Temperature ratings for 8 forested stream segments in the lower end of Cottonwood Creek. Thus, as shown in Table 8, CWEMPs need to be developed.

Table 8. Stream Temperature Adverse Condition Key1.

Temperature Rating	Adverse Condition?	Management Direction
High	Yes	CWEMPs
Low	No	Standards BMPs

1 Shaded blocks show conditions for Cottonwood Creek Watershed.

C. Hydrology Adverse Condition – Adverse conditions do not exist.

The hydrological risk ratings (HRR) derived from the Canopy Removal Indexes and the Channel Stability Indexes are low for Cottonwood Creek. Therefore, no hydrologic adverse conditions exists.

D. Nutrient Adverse Condition – Adverse conditions do not exist.

Cottonwood Creek does not flow into a lake or reservoir so a nutrient current condition assessment is not necessary. Standard BMPs should continue to be implemented (Table 9).

Table 9. Nutrient Adverse Condition Key[1].

Lake Present ?	Overall Nutrient Rating	Adverse Condition?	Management Direction
Yes	H	Yes	CWEMPs
Yes	M,L	No	Standard BMPs
No	NA	No	Standard BMPs

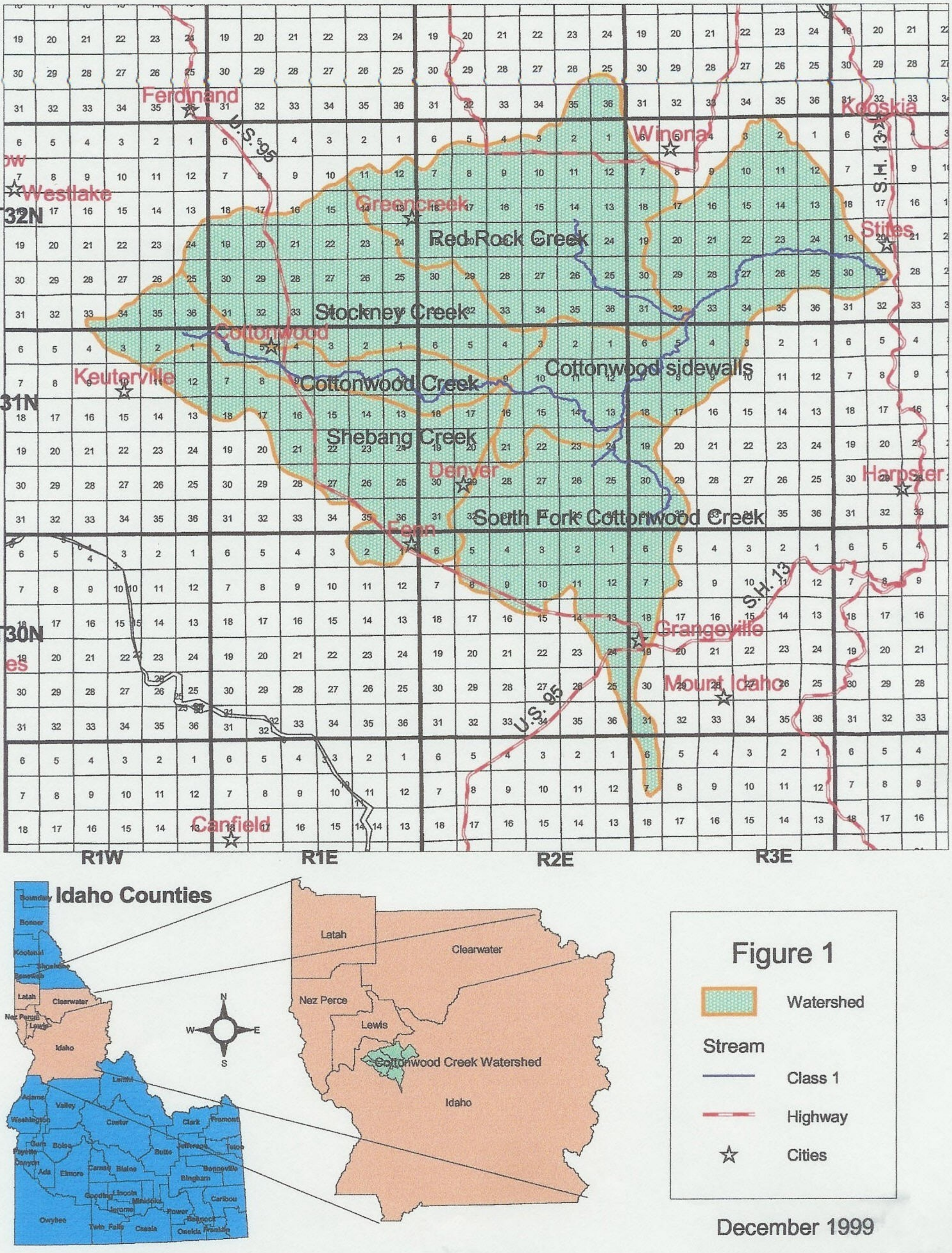
[1] Shaded blocks show conditions for Cottonwood Creek .

V. MANAGEMENT PRESCRIPTIONS AND RECOMMENDATIONS

Adverse conditions exist for Canopy Closure/Stream Temperature for the stream segments associated with forest practices in the canyonlands of the watershed. CWEMPs should be developed for these segments, and will appear in this section of the report.

Additional analysis is required for the Beneficial Uses/Fine Sediment assessment. Sediment production and delivery from the forested portion of the watershed is low; however, BURP results indicate that beneficial uses are not being fully supported. The additional analysis being done is the TMDL for the watershed which should identify that portion of the sediment load attributable to forestry. These CWE results indicate that it should be a very small proportion.

Figure 1. Location of Cottonwood Creek watershed in Idaho.



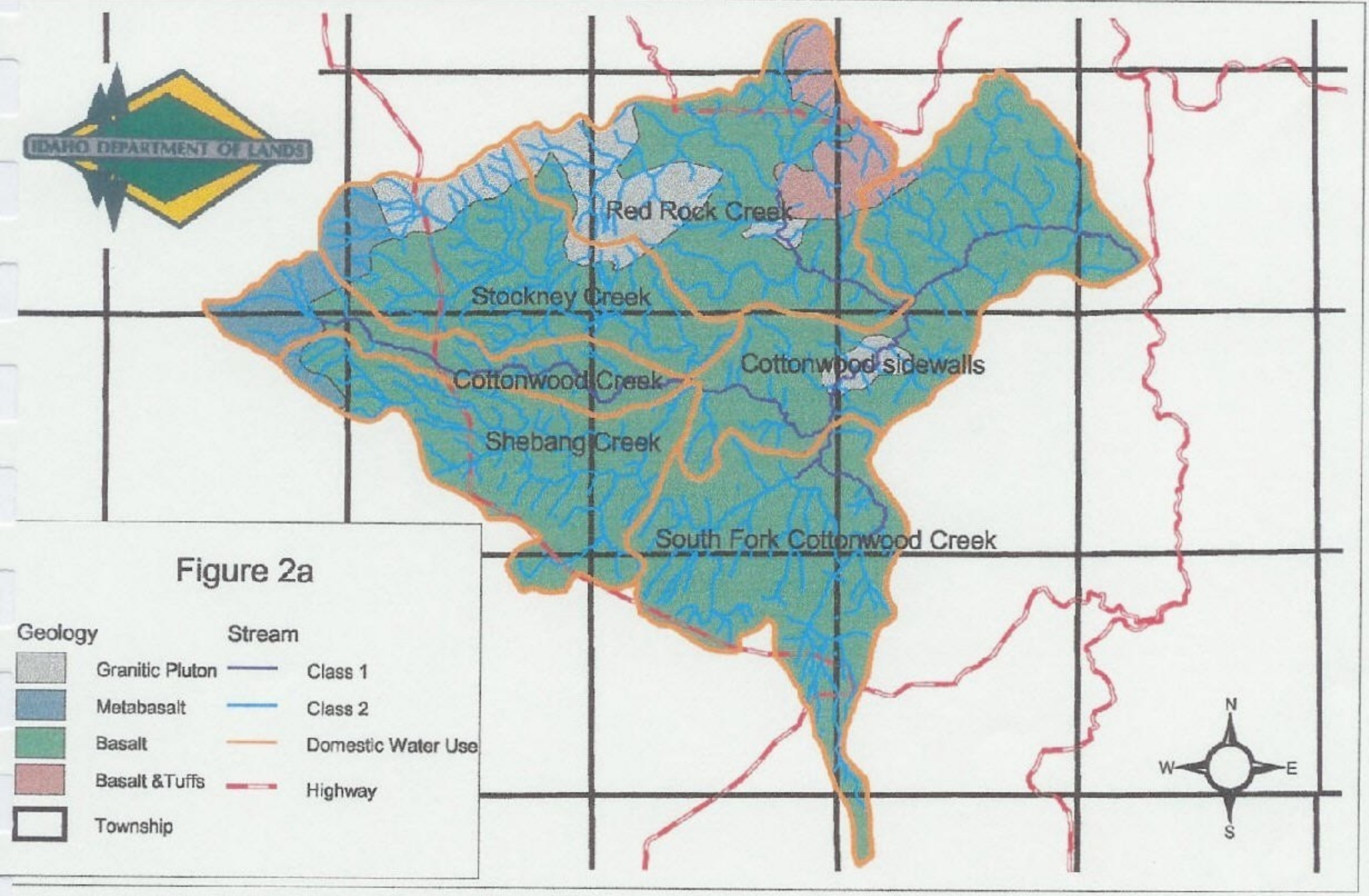


Figure 2a

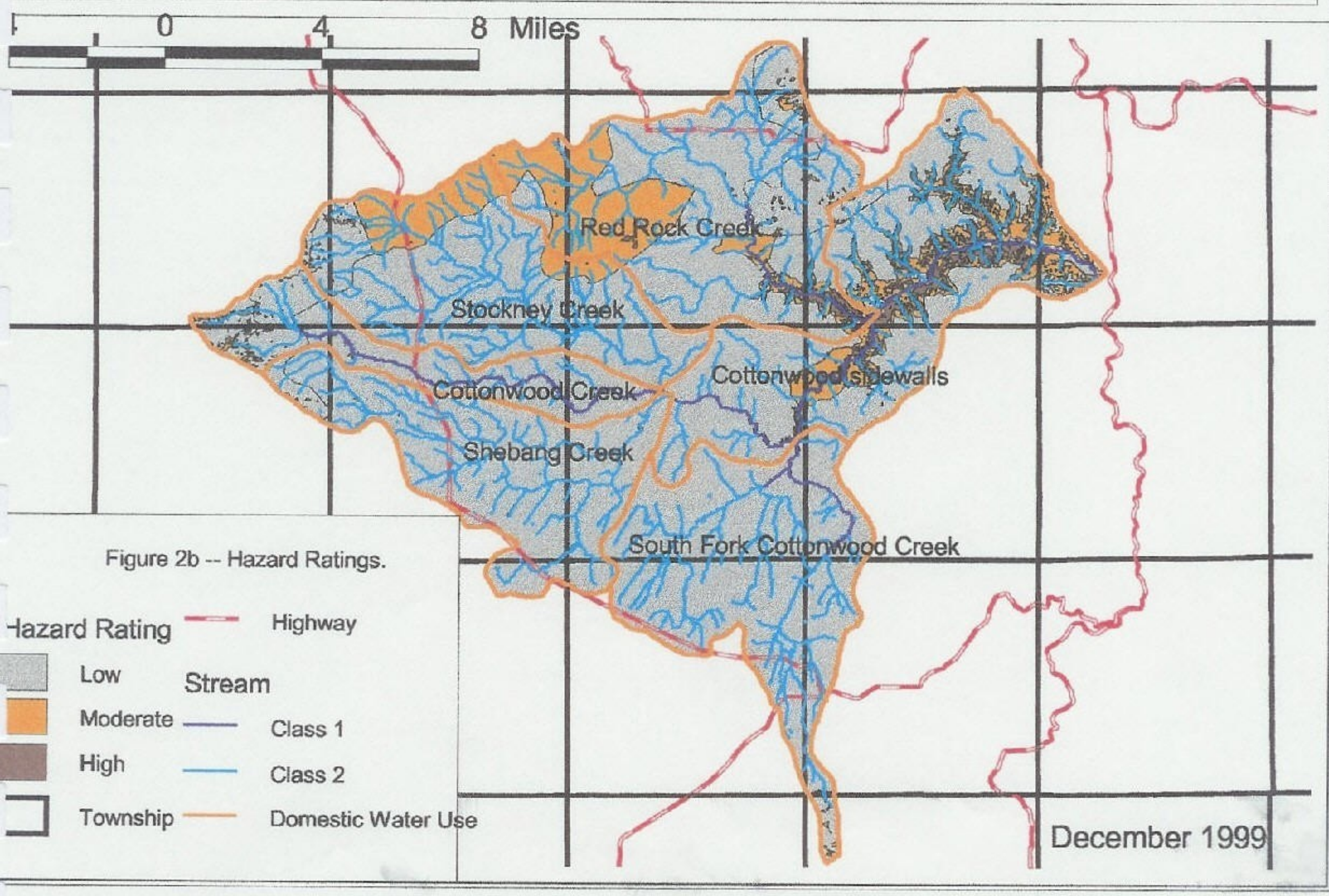
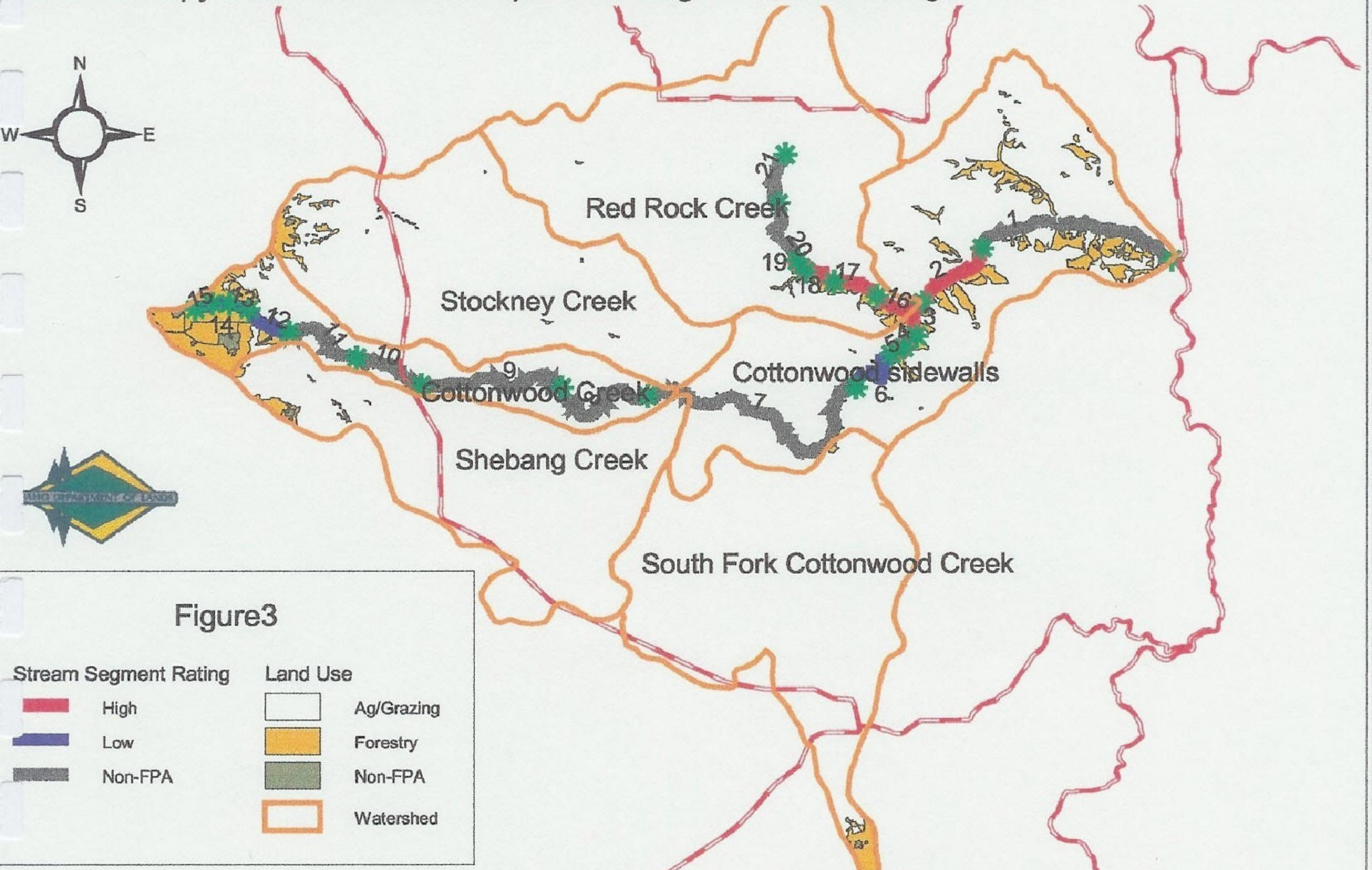


Figure 2b -- Hazard Ratings.

ıre 3. Canopy Closure/Stream Temperature Segments and Ratings.



ıre 4. Percent Canopy Removal in Forested Areas of Cottonwood Creek.

