Willow Creek Subbasin Assessment and TMDLs

Department of Environmental Quality

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Cover photo provided by Idaho Department of Environmental Quality.

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Abbreviations, Acronyms, and Symbols

§303(d) Refers to section 303 subsection (d) of the Clean Water Act, or a list of impaired waterbodies required by this section

µ micro, one-one thousandth

§ Section (usually a section of federal or state rules or statutes)

ADB assessment database

AWS agricultural water supply

BLM United States Bureau of Land Management

BMP best management practice

BOD biochemical oxygen demand

BOR United States Bureau of Reclamation

BURP Beneficial Use Reconnaissance Program

C Celsius

CFR Code of Federal Regulations (refers to citations in the federal administrative rules)

cfs cubic feet per second

cm centimeters

CWA Clean Water Act

CWAL cold water aquatic life

DEQ Department of Environmental Quality

DO dissolved oxygen

DWS domestic water supply

EPA United States Environmental Protection Agency

F Fahrenheit

GIS Geographical Information Systems

HUC Hydrologic Unit Code

I.C. Idaho Code

IDAPA Refers to citations of Idaho administrative rules

IDFG Idaho Department of Fish and Game

IDL Idaho Department of Lands

km kilometer

km^2 square kilometer

LA load allocation

LC load capacity

m meter

m^3 cubic meter

mi mile

mi^2 square miles

MBI macroinvertebrate index

mg/L milligrams per liter

mm millimeter

MOS margin of safety

n.a. not applicable

NA not assessed

NB natural background

nd no data (data not available)

NFS not fully supporting

NPDES National Pollutant Discharge Elimination System

NRCS Natural Resources Conservation Service

PCR primary contact recreation

PFC proper functioning condition

ppm part(s) per million

QA quality assurance

QC quality control

SBA subbasin assessment

SCR secondary contact recreation

SFI DEQ's stream fish index

SHI DEQ's stream habitat index

SMI DEQ's stream macroinvertebrate index

SS suspended sediment

STATSGO State Soil Geographic Database

TDS total dissolved solids

TKN total Kjeldahl nitrogen

TMDL total maximum daily load

TP total phosphorus

TS total solids

TSS total suspended sediment

t/y tons per year

U.S. United States

U.S.C. United States Code

USDA United States Department of Agriculture

USFS United States Forest Service

USGS United States Geological Survey

WAG Watershed Advisory Group

WBAG *Waterbody Assessment Guidance*

WBID waterbody identification number

WLA wasteload allocation

WQLS water quality limited segment

WQS water quality standard

Executive Summary

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to Section 303 of the CWA, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the waters whenever possible. Section 303(d) of the CWA establishes requirements for states and tribes to identify and prioritize waterbodies that are water quality limited (i.e., waterbodies that do not meet water quality standards). States and tribes must periodically publish a priority list of impaired waters, currently every two years. For waters identified on this list, states and tribes must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve water quality standards. This document addresses the waterbodies in the Willow Creek subbasin that have been placed on what is known as the "§303(d) list."

This subbasin assessment and TMDL analysis has been developed to comply with Idaho's TMDL schedule. This assessment describes the physical, biological, and cultural setting; water quality status; pollutant sources; and recent pollution control actions in the Willow Creek Subbasin located in southeast Idaho. The first part of this document, the subbasin assessment, is an important first step in leading to the TMDL. The starting point for this assessment was Idaho's current §303(d) list of water quality limited waterbodies. Twenty segments of the Willow Creek Subbasin were listed on this list. The subbasin assessment portion of this document examines the current status of §303(d) listed waters and defines the extent of impairment and causes of water quality limitation throughout the subbasin. The loading analysis quantifies pollutant sources and allocates responsibility for load reductions needed to return listed waters to a condition of meeting water quality standards.

Subbasin at a Glance

The Willow Creek Subbasin in southeastern Idaho (Figure A) is a watershed of the Upper Snake River Basin. Waters of Willow Creek are connected to the Snake River through a complex irrigation system located below the Ririe Reservoir.

Native fish populations, water quality, and riparian habitat conditions are issues of concern in the subbasin. The cumulative effects of land management in riparian areas, human-caused stream alterations, roads, limited recreation, and pockets of timber harvesting have combined to limit compliance with water quality standards. The production and survival of resident fishes is also impacted throughout the watershed.

Rainbow trout, Yellowstone cutthroat trout, brook trout, and brown trout have all been documented in the watershed. Yellowstone cutthroat trout is a state sensitive species carefully managed by the Idaho Department of Fish and Game (IDFG). Fish count data show that salmonid populations, a family to which the fish listed belong, are trending downwards in the subbasin.

Designated uses for Willow Creek (proper) are: cold water aquatic life, salmonid spawning, primary contact recreation, secondary contact recreation, domestic water supply, and special resource water. Undesignated uses are cold water aquatic life and primary and secondary contact recreation for the remainder of the watershed, which includes the following: Birch Creek, Sellars Creek, Mill Creek, Crane Creek, Long Valley Creek, Grays Lake Outlet, Homer Creek, Brockman Creek, Corral Creek, Sawmill Creek, Lava Creek, Hell Creek, Tex Creek, and Meadow Creek.

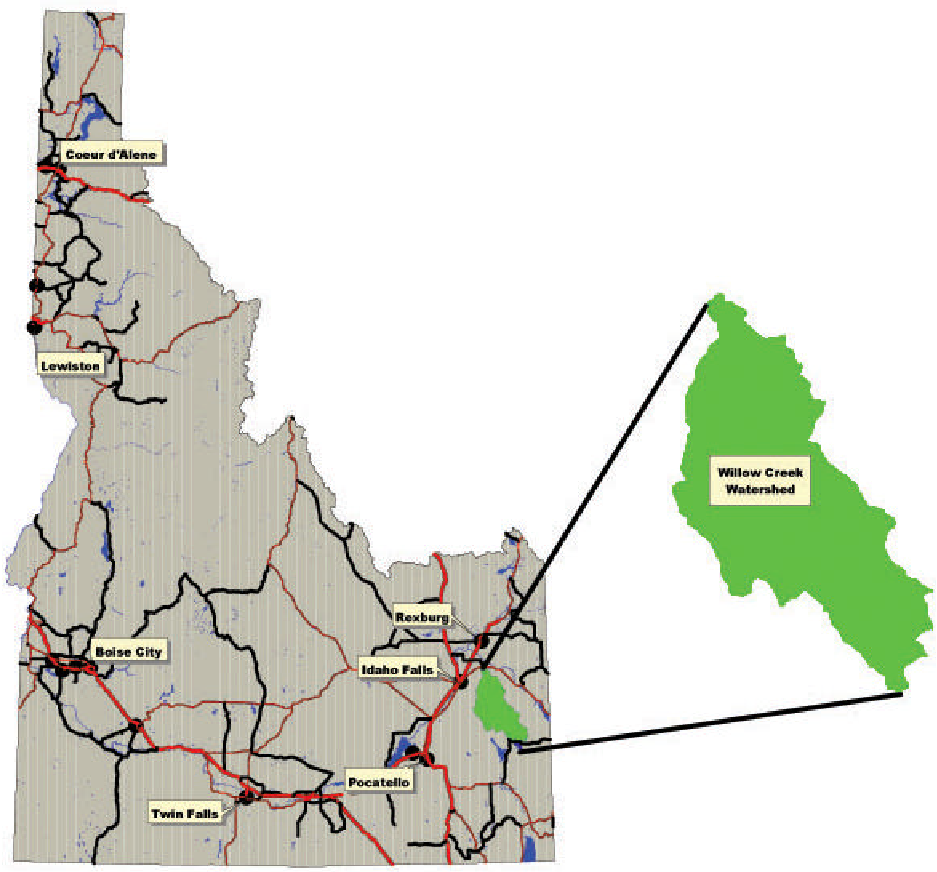

Figure A. Willow Creek Subbasin at a Glance

Biological assessments conducted by the Idaho Department of Environmental Quality (DEQ) in discrete locations have shown that several streams in the subbasin are water quality limited. Sediment and temperature are the primary pollutants of concern with some nutrient listings. Flow alteration has also been identified as a source of perturbation in the subbasin.

Data has been collected and analyzed to evaluate the scope of the water quality limiting issues on the 303(d) listed streams in the Willow Creek Subbasin. Fourteen sediment, twelve temperature, and one nutrient TMDLs, as summarized in Table A, have been developed from the results of the data, or in response to the data.

Table A. Streams and pollutants for which TMDLs were developed.

Stream	Pollutant(s)
Brockman Creek	Sediment, Temperature
Buck Creek	Sediment
Corral Creek	Sediment, Temperature
Crane Creek	Sediment
Grays Lake Outlet	Temperature
Hell Creek	Sediment, Temperature
Homer Creek	Sediment, Temperature
Lava Creek	Sediment, Temperature
Meadow Creek	Sediment
Mill Creek	Sediment, Temperature
Rock Creek	Temperature
Sawmill Creek	Sediment, Temperature
Sellars Creek	Sediment, Temperature
Seventy Creek	Sediment
Tex Creek	Sediment, Temperature
Willow Creek	Sediment, Temperature, Nutrients

TMDLs for sediment are quantified through streambank erosion inventories and road sediment modeling. Sediment loading targets were developed based on literature detailing expected natural conditions and substrate sediment impacts on salmonid spawning. The target values established will be used to quantify streambank recovery and determine the need for additional management practices to improve water quality.

TDML targets for substrate sediment are adopted from literature detailing its impact on salmonid egg and fry emergence. The target values established in this assessment will be used to indicate trends related to channel morphology and streambank recovery. Beneficial use support status and compliance with state water quality standards will be used to determine the need for additional best management practices to improve water quality.

Temperature TMDLs have been developed for all streams, where thermograph data has been collected, to support salmonid spawning and cold water aquatic life. Salmonid spawning has been determined to be the presumed use for all streams in the subbasin.

Reduced riparian vegetation contributes to accelerated streambank erosion which results in increased thermal loading which, combined with associated changes in channel morphology are the primary causes of increased temperature loading in affected streams.

Elevated temperatures from reduced riparian vegetation and accelerated streambank erosion have been exacerbated by an ongoing drought in the subbasin.

TDMLs were not developed for streams listed as flow altered. Streams listed as flow altered and streams discovered to be flow altered for significant portions of the year do not have a reasonable potential to support beneficial uses. The EPA does not believe that flow (or lack of flow) is a pollutant as defined by CWA Section 502(6). Since TMDLs are not required to be established for waterbodies impaired by pollution but not pollutants, TMDLs will not be developed for flow altered streams, at this time. They will be relisted as flow altered.

Key Findings

Land use and management, along with stream conditions throughout the entire subbasin, are primarily homogeneous. The magnitude of sediment loading within the subbasin is widespread, predominantly attributable to streambank erosion from over-utilization of riparian habitat. Some additional sources of sediment loading are poor road maintenance, road crossings, and limited mass wasting (downward movement of earth and rock due to the force of gravity.)

Anthropogenic (human-related) causes of flow alteration in the subbasin include diversion for stock watering and irrigation. It is not likely that beneficial uses will be restored in streams of the watershed where dewatering from surface water diversion occurs during significant portions of the year. The potential exists for a voluntary and cooperative management agreement to improve flow conditions without negatively impacting the rural economy.

DEQ has developed recommendations for the reduction of sediment from streambank erosion and road erosion within the Willow Creek Subbasin. The recommendations result in beneficial use support through improving streambank stability and reducing road erosion, ultimately improving riparian vegetation. All sediment loads are developed through the estimation of sediment delivery to streams from streambank and road erosion.

TDMLs are recommended for sediment, temperature, and nutrients based upon the following criteria:

Sediment TMDLs are based on literature suggesting that 80% bank stabilities show for full beneficial use support. Cold water aquatic life and salmonid spawning are expected to be fully supported at 80% streambank stability. Instream sediment targets have been identified from literature values that are supportive of salmonid spawning and coldwater aquatic life. These target values are set at 28% fine sediment less than 6.35 mm in diameter in spawning habitat and will be used to track the progress of streambank stabilization and the reduction of depth fines to determine the need for additional management practices to improve water quality in the Willow Creek Subbasin.

Temperature TMDLs have been developed for streams where temperature data has been collected and shows an exceedance of temperature criteria in greater than 10% of observation days during spring or fall spawning periods. Thermograph data established that temperature TMDLs were necessary to meet the numeric salmonid spawning criteria [IDAPA 58.01.02.250(02)]. All Temperature TMDL load reductions were developed by quantifying the daily temperature exceedance during spring and fall spawning and subtracting that from the spawning temperature criteria to formulate the load reduction (allocation). Streambank erosion, reduced riparian vegetation, and low flow conditions are the causes of increased water temperatures in the subbasin. The TMDL temperature targets are the salmonid spawning temperature criteria established in Idaho's administrative code [IDAPA 58.01.02.250(02)].

Nutrient TMDLs have been established for Willow Creek where nutrient monitoring data shows elevated levels of phosphorus and nitrogen in conjunction with low dissolved oxygen levels in the stream and visual observation of deleterious levels of aquatic plant growth. The TMDL target values are based on EPA suggestions for the preservation of cold water aquatic life.

There are twenty-two 303(d) listed stream segments in the Willow Creek Subbasin. In the text that follows there are descriptions of the water quality issues related to the 303(d) listed streams. Table B provides a summary of the assessment outcomes for each of the 303(d) listed stream segments.

Birch Creek

Birch Creek's water is retained upstream in two locations, thus reducing flow below Bone Road to less than 1 cfs a large portion of the year. Flow alteration is the driving issue here so, a sediment TMDL will not be developed for Birch Creek.

Brockman Creek

Predominant landuse activities on Brockman Creek are sheep and cattle grazing. The over utilization of riparian zones has contributed to active downcutting, creating a stream that is highly entrenched with high width/depth ratios and lateral recession rates. The estimated current sediment-loading rate is 384 tons/mile/year. To address sediment issues, a TMDL was developed prescribing an annual loading rate of 25 tons/mile/year, provided banks are restored to 80% stability.

Brockman Creek is not listed for temperature, but thermograph data show that stream temperatures exceed Idaho's salmonid spawning criteria. In order to protect beneficial use support, TMDLs were developed for Brockman Creek. Brockman Creek's current temperature-loading rate is 19.7°C (maximum daily) and 17.84°C (maximum daily average). A 34% reduction in the maximum daily temperature is necessary to meet the criteria.

Corral Creek

Corral Creek is listed for sediment and temperature. Land use is predominated by sheep and cattle grazing where riparian impacts are evident with high bank instabilities. The current estimated erosion rate is 226 tons/mile/year. The TMDL prescribes a sediment-loading rate of 18 tons/mile/year.

Temperature exceedances were also documented on Corral Creek, with a current maximum daily temperature load of 22.39°C. The temperature TMDL prescribes a 42% reduction in the maximum daily average temperatures.

Crane Creek

Crane Creek is 303(d) listed for sediment from source to mouth. Grazing is the predominant source of sedimentation in the drainage, with limited riparian road impacts. Bank stabilities of 67% and 66% were documented on Crane Creek. The current estimated erosion rate is 172 tons/mile/year. The TMDL prescribes a sediment-loading rate of 25 tons/mile/year.

Grays Lake Outlet

Sediment, nutrients, and temperature are 303(d) listed pollutants above the falls on Grays Lake Outlet. The water from Grays Lake is allocated for irrigation, hence discharge to Grays Lake Outlet is limited above the falls. Temperature, nutrient and sediment TMDLs will not be developed for the upper section of Grays Lake Outlet because flow alteration is the overriding issue is this particular stream segment. Grays Lake Outlet, above the falls, should be delisted for sediment and nutrients and relisted as flow altered.

Channel recharge restores streamflow to Grays Lake Outlet below the falls, and Grays Lake Outlet is temperature listed from headwaters to mouth and temperature exceedances were documented in two locations. Current temperature loading is 28.34°C (maximum daily) and 21.58°C (maximum daily average). The TMDL prescribes a 54% and 58% reduction in maximum and average daily stream temperatures. Because Grays Lake Outlet is flow limited above the falls, the temperature TMDL applies to waters below the falls.

Hell Creek

Hell Creek is listed for sediment and nutrients. Land use is predominated by cattle grazing, and streambank stabilities less than the 80% stability target were observed. The current estimated sediment-loading rate on Hell Creek is 402 tons/mile/yr. The TMDL prescribes a sediment-loading rate of 39 tons/mile/year.

Hell Creek is not 303(d) listed for temperature, but stream temperature exceedances were documented. Current temperature loading is 19.51°C (maximum daily) and 17.41°C (maximum daily average). The TMDL prescribes 33% and 48% reductions in maximum and average daily temperatures.

Homer Creek

Homer Creek is 303(d) listed for sediment and Homer Creek’s sediment sources are related to grazing. Streambank conditions that are below the DEQ 80% stability target were observed. The current estimated erosion rate is 411 tons/mile/year, and the TMDL prescribes an erosion rate of 20 tons/mile/year.

Homer Creek is not 303(d) listed for temperature, but stream temperature exceedances were documented. Current temperature loading is 26.42°C (maximum daily) and 18.79°C (maximum daily average). The temperature TMDL prescribes 51% and 52% load reductions in the maximum and average daily temperatures.

Lava Creek

Lava Creek is 303(d) listed for sediment and temperature. Stream temperature data reveal current temperature loads of 22.80°C (maximum daily) and 18.44°C (maximum daily average). The TMDL prescribes a 43% and 51% reduction in maximum and average daily temperatures. It is expected that stream temperatures will improve with riparian zone enhancement.

A culvert on upper Lava Creek continuously exists in a state that inhibits downstream flow. It is speculated that beaver activity, combined with anthropogenic actions, continue to create this condition. It is likely that eliminating the anthropogenic cause of this condition and clearing the obstruction will assist in improving stream temperatures.

Streambank erosion inventories show bank stabilities of 26% at the upper inventory site and 55% at the lower inventory site. The current sediment-loading rate is 537 tons/mile/year. The TMDL prescribes a sediment-loading rate of 16 tons/mile/year.

Long Valley Creek

Listed for sediment and temperature, Long Valley Creek parallels the Long Valley Road. Land use on Long Valley Creek consists of grazing and hay production and bank stabilities were observed below the 80% stability target. An earthen dam retains water in the Robinson Reservoir to impound spring runoff waters for irrigation. Because flow alteration is the prevailing issue, TMDLs will not be developed for Long Valley Creek. Long Valley Creek should be delisted for sediment and temperature and relisted as flow altered.

Meadow Creek

Meadow Creek is listed for sediment, and the principal sources of sediment are streambank erosion in the upper reaches and road erosion in the lower sections. The sediment load allocations have been developed via erosion inventories and road erosion modeling. From headwaters to South Fork Meadow Creek, streambank stabilities of 80% have been achieved from cessation and/or rotation of grazing practices in the vicinity. The current estimated erosion rate from road and streambank erosion is 60 tons/mile/year. A sediment-loading rate of 34 tons/mi/year, from bank erosion, is anticipated if all streambanks are restored to 80% stability. A 50% reduction in road erosion should occur for beneficial use support, prescribing a road sediment-loading rate of 6 tons/mile/year.

Mill Creek

The land surrounding Mill Creek is private and state owned with grazing the principal land use. Monitoring and observations show the largest impacts on the creek are in the middle and lower reaches where land utilization is maximized. Riparian fencing below the headwaters has contributed to riparian improvement, thereby reducing streambank erosion. Substrate samples collected on Mill Creek, above the Willow Creek confluence, had 51% of the sediment fines less than 6.35 mm. Streambank erosion inventories showed the highest concentration of sedimentation occurring in the middle reaches of Mill Creek, above the Blackfoot Reservoir Road crossing. The current estimated erosion rate from streambank erosion is 26 tons/mile/year. The TMDL prescribes a loading rate of 8 tons/mile/year.

Stream temperature exceedances were documented with current temperature loading at 24°C (maximum daily) and 18.2°C (maximum daily average). The TMDL prescribes a 46% and 51% reduction in maximum and average daily temperatures.

Buck Creek is a tributary of Mill Creek and it is located in the Mill Creek assessment unit therefore, Mill Creek load allocations apply to Buck Creek.

Sawmill Creek

Sawmill Creek is 303(d) listed for temperature and sediment. Stream temperature data documented major exceedances in salmonid spawning criteria at 20.9°C (maximum daily) and 18.11°C (maximum daily average). The TMDL prescribes 38% and 50% reductions in maximum and average daily temperatures. The current estimated streambank erosion rate on Sawmill Creek is 340 tons/mile/year. It is expected that a rate of 19 tons/mile/year will occur if banks are restored to 80% stable.

Sellars Creek

Sellars Creek is 303(d) listed for sediment and temperature. Riparian road impacts, riparian grazing, and flow alteration are the three principal causes of perturbation on Sellars Creek. Subsurface fines are higher than the target level of 28% and bank erosivities are highest above the Long Valley Road crossing. Streambank erosion on lower Sellars Creek, below Long Valley Road crossing, is nominal due to limited grazing. The current estimated erosion rate is 304 tons/mile/year. The TMDL prescribes an erosion rate of 11 tons/mile/year.

Stream temperatures in Sellars Creek were above the spawning criteria 65% and 85% of the time. Temperature data show that current temperature loads are 26.7°C (maximum daily) and 18.51°C (maximum daily average). The TMDL prescribes a 51% reduction in both maximum and average daily temperatures.

Seventy Creek

Seventy Creek is 303(d) listed for temperature, sediment, and flow alteration. At this time, data is not available to verify that Seventy Creek is temperature impaired. It is inferred that temperature impairment from sedimentation will improve, as much as possible in light of flow alterations, with reduced sedimentation and riparian zone improvement. Streambank erosion inventories show banks on Seventy Creek, above the Blackfoot Reservoir Road, to be relatively stable. In the lower reaches, bank stabilities are as low as 39%. Bank erosion on Seventy Creek should not exceed 11 tons/mile/year. The current estimated sediment-loading rate is 288 tons/mile/year.

Tex Creek

Tex Creek is not listed for temperature, but stream temperature data show that there were elevated spawning temperatures at 24.19°C (maximum daily) and 17.96°C (maximum daily average). The TMDL calls for a 46% and 50% reduction in maximum and average daily temperatures.

Sediment impacts on Tex Creek have not been quantified via subsurface sediment sampling because extremely dry conditions over recent years have prohibited the accurate identification of viable spawning habitat. However, it is well documented that the Tex Creek fishery is declining, most likely from stream sedimentation. Based on historic knowledge and fish data spanning several decades, a sediment TMDL is necessary for Tex Creek. Road impacts are the primary source of sedimentation in Tex Creek, so the TMDL is based on road erosion. The current estimated sediment-loading rate is 8 tons/mile/year. The TMDL prescribes a loading rate of 4 tons/mile/year hence, a 50% reduction in road erosion is recommended.

Willow Creek

The entire Willow Creek is 303(d) listed for temperature above and below the reservoir. Temperature logger data show that stream temperatures at Kepp’s Crossing are above the salmonid spawning criteria. Documented maximum daily temperatures are 24.54°C during spring spawning and 18.72°C during fall spawning. The TMDL prescribes 47% and 60% reductions in maximum and average daily temperature loads.

Willow Creek, below the reservoir dam to Eagle Rock Canal, is listed for temperature and sediment. Flow from the Ririe Reservoir dam is reduced to no discharge for four to five months of the year. Flow is the limiting factor for beneficial use support below the Ririe Reservoir, so it should be delisted for sediment and temperature and relisted as flow altered.

Willow Creek, from headwaters to Sellars Creek and then from Grays Lake Outlet to the Reservoir, is listed for sediment and temperature. Streambed sampling shows that sediment impacts are evident in spawning gravels at Grays Lake Outlet and Kepp’s Crossing. In both instances, subsurface fines were greater than 28%, at 31%. Streambank stabilities are less than 80% in most areas above the Grays Lake Outlet confluence. Bank stabilities meet the 80% target in the steep walled canyons below the confluence with Grays Lake Outlet. The current sediment-loading rate on Willow Creek is 213 tons/mile/year. The TMDL prescribes a sediment-loading rate of 14 tons/mile/year.

High nutrient concentrations in the water column along with nuisance levels of aquatic plant growth were detected in Willow Creek. To address the excess nutrients in Willow Creek, phosphorus and nitrogen load allocations were developed. The load allocations prescribe a 23% reduction in total phosphorus loading and a 73% reduction in nitrogen loading to Willow Creek.

The Ririe Reservoir is 303(d) listed for sediment. Aquatic conditions in the reservoir environment differ from that of streams. Current biological indices for cold water aquatic life apply to streams, not reservoirs. Given this, the Ririe Reservoir listing for sediment should be delisted, because there is insufficient data to compile an accurate assessment. Even though a TMDL will not be developed for the Reservoir, it should be noted that load reductions for upstream Willow Creek and its tributaries should result in an overall net reduction of sediment loading to the Reservoir.

Rock Creek, a tributary of Willow Creek, is 303(d) listed for temperature. Temperature data for Rock Creek itself does not exist however, temperature data is available just downstream of Rock Creek, on Willow Creek (Kepp's Crossing). For the purpose of this TMDL, and the assessment unit reporting system, Rock Creek will receive the same load allocation as Willow Creek proper.

The sediment load that can be assimilated by the streams in the Willow Creek Subbasin, and still meet Idaho's water quality narrative standard for sediment, is unknown. The loading capacity lies somewhere between the current loading level and sediment loads from natural streambank erosion. It is assumed that cold water aquatic life and salmonid spawning would be fully supported at natural background sediment loading rates.

Table B. Summary of assessment outcomes.

Waterbody Segment	Assessment Unit(s) of ID17040205	Pollutant	TMDL(s) Completed	Recommended Changes to §303(d) List	Justification
Birch Creek (WQLS 2042) Headwaters to Willow Creek	SK006_02 SK006_03	Sediment	No	Delist for sediment and relist as flow altered	Flow Altered (Anthropogenic)
Brockman Creek (WQLS 2047) Headwaters to Grays Lake Outlet	SK024_02 SK024_03 SK025_02 SK025_03	Nutrient	No	Delist	No Exceedances Documented
		Sediment	Yes	None	TMDL completed
		Temperature	Yes	None	Exceedances Documented TMDL Completed
Buck Creek (WQLS 5232) Headwaters to Mill Creek	SK012_02	Sediment	Yes	None	TMDL completed
Corral Creek (WQLS 2048) Headwaters to Brockman Creek	SK026_02	Sediment	Yes	None	TMDL completed

Waterbody Segment	Assessment Unit(s) of ID17040205	Pollutant	TMDL(s) Completed	Recommended Changes to §303(d) List	Justification
		Temperature	Yes	None	Exceedances Documented TMDL completed
Crane Creek (WQLS 2056) Headwaters to Willow Creek	SK014_02	Sediment	Yes	None	TMDL completed
Grays Lake Outlet (WQLS 2044) Grays Lake to Above Falls	SK020_02	Nutrient	No	Delist for nutrient and relist as flow altered	Flow Altered (Anthropogenic)
		Sediment	No	Delist for sediment and relist as flow altered	Flow Altered (Anthropogenic)
Grays Lake Outlet (WQLS 2044) Grays Lake to Willow Creek	SK016_04 SK017_04 Sk019_04	Temperature	Yes	None	Exceedances Documented TMDL completed
Hell Creek (WQLS 2045) Headwaters to Grays Lake Outlet	SK029_02 SK029_03	Nutrient	No	Delist	No Exceedances Documented
		Sediment	Yes	None	TMDL completed
		Temperature	Yes	None	Exceedances Documented TMDL completed
Homer Creek (WQLS 2050) Headwaters to Grays Lake Outlet	SK018_02 SK018_03	Sediment	Yes	None	TMDL completed
		Temperature	Yes	None	Exceedances Documented TMDL completed
Lava Creek (WQLS 2046) Headwaters to Grays Lake Outlet	SK028_02 SK028_03	Sediment	Yes	None	TMDL completed
		Temperature	Yes	None	Exceedances Documented TMDL completed
Long Valley Creek (WQLS 2053) Headwaters to Willow Creek	SK015_02	Sediment	No	Delist for sediment and relist as flow altered	Flow Altered (Natural and Anthropogenic)
		Temperature	No	Delist for temperature and relist as flow altered	Flow Altered (Natural and Anthropogenic)
Meadow Creek (WQLS 2040) Headwaters to Ririe Reservoir	SK032_02 SK032_03	Sediment	Yes	None	TMDL Completed
		Temperature	Yes	None	Exceedances Documented TMDL completed

Waterbody Segment	Assessment Unit(s) of ID17040205	Pollutant	TMDL(s) Completed	Recommended Changes to §303(d) List	Justification
Mill Creek (WQLS 2054) Headwaters to Willow Creek	SK012_02 SK012_03	Sediment	Yes	None	TMDL completed
		Temperature	Yes	None	Exceedances Documented TMDL completed
Ririe Lake (WQLS 2036)	SK002_05	Sediment	No	Delist	Not assessed
Rock Creek (WQLS 2028) Headwaters to Willow Creek	SK005_02	Temperature	Yes	None	Exceedances Documented TMDL completed
Sawmill Creek (WQLS 2049) Headwaters to Brockman Creek	SK027_02	Sediment	Yes	None	TMDL completed
		Temperature	Yes	None	Exceedances Documented TMDL completed
Sellars Creek (WQLS 2051) S FK Sellars to Willow Creek	SK010_02 SK010_03	Flow Alteration	No	None	EPA Policy
		Sediment	Yes	None	TMDL completed
		Temperature	Yes	None	Exceedances Documented TMDL completed
Seventy Creek (WQLS 2057) Headwaters to Willow Creek	SK011_02	Flow Alteration	No	None	EPA Policy
		Sediment	Yes	None	TMDL completed
		Temperature	No		Insufficient Data
Tex Creek (WQLS 2041) Headwaters to Indian Fork	SK031_02 SK031_03	Sediment	Yes	None	TMDL completed
		Temperature	Yes	None	Exceedances Documented TMDL completed
Willow Creek (WQLS 2035) Ririe Dam to HUC boundary	SK001_05	Sediment	No	Delist for sediment and relist as flow altered	Flow Altered (Anthropogenic)
		Temperature	No	Delist for temperature and relist as flow altered	Flow Altered (Anthropogenic)
Willow Creek (WQLS 2037) Grays Lake Outlet to Ririe Reservoir	SK004_05 SK005_05	Sediment	Yes	None	TMDL completed
		Temperature	Yes	None	Exceedances Documented
		Nutrients	Yes	None	Exceedances Documented

Waterbody Segment	Assessment Unit(s) of ID17040205	Pollutant	TMDL(s) Completed	Recommended Changes to §303(d) List	Justification
Willow Creek (WQLS 2038) Sellars Creek to Grays Lake Outlet	SK008_04 SK005_04	Nutrients	Yes	None	Exceedances Documented
Willow Creek (WQLS 2039) Headwaters to Sellars Creek	SK011_04 SK013_03	Sediment	Yes	None	TMDL completed
		Temperature	Yes	None	Exceedances Documented
		Nutrients	Yes	None	Exceedances Documented

1. Subbasin Assessment – Watershed Characterization

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to Section 303 of the CWA are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the waters whenever possible. Section 303(d) of the CWA establishes requirements for states and tribes to identify and prioritize waterbodies that are water quality limited (i.e., waterbodies that do not meet water quality standards). States and tribes must periodically publish a priority list of impaired waters, currently every two years. For waters identified on this list, states and tribes must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve water quality standards. This document addresses the waterbodies in the Willow Creek Subbasin that have been placed on what is known as the "§303(d) list."

The overall purpose of this subbasin assessment and TMDL is to characterize and document pollutant loads within the Willow Creek Subbasin. The first portion of this document, the subbasin assessment, is partitioned into four major sections: watershed characterization, water quality concerns and status, pollutant source inventory, and a summary of past and present pollution control efforts (Chapters 1 – 4). This information will then be used to develop a TMDL for each pollutant of concern for the Willow Creek Subbasin (Chapter 5).

1.1 Introduction

In 1972, Congress passed the Federal Water Pollution Control Act, more commonly called the Clean Water Act. The goal of this act was to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Water Pollution Control Federation 1987). The act and the programs it has generated have changed over the years as experience and perceptions of water quality have changed. The CWA has been amended 15 times, most significantly in 1977, 1981, and 1987. One of the goals of the 1977 amendment was protecting and managing waters to insure "swimmable and fishable" conditions. This goal, along with a 1972 goal to restore and maintain chemical, physical, and biological integrity, relates water quality with more than just chemistry.

Background

The federal government, through the U.S. Environmental Protection Agency (EPA), assumed the dominant role in defining and directing water pollution control programs across the country. The Department of Environmental Quality (DEQ) implements the CWA in Idaho, while the EPA oversees Idaho and certifies the fulfillment of CWA requirements and responsibilities.

Section 303 of the CWA requires DEQ to adopt, with EPA approval, water quality standards and to review those standards every three years. Additionally, DEQ must monitor waters to identify those not meeting water quality standards. For those waters not meeting standards, DEQ must establish TMDLs for each pollutant impairing the waters. Further, the agency must set appropriate controls to restore water quality and allow the waterbodies to meet their designated uses. These requirements result in a list of impaired waters, called the "§303(d) list." This list describes waterbodies not meeting water quality standards. Waters identified on this list require further analysis. A subbasin assessment and TMDL provide a summary of the water quality status and allowable TMDL for waterbodies on the §303(d) list. The *Willow Creek Subbasin Assessment and TMDL* provides this summary for the currently listed waters in the Willow Creek Subbasin.

The subbasin assessment section of this report (Chapters 1 – 4) includes an evaluation and summary of the current water quality status, pollutant sources, and control actions in Willow Creek Subbasin to date. While this assessment is not a requirement of the TMDL, DEQ performs the assessment to ensure impairment listings are up to date and accurate. The TMDL is a plan to improve water quality by limiting pollutant loads. Specifically, a TMDL is an estimation of the maximum pollutant amount that can be present in a waterbody and still allow that waterbody to meet water quality standards (Water quality planning and management, 40 CFR 130). Consequently, a TMDL is waterbody- and pollutant-specific. The TMDL also includes individual pollutant allocations among various sources discharging the pollutant. The EPA considers certain unnatural conditions, such as flow alteration, a lack of flow, or habitat alteration, that are not the result of the discharge of a specific pollutant as "pollution." TMDLs are not required for waterbodies impaired by pollution, but not specific pollutants. In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several waterbodies and/or pollutants within a given watershed.

Idaho's Role

Idaho adopts water quality standards to protect public health and welfare, enhance the quality of water, and protect biological integrity. A water quality standard defines the goals of a waterbody by designating the use or uses for the water, setting criteria necessary to protect those uses, and preventing degradation of water quality through antidegradation provisions.

The state may assign or designate beneficial uses for particular Idaho waterbodies to support. These beneficial uses are identified in the Idaho water quality standards and include:

- Aquatic life support – cold water, seasonal cold water, warm water, salmonid spawning, modified
- Contact recreation – primary (swimming), secondary (boating)
- Water supply – domestic, agricultural, industrial
- Wildlife habitats, aesthetics

The Idaho legislature designates uses for waterbodies. Industrial water supply, wildlife habitat, and aesthetics are designated beneficial uses for all waterbodies in the state. If a waterbody is unclassified, cold water and primary contact recreation are used as additional default designated uses when waterbodies are assessed.

A subbasin assessment entails analyzing and integrating multiple types of waterbody data such as, biological, physical/chemical, and landscape data to address several objectives:

- Determine the degree of designated beneficial use support of the waterbody (i.e., attaining or not attaining water quality standards).
- Determine the degree of achievement of biological integrity.
- Compile descriptive information about the waterbody, particularly the identity and location of pollutant sources.
- When waterbodies are not attaining water quality standards, determine the causes and extent of the impairment.

1.2 Physical and Biological Characteristics

The Willow Creek Subbasin is located in portions of Bingham, Bonneville, and Caribou counties of southeastern Idaho. The subbasin covers a geographical area of 647 square miles (mi^2), with the widest section, the middle of the basin, being approximately 25 miles (mi) wide. The basin narrows at the northern and southern ends to a width of four miles at the Ririe Reservoir and 9.5 mi in the Grays Lake area. Total basin length, from southernmost point to northernmost point, is 52 mi.

Three mountain ranges surround the subbasin: the Caribou Range is to the east, the Blackfoot Range to the west, and the Grays Range to the south. The highest peak is Caribou Mountain at 9803 feet (ft), which is located on the southeastern portion of the watershed above the headwaters of North Fork Eagle Creek, a tributary of Grays Lake. The highest peak to the west is Birch Creek Mountain at 7487 ft, where the headwaters of Birch Creek originate. To the south, Henry Peak, above headwaters for Gravel Creek, has an elevation of 8317 ft. The Grays Lake wetland complex and its source reaches reside on the southern tip of the subbasin where the elevation is approximately 7000 ft. Drainage flows towards the Ririe Reservoir, the lower end of the watershed at 5200 ft.

There are 543 stream miles in the Willow Creek Subbasin. Willow Creek is the longest stream at 57 mi; Grays Lake Outlet, a tributary of Willow Creek is the second longest at 37 mi. Headwaters for Willow Creek are located in a high elevation, spring-fed, meadow-marsh complex at approximately 6600 ft. Willow Creek proceeds through the subbasin where several tributaries merge with it to flow to the Hydrologic Unit Code (HUC) boundary, below the Ririe Reservoir at 5250 ft. The approximate valley gradient for Willow Creek, from headwaters to HUC boundary, is 24 miles.

Climate

The climate of the subbasin is classified as semiarid high desert characterized by warm to hot dry summers and long, cool winters. The climate of Idaho is primarily influenced by air masses moving inland from the Pacific Ocean (Godfrey 1999). The major source of moisture is the maritime air from the prevailing westerly winds. Convection thunderstorms during spring and summer months also contribute to precipitation in the subbasin.

Eastern Idaho tends to be more continental in character than western or northern Idaho (Godfrey 1999), resulting in a greater range between winter and summer temperatures. In summer months, rainfall, cloud cover, and relative humidity are at a minimum due to the weakening of the westerly winds, allowing continental climate conditions to prevail (Abramovich *et al*. 1998).

Table 1 lists weather stations in the vicinity of the Willow Creek Subbasin, showing the period over which the station has recorded data, the geographic location of the station, and the elevation at which the station is located.

Table 1. Weather Stations in the vicinity of the Willow Creek Subbasin.

Station Name	Station ID	Period of Record	Latitude	Longitude	Elevation (feet)
Henry, ID	104230	9/23/1971 to 10/31/1987	42°54’	111°31’	6140
Swan Valley 2E, ID	108937	7/8/1960 to 12/31/2000	43°27’	111°18’	5360
Palisades, ID	106764	7/8/1947 to 8/31/1993	43°21’	111°13’	5390
Idaho Falls 2ESE, ID	104455	5/20/1952 to 12/31/2000	43°29’	112°01’	4770
Idaho Falls 16SE, ID	104456	11/10/1955 to 12/31/2000	43°21’	111°47’	5850

Precipitation throughout the subbasin varies somewhat, as shown in Tables 2 – 6, which show monthly averages for each weather station listed in Table 1. In these tables, 1= Average Maximum Temperature (°F), 2= Average Minimum Temperature (°F), 3= Average Total Precipitation (in.), 4= Average Total Snowfall (in.), and 5= Average Snow Depth (in.).

The average annual precipitation is about 20.38 inches (in) at Henry (Table 2) near the upper end of the subbasin and is 12.25 inches at the lower end of the subbasin near Idaho Falls (Table 5). The precipitation in the area is relatively evenly distributed throughout the year with slight increases during the winter and again in May and June. Abramovich et al. (1998) indicate that southeastern Idaho is somewhat unique with these two precipitation peaks as compared to the rest of the state, which typically has one winter peak in precipitation.

The western and eastern boundaries of the subbasin probably receive the majority of the precipitation originating from orographic lifting (the rise of warm arm as it reaches a mountain range) along the Blackfoot Mountains and the Caribou Mountains (see Figure 3). The northwestern portion of the subbasin is adjacent to the relatively flat Snake River Plain and average annual precipitation in this region is the lowest at 12.25 inches (Table 5). The Idaho Falls 16SE station (Table 6) is located within the Willow Creek subbasin in the region between Ozone and Bone. Precipitation in the Willow Creek foothills show the immediate effects of that orographic lifting with average annual precipitation up to 15.67 inches as compared to the 12 inches at Idaho Falls. Swan Valley (Table 3) and Palisades (Table 4) located on the other side of the Caribou Mountains receive average annual precipitation of 17.79 inches and 19.72 inches, respectively.

The annual average snowfall for the subbasin varies from 28.5 inches at Idaho Falls (Table 5) to 84.9 inches at Henry (Table 2) with majority of the snowfall occurring between November and March. Snow-pack tends to be greatest at the upper end of the subbasin and decreases towards the West consistent with elevation. Light snowfall begins in September in the higher elevations but the lower elevations in the subbasin generally do not receive snow until October.