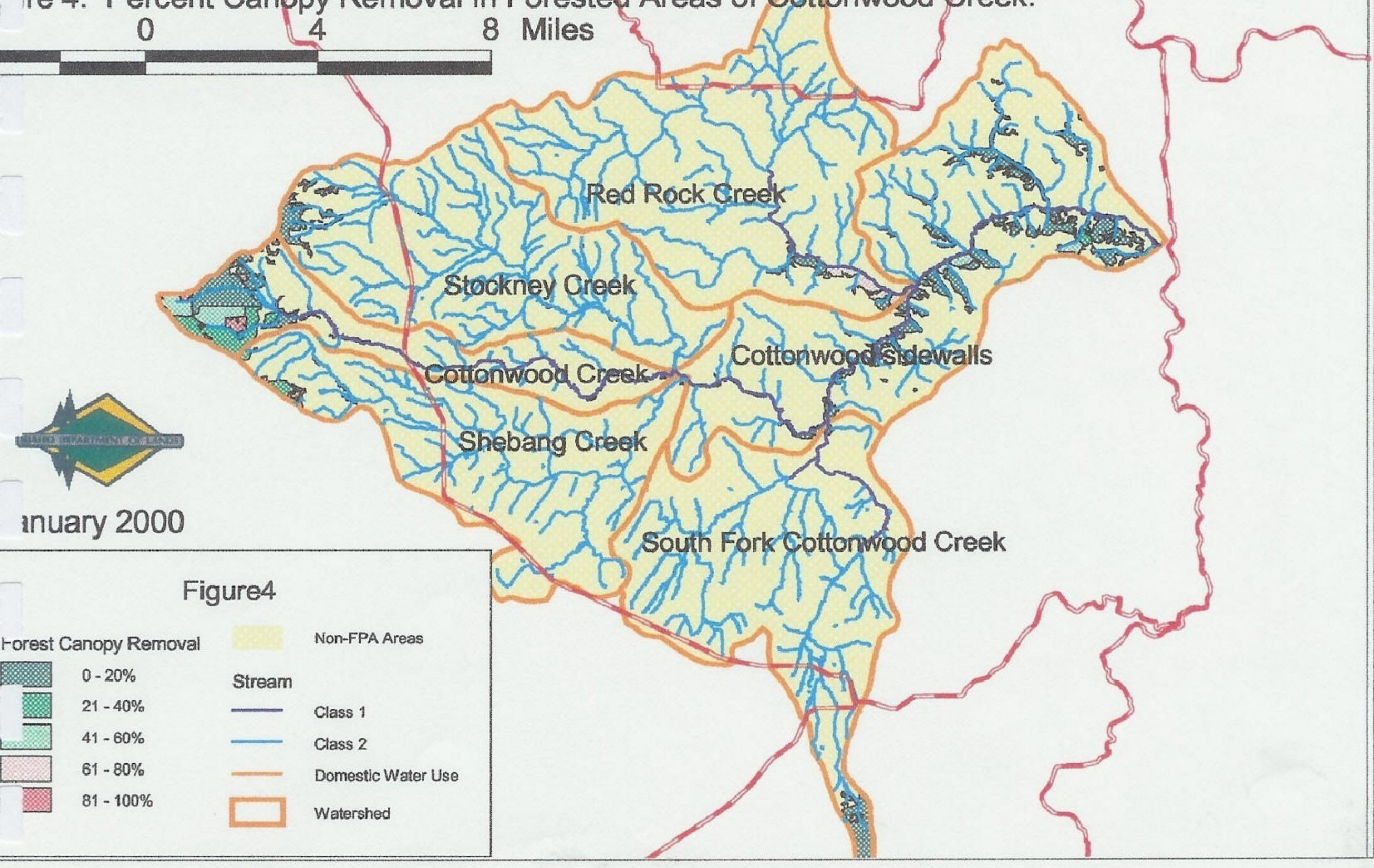
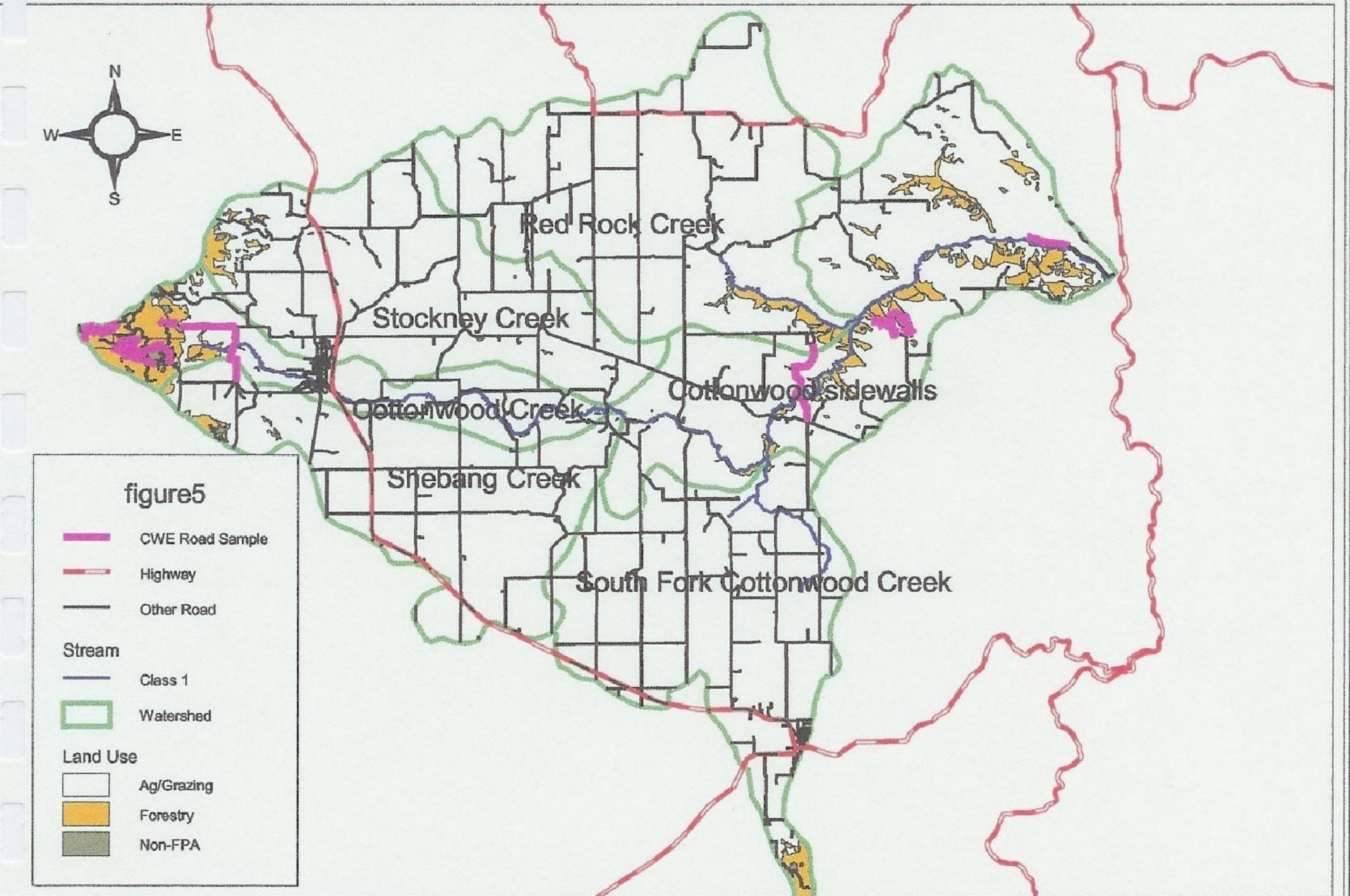
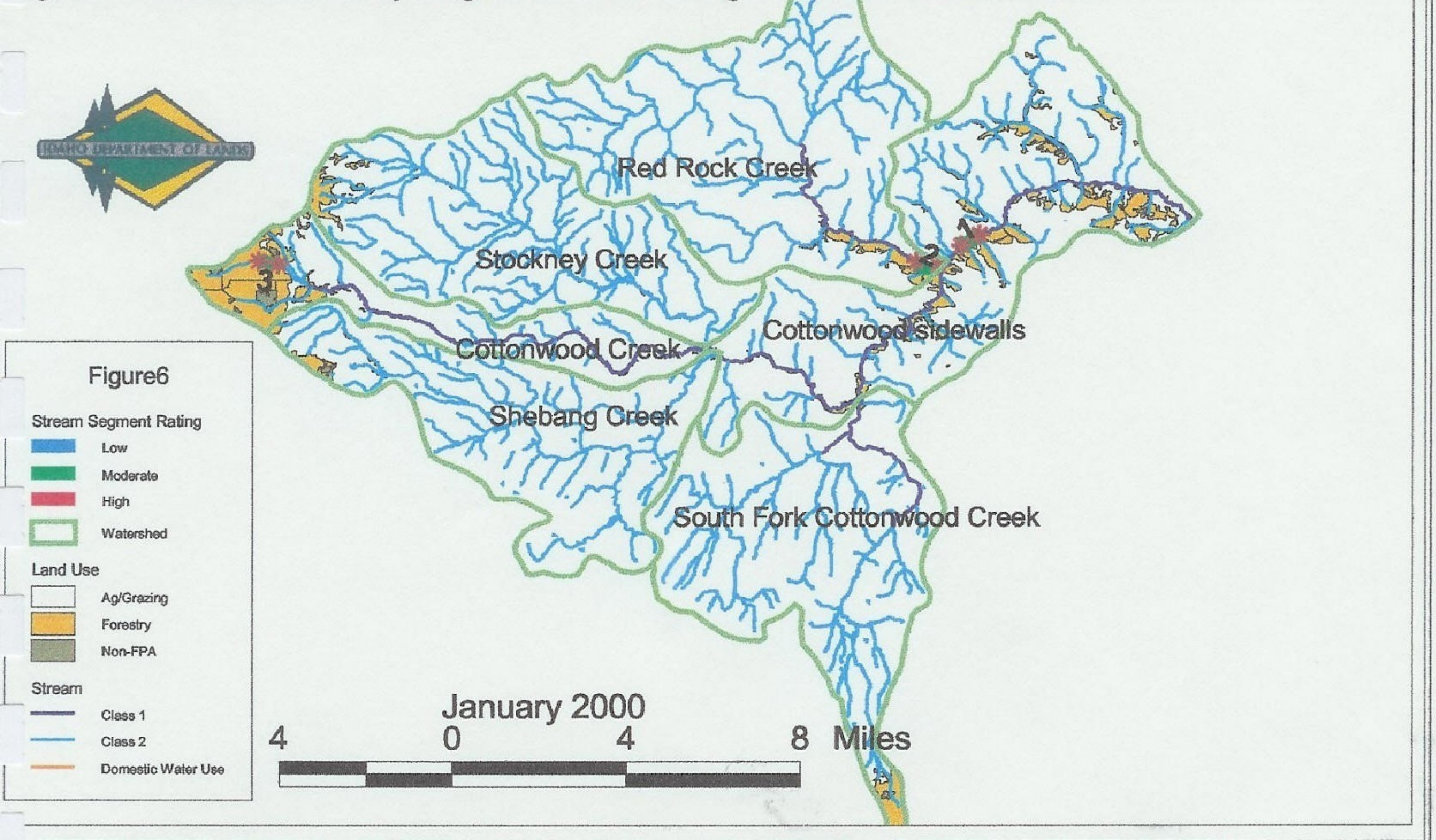


Figure 5. Roads and CWE Sampled Roads in Cottonwood Creek.



igure 6. Channel Stability Segments and Ratings for Cottonwood Creek.



1995 Beneficial Use Reconnaissance Project
Idaho Division of Environmental Quality - Lewiston Office
Site Summary Sheet

Stream Name: Cottonwood Creek (upper) Date Surveyed: 6/22/95
BURP Site ID #: 95NCIROA06 Number of sites monitored on this stream: 2
County: Idaho Legal Description: T31N R01E Sec 11 NE¼ SW¼ NW¼
Ecoregion: Columbia Basin Elevation: 1006 m Photos Taken: Yes

Stream Data

Habitat Type (%): Pool 18 Glide 0 Run 35 Riffle 47
Streambank Condition (%): Stable 100 Unstable 0 Canopy: 55%
Reach Length: 100 m Flow (CFS): 3.6 Gradient: 1.1% Temperature: 18°C

Assessment Information

Beneficial Uses:

	Designated	Existing
Domestic Water Supply		
Agricultural Water Supply	X	X
Cold Water Biota	X	X
Warm Water Biota		
Salmonid Spawning	X	
Primary Contact Recreation		
Secondary Contact Recreation	X	X

Beneficial Use Status

	Full Support	Not Full Support	Other
Domestic Water Supply			
Agricultural Water Supply			not assessed
Cold Water Biota		X	
Warm Water Biota			
Salmonid Spawning		X	
Primary Contact Recreation			
Secondary Contact Recreation			not assessed

Overall status for this site: NOT FULL SUPPORT

Stream Name: Cottonwood Creek (upper) Date Surveyed: 6/22/95 Site ID #: 95NCIROA06

Biologic Data

Macroinvertebrate Biotic Index Score: 1.83 **Habitat Score:** 99

Fisheries:

Species/Common Name	# of Different Size Classes	YOY Present	# of Individuals	Cold or Warm Water Species
no fish collected				
Electrofished by DEQ in 1995				

Comments

This is a major drainage for the Camas Prarie. The stream in this area is small and entirely on private property in an agriculture area. Most of the stream is scoured to bedrock. Banks are stable, covered with reed canary grass, and about 90% undercut. There are no trees on this section on the stream. A small dace was caught in the Hess sampler. Observed long billed curlews near upper part of reach. Town of Cottonwood wastewater plant is about one mile upstream.

Human activities affecting reach: agriculture

Factors which affect beneficial use status

Macroinvertebrate score is in the impaired range, therefore not full support

1995 Beneficial Use Reconnaissance Project
Idaho Division of Environmental Quality - Lewiston Office
Site Summary Sheet

Stream Name: Cottonwood Creek (lower) Date Surveyed: 6/15/95
BURP Site ID #: 95NCIROA05 Number of sites monitored on this stream: 2
County: Idaho Legal Description: T31N R02E Sec 15 NE¼ NE¼ NE¼
Ecoregion: Columbia Basin Elevation: 893 m Photos Taken: Yes

Stream Data

Habitat Type (%): Pool 16 Glide 58 Run 0 Riffle 26
Streambank Condition (%): Stable 10 Unstable 90 Canopy: 5%
Reach Length: 113 m Flow (CFS): 3.9 Gradient: 0.2% Temperature: 16°C

Assessment Information

Beneficial Uses:

	Designated	Existing
Domestic Water Supply		
Agricultural Water Supply	X	X
Cold Water Biota	X	X
Warm Water Biota		
Salmonid Spawning	X	
Primary Contact Recreation		
Secondary Contact Recreation	X	X

Beneficial Use Status

	Full Support	Not Full Support	Other
Domestic Water Supply			
Agricultural Water Supply			not assessed
Cold Water Biota		X	
Warm Water Biota			
Salmonid Spawning		X	
Primary Contact Recreation			
Secondary Contact Recreation			not assessed

Overall status for this site: NOT FULL SUPPORT

Stream Name: Cottonwood Creek (lower) Date Surveyed: 6/15/95 Site ID #: 95NCIROA05

Biologic Data

Macroinvertebrate Biotic Index Score: 2.22 **Habitat Score:** 61

Fisheries:

Species/Common Name	# of Different Size Classes	YOY Present	# of Individuals	Cold or Warm Water Species
Redside shiner	4	Yes	117	Cold
Black bullhead	2	No	6	Warm
Longnose dace	3	Yes	29	Cold
1995 DEQ electrofishing data				

Comments

Survey reach is on John Gise property near the highway. Reach is typical of the Camas Prairie - low gradient with willows, grasses, thornbush, and forbs prevalent. Observed songbirds and heard quail and pheasants. Property owner says they used to catch trout out of the creek, there is currently large numbers of crayfish. Large fish barrier (falls) several miles downstream from site. Observed a badger close to the site. Area has been grazed heavily in the past but is in a recovery period now.

Human activities affecting reach: grazing, roads, agriculture

Factors which affect beneficial use status

Macroinvertebrate score was <2.5, therefore impaired and not full support

APPENDIX F TECHNICAL DOCUMENTATION OF COTTONWOOD CREEK FINE AND COARSE SEDIMENT TMDLS

Introduction

The goal of this sediment TMDL is to reduce the fine and coarse sediment load of Cottonwood Creek. The purpose of this Appendix is to report the methods, data, and results of the sediment TMDL analyses. Two analyses are reported: 1) fine sediment analysis; and 2) coarse sediment analysis. The fine (i.e. < 0.25 mm) and coarse (i.e. > 45 mm) sediment analyses are independent of one another.

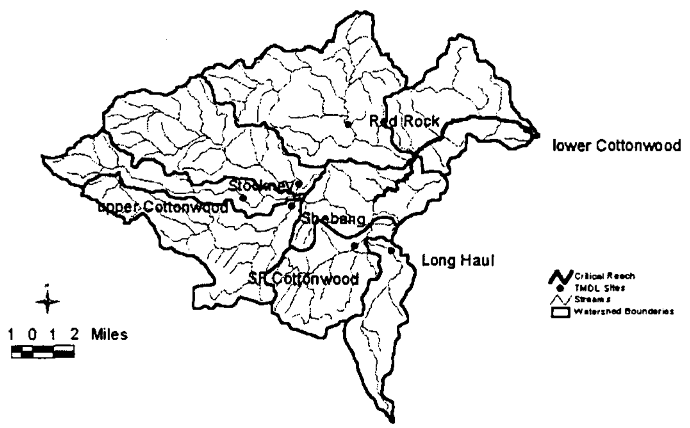


Figure F-1. Location map showing sites where fine sediment TMDLs are developed, and critical reach where coarse sediment TMDL is developed.

F-1. Fine Sediment

Sediment Targets

This TMDL establishes a quantitative fine sediment target using the total suspended sediment (TSS) water quality parameter. The TSS load capacity is a function of stream discharge where the daily average TSS concentration should not exceed 50 mg/L at the 84th percentile TSS load during the critical time period (ie, January through May). This target was selected based on IDEQ guidance (IDEQ 1999e) and is intended to account for the acute and chronic affects of TSS on the various life stages of salmonids. Included in this target is fine sediment resulting from natural and anthropogenic sources.

Methods

The fine sediment TMDL uses existing stream discharge and TSS data to estimate the long-term sediment reductions needed to improve water quality. Unfortunately, there are not enough data to evaluate the long-term TSS trends of Cottonwood Creek using a trend analysis. As a result, standard techniques are used to analyze the available stream discharge and TSS data, and from these data, predict the existing and desired TSS load.

Stream discharge is estimated for 7 sites within the Cottonwood Creek watershed. For Lower Cottonwood Creek, the MOVE.1 equation is used to predict daily average stream discharge for water years 1974 to 1998. For the subwatersheds of Cottonwood Creek, flow duration curves predicted from USGS regional equations are used to estimate the 50^{th} percentile daily average stream discharge for a given month (see Appendix A for details)

For Lower Cottonwood Creek, a sediment transport curve is developed from the predicted stream discharge and measured TSS data. This curve is used to predict daily average TSS concentration for water years 1974 to 1998. Regression analysis is used to develop the sediment transport curve and predict the daily TSS concentration as a power function of stream discharge. The paired stream discharge and TSS data are then used to estimate the mean daily suspended load in tons per day.

For the subwatersheds of Cottonwood Creek, the 50^{th} percentile daily average stream discharge and measured TSS data are used to estimate the existing fine sediment load for the critical time period. The TSS load capacity and existing load are esimated using the following steps. First, the measured daily fine sediment load for the critical time period is calculated by multiplying the estimated daily stream discharge and TSS concentration. Second, the 84^{th} percentile TSS load for the target (ie, load capacity) and existing condition are calculated for the critical time period. Finally, the 84^{th} percentile TSS load capacity is compared to the 84^{th} percentile existing TSS load to esimate the needed TSS load reductions by subwatershed.

Data

There are limited stream discharge and TSS data for Cottonwood Creek. The most comprehensive sampling effort to date, implemented by the ICSWCD, occurred from October 1996 to April 1998. A total of 49 TSS samples were collected at the Lower Cottonwood Creek site, and a total of 36 TSS samples at seven sites within the subwatersheds (Figure F-1). Raw data are reported in Plate 1. Presently, the Cottonwood Creek TAG is monitoring stream discharge and TSS at these sites. Data collected as part of this sampling effort will be used to refine the assumption described below and revise the analysis results.

For the ICSWCD data set, TSS samples were collected using the grab and composite sampling techniques. Grab samples are point in time measurements and, as part of this analysis, are assumed to represent the daily average TSS concentration. The composite samples were collected using pump samplers and composited over a week during high flow and bi-weekly during low flow. These samples represent TSS concentration over time and may include one or more storm events.

Typically, for sediment samples collected using a pump sampler, a box coefficient is developed which relates the pump sampler results to depth integrated sample results. In this case, no box coefficient can be developed because no comparison was made between the point and depth integrated sampling techniques. Using the available data, a student t-test comparing the grab and composite sampling techniques shows no significant difference at the $P < 0.24$ level ($n = 13$). For simplicity, this analysis assumes that these TSS data are comparable recognizing that they may not accurately represent TSS concentration across the stream channel.

The ICSWCD TSS samples were analyzed using the total suspended solids technique (EPA 160.2) which is different from the USGS TSS technique. In coarse systems (i.e., high % of sands) there can be differences between the techniques, however, for clay to silt dominated systems there is typically very little difference. Because the TSS of Cottonwood Creek is typically silt to fine sand, this analysis assumes that the TSS concentration is directly proportional to the TSS concentration.

TSS data collected as part of Cottonwood Creek TMDL implementation phase will be used to refine the above assumptions. Stream discharge and TSS data will be used to develop a more reliable sediment transport curve for lower Cottonwood Creek and for all the gaged subwatersheds. These data will also be used to evaluate TSS load trends as the TMDL is implemented.

Results and Discussion

This section describes and discusses the results of the fine sediment load analysis for Cottonwood Creek. The results for Lower Cottonwood Creek are presented separate from the subwatersheds because different methods were used to estimate the existing TSS load. This analysis shows that to meet the TSS target, the TSS load needs to be reduced about 60% across the Cottonwood Creek watershed. The sediment reductions vary by subwatershed, however.

The results of the Lower Cottonwood Creek TSS loading analysis are presented in Plate 2a. As stated above, the sediment transport curve is developed from the predicted stream discharge (i.e. MOVE.1) and measured TSS data. Regressing the log-10 of these data produces a statistically significant curve ($P < 0.05$). A power function is fit to the data which is the typical curve used to evaluate log transformed stream discharge and TSS data. For this type of sediment transport curve the USGS suggests applying a correction factor due to the potential bias introduced by the log retransformation (Cohn and Gilroy 1991). However, the measured and predicted TSS loads agree better using the uncorrected regression model results. As a result, the uncorrected power function is used in this analysis to predict daily average TSS concentration for water years 1974 to 1998 (Figure F-2). The equation is defined as follows:

$$TSS = 0.95\,Q^{1.18}$$
$$R^2 = 0.647$$
$$P < 0.05$$
$$n = 49$$

where:
TSS = average daily TSS concentration (mg/l)
Q = average daily stream discharge (cfs)

The TSS load is predicted using the following equation:

$$Q_s = TSS*Q*0.0027$$

where:
Q_s = average daily TSS load (tons/day)

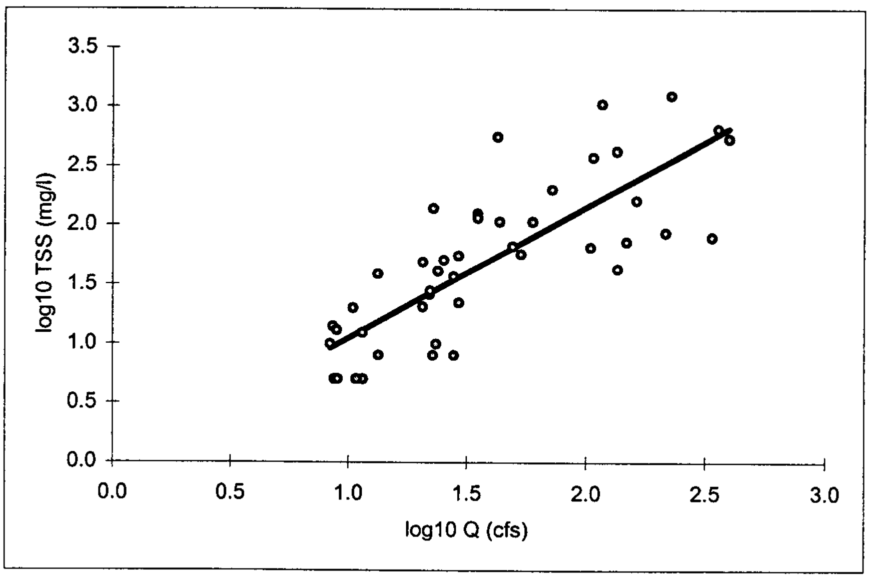


Figure F-2. Scatter plot showing TSS as a power function of stream discharge.

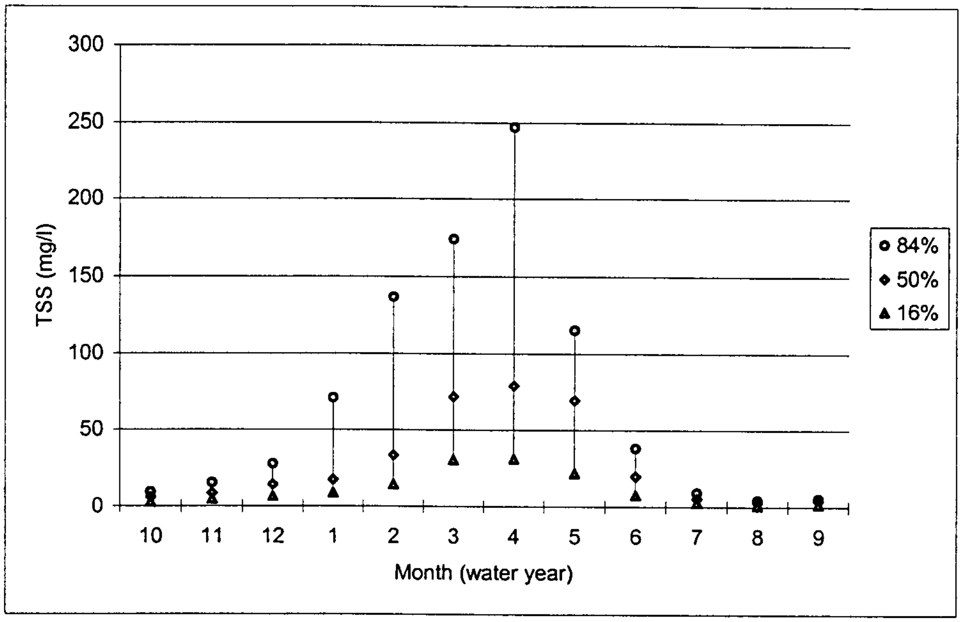


Figure F-3. Wisker plot showing predicted TSS concentration by month for the period of record (1974-1998).

As stated above, this TMDL evaluates the critical time period for which the TSS load needs to be reduced. The timing of measured high TSS concentration, peak flood flows, and anadromous fish migration are used to define the critical time period. Data show that the highest TSS concentrations occur between January and May (Figure F-3). Similarly, sediment load tends to be highest during this period with the greatest loads during spring runoff (i.e. February to April) (Figure F- 4).

The critical time period chosen from these data is January to May since these are the months when the highest TSS load are coincident with steelhead migration. In addition, each of these months are not meeting the target TSS load at the 84th percentile, as illustrated in Figure F-4. The TSS load for the 84th percentile of the period of record is the value chosen to evaluate the needed TSS load reductions. The 84th percentile is chosen as a conservative value and is factored into the TMDL as a margin of safety.

Table F-1. TSS Load Reduction by Month for Lower Cottonwood Creek

Month	Percent Reduction
January	30
February	64
March	71
April	80
May	57
average	60 +/- 9

For Lower Cottonwood Creek, a 60% reduction of TSS load is needed to meet the TSS load capacity during the critical time period. However, the percent reduction varies by month with the greatest reduction of 80% during April and the smallest reduction of 30% during January (Table F-1). These data indicate that the greatest reductions are needed during spring runoff when the majority of sediment production, transport and delivery are occurring. Because these are estimates of actual sediment load, this TMDL sets a 60% reduction for Lower Cottonwood Creek as an interim goal. New stream discharge and TSS data will be used to revise this estimate over time.

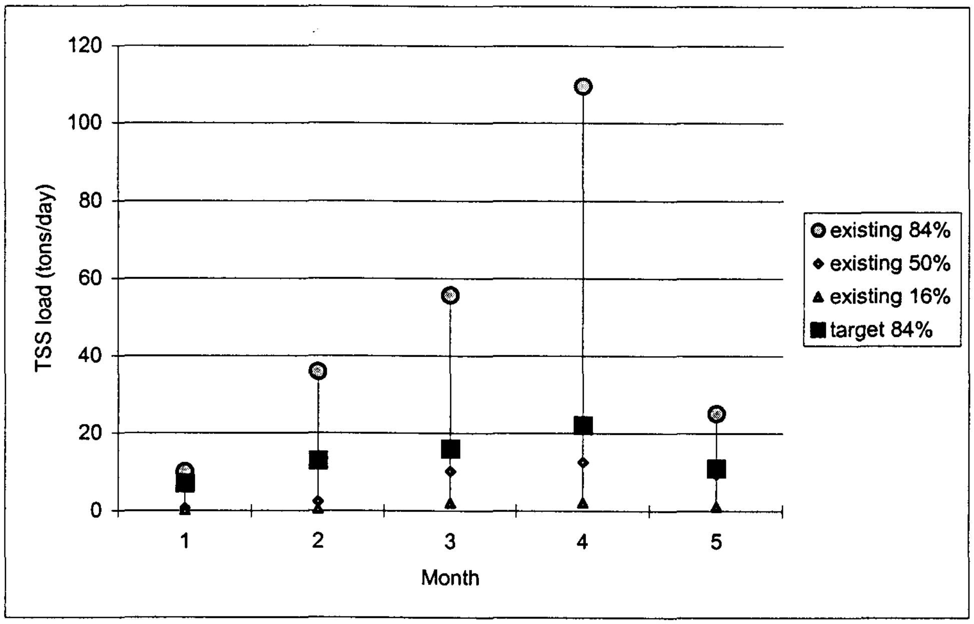


Figure F-4. Wisker plot showing predicted TSS load by month for the critical period (January-May).

The TSS load reductions for the subwatersheds of Cottonwood Creek are presented separately because no continuous flow data are available. Instead, flow duration curves predicted from USGS regional equations are used to estimate the sediment load for the 50th percentile daily average stream discharge of a given month (see Appendix A for details). There are 6 delineated subwatersheds within the Cottonwood Creek catchment (Figure F-1). TSS load reductions are set for each of these subwatersheds for the same critical time period as Lower Cottonwood Creek (i.e. January to May).

TSS data are only available for about two years and no transport curves can be developed given the available flow data. As a result, the actual TSS data are used to estimate load reductions. The 84th percentile of stream discharge, TSS concentration, target TSS load, and existing TSS load is calculated between January and May of water years 1997 and 1998. The percent load reduction is set using the 84th percentile TSS load. The load reduction for each of the subwatersheds is listed in Table F-2. For the raw load calculations refer to Plates 2b-2g.

The needed TSS load reductions are greatest for the South Fork Cottonwood, Stockney, Long Haul, and Shebang subwatersheds (Table F-2). These load reductions are set so that the TSS target is met at the mouth of each subwatershed, and they do not consider the reduction needed at Lower Cottonwood. This analysis assumes that actions taken to reduce the subwatershed TSS load will effectively reduce the TSS load of Lower Cottonwood.

Table F-2. TSS Load Reductions for Subwatersheds of Cottonwood Creek During Critical Period

Site Number	Site Name	Percent Reduction
1	Stockney Creek	88
2	Upper Cottonwood Creek	60
3	Shebang Creek	80
4	South Fork Cottonwood Creek	95
5	Long Haul Creek	85
6	Red Rock Creek	64

To help verify the above TSS load estimates and show that fine sediment reductions made in the subwatersheds will help meet the reduction needed at Lower Cottonwood, the mass balance between incoming and measured TSS load at the mouth of Lower Cottonwood Creek is calculated. Predicted stream discharge and measured TSS data are used in this calculation. Results indicate about a 5% difference between the measured incoming TSS and outgoing TSS at the mouth site which is well within an acceptable range (i.e. ~ 30%) (Table F-3).

Table F-3. Calculated Mass Balance Between Incoming and Measured TSS Load at the Lower Cottonwood Creek Site

Site Number	Site Name	Total Measured TSS (tons)
1	Stockney Creek	1,720
2	Upper Cottonwood Creek	147
3	Shebang Creek	401
4	South Fork Cottonwood Creek	1,332
5	Long Haul Creek	494
6	Red Rock Creek	321
	total incoming to Lower Cottonwood Creek	4,415
7	measured at Lower Cottonwood Creek	4,645
	percent difference	5

F-2. Coarse Sediment

Sediment Targets

Because it is difficult to directly measure bedload, surrogate sediment targets are established for the coarse sediment TMDL. Measures of channel geometry and substrate conditions are used to include: 1) bankfull channel width to depth ratio; 2) pool frequency; 3) residual pool volume; and 4) depth fines. The existing and desired target levels are summarized in Table F-4.

Table F-4. Coarse Sediment TMDL Targets for Critical Reach of Lower Cottonwood Creek

Target	Existing Condition	DesiredCondition (reference)	Percent Change
Bankfull width/depth ratio	86	< 40 (NMFS et al. 1998)	53
Pool frequency (pool/100 meters)	0.5	3 (Montgomery and Buffington 1993)	83
Residual pool volume (m^3)	11	increasing trend (see Section F-2)	?
Depth fines	Data Gap	5-year mean not to exceed 27 percent with no individual year to exceed 29 percent, and subsurface fines < 0.85 mm not exceed 10 percent (IDEQ 1999e)	?

Excess bedload transport is degrading the rearing and spawning habitat of salmonids in Lower Cottonwood Creek. Given the available information, it is hypothesized that salmonid rearing and spawning are limited by a wide and shallow stream channel, a lack of pools space, and spawning gravels free of excess fine bed-material (i.e. < 6.3 mm). Increased bedload mobility results from elevated hillslope and instream coarse sediment production, peak flow alteration, and removal of large woody debris. In combination, these changes have effectively destabilized Lower Cottonwood Creek and degraded steelhead habitat.

Excess bedload transport can increase the channel width to depth ratio, reduce pool frequency and depth, and decrease residual pool volume. Steelhead use pools as refuge during the summer when the stream flow is lowest and the water temperature is highest. Waters (1995) states that sedimentation of rearing habitat is one of the critical factors that eventually damages adult fish populations. The desired width to depth ratio and critical number of pools to support rearing for a given stream reach is a function of geology, valley-channel morphology, stream flow, and sometimes large woody debris.

Residual pool volume is a measure of the pool volume which is not dependent upon stream stage at the time of measurement (Lisle 1989). These measure are effective sediment surrogates because they primarily reflect chronic sediment sources (Lisle and Hilton 1999; Lisle and Hilton 1991). The desired pool volume is related to pool frequency. As pool volume is increased, the pool frequency and residual pool depth increase.

It is difficult to quantify the level at which beneficial uses support will be met relative to the pool frequency and volume surrogates. Reference or undisturbed streams are often used to help set instream goals, however, in Cottonwood Creek there is a lack of reference conditions. As a result, this TMDL uses existing stream inventory data and infers the potential stream channel characteristics to establish target values. Reference reach channel geometry data indicate this stream has a potential pool frequency of about 3 pools per 100 meters. Residual pool volume data will be collected by the TAG in 2000 to help further develop this target.

Depth fines is a measure of the substrate grain size distribution in a sediment core. These measures are good indicators of the quality of spawning gravels and threshold values are well established in the literature (Waters 1995; Overton et al. 1995; Burton et al. 1990; Hall, 1986). The depth fines target for Cottonwood Creek is to reduce depth fines to a 5-year mean not to exceed 27 percent with no individual year to exceed 29 percent, and subsurface fines < 0.85 mm not exceed 10 percent. This surrogate was selected based on IDEQ guidance (IDEQ 1999e). No depth or subsurface fines data are presently available, however, the TAG will fill this data gap in 2000 as part other TMDL monitoring.

Methods

The coarse sediment TMDL is developed for Lower Cottonwood Creek and uses bankfull discharge and bedload transport analyses to estimate present and desired bedload transport rates. Unlike the fine sediment TMDL, this analysis focuses on the lower mainstem, defined as the critical reach, below the natural fish migration barrier (Figure F-1).

The technical basis for this analysis is reported in Olsen et al. (1997) and Buffington and Montgomery (1999). One-dimensional stream discharge and bedload transport equations are used to estimate the existing reach average boundary shear stress at bankfull discharge defined as:

$$\tau_{bfq} = gRS$$

τ_{bfq} = boundary shear stress at bankfull discharge
ρ = density of water
g = acceleration due to gravity
R = hydraulic radius
S = stream gradient

The critical dimensionless shear stress defined as:

$$\tau_{ci*} = 0.045(d_{84}/d_{50})^{-0.7}$$

τ_{ci*} = critical dimensionless shear stress
d_{84} = particle size 84th percentile
d_{50} = particle size 50th percentile

The critical shear stress required to move the d_{50} particle size defined as:

$$\tau_{ci} = \tau_{ci*}(\rho s-\rho)gd_{50}$$

τ_{ci} = critical shear stress
ρ_s = density of water

The quotient of the critical shear stress and the boundary shear stress indicates how stable the streambed is relative to water and sediment inputs. The Relative Bed Stability (RBS) index is defined as:

$$RBS = \tau_{ci}/\tau_{bfq}$$

The units for these variables are defined in Table F-4. As a conservative assumption, factored into the TMDL margin of safety, the d_{50} particle size is chosen as the index particle size rather than the d_{84} particle size (Olsen et al. 1997).

The stream discharge analysis uses the MOVE.1 gage extension technique and the slope area method to estimate bankfull discharge. The estimated bankfull discharge of Lower Cottonwood Creek is 244 +/- 16 cfs (see Appendix A for details). Cottonwood Creek has been gaged for about 2 water years, so very few bankfull discharge values are available. Future stream discharge monitoring will help refine this estimate.

The one-dimensional flow and bedload transport equations have the following built in assumptions: 1) constant width, depth, area, and velocity; 2) water surface slope and energy grade line approach the slope of the streambed; 3) streamlines are parallel and straight; and 4) channel uniform, with no obstructions (e.g., boulders) or backwater. Bedload transport equations assume the following as well: 1) surface and subsurface d_{50} particle sizes are similar; 2) equal mobility of the streambed; and 3) bankfull discharge is the channel maintaining flow and flood discharge is the channel changing flow.

Data

Channel geometry data collected in 1999 as part of Lower Cottonwood Creek TMDL monitoring are used to estimate the existing and desired RBS. Data from the channel reference reach is used estimate reach average bedload mobility characteristics. The input variables and results are listed in Table F-5.

The Cottonwood Creek TAG has implemented a long-term bedload monitoring program on Lower Cottonwood Creek. The data from this monitoring will be used to refine the coarse sediment TMDL over time and track the effectiveness of TMDL implementation actions. Presently, the TAG is monitoring stream discharge, suspended and bedload, cross-sectional and longitudinal channel geometry, scour and fill depths (i.e. scour chains), and substrate characteristics.

Results and Discussion

Bedload mobility at bankfull discharge is a function of sediment supply, channel geometry, and roughness (Buffington and Montgomery 1999). For Cottonwood Creek, removal of large woody debris and peak flood increases are contributing to channel instability mainly effecting the routing and storage of coarse bed-material. Coarse sediment delivered from the hillslopes is easily transported given the available stream energy. In addition, for the higher gradient reaches available stream energy exceeds the coarse sediment supply causing channel incision which in effect is another source of coarse sediment to the lower gradient reaches.

Bedload modeling indicates that to stabilize the streambed at bankfull discharge, the RBS needs to be increased about 46%. In other words, to reduce the mobility of the median substrate particle size, the boundary shear stress at bankfull flow needs to be reduced. This can be accomplished several ways: 1) increase the roughness of the stream channel (e.g. large woody debris); 2) reduce the magnitude of bankfull discharge by retaining water on the land longer; and 3) reduce the hillslope and instream production of coarse sediment. In combination, these actions will help stabilize the lower reaches of Cottonwood Creek.

A sediment source analysis is used to evaluate the needed sediment reductions by subwatershed. The sources of coarse sediment are categorized into one of the following: 1) mass failure; 2) vertical channel scour; 3) lateral channel erosion (i.e. bank erosion); 4) rill and gully erosion. The potential anthropogenic sources include surface and mass erosion associated with roads, agriculture, and grazing.

The lithology of the measured bed-material is dominantly basalt material. This quasi-homogeneous bed-material composition is a good indicator of source areas. Sources of coarse basalt material are rather obvious in the lower reaches of Cottonwood Creek and it is likely that very little of this material is sourced near the headwaters. Whereas finer bed-material that is likely sourced from intrusive rock types present in the upper watershed could be inundating spawning gravels. In addition, the prairie soils are also a likely source of finer bed-material. Implementation efforts should focus on these source areas to reduce the amount of bedload.

Table F-5. Streambed Stability Analysis Input Variables and Results

Parameter*	T-1	T-2	T-3	Average	Std Error
Wbf (ft)	103	65	78	82	11
Wfs (ft)	290	150	107	182	55
Abf (ft^2)	107	95	92	98	5
Afs (ft^2)	547	347	262	386	84
Dbf (ft)	1.0	1.5	1.2	1.2	0.1
Dfs (ft)	1.9	2.3	2.4	2.2	0.2
Sbf (ft/ft)	0.008	0.008	0.008	0.008	0
Sfs (ft/ft)	0.008	0.008	0.008	0.008	0
Pbf (ft)	106	66	78	83	12
Pfs (ft)	297	155	108	186	57
Rbf (ft)	1.0	1.4	1. 2	1.2	0.1
Rfs (ft)	1.8	2.2	2.4	2.2	0.2
Jrrt nbf	0.06	0.06	0.06	0.06	0.001
Jrrt nfs	0.06	0.05	0.06	0.06	0.001
Mnng Qbf (cfs)	232	275	224	244	16
Mnng Qfs (cfs)	1941	1449	1168	1519	226
d16 (mm)	18	6	15	13	4
d50 (mm)	40	30	35	35	3
d84 (mm)	80	55	65	67	7
τ_{ci}* (N/m^2)	0.028	0.029	0.029	0.029	0.001
τ_{ci} (N/m^2)	17.4	13.9	16.0	15.7	1.0
τ_{bfq} (N/m^2)	24.3	34.4	28.1	28.9	3.0
RBS	0.7	0.4	0.6	0.5	0.09
RBS Increase (%)	28	60	43	46	9

***Input Variables**
W = stream width
A = cross-sectional area
d = hydraulic depth
s = stream gradient
P = wetted perimeter
R = hydraulic radius
n = roughness
Q = stream discharge
d = particle size by percentile

***Output Variables**
τ_{ci}* = dimensionless critical shear stress
τ_{ci} = Sheild's critical shear stress
τ_{bfq} = boundary shear stress at bankfull discharge
RBS = relative bed stability index

Plate 1. Raw total suspended sediment data in mg/l for all seven monitoring sites.