Table 2. Monthly climate summary for Henry, Idaho.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
1.	27.1	34.4	40.8	52	61.5	72.2	80.4	79.4	69.5	56.4	39.9	30.9	53.7
2.	3.9	7.6	14.5	22.8	33.1	39.9	43.6	41.9	34.4	26	15.6	7.6	24.2
3.	1.95	1.72	1.64	1.03	2.44	1.33	1.65	1.35	1.7	1.59	1.87	2.13	20.38
4.	17.7	15.2	10.6	4.3	1.5	0.1	0	0	0.4	2.5	14.6	17.9	84.9
5.	28	33	26	9	0	0	0	0	0	0	3	17	10

Table 3. Monthly climate summary for Swan Valley 2E, Idaho.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
1.	30	35.9	44.1	54.8	65	74.7	84.1	83.2	73.5	60.3	42.1	31.2	56.6
2.	10.3	13.2	20.6	27.5	34.6	40.3	44.6	43.5	36	27.4	20.8	11.7	27.6
3.	1.56	1.07	1.22	1.58	2.55	1.65	1.30	1.27	1.51	1.25	1.54	1.29	17.79
4.	17	8.6	7.2	3.7	1.1	0.1	0	0	0.1	0.9	7.2	12	57.9
5.	10	10	4	0	0	0	0	0	0	0	1	4	3

Table 4. Monthly climate summary for Palisades, Idaho.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
1.	29	34.2	42.1	53.9	65.4	74.7	84	82.1	73.1	60.2	42.4	31.5	56
2.	11.8	14.3	19.9	29	37.5	44.3	50.8	49.1	41	32.6	23.9	15.9	30.8
3.	1.94	1.63	1.52	1.56	2.16	1.94	1.12	1.29	1.49	1.37	1.76	1.94	19.72
4.	21	14.8	11	3.5	0.5	0	0	0	0	1	7.3	17.7	76.9
5.	12	14	10	1	0	0	0	0	0	0	1	5	4

Table 5. Monthly climate summary for Idaho Falls 2 ESE, Idaho.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
1.	30.1	37.4	47	58.2	68.4	77.5	86.4	85.5	75.2	61.5	43.9	32	58.6
2.	12.8	17.9	24.3	31.6	39.5	46.6	52	50.2	41.5	32	23.3	14.1	32.2
3.	1.03	0.94	1.03	1.1	1.68	1.3	0.59	0.76	0.84	0.94	1	1.04	12.25
4.	8.3	5.3	3.2	0.5	0.4	0	0	0	0	0.4	3.3	7.1	28.5
5.	4	2	0	0	0	0	0	0	0	0	0	2	1

Table 6. Monthly climate summary for Idaho Falls 16SE, Idaho.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
1.	31.1	35.9	42.1	52	62.2	71.2	80.3	79.1	69.5	57.8	41.5	32	54.6
2.	10.9	14.1	20.4	27.6	34.5	40.5	45.8	44.4	36.6	28.1	19.9	11.4	27.9
3.	1.57	1.17	1.36	1.41	1.82	1.47	0.89	0.85	1.14	1.09	1.46	1.44	15.67
4.	17.9	12.5	11.1	7	1.9	0.2	0	0	0.6	2.3	9.3	16.1	78.8
5.	9	9	4	0	0	0	0	0	0	0	1	5	2

Air Temperature

Maximum daily air temperatures (^{o}F) were examined at two United States Bureau of Reclamation (BOR) Pacific Northwest Region Hydromet System Data (Agrimet) stations near the Willow Creek Subbasin (http://mac1.pn.usbr.gov/agrimet/location.html). One station is in Rexburg, Idaho and the second station is in Afton, Wyoming.

For each of these two stations, seven-day moving averages were calculated for all mean daily air temperatures on record (Table 7). From these data, the maximum seven-day moving average was calculated for each year on record. Then the 90th percentile of the maximum annual seven-day averages was calculated. Finally, the number of times the 90th percentile value was exceeded by maximum daily air temperatures was determined for the entire record (minimum of ten years).

The 90th percentile of seven-day moving averages of the maximum daily air temperatures was lowest at Afton, Wyoming and highest at Rexburg, Idaho, and the differences are similar to what might be expected due to differences in elevation.

Table 7. Mean maximum daily air temperature data for two Agrimet Stations.

Rexburg, Idaho	
Period of Record	01/01/88 to 12/31/02
90th Percentile of 7-day moving average	92.9°F
Number of times 90th percentile exceeded since 01/01/88	33
Afton, Wyoming	
Period of Record	01/01/83 to 12/31/02
90th Percentile of 7-day moving average	91.2°F
Number of times 90th percentile exceeded since 01/01/83	22

Snow Water Content

There are four Natural Resources Conservation Service (NRCS) Snotel sites (sites outfitted with special weather stations that measure snow water content) within the vicinity of the Willow Creek Subbasin (Table 8 and Appendix A). Pine Creek Pass site is north of the Willow Creek Subbasin in the Snake River Range. The other three sites are south of the subbasin in the hills surrounding Soda Springs.

Snotel Graphs in Appendix A show snow water content at these four sites from 1988 to 2001. These graphs show daily average snow water content (heavier blue line) superimposed over the period of record's average snow water content (lighter blue line). The period of record average snow water content varies from 11 in. at Somsen Ranch to about 17 in. at Sedgewick Peak. Since 1988, data show that snow water content was below average in 1990, 1992, and 2001, very much above average in 1997, and at or above average in remaining years.

Table 8. Snotel (NRCS) Snow Water Content Monitoring sites nearest the Willow Creek Subbasin.

Site Name	Site ID	Latitude	Longitude	Elevation (feet)	Ave. Snow Water Content
Pine Creek Pass, ID	PCPI1	43.34	111.30	6720	~13 inches
Sedgewick Peak, ID	SEPI1	42.81	111.57	7900	~17 inches
Slug Creek Divide, ID	SLGI1	42.34	111.18	7225	~15 inches
Somsen Ranch, ID	SORI1	42.57	111.22	7000	~11.5 inches

Subbasin Characteristics

Subbasin characteristics relevant to this report include hydrography/hydrology, geology, topography, soils and vegetation, and fish, all of which are discussed in the following.

Hydrography/Hydrology

The Willow Creek Subbasin, a tributary basin to the Snake River, is contained within the political boundaries of three southeastern Idaho counties: Bonneville, Bingham, and Caribou (Figure 1). The Caribou Range lies to the east and the Blackfoot Mountains are along the western border of the subbasin. Drainage from the Willow Creek Subbasin proceeds northward, below the Ririe Reservoir, to the Idaho Falls subbasin (4^{th} field HUC) where it discharges into the Snake River.

Major tributaries to Willow Creek (the largest creek in the drainage) are Grays Lake Outlet, Tex Creek, Brockman Creek, Homer Creek, Crane Creek, Sellars Creek and Meadow Creek.

Within the subbasin there are two major hydrologic features, the Ririe Reservoir and Grays Lake, both of which contain water diversion/control structures. Ririe Reservoir serves as a flood control and irrigation structure on the lower reaches of the subbasin, while at the far upper reach of the subbasin lies the Grays Lake wetland complex. Water from Grays Lake is diverted to the Blackfoot Reservoir, located in the adjacent Blackfoot subbasin.

Detailed discussions of each of these two hydrologic features are presented in the following.

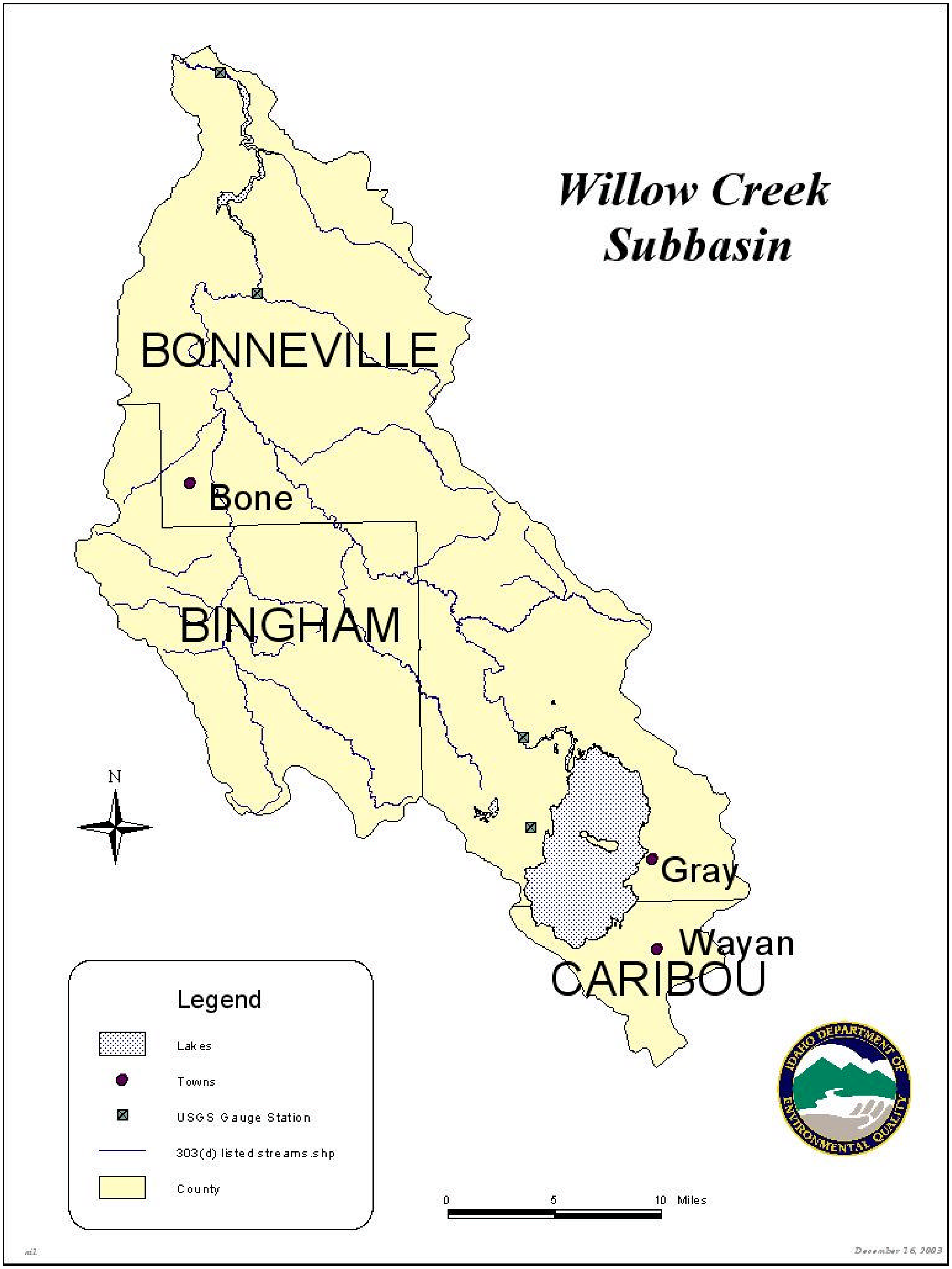

Figure 1. Willow Creek Subbasin

Grays Lake

Gray's Lake is a large wet meadow/marsh complex at the upper end of the Willow Creek Subbasin. Grays Lake historically and currently is a eutrophic lake, where an aquatic vegetation community is enriched, the lake's natural outlet is Willow Creek via Gray's Lake Outlet. Major inlets are Bridge Creek and Gravel Creek, both of which are fed by springs and runoff from nearby mountains.

Gray's Lake is named after John Grey, an Iroquois explorer and trapper (USFWS 1982). While the lake may not have been a true "lake," in that there probably was very little open water (Humphreys 1934, Simpson 2000), there was, however, abundant bullrush (*Scirpus sp*.) and other emergent vegetation (USFWS 1982, Simpson 2000).

The maximum elevation of Gray's Lake is 6390.5 ft, at which point water will either drain out the natural outlet or the artificial diversion (USFWS 1982). We suspect that the open water aspect probably varied considerably from wet years to dry years. The area fills with water after snowmelt, which in turn quickly drained away in spring. Some areas may be relatively dry meadow, whereas other areas remain spongy and wet throughout the summer. Since settlement, the area has been used for cattle grazing and hay cutting.

In 1875, Gray's Lake was surveyed and a meander line drawn to represent the high water mark (Humpherys1934, Simpson 2000). The lands adjacent to the meander line were then homesteaded.

In 1906, Brazilla Clark filed for Grays Lake water with the state engineer's office, which was granted (Humpherys 1934, Simpson 2000). Clark built a canal and diversion works known as "Clark's Cut," which took water from the southwestern corner of Gray's Lake and diverted it to Meadow Creek, a tributary to Blackfoot Reservoir. On March 20, 1907 a series of withdrawal orders were made covering lands inside the meander line. In 1908, the US Government, specifically the Indian Irrigation Service, bought Clark's interests in Gray's Lake, and the water became a part of the Fort Hall Irrigation Project (Humpherys 1934, Simpson 2000).

The US Fish and Wildlife Service (USFWS), Bureau of Sport Fisheries and Wildlife believed that the irrigation draw down and other uses of Gray's Lake were harming the wildlife values in the areas, and attempted it mitigate the dispute regarding Gray's Lake ownership (USFWS 1982). In 1964, a Memorandum of Understanding was developed between the USFWS and the Bureau of Indian Affairs (BIA) to control water levels in the lake so that USFWS could enhance waterfowl production and protect wildlife by delaying the release of water through Clark's Cut (USFWS 1982). Likewise, the Refuge Use and Cooperative Use Agreement of 1965 was established between FWS and 22 private landowners of 30 tracts surrounding Gray's Lake (USFWS 1982). In 1965 the USFWS established the Gray's Lake National Wildlife Refuge on 13,000 acres of the lakebed. This allowed usage of lands between the meander line and the refuge boundary (known as "No-Man's Land") by landowners, and maintained water levels within the refuge through the construction of levees and the controlled release of water. In 1972, the refuge boundary was expanded to 32,825 acres (USFWS 1982). Of this acreage, 56% of the land is controlled by the USFWS.

More recently, the annual release of water from Gray's Lake continues to be a source of disagreement with the landowners and the government (Simpson 2000). Apparently, the delayed release of water from the refuge affects the quality of meadow grasses or the landowners' ability to utilize the meadow grasses. The USFWS maintains that higher water levels in spring are needed to support wildlife propagation.

Ririe Reservoir

The Ririe Reservoir is located on Willow Creek, approximately 15 miles northeast of Idaho Falls, Idaho. A dam was constructed from 1970-1977 by the Corps of Engineers to serve as an impoundment structure for the waters of Willow Creek. The reservoir has a total capacity of 100,500 acre-feet, with 10,000 acre-feet of inactive space and 80,500 acre-feet used for flood control and irrigation. The remaining 10,000 acre-feet are allocated solely for flood control operations.

In addition to flood control and irrigation, Ririe Reservoir is used for recreation such as fishing and watersports. There are four recreation areas associated with the reservoir, Juniper and Blacktail Parks support camping and day-use facilities, including a floating fishing dock and a boat-launching ramp. Benchland Park is also on the lake, but is accessible only by boat and has limited day-use facilities. Creekside Park has day-use facilities and access to Willow Creek just downstream from the dam. (http://dataweb.usbr.gov/dams/id00344.htm).

Flow Regimes

A variety of landscapes influence channel morphology within the Willow Creek Subbasin. Fluvial hydrology ranges from steep streams with low sinuosity in the mountain areas to gently sloped transport reaches in narrow valleys, open meadows, and occasionally in small canyons. Response streams tend to be entrenched in canyons. (Spatial Dynamics 2002)

Two United States Geological Survey (USGS) gauging stations (Table 9) located within the Willow Creek Subbasin have long-term trend data available. Station number 13057940 is located on Willow Creek, 0.3 miles below Tex Creek and 13.2 miles southeast of Ririe. Station number 1305800 is located further downstream on Willow Creek below Ririe Reservoir. Both stations are currently active.

Two additional USGS stations with discontinuous data are important to note because they are essential to understanding the hydrology in the upper reaches of the basin. Also listed in Table 9, these two stations are discharge points for Grays Lake: station number 13057500, Grays Lake Outlet near Herman, Idaho and station number 13057300, Grays Lake Diversion to Blackfoot Reservoir Basin near Wayan, Idaho.

Table 9. USGS Gauging Stations.

Station Number	Station Name	Location	Elevation Above Sea Level	Drainage Area (mi^2)	Period of Record
13057940	Willow Creek below Tex Creek near Ririe, ID	Latitude 43°26'30" Longitude 111°43'42"	5200	568	1977-1979, 1985–present
13058000	Willow Creek near Ririe, ID	Latitude 43°35'35" Longitude 111°46'07"	4940	627	1903-1904, 1917-1928, 1962-present
13057500	Grays Lake Outlet near Herman, ID	Latitude 43°08'05" Longitude 111°29'40"	6377		1916-1925, 1956, 1966-1970, 2002-present
13057300	Grays Lake Diversion to Blackfoot Reservoir near Wayan, ID	Latitude 43°00'21" Longitude 111°29'40"			1966-1970, 2000-present

Geology

The Willow Creek Subbasin is located in a transition zone between three physiographic provinces: the western edge of the central Rocky Mountains, the eastern margin of the Snake River Plain, and the northern extent of the Basin and Range. Geologic features common to each province are observed in the subbasin.

The subbasin is primarily underlain by a complex assortment of Paleozoic and Mesozoic sedimentary rocks in the upper portion of the subbasin and Tertiary and Quaternary igneous rocks in the lower portion. Figure 2 shows a generalized geologic map of the Willow Creek Subbasin. Both the stratigraphy and structural geology of the area strongly control the geomorphology and hydrologic features of the subbasin.

The structural geology and stratigraphy control the local groundwater flow systems within the subbasin. The Caribou Range is a regional topographic high point with a relatively high rate of precipitation. As such, the Caribou Range is the probable recharge area for much of the shallow aquifer system in the subbasin. Willow Creek Hills, located in the south-central part of the subbasin, receives less precipitation, and therefore, probably has lower recharge potential. Groundwater flow paths in the sedimentary rocks are primarily bedding plane controlled, whereas the discharge points are controlled by the geologic structure. Highly fractured, near-surface aquifers exhibit high hydraulic conductivity that decreases with depth as the fractures close. Numerous springs and seeps are present in the fractured sedimentary rocks exposed in the mountains, but most of these shallow flow systems dry up by late fall. Some springs located along range-forming extensional faults are geothermally heated, and discharge at temperatures in excess of 30 °C. The thermal springs appear to be controlled by the deep-seated extensional faults, which provide for higher geothermal gradients at depth (Ralston 1983).

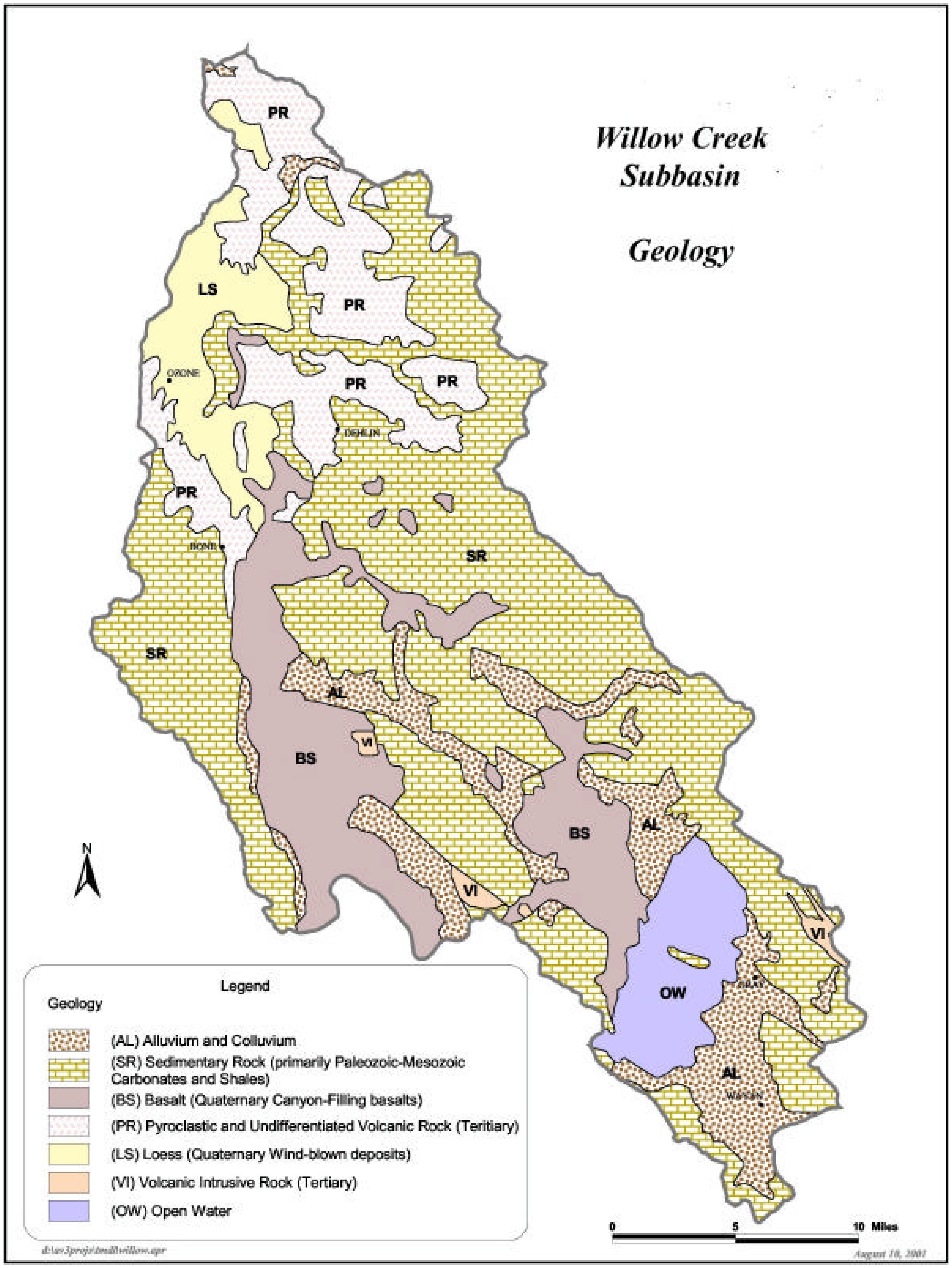

Figure 2. Willow Creek Subbasin Geology.

Topography

The topography of the Willow Creek Subbasin results from a combination of Basin and Range type geology, higher elevation marshland, and lower elevation canyon erosion. Three prominent features of the subbasin's topography are: 1) the flat, high elevation marsh known as Gray's Lake at the southern end of the subbasin; 2) the steep-walled canyon formed by Willow Creek, a part of which is now filled by Ririe Reservoir; and 3) the parallel valleys and ridges in the center of the subbasin formed by Gray's Lake Outlet, Homer Creek, and upper Willow Creek. The east and west sides of the subbasin are lined with mountain ranges and contain the highest elevations and, in general, the steepest slopes (Figure 4). Elevations range from 4,900 feet to 9,700 feet, with the mean elevation equal to 6,382 feet. Slopes in and around Gray's Lake are less than 4% (Figure 4). In many of the valley areas slopes are less than 20%. Slopes increase rapidly to greater than 35% on mountain and foothill ranges. The lower Willow Creek canyon, including lower Gray's Lake Outlet and Tex Creek, are general steep sloped as well.

Soils and Vegetation

The Willow subbasin is in the Middle Rocky Mountain Province (USDA, 1984). In Idaho, this province extends from the Utah border to within a few miles of Montana, bordered on the east by Wyoming. Mean annual soil temperatures are between 0^0 C and 8^0 C (cryic soil temperature regime) for most soils in the province. Frigid soils with mean annual soil temperatures less than 8^0 C but with warmer summer soil temperatures can occupy wider mountain valleys.

Major soil orders in this province, according to USDA (1984), are mostly Mollisols (soils with organic rich surface horizon) and Alfisols (marginal moisture forest soils), with smaller areas of Inceptisols (young soils) and Histosols (organic soils).

There are about 414,200 acres within the Willow Subbasin delineation. Soils in the project area are described by generalized soil map units called STATSGO Map Units, from the **Stat**e **S**oil **G**e**o**graphic Database (USDA, 1994). The twelve STATSGO map units comprised by this acreage are shown in Figure 3, and are summarized in Table 10. It is important to note that Idaho STATSGO map units are currently undergoing revision based upon current detailed soil survey information; revised units should not be expected for at least a few years, however (Swenson 2001).

The K factor is a measure of the susceptibility of a soil to particle detachment and transport by rainfall, and this factor ranges from 0.02 to 0.64 or more (USDA, 1983, Part 603.02-(m)(1)(i) and (ii)). (The higher the value, the more susceptible the soil to erosion from precipitation, all other factors being equal.) Soil erodibility (hereafter 'K') factors are shown in the last column of Table 10, and in Figure 3.

Precipitation information (range and mean) is presented in Column 5 of Table 10. Figure 4 displays precipitation data for the subbasin by STATSGO map unit.

Column 6 of Table 10 shows average slope ranges for STATSGO map units. Figure 5 displays slope data for the subbasin by STATSGO map unit.

Figure 6 displays general landcover for the subbasin by STATSGO map unit.

Table 10. STATSGO Map Unit Summary

STATSGO Map Unit No.	Number of Delineation in Subbasin	Land Area: Acreage / Square Miles	Average Soil Depth[1] (inches)	Precipitation Range and Mean	Average Slope[2] (%)	K Factor Range
ID002	1	9,560 / 14.9	>60	23 – 29; 24.2	0 – 3	0.028 – 0.042
ID007	4	115,950 / 181.2	60	15 – 29; 23.2	4 – 13	0.028 – 0.042
ID010	1	107,150 / 167.4	50	13 – 33; 21	3 – 30	0.014 – 0.028
ID023	1	260 / 0.4	15	33 – 37; 35.6	1 – 93	0 – 0.014
ID027	4	26,410 / 41.3	22 – 32	13 – 31; 15	27 – 74	0 – 0.014
ID030	4	15,480 / 24.2	27 – 41	23 – 37; 28.9	25 – 55	0.042 – 0.056
ID031	5	41,850 / 65.4	54	13 – 19; 14.5	6 – 24	0.028 – 0.042
ID032	1	1980 / 3.1	60	15 – 17; 16.4	7 – 23	0.028 – 0.042
ID034	1	60 / 0.1	60	NA; 13	0 – 2	0.028 – 0.042?
ID427	2	65,990 / 103.1	42	19 – 35; 24	22 – 51	0.042 – 0.056
ID456	1	7920 / 12.4	14 – 38	19 – 31; 22	29 – 68	0 – 0.014
IDW	1	23,350 / 36.5	NA	ND[4]	0	NA

Footnotes:
1) Acreage weighted average upper and lower soil depths. If different, a range is given.
2) Acreage weighted average upper and lower slopes rounded to the nearest whole number.
3) Acreage weighted mean.
4) No Data.

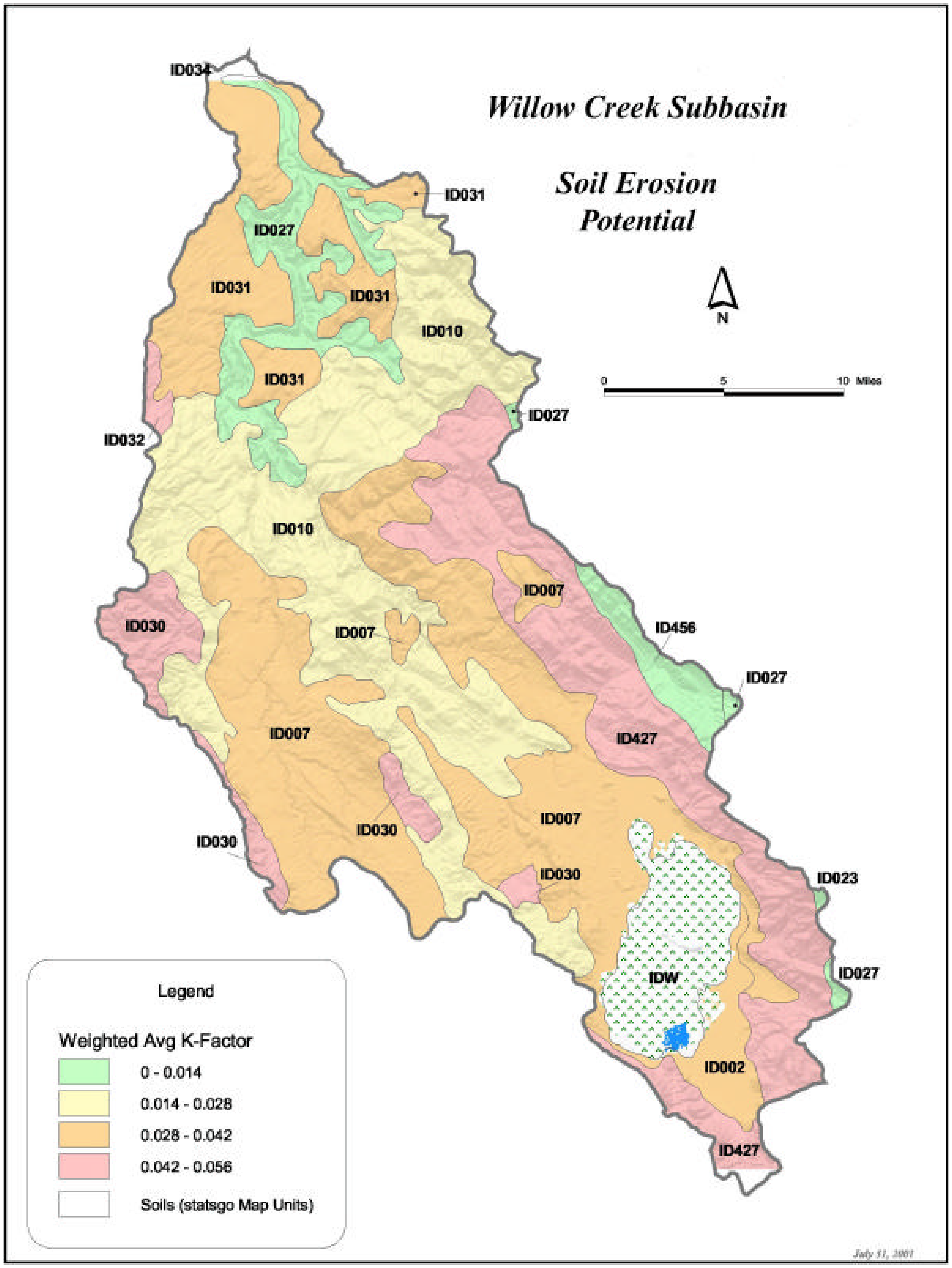

Figure 3. Soil Units on Soil Erosion Potential.

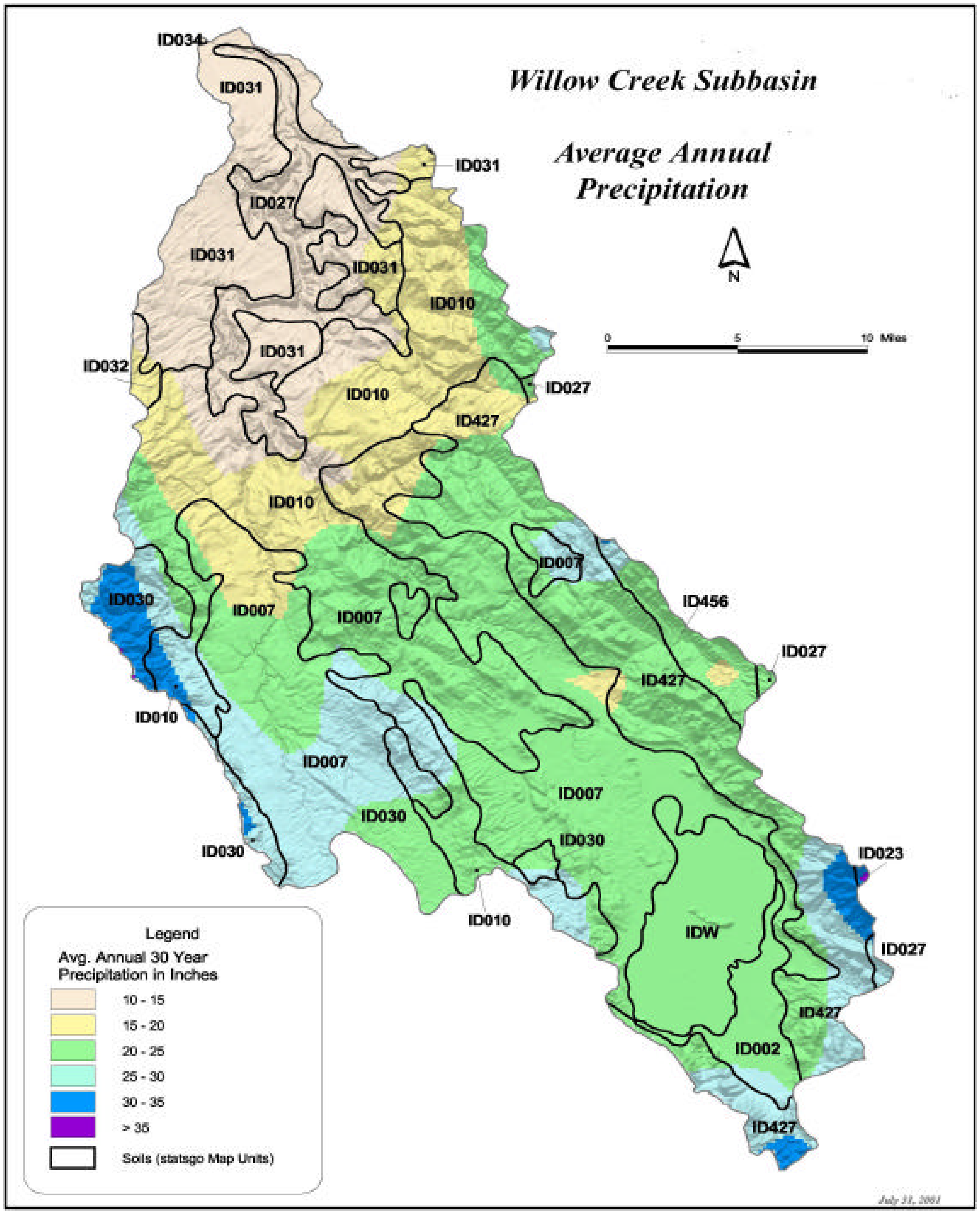

Figure 4. Soil Units on Average Annual precipitation.

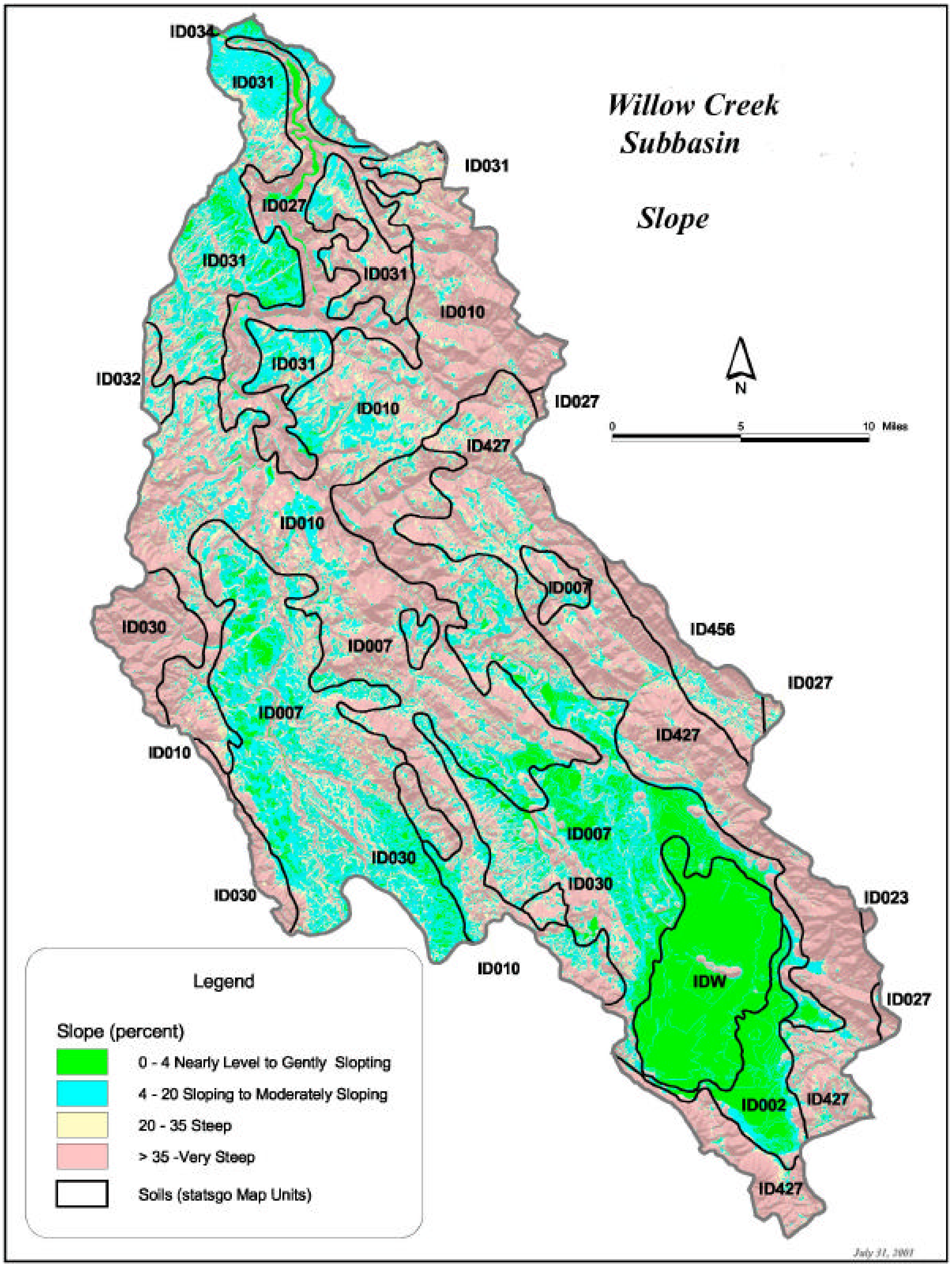

Figure 5. Soil Units on Slope.

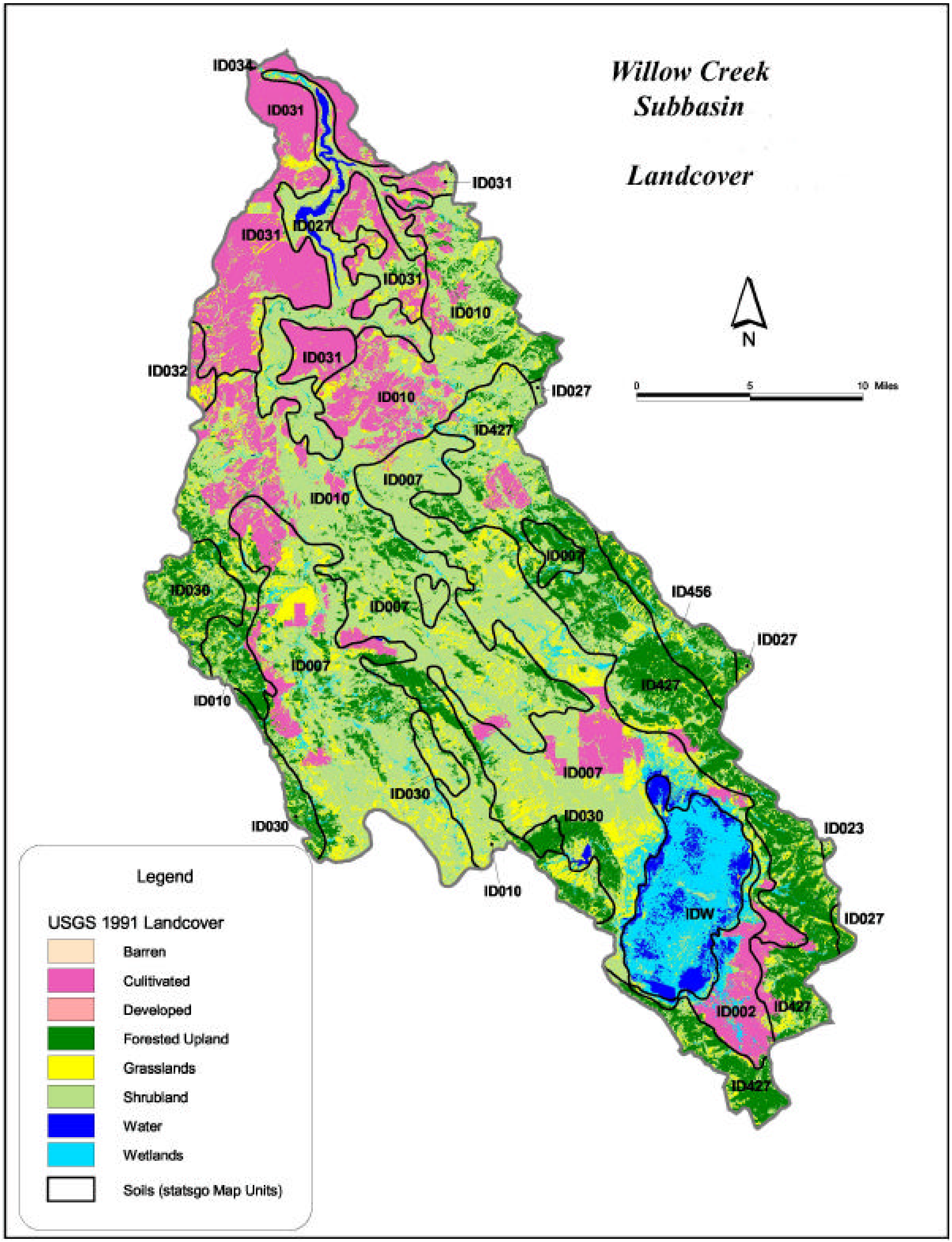

Figure 6. Soil Units on Landcover.