	Site Number						
Date	1	2	3	4	5	6	7
12/11/96	113.0	104.0	174.0	384.0	130.0	146.0	107.0
01/02/97	410.0	135.0	196.0	457.0	256.0	393.0	539.0
01/20/97	38.2	30.0	206.0	335.0	188.0	201.0	60.0
02/06/97	33.6	22.8	39.0	100.0	72.2	73.2	378.0
02/13/97	4,600.0	46.0	825.0	114.0	309.0	243.0	107.0
02/20/97	6,840.0	1,090.0	204.0	7,880.0	5,500.0	176.0	1,060.0
02/26/97	225.0	210.0	69.0	129.0	35.0	100.0	201.0
03/06/97	186.0	74.0	17.0	138.0	162.0	71.0	62.0
03/12/97	4,160.0	125.0	648.0	1,110.0	328.0	391.0	272.0
03/19/97	3,160.0	783.0	3,490.0	5,380.0	1,240.0	275.0	1,580.0
03/26/97	185.0	123.0	148.0	691.0	162.0	140.0	211.0
04/02/97	308.0	209.0	383.0	2,020.0	455.0	103.0	426.0
04/09/97	42.0	25.0	30.0	940.0	121.0	112.0	112.0
04/16/97	54.0	32.0	45.0	635.0	76.0	66.0	43.0
04/24/97	428.0	87.0	320.0	4,440.0	554.0	2,590.0	650.0
04/30/98	618.0	194.0	785.0	1,279.0	785.0	381.0	1,249.0
05/07/98	188.0	87.0	148.0	363.0	195.0	102.0	161.0
05/15/98	44.0	38.0	44.0	74.0	63.0	45.0	58.0
05/23/98	22.0	16.0	0.1	47.0	25.0	22.0	8.0
06/13/98	68.0	169.0	79.0	132.0	56.0	72.0	51.0
06/27/98	132.0	34.0	20.0	28.0	34.0	14.0	20.0
09/29/98	5.0	8.0	5.0	5.0	5.0	5.0	14.0
10/14/98	17.0	5.0	26.0	20.0	19.0	23.0	13.0
11/03/98	18.0	5.0	24.0	19.0	30.0	10.0	12.0
11/24/98	5.0	9.0	23.0	8.0	13.0	7.0	5.0
12/11/98	5.0	5.0	5.0	9.0	5.0	9.0	5.0
01/19/98	28.0	28.0	29.0	614.0	207.0	191.0	138.0
01/26/98	76.0	5.0	234.0	110.0	76.0	55.0	41.0
02/01/98	168.0	118.0	179.0	218.0	210.0	115.0	126.0
02/10/98	65.0	45.0	60.0	80.0	164.0	53.0	56.0
02/16/98	13.0	40.0	54.0	65.0	193.0	43.0	49.0
03/02/98	37.0	14.0	56.0	53.0	160.0	34.0	39.0
03/16/98	5.0	25.0	47.0	60.0	120.0	51.0	37.0
04/04/98	25.0	52.0	66.0	40.0	89.0	5.0	26.0

Plate 2. Load calculations for lower Cottonwood Creek site.

TSS (mg/l) — Q50

	1	2	3	4	5
average	39	71	96	115	73
maximum	183	402	266	301	200
84%	71	137	174	247	115
50%	17	33	71	79	69
16%	9	15	31	31	22

Water Year	1	2	3	4	5	1	2	3	4	5
1975	18	25	63	99	158	17	24	50	71	106
1976	137	38	72	301	78	94	30	53	196	56
1977	7	6	8	22	15	7	6	7	18	13
1978	83	123	158	103	88	61	87	109	74	64
1979	9	76	225	272	200	8	55	149	178	131
1980	24	44	65	65	80	20	34	49	49	58
1981	14	38	31	49	31	12	28	25	38	25
1982	65	245	190	237	97	47	156	129	157	70
1983	42	53	92	47	26	33	40	67	37	21
1984	55	30	167	177	99	41	25	113	121	72
1985	12	21	71	186	32	10	17	53	126	26
1986	34	187	106	53	38	26	124	77	41	30
1987	15	55	98	35	12	13	42	71	28	10
1988	7	13	20	34	25	7	11	17	27	21
1989	14	15	218	144	46	12	13	144	100	35
1990	14	23	53	24	74	12	19	40	20	53
1991	24	26	47	69	65	19	21	36	51	48
1992	10	16	10	11	4	9	14	9	10	4
1993	6	8	54	100	101	6	7	40	72	70
1994	9	6	29	26	10	8	6	23	21	9
1995	17	63	82	89	116	14	47	60	65	81
1996	108	402	144	292	174	77	243	101	188	119
1997	183	166	266	270	115	119	113	173	176	80
1998	26	29	35	57	65	21	24	28	43	46

Existing TSS Load (tons/day)

	1	2	3	4	5
average	6.6	23.4	28.4	39.6	15.0
maximum	58.6	264.1	124.5	159.1	70.7
existing 84%	9.97	35.8	56.7	109.4	25.0
existing 50%	0.75	2.4	10.2	12.5	9.4
existing 16%	0.2	0.5	2.0	2.1	1.1

1	2	3	4	5
0.8	1.7	8.6	19.0	44.7
34.8	3.1	10.2	159.1	11.5
0.1	0.1	0.1	1.1	0.5
13.8	28.9	46.5	20.5	15.3
0.2	11.3	90.3	130.8	70.7
1.3	3.9	8.8	8.6	12.4
0.4	2.8	2.1	5.1	2.1
8.2	102.8	68.1	100.3	18.4
3.8	5.8	16.5	4.7	1.5
6.1	2.0	50.7	57.7	19.2
0.3	1.0	10.1	63.1	2.2
2.4	62.5	22.0	5.9	3.1
0.5	6.3	18.9	2.7	0.3
0.1	0.4	0.9	2.5	1.4
0.5	0.5	85.1	39.1	4.2
0.5	1.2	5.8	1.3	10.4
1.2	1.5	4.6	9.5	8.4
0.2	0.6	0.2	0.3	0.0
0.1	0.2	5.8	19.6	18.9
0.2	0.1	1.8	1.5	0.2
0.7	8.0	13.2	15.5	25.4
22.4	264.1	39.3	148.6	55.8
58.6	50.6	124.5	128.7	24.8
1.5	1.9	2.6	6.6	8.0

Target Load Capacity (tons/day)

	1	2	3	4	5
average	4	7	9	11	7
maximum	16	33	23	26	18
target 84%	7	13	16	22	11
target 50%	2	4	7	8	7
target 16%	1	2	3	3	2

1	2	3	4	5
2.3	3.3	6.8	9.6	14.2
12.7	4.1	7.1	26.5	7.5
0.9	0.8	0.9	2.5	1.7
8.3	11.7	14.7	10.0	8.7
1.1	7.5	20.1	24.1	17.7
2.7	4.5	6.6	6.6	7.8
1.6	3.8	3.4	5.1	3.4
6.3	21.0	17.4	21.2	9.5
4.4	5.4	9.0	4.9	2.9
5.5	3.3	15.2	16.4	9.7
1.4	2.3	7.1	17.0	3.5
3.5	16.7	10.3	5.5	4.0
1.7	5.7	9.6	3.8	1.4
0.9	1.5	2.3	3.6	2.8
1.7	1.8	19.5	13.6	4.7
1.7	2.6	5.5	2.7	7.1
2.6	2.9	4.9	6.9	6.5
1.2	1.9	1.2	1.3	0.5
0.8	1.0	5.4	9.8	9.4
1.1	0.8	3.1	2.6	1.2
2.0	6.4	8.0	8.7	11.0
10.4	32.8	13.6	25.4	16.1
16.0	15.2	23.4	23.8	10.8
2.9	3.2	3.7	5.8	8.2

TSS Load Reductions (%)

	1	2	3	4	5
average	41	71	65	73	53
maximum	73	88	81	83	75
84%	30	64	71	80	57
50%	-186	-49	30	37	28
16%	-456	-241	-83	-58	-118

1	2	3	4	5
64	49	-27	-98	-216
-174	24	-43	-501	-53
85	88	85	55	71
-67	-146	-216	-106	-78
82	-51	-350	-443	-300
51	13	-30	-30	-60
72	27	37	2	38
-29	-390	-279	-373	-95
15	-7	-83	6	49
-10	39	-233	-253	-98
77	58	-42	-272	36
33	-273	-113	-6	24
71	-10	-97	30	77
86	74	60	33	49
72	89	-337	-189	9
72	54	-5	51	-47
53	48	6	-37	-30
80	68	80	78	93
88	84	-7	-101	-101
82	87	42	49	80
66	-26	-64	-77	-132
-116	-705	-189	-484	-248
-265	-232	-432	-440	-129
48	42	30	-13	-30

TSS Load Reduction Summary

average	61	13.52	6.048
maximum	80	6.122	2.738
84%	60	18.93	8.466

Monthly reduction for 84th percentile

Jan	30
Feb	64
March	71
April	80
May	57
average	60.4

Plate 2b. TSS load calculations for the subwatersheds of Cottonwood Creek.

Station #	Date	Q50 (cfs)	TSS (mg/l)	TRG Qs (t/d)	Qs (t/d)	% Reduction	% Reduction
1	1/2/97	15.2	410	2.1	16.8	87.8	87.8
1	1/20/97	15.2	38	2.1	1.6	-30.9	0.0
1	2/6/97	18.5	34	2.5	1.7	-48.8	0.0
1	2/13/97	18.5	4,600	2.5	229.8	98.9	98.9
1	2/20/97	18.5	6,840	2.5	341.7	99.3	99.3
1	2/26/97	18.5	225	2.5	11.2	77.8	77.8
1	3/6/97	43.7	186	5.9	21.9	73.1	73.1
1	3/12/97	43.7	4,160	5.9	490.8	98.8	98.8
1	3/19/97	43.7	3,160	5.9	372.8	98.4	98.4
1	3/26/97	43.7	185	5.9	21.8	73.0	73.0
1	4/2/97	28.3	308	3.8	23.5	83.8	83.8
1	4/9/97	28.3	42	3.8	3.2	-19.0	0.0
1	4/16/97	28.3	54	3.8	4.1	7.4	7.4
1	4/24/97	28.3	428	3.8	32.7	88.3	88.3
1	4/30/98	28.3	618	3.8	47.2	91.9	91.9
1	5/7/98	14.1	188	1.9	7.2	73.4	73.4
1	5/15/98	14.1	44	1.9	1.7	-13.6	0.0
1	5/23/98	14.1	22	1.9	0.8	-127.3	0.0
1	1/19/98	15.2	28	2.1	1.1	-78.6	0.0
1	1/26/98	15.2	76	2.1	3.1	34.2	34.2
1	2/1/98	18.5	168	2.5	8.4	70.2	70.2
1	2/10/98	18.5	65	2.5	3.2	23.1	23.1
1	2/16/98	18.5	13	2.5	0.6	-284.6	0.0
1	3/2/98	43.7	37	5.9	4.4	-35.1	0.0
1	3/16/98	43.7	5	5.9	0.6	-900.0	0.0
1	4/4/98	28.3	25	3.8	1.9	-100.0	0.0

Percentile	Q50 (cfs)	TSS (mg/l)	TRG Qs (t/d)	Qs (t/d)	Percent Reduction
16th	15.2	28.0	2.1	1.6	-31
50th	18.5	122.0	2.5	5.8	57
84th	43.7	618.0	5.9	47.2	88

Plate 2c. TSS load calculations for the subwatersheds of Cottonwood Creek.

Station #	Date	Q50 (cfs)	TSS (mg/l)	TRG Qs (t/d)	Qs (t/d)	% Reduction	% Reduction
2	1/2/97	7.8	135	1.1	2.8	63.0	63.0
2	1/20/97	7.8	30	1.1	0.6	-66.7	0.0
2	2/6/97	9.5	23	1.3	0.6	-119.3	0.0
2	2/13/97	9.5	46	1.3	1.2	-8.7	0.0
2	2/20/97	9.5	1,090	1.3	28.0	95.4	95.4
2	2/26/97	9.5	210	1.3	5.4	76.2	76.2
2	3/6/97	22.4	74	3.0	4.5	32.4	32.4
2	3/12/97	22.4	125	3.0	7.6	60.0	60.0
2	3/19/97	22.4	783	3.0	47.4	93.6	93.6
2	3/26/97	22.4	123	3.0	7.4	59.3	59.3
2	4/2/97	14.4	209	1.9	8.1	76.1	76.1
2	4/9/97	14.4	25	1.9	1.0	-100.0	0.0
2	4/16/97	14.4	32	1.9	1.2	-56.3	0.0
2	4/24/97	14.4	87	1.9	3.4	42.5	42.5
2	4/30/98	14.4	194	1.9	7.5	74.2	74.2
2	5/7/98	7.4	87	1.0	1.7	42.5	42.5
2	5/15/98	7.4	38	1.0	0.8	-31.6	0.0
2	5/23/98	7.4	16	1.0	0.3	-212.5	0.0
2	1/19/98	7.8	28	1.1	0.6	-78.6	0.0
2	1/26/98	7.8	5	1.1	0.1	-900.0	0.0
2	2/1/98	9.5	118	1.3	3.0	57.6	57.6
2	2/10/98	9.5	45	1.3	1.2	-11.1	0.0
2	2/16/98	9.5	40	1.3	1.0	-25.0	0.0
2	3/2/98	22.4	14	3.0	0.8	-257.1	0.0
2	3/16/98	22.4	25	3.0	1.5	-100.0	0.0
2	4/4/98	14.4	52	1.9	2.0	3.8	3.8

Percentile	Q50 (cfs)	TSS (mg/l)	TRG Qs (t/d)	Qs (t/d)	Percent Reduction
16th	7.8	25.0	1.1	0.6	-67
50th	9.5	49.0	1.3	1.6	21
84th	22.4	194.0	3.0	7.5	60

Plate 2d. TSS load calculations for the subwatersheds of Cottonwood Creek.

Station #	Date	Q50 (cfs)	TSS (mg/l)	TRG Qs (t/d)	Qs (t/d)	% Reduction	% Reduction
3	1/2/97	7.8	196	1.1	4.1	74.5	74.5
3	1/20/97	7.8	206	1.1	4.3	75.7	75.7
3	2/6/97	9.5	39	1.3	1.0	-28.2	0.0
3	2/13/97	9.5	825	1.3	21.2	93.9	93.9
3	2/20/97	9.5	204	1.3	5.2	75.5	75.5
3	2/26/97	9.5	69	1.3	1.8	27.5	27.5
3	3/6/97	22.4	17	3.0	1.0	-194.1	0.0
3	3/12/97	22.4	648	3.0	39.2	92.3	92.3
3	3/19/97	22.4	3,490	3.0	211.1	98.6	98.6
3	3/26/97	22.4	148	3.0	9.0	66.2	66.2
3	4/2/97	14.4	383	1.9	14.9	86.9	86.9
3	4/9/97	14.4	30	1.9	1.2	-66.7	0.0
3	4/16/97	14.4	45	1.9	1.7	-11.1	0.0
3	4/24/97	14.4	320	1.9	12.4	84.4	84.4
3	4/30/98	14.4	785	1.9	30.5	93.6	93.6
3	5/7/98	7.4	148	1.0	3.0	66.2	66.2
3	5/15/98	7.4	44	1.0	0.9	-13.6	0.0
3	5/23/98	7.4	0	1.0	0.0	-45354.5	0.0
3	1/19/98	7.8	29	1.1	0.6	-72.4	0.0
3	1/26/98	7.8	234	1.1	4.9	78.6	78.6
3	2/1/98	9.5	179	1.3	4.6	72.1	72.1
3	2/10/98	9.5	60	1.3	1.5	16.7	16.7
3	2/16/98	9.5	54	1.3	1.4	7.4	7.4
3	3/2/98	22.4	56	3.0	3.4	10.7	10.7
3	3/16/98	22.4	47	3.0	2.8	-6.4	0.0
3	4/4/98	14.4	66	1.9	2.6	24.2	24.2

Percentile	Q50 (cfs)	TSS (mg/l)	TRG Qs (t/d)	Qs (t/d)	Percent Reduction
16th	7.8	39.0	1.1	1.0	-2
50th	9.5	108.5	1.3	3.2	60
84th	22.4	383.0	3.0	14.9	80

Plate 2e. TSS load calculations for the subwatersheds of Cottonwood Creek.

Station #	Date	Q50 (cfs)	TSS (mg/l)	TRG Qs (t/d)	Qs (t/d)	% Reduction	% Reduction
4	1/2/97	9.4	457	1.3	11.6	89.1	89.1
4	1/20/97	9.4	335	1.3	8.5	85.1	85.1
4	2/6/97	11.2	100	1.5	3.0	50.0	50.0
4	2/13/97	11.2	114	1.5	3.4	56.1	56.1
4	2/20/97	11.2	7,880	1.5	238.3	99.4	99.4
4	2/26/97	11.2	129	1.5	3.9	61.2	61.2
4	3/6/97	26.6	138	3.6	9.9	63.8	63.8
4	3/12/97	26.6	1,110	3.6	79.7	95.5	95.5
4	3/19/97	26.6	5,380	3.6	386.4	99.1	99.1
4	3/26/97	26.6	691	3.6	49.6	92.8	92.8
4	4/2/97	17.3	2,020	2.3	94.4	97.5	97.5
4	4/9/97	17.3	940	2.3	43.9	94.7	94.7
4	4/16/97	17.3	635	2.3	29.7	92.1	92.1
4	4/24/97	17.3	4,440	2.3	207.4	98.9	98.9
4	4/30/98	17.3	1,279	2.3	59.7	96.1	96.1
4	5/7/98	8.7	363	1.2	8.5	86.2	86.2
4	5/15/98	8.7	74	1.2	1.7	32.4	32.4
4	5/23/98	8.7	47	1.2	1.1	-6.4	0.0
4	1/19/98	9.4	614	1.3	15.6	91.9	91.9
4	1/26/98	9.4	110	1.3	2.8	54.5	54.5
4	2/1/98	11.2	218	1.5	6.6	77.1	77.1
4	2/10/98	11.2	80	1.5	2.4	37.5	37.5
4	2/16/98	11.2	65	1.5	2.0	23.1	23.1
4	3/2/98	26.6	53	3.6	3.8	5.7	5.7
4	3/16/98	26.6	60	3.6	4.3	16.7	16.7
4	4/4/98	17.3	40	2.3	1.9	-25.0	0.0

Percentile	Q50 (cfs)	TSS (mg/l)	TRG Qs (t/d)	Qs (t/d)	Percent Reduction
16th	9.4	65.0	1.3	2.4	48
50th	11.2	276.5	1.5	8.5	82
84th	26.6	1279.0	3.6	79.7	95

Plate 2f. TSS load calculations for the subwatersheds of Cottonwood Creek.

Station #	Date	Q50 (cfs)	TSS (mg/l)	TRG Qs (t/d)	Qs (t/d)	% Reduction	% Reduction
5	1/2/97	9.4	256	1.3	6.5	80.5	80.5
5	1/20/97	9.4	188	1.3	4.8	73.4	73.4
5	2/6/97	11.2	72	1.5	2.2	30.7	30.7
5	2/13/97	11.2	309	1.5	9.3	83.8	83.8
5	2/20/97	11.2	5,500	1.5	166.3	99.1	99.1
5	2/26/97	11.2	35	1.5	1.1	-42.9	0.0
5	3/6/97	26.6	162	3.6	11.6	69.1	69.1
5	3/12/97	26.6	328	3.6	23.6	84.8	84.8
5	3/19/97	26.6	1,240	3.6	89.1	96.0	96.0
5	3/26/97	26.6	162	3.6	11.6	69.1	69.1
5	4/2/97	17.3	455	2.3	21.3	89.0	89.0
5	4/9/97	17.3	121	2.3	5.7	58.7	58.7
5	4/16/97	17.3	76	2.3	3.5	34.2	34.2
5	4/24/97	17.3	554	2.3	25.9	91.0	91.0
5	4/30/98	17.3	785	2.3	36.7	93.6	93.6
5	5/7/98	8.7	195	1.2	4.6	74.4	74.4
5	5/15/98	8.7	63	1.2	1.5	20.6	20.6
5	5/23/98	8.7	25	1.2	0.6	-100.0	0.0
5	1/19/98	9.4	207	1.3	5.3	75.8	75.8
5	1/26/98	9.4	76	1.3	1.9	34.2	34.2
5	2/1/98	11.2	210	1.5	6.4	76.2	76.2
5	2/10/98	11.2	164	1.5	5.0	69.5	69.5
5	2/16/98	11.2	193	1.5	5.8	74.1	74.1
5	3/2/98	26.6	160	3.6	11.5	68.8	68.8
5	3/16/98	26.6	120	3.6	8.6	58.3	58.3
5	4/4/98	17.3	89	2.3	4.2	43.8	43.8

Percentile	Q50 (cfs)	TSS (mg/l)	TRG Qs (t/d)	Qs (t/d)	Percent Reduction
16th	9.4	76.0	1.3	2.2	42
50th	11.2	176.0	1.5	6.1	75
84th	26.6	455.0	3.6	23.6	85

Plate 2g. TSS load calculations for the subwatersheds of Cottonwood Creek.

Station #	Date	Q50 (cfs)	TSS (mg/l)	TRG Qs (t/d)	Qs (t/d)	% Reduction	% Reduction
6	1/2/97	10.5	393	1.4	11.1	87.3	87.3
6	1/20/97	10.5	201	1.4	5.7	75.1	75.1
6	2/6/97	12.9	73	1.7	2.5	31.7	31.7
6	2/13/97	12.9	243	1.7	8.5	79.4	79.4
6	2/20/97	12.9	176	1.7	6.1	71.6	71.6
6	2/26/97	12.9	100	1.7	3.5	50.0	50.0
6	3/6/97	30.1	71	4.1	5.8	29.6	29.6
6	3/12/97	30.1	391	4.1	31.8	87.2	87.2
6	3/19/97	30.1	275	4.1	22.3	81.8	81.8
6	3/26/97	30.1	140	4.1	11.4	64.3	64.3
6	4/2/97	19.7	103	2.7	5.5	51.5	51.5
6	4/9/97	19.7	112	2.7	6.0	55.4	55.4
6	4/16/97	19.7	66	2.7	3.5	24.2	24.2
6	4/24/97	19.7	2,590	2.7	137.8	98.1	98.1
6	4/30/98	19.7	381	2.7	20.3	86.9	86.9
6	5/7/98	9.4	102	1.3	2.6	51.0	51.0
6	5/15/98	9.4	45	1.3	1.1	-11.1	0.0
6	5/23/98	9.4	22	1.3	0.6	-127.3	0.0
6	1/19/98	10.5	191	1.4	5.4	73.8	73.8
6	1/26/98	10.5	55	1.4	1.6	9.1	9.1
6	2/1/98	12.9	115	1.7	4.0	56.5	56.5
6	2/10/98	12.9	53	1.7	1.8	5.7	5.7
6	2/16/98	12.9	43	1.7	1.5	-16.3	0.0
6	3/2/98	30.1	34	4.1	2.8	-47.1	0.0
6	3/16/98	30.1	51	4.1	4.1	2.0	2.0
6	4/4/98	19.7	5	2.7	0.3	-900.0	0.0

Percentile	Q50 (cfs)	TSS (mg/l)	TRG Qs (t/d)	Qs (t/d)	Percent Reduction
16th	10.5	45.0	1.4	1.6	9
50th	12.9	102.5	1.7	4.8	64
84th	30.1	275.0	4.1	11.4	64

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APPENDIX G SUPPLEMENT TO TEMPERATURE TMDL

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11/5/99

G-1. Cottonwood Watershed Shade Evaluation

Introduction

The percent shading values for the Cottonwood Creek watershed were determined using data obtained from 1995-96 ISCC stream surveys. This data was used for temperature evaluation in the TMDL using the USGS SSTEMP model and it's components. This model measures heat flux in the flowing stream segments, and may be used to determine the amount of shade required to meet temperature criteria.

Methods

Survey crews determined percent shading at solar noon by looking upstream and estimating (ocularly) for each reach. Surveys were conducted at base flow in mid-October, 1995, for Stockney, Shebang, Long Haul, South Fork, and Upper Cottonwood Creeks. Red Rock and Lower Cottonwood Creeks were surveyed in mid-July, 1996.

Tributaries were evaluated for the extent of their perennial flow length as determined by crew judgement. In some cases, upstream of where the surveys started, there would be flow in the morning, but none by afternoon. Mainstem Cottonwood Creek did have minimal perennial flow above where the survey started which may have been seep or sourced at the sewer ponds.

Percents shading in Table G-1 below and indicated in the Figure G-1 were weighted by reach length for each subwatershed. These values represent stream shading conditions of flowing segments during the critical time period (July) when temperatures exceed standards. Survey distances varied from 5 to 30 percent for each subwatershed. Maps are available with reach delineations.

Table G-1. Cottonwood Watershed Percent Shading

Waterbody	Length of Tributary (ft)	Length Surveyed (ft)	% of SWS Surveyed	% Shade
Long Haul	79,334.6	11,974	0.15	2
SF Cottonwood	178,509.4	11,314	0.06	13
Shebang	222,533.8	11,155	0.05	19
Stockney	279,534.6	28,525	0.10	48
Red Rock	321,291.9	32,736	0.10	19
Mainstem Cottonwood	441,793.2	130,755	0.30	
Upper Cottonwood				37
Lower Cottonwood				16

G-2. Thermograph Locations

Thermograph monitoring locations for 1996-1997, 1998, and 1999 temperature monitoring are shown in Figures G-2, G-3, and G-4, respectively.

G-3 Atmospheric Condition Data

The Stream Segment Temperature Model (SSTEMP) was used to develop the shade target for each subwatershed. Calibration of the model for each subwatershed relied on stream temperature data, estimated streamflow data and climatic information for the identified critical time periods. The Stream Segment Shade Model (SSHADE), a sub-component of SSTEMP, was used to estimate existing and desired riparian shade for specific channel widths. The Stream Segment Solar Model (SSSOLAR) was used to estimate solar radiation available to increase instream temperature at a given time of year. Parameters for SSSOLAR and SSSHADE included: streamflow; relative humidity; wind speed; cloud cover; vegetative characteristics (site potential characteristics); and air temperature. Air temperature data was available for three weather stations: Grangeville, Kooskia, and Cottonwood. Location and elevation of the subwatershed determined choice of air temperature station for use in the model. Relative humidity wind speed and cloud cover dstimations were made using the NOAA Climatic Atlas (see Margin of Safety). Estimated relative humidity was corrected for changes in elevation within each subwatershed (Appendix G). Daily average streamflow, a critical factor in the model calibration exercise, was limited to sporadic, instantaneous readings obtained from IDEQ BURP field sheets. Additional streamflow data should be collected to more fully characterize this watershed.

Atmospheric condition data needed to calibrate the SSSOLAR and SSTEMP as well as to complete the modeling exercise include air temperature, wind speed, relative humidity and cloud cover Air temperature data was made available from the National Climatological Data Center for Grangeville, Idaho, Kooskia, Idaho and Cottonwood, Idaho. Each of these stations represent different elevations and therefore were used in the modeling exercise. Each stations contained daily maximum and minimum air temperature which were then averaged for each day for the entire period of record. The average monthly air temperature was the temperature used in the modeling analysis (Table G2).

No wind speed data was available. The National Oceanic Atmospheric Administration Climatic Atlas was used estimating wind speed. This atlas presents an average monthly wind speed for the month. The wind speed used in the analysis was 8 mph. No relative humidity data was available. The climatic atlas shows that relative humidity ranged from 20 - 40% depend upon elevation. The relative humidity for each watershed was corrected for a given elevation.

Table G2- Mean Air Temperature for Salmonid Spawning and Rearing Time Period

	Surface Air Station Locations		
Date	Grangeville, ID 1948 - 1998	Kooskia, ID 1989 - 1998	Cottonwood,ID 1978 - 1998
June	58.5	60.6	58.6
July	65.9	68.9	65.9
Aug	65.3	68.8	67.2
Sept	56.9	61.8	58.9

G-4 Frequently Occurring Stream Temperature

Frequently recurring stream temperatures was evaluated for each sub-watershed. Thermograph data for the July 1st - August 16th time period was sorted into temperature groups an the frequency of occurrence was then determined (Figure G1). The frequency distribution charts (Figure G2a - G2) below represent the data used in determining the most frequently occurring stream temperature.

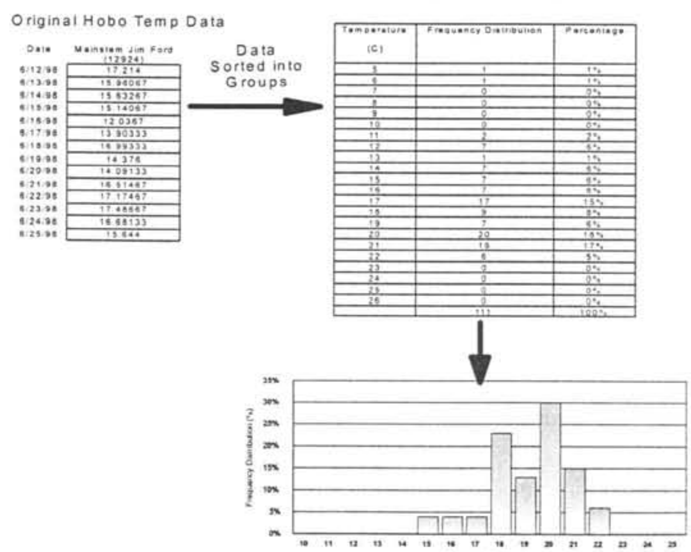
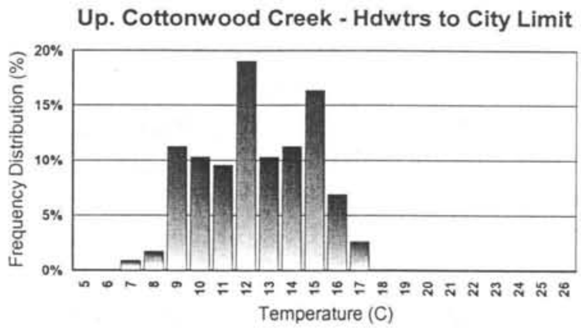
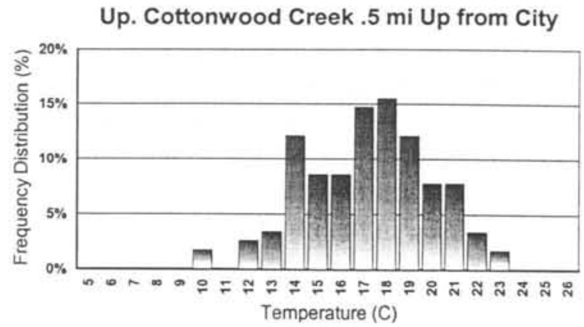
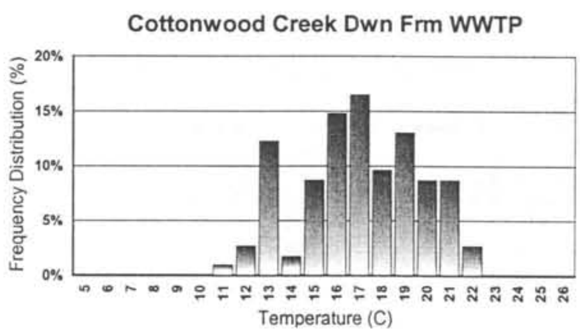


Figure G1







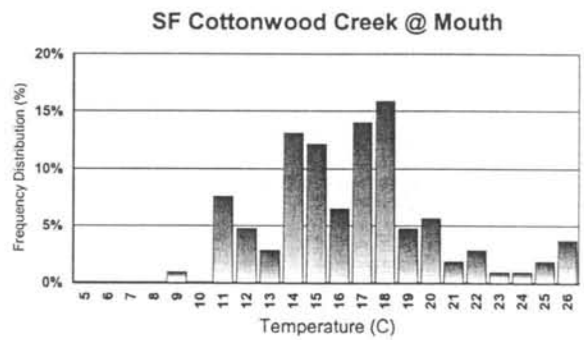


Figure G2a - G2d - G2a (Upper Cottonwood Creek (headwaters to city limits), G2b (Upper Cottonwood Creek .5 mi Up from City Limit),G2c (Cottonwood Creek Dwn from WWTP), G2d (SF Cottonwood Creek @ Mouth)

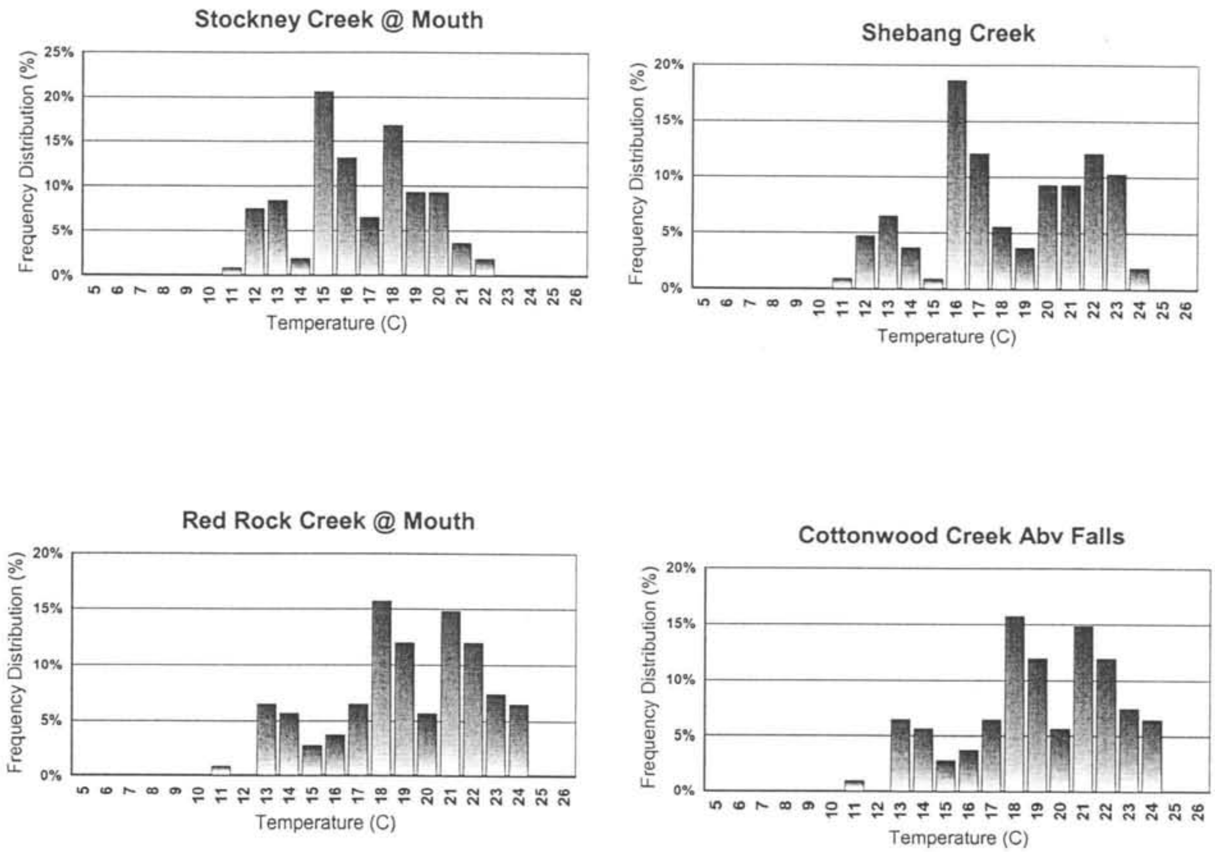
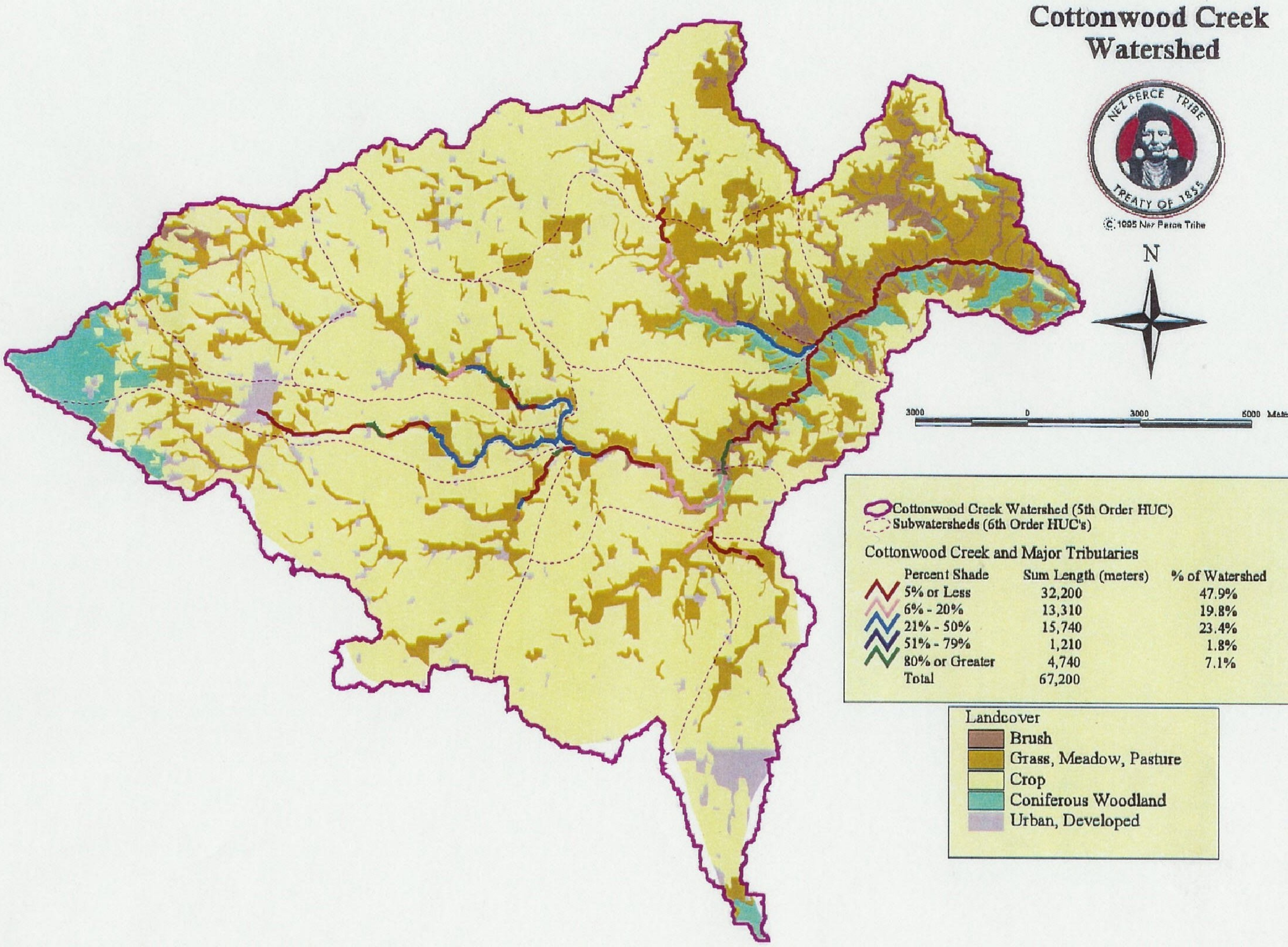


Figure G2e - G2h - G2e (Stockney Creek @ Mouth), G2f (Shebang Creek @ Mouth),G2g Red Rock Creek @ Mouth), G2h (Cottonwood Creek Abv Falls)

Cottonwood Creek Watershed



Cottonwood Creek Watershed

Thermograph Locations 1996-1997

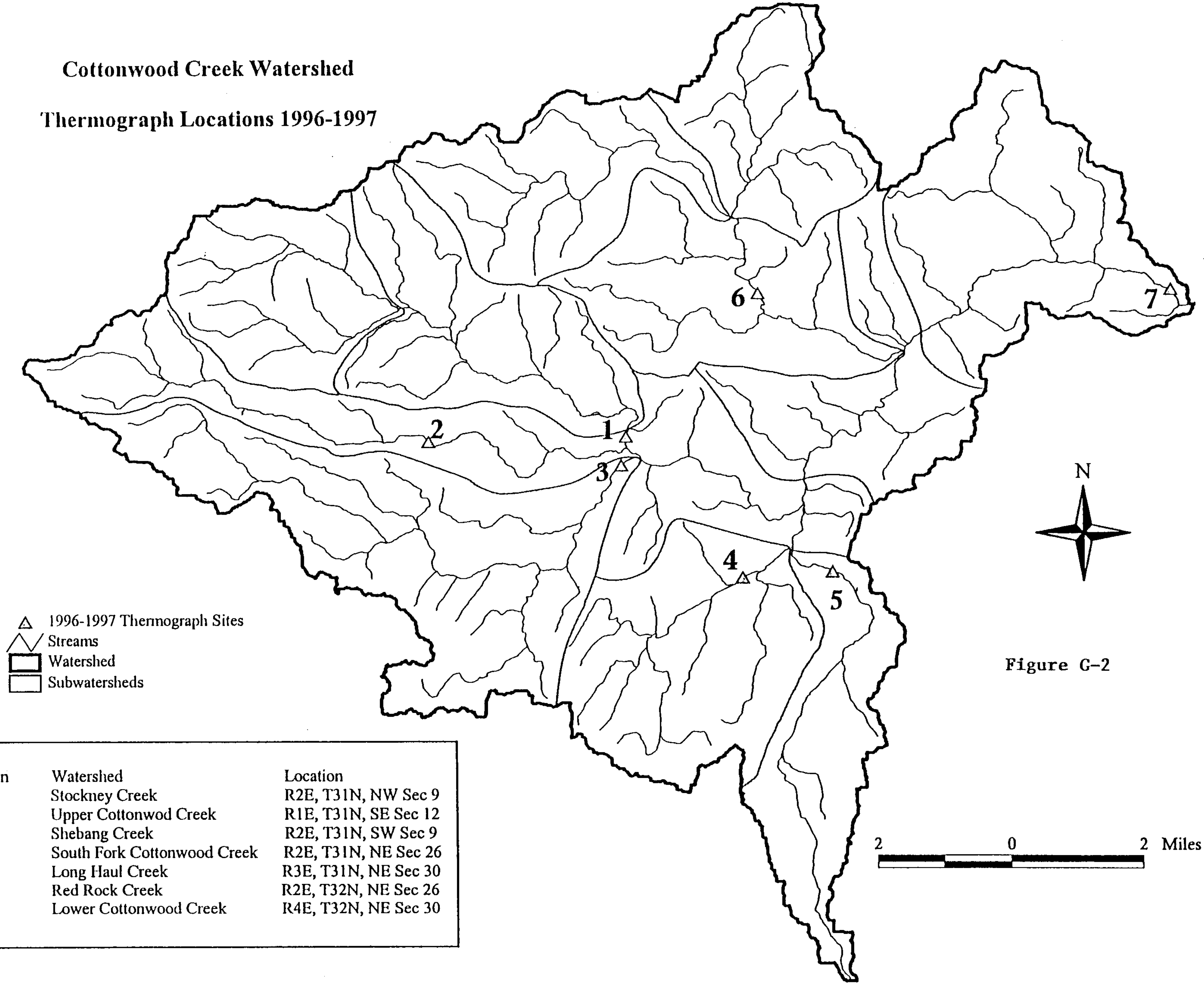


Figure G-2

Station	Watershed	Location
1	Stockney Creek	R2E, T31N, NW Sec 9
2	Upper Cottonwood Creek	R1E, T31N, SE Sec 12
3	Shebang Creek	R2E, T31N, SW Sec 9
4	South Fork Cottonwood Creek	R2E, T31N, NE Sec 26
5	Long Haul Creek	R3E, T31N, NE Sec 30
6	Red Rock Creek	R2E, T32N, NE Sec 26
7	Lower Cottonwood Creek	R4E, T32N, NE Sec 30