The USDA Soil Conservation Service has conducted and published soil surveys of most of the Willow Creek Subbasin. USDA (1973) covers from Grays Lake northwest to the Bonneville County boundary. USDA (1981) covers the area northwest of the Bingham County boundary, with the exception of the Caribou National Forest (to the southeast). The soil survey of Caribou Co., covering the southernmost portion of the subbasin, is not yet published, and no mapping has been done to date around Grays Lake (Kyar 2001). The US Forest Service (USDA-FS) has published a draft Ecological Unit Inventory of the Targhee National Forest (USDA 1997), providing soils information for the Caribou Range mountains adjacent to the eastern boundary of the subbasin. Figures 7 and 8 show soil associations (hereafter called *soil associations* or *associations*) of both Bonneville and Bingham County Soil Surveys.

While there are differences between STATSGO map units and SCS Soil Survey soil associations there is a substantial degree of similarity between boundaries and concepts between the two mapping units. Correlations between STATSGO map units and soil associations found in the soil surveys are given in Table 11, which correlates STATSGO map units with Bonneville Co. Soil Survey soil associations, and Table 12, which correlates STATSGO map units with Bingham Co. Soil Survey soil associations.

Table 11. Correlation between STATSGO Map Units and Bonneville County Soil Associations.

STATSGO Map Unit	Soil Association (Number and Name)	Brief Description of USDA Soil Association
ID027	#4: Torriorthents - Cryoborolls – Rock Outcrop	Very steep, shallow to very deep, well drained soils, and rock outcrop; on sides of mountains and canyons
ID031 ID032 ID034	#5: Ririe – Potell	Gently sloping to steep, very deep, well drained soils; on loess foothills
ID007 ID010 ID427	#6: Dranyon – Paulson – Rock Outcrop	Sloping to very steep, deep and very deep, well drained soils, and Rock outcrop; on mountainsides

Table 12. Correlation between STATSGO Map Units and Bingham Area Soil Associations.

STATSGO Map Unit	Soil Association (Number and Name)	Brief Description of USDA Soil Association
ID002 ID007	#4: Robin – Lanark	Nearly level to steep, deep, medium textured soils, on loess covered uplands
ID010 & ID427	#8: Dranyon – Sessions – Nielsen	Nearly level to steep, deep and shallow, well drained, medium textured soils, on mountains and footslopes
ID030	#9: Sheege – Pavohroo	Nearly level to steep, shallow and deep, Well drained, medium textured soils, on mountains

As shown in Table 11, there are three soil associations, described in the Bonneville Co. Soil Survey (USDA 1981), that occur in the Willow subbasin. The following summarizes those association descriptions.

Soil Association # 4, Torriorthents - Cryoborolls - Rock Outcrop, describes those soils making up the drainage ways of Willow Creek, Meadow Creek and Tex Creek, extending northwest towards Ririe Dam. Torriorthents are on the south and west facing canyon and mountain slopes, while cryoborolls occupy north and east facing slopes. Both soils are shallow (less than 20 inches) to very deep (greater than 60 inches) with stony surface textures. Rock outcrops consist of exposed rhyolite or basalt bedrock. Vegetation in this association includes Indian ricegrass, aspen, and big sagebrush. This soil association is used primarily for rangeland and wildlife habitat. There is a hazard of erosion noted for this association.

Soil Association # 5, Ririe – Potell, occurs in the northwest portion of the Willow subbasin in loess foothills. The association’s southern boundary is just below the latitude where Tex Creek joins Bulls Fork. Both soils are very deep silt loams. This association is used primarily for dryland winter wheat and spring barley. Native vegetation can include bluebunch wheatgrass, slender wheatgrass, big sagebrush and mountain big sagebrush. Minor uses include rangeland and some sprinkle irrigated agriculture. There is a hazard of erosion noted for this association.

Soil Association # 6, Dranyon – Paulson – Rock Outcrop, an upper elevation mountainous unit, occurs in the upper middle of the Willow subbasin, just north of the Bingham and Bonneville county line. As discussed previously, this association delineation joins, and is related to, Soil Association #s 4 and 8 of the Bingham Co. Soil Survey (USDA 1973), which associations are described below. Dranyon soils are deep (40 to 60 inches) and have extremely stony silt loam surface textures. Paulson soils are very deep with a silt loam surface and heavier textures in the subsurface. Rock outcropping is exposed sandstone and shale bedrock. Vegetation in this association includes aspen, bluebunch wheatgrass, snowberry, blue wildrye, and antelope bitterbrush. Uses of this association include grazeable woodland, rangeland, and wildlife. Additional information about these Bonneville County soil associations is found in Table 13

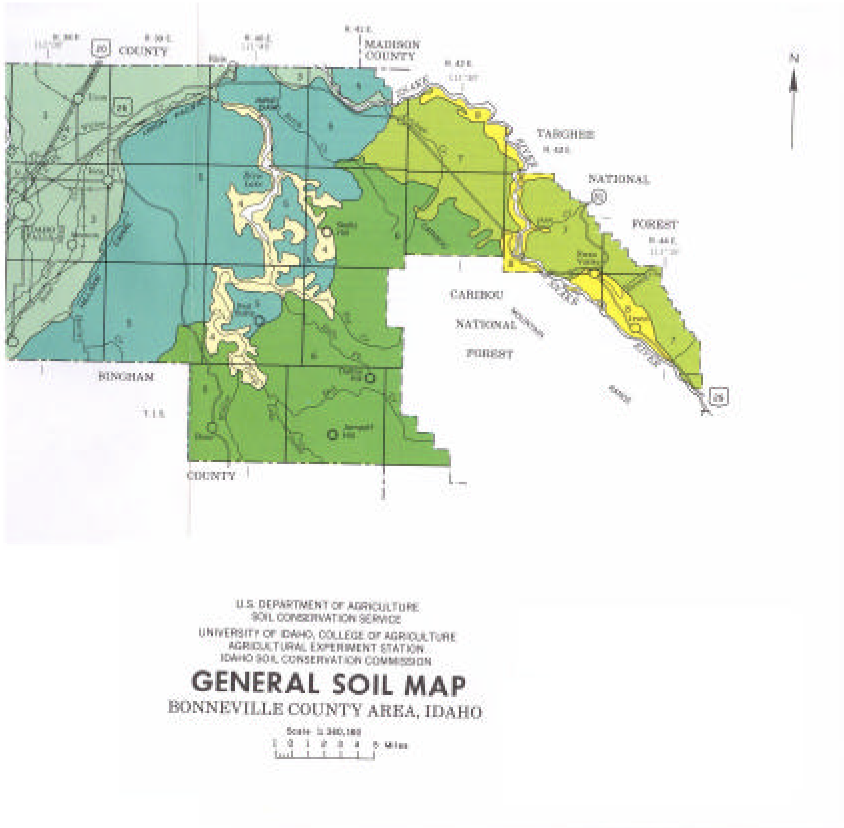

Figure 7. General Soils Map – Bonneville County.

As shown in Table 12, there are three soil associations described in the Bingham Co. Soil Survey (USDA 1973), which occur in the Willow subbasin. The following summarizes and paraphrases those association descriptions.

Soil Association # 4, Robin – Lanark, together with Soil Association # 8 (Dranyon – Sessions – Nielsen), corresponds to Bonneville Co. Soil Association # 6 (Dranyon – Paulson – Rock Outcrop). The Robin – Lanark association occurs on loess uplands. There are two major delineations of this association in the Willow subbasin: one south of Bone, broadly following Willow, Cranes, and Meadow Creeks southward, and the other broadly following Grays Lake Outlet, roughly from the confluence of Lava Creek southward to Grays Lake.

Vegetation in upland areas of this association includes Idaho fescue, streambank wheatgrass, and Colombia needlegrass. Vegetation in lowland areas of this association includes Kentucky bluegrass, timothy, and tufted hairgrass. Uses of this association include summer grazing and dryland small grain farming.

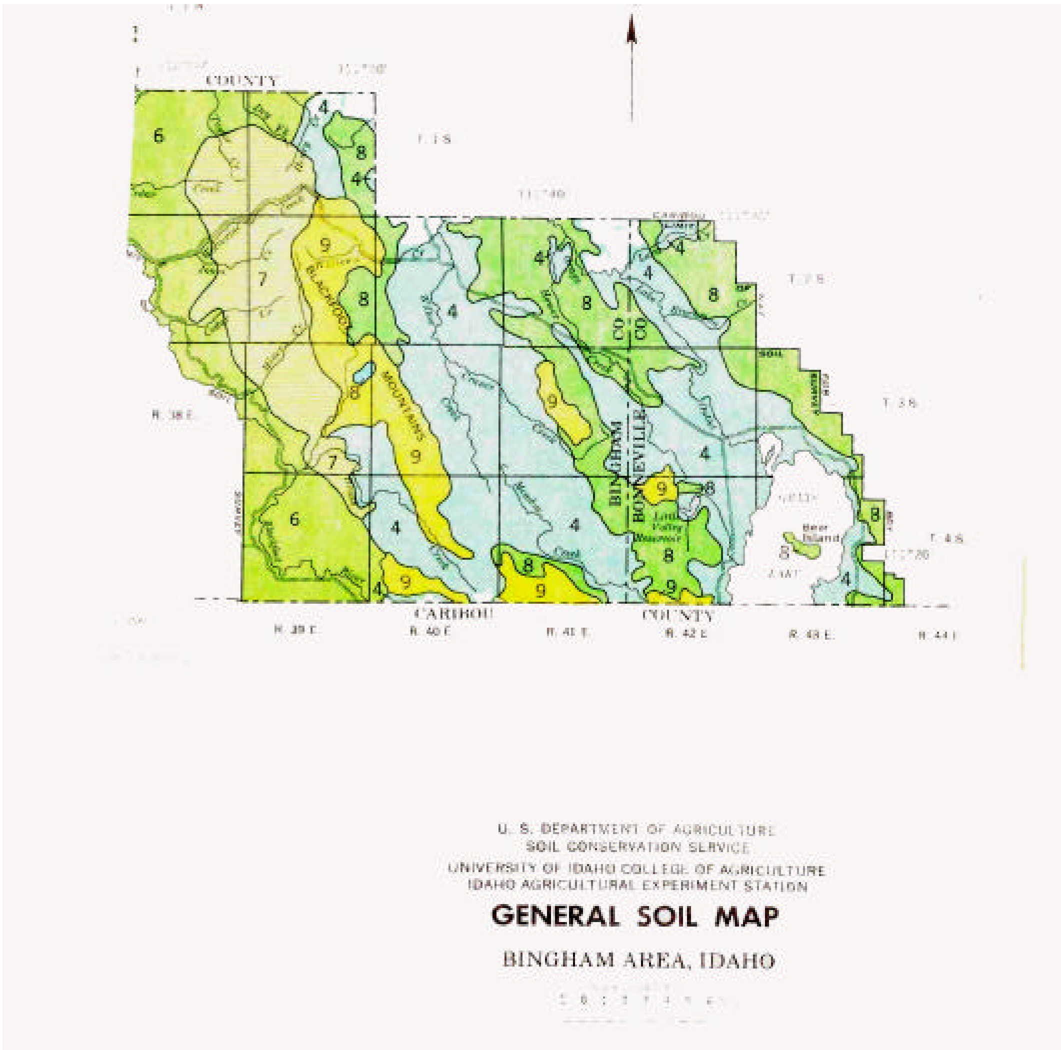

Figure 8. General Soils Map – Bingham County.

Soil Association # 8 (Dranyon – Sessions – Nielsen), together with Soil Association # 4, (Robin – Lanark), corresponds to Bonneville Co. Soil Association # 6 (Dranyon – Paulson – Rock Outcrop). The Dranyon – Sessions – Nielsen association is found at higher elevations, mostly on mountain ridges, side slopes and foot slopes. Two major delineations of this association are found in the southwest trending mountains, both to the northeast of Willow, Cranes, and Meadow Creeks, and to the northeast of Grays Lake Outlet (i.e. to the northeast of the two major delineations of the Robin – Lanark Soil Association above. Another smaller delineation is found to the west of Willow Creek, extending from northwest of Bone, southward to the west of the confluence of Cranes and Willow Creeks.

Table 13. Bonneville County Soil Associations – Additional Information.

Soil Association (Number and Name)	Percent (%) Composition	Precipitation (inches)	Average Annual Air Temperature (F^{O})	Elevation (feet)	Frost Free Season (days)
#4: Torriorthents - Cryoborolls – Rock Outcrop	 45 % 35 % 15 %	8 – 18	41 - 43	4,700 – 8,000	50 – 80
#5: Ririe – Potell	 70 % 15 %	11	43	4,600 – 6,200	90
#6: Dranyon – Paulson – Rock Outcrop	 35 % 25 % 15%	20	41	6,000 – 8,000	50

Dranyon and Sessions soils are moderately deep (20 to 40 inches) and very deep respectively. Both have heavier textured subsoils (clay loam and silty clay respectively). Nielsen soils are on footslopes and are shallow with extremely stony loam soil textures. Vegetation in this association includes Idaho fescue, slender wheatgrass, and mountain brome. Woody species include aspen, Douglas fir, subalpine fir and lodgepole pine. Uses of this association include summer grazing, timber production, and dryland farming.

Soil Association # 9 (Sheege – Pavohroo) is found on the west-central part of the Willow Creek Subbasin (the eastern part of the Blackfoot mountains). Sheege soils occupy south slopes and ridge tops, and Pavohroo soils the north slopes. Sheege soils are shallow to limestone bedrock and have extremely stony loam soil textures. Pavohroo soils are very deep, having loam or silt loam surface textures, underlain by clay loam and very gravelly loam. Vegetation in this association includes Douglas fir, aspen and pinegrass on north slopes, and big sagebrush, snowberry, and western wheatgrass on south slopes. Uses of this association include summer grazing and timber production. Additional information about these Bingham County soil associations is found in Table 14.

As stated previously, USDA (1997) provides soils information for the Caribou Range mountains adjacent to the eastern boundary of the subbasin. Mapping does not extend south of the boundary between T2S and T3S (i.e. a mile north of Grays Lake). There are several Ecological Units that describe these lands, with Unit 1303 comprising the majority of the acreage. This unit is a transitional unit in foothills between cool moist shrub steppe and warm forested zone.

Table 14. Bingham County Soil Associations – Additional Information.

Soil Association (Number and Name)	Percent (%) Composition	Precipitation (inches)	Average Annual Air Temperature (F^O)	Elevation (feet)	Frost Free Season (days)
#4: Robin – Lanark	 55 % 15 %	13 – 19	36 – 43	5,000 – 7,000	80 – 100
#8: Dranyon – Sessions – Nielsen	 30 % 30 % 15 %	16 – 24	35 – 45	5,400 – 8,000	50 – 80
#9: Sheege – Pavohroo	 55 % 35 %	16 – 22	40 - 45	5,500 – 7,500	50 – 80

Major soils include Edgeway, Jumpstart, and Tophat. Edgeway is found on sideslopes; it has a shallow silt loam surface underlain by very cobbly subsoil. Jumpstart is found on north facing slopes; it is a very deep soil with silt loam surface and silty clay loam subsoil. Tophat is found on south facing slopes; it is very deep, cobbly soil with loam surface and clay loam subsoil. Vegetation includes sagebrush, aspen, and mixed conifers. Table 15 gives both common and scientific names for vegetation discussed in this report.

Table 15. Common and Scientific Names for Vegetation Mentioned in this Report.

Common Name	Scientific Name	Common Name	Scientific Name
Antelope bitterbrush	*Purshia tridentata*	Lodgepole pine	*Pinus contorta*
Aspen	*Populus tremuloides*	Mountain big sagebrush	*Artemesia tridentata Nutt ssp. (vaseyana)*
Big Sagebrush	*Artemesia tridentata*	Mountain brome	*Bromus marginatus*
Bluebunch wheatgrass	*Pseudoroegneria spicata*	Pinegrass	*Calarnagrostis rubescens*
Blue wildrye	*Elymus glaucus*	Slender wheatgrass	*Elymus trachycaulus*
Columbia needlegrass	*Achnatherum nelsonii*	Snowberry	*Symphoricarpos albus*
Douglas fir	*Pseudotsuga menziesii*	Streambank Wheatgrass	*Elymus lanceolatus*
Idaho fescue	*Festuca idahoensis*	Subalpine fir	*Abies lasiocarpa*
Indian ricegrass	*Achnatherum hymenoides*	Timothy	*Phleum pratense*
Kentucky bluegrass	*Poa pratensis*	Tufted hairgrass	*Deschampsia caespitosa*
		Western wheatgrass	*Pascopyrum smithii*

Geology and Soils Correlation

Table 16 shows tentative correlations between both geological and soil association delineations. Correlation between the subbasin geology (Figure 2) and soil delineations (Figures 3 - 8) is difficult: in most cases, generalized soil delineations in the subbasin do not directly correspond to the geological map units in Figure 2. This discrepancy between geology and soil delineations occurs, in part, because subbasin soils reflect a combination of soil forming factors in addition to the influence of parent material. In addition, some geologic map units are highly generalized and actually denote a wide variety of rock types. For example, the symbol *SR* can include limestones, dolostones, chert, shales, or sandstones, each of which may have varying resistances to weathering and erosion.

Table 16. Tentative Correlations between Geologic Map Units and Soil Associations.

Bonneville County Soil Associations			
STATSGO Map Unit	Geological Delineations	Soil Association (Number and Name)	Brief Description of USDA Soil Association
ID027	SR	#4: Torriorthents - Cryoborolls – Rock Outcrop	Very steep, shallow to very deep, well drained soils, and rock outcrop; on sides of mountains and canyons
ID031 ID032 ID034	LS; PR	#5: Ririe – Potell	Gently sloping to steep, very deep, well drained soils; on loess foothills
ID007 ID010 ID427	SR; BS	#6: Dranyon – Paulson – Rock Outcrop	Sloping to very steep, deep and very deep, well drained soils, and rock outcrop; on mountainsides
Bingham Area Soil Associations			
ID002 ID007	BS (major) SR, AI (minor)	#4: Robin – Lanark	Nearly level to steep, deep, medium textured soils, on loess covered uplands
ID010 & ID427	SR (major)	#8: Dranyon – Sessions – Nielsen	Nearly level to steep, deep and shallow, well drained, medium textured soils, on mountains and footslopes
ID030	SR (major)	#9: Sheege – Pavohroo	Nearly level to steep, shallow and deep, well drained, medium textured soils, on mountains

AL = alluvium; LS = loess; BS = basalt; PR = pyroclastic rock; SR = sedimentary rock.

Vegetation – Special Status Species

Both the Conservation Data Center (CDC) of the Idaho Department of Fish and Game and the US Fish and Wildlife Service (USFWS) maintain lists of special status plants by county. However, their lists are slightly different from each other. The CDC Special Status Plants list includes plants identified on a variety of other lists, including lists created by the Idaho

Native Plant Society, the USFWS, the Forest Service, and the BLM (see Web site: http://www2.state.id.us/fishgame/info/cdc.htm). In contrast, the USFWS list contains only those species identified by that agency as being listed under the Endangered Species Act, proposed for listing, candidates for listing, or belonging to those species of concern and watch species identified by the USFWS (Burch 2001).

The Willow Creek Subbasin straddles the border between Bonneville and Bingham Counties in Idaho, with an additional small area of Gray's Lake headwaters in Caribou County. Ute ladies'-tresses (*Spiranthes diluvialis*) is the only plant species in this subbasin listed under the Endangered Species Act, it is listed as "threatened."

Fish

There are several species of fish residing in the Willow Creek Subbasin. Representatives of the sucker family (Catostomidae), sculpin family (Cottidae), minnow family (Cyprinidae), as well as the trout and salmon family (salmonidae) are known to occur. Suckers reported in the subbasin include the Utah sucker (*Catostomus ardens*) and mountain sucker (*Catostomus platyrhynchus*). Sculpins in the subbasin include the mottled sculpin (*Cottus bairdi*) and piute sculpin (*Cottus beldingi*). Minnows reported in the subbasin include the longnose dace (*Rhinichthys cataractae*), speckled dace (*Rhinichthys osculus*), redside shiner (*Richardsonius balteatus*), and utah chub (*Gila atraria*). Species of the salmonidae reported in the subbasin include cutthroat trout (*Oncorhynchus clarki*), brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis*), mountain whitefish (*Prosopium williamsoni*), rainbow trout (*Oncorhynchus mykiss*) and rainbow x cutthroat hybrids. No bull trout (S*alvelinus conflentus*) occur in the Willow Creek Subbasin.

Yellowstone cutthroat trout (*Oncorhynchus clarki*) is a native species and the species of greatest concern in the subbasin. According to fish count data and local knowledge, cutthroat trout numbers have diminished significantly over the years. Problems include habitat degradation, stream flow alteration, diversions that prevent migration, and the introduction of non-native salmonids. Human activities and fish eradication and subsequent stocking programs have played a major role in the frequency and distribution of species within the watershed.

The Yellowstone cutthroat is considered a state sensitive species in Idaho and is carefully managed by the Idaho Department of Fish and Game (IDFG). In 1998 it was petitioned to become a threatened species, but after review in February 2001, the USFWS declined the petition to list the Yellowstone cutthroat under the Endangered Species Act.

Historically, IDFG has stocked fish in several streams in the Willow Creek Subbasin. Stocking records show that cutthroat, rainbow, brown, and brook trout have been planted. Within the past 25 years, Willow Creek and Ririe Reservoir are the only locations where fish stocking has occurred. IDFG ceased stocking Willow Creek in 1998 (brown trout) with the last introduction of rainbow trout in May 1996. In 2003 the Ririe Reservoir was stocked with kokanee salmon and cutthroat trout.

Beaver

The beaver (*Castor canadensis*) is an important species in the development and continued sustenance of healthy stream and riparian systems. Beavers play an important role in maintaining stable channels by preserving riparian vegetation, reducing streambank erosion, storing sediment, raising the water table, and storing water for late season release. Beaver dams are typically constructed in willow dominated, medium to low gradient, meandering, valley bottom streams (Rosgen C or B type Channels). These channels evolved over time as beaver dams trapped fine sediments that were stabilized by willows. When vegetation and beaver are removed from the system (due to trapping and/or browsing competition) dams are no longer maintained and hence are more likely to fail and release stored sediment. The increase of upstream sediment supply from grazing, cultivated agriculture, roads, urban development and timber harvest can accelerate dam failure resulting in rapid sediment release. When changes occur in the riparian plant community, the positive benefits of beavers are lost and the stream is susceptible to incising and the productive riparian areas convert to drier upland sagebrush regions as a result of lowering the water table (Caribou-Targhee 2000).

The current and historic extent and distribution of beaver in the Willow Creek Subbasin is not well documented however, long-time residents claim that beaver populations, at one time, were higher. Trapping and the reduction in suitable beaver habitat are the two principal causes of the diminished presence of beavers in the watershed. It is expected that if the riparian conditions were restored, beaver could recolonize suitable habitat and improve hydrologic conditions. Such improvements would include, (1) reduced channel degradation, (2) lower erosion rates, (3) improved late summer and drought flows, (4) increased sediment storage capacity, (5) improved water quality, (6) enhanced fish and wildlife habitat and (7) increased forage and shelter for livestock, following recovery.

Sub-watershed Characteristics

The Willow Creek Subbasin is divided into nine sub-watersheds as shown in Figure 9. Table 17 summarizes the physical attributes of fifth field HUCs based on DEQ GIS coverages. Basin length is defined as the greatest distance water flows within the sub-watershed. Basin length is useful in tabulating overall gradient of the subbasin (Spatial Dynamics 2002). The Upper Grays sub-watershed has the longest basin length at 22.61 miles. The Tex Creek sub-watershed has the shortest basin length at 12.6 miles. Refer to appendix C for unit conversions.

Table 17. Physical attributes of the 5th field HUCs within the Willow Creek Subbasin.

HUC5 Name	Area (mi^2)	Total # of Stream Miles	Elevation Range		Basin Length (mi)	Relief Ratio	Drainage Density (mi/mi^2)
			Pour Point (ft)	High Point in Watershed (ft)			
Grays Lake	134.6	74.14	6562	9515	21.89	0.0256	0.551
Homer Creek	45.14	54.96	6234	7218	19.56	0.0095	1.218
Lower Grays Outlet	61.87	67.18	5250	7218	19.51	0.0191	1.086
Lower Willow (Ozone)	41.44	22.2	5250	6562	14.37	0.0173	0.536
Middle Willow (Bone)	75.57	72.69	5250	6562	19.12	0.0130	0.962
Tex Creek	48.6	43.27	5578	7218	12.56	0.0247	0.890
Upper Grays Outlet	134.6	93.03	6234	7546	22.61	0.0110	0.691
Upper Willow	82.64	82	6234	7218	17.69	0.0105	0.992
Willow Reservoir	79.38	34.85	5250	6890	18.60	0.0167	0.439

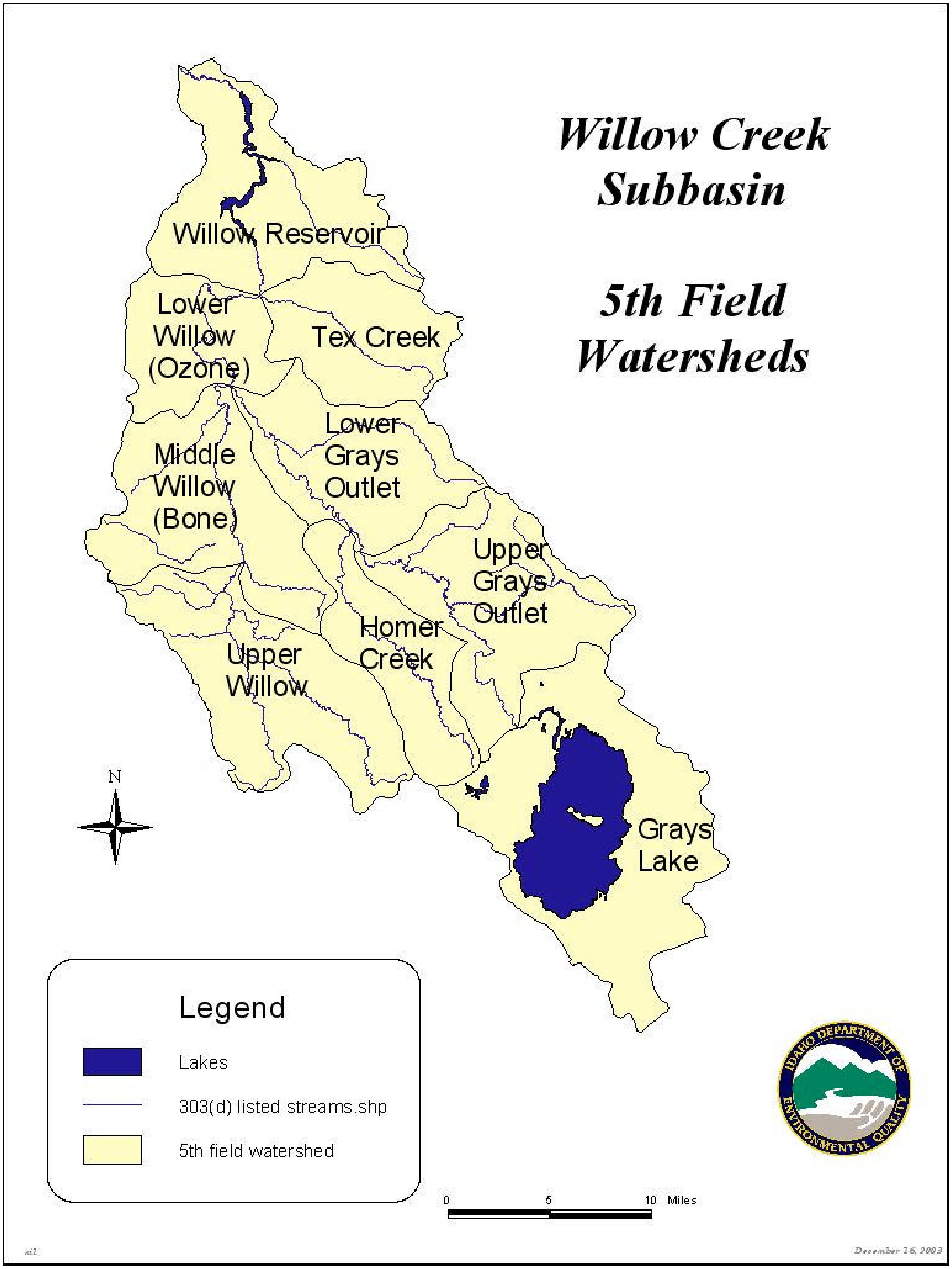

Figure 9. Willow Creek Subbasin 5th Field Watersheds.

The relief ratio has been calculated for each sub-watershed by taking the difference in elevation between the high point (maximum elevation) and the pour point (minimum elevation) in the sub-watershed and dividing that value by the length of the sub-watershed (basin length). A relief ratio of zero indicates that the land is flat and the watershed has no erosive power. The Grays Lake sub-watershed has the largest relief ratio value. It is the steepest sub-watershed and contains the highest potential erosive power.

The drainage density is calculated by dividing the total length of streams by the sub-watershed land area. This value can provide a relative measure of transport efficiency as well as a measurement of the average spatial diversity of a stream system. The Homer Creek sub-watershed has the largest drainage density, meaning it has the greatest concentration of stream miles for that given area.

A brief description of each fifth field HUC within the Willow Creek Subbasin has been provided below.

Willow Reservoir (1704020501)

The Willow Reservoir sub-watershed is positioned at the lowest elevation in the chain of sub-watersheds in the subbasin. All drainage exits the subbasin at the HUC boundary at approximately 5200 feet in elevation, just below the Ririe Reservoir on Willow Creek. Willow Creek then proceeds into the Idaho Falls subbasin where it subsequently drains into the Snake River.

This sub-watershed contains Willow Creek (SK001) and all of the unnamed ephemeral streams that drain into it below the Ririe Reservoir (SK002). The Blacktail Creek (SK003) and Meadow Creek (SK032) drainages are tributary systems of the Ririe Reservoir, with Blacktail Creek draining from the west and Meadow Creek from the east.

Tex Creek (1704020502)

This sub-watershed, relatively small, with an area of 48.6 mi^2, primarily contains the Tex Creek Wildlife Management Area. The Tex Creek sub-watershed contains the streams: Tex Creek, Bulls Fork Creek, Indian Fork Creek, and Pipe Creek. Indian Fork Creek drains from source to Tex Creek. Pipe Creek, the most northern stream discharges into Tex Creek (SK031). Indian Fork Creek, Pipe Creek, and Bulls Fork Creek (SK030) are all tributaries of Tex Creek.

Lower Willow (1704020509)

The Lower Willow 5^{th} field watershed, sometimes referred to as Ozone, contains Willow Creek (SK005) from the Grays Lake outlet confluence to its confluence with Tex Creek. A commonly known landmark on Willow Creek, Kepp’s Crossing, is located in this drainage. Badger Creek and Rock Creek are named tributaries in this sub-watershed. Elevations in the watershed range from approximately 6,500 ft to 5,200 ft with a relief ratio around 0.0173.

Lower Grays Outlet (1704020503*)*

The Lower Grays sub-watershed, having an area of 61.87 mi^2, contains Grays Lake Outlet (SK017) and several of its tributaries, Cattle Creek, Hell Creek, Dan Creek and Jim Creek. The Hell Creek drainage (SK029) is the largest in this sub-watershed, with its largest tributary being Dan Creek. Jim Creek (SK019) is located in the southernmost (upper) part of the drainage. Cattle Creek (SK016) is the lowermost tributary of Grays Lake Outlet (SK019) in the drainage. Sub-watershed boundaries are from the confluence of Jim Creek with Grays Lake Outlet to Grays Lake Outlet's confluence with Willow Creek. There are over 67 stream miles in the sub-watershed and a drainage density of 1.086 mi/mi^2.

Middle Willow (1704020508)

The Middle Willow (Bone) sub-watershed covers a land area of 75.57 mi^2 and contains a total of 72.69 steam miles. Willow Creek and several of its tributaries are located in this 5th field HUC. Squaw Creek (SK007), Birch Creek (SK006), Canyon Creek (SK008), Sellars Creek (SK010), Mud Creek (SK009), Horse Creek (SK015) and Long Valley Creek (SK 015) are all located here. There are two AUs assigned to Willow Creek in this sub-watershed, SK 008 in the lower area, near Canyon Creek and SK001 by Horse Creek. Sub-watershed boundaries are the Long Valley Creek-Willow Creek confluence, downstream to the Willow Creek Grays-Lake Outlet confluence.

Upper Grays Outlet (170402050)

The streams Grays Lake Outlet, Lava Creek, Sawmill Creek, Corral Creek, Brockman Creek, and Shirley Creek are located in the Upper Grays Outlet sub-watershed. Lava Creek (SK028) and Brockman Creek (SK024) drain directly into Grays Lake Outlet. Corral (SK026), Sawmill (SK027), and Shirley Creeks (SK024) drain into Brockman Creek, which ultimately drains into Grays Lake Outlet. This sub-watershed contains over 93 stream miles, making it the 5th field with the largest quantity of stream miles. Elevation ranges from over 7500 feet to approximately 6200 feet and a total basin length of 22.61 miles.

Homer Creek (1704020506)

The Homer Creek sub-watershed contains the entire Homer Creek (SK018) drainage, over 45 mi^2 and 19.56 mi long. Sub-watershed boundaries are Homer Creek from headwaters to its confluence with Grays Lake Outlet.

Upper Willow (1704020507)

The Upper Willow Creek sub-watershed contains Willow Creek from its headwaters to just below the Long Valley Creek confluence. The streams contained in this sub-watershed are: Willow Creek (SK013), Buck Creek (SK012), Mill Creek (SK012), Seventy Creek (SK013) and Crane Creek (SK014). Buck, Mill, and Crane Creeks are all tributaries of Willow Creek.

Grays Lake (1704020505)

The Lower Willow sub-watershed is the fifth field HUC where the Grays Lake (SK021) wetland complex is located (eutrophic lake). This sub-watershed contains all of the source streams that drain into the wetland area. Streams in this drainage include: Little Valley Creek (SK022), Jones Creek, Gravel Creek, Bridge Creek, North Fork Eagle Creek, Clark Creek, and Willow Creek. Note: the Willow Creek that is mentioned in this sub-watershed is not the same creek as the Willow Creek in which the subbasin is named. For the purposes of this document the Willow Creek in the Grays Lake fifth field HUC will be hereafter referred to as Willow Creek2.

Geomorphic Risk

In 2002, per DEQ, Spatial Dynamics, Boise, Idaho, completed a Geomorphic Risk Assessment (GRA) on the Willow Creek Subbasin. A GRA provides a preliminary measure of erosivity within the subbasin, allowing for the evaluation of those areas of the watershed that are most susceptible to sedimentation. The GRA was conducted utilizing a geomorphic risk assessment model using Geographic Information Systems (GIS) technology. There are two primary components to the model, the potential sediment transport coefficient and the cumulative source coefficient. Both coefficients are derived from multiple geographic data sets and spatial analysis functions. The potential sediment transport coefficient expresses the watershed’s geomorphic characteristics: relief ratio, drainage density, and bankfull discharge, which in turn describe the ability of a stream to carry sediment during a time of bankfull flow. Anthropogenic sediment sources and a natural sensitivity index produce the cumulative source coefficient component of the model. (Spatial Dynamics 2002)

A graphic of the sediment transport coefficient in the Willow Creek Subbasin is shown in figure 10. According to the GRA, Grays Lake Outlet and lower Willow Creek have the highest ability to carry sediment at bankfull flow. Figure 11 and 12 show the human caused sediment sources and the natural sensitivity index, the two major elements to the cumulative source coefficient component of the GRA. Some anthropogenic sediment sources are riparian road impacts and grazing, both are widely distributed throughout the subbasin.

Figure 13 shows the final GRA for the Willow Creek Subbasin. With all factors involved, the geomorphic risk is greatest along middle Grays Lake Outlet and on Willow Creek at its confluence with Grays Lake Outlet. The eastern perimeter of the watershed, the eastern portion of Grays Lake and the mid-western edge of the watershed, in the Sellars Creek and Birch Creek areas all have a relatively high geomorphic risk. The Tex Creek area and the Ririe Reservoir perimeter are concluded to have the lowest geomorphic risk in the subbasin

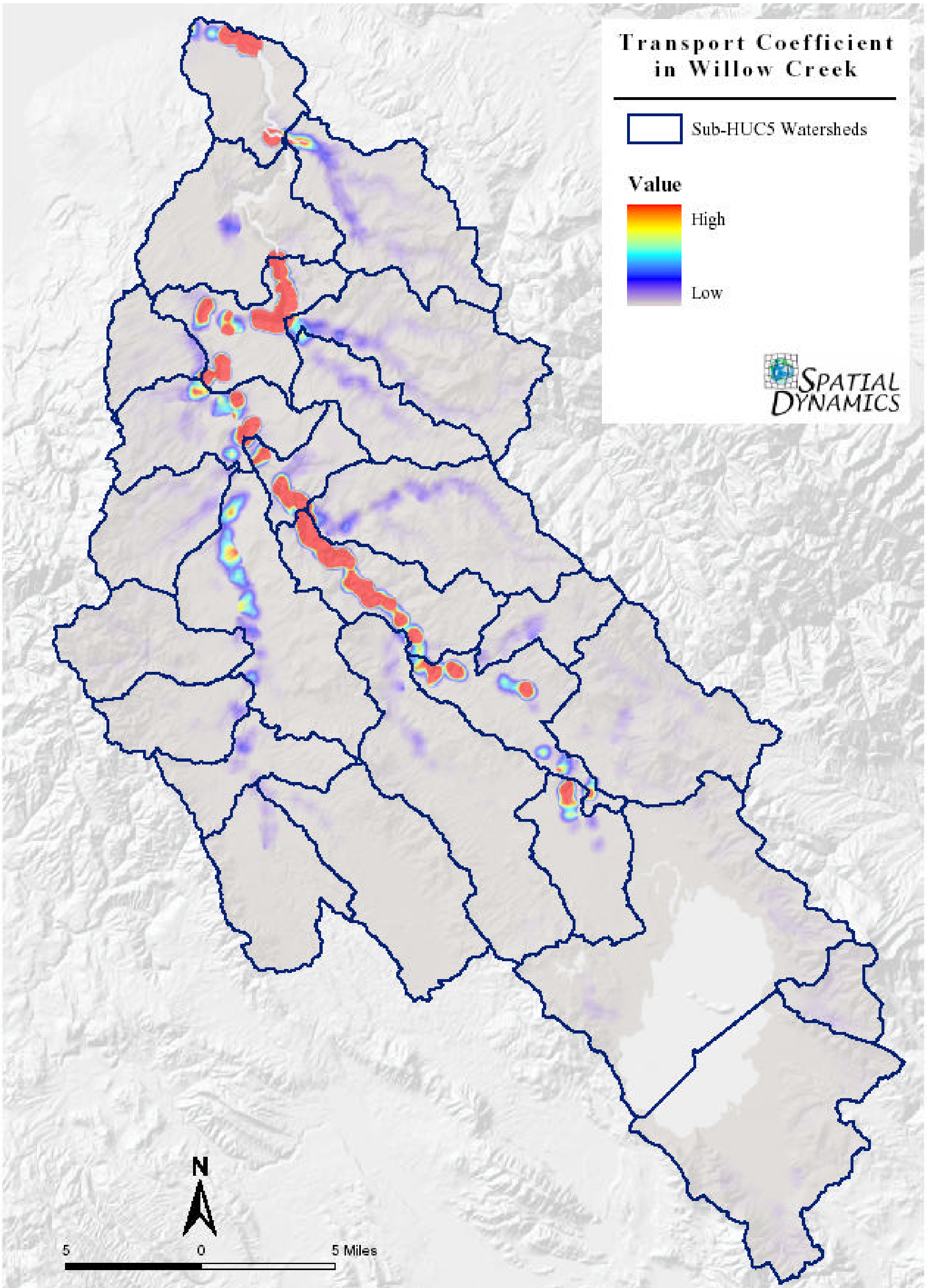

Figure 10. Transport Coefficient in Willow Creek Subbasin.

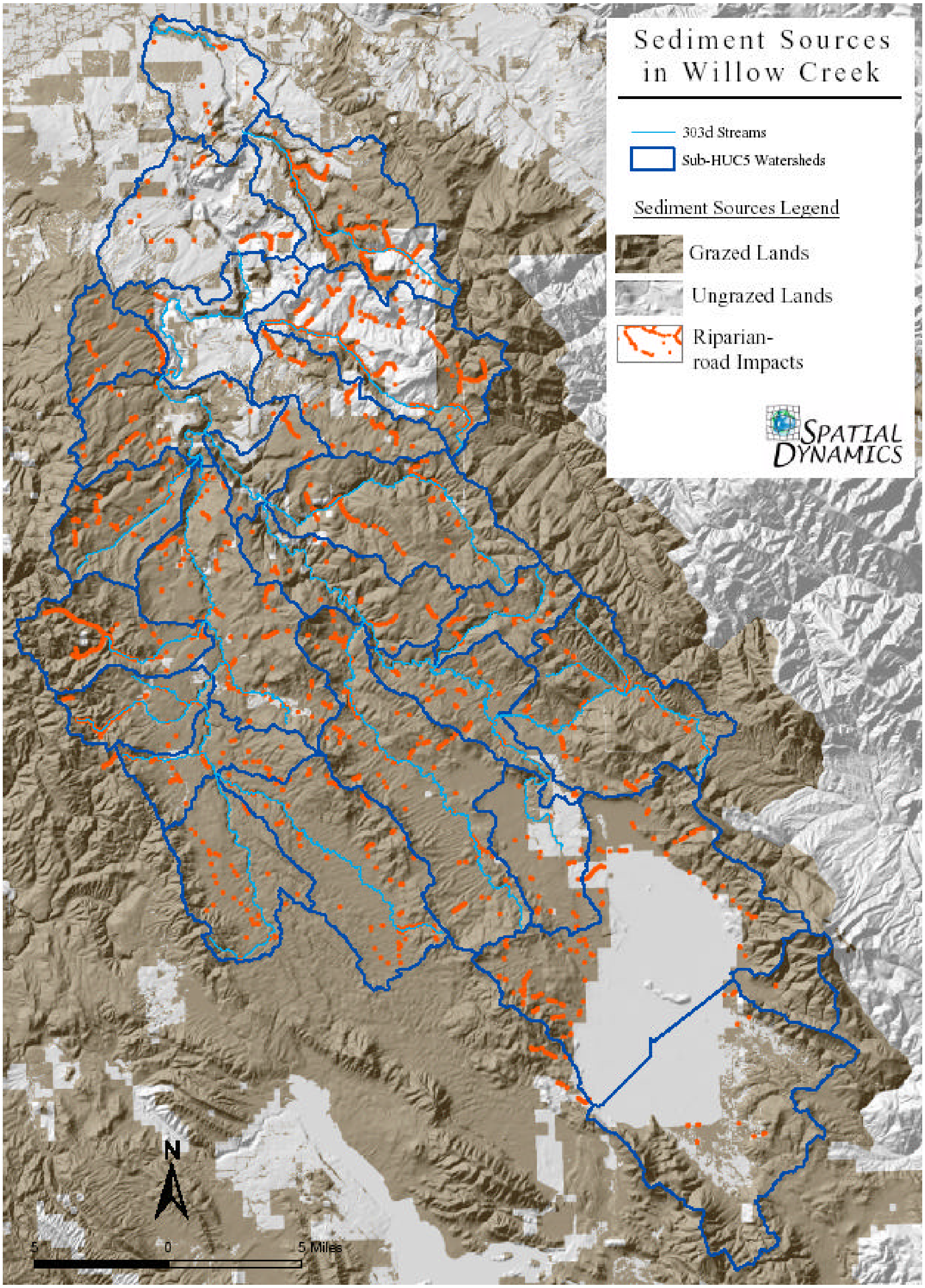

Figure 11. Sediment Sources in the Willow Creek Subbasin.