Cottonwood Creek Watershed

Thermograph Locations 1998

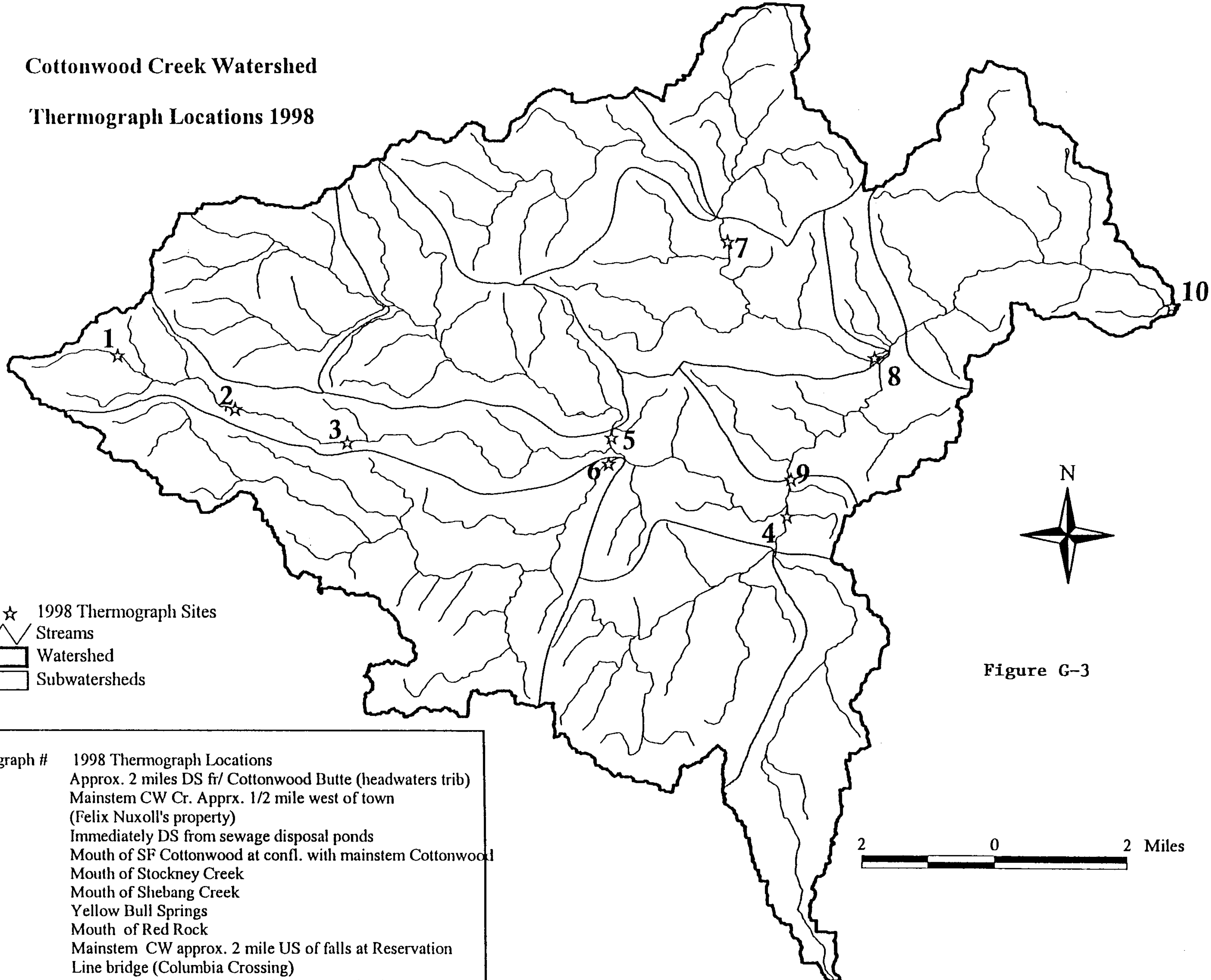


Figure G-3

Site #	Thermograph #	1998 Thermograph Locations
1	74457	Approx. 2 miles DS fr/ Cottonwood Butte (headwaters trib)
2	74460	Mainstem CW Cr. Apprx. 1/2 mile west of town (Felix Nuxoll's property)
3	14436	Immediately DS from sewage disposal ponds
4	74504	Mouth of SF Cottonwood at confl. with mainstem Cottonwood
5	74458	Mouth of Stockney Creek
6	74475	Mouth of Shebang Creek
7	74481	Yellow Bull Springs
8	74497	Mouth of Red Rock
9	18712	Mainstem CW approx. 2 mile US of falls at Reservation Line bridge (Columbia Crossing)
10	18971	Mouth of CW, approx. 0.5 miles US from bridge

Cottonwood Creek Watershed

Thermograph Locations 1999

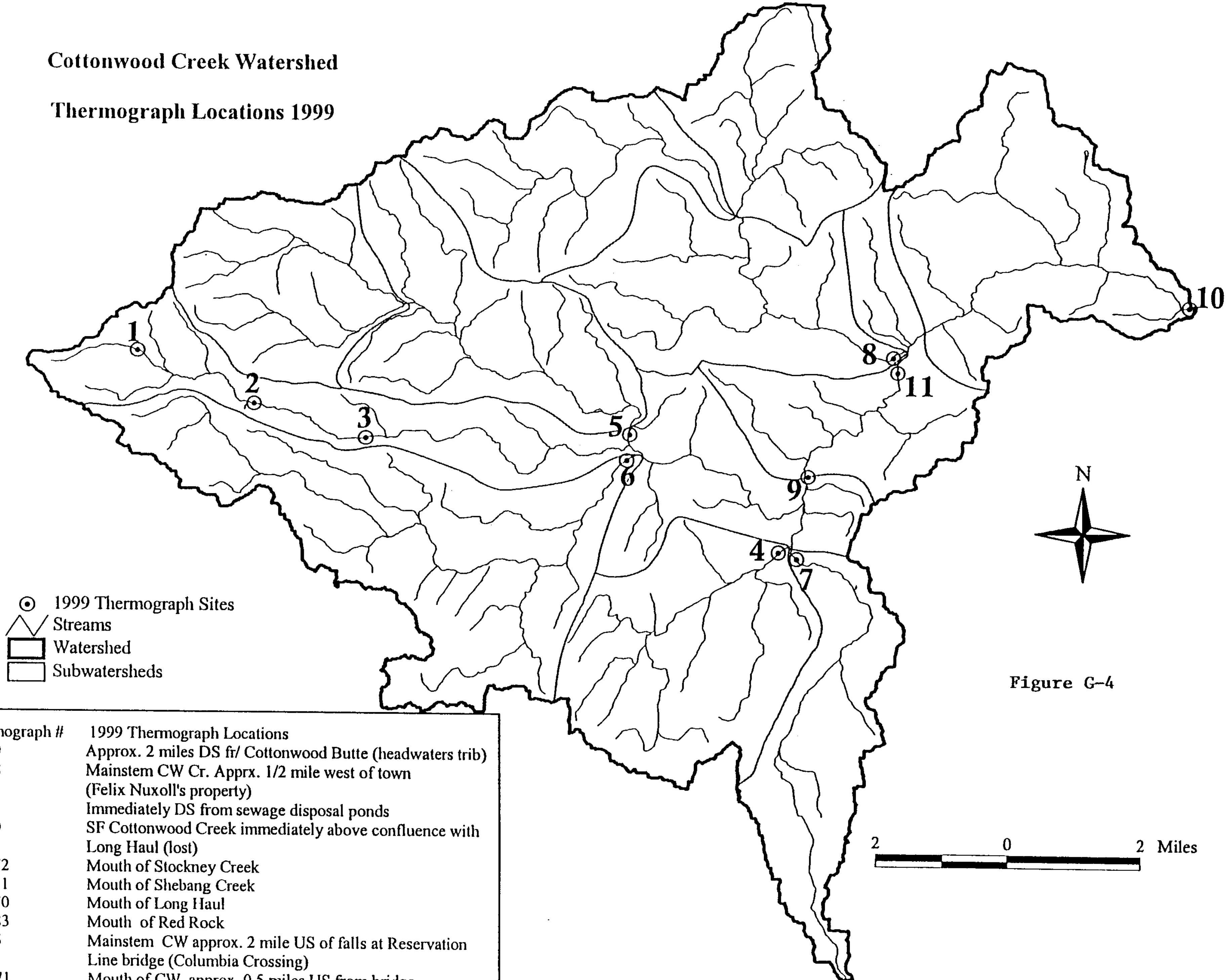


Figure G-4

Site #	Thermograph #	1999 Thermograph Locations
1	12920	Approx. 2 miles DS fr/ Cottonwood Butte (headwaters trib)
2	12918	Mainstem CW Cr. Apprx. 1/2 mile west of town (Felix Nuxoll's property)
3	12925	Immediately DS from sewage disposal ponds
4	12100	SF Cottonwood Creek immediately above confluence with Long Haul (lost)
5	102072	Mouth of Stockney Creek
6	102081	Mouth of Shebang Creek
7	102070	Mouth of Long Haul
8	102083	Mouth of Red Rock
9	95575	Mainstem CW approx. 2 mile US of falls at Reservation Line bridge (Columbia Crossing)
10	102071	Mouth of CW, approx. 0.5 miles US from bridge
11	95577	Mainstem CW, immed US fr/ confl with Red Rock

APPENDIX H WATERSHED RESTORATION STRATEGY

Overview

The Cottonwood Creek Total Maximum Daily Load (TMDL), developed under an existing Memorandum of Agreement between the Nez Perce Tribe, the Environmental Protection Agency (EPA), and the State of Idaho Department of Environmental Quality (IDEQ) was established to restore beneficial uses and achieve state water quality standards. The temperature component of the Cottonwood Creek TMDL establishes a percent reduction target in instream temperature and a corresponding "*Percent Increase In Shade*" target for each sub-watershed. These targets, over time, will ensure reasonable progress toward the attainment of the water quality criteria and protection of sensitive fish species in the Cottonwood Creek watershed.

The Cottonwood Watershed Advisory Group has participated in developing a Watershed Restoration Strategy (WRS) to ensure reasonable progress toward attainment of water quality standards through watershed improvement projects, restoration activities and management practices. As presented in Figure H-1, the structure and success of the WRS implementation rely heavily on the cooperation of landowners in the watershed. Once the strategy is complete, measures identified will be used to develop the analytical component of the temperature TMDL for nonpoint sources in the watershed. The streams affected by this plan include:

- Stockney Creek, Headwaters to Mouth
- Lower Cottonwood Creek, Headwaters to Mouth
- Shebang Creek, Headwaters to Mouth
- Upper Cottonwood Creek, Headwaters to Mouth
- Long Haul Creek, Headwaters to Mouth
- Red Rock Creek, Headwaters to Mouth
- South Fork Cottonwood Creek, Headwaters to Mouth

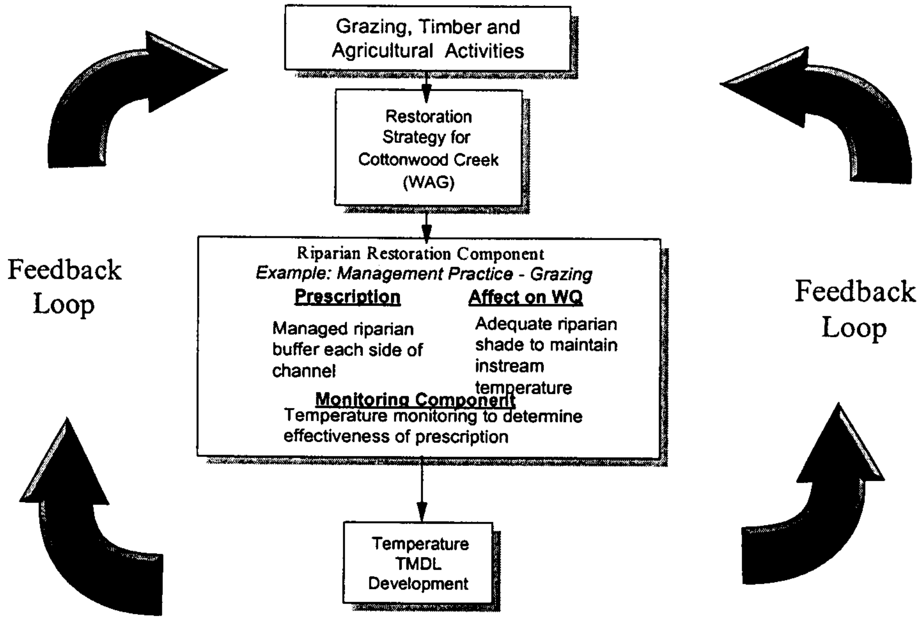


Figure H-1- Riparian Restoration Strategy and Feedback Process

Problem

Streams in the Cottonwood Creek watershed are impaired due to excess heating causing temperature exceedences. Stream temperature is an expression of heat energy per unit volume of water. Temperatures can increase as a result of land management activities which alter basic watershed processes. Stream temperature is affected by the amount of water surface area exposed to direct solar radiation (i.e. sunlight), which is absorbed and dissipated as heat. Land management practices may result in water temperature increases through the process described in Tables H-1 and H-2.

Table H-2 identifies watershed conditions in Cottonwood Creek and their effect on water quality and the human-caused sources attributed to the condition(s).

Table H-1. Watershed Conditions in Cottonwood and Their Effects on Water Quality

Watershed Condition	Description	NPS pollution: relation to watershed condition	Human-Caused Sources of Watershed Condition
I. Riparian area in sub-optimal condition	A. Streambank shade less than 20 percent	High stream temperature: Increased exposure to sun allowing solar heating	•Historic domestic livestock grazing practices with high concentrations or overuse during critical growing season resulting in loss of species diversity, especially riparian woody species •Low level management of livestock •Timber removal •Reduction of wetlands, increased depth to groundwater •Conversion of wetland meadows to pasture and cropland •Removal of shrubs along ditches and streams •Removal of beaver resulting in lower water table
	B. Less than 80 percent streambank stability	High stream temperature: streambank erosion resulting in widening of stream allowing increased solar heating; reduced shade from overhanging banks; low summer flows and reduced cool ground water inflow Sedimentation from bank erosion and channel downcutting	•Historic domestic livestock grazing practices with high concentrations or overuse during critical growing season resulting in increase of nonriparian herbaceous species with shallower and fewer roots; high concentrations or overuse during periods when streambanks are saturated and vulnerable to trampling or chiseling •Stream channelization, straightening •Removal of shrubs along ditches and streams stabilizing banks •Woody debris removal
	C. Reduced riparian vegetation acting as buffer, filter, and sediment trap	Sediment, suspended solids, nutrients, and bacterial input resulting in reduced water quality	• Wildfires •Construction of drainage ditches •Stream channelization, straightening • Soil disturbance from tillage, erosion from road construction and maintenance •Nutrient input from agricultural and grazing practices (algal growth) •Bacteria input from grazing •Reduction and conversion of wetlands •Removal of shrubs along ditches and streams •Removal of beaver resulting in lower water table, reduced wetland areas
II. Other	Mass failure risk in lower reach	Sedimentation, high stream temperature: increased exposure to sun allowing solar heating	• Reduced canopy cover, and land use practices resulting in "flashy" water yield affecting the lower reaches of Cottonwood Creek [1]

1 Evidence of natural mass failures in the canyon reach have been observed.

Objectives

The objectives of the WRS are to:

1. Reestablish natural ecologic regimes in riparian meadows, uplands and grasslands by incorporating best management practices for sensitive landscapes and communities.
2. To implement an adaptive management strategy for agriculture, livestock grazing, forest practices and road building and maintenance. The management strategy will be adjusted annually, as needed, to ensure temperature reductions occur over time.

Proposed management measures

Human activities in the Cottonwood Creek watershed, contribute to temperature increases and other non-point source pollutants (i.e. sediment, nutrients) through timber harvest, grazing, agricultural, recreation, and construction activities. The proposed management measures were developed to improve past practices and aid in the improvement of water quality in the Cottonwood Creek watershed. The WRS calls for the following prescriptions throughout the watershed to ensure progress toward the attainment of water quality standards. Once the WRS is implemented, if reasonable progress toward the attainment of water quality standards is not evident, the WRS will be revisited to determine the necessary changes.

Table H-2. Land Management Practice Proposed, Management Objective Addressed and Implementation Schedule and Monitoring Requirements to Measure Progress

Land Management Practice	Management Objective and Effects on Riparian or Upland Condition	Landowner /Location (sub-watershed)	Specific Management Practice (Specific Sub-watershed) and Effects on Riparian or Upland Condition	Recommended Changes in Current Practices in the Watershed	Implementation and Monitoring
<u>Livestock/Grazing Management</u>					
1. Adaptive management by landowners to adjust timing and season of use of livestock on the pastures to allow improved growth and regrowth of riparian vegetation, improved health of upland vegetation; increased standing vegetation, litter, and diversity	Improvements in riparian vegetation; reduction in bank trampling during periods of saturation; improvements in upland vegetation condition Decrease concentration of animals by providing alternative forage	***EXAMPLE:*** Jim's Ranch-- Shebang Creek subwatershed	Landowner:Current Management Practice(s) No controlled grazing scheme	Recommended Changes in Practice(s): Rotational grazing system would allow critical areas to rest during the critical time period. Timeframe for Monitoring Progress	Implementation: Management: Resources:
2. Implementation of a managed riparian zone (riparian buffer and filter strips) for key areas (to be determined) in theCottonwood Creek watershed.	Improvements in riparian vegetation; reduction in bank trampling during periods of saturation; improvements in upland vegetation condition Decrease concentration of animals by providing alternative forage				

Land Management Practice	Management Objective and Effects on Riparian or Upland Condition	Landowner /Location (sub-watershed)	Specific Management Practice (Specific Sub-watershed) and Effects on Riparian or Upland Condition	Recommended Changes in Current Practices in the Watershed	Implementation and Monitoring
3. Construction of diversion in key areas of the watershed to provide water to livestock during the summer months.	Improvements in riparian vegetation; reduction in bank trampling during periods of saturation; improvements in upland vegetation condition.				
4. Target utilization of __ for uplands annual growth on key herbaceous upland species and __ percent on key woody upland species. Private Land Owners __	Improvements in upland vegetation condition.				
5. Private use of riders to keep livestock away from riparian areas and to ensure areas are not overgrazed.	Improvements in upland vegetation condition.				
6. Construction of fences for improved livestock control adjustments for timing and season of use.					

Land Management Practice	Management Objective and Effects on Riparian or Upland Condition	Landowner /Location (sub-watershed)	Specific Management Practice (Specific Sub-watershed) and Effects on Riparian or Upland Condition	Recommended Changes in Current Practices in the Watershed	Implementation and Monitoring
7. Construction of private holding pens in headwater area for improved livestock control and timely gathering and removal.	Streambank shade will be increased through improvement of shade-providing riparian woody species. Streambank stability will improve through improvement of herbaceous and woody species to provide root mass to provide a matrix for holding the soil particles together. Infiltration will be improved through increase in basal and canopy vegetative cover to intercept overland flow and precipitation.				
8. Water spreading, diversions, wetlands, and holding ponds.	Maintain the water table, especially during the summer.				
9. Tree and shrub planting.					

Land Management Practice	**Management Objective and Effects on Riparian or Upland Condition**	**Landowner /Location (sub-watershed)**	**Specific Management Practice (Specific Sub-watershed) and Effects on Riparian or Upland Condition**	**Recommended Changes in Current Practices in the Watershed**	**Implementation and Monitoring**
Forest Management					
1. Restriction of timber extraction activities in the stream protection zone (riparian area) of Cottonwood Creek.	Streambank shade will be increased through improvement of shade-providing riparian woody species. Streambank stability will improve through improvement of herbaceous and woody species to provide root mass to provide a matrix for holding the soil particles together. Decrease in rate of mass failures in the lower reaches of Cottonwood Creek.				
2. Road management abandonment, closure, obliteration.					