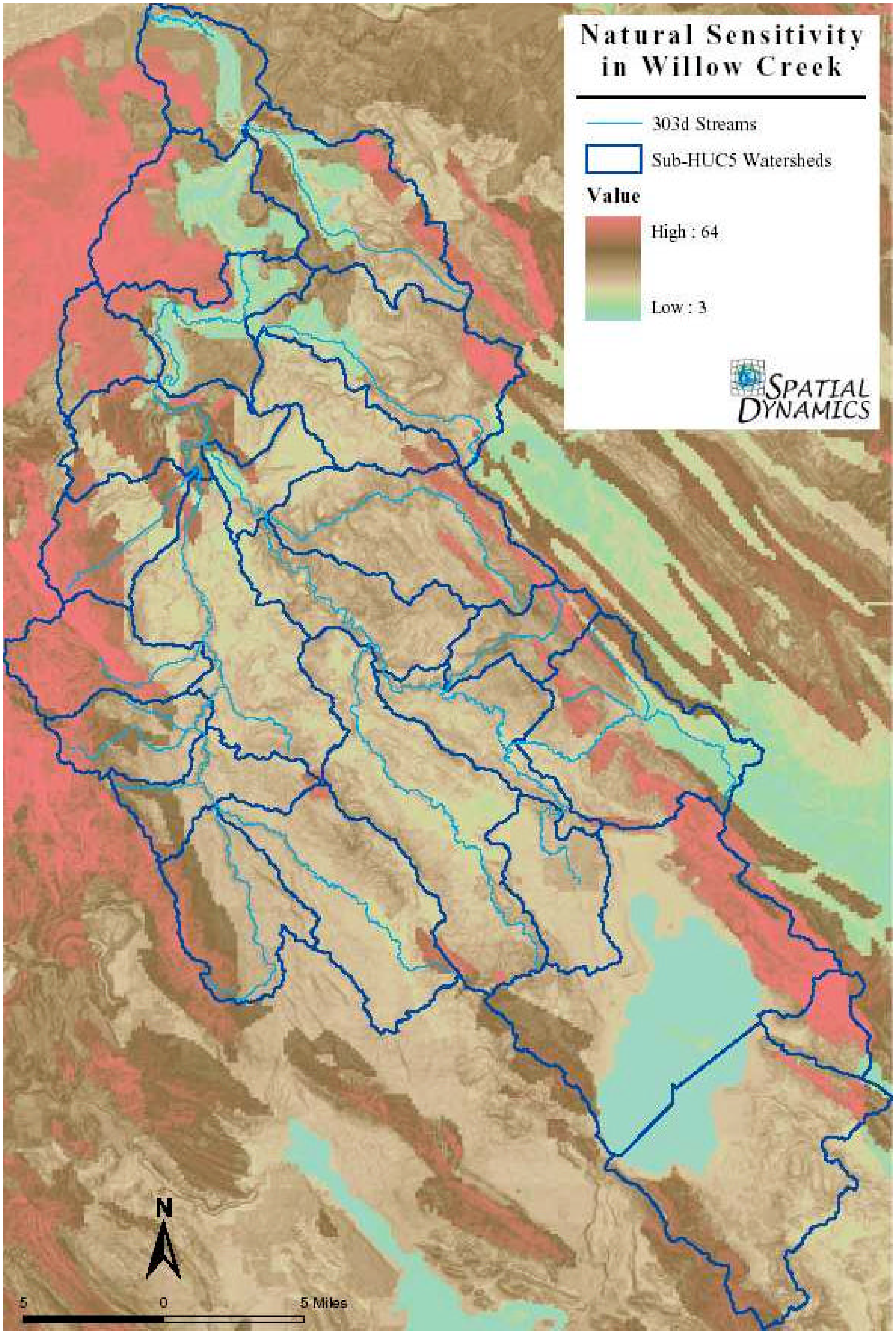

Figure 12. Natural Sensitivity in the Willow Creek Subbasin.

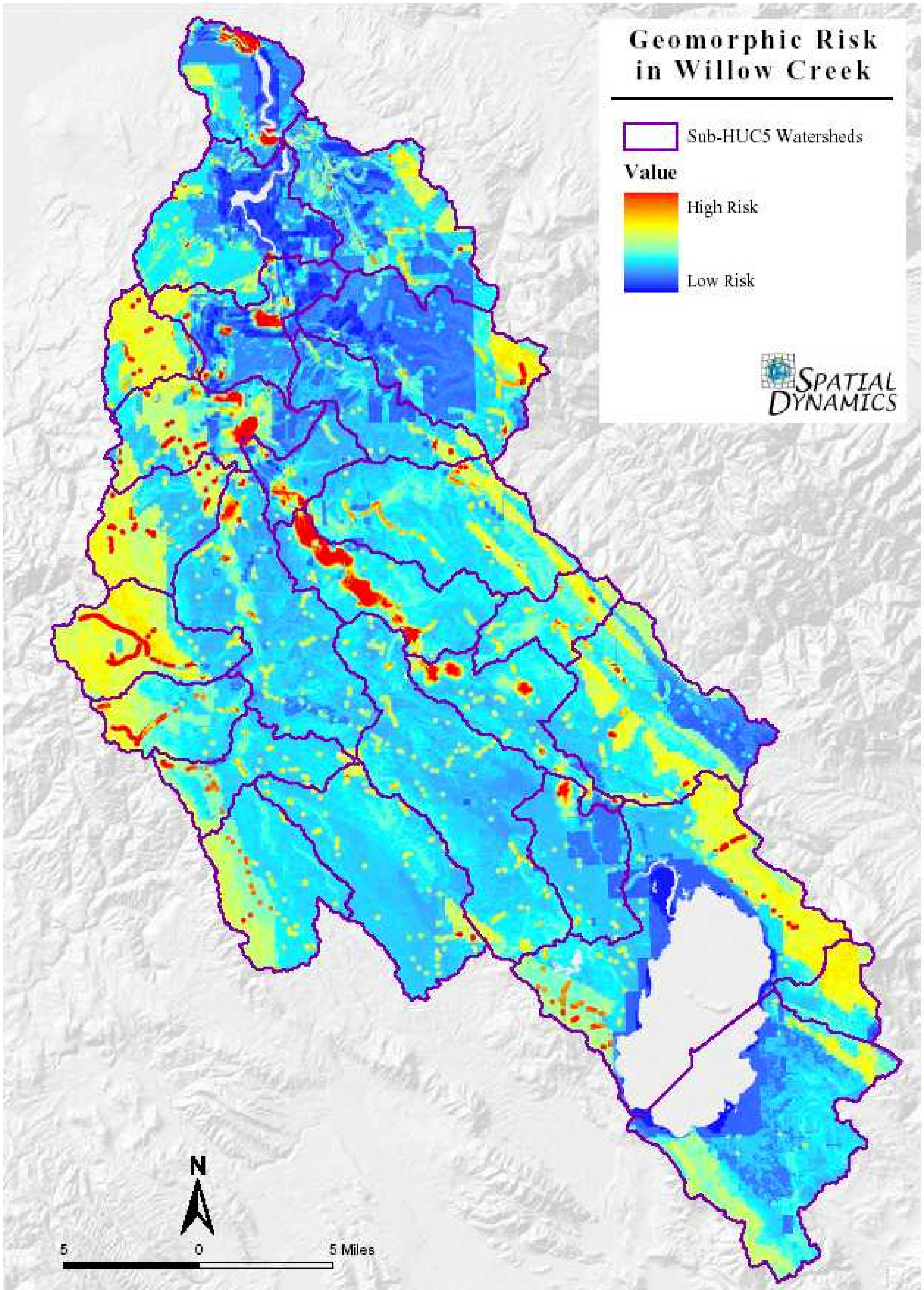

Figure 13. Geomorphic Risk in the Willow Creek Subbasin.

Stream Characteristics

Geomorphic characteristics of the streams in the Willow Creek Subbasin vary considerably. Appendix B contains a summary of the subbasin's stream characteristics collected by the DEQ Beneficial Use Reconnaissance Program (BURP). These data provide a detailed description of several stream characteristics.

Geomorphic characterization of the steam channels was achieved utilizing the Rosgen Stream Classification System, Level 1 for stream types. Rosgen type A streams are entrenched, high energy, steep gradient streams with cascades and step/pool morphology. Rosgen type B streams are moderate gradient, with riffles. Rosgen type C streams are low gradient, slightly entrenched, meandering streams with point bar development, riffle/pool morphology and a well-defined floodplain. Rosgen type D streams occur in broad valleys and are braided streams with point bar formations. Rosgen E type streams are very low gradient, found in broad valleys, and highly sinuous. Rosgen F type streams are low gradient, entrenched meandering streams with riffle/pool formations. Rosgen G type streams are moderate gradient, entrenched streams with step/pool morphology. (Rosgen 1996)

Stream order is a hierarchical system for categorizing streams based on their degree of branching. For example, a first order stream is unbranched, a second order stream is a combination of two first order streams and, two second order streams make a third order stream, etc. Stream order is determined using a 1:100,000-scale map.

Stream gradient is a measurement of the slope of the waters surface. Substrate measurements are collected via a modified Wolman Pebble Count. The width/depth ratio is the ratio of the bankfull surface to the average depth of the bankfull channel. This measurement is essential to comprehending the distribution of available energy within a channel and the capability of discharges within the channel to transport sediment. Width/depth ratios are beneficial in determining channel stability. Sinuosity is "the ratio of channel length between two points in a channel to the strait line distance between the same two points".

Figure 14 shows the location of waterbodies located in the Willow Creek Subbasin.

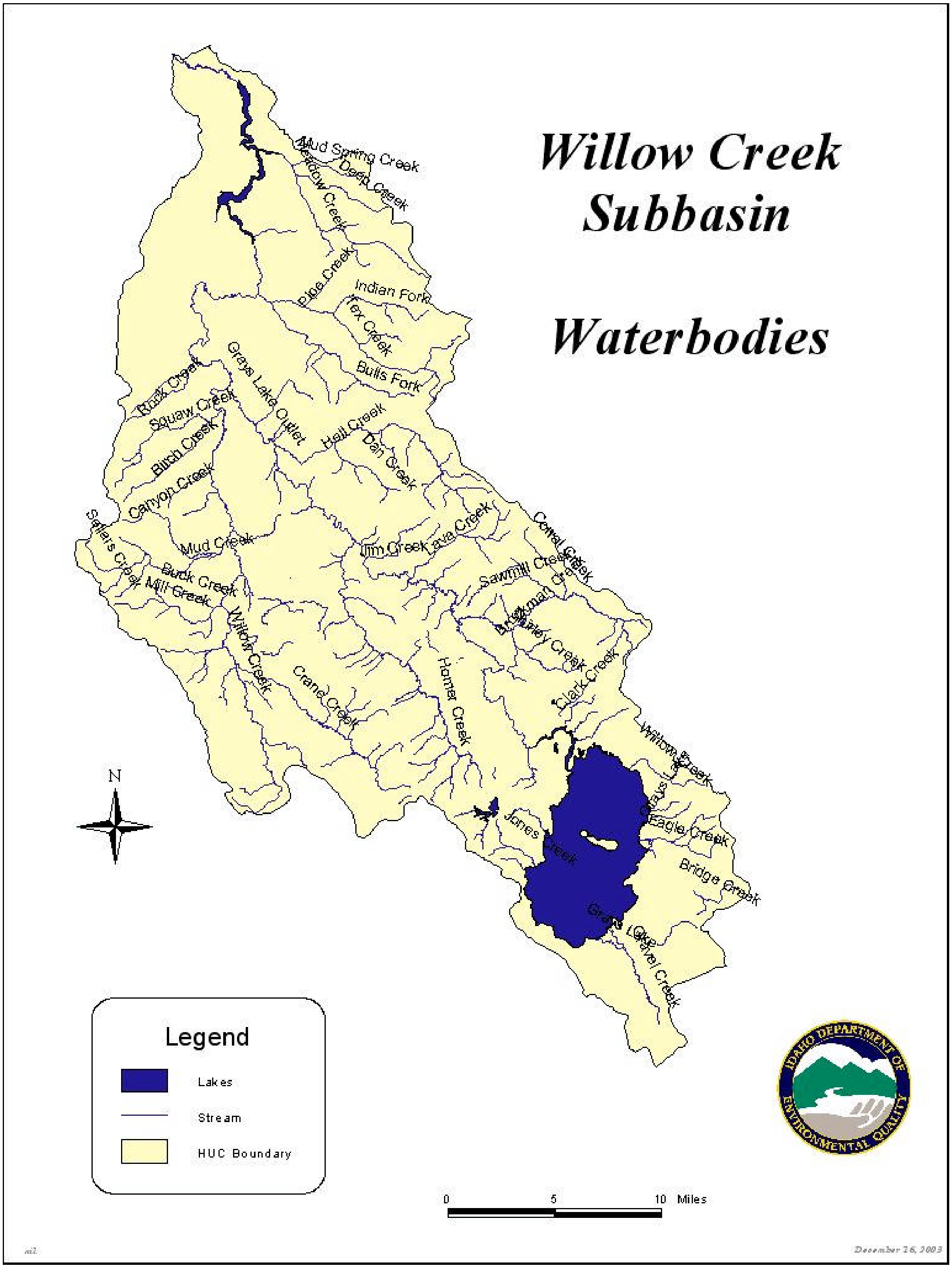

Figure 14. Willow Creek Subbasin Waterbodies

1.3 Cultural Characteristics

The majority of land ownership in the Willow Creek Subbasin is private. Landuse for the most part consists of grazing and dryland farming. Recreational activities are predominantly located near Grays Lake, Tex Creek, and the Ririe Reservoir.

Cattle and sheep grazing are the principal economic activities in the Willow Creek Subbasin. The Bureau of Land Management (BLM), Idaho Department of Lands (IDL), and United States Forest Service (USFS) have grazing allotments within the subbasin. The BLM has 35 allotments with a total of 4135 animal unit months (AUM), where an animal unit month is the amount of forage needed to feed an animal for a month.. The USFS has six allotments with 4210 animals, the majority being sheep. IDL grazing allotments for cattle and sheep exist on nearly 100 percent of the nearly 68,000 acres of Idaho endowment lands.

Land Use

As shown in Table 18, the primary land use category in the Willow Creek Subbasin is rangeland. 241,000 acres are allocated towards rangeland activity, accounting for 58 % of the total land use. Rangelands are located in the lower portions of the subbasin where the land has less relief and the hydrography is less compelling.

The next largest land use category is cropland at 23 %. The majority of cropland is located in the lower portion of the subbasin, in the Ririe Reservoir sub-watershed. Some land near Grays Lake is also used for crops. The largest component of cropland activity is dryland farming. Most of the forestland is located along the eastern edges of the Willow Creek Subbasin, with the headwaters of Willow Creek2 (tributary of Grays Lake), Corral Creek, Brockman Creek, Sawmill Creek, and Tex Creek on forestland. Figure 16 delineates land use activities in the Willow Creek Subbasin. See appendix C for a unit conversion chart.

Table 18. Land use in the Willow Creek Subbasin.

Land Use Category	Acres	Square mi	Square km	% of Total
Grays Lake	25,400	39.69	102.79	6
Cropland	94,825	148.16	383.74	23
Rangeland	241,940	378.03	979.10	58
Forest	55,950	87.42	226.42	13
	418,115	653.30	1,692.06	

The majority of roads within the Willow Creek Subbasin are county and private. The overwhelming majority of the roads within the basin are unpaved. The only paved road in the subbasin is the main road into the watershed from Sunnyside Road in Idaho Falls. This road (Bone Road) is paved to Bone, where the road splits into two main unpaved roads. The Long Valley Road runs southeast towards the northernmost tip of the Grays Lake wetland complex. The Blackfoot Reservoir Road runs directly south towards the Blackfoot Reservoir (Blackfoot Reservoir subbasin).

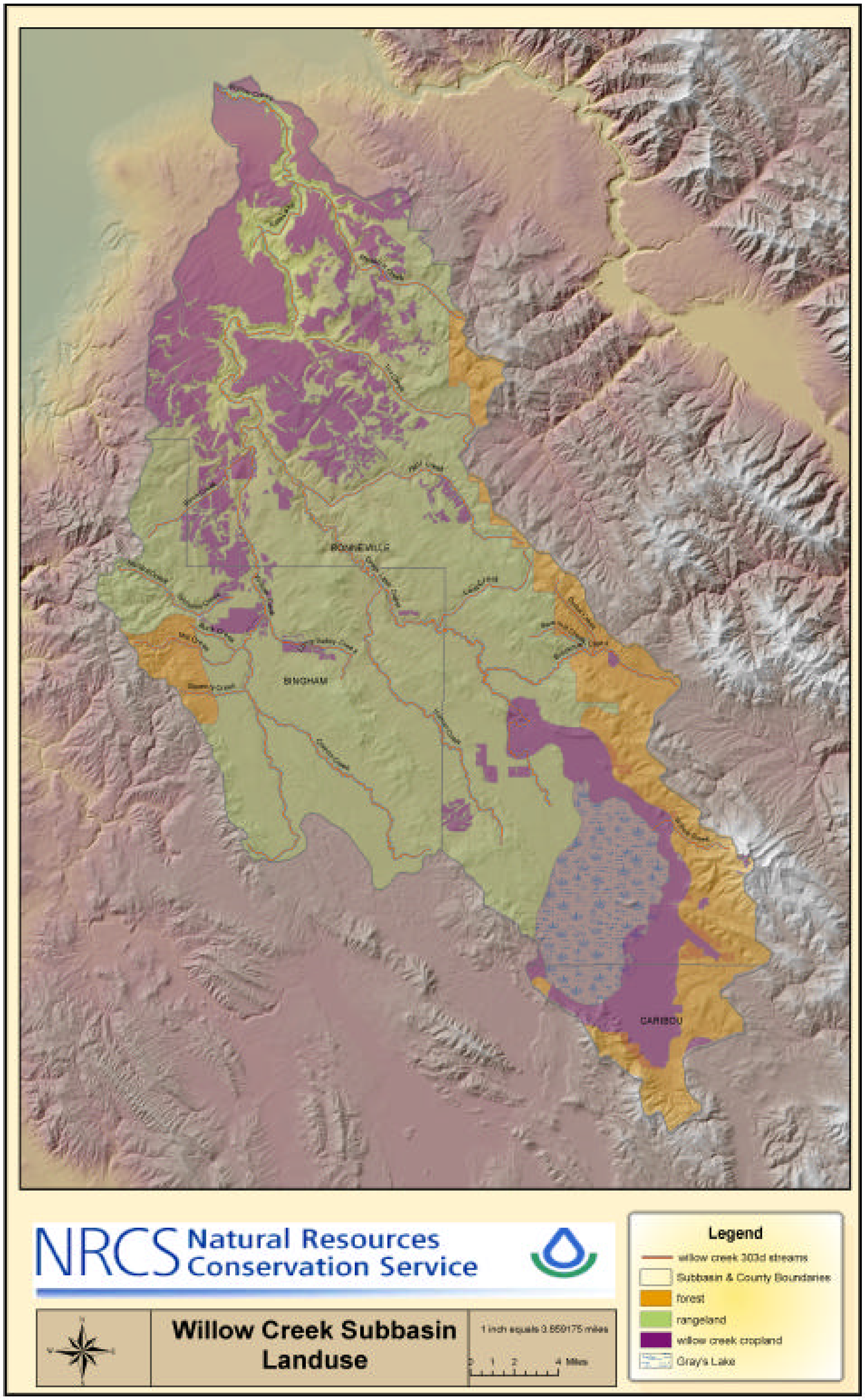

Figure 15. Land Use in the Willow Creek Subbasin.

Land Ownership, Cultural Features, and Population

The Willow Creek watershed is rural, with very small towns within its boundary. Bone and Herman are located in Bonneville County, and the town of Wayan is located in Caribou County. There are no point source discharge facilities in the subbasin and the principal economic activity is agriculture. Clarks Cut Canal, off Grays Lake and the Ririe Reservoir Dam, are the two largest water diversion structures within the subbasin. Figure 16, Subbasin Cultural Features, shows county boundaries, town locations, and major water control structures in the Willow Creek drainage.

This watershed has a very low population density, with the majority of land ownership private at 57.8 % (Table 19). Most of the private land is used for agriculture, principally as rangeland and for dryland crops. The Idaho Department of Lands (IDL) manages approximately 67.8 thousand acres, with the majority leased for rangeland grazing. There are two wildlife management areas in the Willow Creek Subbasin. In the south, the U.S. Fish and Wildlife Service (USFWS) owns and manages the Grays Lake National Wildlife Refuge (31,816 acres) and in the north, the Idaho Department of Fish and Game (IDFG) owns and manages the Tex Creek Wildlife Management Area (31,895 acres). Forestland along the eastern perimeter of the subbasin belongs to the U.S. Forest Service (USFS), constituting 8.7 % of the subbasin's property ownership. Figure 17 shows the land ownership coverages for the Willow Creek Subbasin.

Table 19. Land ownership in the Willow Creek Subbasin.

Owner	Acres	Square miles	Square km	% of Total
Private	**238,171**	**372**	**964**	**57.8%**
Public				
BLM	5,696	9	23	1.4%
US Forest Service	35,686	56	144	8.7%
Bureat of India Affairs	863	1	3	0.2%
State of Idaho	67,766	106	274	16.5%
Idaho Fish & Game	31,895	50	129	7.7%
US Fish & Wildlife Service	31,816	50	129	7.7%
Subtotal	**173,722**	**271**	**703**	**42.2%**
Total	**411,893**	**644**	**1,667**	**100%**

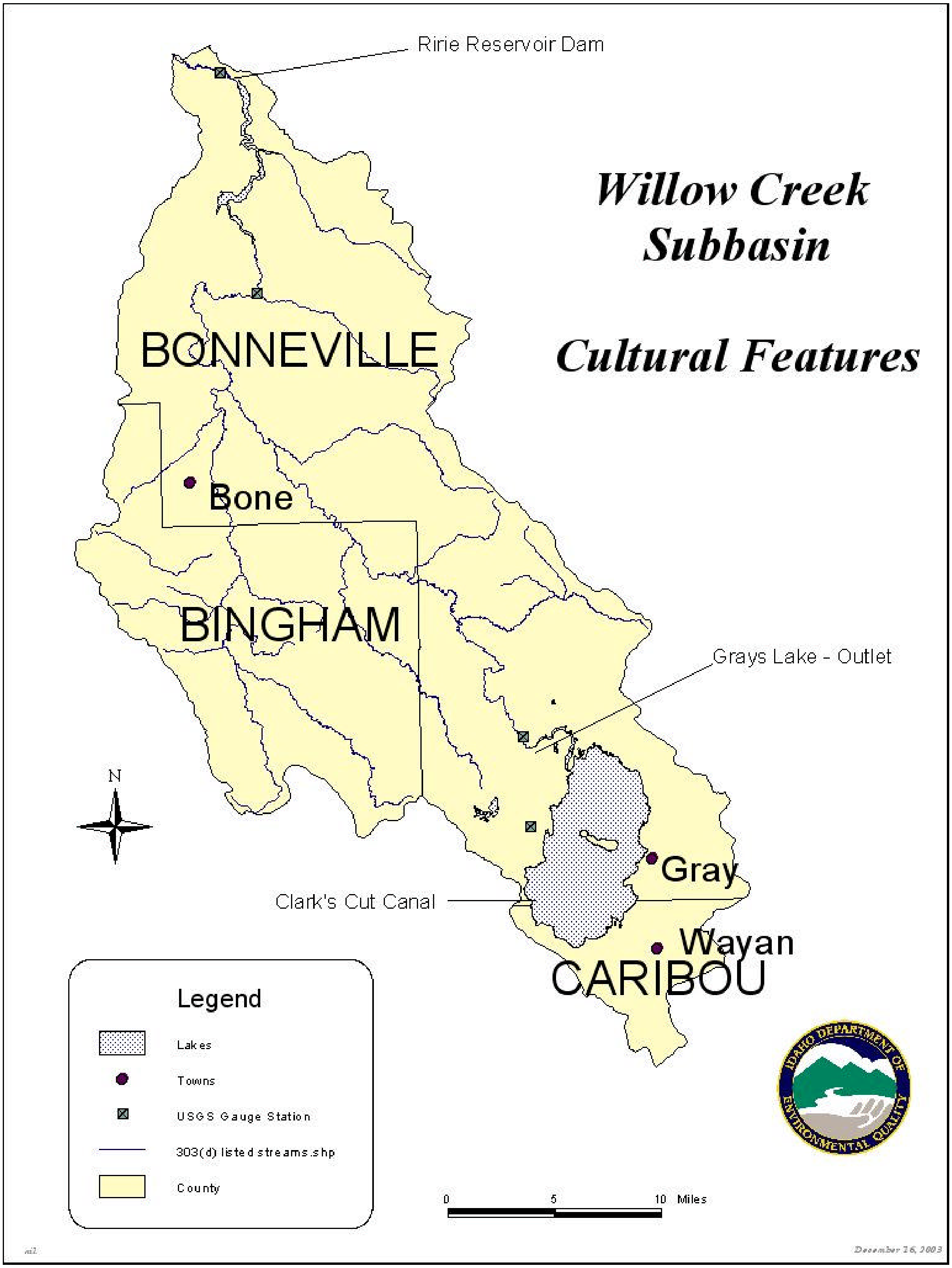

Figure 16. Major Cultural Features of the Willow Creek Subbasin.

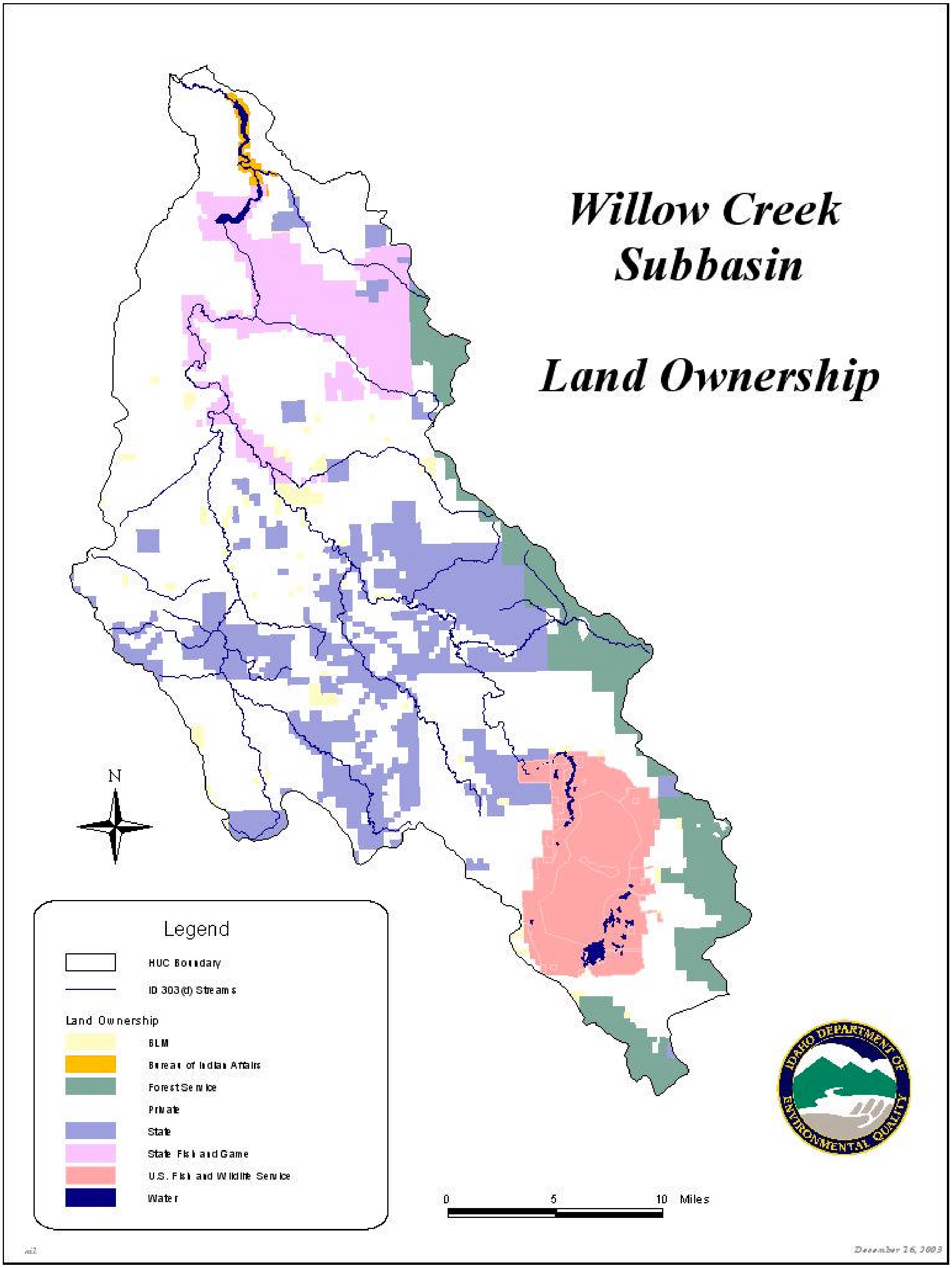

Figure 17. Land Ownership in the Willow Creek Subbasin.

History and Economics

The Willow Creek Subbasin has primarily been used for agricultural purposes since the late 1800's. Human use of the watershed is limited to rangeland, crop production, and recreation.

Three special features of the watershed are discussed in the following: Grays Lake National Wildlife Refuge, Tex Creek Wildlife Management Area, and the Ririe Reservoir.

The Grays Lake Wildlife Refuge (32,825 acres) is situated in "a relatively remote and sparsely populated high altitude mountain valley" (USGS 2002). The refuge was established in 1965 to protect and restore waterfowl nesting habitat. Public access to the refuge is seasonal and relatively light, limited to observation and waterfowl hunting in designated areas. Pursuant to a 1964 agreement, water levels from approximately 13,000 acres of lakebed continue to be managed by the BIA's Fort Hall Irrigation Project, as they have been since the early 1920's. Grays Lake Outlet, Grays Lake's sole original outlet, is now controlled by gates and Clark's Cut a man-made canal, installed in 1924 has diverted up to 20,000 acre feet a year of water into the Blackfoot Reservoir via Meadow Creek. (USGS 2002)

The Tex Creek Wildlife Management Area (WMA) was established in response to the loss of wildlife habitat, directly related to the construction of the Ririe and Teton Reservoirs in the early 1970's. Today, Tex Creek WMA encompasses more than 28,750 acres and is managed by the Idaho Department of Fish & Game (IDFG) for winter range for elk and mule deer and habitat for upland game birds. Land use agreements with private landowners provides additional forage for big game. In exchange, in the absence of big game, select portions of the WMA are used for livestock grazing. Public use of the land is limited to wildlife viewing, day hiking, horseback riding, overnight camping in designated sites, and seasonal big game, little game, and upland bird hunting. (IDFG 1996)

Construction on the Ririe Reservoir Dam, as mentioned in section 1.2, was completed in 1977. Since that time, the Ririe Reservoir has functioned as a structure to impound and control the waters of Willow Creek for recreation, flood control, and irrigation. The reservoir has a total capacity of 100,500 acre-feet (active 90,500).

2. Subbasin Assessment – Water Quality Concerns and Status

Monitoring performed by DEQ has identified several streams in the Willow Creek Subbasin having water quality concerns. All segments except Grays Lake Outlet, Grays Lake to Willow Creek; Rock Creek, headwaters to mouth; and Willow Creek, Grays Lake Outlet to mouth; were included on the original 1998 § 303(d) list. The above mentioned segments were added to the 1998 § 303(d) list by the EPA in 2001.

2.1 Water Quality Limited Segments Occurring in the Subbasin

The Willow Creek Subbasin has twenty water quality limited segments that are included on the Idaho 1998 § 303(d) list. Nineteen of the twenty segments were carryovers from the 1996 § 303(d) list, with Buck Creek as the new addition. DEQ BURP monitoring data for the years of 1993-1996 identified all of the listed segments as not fully supporting their designated beneficial uses. The 303(d) segments were listed based on having low stream macroinvertebrate index (SMI), stream habitat index (SHI), and stream fish index (SFI) scores based on the second edition Water Body Assessment Guidance (WBAGII). Grays Lake Outlet, Grays Lake to Willow Creek, Rock Creek, headwaters to mouth, and Willow Creek, Grays Lake Outlet to mouth were all added by the EPA to the 1998 § 303(d) list in 2001, with temperature as the pollutant.

Figure 18 shows the 303(d) listed water quality segments in the Willow Creek Subbasin. Table 20 summarizes the 303(d) listed water body, its boundaries, assessment units, water quality limited segment number, listed pollutants, and listing basis.

Table 20. §303(d) Segments in the Willow Creek Subbasin.

Waterbody Name	WQL SEG	Assessment Units of ID1740205	1998 §303(d)[1] Boundaries	Pollutants	Listing Basis
Birch Creek	2042	SK006_02 SK006_03	Headwaters to Willow Creek	Sediment	Low SMI, SFI, and SHI scores
Brockman Creek	2047	SK024_02 SK024_03 SK025_02 SK025_03	Headwaters to Grays Lake Outlet	Nutrient, Sediment	Low SMI, SFI, and SHI scores
Buck Creek	5232	SK012_02 (Mill Creek AU)	Headwaters to Mill Creek	Unknown	Low SMI, SFI, and SHI scores
Corral Creek	2048	SK026_02	Headwaters to Brockman Creek	Sediment, Temperature	Low SMI, SFI, and SHI scores

Waterbody Name	WQL SEG	Assessment Units of ID1740205	1998 §303(d)[1] Boundaries	Pollutants	Listing Basis
Crane Creek	2056	SK014_02 SK014_03	Headwaters to Willow Creek	Sediment	Low SMI and SFI scores
Grays Lake Outlet	2044	SK020_02 SK020_04	Grays Lake to Above Falls	Nutrient, Sediment	Low SMI score
Grays Lake Outlet	2044	SK016_04 SK017_04 SK019_04 SK020_02 SK020_04	Grays Lake to Willow Creek	Temperature*	Low SFI and SMI
Hell Creek	2045	SK029_02 SK029_03	Headwaters to Grays Lake Outlet	Nutrient, Sediment	Low SMI, SFI, and SHI scores
Homer Creek	2050	SK018_02 SK018_03	Headwaters to Grays Lake Outlet	Sediment	Low SMI, SFI, and SHI scores
Lava Creek	2046	SK028_02 SK028_03	Headwaters to Grays Lake Outlet	Sediment, Temperature	Low SFI and SHI scores
Long Valley Creek	2053	SK015_02	Headwaters to Willow Creek	Sediment, Temperature	Low SMI, SFI, and SHI scores
Meadow Creek	2040	SK032_02 SK032_03	Headwaters to Ririe Reservoir	Sediment	Low SMI, SFI, and SHI scores
Mill Creek	2054	SK012_02 SK012_03	Headwaters to Willow Creek	Sediment, Temperature	Low SMI, SFI, and SHI scores
Ririe Lake	2036	SK002_05		Sediment	Low SMI score
Rock Creek (Willow Creek)	2028	SK005_02	Headwaters to Mouth (Birch Creek to Bulls Fork)	Temperature*	Low SMI and SFI
Sawmill Creek	2049	SK027_02	Headwaters to Brockman Creek	Sediment, Temperature	Low SMI, SFI, and SHI scores
Sellars Creek	2051	SK010_03	Confluence of South Fork Sellars to willow Creek	Flow Alteration, Sediment, Temperature	Low SMI score
Seventy Creek	2057	SK011_02	Headwaters to Willow Creek	Flow Alteration, Sediment, Temperature	Low SMI, SFI, and SHI scores

Waterbody Name	WQL SEG	Assessment Units of ID1740205	1998 §303(d)[1] Boundaries	Pollutants	Listing Basis
Tex Creek	2041	SK031_02 SK031_03	Headwaters to Indian Fork	Sediment	Low SMI, SFI, and SHI scores
Willow Creek	2035	SK001_05	Ririe Dam to HUC boundary	Sediment Temperature*	Low SMI and SFI scores
Willow Creek	2037	SK004_05 SK005_05	Grays Lake Outlet to Ririe Reservoir	Sediment Temperature*	Low SMI, SFI, and SHI scores
Willow Creek	2039	SK011_04 SK013_02 SK013_03	Headwaters to Sellars Creek	Sediment Temperature*	Low SMI, SFI, and SHI scores

[1]Refers to a list created in 1998 of waterbodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303 subsection “d” of the Clean Water Act.
* 2001 EPA temperature addition to the 1998 303(d) list

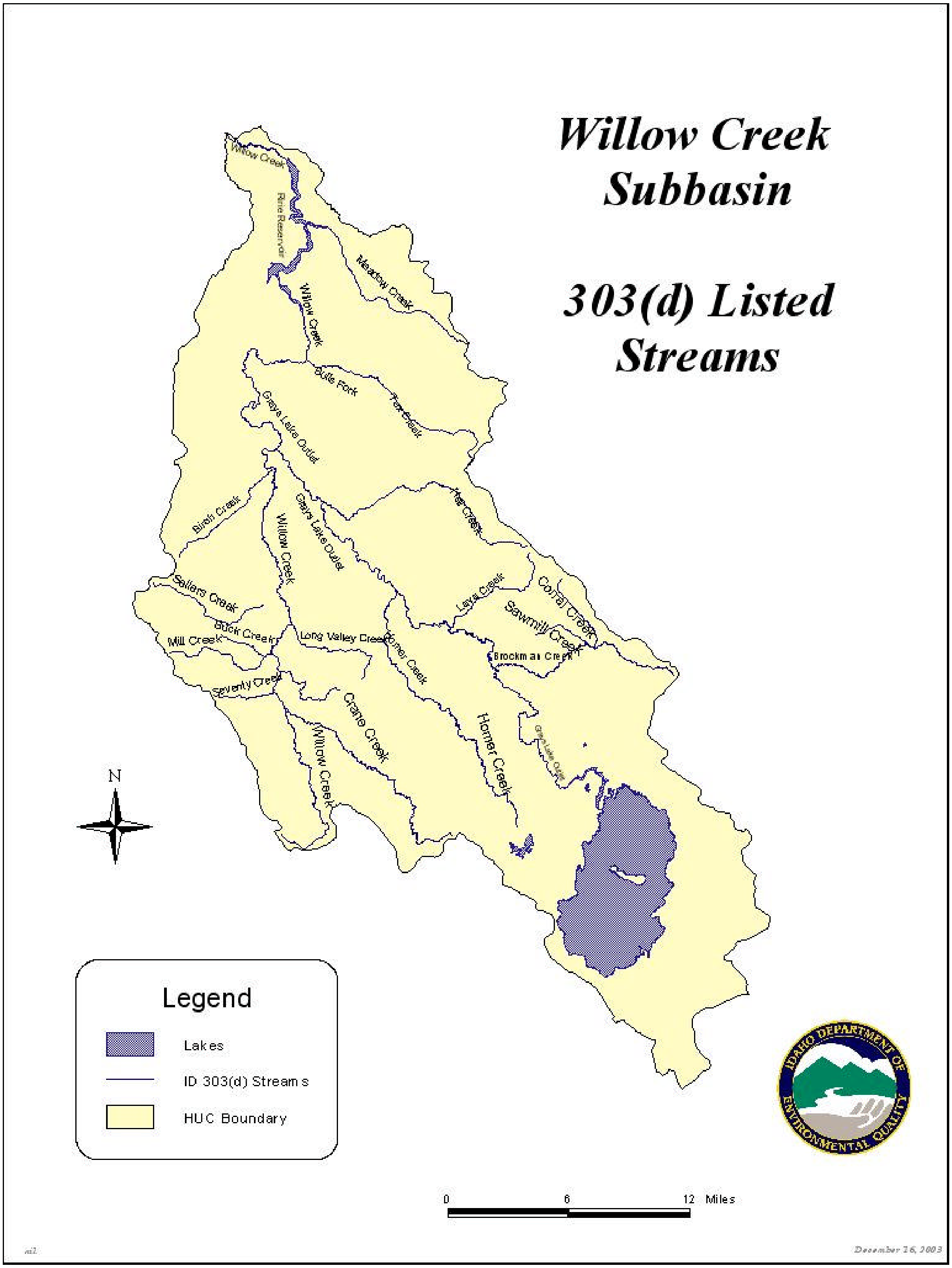

Figure 18. 303(d) listed streams in the Willow Creek Subbasin.

2.2 Applicable Water Quality Standards

Idaho water quality standards are in Idaho's Administrative Procedures Act at IDAPA 58.01.02. Water Quality Standards are legally enforceable rules and consist of three parts: (1) beneficial use designations for the states waters, (2) the numeric and narrative criteria to protect those uses, and (3) an antidegradation policy.

Beneficial Use Designations

Water quality standards require that surface waters of the state be protected for beneficial uses, wherever attainable (IDAPA 58.01.02.050.02). Beneficial uses (BU) are the characteristics of Idaho's streams to be utilized for various purposes, and support status is defined at IDAPA58.01.02.053. The Water Body Assessment Guidance, second edition (DEQ 2002) gives a more detailed description of the procedure for assessing beneficial uses. Beneficial uses are categorized as existing uses, designated uses, and presumed uses. See appendix D applicable water quality standards in their entirety.

Existing Uses

Existing uses under the CWA are "those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards." The existing instream water uses and the level of water quality necessary to protect the uses shall be maintained and protected (IDAPA 58.01.02.003.35, .050.02, and 051.01 and .053). Existing uses include uses actually occurring whether or not the level of quality to fully support the uses exists. Practical application of this concept would be when a water could support salmonid spawning, but salmonid spawning is not yet occurring.

Designated Uses

Designated uses under the CWA are "those uses specified in water quality standards for each water body or segment, whether or not they are being attained." Designated uses are simply uses officially recognized by the state. In Idaho, these include things such as aquatic life support, recreation in and on the water, domestic water supply, and agricultural use. Water quality must be sufficiently maintained to meet the most sensitive use. Designated uses may be added or removed using specific procedures provided for in state law, but the effect must not be to preclude protection of an existing higher quality use such as cold water aquatic life or salmonid spawning. Designated uses are specifically listed for waterbodies in Idaho in tables in the Idaho water quality standards (see IDAPA 58.01.02.003.22 and .100, and IDAPA 58.01.02.109-160 in addition to citations for existing uses.) Table 21 identifies the designated uses for waterbodies in the Willow Creek Subbasin.

Table 21. Willow Creek Subbasin designated beneficial uses.

Waterbody	Water Body Unit (WBID)	Boundaries	Designated Uses[1]	1998 §303(d) List[2]
Willow Creek	US-1	Ririe Reservoir Dam to Eagle Rock Canal	CWAL, SS, and SCR	Yes
Ririe Reservoir (Willow Creek)	US-2		CWAL, SS, PCR, DWS, and SRW	Yes
Willow Creek	US-4	Bulls Fork to Ririe Reservoir	CWAL, SS, RCR, DWS, and SRW	Yes
Willow Creek	US-5	Birch Creek to Bulls Fork	CWAL, SS, PCR, DWS, and SRW	Yes
Willow Creek	US-8	Mud Creek to Birch Creek	CWAL, SS, PCR, DWS, and SRW	No
Willow Creek	US-11	Crane Creek to Mud Creek	CWAL, SS, PCR, DWS, and SRW	Yes
Willow Creek	US-13	Source to Crane Creek	CWAL, SS, PCR, DWS, and SRW	Yes

[1]CWAL – Cold Water Aquatic Life, SS – Salmonid Spawning, PCR – Primary Contact Recreation, SCR – Secondary Contact Recreation, AWS – Agricultural Water Supply, DWS – Domestic Water Supply, SRW – Special Resource Water.
[2]Refers to a list created in 1998 of waterbodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303 subsection "d" of the Clean Water Act.

Presumed Uses

In Idaho, most waterbodies listed in the in the water quality standards do not yet have specific use designations. These undesignated uses are to be designated. In the interim, and absent information on existing uses, DEQ presumes that most waters in the state will support cold water aquatic life and either primary or secondary contact recreation (IDAPA 58.01.02.101.01). To protect these so-called "presumed uses," DEQ will apply the numeric criteria cold water and primary or secondary contact recreation criteria to undesignated waters. If in addition to these presumed uses, an additional existing use, (e.g., salmonid spawning) exists, because of the requirement to protect levels of water quality for existing uses, then the additional numeric criteria for salmonid spawning would additionally apply (e.g., intergravel dissolved oxygen, temperature). However, if for example, cold water is not found to be an existing use, a use designation to that effect is needed before some other aquatic life criteria (such as seasonal cold) can be applied in lieu of cold water criteria. (IDAPA 58.01.02.101.01). Table 22 identifies the presumed uses for waterbodies in the Willow Creek Subbasin.

Table 22. Willow Creek Subbasin existing/presumed beneficial uses.

Waterbody	Water Body Unit (WBID)	Boundaries	Existing/Presumed Uses[1]	1998 §303(d) List[2]
Blacktail Creek	US-3	Source to Ririe Reservoir	CWAL and PCR or SCR	No
Birch Creek	US-6	Source to Mouth	CWAL and PCR or SCR	Yes
Squaw Creek	US-7	Source to Mouth	CWAL and PCR or SCR	No
Mud Creek	US-9	Source to Mouth	CWAL and PCR or SCR	No
Sellars Creek	US-10	Source to Mouth	CWAL and PCR or SCR	Yes
Mill Creek	US-12	Source to Mouth	CWAL and PCR or SCR	Yes
Crane Creek	US-14	Source to Mouth	CWAL and PCR or SCR	Yes
Long Valley Creek	US-15	Source to Mouth	CWAL and PCR or SCR	Yes
Grays Lake Outlet	US-16	Hell Creek to Mouth	CWAL and PCR or SCR	Yes
Grays Lake Outlet	US-17	Homer Creek to Mouth	CWAL and PCR or SCR	Yes
Homer Creek	US-18	Source to Mouth	CWAL and PCR or SCR	Yes
Grays Lake Outlet	US-19	Brockman Creek to Homer Creek	CWAL and PCR or SCR	Yes
Grays Lake Outlet	US-20	Grays Lake to Brockman Creek	CWAL and PCR or SCR	Yes
Grays Lake	US-21		CWAL and PCR or SCR	No
Little Valley Creek	US-22	Source to Mouth	CWAL and PCR or SCR	No
Gravel Creek	US-23	Source to Mouth	CWAL and PCR or SCR	No
Brockman Creek	US-24	Corral Creek to Mouth	CWAL and PCR or SCR	Yes
Brockman Creek	US-25	Source to Corral Creek	CWAL and PCR or SCR	Yes
Corral Creek	US-26	Source to Mouth	CWAL and PCR or SCR	Yes
Sawmill Creek	US-27	Source to Mouth	CWAL and PCR or SCR	Yes
Lava Creek	US-28	Source to Mouth	CWAL and PCR or SCR	Yes
Hell Creek	US-29	Source to Mouth	CWAL and PCR or SCR	Yes
Bulls Fork	US-30	Source to Mouth	CWAL and PCR or SCR	Yes
Tex Creek	US-31	Source to Mouth	CWAL and PCR or SCR	Yes
Meadow Creek	US-32	Source to Ririe Reservoir	CWAL and PCR or SCR	Yes

[1]CWAL – Cold Water Aquatic Life, SS – Salmonid Spawning, PCR – Primary Contact Recreation, SCR – Secondary Contact Recreation, AWS – Agricultural Water Supply, DWS – Domestic Water Supply, SRW – Special Resource Water.
[2]Refers to a list created in 1998 of waterbodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303, subsection “d” of the Clean Water Act.

Beneficial uses identified for waterbodies for the Willow Creek Subbasin include the following:

- *Cold Water Aquatic Life (CW):* water quality appropriate for the protection and maintenance of a viable aquatic life community for cold water species.

- *Salmonid Spawning (SS):* waters that provide or could provide a habitat for active self-propagating populations of salmonid fishes.

- *Primary contact recreation (PCR):* water quality appropriate for prolonged and intimate contact by humans or for recreational activities when the ingestion of small quantities of water is likely to occur. Such activities include, but are not restricted to, those used for swimming, water skiing, or skin diving.

- *Secondary contact recreation (SCR):* water quality appropriate for recreational uses on or about the water and which are not included in the primary contact category. These activities may include fishing, boating, wading, infrequent swimming, and other activities where ingestion of raw water is not likely to occur.

- *Domestic water supply (DWS):* water quality appropriate for drinking water supplies.

- *Special resource waters (SRW):* waters of the state designated as special resource waters.

All designated uses in the Willow Creek Subbasin—CW, SS, PCR, SCR, DWS, and SRW—are assigned to Willow Creek. All other streams in the subbasin are presumed to support CW and PCR or SCR.

Water Quality Criteria

Water quality criteria to protect these beneficial uses include narrative “free form” criteria applicable to all waters (IDAPA 58.01.02.200), and numeric criteria that vary according to beneficial uses (IDAPA 58.01.02.250, 251, and 252). Typical numeric criteria include bacteriological criteria for recreational uses, physical chemical criteria for aquatic life (e.g. pH, temperature, dissolved oxygen, ammonia, toxics, etc), and toxics and turbidity criteria for water supplies.

Of particular importance regarding listed water bodies in this subbasin are the criteria for sediment, temperature, and nutrients.

Sediment

The narrative criterion for sediment is as follows:

> “Sediment shall not exceed quantities specified in Section 250, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses.

> Determination of impairment shall be based on water quality monitoring and surveillance and the information utilized in Section 350.02.b."

Quantities specified in Section 250 refer to turbidity criteria identified for cold water aquatic life use and small public domestic water supplies. Turbidity must be measured upstream and downstream from a sediment input in order to determine a violation of criteria. The quantitative criterion for turbidity is as follows:

> "Turbidity, below any applicable mixing zone set by the Department, shall not exceed background turbidity by more than fifty (50) NTU instantaneously or more than twenty-five (25) NTU for more than ten (10) consecutive days."

Indirectly, specific sediment criteria also include intergravel dissolved oxygen measures for salmonid spawning uses. Intergravels filled with sediment can't hold enough dissolved oxygen (DO) for successful incubation. Intergravel DO measurement requires the placement of special apparatus in spawning gravels. Turbidity and intergravel DO are rarely measured as part of routine reconnaissance-level monitoring and assessment. These measurements are usually conducted in special cases during higher-level investigations of potential problems. The quantitative criterion for intergravel DO is as follows:

> "(a) One (1) day minimum of not less than five point zero (5.0) mg/L. (b) Seven (7) day average mean of not less than six point zero (6.0) mg/L.

Because of the lack of specific numeric criteria for sediment, surrogate measures are often used as a mechanism to reflect potential sediment problems. Often the percentage of depth fine sediments found in spawning gravels is used as an indicator of sediment problems that will affect salmonid species. Generally, depth fines greater than 28% are considered unhealthful for spawning gravels. Streambank stability can be another indicator of sediment problems in streams. When bank stability falls below 80%, these banks may be contributing unhealthy levels of sediment to aquatic habitats. There are other surrogate measures for sediment, however, caution is advised as specific levels can b e highly variable depending on stream morphology and geology of the area, and it may be difficult to pinpoint levels that are universally acceptable.

Nutrients

The narrative criterion for nutrients is as follows:

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

The measures for excess nutrients that are often examined are total phosphorus (P) and nitrate (NO_3) + nitrite (NO_2) nitrogen. Although there is no maximum level specified by law, it is recommended by the EPA that total phosphorus should not exceed (1) 0.1 mg/L in streams not flowing directly into lakes or reservoirs and (2) 0.05 mg/L in any stream at the point where it enters any lake or reservoir and nitrate (NO_3) + nitrite (NO_2) nitrogen shall not exceed 0.3 mg/L. The desired goal associated with these limits is to prevent eutrophication or nuisance algal growths in the waterbody which can impair beneficial use support.

Temperature

The temperature criteria are dependent upon the aquatic life residing in the waters in question. For the waters in the Willow Creek Subbasin, the numeric temperature criteria for cold water aquatic life and salmonid spawning apply.

The temperature criterion (values not to be exceeded) for cold water aquatic life use is:

- 22°C (66.2°F) or less with a maximum daily average of no greater than 19°C (71.6°C).

The temperature criterion (values not to be exceeded) for salmonid spawning is:

- 13°C (55.4°F) or less with a maximum daily average no greater than 9°C (48.2°F).

Antidegradation Policy

Idaho's Antidegradation Policy (IDAPA 16.01.02.051) states that:

> "Existing instream water uses and the level of water quality necessary to protect existing uses shall be maintained and protected."

The policy makes provisions for degradation when it is "…necessary to accommodate important economic or social development in the area in which the waters are located," though water quality must continue to support beneficial uses.

2.3 Summary and Analysis of Existing Water Quality Data

Water quality data in the Willow Creek Subbasin is available, with multiple government agencies collecting data in the watershed, as shown in appendix E. All continuous flow data was provided by the USGS. Water column data, such as stream temperatures, nutrient, dissolved oxygen (DO), and total suspended sediment, was collected by the following agencies: BLM, USFS, IDFG, and IASCD. DEQ has contributed by collecting temperature, Beneficial Use Reconnaissance (BURP) biological data, streambank erosion inventories, and subsurface sediment sampling. The BLM provided information on the riparian conditions in the watershed. The IDL evaluated general stream health in the subbasin. DEQ, IDFG, USFS, and BLM collected fish data.

Flow Characteristics

Several USGS flow gauge stations are maintained in the Willow Creek Subbasin. Two stations are located on Willow Creek: one below Tex Creek (#13057940) and the other below Ririe Reservoir (#13058000). There are two gauge stations at Grays Lake, one at the Outlet (#13057500) and the other at the Diversion to Blackfoot Reservoir (#13057300). Eighteen years of streamflow data is available for station number 13057940. Data years are 1978-1979 and 1985-2001. Streamflow data is available for station number 13058000 for the water years of 1903-1904, 1917-1928, 1962-2001. Limited data is available for the Grays Lake stations; however, it is useful in determining the quantity of water diverted from the Willow Creek watershed to the Blackfoot Reservoir watershed. Flow data is available for station number 13057300, at the diversion, for 1966-1970 and 2000-2002. Data is available for Gray's Lake Outlet, station number 13057500, through the years of 1916-1925 (before Clark's Cut was constructed), 1956, 1966-1970, and 2002 (May-Sept.).

Willow Creek, below Tex Creek, contributes an annual mean flow of 124 cubic feet per second (cfs) for the years of 1978 and 1986-2000. Figure 19 shows the average annual discharge for Willow Creek station number 13057940. Gaps in the chart represent the years when data was not collected at this station. Table 23 and Figure 20 summarize monthly mean flow statistics for the entire period of record, 1977-1979 and 1985-2001. Streamflows peak in the spring with May's flow average at 450 cfs. The lowest recorded mean monthly flows occur in September at 31.0 cfs (Table 22). Peak streamflow data for station number 13057940 is summarized in Table 24. The highest flow on record occurred on May 7, 1997. NRCS Snotel data, discussed in section 1.2, confirms that 1997 was an above average water year.

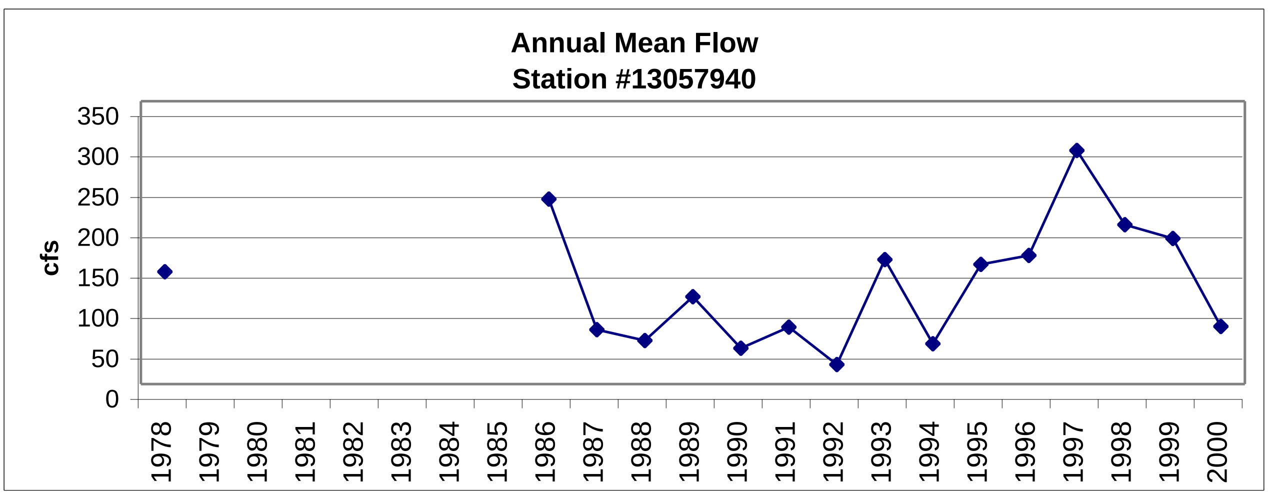

Figure 19. Annual mean flow (cfs) for station #13057940, Willow Creek below Tex Creek near Ririe, ID (1978 and 1986-2000).

Streamflow data from station number 13058000 is heavily influenced by local water needs because the Ririe Reservoir is an impoundment that controls the waters of Willow Creek to provide flood control, irrigation and recreation. Reservoir construction began in 1970 and was completed in 1977. (http://dataweb.usbr.gov/dams/id00344.htm)

Figure 20 shows the annual mean flow for USGS station number 13058000, below Ririe Reservoir. Annual average flow ranges from a high of 378 cfs in 1917 to a low in 24.3 cfs in 1977. Peak streamflow data (Figure 23) shows that the highest flow ever recorded occurred in 1962 (5080 cfs), and the second highest occurrence was in 1917 (4200 cfs). As stated in section 1.2, Willow Creek flood damage experienced in 1917 and 1962 led to the construction and coordinated operation of the Ririe Dam and its floodway bypass channel to control the flows in Willow Creek.

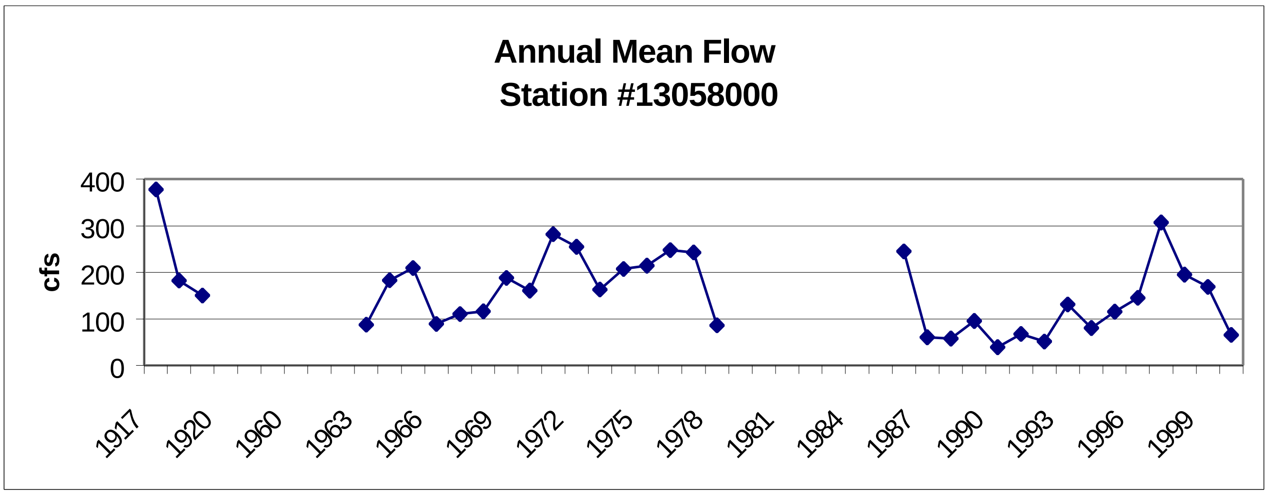

Figure 20. Annual mean flow (cfs) for station #13058000, Willow Creek near Ririe, Id (1917-1919, 1963-1978, and 1986-2000).

Table 23 and Figures 21 and 22 summarize monthly mean flow statistics for the station's reporting time frames. Streamflows below the reservoir tend to peak in May, with a monthly average of 606 cfs, and reach base flows in the winter. Station streamflow data also indicates that flow from the reservoir to Willow Creek is often completely eliminated in the months of December through March.

Table 23. Monthly flow statistics for Willow Creek USGS gauging stations in HUC #17040205.

Station #	Stat.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
13057940	Ave.	42.3	45.1	91.7	343	450	178	62.7	35.6	31.0	39.4	43.9	42.4
	Max.	101	65.1	264	867	1427	409	148	93.1	72.7	73.9	80.0	67.7
	Min.	20.2	20.3	42.7	63.5	25.3	15.2	11.9	3.16	7.38	10.5	16.7	19.5
13058000	Ave.	29.4	35.5	68.5	247	606	286	100	94.0	149	127	59.4	28.8
	Max.	160	98.8	274	750	2133	1325	340	670	610	443	223	91.6
	Min.	0	0	0	0	29.5	30.4	27.8	12.6	16.6	18.4	0	0
13057300	Ave.	0.83	0.49	0.55	19.9	169	178	19.9	1.08	0.48	0.94	2.19	2.22
	Max.	2.48	0.80	0.99	46.0	348	335	65	6.88	1.51	2.24	3.62	5.48
	Min.	0.20	0.17	0.21	0.44	0.13	0.26	0.091	0.01	0	0	0.20	0.20
13057500	Ave.	0.24	0.25	0.27	6.22	215	91	26.9	4.59	1.95	2.33	0.31	0.26
	Max.	0.34	0.38	0.36	12	644	337	45.3	8.34	3.95	10.5	0.31	0.38
	Min.	0.13	0.12	0.1	0.37	0.74	0.74	0.63	0.21	0.15	0.12	0.10	0.13

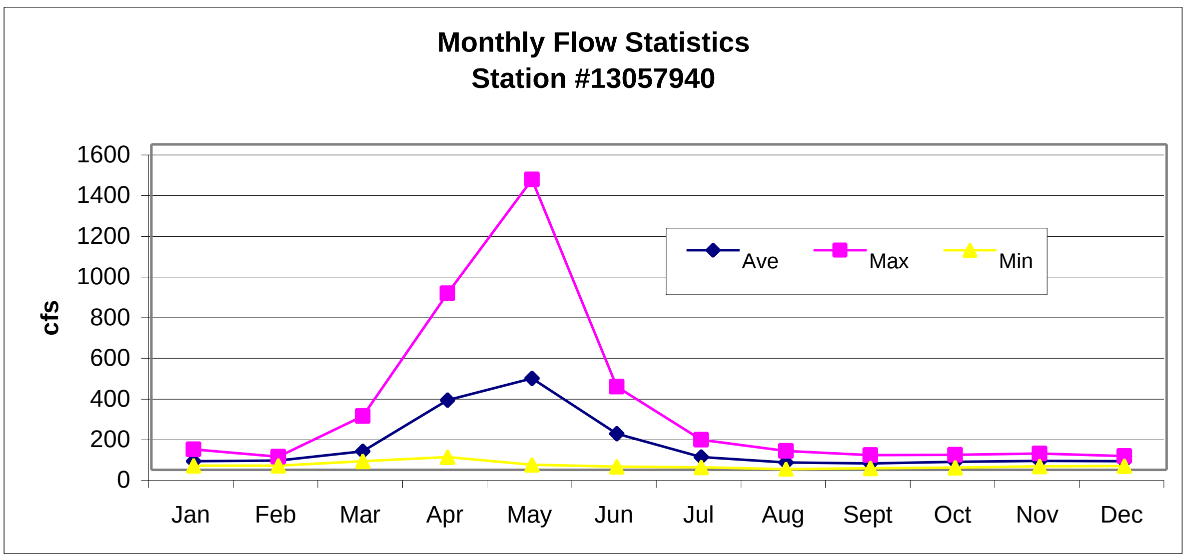

Figure 21. Monthly flow statistics for station #13057940, Willow Creek below Tex Creek near Ririe, ID (1977-1979, 1985-2001).

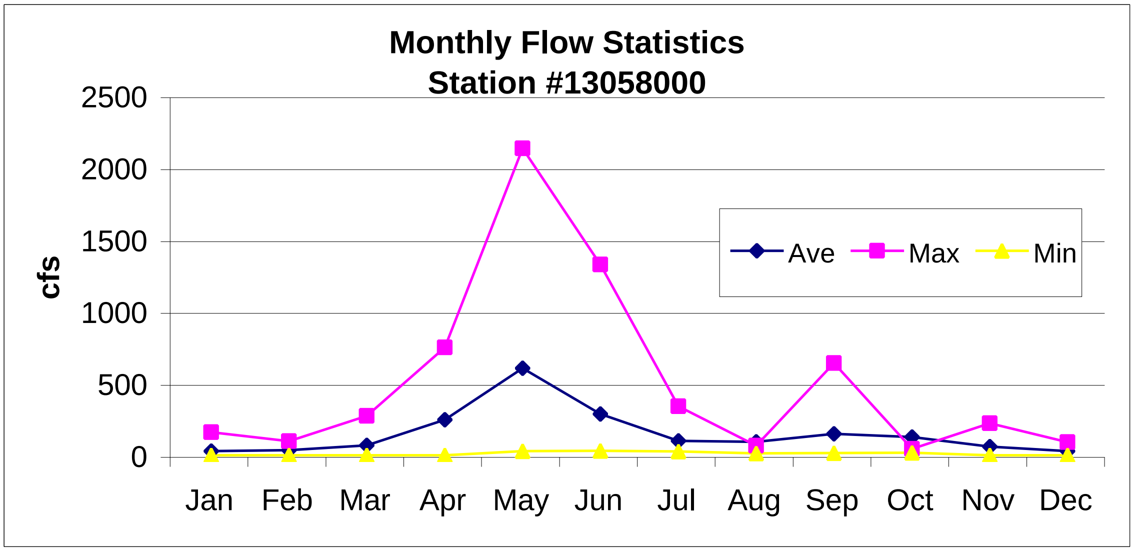

Figure 22. Monthly flow statistics for station #13058000, Willow Creek near Ririe, ID (1903-1904, 1917-1928, and 1962-2001).

Table 24. Peak streamflow (cfs) for station #13057940, Willow Creek below Tex Creek near Ririe, ID (1978-1979, 1986-2001).

Water Year	Date	Stream Flow (cfs)
1978	05/01/78	868[5]
1979	04/30/79	761[5]
1986	04/23/86	1490[5]
1987	04/06/87	495[5]
1988	04/18/88	499[5]
1989	04/21/89	1340[5,B]
1990	04/29/90	309[5]
1991	05/10/91	486[5,B]
1992	04/18/92	94[5]
1993	05/07/93	1460[5]
1994	04/19/94	418[5]
1995	05/07/95	897[5]
1996	05/19/96	1210[5]
1997	05/07/97	2420[5]
1998	05/01/98	1250[5]
1999	04/30/99	1790[5]
2000	04/19/00	580[5]
2001	04/20/01	208[5]

5= Discharge affected to unknown degree by Regulation or Diversion
B= Month or Day of occurrence is unknown or not exact

As shown in Figure 23, the majority of water from Grays Lake is diverted through Clark's Cut Canal to the Ririe Reservoir. In 2002, the USGS recorded a total discharge of 1362.44 cfs for the months of April through September at station number 13057300 (Grays Lake Diversion). This constituted 95 percent of the total discharge from Grays Lake in the 2001-2002 water year. USGS only collects data from the Grays Lake stations in the months of April-September (Bateman 2003).

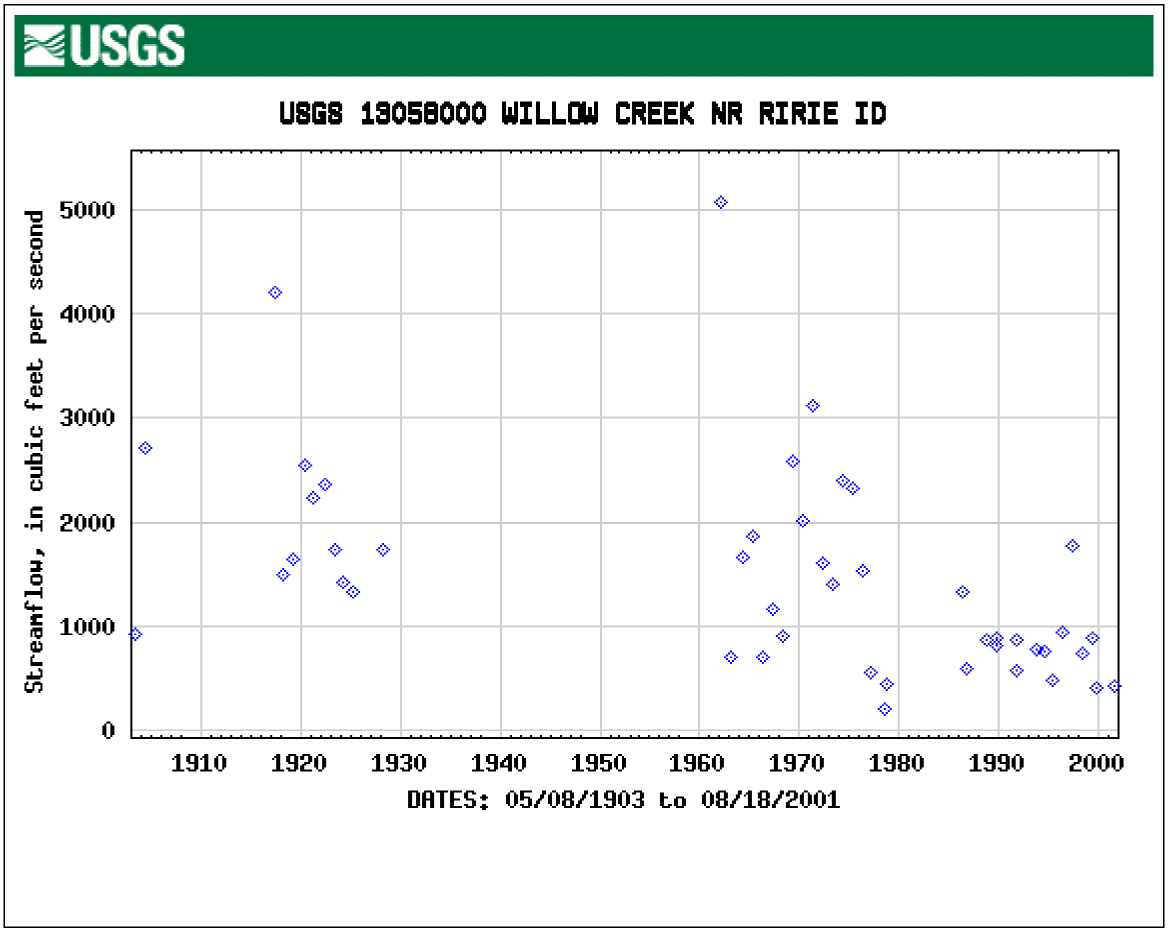

Figure 23. Peak streamflow (cfs) for station # 13058000, Willow Creek near Ririe, ID (1903-2001).

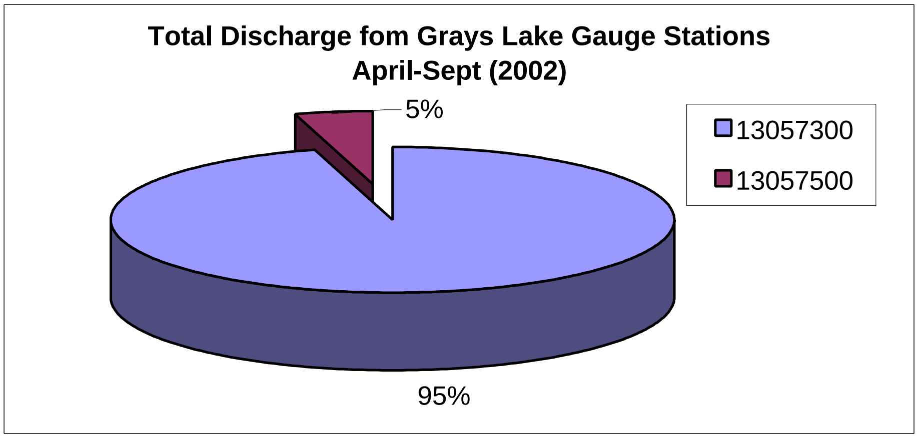

Figure 24. **Total discharge from gauge stations at Grays Lake, Outlet (13057500) and Diversion (13057500) for the months of April-Sept. 2002.**

Water Column Data

Water column data includes stream temperature, total suspended sediment, and nutrient data, all of which are discussed in the following.

Stream Temperature Data

DEQ, United States Forest Service (USFS), and Idaho Fish and Game (IDFG) have collected stream temperature data in the Willow Creek Subbasin. In 2001, IDFG placed 17 temperature loggers in the Willow Creek watershed. Of the 17 loggers, four contained excessive dry stream data and, therefore, were not used to assess stream temperatures. The four dry streams were Shirley Creek, Brockman Creek, Sawmill Creek, and Homer Creek (upper). The 13 remaining temperature loggers were located in Grays Lake Outlet, Hell Creek, Homer Creek (lower), Sellars Creek, Tex Creek, and Willow Creek. USFS maintained thermograph sampling sites along Brockman Creek (at forest boundary), in 2001 and 2002, and Corral Creek (mouth) in 2000 and 2001. In 2003, DEQ collected thermograph data on Mill, Sellars, Long Valley, Lava, and Sawmill Creeks

Raw stream temperature data was obtained and evaluated for State of Idaho water temperature criteria for all of these sites. These criteria are in two categories: cold water aquatic life (CWAL) and salmonid spawning (SS). The temperature criteria for CWAL is 22°C (66.2°F) or less, with a maximum daily average of no greater than 19°C (71.6°C). A CWAL criterion is evaluated for the summer season (June 22 through September 21). The criterion for salmonid spawning is 13°C (55.4°F) or less with a maximum daily average no greater than 9°C (48.2°F). (IDAPA 58.01.02.250.02) According to IDFG, spring SS generally occurs between the first of May through the end of June (Schrader 2003). Fall spawning is known to occur from September 15th through November 15th , although this is an approximation.

A major exceedance of temperature criteria occurs when the criteria are exceeded 10% of the time. A minimum of two measurements must be evaluated before the determination of a violation can be made. See tables 25-30 for temperature exceedances on each site and the thermograph location(s) for each stream. Major exceedances (>10%) are shaded in gray on the tables.

Table 25. 2001 IDFG Temperature data and number of days where water temperatures exceeded the cold water aquatic life criteria during the entire monitoring period.

		Cold Water Aquatic Life						
			22°C Inst.			19°C Daily Ave.		
Stream Name	**Date Period**	**# Days Evaluated**	**# Days Over**	**Max Temp**	**Max Date**	**# Days Over**	**Max Temp**	**Max Date**
Grays Lake Outlet	05/28/01-10/21/01	92	55	28.7	03-Jul	38	22.3	04-Jul
Grays Lake Outlet, Bridge	07/14/01-09/23/01	70	14	23.8	19-Jul	26	20.8	07-Aug
Grays Lake Outlet, Mouth	07/14/01-10/05/01	70	7	23.4	14-Aug	14	20.6	14-Aug
Hell Creek	05/28/01-10/21/01	92	0	19.8	05-Jul	0	18.2	06-Jul
Homer Creek	05/28/01-10/21/01	92	75	29.9	02-Sept	4	19.8	04-Jul
Sellars Creek	05/28/01-10/21/01	92	0	18.9	04-Jul	0	14.7	05-Jul
Sellars Creek, South Fork	05/28/01-10/21/01	92	0	22.4	10-Jul	0	15.6	05-Jul
Tex Creek	05/27/01-10/21/01	92	11	24.2	22-Jun	0	18.7	05-Jul
Willow Creek	05/28/01-10/21/01	92	39	25.6	03-Jul	58	23.4	05-Jul
Willow Creek, Cloward's Crossing	07/14/01-09/23/01	70	38	26.7	21-Jul	33	21.4	09-Aug
Willow Creek, Grays Lake Outlet	07/14/01-10/15/01	70	48	26.6	06-Aug	34	21.8	07-Aug
Willow Creek, High Bridge	07/14/01-09/23/01	70	40	24.9	19-Jul	21	20.1	07-Aug
Willow Creek, Pole Bridge	07/14/01-09/23/01	70	3	22.76	06-Aug	21	20.59	07-Aug

Table 26. 2001 IDFG Temperature data and number of days where water temperatures exceeded the salmonid spawning criteria during the entire monitoring period.

		Salmonid Spawning						
			13 Inst.			9°C Daily Ave.		
Stream Name	**Date Period**	**# Days Evaluated**	**# Days Over**	**Max Temp**	**Max Date**	**# Days Over**	**Max Temp**	**Max Date**
Grays Lake Outlet	05/28/01-10/21/01	71	52	23.34	28-Jun	52	21.31	30-Jun
Grays Lake Outlet, Bridge	07/14/01-09/23/01	9	9	16.84	15-Sept	9	14.66	5-Sept
Grays Lake Outlet, Mouth	07/14/01-10/05/01	31	20	20.42	15-Sept	22	15.87	15-Sept
Hell Creek	05/28/01-10/21/01	71	30	19.51	25-Jun	41	17.41	24-Jun
Homer Creek	05/28/01-10/21/01	71	55	26.42	28-Jun	51	18.79	24-Jun

		Salmonid Spawning						
			13 Inst.			9°C Daily Ave.		
Stream Name	**Date Period**	**# Days Evaluated**	**# Days Over**	**Max Temp**	**Max Date**	**# Days Over**	**Max Temp**	**Max Date**
Grays Lake Outlet	05/28/01-10/21/01	71	52	23.34	28-Jun	52	21.31	30-Jun
Grays Lake Outlet, Bridge	07/14/01-09/23/01	9	9	16.84	15-Sept	9	14.66	5-Sept
Grays Lake Outlet, Mouth	07/14/01-10/05/01	31	20	20.42	15-Sept	22	15.87	15-Sept
Hell Creek	05/28/01-10/21/01	71	30	19.51	25-Jun	41	17.41	24-Jun
Homer Creek	05/28/01-10/21/01	71	55	26.42	28-Jun	51	18.79	24-Jun
Sellars Creek	05/28/01-10/21/01	71	22	18.07	29-Jun	25	13.19	30-Jun
Sellars Creek, South Fork	05/28/01-10/21/01	72	31	22.44	10-Jun	48	15.12	23-Jun
Tex Creek	05/27/01-10/21/01	72	42	23.33	23-Jun	49	17.96	23-Jun
Willow Creek	05/28/01-10/21/01	71	51	24.54	30-Jun	57	21.97	30-Jun
Willow Creek, Cloward's Crossing	07/14/01-09/23/01	9	9	19.76	15-Sept	9	16.69	19-Sept
Willow Creek, Grays Lake Outlet	07/14/01-10/15/01	31	20	20.19	15-Sept	21	16.35	15-Sept
Willow Creek, High Bridge	07/14/01-09/23/01	9	9	18.58	15-Sept	9	14.81	15-Sept
Willow Creek, Pole Bridge	07/14/01-09/23/01	9	9	16.72	15-Sept	9	14.92	51-Sept

Table 27. 2000, 2001, 2002 USFS Temperature data and number of days where water temperatures exceeded the cold water aquatic life criteria during the entire monitoring period.

		Cold Water Aquatic Life						
			22°C Inst.			19°C Daily Ave.		
Stream Name	**Date Period**	**# Days Evaluated**	**# Days Over**	**Max Temp**	**Max Date**	**# Days Over**	**Max Temp**	**Max Date**
Brockman Creek, Forest Boundary	06/12/01-09/04/01	75	0	19.9	14-Aug	0	16.34	22-Jun
Brockman Creek, Forest Boundary	06/20/02-09/10/02	81	0	20.5	12-Jul	0	18.2	08-Jul
Corral Creek, Mouth	07/07/00-09/27/00	64	42	26.9	30-Jul	4	21.9	21-Sept
Corral Creek, Mouth	06/20/02-09/10/02	81	22	25.4	12-Jul	20	21.4	15-Jul

Table 28. 2000, 2001, 2002 USFS Temperature data and number of days where water temperatures exceeded the salmonid spawning criteria during the entire monitoring period.

		Salmonid Spawning						
			13°C Inst.			9°C Daily Ave.		
Stream Name	Date Period	# Days Evaluated	# Days Over	Max Temp	Max Date	# Days Over	Max Temp	Max Date
Brockman Creek, Forest Boundary	06/12/01-09/04/01	19	17	19.54	29-Jun	19	17.30	24-Jun
Brockman Creek, Forest Boundary	06/20/02-09/10/02	11	11	19.70	30-Jun	11	17.84	29-Jun
Corral Creek, Mouth	07/07/00-09/27/00	7	7	22.39	21-Sept	7	21.95	21-Sept
Corral Creek, Mouth	06/20/02-09/10/02	11	11	22.82	30-Jun	11	19.46	30-Jun

USFS thermograph data (tables 27 and 28) show that there were major exceedances of CWAL criteria at the mouth of Corral Creek in 2000 and 2002. However, potentially dewatered stream conditions may play a role in documented exceedances. Major exceedances in SS occurred on Corral and Brockman Creeks on both data collection events.