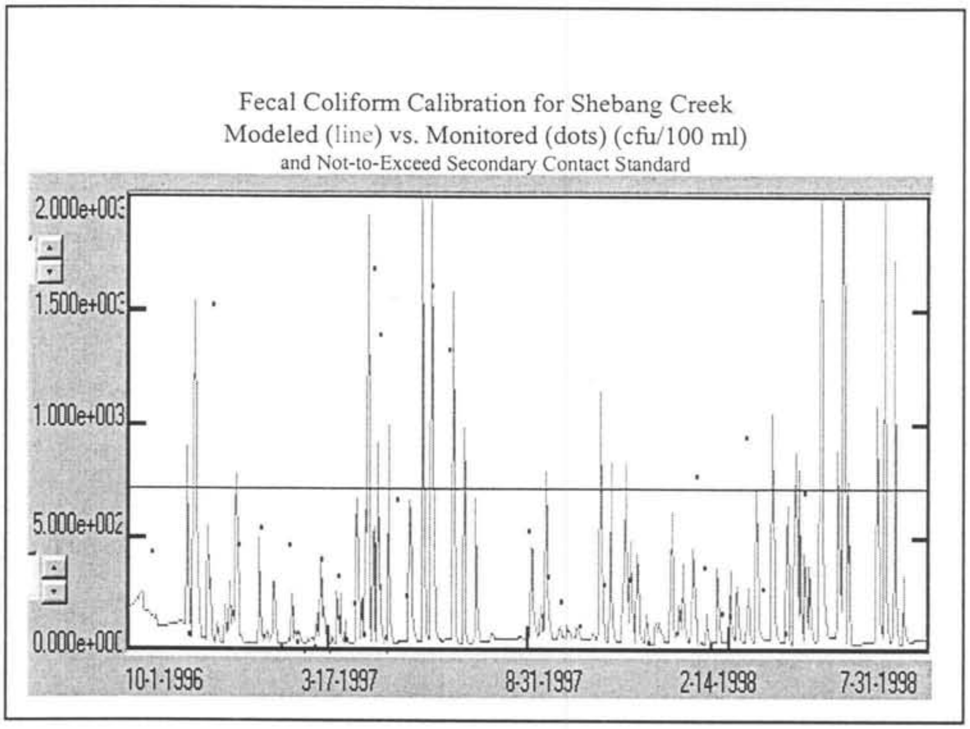
Land Management Practice	Management Objective and Effects on Riparian or Upland Condition	Landowner /Location (sub-watershed)	Specific Management Practice (Specific Sub-watershed) and Effects on Riparian or Upland Condition	Recommended Changes in Current Practices in the Watershed	Implementation and Monitoring
3.Land management activities which attenuate water yield.					
4. Tree and shrub planting.					
Agricultural Management Practices					
1. Nutrient management.					
2. Erosion reduction from croplands, streambanks, roads and ditches ie. grassed waterways, CRP, etc.					
3. Tree and shrub planting.					
4. Stream channel modification.	Streambank stability will improve through restoring old meanders, eliminating the drainage ditch effect. Reduce channel widening and downcutting				
5. Water spreading, wetlands and ponds.	Maintain the water table during the critical time period (i.e. summer)				

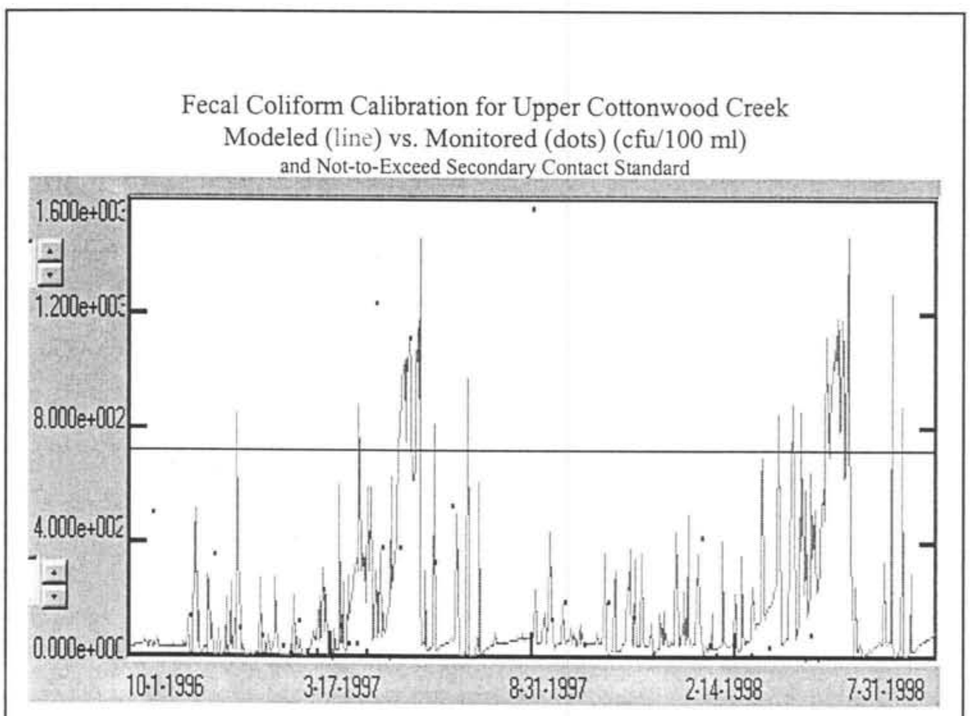
Land Management Practice	Management Objective and Effects on Riparian or Upland Condition	Landowner /Location (sub-watershed)	Specific Management Practice (Specific Sub-watershed) and Effects on Riparian or Upland Condition	Recommended Changes in Current Practices in the Watershed	Implementation and Monitoring
6. Wildlife management to improve and maintain vegetative cover.					
7. Implementation of a managed riparian zone (riparian buffer and filter strips) for key areas (to be determined) in the Cottonwood Creek watershed.					
8. Wetland development for nutrient filtering, water table maintenance, and wildlife habitat.					
9. Pond development for off-stream watering, fire protection, and water table maintenance.					

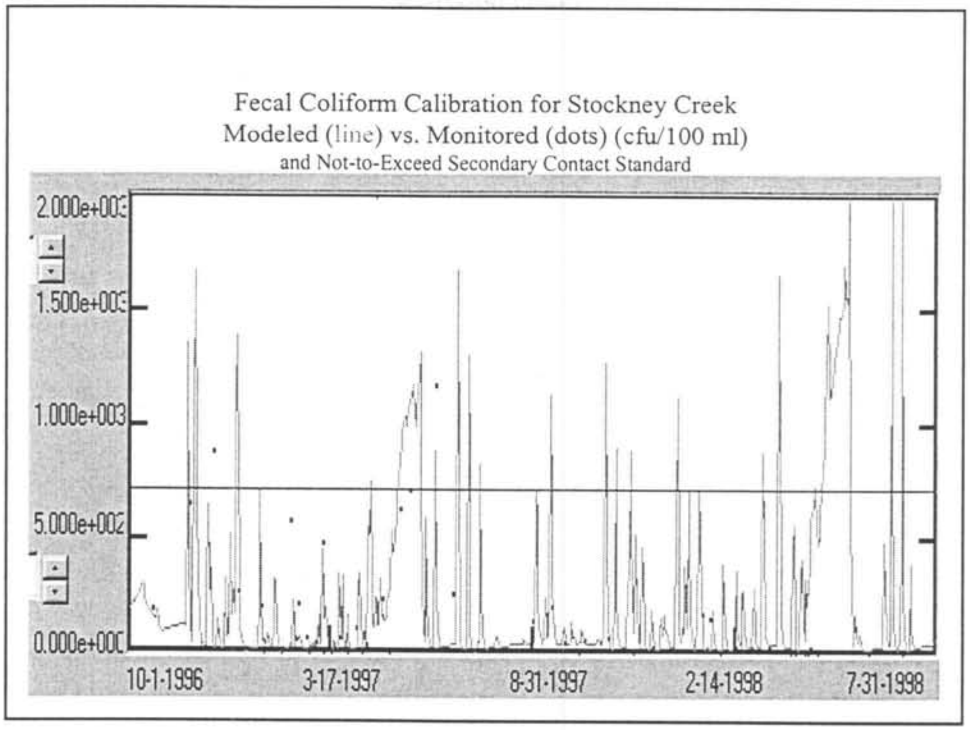
APPENDIX I SUPPLEMENT TO BACTERIA TMDL

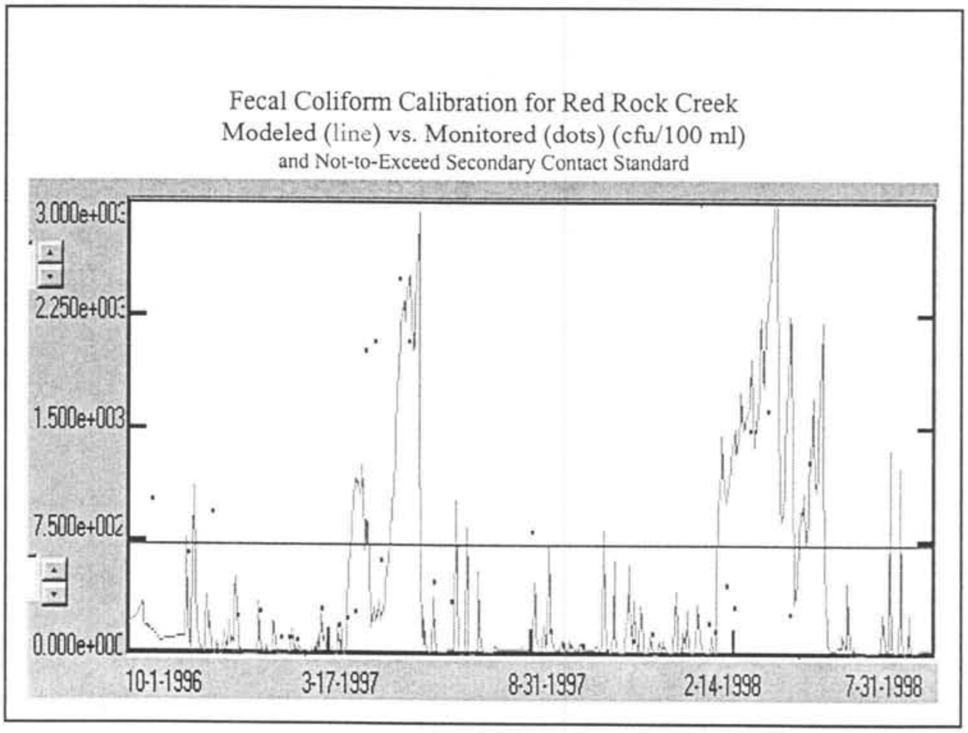
Prepared by:
Paul Cocca,
EPA Headquarters Office
11/24/99

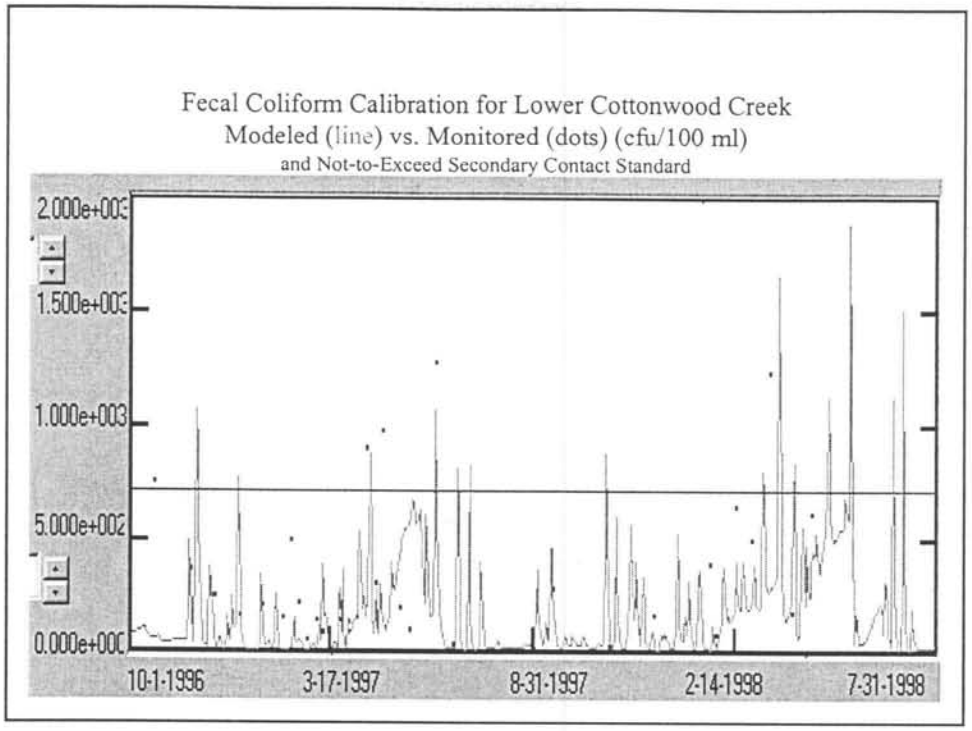
This Appendix contains the BASINs model calibration graphs for all the tributaries in addition to the graph provided in the Bacteria TMDL (Section 3.4) for Lower Cottonwood Creek. The graphs demonstrate the comparison of fecal coliform monitoring data to the modeling for the Cottonwood Creek tributaries.

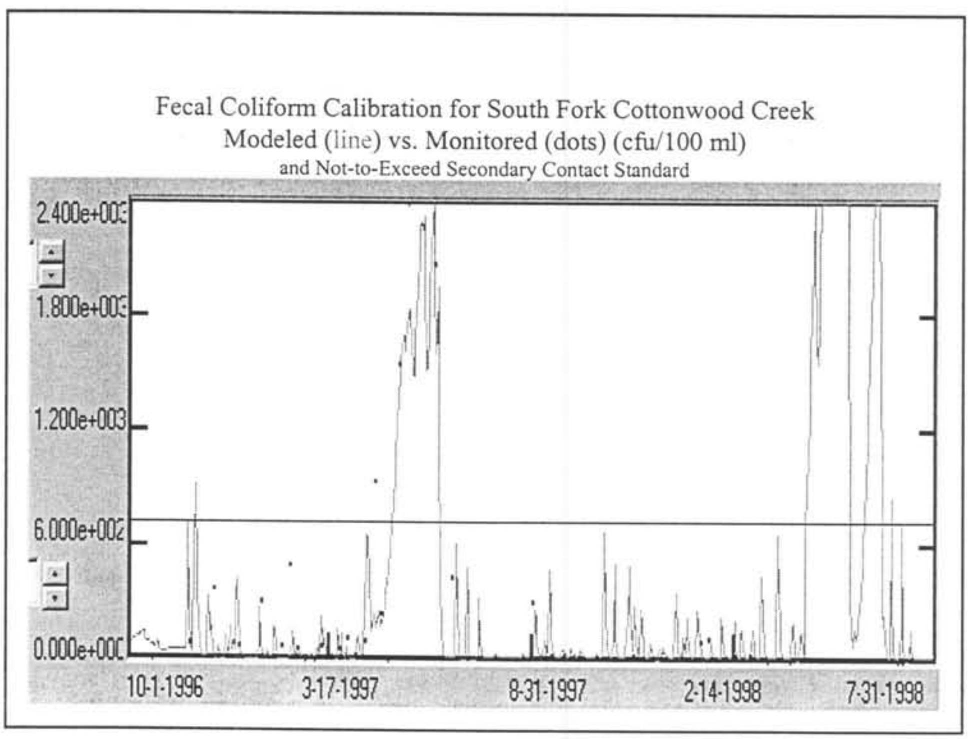

Fecal Coliform Calibration for Shebang Creek
Modeled (line) vs. Monitored (dots) (cfu/100 ml)
and Not-to-Exceed Secondary Contact Standard
2.000e+003
1.500e+003
1.000e+003
5.000e+002
0.000e+000
10-1-1996
3-17-1997
8-31-1997
2-14-1998
7-31-1998

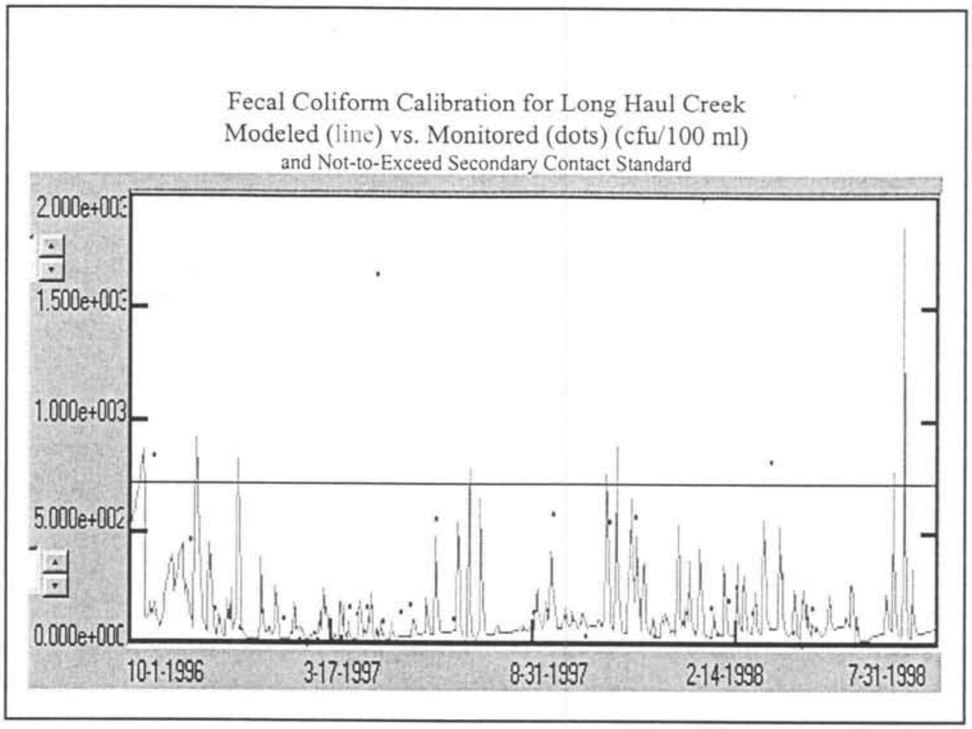

Fecal Coliform Calibration for Upper Cottonwood Creek
Modeled (line) vs. Monitored (dots) (cfu/100 ml)
and Not-to-Exceed Secondary Contact Standard
1.600e+003
1.200e+003
8.000e+002
4.000e+002
0.000e+000
10-1-1996
3-17-1997
8-31-1997
2-14-1998
7-31-1998


Fecal Coliform Calibration for Stockney Creek
Modeled (line) vs. Monitored (dots) (cfu/100 ml)
and Not-to-Exceed Secondary Contact Standard
2.000e+003
1.500e+003
1.000e+003
5.000e+002
0.000e+000
10-1-1996
3-17-1997
8-31-1997
2-14-1998
7-31-1998


Fecal Coliform Calibration for Red Rock Creek
Modeled (line) vs. Monitored (dots) (cfu/100 ml)
and Not-to-Exceed Secondary Contact Standard
3.000e+003
2.250e+003
1.500e+003
7.500e+002
0.000e+000
10-1-1996
3-17-1997
8-31-1997
2-14-1998
7-31-1998


Fecal Coliform Calibration for Lower Cottonwood Creek
Modeled (line) vs. Monitored (dots) (cfu/100 ml)
and Not-to-Exceed Secondary Contact Standard
2.000e+003
1.500e+003
1.000e+003
5.000e+002
0.000e+000
10-1-1996
3-17-1997
8-31-1997
2-14-1998
7-31-1998


Fecal Coliform Calibration for South Fork Cottonwood Creek
Modeled (line) vs. Monitored (dots) (cfu/100 ml)
and Not-to-Exceed Secondary Contact Standard
2.400e+003
1.800e+003
1.200e+003
6.000e+002
0.000e+000
10-1-1996
3-17-1997
8-31-1997
2-14-1998
7-31-1998


Fecal Coliform Calibration for Long Haul Creek
Modeled (line) vs. Monitored (dots) (cfu/100 ml)
and Not-to-Exceed Secondary Contact Standard
2.000e+003
1.500e+003
1.000e+003
5.000e+002
0.000e+000
10-1-1996
3-17-1997
8-31-1997
2-14-1998
7-31-1998

APPENDIX J RESPONSE TO PUBLIC COMMENTS

The draft Cottonwood Creek TMDL was made available for public comment as described in Section 4.0. One individual provided oral and written comments at the December 9, 1999 Clearwater Basin Advisory Group meeting; 3 individuals provided oral comment at the December 15, 1999 public comment meeting and 9 individuals provided written comment. In addition to these comments received during the public comment period, the Cottonwood Creek WAG provided their comment/concerns regarding the TMDL in Section 4.0. This Appendix summarizes both sets of comments and provides responses to them.

Individuals and groups that commented are coded by number in Table J-1. The number is then referenced throughout the following sections. The comments are grouped by subject to reduce duplication of responses. The comments listed are not verbatim. Each comment is followed by a response that addresses how the comment has been incorporated into the Cottonwood Creek TMDL.

Table J-1. Summary of comments

Number	Date of Comment	Type of Comment	Commentator
1	December 6, 1999	written	Cottonwood Creek WAG group comments as provided in Section 4.0 of TMDL
2	December 9, 1999	Oral and written	Cliff Tacke Rt. 1, Box 141 Greencreek, ID 83533
3	December 15, 1999	oral	Lee Rehder Rt. 3, Box 155 Cottonwood, ID 83522
4	December 15, 1999	oral	Lanny Wilson, Chairman Cottonwood Creek WAG HCR 3, Box 151-C Cottonwood, ID 83522
5	December 15, 1999	oral	Gregg Teasdale P.O. Box 446 Genesee, Idaho 83832
6	December 17, 1999	written	Lanny Wilson (see above)

Number	Date of Comment	Type of Comment	Commentator
7	December 17, 1999	written	Don DeArmond Rte. 1, Box 90 Grangeville, ID 83530
8	December 17, 1999	written	David Lustig Rt. 2 Box 53 Kamiah, ID 83536-95
9	December 20, 1999	written	Henry Leandeau City Councilman City of Cottonwood P.O. Box 571 Cottonwood, ID 83522-0571
10	December 28, 1999	written	Kevin Gardes Kimball Engineering 114 Thain Road Lewiston, ID 83501
11	December 31, 1999	written	Richard Holthaus Rt. 1, Box 145 Cottonwood, ID 83522
12	January 3, 2000	written	Allen *(not legible)*
13	January 3, 2000	written	Gregg Teasdale (*not legible*)

J-1. General Issues

Recognition of Past Improvement in Land Use Practices and Water Quality - 1, 2, 3, 8
Comment: Current watershed conditions and land management practices are better than historic conditions and practices.

Response: Section 2.4.2.1 provides some estimates of land use improvements but also recognizes the information is limited. Regardless of past improvements and water quality conditions, the TMDL was required because Cottonwood Creek is remains water quality limited for (NEED TO REWRITE) meet certain water quality criteria and does not fully support beneficial uses. Thus this comment is noted for the record but does not trigger a change in the TMDL.

Designation of Salmonid Spawning Beneficial Use - 1, 2 and 6

Comment: The designated aquatic life beneficial use for Cottonwood Creek (source to mouth) of salmonid spawning is incorrect because of the presence of a waterfall 9 miles from the mouth that is a barrier to fish migration. Only the lower reaches of Cottonwood Creek below these falls should be designated for salmonid spawning. An official request was made that the appropriate regulatory agencies initiate the regulatory process to accomplish this redesignation.

The procedure for changing a designated beneficial use from Salmonid Spawning to Cold Water Biota requires a use attainability analysis (UAA) be completed to determine whether the Salmonid Spawning use is attainable. A UAA was completed for Cottonwood Creek in 1992. The analysis concluded salmonid spawning was a attainable for Cottonwood Creek from its source to mouth as described in Section 2.2.4.

No changes in the TMDL are made as a result of this comment. As has been explained at past WAG meetings, salmonid Spawning beneficial use is not limited to anadromous salmonids. As explained in the 1992 Cottonwood Creek UAA, Salmonid Spawning is attainable above the falls for resident populations. In addition, restricting the salmonid spawning designation to just below the falls would not change the estimated pollutant reductions in the TMDL since conditions in the upper watershed affect conditions in the lower watershed.

Salmonid Spawning Time Frame - 1, 2, and 6
Comment: The salmonid spawning dates for lower Cottonwood Creek should be changed from January 15 to July 15 to January 15 - June 15. Data from expert fisheries biologists support this change. Using the documented instead of default time frame would result in more realistic temperature targets.

Response: The data from the expert fisheries biologist is recognized in Section 2.1.6. The default time frame of January 15 to July 15 is the time frame set out in Idaho water quality standards (IDAPA 16.01.01.250.02.d.iv.). The TMDL must rely on existing standards. The State of Idaho has proposed rulemaking that will be considered by the 2000 Legislature that, if approved, would exclude the default salmonid spawning time frames upon which the temperature TMDL is based and allow for consideration of site-specific spawning conditions. In addition, EPA Region 10 is in the process of developing temperature requirements for salmonid habitat which will be applied in Oregon, Idaho, and Washington. Thus, while a change in the TMDL can not be made at this time as a result of this comment, the TMDL can be revised if new standards become effective that would allow for designation of site-specific salmonid spawning periods.

Unrealistic Goals/Targets - 1, 4, 8, 12
Comment: The goals/targets were unrealistic, probably unattainable and should be changed.
Comment: Goals can be changed.

Response: Since these comments were general and applied to all the pollutants, the issue of the reasonableness of the TMDL targets is addressed separately below on a pollutant specific basis. As a phased TMDL, the document recognizes in several locations that the targets, load capacity, and allocations can be changed based on new information (Sections 1.7, 2.2.7, 3.0, and also in the various load analyses sections). As noted in the document in several places, "Per the State of Idaho's TMDL guidance and concurrence of U.S. EPA and the Nez Perce Tribe, the ultimate measure of TMDL success is beneficial use support."

Use of Limited Data; Worst Case Data - 2, 7, 8 and 12
Comment: The data was extremely limited and taken during two of the worst years of erosion caused by extreme weather conditions. We don't know what was going on 50, 500, 500,000 or 50 million years ago. Historical conditions were considered irrelevant.

Response: The TMDL relied on two major studies conducted between 1996 and 1998. The unusual climatic conditions during that time period is discussed in Section 2.1.2. Additions were made to Section 2.2.7 on TMDL Data Gaps regarding this unusual conditions as well as the phased nature of the TMDL as described in response to the above comment.

Rushed Process: - 7, 12
Comment: The TMDL process was too rushed to meet the deadline. We need to work with changing standards and new information.

Response: This TMDL is being conducted pursuant to a 1997 stipulated lawsuit settlement that specifies a 8 year schedule for TMDL to be completed in Idaho. Based on a TMDL prioritization scheme, the Cottonwood Creek TMDL was scheduled to completed in 1999. This schedule is ambitious and requires documents/decision to be based on the readily available information. While it would be desirable to complete these documents over a longer period of time to allow for a more comprehensive database collected over a decade or more, meeting legal obligations does not allow this luxury. This TMDL and many others are recognized as phased documents that can be changed with the availability of new relevant information. Since the phased nature of the document is recognized in many sections of the document (as noted in the following response regarding targets), no changes are required in the TMDL.

Suggested Land Use Practices - 11
Comment: To improve water quality, the following practices should be employed: 1) sediment basins or ponds; 2) channel straightening and cleaning out; 3) grassed waterways, and 4) general trash cleanup.

Response: These comments pertain to the implementation phase of the project where specific land use practices are recommended; therefore, this comment does not require a change in the TMDL. The TAG generally agrees with these recommendations, however, the TAG does not endorse channel straightening and cleaning out. Channel alteration done in this fashion will only exacerbate the water quality and habitat problems of Cottonwood Creek. Ideally, implementation activities will emphasize restoring natural stream function: for example, straighting the channel of Cottonwood would increase flood magnitude, not reduce it, hence causing more of a sediment problem. See NRCS SAWQP report for more specifics on the stream function and runoff processes of Cottonwood Creek.

Comments regarding issues outside of TMDL - 2, 3, 7

Comment : The WAG has no power or authority to control their own destiny. Decision-making bureaucrats make will not effect their personal livelihoods but will affect the livelihoods of those who live in the watershed.

Comments : The economic condition of agriculture today will affect ability to meet requirements.

Comment: Improvements can be made but they will take a long time. We have to live with the CWA whether we like it or not. We need to do what we can to keep the federal government out of our backyards.

Response: The Cottonwood Creek Watershed Advisory Group was established to provide assistance and advise to the agencies responsible for meeting the legal requirements associated with the development and approval of the TMDL. The degree to which such advice and assistance can be incorporated into the TMDL is dependent on the responsible agencies' limitations associated with application of the state and federal laws. These comments are noted for the record but do not require a change in the TMDL document. The comment regarding the need for time to make improvement pertains to the development of the Implementation Plan and will be considered at that time.

J-2. TMDL Parameter Specific Issues

Sediment TMDL - 2, 4

Comments: The sediment targets are unrealistic and unattainable (see general comment regarding targets above).

Response: The sediment targets established in this TMDL are a numeric interpretation of the State of Idaho narrative sediment standard (IDAPA 16.01.02.200.08). Two targets are established using this numeric interpretation of the standard one for fine and coarse sediment. The numeric interpretations of the standard are based on an extensive literature search that recommends specific criteria which, according to the state of the science, are protective of coldwater biota and salmonid spawning (IDEQ 1999).

The fine sediment target is established as a function of stream discharge where the daily average TSS concentration should not exceed 50 mg/L at the 84th percentile suspended sediment load during the critical time period (i.e. January - May). Given the available information and data, the TAG made the most informed decision possible and expects that achievement of these targets will help Cottonwood Creek and the tributaries meet the narrative sediment standard which, in effect, is full support of the beneficial uses.

The coarse sediment target is established using an empirical linkage analysis where, due to excess bedload input and transport, full support of beneficial uses is measured against the channel stability of lower Cottonwood Creek. To make this a realistic goal, the coarse sediment targets are not established for the upper watershed. Instead, the tributaries are treated as sources of water and sediment to the lower mainstem. Given the available information and data, the TAG made the most informed decision possible and expects that achievement of these targets will help lower Cottonwood Creek meet the narrative sediment standard which, in effect, is full support of the beneficial uses.

Comment: An arbitrary margin of safety was added to the fine sediment estimated reductions that increased reductions from what had been presented to the WAG and believed by the WAG to be achievable.

Response: The **preliminary** results of the fine sediment TMDL were presented at the November 22, 1999 WAG meeting. Subsequently, the results presented at the WAG meeting changed because of a calculation error. As stated in the document, lower Cottonwood Creek and the tributaries were analyzed separately because of the available flow data. The tributary fine sediment load reductions presented at the WAG meeting were wrong because a 80 mg/L target was used rather than a 50 mg/L. The error caused the needed reductions to increase. However, the overall 60% reduction for the watershed did not change, and the relative contribution from each of the tributaries did not change. This should not be seen as a significant complication since these results are based on the available TSS and stream discharge data.

A MOS is a required component of any TMDL and is intended to include a conservative approach to achievement of water quality standards when limited data are available. In this case, the 84th percentile suspended sediment load is used as a conservative approach to establishing the fine sediment load capacity. This approach in not arbitrary and, given the available data, is the best approach possible at present. If better data become available, the fine sediment load capacity can be refined to provide more accurate TMDL goals.

Comment: Roads are the biggest contributor to sediment and contribute more than the TMDL indicates.

Response: Specific water and sediment sources are identified in the sediment TMDL. However, very limited information is available to conclude that roads contribute more sediment than other sources within the watershed. The TAG agrees that roads are a substantial source of sediment to Cottonwood Creek which need to be considered as part of TMDL implementation. The NRCS SAWQP report provides a rough estimate of sediment contribution from roads relative to other sources. To address this comment more a more specific sediment source analysis is incorporated into the sediment TMDLs.

Temperature TMDL - 1 and 7

Comments: The temperature targets, are unrealistic and unattainable (see general comment regarding targets above). In particular the salmonid spawning temperature criteria of 9°C can not be attained no matter what practices are implemented not was it likely to have been met historically. Shading with trees will take a long time.

Response: As stated in the TMDL, achievement of the Idaho salmonid spawning criteria of 9°C in Cottonwood Creek will rely on implementation measures in Cottonwood Creek aimed at controlling the rate of temperature increases. The attainment of water quality standards should occur over time as a direct result of changes in riparian conditions and overall watershed management. While the temperature target is based on a percentage increase in shade that is linked to State temperature criteria, the TMDL recognizes that other factors (such as changes in channel morphology) in addition to an increase in shade will be needed to sufficiently reduce stream temperature. In addition, the TMDL relied on 1998 data considered to be conservative data representing warmest conditions, which resulted in worst-case predictions of necessary temperature reductions. The TMDL notes preferred temperature levels for steelhead and chinook are slightly higher than the existing State criteria and states, "Per the State of Idaho's TMDL guidance and concurrence of U.S. EPA and the Nez Perce Tribe, the ultimate measure of TMDL success is beneficial use support" (p. 3-19).

The expected time frame to achieve the temperature criteria is not specified in the TMDL document, but will be specified in the implementation plan developed 18 months after the approval of the TMDL. As trees may take decades to grow, improvement in stream corridor shading will occur over long time intervals. Improvements in channel conditions which promote cooler temperatures will occur under variable time frames depending on landowner participation and biologic and hydrologic conditions.

Because the Jim Ford Creek TMDL is a phased TMDL, modification to the TMDL can occur to reflect new or additional information (This is recognized in several parts of the document (Section 1.0, Section 3.0, plus several references in the pollutant loading analysis, including in the Temperature TMDL (Section 3.2)).

The TMDL recognizes current study efforts underway by the State and U.S. EPA that may lead to change in temperature criteria and consequent changes in the TMDL. In addition, EPA Region 10 is in the process of developing temperature requirements for salmonid habitat which will be applied in Oregon, Idaho, and Washington. The State has proposed rules that will be considered by the Legislature in 2000 that will address natural conditions, site-specific application of temperature criteria, determination of temperature exceedances, and salmonid spawning time frames. These rule changes, if adopted, will address some of the commentator's concerns.

Because the draft document does not specify time frames for achievement of temperature criteria, and recognizes the ultimate criterion of full support of beneficial uses, no changes will be made in the final TMDL as a result of these comments.

J-8

Nutrient TMDL - 5, 9, 10, 13

Comment: April should be excluded from the aquatic plant growing season. Reasons provided to exclude April in the comments include:

- Other TMDLs is Idaho and neighboring states do not support the inclusion of April in the growing season.
- Including April would require changes in the Cottonwood WWTP money could be wasted given the data gaps on this issue and uncertainties regarding whether those changes will result in the anticipated water quality improvements.
- There is compelling evidence that periphyton accruals are controlled by abiotic factors in the spring.
- The discharge of nutrients in effluent in April and May is not likely to contribute significantly to nutrients available for nuisance algae growth later in the year.
- The justification on why to include April in the growing season is weak.
- There is no definitive relationship between algae growth and nutrient levels.
- Insufficient data exists on both WWTP effluent and instream nutrient and flow data.

Response: Based on these comments and further investigation of this issue, the Cottonwood Creek nutrient TMDL will be revised to exclude April from the aquatic plant growing season. The U.S. Environmental Protection Agency (U.S. EPA) agreed to this change based on several conditions:

- The State, Nez Perce Tribe, and U.S. EPA will pursue funding of additional studies. It is uncertain whether State funding is available for this project, which is why all the agencies agreed to pursue further funding sources.
- The concern of an appropriate growing season and targets will be revisited through revisions to the TMDL triggered by new information or through the EPA NPDES permitting process. New information is expected within 18 months of approval of this TMDL either by the nutrient study described above or additional water quality monitoring information collected by the Nez Perce Tribe. The timing and schedule associated with the NPDES permit process , which is handled by the U.S. EPA, is currently unknown.
- EPA will determine a minimum creek flow requirement for the WWTP NPDES discharge permit so discharges will be discontinued when flows in Cottonwood Creek are too low.

As a result of excluding April in the aquatic plan growing season, the estimated load reductions were modified in Table 39 and 40 and the waste load analysis was deleted from the TMDL. TIN reductions changed from 80 - 92% to 56-89%; TP load reductions changed from 87 - 97% to 83 - 93%.

Comment: The nutrient targets are unrealistic and unattainable (see general comment regarding targets above).

Response: As recognized in Sections 3.3.1.1 and 3.3.1.2, the targets were derived from literature and guidance levels since watershed specific studies have not been conducted. The uncertainties of these targets and ability to change the TMDL targets based on monitoring feedback and other new information is included in two sections, in Section 3.3.6 on Margin of Safety, and in other sections throughout the document that explain the phased TMDL process (refer to response to general comment on targets above). To reiterate the uncertainties and likelihood that changes will be make with better information, the targets are purposely referred to as **preliminary interim instream targets**. As noted in the previous response to the comments regarding algae growing season, the estimated ranges for nutrient reductions were reduced as a result of excluding April data and the relevant portions of the document were reflected accordingly.

Bacteria TMDL - 1, 2

Comment: The appropriate use classification for all tributaries is secondary contact and the government agencies should reconsider use of primary contact criteria in the bacteria TMDL for Red Rock Creek.

Response: According to Idaho water quality standards, primary or secondary contact recreation criteria is the presumed use for undesignated tributaries such as the tributaries to Cottonwood Creek. Thus, an option existed on which criteria to apply in the Cottonwood TMDL. Idaho State DEQ maintains the TMDL should use the secondary contact recreation criteria. The State's position is based on two major points, swimming is a very infrequent activity in Red Rock and the Idaho secondary contact recreation criteria is protective of infrequent swimming.. The Nez Perce Tribe disagreed and maintained a position that the more protective criteria of primary contact recreation should be applied. The U.S. EPA decided that given the Tribal position and that Red Rock Creek is all with the Nez Perce Reservation, it would only approve the use of primary contact recreation. Since the U.S. EPA has the final TMDL approval authority, primary contact recreation criteria were applied to Red Rock. No changes were made in the document as a result of this comment.

The difference in results is presented in Table 52 (47% estimated reduction using secondary criteria and 67% using primary criteria).

Comment: The bacteria targets are unrealistic and unattainable (see general comment regarding targets above).

Response: The bacteria targets were based on current Idaho water quality standards with a 10% margin of safety. The Cottonwood Creek TMDL legally must by based any applicable numeric criteria that are Idaho water quality standards such as the fecal coliform numeric criteria used. The 10% margin of safety is considered an appropriate margin of safety based on uncertainties associated with limited flow and bacteria data. Data limitations and uncertainties associated with the TMDL are recognized in the document. Given that these targets were based on legal standards and limitations are recognized in the document, no changes were made in the TMDL as a results of this comment.

Comment: The commentators supported the current effort by the State to revised the recreational contact standard from one based on fecal coliform to one based on *E. coli.*

Response: This change in the state standards will be considered by the State Legislature and is addressed in the TMDL document in Section 2.2.6.5 and Section 3.4.1. The support of the proposed change is noted for the record but does not require a change in the TMDL document.

Comment: The WAG considered the wildlife estimates used in the bacteria TMDL to be too low.

Response: The estimates in the TMDL were the best guesses from the IDFG given the lack of adequate wildlife population studies in the watershed. No better estimates are available at this time. A sentence will be added regarding the uncertainty of these estimates and the input from the local community that they are too low to Section 3.4.3.3.

Comment: The assumption of the contribution from cattle in the streams is too high based on their observations that cattle don't spend a long time in creeks nor typically defecate in creeks.

Response: As a result of the WAG's earlier similar input, the BASINs model was rerun without cattle in the stream loading as explained in 3.4.3.3. However, when all cattle-in-stream load was entirely taken out, the model calibration for some of the tributaries showed higher levels based on instream data than predicted by the model. In order to get the model output to provide a good fit for the observed data, we needed to add a "point source" during April and May for Upper Cottonwood, Stockney, Red Rock, and South Fork of Cottonwood. A significant fecal coliform load was added directly to creek water in the model since in some creek fecal coliform concentrations were high during periods of no rain, indicative of a significant in-stream point source. The point source was added only for those streams (and months) where concentrations were high during periods of no rain. Whether or not cattle were the "point" source in these streams and these months is an uncertainty and subject of dispute. The loads in question occurred only during late Spring (April and May) and not in summer. Red Rock Creek was particularly odd because the fit for 1998 required a point source starting in February. Given this uncertainty, the reference to "cattle-in-streams" will be changed to "unknown direct source" throughout the bacteria TMDL. An explanation will be added to Section 3.4.3.4 that further investigation is needed to determine the direct source of fecal coliform loads and possibilities include but are not limited to cattle in the streams and migrating birds.

Comment: The assumption that 1/3 of the septic systems are failing may be an underestimate. More information is needed on the proportionate contributions of the various nonpoint sources to bacteria loading.

Response: The assumption is based on an estimate provided by the North Central Health District staff that regulate septic systems in North Central Idaho. An additional explanation will be made in Section 3.4.3.5 regarding this assumption that notes the uncertainty of this estimate based on limited records kept since 1985. The need for better data regarding septic system contributions will be added to the recommendations in Section 3.4.9.