Homer Creek, 303(d) listed for nutrients and sediment—not for temperature, had major exceedances in CWAL and SS criteria. Hell and Tex Creeks, 303(d) listed for sediment—not for temperature, show major exceedances in SS criteria. Coldwater aquatic life criteria were exceeded throughout Willow Creek. Brockman Creek, from headwaters to Grays Lake Outlet is 303(d) listed for nutrient and sediment, not for temperature. USFS thermograph data show that SS temperature criteria exceedances were documented in 2001 and 2002.

Table 29. 2003 DEQ Temperature data and number of days where water temperatures exceeded the cold water aquatic life criteria during the entire monitoring period.

		Cold Water Aquatic Life						
			22°C Inst.			19°C Daily Ave.		
Stream Name	Date Period	# Days Evaluated	# Days Over	Max Temp	Max Date	# Days Over	Max Temp	Max Date
Lava Creek, Dan Creek Rd	05/07/03-09/25/03	92	20	24.8	07-Jul	2	19.89	25-Jul
Long Valley Creek, Rd x-ing	05/07/03-07/21/03	30	0	21.3	21-Jul	0	18.6	21-Jul
Mill Creek, Res. Rd X-ing	05/07/03-10/27/03	92	36	25.9	21-Jul	7	20.73	21-Jul
Sawmill Creek, Brockman Rd	05/07/03-08/06/03	46	12	24	12-Jul	0	18.77	30-Jun
Sellars Creek, Res. Rd	05/07/03-10/26/03	92	51	27.9	21-Jul	22	22.04	21-Jul

Table 30. 2003 DEQ Temperature data and number of days where water temperatures exceeded the salmonid spawning criteria during the entire monitoring period.

		Salmonid Spawning						
			13°C Inst.			9°C Daily Ave.		
Stream Name	**Date Period**	**# Days Evaluated**	**# Days Over**	**Max Temp**	**Max Date**	**# Days Over**	**Max Temp**	**Max Date**
Lava Creek, Dan Creek Rd	05/07/03-09/25/03	66	53	22.8	30-Jun	53	18.44	18-Jun
Long Valley Creek, Rd x-ing	05/07/03-07/21/03	55	38	18.2	30-Jun	45	16.04	30-Jun
Mill Creek, Res. Rd	05/07/03-10/27/03	98	61	24	30-Jun	72	18.2	30-Jun
Sawmill Creek, Brockman Rd	05/07/03-08/06/03	55	44	22.1	18-Jun	48	18.77	30-Jun
Sellars Creek, Res. Rd	05/07/03-10/26/03	97	50	26.7	30-Jun	68	18.51	30-Jun

Willow Creek, Grays Lake Outlet, Rock Creek, Lava Creek, Corral Creek, Sawmill Creek, Sellars Creek, Long Valley Creek, Mill Creek, and Seventy Creek are 303(d) listed with temperature as a pollutant. Sawmill Creek is listed from headwaters to Brockman Creek. DEQ 2003 thermograph data documented major exceedances in SS criteria. Sellars Creek is listed from the confluence with South Fork Sellars Creek to Seventy Creek. IDFG temperature data is available above the listed reach on South Fork Sellars Creek and on the listed reach at the Ririe Reservoir Road crossing. In both cases, major exceedances of the SS criteria were documented. Two USFS thermographs were placed on the listed reach of Corral Creek in 2000 and 2002. In both cases, there were major temperature exceedances for SS criteria in Corral Creek. Thermograph data is available for Grays Lake Outlet and Willow Creek.

As summarized in tables 25 and 26 major exceedances in CWAL and SS were documented in every location with the exception of Pole Bridge. At Pole Bridge, the major exceedance was for SS only. Stream temperatures were not collected for Rock Creek. The Willow Creek-Kepp's Crossing sample site is located just below the Rock Creek confluence.

All of the streams sampled by DEQ, IDFG, and USFS had major exceedances of the SS criteria. The data presented in Tables 26, 28, and 30 show the number of days that water temperature exceeded salmonid spawning criteria temperatures. Major exceedances are shaded in gray.

Total Suspended Sediment

Total suspended sediment (TSS) data was collected by the BLM in 1983, 1992, 1994, and 2000. Sample locations were on Willow Creek, Tex Creek, Grays Lake Outlet, and Hell Creek. BLM water quality data collected within the past ten years is shown in Table 31. In 2003 IASCD collected TSS data (Appendix F) on Meadow, Tex, Willow, Birch, Sellars, and Homer Creeks and Grays Lake Outlet.

Table 31. BLM water quality monitoring data.

Location	Date	Flow (cfs)	Cond. (µmhos/cm)	Temp (F)	P.H.	TSS (mg/L)	Sed. Load (t/d)
Willow Creek, At Cloward's Crossing	8/17/94	8.03	250	70			
Willow Creek ,at Kepp's Crossing	5/04/92	51.62					
	6/20/94	24.42	265	72			
	5/23/00	112	220	65	8.63	19	5.58
	6/13/00	69.25	285	55.4	8.63	13	2.32
	7/12/00	26.08					
	8/29/00	17.28		59	8.68		
Grays Lake Outlet, below Hell Creek	8/22/94	0.62	260	63			
	5/23/00	54.42	260	63	8.5	25.5	3.58
	6/13/00	25.74	280	58	8.82	6	0.40
	7/12/00	24.16					
	8/2/00	2.2	150	66	8.8		
	8/29/00	2.4		57	9.11		
Hell Creek, above Grays Lake Outlet	5/23/00	6.58		59	8.44	36	0.61
	6/13/00	3.13	370	57	7.79	6	0.05
	7/12/00	3.66					
	8/2/00	0					
Grays Lake Outlet (Upper), above Homer Creek	8/8/83	23.46	300				
	8/17/94	1.73	195				
Tex Creek , above Pipe Creek	8/18/94	1000	60.8				
Tex Creek, below Pipe Creek	5/23/00	3.84	350	64	8.26	59	
	6/13/00	8.28	390	61	8.75	92	

Total suspended sediment is a measure of particles found in suspension. Elevated suspended sediment levels are linked to increased mortality in younger fish, particularly sac fry. Lower, less lethal concentrations induce behavioral responses, which can lead to growth reduction, avoidance, and reproductive failure.

Three levels of TSS have been recommended by DEQ for categorizing fish habitat conditions; 1) <25 mg/L, best conditions, 2) 25-80 mg/L, some effects, 3) >80 mg/L, definite effects. Based on this recommendation, four of the TSS samples shown in table 31 meet the best condition criteria, three samples fall within the range where some effects on fish survival and reproduction are evident, and one sample on Tex Creek was within the definite effects on fish habitat range. TSS data collected by IASCD in 2003 (Appendix F) show most waters in the best condition range with Birch and Meadow Creeks the exception showing levels with some effects on fish habitat. When evaluating the effects of TSS on the aquatic environment, it is important to consider concentration measurements over time. Literature states that sediment effects are dependent on the frequency and duration of exposure as much as the concentration. (DEQ 2003)

Nutrient Data

Excessive concentrations of nutrients, specifically nitrogen and phosphorous, may diminish water quality and impair beneficial uses through the process of eutrophication. According to IDAPA 58.01.02.200.06, surface waters shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growth impairing designated beneficial uses. To protect against the impairment of designated beneficial uses due to excess nutrients, numeric targets have been established by the EPA at 0.1 mg/L Total Phosphorus (TP) in streams not discharging directly into a lake or reservoir, 0.05 mg/L TP in streams were the water enters the reservoir, and 0.3 mg/L nitrate (NO_3) + Nitrite (NO_2) Nitrogen. (EPA 1986)

Since Willow Creek and Meadow Creek flow directly into a reservoir, the TP target is 0.05 mg/L. The remaining streams in the watershed will be evaluated based on the TP target of 0.1 mg/L for streams not discharging into a reservoir. The nitrogen target will be the same for all of the streams at 0.3 mg/L nitrate + nitrite nitrogen.

Table 32 shows the nutrient associated data for five locations: one location on Willow Creek, one on Hell Creek and three locations on Grays Lake Outlet. This data was collected by the BLM in 2000. Total P measured on Grays Lake Outlet, below Hell Creek, in late August was 0.01mg/L, the same concentration as the numeric target. Data show that $NO_3 + NO_2$ concentrations did not exceeded the target level. Grays Lake Outlet and Hell Creek are 303(d) listed with nutrients as a pollutant. Willow Creek is not 303(d) listed for nutrients.

As shown in appendix F, nutrient data was collected by the IASCD in 2003. Sample locations were on Birch Creek, Homer Creek, Meadow Creek, Sellars Creek, Grays Lake Outlet, and Willow Creek (two locations). Water quality data collected on Birch Creek, below Squaw Creek, exceeded the criteria for phosphorous on two occasions at 0.5 mg/L on 06/03/03 and 0.2 mg/L on 6/16/03. The creek was dry on all subsequent occasions. Homer Creek water quality data, collected at the mouth, showed no exceedances. Monitoring occurred on Meadow Creek, below Squaw Creek, one minor phosphorous exceedance at 0.11 mg/L was documented on 06/13/03. Grays Lake Outlet, above the Homer Creek confluence, met the criteria for P and NO_3+NO_2 on all sample occasions in 2003. The Kepp's Crossing sample location on Willow Creek met the criteria for P and NO3+NO_2 on all nine sampling events (06/03/03-10/07/03). However, further upstream on Willow Creek at the Pole Bridge (Long Valley Road crossing) sample site, the results showed nitrogen levels above the criteria on every occasion with six samples exceeding the nitrogen criteria, averaging 0.82 mg/L. Of all the streams sampled, nutrient levels were the highest on Sellars Creek, below the Mud Creek confluence. Nitrate + nitrite levels were elevated on every occasion (nine), averaging, 0.85 mg/L. Phosphorous levels on Sellars Creek were above criteria on three occasions, with the highest reading 0.15 mg/L.

Hell Creek, Brockman Creek, and Grays Lake Outlet (Outlet to falls) are 303(d) listed with nutrients as a pollutant. The Grays Lake (above Homer Creek) sample site is the closest downstream sample location for Brockman Creek. As stated earlier, nutrient samples at that location fall below the recommended criteria. Nutrient samples collected on Grays Lake Outlet, below Hell Creek, were at or below the criteria for P and below the detection limit for nitrogen.

Table 32. Nutrient data at five BLM sample collection sites.

Location	WBID	Date	Flow (cfs)	Cond. (µmhos /cm)	Temp (C)	NO3/NO2 as N (mg/L)	TKN (mg/L)	Ortho-phosphate PO4 (mg/L)	Total P (mg/L)
Willow Creek At Kepp's Crossing	US-5	7/12/00	26.08			<0.1	0.4	0.028	0.048
		8/29/00	17.28		59	<0.1	0.33	0.012	0.037
Grays Lake Outlet below Hell Creek	US-16	8/2/00	2.2	150	65.7	<0.1	0.75	0.011	0.102
		8/29/00	2.4		56.7	<0.1	0.56	0.005	0.028
Hell Creek above Grays Lake Outlet	US-29	7/12/00	3.66			<0.1	0.36	0.017	0.028
		8/2/00	0						
Grays Lake Outlet above Hell Creek	US-17	7/12/00	24.16			<0.1	0.42	0.016	0.025
Grays Lake Outlet (Upper, above Homer Creek)	US-19	8/8/83	23.46	300					
		8/17/94	1.73	195	62.6				

Ririe Reservoir Water Quality Data

Ambient water quality monitoring is conducted on the Ririe Reservoir. The EPA maintains a data management system containing water quality information for the nation's waters. The STORET database contains water quality monitoring data for the Ririe Reservoir. This data is located on the EPA's STORET web page at www.epa.gov/STORET/. Data from 1996 through 2002 suggests that there is a slight declining trend in suspended solids and nitrate/nitrite concentrations. Total Phosphorous concentrations were highest, on average, at the reservoir sample location 0.6 miles northwest of Meadow Creek.

Biological and Other Data

Surface Fines

Since 1993 DEQ has collected water quality data through the Beneficial Use Reconnaissance Program (BURP). The BURP program characterizes water quality based on biological communities and their attributes. Assessing channel materials is an important key to evaluating the biological function and stability of streams. Channel materials consist of surface particles that make up the bed and banks within the bankfull channel. (Rosgen 1996) One method for evaluating the particle size distribution of streambed sediment is the Wolman Pebble Count. BURP crews conduct Wolman Pebble Counts utilizing a set interval method with a minimum of fifty counts per riffle in three riffle habitat units (DEQ 2002). Counts are obtained from the bankfull width on each side. Included are the margins of the streambed, which are not normally under water and may be more depositional than the main channel. A tally is kept of the size categories into which particles fall based on the intermediate axis diameter. From this data, the percentage of particles in set categories can be determined (DEQ 1998).

Sediment fines are defined as materials <6.35 mm in diameter. They are used as an index of sedimentation and beneficial use impairment (DEQ 2002). Studies have shown that many salmonid species prefer particles of this size or greater for spawning success. Studies show that spawning success is diminished when the proportion of finer materials becomes too great. Fine sediment also affects the living space of insects as well as fish (DEQ 2002).

Surface fines and related data is summarized in appendix G, DEQ BURP monitoring data. BURP sample locations are identified in figure 25. The average of percent fines is greater for non-listed streams than for listed streams however, the streambanks are more stable in the non-listed streams. Eagle Creek North Fork, Gravel Creek, and Willow Creek2 (tributary of Grays Lake) are the non-listed streams that tend to have the lowest percentage of surface fines. Brockman Creek, Corral Creek, Grays Lake Outlet, Homer Creek, Lava Creek, Tex Creek and some portions of Willow Creek are the listed reaches that tend to have the lowest percentage surface fines. The listed and non-listed streams with lower surface fine numbers tend to reside in the upper regions of the subbasin.

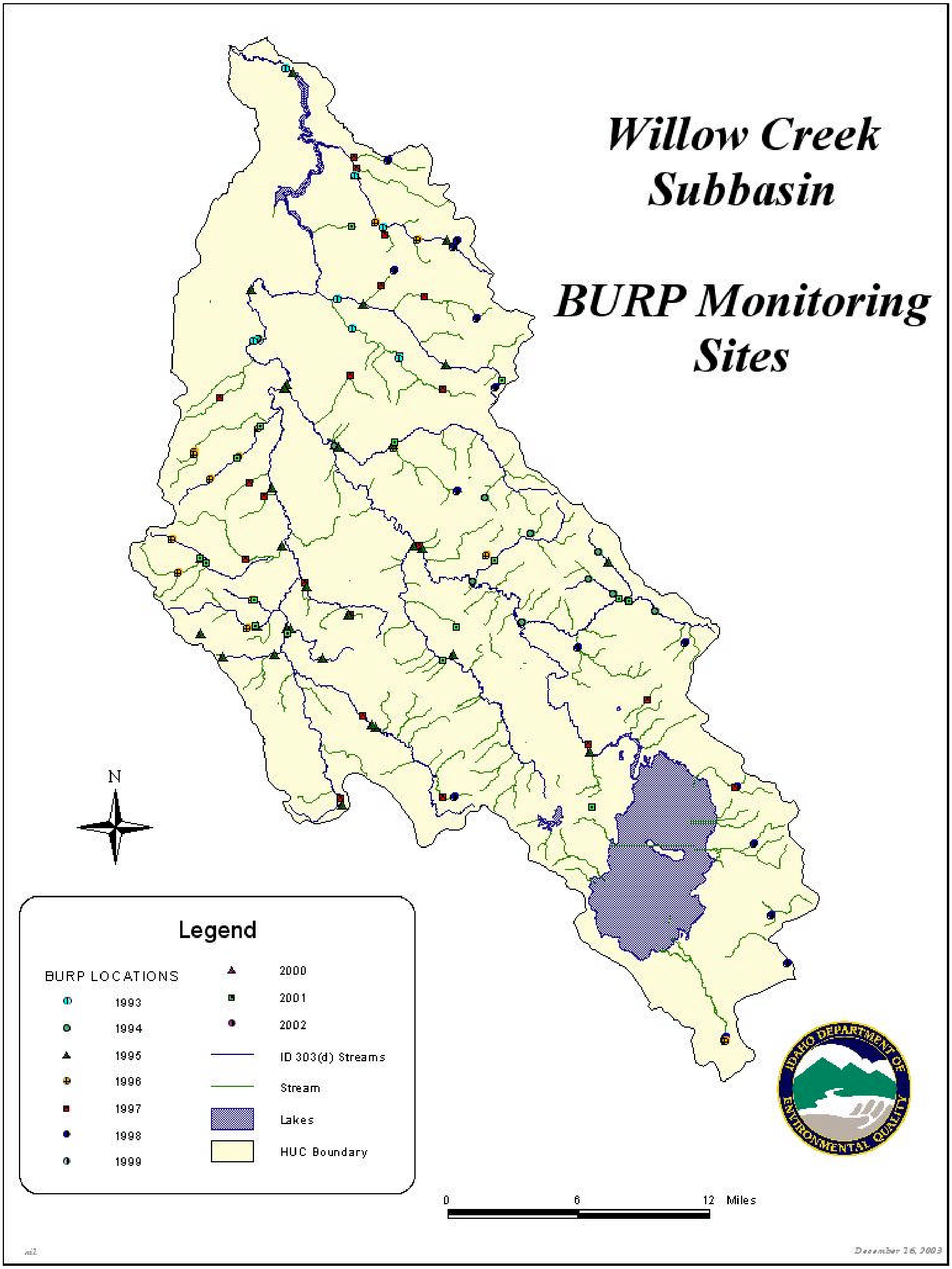

Figure 25. Willow Creek Subbasin BURP Monitoring Sites.

Subsurface Fines

Determining percent composition of surface and depth fine sediment in spawning habitat is used as a complimentary target to track changes in sediment loading over time. Since it is believed that surface fines can easily be swept away by spawning fish, subsurface sediment core samples are more biologically meaningful. Research has shown that subsurface fine sediment composition is important to egg and fry survival, Hall (1986), Reiser and White (1988). McNeil and Ahnell (1964) state that, "size composition of bottom materials greatly influences water quality by affecting rates of flow within spawning beds and ranges of exchange between intragravel and stream water". According to Bjornn, Peery, and Garmann (1998) "Salmonid embryo survival and fry emergence are inversely related to the amount of fine sediment in stream substrates." Fine sediment can decrease the amount of dissolved oxygen (DO) available to developing embryos by impeding flow of water through the substrate and through the oxidation of organic material in fine sediment. Low oxygen availability from excess fine sediment has been associated with smaller and less developed emergent fry."

McNeil Sediment Core samples can describe size composition of bottom materials in identified salmonid spawning locations. McNeil Sediment Core samples are collected by isolating a small area of the stream bottom from the current with an open stainless steel cylinder (12 in). The cylinder is worked to a depth of approximately 4-6 inches into the spawning habitat. Substrate is then removed from the cylinder, washed through a series of ten sieves (63 to .053 mm diameter openings), and then measured via volumetric displacement. Three sediment core samples are obtained for each site and averaged to calculate the percentage of depth fines at the sample location. The percentage of intergravel fines less than 6.35 mm (1/4 in) in diameter is correlated with expected fry survival.

In 2000 Millennium Science Engineering (MSE) was contracted by DEQ to perform subsurface sediment sampling at five locations in the Willow Creek Subbasin. Table 33 shows the output from the McNeil Sediment Core samples. The output shows the percent composition of fine sediment less than 6.35 mm diameter. DEQ has a target for volcanic, granitic, and sedimentary watersheds that is less than 28% fine sediment (<6.35 mm diameter) in identifiable spawning habitat. Channel morphology provides flow dynamics that result in fine sediment levels less than 28% in unperturbed conditions. Excessive fine sediment inputs or disturbed channel morphology are indicated by fine sediment compositions above 28%.

Of the streams evaluated by MSE, four of the five were above the 28% target for depth fines. Mill Creek, Sawmill Creek, and Willow Creek at Grays Lake Outlet and Kepp's Crossing were above the target level. Lava Creek was below the target level with 24% fines. All of the streams sampled for surface fines by MSE are 303(d) listed for sediment.

Table 33. MSE McNeil Sediment Core sample sites and percentage depth fines.

Stream	WBID	Date of data collection	Location	Location Description	% of fine material <6.35mm
Lava Creek	US-28	09/29/01	N 3°15'24.8" W 111°34'27.7"	Downstream of Dan Creek road crossing	24.44
Mill Creek	US-12	09/27/01	N 43°13'43" W 111°46'12.8"	Above Willow Creek	43.11
Sawmill Creek	US-27	08/31/01-09/01/01	N 43°14'13" W 111°29'24"		47.34
Willow Creek	US-5	09/26/01	N 43°22'32.9" W 111°45'32.6"	At Grays Lake Outlet	31.42
Willow Creek	US-5	09/05/01	N 43°24'33.3" W 111°47'0.2"	At Kepp's Crossing	30.69

In 2003 DEQ attempted to collect fine sediment samples, via McNeil method, on nine streams, Corral, Grays Lake Outlet, Lava, Meadow, Mill, Sawmill, Sellars, Tex, and Willow Creeks. Of the nine streams, Willow Creek, Sellars Creek, and Grays Lake Outlet had sufficient flow to properly identify spawning habitat. Streambed sediment compositions were above the 28% target on Sellars Creek and Grays Lake Outlet and below the target on Willow Creek with 24% fines. Table 34 shows the location and results of DEQ subsurface fine sampling. Appendix H contains the computation sheets for depth fine sampling.

Table 34. DEQ Sediment Core sample locations and percentage depth fines.

Stream	Date of data collection	Location	Location Description	% of fine material <6.35mm
Grays Lake Outlet	09/18/03	N 43°16'7.01" W 111°38'26"	Near Homer Creek Confluence	44.06
Sellars Creek	09/15/03	N 43°15'39.55" W 111°50'0.96"		54.27
Willow Creek	09/17/03	N 43°24'27.9" W 111°47'6.88"	At Kepp's Crossing	23.65

Streambank Assessments

DEQ utilizes streambank erosion inventories (SEI) to assess current erosion conditions within a stream. This method is very useful in identifying load reductions necessary to achieve desired future conditions that are expected to restore beneficial uses to a stream.

DEQ SEIs are conducted in accordance with methods outlined in proceedings from the Natural Resource Conservation Service (NRCS) Channel Evaluation Workshop (NRCS 1983). The NRCS technique measures streambank/channel stability, length of active eroding banks, and bank angles. Streambank and channel stability field measurements are used to ascertain the long-term lateral recession rate. The recession rate is determined from field evaluation of streambank characteristics that are assigned a categorical rating ranging from 0 to 3. The categorical ratings are summed to a cumulative rating. From the cumulative rating a lateral recession rate is assigned ranging from slight at 0.01 ft/yr. to very severe at 0.5 +

ft/yr. An average volume of eroded bank is obtained with the estimated recession rate. By applying a measured or estimated standard bulk density based on composition of streambank material an estimate of tons of sediment from streambank erosion is obtained for comparison to other reaches or for applying a load allocation based on a prescribed reference condition. Appendix I outlines the method for conducting SEIs.

It is assumed that natural background sediment loading rates from bank erosion equate to 80% bank stability as described in Overton and others (1995), where banks are expressed as a percentage of the total estimated bank length. Natural condition streambank stability potential is generally 80% or greater for Rosgen A, B, and C channel types in plutonic, volcanic, metamorphic, and sedime0.ntary geology types. Therefore, an 80% bank stability target based on streambank erosion inventories shall be the target for sediment.

Streambank erosion inventories were conducted by DEQ in 2003 on Grays Lake Outlet, Lava Creek, Meadow Creek, Mill Creek, Seventy Creek, and Willow Creek. As shown in table 35, upper Mill Creek is the only inventory site where bank stabilities meet the 80% target. The recession rate is highest at the lower Willow Creek inventory site (below Long Valley Rd crossing) being 0.61 ft/yr.

Table 35. DEQ Streambank Erosion Inventory Summary

Reach Location	Total Inventoried (ft)	Erosive (ft)	% Erosive	Ave Bank Height (ft)	Ave Recession Rate (ft/yr)
Grays Lake Outlet					
Middle	2025	873	43	2.7	0.16
Lava Creek					
Upper	270	228	84	3.7	0.16
Meadow Creek					
Upper	1240	468	38	4.1	0.12
Mill Creek					
Upper	1625	132	8	1.1	0.05
Middle	653	235	36	2.9	0.16
Lower	483	173	36	2.8	0.05
Seventy Creek					
Lower	1391	844	61	3.2	0.61
Willow Creek					
Lower	1578	790	50	1.7	0.61
Sellars Creek					
Upper	2133	1140	53	2.5	0.27
Middle	1408	1098	78	2.4	0.5

In 2001 MSE conducted streambank erosion inventories and Stream Visual Assessment Protocol (SVAP) at 25 sites in the Willow Creek watershed (Figure 26). Streambank erosion worksheets were completed to calculate a lateral recession rate for the reach. Field measurements were taken of eroding streambanks to determine the percentage of unstable streambanks along the reach, total reach erosion (tons/year), and the erosion rate (tons/mile/year). Table 36 contains a summary of streambank erosion data collected in the study.

Thirteen 303(d) listed streams were inventoried in the MSE SEI study. Brockman Creek was separated into four reach segments, one above the confluence with Corral Creek, two middle reaches between Sawmill Creek and Grays Lake Outlet and a lower reach just above the confluence with Grays Lake Outlet. On Brockman Creek 1.46 stream miles were assessed, of that, 0.61 miles contained actively eroding banks. Willow Creek was divided into three reach segments: upper, upper-middle (above Crane Creek confluence), and lower (Buck Creek confluence), at the confluence with Buck Creek. The calculated reach erosion rates on Willow Creek were between 59 and 45 tons/year (t/y). Three segments of Homer Creek were inventoried totaling 1.14 stream miles assessed with bank heights averaging 4.7 ft. The Grays Lake Outlet, upper Hell Creek, upper Lava Creek, and middle Mill Creek reaches had the least erosive banks at 20%, 16%, 19%, and 10 % respectively. Sediment loading rates for Buck, Corral, Meadow, Sawmill, and Seventy Creeks were calculated at 51, 309, 129, 330, and 24 t/mi/yr, respectively. Two reaches along Crane Creek were evaluated where lateral recession was 0.16 ft/yr in the upper reach and 0.21 ft/yr in the lower reach.

Table 36. MSE streambank assessment data summary.

Reach Location	Total Inventoried (ft)	Erosive (ft)	% Erosive	Ave Bank Height (ft)	Ave Recession Rate (ft/yr)	SVAP
Brockman Creek						
Middle	4500	2323	52	5.2	0.61	Poor
Lower	4700	2703	58	8	0.16	Poor
Buck Creek						
Lower	2150	723	48	2.4	0.16	Fair
Corral Creek						
Lower	4000	1855	46	3.8	0.27	Fair
Crane Creek						
Upper	4000	1718	43	4.8	0.16	Poor
Middle	4000	1771	44	5.5	0.16	Poor
Grays Lake Outlet						
Middle	6000	2693	45	5.1	0.38	Poor
Hell Creek						
Middle	4000	1425	36	6.9	0.16	Poor
Lower	4332	2205	51	9.5	0.27	Fair
Homer Creek						
Upper	4000	1701	43	4	0.5	Poor
Middle	4000	1269	32	4.5	0.27	Poor
Lower	4000	2510	63	4.3	0.5	Poor
Lava Creek						
Lower	4000	1807	45	3.1	0.27	Poor
Meadow Creek						
Lower	4000	814	20	4.2	0.15	Poor
Sawmill Creek						
Lower	4000	1166	29	4	0.61	Poor
Seventy Creek						
Middle	700	212	30	1.4	0.09	Poor
Willow Creek						
Upper	4000	1590	40	4.2	0.16	Poor
Upper-Middle	4000	1751	44	3.2	0.27	Fair
Lower Willow	4000	2141	54	5	0.21	Poor

Stream Visual Assessment Protocol (SVAP) is a method developed by the NRCS to evaluate stream health via a basic field assessment. Assessment protocol elements include channel condition, hydrologic alteration, riparian zone, bank stability, water appearance, nutrient enrichment, fish barriers, fish cover, pools, invertebrate habitat, canopy cover, macroinvertebrates, manure presence, salinity, and riffle embeddedness. Assessment elements are scored and stream conditions are classified as poor, fair, good, or excellent. In 2001, in conjunction with their SEI work, MSE conducted SVAPs. Stream visual assessment protocol results (Table 36) show that all streams assessed received a fair to poor rating for stream health. Upper Brockman, lower Hell, upper-middle Willow, Buck, and Corral Creek reaches were rated fair and the remaining reaches received a poor rating.

Proper Functioning Condition (PFC) is a technique utilized to determine which stream reaches are at greater risk. Inventories for PFC are conducted in the field where stream characteristics, soils, hydrology, and vegetation, are evaluated. Evaluation results are tallied and the reach is classified as being in proper functioning condition (PFC), functional at risk (FAR), or nonfunctional (NF). A stream classified as PFC is considered healthy. A classification of FAR is healthy but at risk whereas a classification of NF is considered an unhealthy reach.

The BLM (1996-2001) and IDL (1999, 2001, and 2002) have conducted PFC surveys in the subbasin on listed and non-listed streams. From 1999-2001 IDL classified a total of 40.4 stream miles as FAR, 4.94 miles as NF, and 34.14 as PFC. In the years of 1996-2001 BLM surveys resulted in a total of 15.41 stream miles as FAR, 7.81 miles as NF, and 11.29 as PFC.

Fish Data

Fish distribution and age classes are important for documentation of the existence and status of the fish in the subbasin. DEQ, IDFG, USFS, and BLM collected fish count data. Age distribution was derived from DEQ, IDFG, and USFS data, documenting the status of the aquatic life present.

In 1984, IDFG conducted a regional fishery management investigation on the Willow Creek drainage. Fish count data show that cutthroat trout is the most abundant salmonid in the drainage with Sellars and Lava Creek supporting the highest density. Brown trout, the second most plentiful salmonid, had the highest densities in Crane Creek and upper Grays Lake Outlet. Brook trout, the third most abundant salmonid, was most plentiful in Homer and Mill Creeks. Rainbow trout (*Oncorhynchus mykiss*) and rainbow x cutthroat hybrids were infrequently observed. Recent fish count data show that cutthroat trout is still the most abundant species in the subbasin with brook trout the second most common. Brown trout were absent in 1999-2002 fish surveys. The last stocking of brown trout in the watershed took place in 1998.

Corsi (1984) identified Corral and Sawmill Creeks as important Yellowstone cutthroat trout spawning tributaries. At the time, dense populations of small cutthroat were located in Corral and Sawmill Creeks (tributaries of Brockman Creek). Recent fish count data (tables

35-38) reports that there are limited salmonids in the Brockman Creek drainage. Lava and Mill Creeks also supported a relatively high density of juvenile cutthroat, attesting to their importance as cutthroat spawning and rearing habitats. Juvenile cutthroats were identified in Lava and Mill Creeks in 2002 however; their densities were much lower than those earlier recorded.

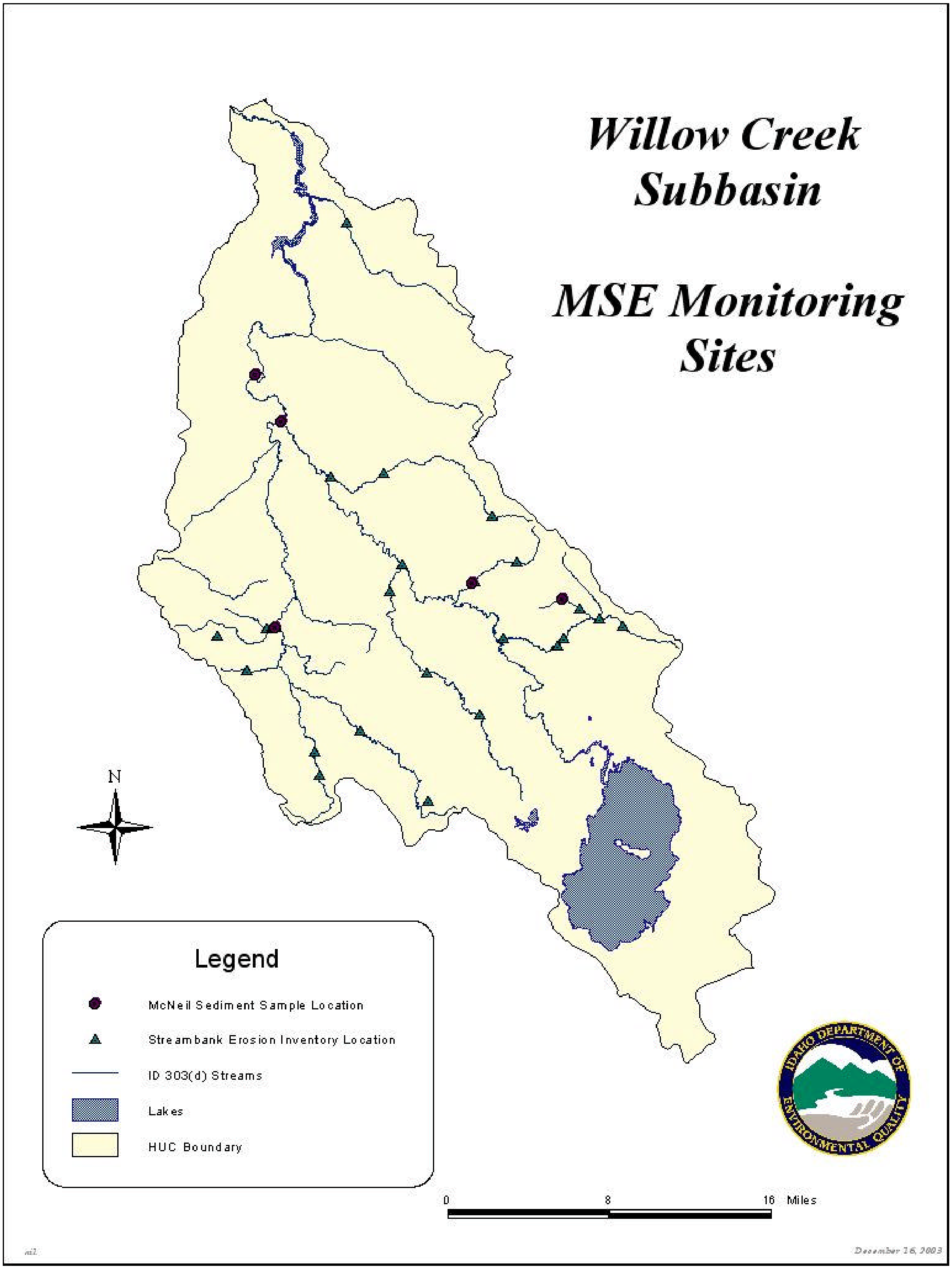

Figure 26. MSE Streambank Erosion Inventory and McNeil Sediment Sample Sites.

In 1983, it was observed that introduced rainbow trout were spawning concurrently with cutthroat trout, creating the potential for hybridization to occur. As of 1997, rainbow trout are no longer stocked in the Willow Creek Subbasin. Rainbow trout were not observed in the most recent fish count surveys, as shown in table 38.

Sellars Creek is very likely the most important tributary for cutthroat spawning in the entire Willow Creek Subbasin. Fish count data show the presence of multiple age classes however, macroinvertebrate numbers are down and habitat is impaired.

In 1985 IDFG conducted a second fishery management investigation on the Willow Creek drainage. This second study focused on the life history and status of the cutthroat trout within the Willow Creek watershed. Study findings show that two stocks of cutthroat trout exist in the drainage, resident and migratory. Resident fish spend their lives in the tributary streams whereas migratory fish emigrate from tributaries to the mainstem of Willow Creek and the Ririe Reservoir (Corsi 1985). In 1985 (Corsi) cutthroat trout were observed in all listed streams, with the exception of Long Valley Creek.

DEQ routinely conducts fish count surveys as part of their BURP assessment. Fish counts were conducted by DEQ in 1996, 1997, 1999, and 2001 as shown in appendix L, table 37. DEQ fish counts identified salmonids in seven 303(d) listed streams. Those streams were Corral Creek, Meadow Creek, Homer Creek, Mill Creek, Sellars Creek, Willow Creek, and Grays Lake Outlet. Multiple age classes were rarely observed.

Table 37. DEQ fish data summary.

Stream Name	Date Collected	YCT	BRN	BRK	RBT	Non-salmonids	comments
Birch Creek	9/30/96					sculpin	
Birch Creek	9/30/96					sculpin	
Bridge Creek	6/29/99	4					
Brockman Creek	6/30/99						no fish
Brockman Creek	6/30/99					sculpin, shiner, sucker, dace	
Brockman Creek	8/29/96					shiner, sucker, sculpin, dace	
Buck Creek	8/22/96					shiner	
Bulls Fork Creek	6/6/97						no fish
Bulls Fork Creek	6/6/97						no fish
Canyon Creek	7/1/99						no fish
Corral Creek	8/29/96	2/J				sucker, dace, shiner, sculpin	
Crane Creek	9/30/99					shiner, dace	
Crane Creek	6/29/99						no fish
Crane Creek	6/29/99						no fish
Dan Creek	8/21/96						sucker
Dan Creek	6/30/99						no fish
Deep Creek	7/1/99						no fish
Eagle Creek N Fk	6/29/99						no fish
Gravel Creek	6/29/99			7/J			
Gravel Creek	6/29/99			6			
Grays Lake Outlet	9/11/97					shiner	
Grays Lake Outlet	10/1/96					dace, shiner	shallow, algae
Grays Lake Outlet	10/1/96					sculpin, shiner, dace	

Stream Name	Date Collected	YCT	BRN	BRK	RBT	Non-salmonids	comments
Grays Lake Outlet	10/1/96	3			2	sculpin, dace, sucker, shiners, chub	
Hancock Creek	8/22/96			7/J		sculpin, speckled dace, shiner	YOY, age I & II
Hell Creek	8/21/96					sculpin	
Hell Creek	8/21/96					sucker, sculpin, speckled dace	
Homer Creek	10/1/96		1			shiner, dace	
Homer Creek	8/22/96					dace, shiner, sucker	
Indian Fk Creek	7/1/99						no fish
Lava Creek	9/3/96	6				shiner, dace, sculpin	
Lava Creek	10/1/96		3			shiner, sculpin, dace, sucker	
Long Valley Creek	8/22/96					shiner, sucker	
Long Valley Creek	7/1/99						no fish
Meadow Creek	6/29/99						no fish
Meadow Creek	7/1/99						
Meadow Creek	7/1/99	9			2		hybrids
Meadow Creek	9/30/96	76/J					Hybrids, YOY, Age 1&2.
Meadow Creek	9/30/96						low flow, hybrid
Meadow Creek	9/30/96	6					
NF Meadow Creek	7/1/99	1					hybrids
Mill Creek	8/21/96			13/J		dace, sculpin, sucker	YOY, Age I
Mud Creek	6/30/99				2	shiner, sucker	
Mudspring Creek	7/1/99						no fish
Mudspring Creek	7/1/99						no fish
Peterson Creek	7/1/99						no fish
Right Creek	7/1/99						no fish
Rock Creek	7/1/99						no access
Sawmill Creek	8/29/96					shiner, sucker, dace, sculpin	
Sawmill Creek	8/29/96					sculpin	
Sellars Creek	8/21/96	18/J				shiner	YOY, age I & II
Sellars Creek	8/1/01					sculpin	hybrids
Seventy Creek	8/22/96					shiner, sucker	
SF Sellars Creek	8/21/96	31/J				sculpin	YOY, age I & II
SF Sellars Creek	8/1/01	3				sculpin	
Shirley Creek	6/30/99					sucker, shiner, dace	
Tex Creek	9/30/96					sucker	
Twin Creek	7/1/99						no fish
W Fk Lava Creek	10/1/96					sculpin	
Willow Creek	8/21/96					sucker, shiner, dace, sculpin	
Willow Creek	8/22/96		1	7/J		dace, sculpin, shiner	YOY, age I & II
Willow Creek	6/30/99			1	3		
Willow Creek	7/1/99					sucker, shiner, sculpin	
Willow Creek							no fish
Willow Creek	8/22/01					shiner, sucker	

YCT = Yellowstone cutthroat; BRN = brown trout; BRK = brook trout; RBT = rainbow trout; YOY = Young of the Year; J = juvenile

Grays Lake Outlet and Eagle Creek are the only streams for which BLM submitted data (table 38). Counts were conducted in 1985 and salmonids were observed in North Fork Eagle Creek.

Table 38. BLM fish data summary

Stream Name	Date Collected	YCT	BRN	BRK	RBT	Non-salmonids
N Fk Eagle Creek	8/27/85	33		3		
Grays Lake Outlet	9/17/85					dace, shiner, sculpin, sucker

YCT = Yellowstone cutthroat; BRN = brown trout; BRK = brook trout; RBT = rainbow trout

In 2002 the USFS conducted fish counts in the subbasin. Table 39 summarizes their findings. USFS count data show that juvenile cutthroat trout were present in Eagle Creek. Salmonids were observed in Gravel Creek, Eagle Creek, and Willow Creek.

Table 39. USFS fish data summary

Stream Name	Date Collected	YCT	BRN	BRK	RBT	Non-salmonids	Comments
Gravel Creek	6/19/02			54			most BRK were in the 1-2 yr range
Gravel Creek	6/20/02			25			most BRK were in the 1-2 yr range
Gravel Creek	6/20/02						No Fish
Eagle Creek	6/13/02	9		30		shiner, sculpin	most BRK in 1-2 year range, most YCT in 1 yr range
Eagle Creek	6/17/02	4		49		sculpin	most BRK in 1-2 year range, most YCT in 2 yr range
Eagle Creek	6/17/02			9			most fish were in the 1-2 year range
N Fk Eagle Creek	6/11/02	27					most YCT YOY and 1 Year
N Fk Eagle Creek	6/12/02	23					most YCT YOY and 1 Year
N Fk Eagle Creek	6/12/02						No Fish
Bridge Creek	7/31/02						No Fish
Bridge Creek	7/31/02						No Fish
Bridge Creek	7/31/02						No Fish
Wayan Creek	7/23/02						Too Dry
Willow Creek	6/18/02					redside shiner, longnosed dace	
Willow Creek	6/18/02	3		11			most YCT YOY, most BRK 1 yr
Willow Creek	6/19/02						No Fish
N Fk Willow Creek	6/19/02	2		2			YCT 1 yr, BRK 1 yr
N Fk Willow Creek	6/19/02						No Fish
N Fk Willow Creek	6/19/02						No Fish

YCT = Yellowstone cutthroat; BRN = brown trout; BRK = brook trout; RBT = rainbow trout; YOY = Young of the Year

Idaho Fish and Game collected fish data in 2001, as shown in table 40. Yellowstone cutthroat trout were identified in Alley Lyons Creek, Brockman Creek, Mill Creek, Lava Creek, Sellars Creek, Sawmill Creek, and Tex Creek. Cutthroat trout were most abundant in Sellars Creek. Fish numbers were much lower in the other streams.

Table 40. IDFG fish data summary

Creek Name	Date Collected	YCT	BRN	BRK	Non-salmonids	comments
Alley Lyons Creek	7/29/01	13				most 1 yr with very little 2 yr
Alley Lyons Creek	7/29/01	1			mottled sculpin	1 yr
Birch Creek	7/30/01					no fish
Birch Creek	7/30/01					no fish
Brockman Creek	7/26/01				sucker, shiner, dace, sculpin	
Brockman Creek	7/27/01	4				YCT 1yr
Brockman Creek	7/27/01				shiner, dace,	
Gravel Creek	8/13/01			94		YOY, age 1-2
Hancock Creek	7/31/01				speckled dace, redside	
Homer Creek	7/30/01					puddled, fish dying
Mill Creek	7/26/01	3		4	shiner, dace, sucker, sculpin	YCT 1 yr, BRK 1-2 yr
Mill Creek	7/28/01			2	mottled sculpin	1- 2 yr
Mill Creek	7/28/01	9		9		YCT 1 yr, BRK 1-2 yr
Mud Creek	7/30/01					no fish
Mud Creek	7/30/01					no fish
N Fk Lava Creek	7/27/01	6			mottled sculpin	1 yr
N Fk Lava Creek	7/27/01	3			piute sculpin	1 yr
S Fk Sellars Creek	7/27/01	72			sculpin	majority in 1 yr range with a few in 2 yr
S Fk Sellars Creek	7/28/01	107			piute sculpin	1 and 2 yr range
S Fk Sellars Creek	7/28/01	32			piute sculpin	mostly YOY and 1 yr. Very little 2 yr
Sawmill Creek	7/26/01				mottled sculpin, speckled dace	
Sawmill Creek	7/26/01	3				1-2 yr
Sawmill Creek	7/29/01					Muddy, no habitat
Sellars Creek	7/26/01	18				2 yr with some 3 yr
Sellars Creek	7/29/01	103				YCT 1 yr
Sellars Creek	7/29/01	4			shiner, sucker, sculpin	YCT 2 yr
Sellars Creek	7/30/01	13			mtn sucker, mottled sculpin	YCT 1 yr
Squaw Creek	7/30/01				sculpin	
Squaw Creek	7/30/01				mtn sucker, mottled sculpin	
Tex Creek	7/25/01	6			Utah sucker	2-3 yr
Tex Creek	7/27/01					Dry

YCT = Yellowstone cutthroat; BRN = brown trout; BRK = brook trout; YOY = Young of the Year

Macroinvertebrate Data

Aquatic insects are an integral component of stream ecosystems. Anthropogenic stressors on aquatic ecosystems can affect the diversity and abundance of stream macroinvertebrates. DEQ uses BURP data to evaluate a stream's ability to support cold water aquatic life. This is accomplished by calculating the stream macroinvertebrate index (SMI) from the BURP water quality data. From the SMI, a condition ranking of 1, 2, or 3 is assigned to the site based on percentile categories of the reference conditions. WBAGII (DEQ 2002) outlines the methodology behind SMI development and calculations. Macroinvertebrate communities are considered not fully supported if the condition ranking score is less than one. As shown in appendix K, condition rankings below one are evident in several streams within the Willow Creek Subbasin.

Status of Beneficial Uses

The data presented in this section confirms that the beneficial uses for salmonid spawning (SS) and cold water aquatic life (CWAL) for listed streams within the Willow Creek Subbasin are not fully supported. Almost all of the 303(d) listed streams evaluated in streambank erosion inventories had bank stabilities less than 80%. Depth fine data show that the majority of streams sampled for sediment exceed the sediment target of 28%.

Thermograph data collected within the subbasin show that water temperatures exceed the temperature criteria for salmonid spawning in every stream sampled. Fish have been observed in all of the 303(d) listed streams where temperature data is available. It is assumed that salmonid spawning may occur in all of the temperature-impaired streams.

Historic fish data compared with current fish data show that salmonid populations were, in the past, denser and widely distributed.

Conclusions

Brockman Creek, Grays Lake Outlet (Grays Lake to above falls), and Hell Creek are all listed for nutrients. Nutrient concentrations on Grays Lake Outlet, above the Homer Creek confluence, were below the EPA recommended criteria. The Brockman Creek confluence is upstream from this location and it is believed nutrient concentrations on Brockman Creek are similar. Nutrient data is available for Grays Lake Outlet at the Hell Creek confluence. The EPA suggested criteria for total phosphorous and nitrate + nitrite nitrogen were met at this location. Because data show that stream nutrient levels are below the EPA recommended criteria, nutrient TMDLs will not be developed for Hell Creek and Brockman Creek.

The section of Grays Lake Outlet that is listed for nutrients is directly downstream of Grays Lake (Grays Lake to falls). Flow data show that this reach of Grays Lake Outlet receives very limited flow. Low or lack of flow conditions are a limiting factor to the reduction of nutrient levels and ultimate beneficial use support above the falls on Grays Lake Outlet. Because of this, a Nutrient TMDL is not warranted for this section of Grays Lake Outlet.

Nutrient levels above the total phosphorous and/or nitrate + nitrite nitrogen recommended criteria were documented several times in Sellars Creek and Willow Creek (Pole Bridge). Nuisance levels of algae growth were observed in Willow Creek and dissolved oxygen (DO) levels in the water column are nearing the cold water minimum, for salmonid survival (4 mg/L) (EPA 1986). Water quality data and field observations show that a nutrient TMDL is warranted for Willow Creek to control and limit the production of deleterious quantities of aquatic plant growth.

In Sellars Creek deleterious levels of aquatic plant growth were not observed and recorded DO levels were above the acute toxicity level for salmonids. Based on field observations, Idaho's narrative water quality criteria, and water column data, it is determined that a nutrient TMDL is not warranted for Sellars Creek. It is inferred that through the sediment TMDL; improved riparian vegetation, higher streambank stability, and modified grazing activities will bring about a reduction in overall nutrient loading to Sellars Creek.

TMDLs are warranted for all of the streams 303(d) listed for sediment, unless the stream is dewatered a majority of the year. Low flow or lack of flow limits beneficial use support therefore flow alteration is the pollutant of concern. Existing field data show that Willow Creek (below Ririe Reservoir), Sellars Creek, Seventy Creek, Long Valley Creek, Birch Creek, and Grays Lake Outlet are, to some extent, anthropogenically flow altered. Birch Creek, Long Valley Creek, and Grays Lake Outlet from Grays Lake to the fall, are flow altered to the extent that it is reasonable to say that beneficial use support is impossible in such low or no flow conditions.

Sediment is the sole listed pollutant on Birch Creek. There are two water impoundment structures on Birch Creek, one above (2.7 stream miles) and one below (down stream of the crossing) Bone Road. Both structures serve as fish barriers and sediment catchment basins. Since Birch Creek is anthropogenically dewatered, beneficial use support attainment is unlikely, until flow is restored.

Streambank stabilities on Long Valley Creek were observed below the >80% target. Robinson Reservoir, on upper Long Valley Creek, is constructed of an earthen dam to impound spring runoff waters for irrigation. It can be inferred that the attainment of beneficial use support in Long Valley Creek is not probable due to low or non-existent flow conditions the majority of the year. Because of natural and anthropogenic flow alterations, TMDLs will not be written for Long Valley Creek.

McNeil core sample data showed elevated levels of fine sediment in salmonid spawning habitat on Sellars Creek, Mill Creek, Sawmill Creek, and Willow Creek (Kepp's Crossing, Grays Lake Outlet confluence, Homer Creek confluence). McNeil sampling identified more than 28% fine sediment in Mill Creek, Sellars Creek, Willow Creek, and Sawmill Creek. Therefore, it is recommended that a load reduction target be set for these streams. Based on McNeil sampling data, sediment TMDLs may be warranted on all tributaries of Willow Creek above the Grays Lake Outlet because they have the potential to serve as sediment transport reaches.

A McNeil sediment sample on Lava Creek, downstream of the Dan Creek road crossing, showed 24% subsurface fines in the salmonid spawning habitat. Despite meeting the DEQ target, a sediment TMDL will be written for this reach because streambank erosion inventory data on the upper and lower portions of Lava Creek show that the streambank stabilities are low.

Stream temperature data is available to provide a measurement of the temperature regimes throughout the Willow Creek Subbasin. Temperature data showed elevated stream temperatures are common throughout the watershed. Temperature load allocations will be developed for all temperature-listed streams in the subbasin, except Seventy Creek. Flow appears to be the limiting factor where Seventy Creek is concerned. Low flow conditions from continuous low water years may be partly responsible for elevated stream temperatures.

Temperature data was provided for several non-listed streams. Elevated temperatures were observed in every stream where data was provided. Major exceedances were documented on non-listed streams (Hell, Homer, Brockman, and Tex Creeks) therefore, temperature TMDLs will be developed in response.

2.4 Data Gaps

Biological and water quality data was collected in the subbasin and it was available for analysis. Subsurface fine sediment data is extremely important in assessing sediment impacts on salmonid spawning habitat. Unfortunately, available depth fine data was limited. The absence of depth fine data is due, mostly, to the extremely dry conditions experienced in the watershed over the past several years. It is extremely difficult to identify spawning habitat for streambed sampling in dry stream conditions. When flow conditions allow for subsurface sediment monitoring, McNeil streambed sampling should be conducted to provide a more accurate assessment of sedimentation impacts on salmonid spawning. Table 41 shows the streams where additional data are needed.

Sediment data are not required for Birch Creek since it too is flow altered. Temperature data are not available for Seventy Creek, however it is expected that low flow conditions prohibit temperatures from meeting the salmonid spawning criteria. Nutrient, sediment, and temperature data are not needed for Grays Lake Outlet above the falls, since flow alteration is the primary source of impairment.

Additional streambank erosion inventories on all listed reaches could provide for a more detailed analysis of overall streambank conditions and sediment loading.

The salmonid spawning criteria set in this TMDL should also be further evaluated during the implementation of this TMDL to ensure that the standards set are reflective of the spawning time periods in the Willow Creek Subbasin.

Table 41. Data gaps in the Willow Creek Subbasin.

1998 303(d) Listed Segment	Listed Pollutant	Data Gaps
Birch Creek	Sediment	No sediment data
Brockman Creek	Sediment	No depth fine data
Corral Creek	Sediment	No depth fine data
Grays Lake Outlet (Grays Lake to above falls)	Nutrient Sediment Temperature	Nutrient data is below the reach No sediment data No depth fine data Temperature data is below the reach
Hell Creek	Sediment	No depth fine data
Homer Creek	Sediment	No depth fine data
Long Valley Creek	Sediment	No sediment data
Meadow Creek	Sediment	No depth fine data
Rock Creek	Temperature	No temperature data
Seventy Creek	Temperature	No temperature data
Tex Creek	Sediment	No depth fine data
Willow Creek (Ririe Reservoir to HUC boundary)	Sediment Temperature	No sediment data No temperature data

3. Subbasin Assessment – Pollutant Source Inventory

The primary source of sediment input to water quality impaired streams within the Willow Creek watershed is streambank erosion. Potential sources of sediment pollution can include roads built too close to streams or improperly maintained, erosion from cultivated fields, mass wasting or landslides related to improper engineering techniques, and urban runoff. Streambank erosion is often significantly greater than these potential sources in the long term.

Sediment from streambank erosion is delivered directly to the stream channel without attenuation or deposition, as is often the case with natural hillslope erosion. Depositional features that result from streambank erosion often further accelerate erosion by redirecting flow into formerly stable banks. Eventually streambank stability is greatly reduced.

As streambanks erode, the width of the stream increases, so that riparian vegetation and the shade provided by the vegetation decreases. This reduction in shade further decrease the stability of streambanks and increase the thermal load to the stream, which is another important pollutant related to streambank stability. This type of pollution occurs over a wide area and is considered nonpoint source pollution.

3.1 Sources of Pollutants of Concern

Point Sources

There are no Superfund or RCRA sites in the Willow Creek Subbasin. There are no national pollution discharge elimination system (NPDES) permitted point sources, nor are there any potentially unpermitted point sources in this area. Since there are no known point sources, no waste load allocations (WLA) will be developed for point sources.

Nonpoint Sources

The primary source of nonpoint source pollution to streams in the Willow Creek Subbasin is sediment from streambank erosion, and the primary cause of streambank erosion is alteration of stabilizing vegetation on streambanks that results in unstable streambanks. As streambank erosion progresses, depositional features form in the channel that redirect current and further reduce bank stability. This process continues until the stream forms a new flood plain and deposition forms new streambanks that become colonized with stabilizing vegetation. This process can take many years to play out once channel alteration begins.

Land use, as previously discussed, is primarily agricultural adjacent to streams impaired by temperature and sediment. The agricultural use that has the greatest effect on streambank stability is grazing. Grazing occurs throughout the subbasin in riparian areas.

Other sources of nonpoint source sediment pollution can include roads and erosion from cultivated fields.

Pollutant Transport

Pollutant transport related to sediment is primarily a function of particle size, channel type, channel width and channel gradient. Affected streams in the Willow Creek watershed are primarily low gradient C channels with elevated fine particle composition above 6.35mm. Small particles of sediment are transported is farther, the higher the stream power the greater the transport capability.

Streambank erosion, road erosion, and mass wasting are the three principal sources of sediment loading in the subbasin, and erosion from these sources peaks during spring runoff and occasional high precipitation events.

4. Subbasin Assessment – Summary of Past and Present Pollution Control Efforts

East Side Soil & Water Conservation District, NRCS, and IDFG are contributing agencies to conservation programs and pollution control efforts in the subbasin.

Over the past 20 years, the East Side Soil & Water Conservation District and the NRCS have managed, in cooperation with local ranchers and farmers, several conservation programs intended to reduce erosion, increase and improve wildlife habitat, and protect surface and ground water by reducing runoff and sedimentation. According to NRCS, 49% of the Willow Creek watershed has been treated with a conservation program at one time or another. Table 42 provides a summary of the conservation programs implemented throughout the Willow Creek Subbasin.

Table 42. Willow Creek Subbasin Conservation Programs.

Program	Acres
Conservation Reserve Program (CRP)	32,080
Environmental Quality Incentives Program (EQIP)	9,855
Resource Conservation and Development Program (RCRDP)	39,624
Water Quality Program for Agriculture (WQPA)	59,680
Long Term Agreements (LTA)	4,400
1985 Food Security Act	60,437
Total	206,076

Listed below are descriptions of each conservation program, along with a summary of their locations in the Willow Creek Subbasin. Figure 27 illustrates the locations of NRCS conservation programs in the subbasin.

- The Conservation Reserve Program (CRP) reduces erosion and enhances wildlife habitat by encouraging farmers to convert highly erodible cropland to vegetative cover in exchange for an annual rental payment. The largest continuous portions of CRP land occur in the Willow Reservoir sub-watershed around the Ririe Reservoir and in the Meadow Creek drainage, the Tex Creek and Lower Willow sub-watersheds, and in the Willow, Tex, and Rock Creek drainages. Small pockets of CRP are on Grays Lake Outlet, between the outlet and Brockman Creek, and on Willow Creek at the Sellars Creek confluence.

- Environmental Quality Incentives Program (EQIP) was established in the 1996 Farm Bill to provide assistance for farmers and ranchers for improvement projects. The program was specifically designed for areas with serious threats to soil and water quality. EQUIP projects in the Willow Creek Subbasin are along Hell Creek, in the Birch Creek and Canyon Creek drainages, and along Willow Creek near the Canyon Creek confluence.

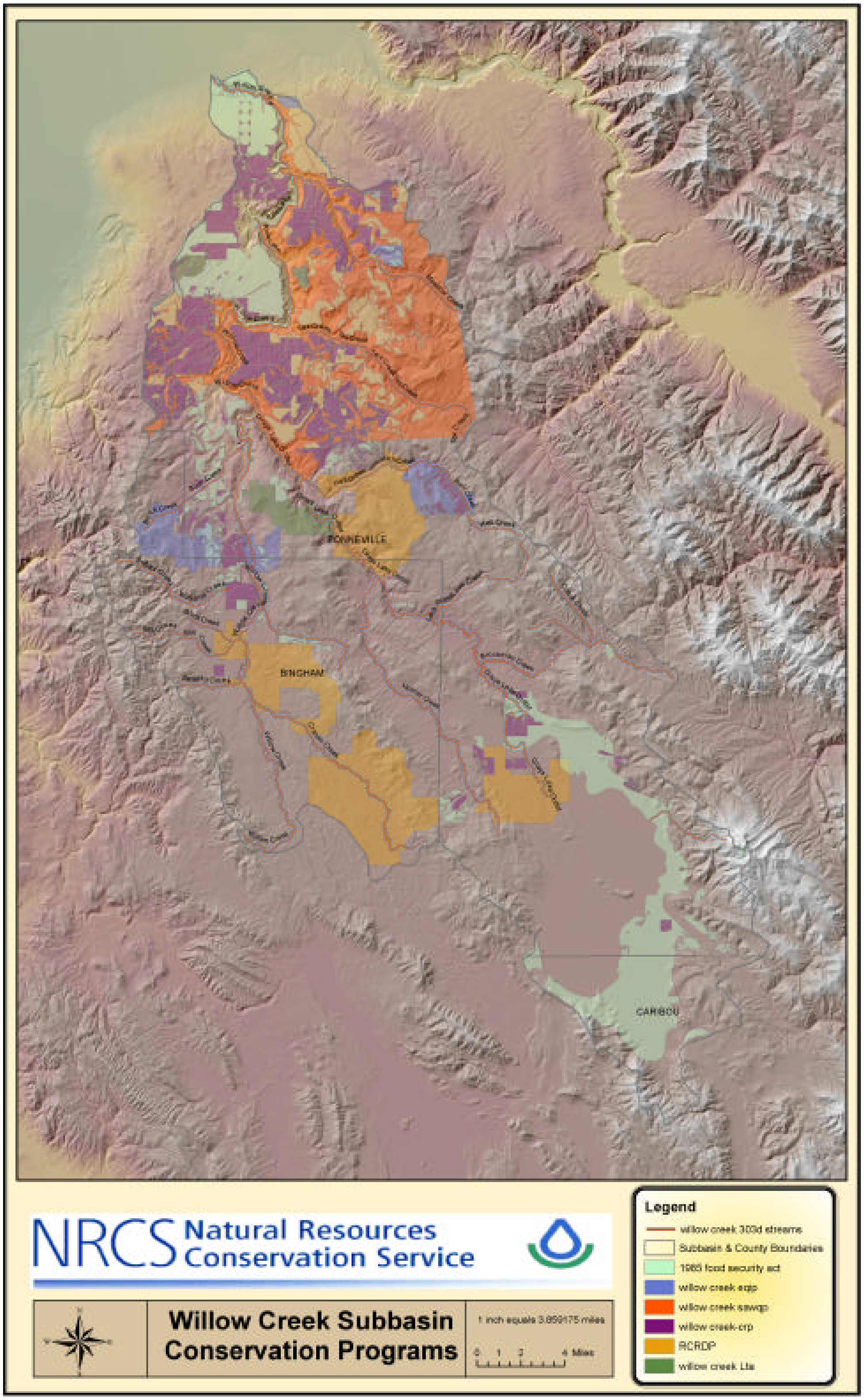

Figure 27. NRCS Conservation Projects in the Willow Creek Subbasin.

- The Resource Conservation and Development Program (RCRD) program is funded through grants authorized by the Idaho Legislature to finance projects focused on improving rangeland and riparian areas. Areas along Hell Creek, Grays Lake Outlet, Crane Creek, and Willow Creek participate in the RCRD program.

- The Water Quality Program for Agriculture (WQPA), formerly known as State Agriculture Water Quality Program (SAWQP), provides financial incentives to owners and operators of agriculture lands to apply conservation practices to protect and enhance water quality and fish and wildlife habitat. All lands treated under WQPA are in the Lower Willow, Tex Creek, and Willow Reservoir sub-watersheds.

- Long Term Agreements (LTA) are binding agreements between the NRCS or the conservation districts and landowner participants that provides cost-sharing for a conservation project aimed at protecting water, soil, and related resources. The most significant LTA project in the subbasin is along Grays Lake Outlet.

To promote and restore fish spawning and rearing in the Willow Creek Subbasin, IDFG coordinated fishery rehabilitation projects along three premier spawning tributaries: Sellars Creek, Mill Creek, and Tex Creek. (Fredericks 2003)

- Regional fisheries management personnel constructed approach pools and installed angle iron fish ladders in culverts crossing Sellars Creek and Mill Creek. These projects were designed to facilitate cutthroat trout spawning migration from Willow Creek to spawning and rearing habitat in upper Sellars and Mill Creeks. The projects were accomplished as cooperative projects with volunteer assistance from local anglers and a Boy Scout troop.

- Two riparian exclusion fences were constructed on Sellars Creek to rehabilitate and protect riparian habitat. Approximately one mile of fence, on both sides of Sellars Creek was constructed on the LDS Stake Farm between the Blackfoot Reservoir Road and Wolverine Road. The second fence was constructed on privately owned property approximately one mile above the Stake Farm fence.

- A box culvert was installed in Tex Creek on the lower Tex Creek road to insure fish passage.

Within the last five years, IDL and its lessees have implemented several range improvement programs in a direct effort to improve riparian area conditions. Some of those projects include:

1) Two wells with associated storage tanks and troughs were installed to provide offsite water and reduce grazing pressure along Grays Lake Outlet.
2) Three wells with associated storage tanks and troughs were installed to provide offsite water and reduce grazing pressure along Willow Creek, Hancock Creek and Crane Creek.

3) Two wells with associated storage tanks and troughs were installed to provide offsite water and reduce grazing pressure along Crane Creek.
4) Two and one-half miles of division fence was constructed to allow for more intensive grazing management and better grazing control on lower Lava Creek.
5) One and one-half miles of division fence was constructed to allow for more intensive grazing management and better grazing control on upper Lava Creek.
6) Eight spring developments with associated troughs are being constructed to provide offsite water and reduce grazing pressure along Grays Lake Outlet and Lava Creek.

Additional range improvements have also been completed over the past 20 years to improve grazing management on streams including Upper Crane Creek and its tributaries, Mill Creek, Upper Willow Creek, Brockman Creek, Homer Creek, Dan Creek, Grays Lake Outlet, Lava Creek and Sawmill Creek.

5. Total Maximum Daily Load(s)

A TMDL prescribes an upper limit on discharge of a pollutant from all sources so as to assure water quality standards are met. It further allocates this load capacity (LC) among the various sources of the pollutant. Pollutant sources fall into two broad classes: point sources, each of which receives a waste load allocation (WLA); and nonpoint sources, which receive a load allocation (LA). Natural background (NB), when present, is considered part of the load allocation, but is often broken out on its own because it represents a part of the load not subject to control. Because of uncertainties regarding quantification of loads and the relation of specific loads to attainment of water quality standards, the rules regarding TMDLs (Water quality planning and management, 40 CFR 130) require a margin of safety (MOS) be a part of the TMDL.

Practically, the MOS is a reduction in the load capacity that is available for allocation to pollutant sources. The natural background load is also effectively a reduction in the load capacity available for allocation to human made pollutant sources. This can be summarized symbolically as the equation: LC = MOS + NB + LA + WLA = TMDL. The equation is written in this order because it represents the logical order in which a loading analysis is conducted. First, the LC is determined. Then the LC is broken down into its components: the necessary MOS is determined and subtracted; then NB, if relevant, is quantified and subtracted; and then the remainder is allocated among pollutant sources. When the breakdown and allocation is completed, we have a TMDL, which must equal the LC.

Another step in a loading analysis is the quantification of current pollutant loads by source. This allows the specification of load reductions as percentages from current conditions, considers equities in load reduction responsibility, and is necessary in order for pollutant trading to occur. Also a required part of the loading analysis is that the LC be based on critical conditions – the conditions when water quality standards are most likely to be violated. If protective under critical conditions, a TMDL will be more than protective under other conditions. Because both LC and pollutant source loads vary, and not necessarily in concert, determination of critical conditions can be more complicated than it may appear on the surface.

A load is fundamentally a quantity of a pollutant discharged over some period of time, and is the product of concentration and flow. Due to the diverse nature of various pollutants, and the difficulty of strictly dealing with loads, the federal rules allow for "other appropriate measures" to be used when necessary. These "other measures" must still be quantifiable, and relate to water quality standards, but they allow flexibility to deal with pollutant loading in more practical and tangible ways. The rules also recognize the particular difficulty of quantifying nonpoint loads, and allow "gross allotment" as a load allocation where available data or appropriate predictive techniques limit more accurate estimates. For certain pollutants whose effects are long term, such as sediment and nutrients, EPA allows for seasonal or annual loads.

5.1 Instream Water Quality Targets

The goal of the TMDL is to restore "full support of designated beneficial uses" on all 303(d) listed streams within the Willow Creek Subbasin. Water quality pollutants of concern for which a TMDL will be written are sediment, temperature, and nutrients. A TMDL will not be written for streams listed with flow alteration as a pollutant since the EPA does not believe that flow (or lack of flow) is a pollutant as defined by CWA Section 502(6). The objective of this TMDL is to establish a declining trend in pollutant loading and to regularly monitor the pollutant load and beneficial use support. Pollutant reductions may be attained, in part, by improving canopy cover, vegetative buffers, and decreasing stream width/depth ratios along streambanks.

Design Conditions

To quantify the seasonal and annual variability and critical timing of sediment loading, climate and hydrology must be considered. This sediment analysis characterizes sediment loads using average annual rates determined from empirical characteristics that developed over time within the influence of peak and base flow conditions. Annual erosion and sediment delivery are functions of a climate where wet water years typically produce the highest sediment loads. Additionally, the annual average sediment load is not distributed equally throughout the year. Erosion typically occurs during a few critical months.

The temperature critical time periods for salmonid spawning in the Willow Creek Subbasin are identified as May 1st through June 30th (Schrader 2003) for rainbow trout and Yellowstone cutthroat trout; and September 15th through November 15th for brook trout and brown trout.

Nutrient loading rates are calculated from a flow-based perspective to account for the seasonal variability associated with streamflow on Willow Creek.

Target Selection

TMDL target selection addresses temperature, sediment, and nutrient values, which are discussed in the following:

Temperature

Temperature TMDL criteria is based on Idaho's existing numeric criteria for salmonid spawning. Instream targets shall be less than the instantaneous temperature (13°C) and the maximum daily average temperature shall be below 9°C during salmonid spawning periods.

Sediment

Target selection of sediment is dependent on existing narrative criteria of [IDAPA 58.01.02.200.08].

Sediment targets for this subbasin are based on streambank erosion quantitative allocations in tons/mile/year. The reduction in streambank erosion prescribed in this TMDL is directly linked to the improvement of riparian vegetation density to armor streambanks thereby reducing lateral recession, trapping sediment and reducing stream energy, which in turn reduces stream erosivity and instream sediment loading. It is assumed that by reducing chronic sediment, there will be a decrease in subsurface fine sediment that will ultimately improve the status of beneficial uses.

It is assumed that natural background sediment loading rates from bank erosion equate to 80% bank stability as described in Overton and others (1995), where banks are expressed as a percentage of the total estimated bank length. Natural condition streambank stability potential is generally 80% or greater for Rosgen A, B, and C channel types in plutonic, volcanic, metamorphic, and sedimentary geology types. Therefore, an 80% bank stability target based on streambank erosion inventories shall be the target for sediment.

Surface erosion from unimproved/unsurfaced roads does on not occur naturally, therefore it is known that natural background sediment loading rates from road impacts are 0%. A target of 50% of the current loading has been established based on a reasonable expectation from best management practice (BMP) implementation.

Unnatural streambed sediment size composition can directly impair spawning success, egg survival to emergence, rearing habitat, and fish escapement from stream. It is necessary to reduce the component of subsurface fine sediment less than 6.35 mm to below 28% of total subsurface sediment. This sediment particle size parameter should be considered as part of target monitoring to evaluate any significant shift in subsurface fine particle frequency distribution.

Nutrients

The target selection for nutrients is dependent on the existing narrative criteria of [IDAPA 58.01.02.200.06].

Both nitrogen and phosphorous reach surface waters at an elevated rate as a result of human activities and it is known that elevated levels of nutrients lead to biological nuisances and eutrophication, both of which impair insect and fish survival. The nitrogen and phosphorus targets established for this TMDL are numeric indicators that have been chosen for the attainment of beneficial uses.

Nutrient targets for this TMDL are based on EPA literature values of 0.05 mg/L total phosphorus (TP) and 0.3 mg/L nitrate + nitrite nitrogen (NO_2+NO_3).

Monitoring Points

Monitoring points for this TDML address subsurface sediment, streambank stability, nutrient, and temperature monitoring, all of which are discussed in the following.

Subsurface Sediment

Subsurface sediment substrate monitoring points shall occur in habitat determined suitable for salmonid spawning within listed stream segments using the McNeil core sediment sampling method. The amount of habitat suitable for salmonid spawning will increase after the implementation of management practices identified to reduce fine sediment.

Streambank Stability

Streambank erosion inventories/assessments shall occur on sediment-impaired streams to evaluate overall bank stability.

Temperature Monitoring

Stream temperatures will be monitored with an instream temperature logger in previously established monitoring sites to maintain consistency.

Nutrient Monitoring

Water column nutrients will be monitored in previously established monitoring sites as well as a new downstream site (near the reservoir) to reflect the downstream end of the listed segment, as well as critical reaches upstream. Continued grab sampling in established monitoring sites also helps maintain consistency. Nutrient grab samples will be collected in accordance with methodologies that yield the most accurate representation of water column nutrient levels.

5.2 Load Capacity

A load capacity is “the greatest loading a waterbody can receive without violating water quality standards” [40 CFR §130.2]. This must be at a level to meet “...water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge...” (Clean Water Act § 303(d)(C)). Likely sources of uncertainty include lack of knowledge of assimilative capacity, uncertain relation of selected target(s) to beneficial use(s), and variability in target measurement.

Load capacities are defined for sediment, temperature, and nutrients as discussed in the following.

Sediment

The load capacity for sediment from streambank erosion shall be based on assumed natural streambank stabilities of greater than or equal to 80% (Overton et al 1995). Because it is presumed that beneficial uses were or would be supported at natural background sediment loading rates, the loading capacity lies somewhere between the current loading level and sediment loading from natural streambank erosion.

- Natural background loading rates are not necessarily the loading capacities. An adaptive management approach will be used to provide reductions in sediment loading based on best management practice (BMP) usage coupled with data collection and monitoring to determine the loading point at which beneficial uses are supported.

- The estimated capacity is directly related to the improvement of riparian vegetation density and structure as well as maintenance of roads and stream crossings. Increased vegetative cover provides a protective covering of streambanks, reduces lateral recession, traps sediment, and reduces erosive energy of the stream.

There is a large degree of uncertainty as to the percentage of sediment loading available before beneficial uses are no longer supported. It is difficult to determine a road erosion target where beneficial uses are supported. Because it is presumed that beneficial uses were or would be supported at natural background sediment loading rates, the loading capacity lies somewhere between the current loading level and sediment loading from natural erosion. The loading capacity for sediment from road erosion shall be an average annual load based on the assumption that BMP improvements will reduce sedimentation to an acceptable level. It is reasonable to suggest that beneficial use support may be obtained at a loading capacity of one half (50%) the current erosion rate.

Temperature

The loading capacities for streams listed for temperature, are based on Idaho's temperature criteria for salmonid spawning. Water temperatures shall be less than the instantaneous temperature [13°C (55.4°F)] and the maximum daily average temperature shall be below 9°C (48.2°F) during salmonid spawning periods. Factors considered in this load capacity value include the following:

- All streams are considered salmonid spawning streams because either salmonids have been observed in the stream or it is a tributary of a major salmonid spawning stream and is potentially spawning ground. Additionally, all streams are considered coldwater aquatic life streams and additional criteria apply during the summer months.

- The loading capacity is season specific and should only apply to salmonid spawning areas.

- The use of the highest recorded temperature rather than the average maximum temperature to compare to the criterion provides an implicit margin of safety over all of the cooler years when temperatures would not be so high.

Nutrients

An average annual load may paint an unrealistic picture in a stream with a wide range in flow regimes. Therefore, loading capacity, current loads and associated load allocations will be visualized from a flow-based perspective. Loading capacity was calculated for TP (Figure 28) and nitrogen as NO2+NO3 (Figure 29) using the target concentrations and flows ranging from one to 2,500 cfs. Flow ranges are based on maximum and minimum streamflows recorded on Willow Creek at station #13057940, below Tex Creek, as discussed in section 2.3 of the Subbasin Assessment.

The loading capacity is calculated in pounds per day based on flow. Figures 28 and 29 show the linear rate of nutrient loading, at target level, based on streamflow. The regression lines illustrate the loading capacity for nitrate + nitrite nitrogen and total phosphorus.

- The loading capacity is calculated from the target concentration based on flow.

- The loading capacity assumes no change in the target concentration as a result of season or location.

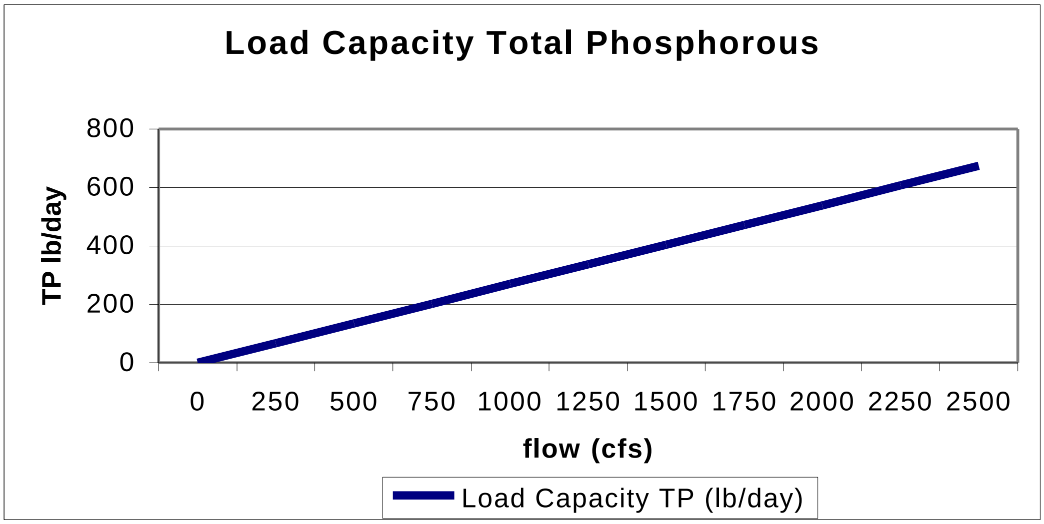

Figure 28. Total Phosphorus Load Capacity for Willow Creek

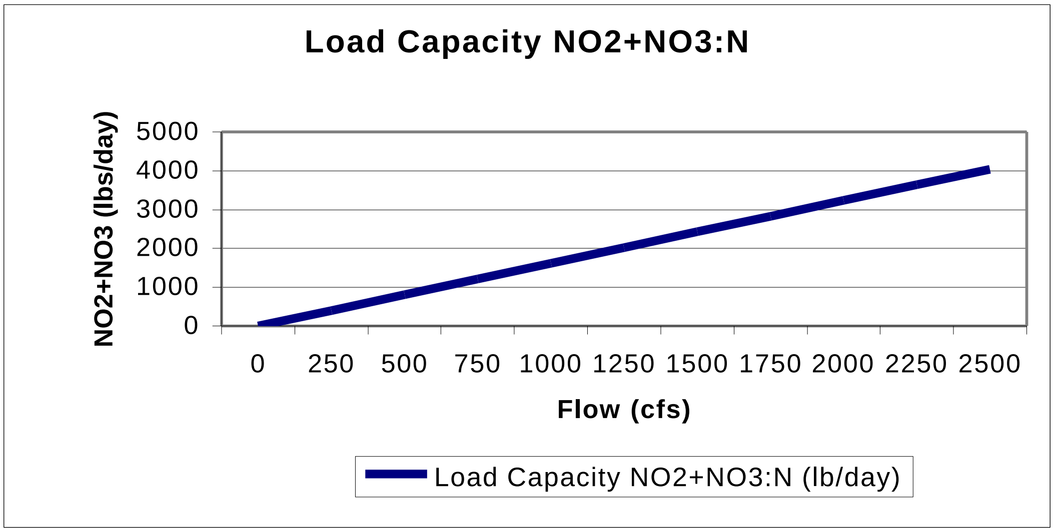

Figure 29. Nitrogen Load Capacity for Willow Creek

5.3 Estimates of Existing Pollutant Loads

Regulations allow that loadings "…may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading," (Water quality planning and management, 40 CFR 130.2(I)). An estimate must be made for each point source. Nonpoint sources are typically estimated based on the type of sources (land use) and area (such as a sub-watershed), but may be aggregated by type of source or land area. To the extent possible, background loads should be distinguished from human-caused increases in nonpoint loads.

Estimated existing pollutant loads for streambank sediment are based on streambank erosion inventories conducted by MSE and DEQ in 2001 and 2003 respectively. Current sediment loading-rates for streams in the Willow Creek Subbasin are quantitatively estimated in tons/mile/year, as shown in Table 43.

Sediment loading from unimproved/unsurfaced roads adjacent to (within 50 m) 303(d) listed waters was estimated using numerical values from the Forest Service Interface for the Water Erosion Prediction Project Model (WEPP). The model provided a quick evaluation of erosion and sediment delivery from unsurfaced roads. Model input parameters are climate, soil, road surface condition, road and buffer topographic features (slope and length), road design, road width, and the presence of gravel. The model estimates (output) quantity of sediment delivered from the buffer to the stream and amount of sediment leaving the eroding portion of the road. These two output parameters combined give the total quantity of sediment delivered to the stream annually. (USDA 2003) Table 43 shows the calculated current sediment loading from road erosion on Meadow and Tex Creeks.

Temperature loads are determined by using the maximum daily and maximum daily average temperatures recorded in the spring and fall spawning periods. Table 44 shows current loads determined for temperature.

Phosphorus and nitrogen loads entering the system are determined based on all of the monitoring data (sites lumped) collected during 2003 (Appendix F). Loads are calculated in lb/day based on analytical results (mg/L) and streamflow data (cfs) at the time of collection.

5.4 Load Allocation

Wasteload Allocation

Because there are no point source discharges in the Willow Creek Subbasin, there are no wasteload allocations (WLA) in the TMDL.

Load Allocation

For the Willow Creek Subbasin, sediment, temperature, and nutrient load allocations have been developed, as shown on tables 43 through 44. The load allocation is the amount of loading capacity allocated to a given source without exceeding water quality criteria.

The sediment load allocations for the Willow Creek Subbasin are developed from streambank erosion inventories and WEPP road erosion modeling. On Tex and Meadow Creeks, road sediment loads have been added to the streambank sediment loads to develop the total load allocation(s).

Table 43. Sediment load allocations for Willow Creek Subbasin.

Stream		CURRENT LOAD Existing Erosion Rate (t/mi/yr)	LOAD CAPACITY Erosion Rate (t/mi/yr)	LOAD ALLOCATION Total Erosion Rate Reduction (t/mi/yr)	Total Erosion % Reduction to Meet Load Capacity
Mill Creek		26	8	-18	68
Sellars Creek		304	11	-293	96
Brockman Creek		384	25	-359	93
Tex Creek		8	4	-4	50
Corral Creek		226	18	-208	92
Sawmill Creek		340	19	-321	94
Crane Creek		172	25	-147	86
Hell Creek		402	39	-363	90
Homer Creek		411	20	-391	95
Lava Creek		537	16	-521	97
Willow Creek		213	14	-199	93
Seventy Creek		288	11	-277	96
Meadow Creek	**Bank**	49	20	-29	59
	Road	11	6	-5	45
	Total	60	26	-34	57

Since cutthroat trout is perhaps the species of most concern and its spawning phase the most critical period, spring spawning will be the focus of the needed reductions in temperature.

Table 44. Temperature load allocations for Willow Creek Subbasin.

Stream	Temperature Statistic	CURRENT LOAD Highest Recorded Temperature	LOAD CAPACITY Criteria	LOAD ALLOCATION Temperature reduction	% Reduction to meet load capacity
Corral Creek	Max Daily	22.39°C	13°C	-9.39°C	42%
	Daily Ave	21.95°C	9°C	-12.95°C	59%
Homer Creek	Max Daily	26.42°C	13°C	-13.42°C	51%
	Daily Ave	18.79°C	9°C	-9.79°C	52%
Hell Creek	Max Daily	19.51°C	13°C	-6.51°C	33%
	Daily Ave	17.41°C	9°C	-8.41°C	48%
Tex Creek	Max Daily	24.19°C	13°C	-11.19°C	46%
	Daily Ave	17.96C	9°C	-8.96°C	50%
Sawmill Creek	Max Daily	20.9°C	13°C	-7.9°C	38%
	Daily Ave	18.11°C	9°C	-9.11°C	50%
Grays Lake Outlet (Homer Creek to mouth)	Max Daily	28.34°C	13°C	-15.34°C	54%
	Daily Ave	21.58°C	9°C	-12.58°C	58%
Grays Lake Outlet (Outlet to Homer Creek)	Max Daily	28.34°C	13°C	-15.34°C	54%
	Daily Ave	21.58°C	9°C	-12.58°C	58%
Brockman Creek	Max Daily	19.70°C	13°C	-6.70°C	34%
	Daily Ave	17.84°C	9°C	-8.84°C	50%
Rock Creek	Max Daily	24.54°C	13°C	-11.54°C	47%
	Daily Ave	21.97°C	9°C	-12.97°C	60%
Willow Creek (Headwaters to Ririe Reservoir)	Max Daily	24.54°C	13°C	-11.54°C	47%
	Daily Ave	21.97°C	9°C	-12.97°C	60%
Sellars Creek	Max Daily	26.7°C	13°C	-13.7°C	51%
	Daily Ave	18.51°C	9°C	-9.51°C	51%
Mill Creek	Max Daily	24°C	13°C	-11°C	46%
	Daily Ave	18.2°C	9°C	-9.2°C	51%
Lava Creek	Max Daily	22.8°C	13°C	-9.8°C	43%
	Daily Ave	18.44°C	9°C	-9.44°C	51%

All load allocations are dedicated to nonpoint sources as whole. No attempt was made to divide the allocation amongst different nonpoint source activities. Nutrient load allocations were developed based on the highest current loading and the loading capacity at the loadings measured discharge (Table 45). The highest TP current load was 13 lb/day at 41 cfs. The loading capacity at 41 cfs would be 11 lb/day. To account for uncertainties, an additional 10% reduction for a margin of safety (MOS) is calculated into the target (load allocation) so, the target load becomes 10 lb/day (10% reduction in 11 lb/day load capacity). The difference between the current load and the target load (10% MOS) becomes the load allocation: -3 lb/day TP or a 23% reduction. The same procedure computed the nitrogen load allocation for Willow Creek.

Table 45. Nutrient load allocations for Willow Creek.

Parameter	Highest Current Load (lb/day)	Flow (cfs)	Load Capacity (lb/day)	Load Capacity (lb/day) with 10% MOS	Load Allocation (lb/day)	% Reduction to Meet Load Capacity
TP	13	41	11	10	-3	23%
N	48	11	18	16	-32	67%

Brockman Creek

Over utilization of the land on Brockman Creek has contributed to active downcutting, creating a stream that is highly entrenched. In 2001 and 2003, streambank erosion inventories were conducted showing bank stabilities ranging from 79% in the upper reaches to 44% in the lower section. Additionally, rigorous grazing occurs along Shirley Creek, contained in the Brockman Creek Assessment Unit (AU); the load allocation for Brockman Creek also applies to Shirley Creek.

Brockman Creek is not listed for temperature, however USFS thermograph data show that stream temperatures exceed Idaho's salmonid spawning criteria. The temperature data collection point is at the forest boundary, upstream of Corral Creek. Although late season, dry stream conditions existed during 2001-2003, nevertheless, historically Brockman Creek has historically maintained flows throughout the summer and into the fall. In order to protect beneficial use support, temperature load allocations are necessary for Brockman Creek (four AUs). The maximum daily temperature recorded from both thermographs is 19.7°C, and the maximum daily average temperature is 17.84°C. A 34% and 50% temperature reduction is necessary to meet the criteria.

The presence of geothermal springs on Brockman Creek has not been documented through analytical data however, some say that there are geothermal springs on Brockman Creek near the Brockman Creek/Dan Creek intersection and on Idaho Endowment Land just upstream from this intersection. With the possible presence of geothermal springs on Brockman Creek, it becomes even more important to protect riparian vegetation since Brockman Creek has two documented salmonid spawning tributaries, Sawmill and Corral Creek.

Corral Creek

Stream temperature data was recorded on Corral Creek (SK026_02) at the mouth in 2000 and 2002. Year 2000 stream temperature data is available from 07/07/00 through 09/27/00, allowing for evaluation of a portion of the fall spawning period (September 15th through November 15th) in 2000. Temperature logger data from 2002 (06/20/02 through 09/10/03) allows for the evaluation of spring spawning temperatures (May 1st through June 30th). The spring and fall spawning times that were recorded occurred during the critical timeframe where temperatures are expected to be the highest: the last 22 days of spring spawning and the first 22 days of fall spawning (DEQ 2002). If the partial data record includes the critical period, it can be inferred that the frequency of temperature exceedances still remains greater than 10%. A 42% reduction in maximum daily temperatures is prescribed in the TMDL.

Road erosion and grazing are the primary sources of beneficial use impairment on Corral Creek. In the fall of 2001, a streambank erosion inventory was conducted on Corral Creek, showing bank erosion at approximately 63%. A 92% reduction in total erosion is prescribed in the TMDL.

Crane Creek

Streambank erosion inventories conducted in the fall of 2001 showed bank stabilities of 67% and 56% in upper and lower reaches, respectively. Topographically some portions of Crane Creek (lower) are in steep walled canyons. The confining nature of the canyon limits the land use and bank stabilities are somewhat higher. The current estimated erosion rate is 172 tons/mile/year. A sediment-loading rate of 25 tons/mile/year is recommended to guarantee beneficial use support.

Grays Lake Outlet

Grays Lake Outlet is temperature listed from headwaters to mouth. Three temperature loggers were placed in the stream by IDFG in 2001. Two loggers were placed near the Homer Creek confluence, with the other logger at the mouth. In all cases, there were exceedances in spawning temperature criteria. Spring spawning temperatures were not recorded at the mouth in 2001, however, spring temperature readings were evaluated at the Homer Creek confluence and the load allocation has been developed for the mouth based on the readings further upstream. Where two data sets exist (above Homer Creek confluence), the highest value for daily maximum and average daily temperatures from both data sets was used for the development of the load allocation. Reductions of 54% and 58% in maximum and average daily temperatures in Grays Lake Outlet are required to meet the temperature loading capacity.

Sediment and nutrients are listed pollutants above the falls on Grays Lake Outlet. Water from Grays Lake is allocated for irrigation, and discharge from Grays Lake to the outlet is seriously limited. Streamflows gradually increase further downstream from groundwater recharge and tributary influences. However, a nutrient TMDL will not be written for this section of Grays Lake Outlet because streamflows are anthropogenically limited and it is nearly impossible to control or regulate the nutrient concentrations of the Grays Lake wetland waters.

A sediment TMDL is also not necessary because the flow altered state of this reach prohibits sediment transport and the falls serve as a fish barrier, hence a fishery cannot be supported in this reach of Grays Lake Outlet.

Grays Lake Outlet, below the falls is not listed for sediment, however, streambed sampling in Fall 2003 show 44% sediment fines in salmonid spawning gravels and bank erosivities around 45% (Homer Creek confluence). Improved land management is necessary to reduce the known sediment impacts in selected areas of the stream.

Hell Creek

Continuous riparian habitat destruction is the primary cause of beneficial use impairment in the drainage. Hell and Dan Creeks are unable to support coldwater aquatic life and salmonid spawning. Hell Creek is 303(d) listed for nutrients and sediment. Nutrient data collected on Grays Lake Outlet, at the Hell Creek confluence is below established criteria, and field observations show that sediment is the limiting factor where beneficial use support attainment is concerned

With regards to sediment, streambank erosion inventories conducted on Hell Creek in 2001 show bank stabilities less than the 80% target with a current estimated erosion rate of 402 tons/mile/year. The load allocation prescribes a sediment-loading rate of 39 tons/mile/year.

Hell Creek is not 303(d) listed for temperature, however, stream temperature data collected by IDFG in 2001 show that temperatures exceeded spring salmonid spawning criteria. Daily maximum stream temperatures were within temperature criterion at the IDFG site in 2001, however, 27% of the time, daily average temperatures were above 13°C.

Homer Creek

Homer Creek is not 303(d) listed for temperature, however, stream temperature data collected at the mouth in 2001 show major exceedances in salmonid spawning temperature criteria (spring and fall). There is an incomplete data set for both the spring and fall spawning period, however, the critical periods are present and according to DEQ policy, it can be inferred that the exceedances in temperature would still be greater than 10%. Stream temperature data on upper Homer Creek showed that spring stream temperatures were above salmonid spawning criteria prior to dry stream conditions in late July.

Streambank erosion is evident on banks along all of Homer Creek. Upper portions of Homer Creek are sparsely vegetated, with grazing the principal land use. On lower Homer Creek, vegetative cover averages around 50%. Riparian impacts are evident with bank stabilities unable to meet the 80% stability target. A 95% reduction in the sediment-loading rate is recommended for beneficial use support.

Lava Creek

Stream temperature data collected at the Dan Creek Road crossing reveal temperature exceedances of 85% (instantaneous) and 91% (average) during the spring spawning. The load allocation for maximum and average daily temperatures is –9.8°C and –9.44°C, respectively. It is expected that stream temperatures will improve with riparian zone enhancement. A culvert on upper Lava Creek continuously exists in a state that inhibits downstream flow. It is speculated that beaver activity combined with anthropogenic actions continue to create this condition. Eliminating the anthropogenic cause of this condition and clearing the obstruction will assist in improving stream temperatures.

Streambank erosion inventories, conducted in 2001 and 2003, show bank stabilities of 24% at the upper inventory site and 55% at the lower inventory site. Current estimated sediment loading is 537 tons/mile/year. The load allocation calls for a sediment-loading rate of 16 tons/mile/year.

Meadow Creek

Grazing in the upper reaches and road erosion in the lower sections principally influence sedimentation in Meadow Creek. The load allocations for this TMDL were developed via erosion inventories and road erosion modeling. From headwaters to South Fork Meadow Creek, streambank stabilities exceed the 80% target; this target was achieved due to cessation and/or rotation of grazing practices in the vicinity.

Mill Creek

The land surrounding Mill Creek is privately and state owned with grazing as the principal land use. Monitoring and observations show that the largest impacts on the creek are in the middle and lower reaches where land utilization is maximized. Riparian fencing in the upper reaches have improved the riparian zone and thereby reduced streambank erosion. Substrate samples collected on Mill Creek, above the Willow Creek confluence, showed the presence of 43% fine sediment in spawning gravels. Streambank erosion inventories show the highest concentration of sedimentation occurring in the middle section of Mill Creek, above the Blackfoot Reservoir Road crossing. A 68% reduction in the erosion rate is recommended for Mill Creek. The 68% reduction in sediment loading applies to Buck Creek, also 303(d) listed, since it is located in the Mill Creek assessment unit.

To evaluate stream temperatures, a temperature logger was placed at the Blackfoot Reservoir Road crossing. Major temperature exceedances occurred during the fall and spring spawning periods. A 51% reduction in the average daily temperature is recommended in this TMDL.

Sawmill Creek

Sawmill Creek is 303(d) listed for temperature and sediment. Stream temperature data collected in 2003 documented major exceedances in the salmonid spawning criteria. A 38% reduction in maximum daily temperatures is warranted for salmonid spawning success. Streambanks evaluated with erosion inventories had bank stabilities around 29%, so a 94% load reduction is necessary for beneficial use attainment.

Sellars Creek

Riparian road impacts, riparian grazing, and flow alteration are the three principal causes of perturbation on Sellars Creek. Based on field observations, riparian grazing is the greatest source of sedimentation in the subbasin. According to IDFG, Sellars Creek is one of the most important spawning tributaries in the subbasin. Recent sampling shows greater than 28% subsurface fines in spawning habitat on Sellars Creek. Streambank erosion inventories were conducted on upper Sellars Creek, just below the South Fork confluence, and middle Sellars Creek, below the Ririe Reservoir Road crossing. Streambank erosion on lower Sellars Creek, below Long Valley Road crossing, is nominal due to limited grazing. The current estimated erosion rate on Sellars Creek is 304 tons/mile/year. The load capacity is 11 tons/mile/year, so an erosion rate reduction of 293 tons/mile/year is prescribed in the TMDL.

Temperature loggers were placed in upper Sellars Creek (above South Fork Confluence) and in South Fork Sellars Creek (mouth) from 05/28/01 through 10/04/01. Spring temperatures through the salmonid spawning (May 1st though June 30th) period exceeded spawning criteria 65% and 85% of the time. Exceedances in fall spawning criteria occurred on South Fork Sellars Creek. In 2003, DEQ placed a temperature sensor at the Blackfoot Reservoir Road crossing from 05/07/03 through 10/26/03. Major exceedances of spring and fall spawning were documented at this location. The temperature TMDL is based on the readings at the Blackfoot Reservoir road because this is the lowermost temperature logger site, and temperatures at this location are higher than those at the upper sites.

Sellars Creek is impaired due to a lack of flow; however, EPA does not believe that flow (or lack of flow) is a pollutant as defined by CWA Section 502(6). Since TMDLs are not required to be established for waterbodies impaired by pollution but not pollutants, a TMDL has not been established for Sellars Creek for flow.

Seventy Creek

Seventy Creek (SK011_02) is 303(d) listed for temperature, sediment, and flow alteration. Currently there is no temperature data available to prove that the stream is temperature impaired. It is assumed that any temperature impairment from sedimentation will improve with riparian zone rehabilitation.

Streambank erosion inventories show banks on Seventy Creek, above the Blackfoot Reservoir Road, are relatively stable whereas, in the lower reaches, bank stabilities are as low as 39%. Sediment loading to Seventy Creek should not exceed 11 tons/mile/year.

Upper Seventy Creek is flow altered, however, EPA does not believe that flow (or lack of flow) is a pollutant as defined by CWA Section 502(6). Since TMDLs are not required to be established for waterbodies impaired by pollution but not pollutants, a TMDL has not been established for Seventy Creek for flow.

Tex Creek

Tex Creek contains the AUs SK031_02 and _03, with _02 encompassing several unnamed tributaries, Indian Fork Creek, and Pipe Creek and _03 being Tex Creek, mainstem to Bulls Fork. Tex Creek is not listed for temperature however, stream temperature data show that there were elevated spawning temperatures in Tex Creek just below the Pipe Creek confluence (approximately 1.7 stream miles above Bulls Fork). Temperature load allocations are necessary to protect beneficial use support.

Sediment impacts on Tex Creek have not been quantified through McNeil subsurface sediment sampling. Extremely dry conditions over recent years have prohibited the proper identification of salmonid spawning habitat. It is known that the Tex Creek fishery has trended downwards for, at a minimum, the past decade. It is presumed that the decline is due to high sedimentation in the stream. A sediment TMDL is necessary for Tex Creek. The load allocation was developed based on road erosion modeling because road impacts are the primary source of sedimentation loading in Tex Creek.

Willow Creek

Willow Creek is 303(d) listed for temperature above and below the reservoir. A temperature logger placed at Kepp's Crossing captured an entire season of data. Thermograph data show that stream temperatures at Kepp's Crossing are above salmonid spawning criteria. Recorded maximum daily temperatures are 24.54°C during spring spawning and 18.72°C during fall spawning.

Willow Creek, below the reservoir dam to Eagle Rock Canal, is listed for temperature and sediment. Temperature regimes below the reservoir are controlled by the Reservoir outlet structures, located well below the surface, stratified as the hypolimnion layer of lake. It is known that waters discharged from the hypolimnion meet Idaho's temperature criterion for cold water aquatic life. However, a temperature TMDL will not be written for this section of Willow Creek because flow from the Ririe Reservoir dam is reduced to zero discharge for four to five months of the year. According to IDFG, a viable fishery does not exist below the reservoir (Fredericks 2003). Salmonid spawning cannot occur here and the only fish present are entrained, meaning they "slipped" through the outlet structures. Streambank stabilities meet the 80% stability target, however, flow is the limiting factor for beneficial use support below the Ririe Reservoir, and therefore a sediment TMDL is not necessary.

Stream characteristics are different on Willow Creek, above the reservoir. Streambed sampling indicates that sediment impacts are present in the spawning gravels at Grays Lake Outlet and Kepp's Crossing. In both instances, 31% subsurface fines were observed. Streambank stabilities are less than 80% in most areas above Grays Lake Outlet with stabilities meeting the target in the steep walled canyons below the confluence with Grays Lake Outlet. The estimated erosion rate from streambank erosion is 213 tons/mile/year. The TMDL prescribes a sediment-loading rate of 14 tons/mile/year.

Ririe Reservoir is 303(d) listed for sediment. A TMDL will not be developed for Ririe Reservoir because the upstream sediment TMDLs will help to reduce sediment input into the reservoir.

Willow Creek is not listed for nutrients however, stream water quality monitoring data show that nutrient levels are above the EPA recommended criteria for nitrate + nitrite nitrogen and total phosphorus. The EPA criteria is based on use attainment standards that are applicable when identifying levels of nitrogen and phosphorus where deleterious levels of aquatic plant growths occur. Along with the elevated nutrient levels, dissolved oxygen (DO) levels on Willow Creek are nearing the acute toxicity level for salmonids, and nuisance levels of plant growth in the stream were observed. Based on water quality data and field observations, nutrient TMDLs for nitrogen and phosphorus are warranted to protect and restore aquatic life in Willow Creek.

The Willow Creek TMDL is also important because it is protective of water quality in the Ririe Reservoir. Monitoring data show that TP levels in the reservoir, on several occasions are above the EPA recommended criteria of 0.025 mg/L for reservoirs. DO levels are at or near the state criteria of 6 mg/L [IDAPA 58.01.02.250.02.a] in waters above the hypolimnic layer of in the reservoir. A reduction in nutrient and sediment loading to the Ririe Reservoir will slow the process of eutrophication and thereby help preserve the reservoir's aesthetic, biological, and recreational values.

Rock Creek

Rock Creek (SK005_02), a tributary of Willow Creek is 303(d) listed for temperature. Temperature data for Rock Creek itself does not exist. However, temperature data is available just downstream of Rock Creek, on Willow Creek at Kepp's Crossing. For the purpose of this TMDL, and the assessment unit reporting system, Rock Creek will receive the same load allocation as Willow Creek proper.

Margin of Safety

The margin of safety (MOS) factored into sediment load allocations is implicit. The MOS includes the conservative assumptions used to develop existing sediment loads. Conservative assumptions made as part of the sediment loading analysis include the following:
Desired bank erosion rates are representative of assumed natural background conditions.
Water quality targets for percent depth fines are consistent with values measured and are set by local land management agencies based on established literature values, incorporating an adequate level of fry survival to provide for stable salmonid production.

With temperature TMDLs, the MOS is implicit by virtue of the following:
Use of the highest recorded temperature as existing load rather than an average high temperature for all sampling years.
The temperatures used were measured during warmer-than-average years. The loading capacity is season specific and should only apply to salmonid spawning areas, however, in flowing streams, temperatures above salmonid spawning areas can influence temperatures downstream.

With nutrient TMDLs, the MOS is explicit. A 10% MOS was used to reduce the available loading capacity in the Willow Creek nutrient TMDL.

Seasonal Variation

Seasonal variability was built-in to this TMDL by developing sediment loads using annual average rates determined from empirical characteristics that developed over time within the influence of runoff events and peak and base flow conditions. Streambank erosion inventories take into account that most bank recession occurs during peak flow events, when the banks are saturated. The estimated annual average sediment delivery is a function of bankfull discharge. It is assumed that the accumulation of sediment within dry channels is continuous until flow resumes and the accumulated sediment is transported and deposited.

Seasonal variability was incorporated into road sediment loads using annual average rates thereby incorporating all yearly climatic and hydrologic events. The WEPP evaluates annual sediment potential from a 30-year climatic record.

Seasonal variability was integrated into temperature TMDLs by taking into account the critical timeframes associated with salmonid reproduction.

There is substantial seasonal variation in flow and this variation was taken into account by visualizing the loading on a flow rate basis. All available sampling data represent low flow conditions, and no information is available on the behavior of nutrient loading at peak flows. If loading trends remain the same at higher flows, then the percent reduction remains the same, but actual loads will be higher at peak flows. The critical time period to control the most loading will be during the peak runoff.

Background

Natural background loading rates are assumed to be the natural sediment loading capacity of 80% or greater streambank stability and 28% or less subsurface fine sediment. Therefore natural background is accounted for in the load capacity. Where road erosion is concerned, natural background loading rates are 0%.

Natural background conditions for temperature can exceed the criteria, however natural temperature regimes in the Willow Creek Subbasin have not been isolated.

For nutrients, the load allocation includes that which would be produced naturally. However, with nutrients, some of the N and P load capacity belongs to background sources, but their quantity is unknown.

Reserve

If uses are supported at load levels different than those specified in the TMDL, then there may be some reserve capacity to adjust the TMDL loads.

5.5 Implementation Strategies

DEQ recognizes that implementation strategies for TMDLs may need to be modified if monitoring shows that the TMDL goals are not being met or significant progress is not being made toward achieving the goals.

Several designated land management agencies are involved where watershed implementation is concerned. The largest portion of the watershed is a mosaic of private and state land. IDL and IASCD will provide implementation strategies for riparian management for the areas that fall under their realm of jurisdiction. A much smaller portion of the watershed is made up of BLM and USFS land, both of which are responsible for developing an implementation plan.

Approach

It is anticipated that by improving riparian management practices, overall riparian zone recovery will precipitate streambank stabilization, reduce sedimentation, increase canopy cover, and lower stream temperatures, all of which will precipitate overall stream habitat improvements. Such improvements will contribute to an overall improvement in stream morphology and habitat, shifting stream health towards beneficial use attainment.

Time Frame

The expected time frame for attaining water quality standard and restoring beneficial use is a function of management intensity, climate, ecological potential, and natural variability of environmental conditions. If implementation of best management practices is embraces enthusiastically some improvements may be seen in as little as several years. Even with aggressive implementation, however, some natural processes required for satisfying the requirements of this TMDL may not be seen for many years. The deleterious effects of historic land management practices have accrued over many years and recovery of natural systems may take longer than administrative needs allow for.

Responsible Parties

IASCD, IDL, BLM, and USFS are the identified as the federal and state entities that will be involved in or responsible for implementing the TMDL. Bonneville, Bingham, and Caribou Counties will be responsible for maintaining roads by utilizing BMPs to reduce road erosion to streams.

Monitoring Strategy

It is presumed that instream temperatures will continue to be monitored with temperature loggers to evaluate improvements or declines in temperature regimes. Streambank erosion inventories are intended for rapid assessment, but will allow for the evaluation of streambank condition in the absence of more rigorous evaluation. Stream subsurface fine sediment should continue to be assessed through McNeil sediment core sampling at established intervals to identify trends toward meeting sediment targets. Nutrient and flow levels should be monitored on Willow Creek at the three designated monitoring sites (Section 5.1). Beneficial Use Reconnaissance Program monitoring will continue to be conducted by DEQ and should also provide insight regarding steam conditions.

5.6 Conclusions

The Willow Creek drainage is a fairly homogeneous drainage with unvarying land uses. The presence of fine sediment in spawning habitat and thermal loading during spawning season are the two largest water quality concerns. The direct relationship between stream sedimentation and stream temperatures is apparent with the coupling of sediment and temperature 303(d) listings. Lateral recession is a natural process however, it can be accelerated by reducing/eliminating riparian vegetation and the detachment of bank material (clumping and sloughing), all of which disrupt the natural stream system contributing to elevated stream temperatures. Where natural stream conditions and beneficial use support are concerned, minimized flow or lack of flow are also issues in the watershed. Increasing width/depth ratios and flow control or water catchment structures contribute to conditions where beneficial use support is strained or impossible.

Implementation plans for the Willow Creek Subbasin will prescribe for the improvement of riparian vegetation and the reduction of streambank and road erosion improving salmonid spawning habitat by reducing stream temperatures and fine sediment.

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GIS Coverages:

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Glossary

305(b)	Refers to section 305 subsection "b" of the Clean Water Act. 305(b) generally describes a report of each state's water quality, and is the principle means by which the U.S. Environmental Protection Agency, Congress, and the public evaluate whether U.S. waters meet water quality standards, the progress made in maintaining and restoring water quality, and the extent of the remaining problems.
§303(d)	Refers to section 303 subsection "d" of the Clean Water Act. 303(d) requires states to develop a list of waterbodies that do not meet water quality standards. This section also requires total maximum daily loads (TMDLs) be prepared for listed waters. Both the list and the TMDLs are subject to U.S. Environmental Protection Agency approval.
Acre-Foot	A volume of water that would cover an acre to a depth of one foot. Often used to quantify reservoir storage and the annual discharge of large rivers.
Adsorption	The adhesion of one substance to the surface of another. Clays, for example, can adsorb phosphorus and organic molecules
Aeration	A process by which water becomes charged with air directly from the atmosphere. Dissolved gases, such as oxygen, are then available for reactions in water.
Aerobic	Describes life, processes, or conditions that require the presence of oxygen.
Assessment Database (ADB)	The ADB is a relational database application designed for the U.S. Environmental Protection Agency for tracking water quality assessment data, such as use attainment and causes and sources of impairment. States need to track this information and many other types of assessment data for thousands of waterbodies, and integrate it into meaningful reports. The ADB is designed to make this process accurate, straightforward, and user-friendly for participating states, territories, tribes, and basin commissions.
Adfluvial	Describes fish whose life history involves seasonal migration from lakes to streams for spawning.
Adjunct	In the context of water quality, adjunct refers to areas directly adjacent to focal or refuge habitats that have been degraded by human or natural disturbances and do not presently support high diversity or abundance of native species.

Alevin	A newly hatched, incompletely developed fish (usually a salmonid) still in nest or inactive on the bottom of a waterbody, living off stored yolk.
Algae	Non-vascular (without water-conducting tissue) aquatic plants that occur as single cells, colonies, or filaments.
Alluvium	Unconsolidated recent stream deposition.
Ambient	General conditions in the environment. In the context of water quality, ambient waters are those representative of general conditions, not associated with episodic perturbations, or specific disturbances such as a wastewater outfall (Armantrout 1998, EPA 1996).
Anadromous	Fish, 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.
Anaerobic	Describes the processes that occur in the absence of molecular oxygen and describes the condition of water that is devoid of molecular oxygen.
Anoxia	The condition of oxygen absence or deficiency.
Anthropogenic	Relating to, or resulting from, the influence of human beings on nature.
Anti-Degradation	Refers to the U.S. Environmental Protection Agency's interpretation of the Clean Water Act goal that states and tribes maintain, as well as restore, water quality. This applies to waters that meet or are of higher water quality than required by state standards. State rules provide that the quality of those high quality waters may be lowered only to allow important social or economic development and only after adequate public participation (IDAPA 58.01.02.051). In all cases, the existing beneficial uses must be maintained. State rules further define lowered water quality to be 1) a measurable change, 2) a change adverse to a use, and 3) a change in a pollutant relevant to the water's uses (IDAPA 58.01.02.003.56).
Aquatic	Occurring, growing, or living in water.
Aquifer	An underground, water-bearing layer or stratum of permeable rock, sand, or gravel capable of yielding of water to wells or springs.
Assemblage (aquatic)	An association of interacting populations of organisms in a given waterbody; for example, a fish assemblage, or a benthic macroinvertebrate assemblage (also see Community) (EPA 1996).
Assimilative Capacity	The ability to process or dissipate pollutants without ill effect to beneficial uses.
Autotrophic	An organism is considered autotrophic if it uses carbon dioxide as its main source of carbon. This most commonly happens through photosynthesis.

Batholith	A large body of intrusive igneous rock that has more than 40 square miles of surface exposure and no known floor. A batholith usually consists of coarse-grained rocks such as granite.
Bedload	Material (generally sand-sized or larger sediment) that is carried along the streambed by rolling or bouncing.
Beneficial Use	Any of the various uses of water, including, but not limited to, aquatic biota, recreation, water supply, wildlife habitat, and aesthetics, which are recognized in water quality standards.
Beneficial Use Reconnaissance Program (BURP)	A program for conducting systematic biological and physical habitat surveys of waterbodies in Idaho. BURP protocols address lakes, reservoirs, and wadeable streams and rivers
Benthic	Pertaining to or living on or in the bottom sediments of a waterbody
Benthic Organic Matter.	The organic matter on the bottom of a waterbody.
Benthos	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 lake and stream bottoms.
Best Management Practices (BMPs)	Structural, nonstructural, and managerial techniques that are effective and practical means to control nonpoint source pollutants.
Best Professional Judgment	A conclusion and/or interpretation derived by a trained and/or technically competent individual by applying interpretation and synthesizing information.
Biochemical Oxygen Demand (BOD)	The amount of dissolved oxygen used by organisms during the decomposition (respiration) of organic matter, expressed as mass of oxygen per volume of water, over some specified period of time.
Biological Integrity	1) The condition of an aquatic community inhabiting unimpaired waterbodies of a specified habitat as measured by an evaluation of multiple attributes of the aquatic biota (EPA 1996). 2) The ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to the natural habitats of a region (Karr 1991).
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 expressed as grams per square meter.
Biota	The animal and plant life of a given region.
Biotic	A term applied to the living components of an area.

Clean Water Act (CWA) — The Federal Water Pollution Control Act (commonly known as the Clean Water Act), as last reauthorized by the Water Quality Act of 1987, establishes a process for states to use to develop information on, and control the quality of, the nation's water resources.

Coliform Bacteria — A group of bacteria predominantly inhabiting the intestines of humans and animals but also found in soil. Coliform bacteria are commonly used as indicators of the possible presence of pathogenic organisms (also see Fecal Coliform Bacteria).

Colluvium — Material transported to a site by gravity.

Community — A group of interacting organisms living together in a given place.

Conductivity — The ability of an aqueous solution to carry electric current, expressed in micro (μ) mhos/cm at 25 °C. Conductivity is affected by dissolved solids and is used as an indirect measure of total dissolved solids in a water sample.

Cretaceous — The final period of the Mesozoic era (after the Jurassic and before the Tertiary period of the Cenozoic era), thought to have covered the span of time between 135 and 65 million years ago.

Criteria — In the context of water quality, numeric or descriptive factors taken into account in setting standards for various pollutants. These factors are used to determine limits on allowable concentration levels, and to limit the number of violations per year. EPA develops criteria guidance; states establish criteria.

Cubic Feet per Second — A unit of measure for the rate of flow or discharge of water. One cubic foot per second is the rate of flow of a stream with a cross-section of one square foot flowing at a mean velocity of one foot per second. At a steady rate, once cubic foot per second is equal to 448.8 gallons per minute and 10,984 acre-feet per day.

Cultural Eutrophication — The process of eutrophication that has been accelerated by human-caused influences. Usually seen as an increase in nutrient loading (also see Eutrophication).

Culturally Induced Erosion — Erosion caused by increased runoff or wind action due to the work of humans in deforestation, cultivation of the land, overgrazing, and disturbance of natural drainages; the excess of erosion over the normal for an area (also see Erosion).

Debris Torrent — The sudden down slope movement of soil, rock, and vegetation on steep slopes, often caused by saturation from heavy rains.

Decomposition	The breakdown of organic molecules (e.g., sugar) to inorganic molecules (e.g., carbon dioxide and water) through biological and nonbiological processes.
Depth Fines	Percent by weight of particles of small size within a vertical core of volume of a streambed or lake bottom sediment. The upper size threshold for fine sediment for fisheries purposes varies from 0.8 to 6.5 mm depending on the observer and methodology used. The depth sampled varies but is typically about one foot (30 cm).
Designated Uses	Those water uses identified in state water quality standards that must be achieved and maintained as required under the Clean Water Act.
Discharge	The amount of water flowing in the stream channel at the time of measurement. Usually expressed as cubic feet per second (cfs).
Dissolved Oxygen (DO)	The oxygen dissolved in water. Adequate DO is vital to fish and other aquatic life.
Disturbance	Any event or series of events that disrupts ecosystem, community, or population structure and alters the physical environment.
E. coli	Short for *Escherichia Coli*, *E. coli* are a group of bacteria that are a subspecies of coliform bacteria. Most *E. coli* are essential to the healthy life of all warm-blooded animals, including humans. Their presence is often indicative of fecal contamination.
Ecology	The scientific study of relationships between organisms and their environment; also defined as the study of the structure and function of nature.
Ecological Indicator	A characteristic of an ecosystem that is related to, or derived from, a measure of a biotic or abiotic variable that can provide quantitative information on ecological structure and function. An indicator can contribute to a measure of integrity and sustainability. Ecological indicators are often used within the multimetric index framework.
Ecological Integrity	The condition of an unimpaired ecosystem as measured by combined chemical, physical (including habitat), and biological attributes (EPA 1996).
Ecosystem	The interacting system of a biological community and its non-living (abiotic) environmental surroundings.
Effluent	A discharge of untreated, partially treated, or treated wastewater into a receiving waterbody.
Endangered Species	Animals, birds, fish, plants, or other living organisms threatened with imminent extinction. Requirements for declaring a species as endangered are contained in the Endangered Species Act.

Environment	The complete range of external conditions, physical and biological, that affect a particular organism or community.
Eocene	An epoch of the early Tertiary period, after the Paleocene and before the Oligocene.
Eolian	Windblown, referring to the process of erosion, transport, and deposition of material by the wind.
Ephemeral Stream	A stream or portion of a stream that flows only in direct response to precipitation. It receives little or no water from springs and no long continued supply from melting snow or other sources. Its channel is at all times above the water table. (American Geologic Institute 1962).
Erosion	The wearing away of areas of the earth's surface by water, wind, ice, and other forces.
Eutrophic	From Greek for "well nourished," this describes a highly productive body of water in which nutrients do not limit algal growth. It is typified by high algal densities and low clarity.
Eutrophication	1) Natural process of maturing (aging) in a body of water. 2) The natural and human-influenced process of enrichment with nutrients, especially nitrogen and phosphorus, leading to an increased production of organic matter.
Exceedance	A violation (according to DEQ policy) of the pollutant levels permitted by water quality criteria.
Existing Beneficial Use or Existing Use	A beneficial use actually attained in waters on or after November 28, 1975, whether or not the use is designated for the waters in Idaho's *Water Quality Standards and Wastewater Treatment Requirements* (IDAPA 58.01.02).
Exotic Species	A species that is not native (indigenous) to a region.
Extrapolation	Estimation of unknown values by extending or projecting from known values.
Fauna	Animal life, especially the animals characteristic of a region, period, or special environment.
Fecal Coliform Bacteria	Bacteria found in the intestinal tracts of all warm-blooded animals or mammals. Their presence in water is an indicator of pollution and possible contamination by pathogens (also see Coliform Bacteria).
Fecal Streptococci	A species of spherical bacteria including pathogenic strains found in the intestines of warm-blooded animals.
Feedback Loop	In the context of watershed management planning, a feedback loop is a process that provides for tracking progress toward goals and revising actions according to that progress.
Fixed-Location Monitoring	Sampling or measuring environmental conditions continuously or repeatedly at the same location.

Flow	See Discharge.
Fluvial	In fisheries, this describes fish whose life history takes place entirely in streams but migrate to smaller streams for spawning.
Focal	Critical areas supporting a mosaic of high quality habitats that sustain a diverse or unusually productive complement of native species.
Fully Supporting	In compliance with water quality standards and within the range of biological reference conditions for all designated and exiting beneficial uses as determined through the *Water Body Assessment Guidance* (DEQ 2002).
Fully Supporting Cold Water	Reliable data indicate functioning, sustainable cold water biological assemblages (e.g., fish, macroinvertebrates, or algae), none of which have been modified significantly beyond the natural range of reference conditions (EPA 1997).
Fully Supporting but Threatened	An intermediate assessment category describing waterbodies that fully support beneficial uses, but have a declining trend in water quality conditions, which if not addressed, will lead to a "not fully supporting" status.
Geographical Information Systems (GIS)	A georeferenced database.
Geometric Mean	A back-transformed mean of the logarithmically transformed numbers often used to describe highly variable, right-skewed data (a few large values), such as bacterial data.
Grab Sample	A single sample collected at a particular time and place. It may represent the composition of the water in that water column.
Gradient	The slope of the land, water, or streambed surface.
Ground Water	Water found beneath the soil surface saturating the layer in which it is located. Most ground water originates as rainfall, is free to move under the influence of gravity, and usually emerges again as stream flow.
Growth Rate	A measure of how quickly something living will develop and grow, such as the amount of new plant or animal tissue produced per a given unit of time, or number of individuals added to a population.
Habitat	The living place of an organism or 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 (also see Watershed).

Hydrologic Cycle	The cycling of water from the atmosphere to the earth (precipitation) and back to the atmosphere (evaporation and plant transpiration). Atmospheric moisture, clouds, rainfall, runoff, surface water, ground water, and water infiltrated in soils are all part of the hydrologic cycle.
Hydrologic Unit	One of a nested series of numbered and named watersheds arising from a national standardization of watershed delineation. The initial 1974 effort (USGS 1987) described four levels (region, subregion, accounting unit, cataloging unit) of watersheds throughout the United States. The fourth level is uniquely identified by an eight-digit code built of two-digit fields for each level in the classification. Originally termed a cataloging unit, fourth field hydrologic units have been more commonly called subbasins. Fifth and sixth field hydrologic units have since been delineated for much of the country and are known as watershed and sub-watersheds, respectively.
Hydrologic Unit Code (HUC)	The number assigned to a hydrologic unit. Often used to refer to fourth field hydrologic units.
Hydrology	The science dealing with the properties, distribution, and circulation of water.
Impervious	Describes a surface, such as pavement, that water cannot penetrate.
Influent	A tributary stream.
Inorganic	Materials not derived from biological sources.
Instantaneous	A condition or measurement at a moment (instant) in time.
Intergravel Dissolved Oxygen	The concentration of dissolved oxygen within spawning gravel. Consideration for determining spawning gravel includes species, water depth, velocity, and substrate.
Intermittent Stream	1) A stream that flows only part of the year, such as when the ground water table is high or when the stream receives water from springs or from surface sources such as melting snow in mountainous areas. The stream ceases to flow above the streambed when losses from evaporation or seepage exceed the available stream flow. 2) A stream that has a period of zero flow for at least one week during most years.
Interstate Waters	Waters that flow across or form part of state or international boundaries, including boundaries with Indian nations.
Irrigation Return Flow	Surface (and subsurface) water that leaves a field following the application of irrigation water and eventually flows into streams.

Key Watershed	A watershed that has been designated in Idaho Governor Batt's *State of Idaho Bull Trout Conservation Plan* (1996) as critical to the long-term persistence of regionally important trout populations.
Knickpoint	Any interruption or break of slope.
Land Application	A process or activity involving application of wastewater, surface water, or semi-liquid material to the land surface for the purpose of treatment, pollutant removal, or ground water recharge.
Limiting Factor	A chemical or physical condition that determines the growth potential of an organism. This can result in a complete inhibition of growth, but typically results in less than maximum growth rates.
Limnology	The scientific study of fresh water, especially the history, geology, biology, physics, and chemistry of lakes.
Load Allocation (LA)	A portion of a waterbody's load capacity for a given pollutant that is given to a particular nonpoint source (by class, type, or geographic area).
Load(ing)	The quantity of a substance entering a receiving stream, usually expressed in pounds or kilograms per day or tons per year. Loading is the product of flow (discharge) and concentration.
Loading Capacity (LC)	A determination of how much pollutant a waterbody can receive over a given period without causing violations of state water quality standards. Upon allocation to various sources, and a margin of safety, it becomes a total maximum daily load.
Loam	Refers to a soil with a texture resulting from a relative balance of sand, silt, and clay. This balance imparts many desirable characteristics for agricultural use.
Loess	A uniform wind-blown deposit of silty material. Silty soils are among the most highly erodible.
Lotic	An aquatic system with flowing water such as a brook, stream, or river where the net flow of water is from the headwaters to the mouth.
Luxury Consumption	A phenomenon in which sufficient nutrients are available in either the sediments or the water column of a waterbody, such that aquatic plants take up and store an abundance in excess of the plants' current needs.
Macroinvertebrate	An invertebrate animal (without a backbone) large enough to be seen without magnification and retained by a 500µm mesh (U.S. #30) screen.

Macrophytes	Rooted and floating vascular aquatic plants, commonly referred to as water weeds. These plants usually flower and bear seeds. Some forms, such as duckweed and coontail (*Ceratophyllum sp.*), are free-floating forms not rooted in sediment.
Margin of Safety (MOS)	An implicit or explicit portion of a waterbody's loading capacity set aside to allow the uncertainly about the relationship between the pollutant loads and the quality of the receiving waterbody. This is a required component of a total maximum daily load (TMDL) and is often incorporated into conservative assumptions used to develop the TMDL (generally within the calculations and/or models). The MOS is not allocated to any sources of pollution.
Mass Wasting	A general term for the down slope movement of soil and rock material under the direct influence of gravity.
Mean	Describes the central tendency of a set of numbers. The arithmetic mean (calculated by adding all items in a list, then dividing by the number of items) is the statistic most familiar to most people.
Median	The middle number in a sequence of numbers. If there are an even number of numbers, the median is the average of the two middle numbers. For example, 4 is the median of 1, 2, 4, 14, 16; and 6 is the median of 1, 2, 5, 7, 9, 11.
Metric	1) A discrete measure of something, such as an ecological indicator (e.g., number of distinct taxon). 2) The metric system of measurement.
Milligrams per liter (mg/L)	A unit of measure for concentration in water, essentially equivalent to parts per million (ppm).
Million gallons per day (MGD)	A unit of measure for the rate of discharge of water, often used to measure flow at wastewater treatment plants. One MGD is equal to 1.547 cubic feet per second.
Miocene	Of, relating to, or being an epoch of, the Tertiary between the Pliocene and the Oligocene periods, or the corresponding system of rocks.
Monitoring	A periodic or continuous measurement of the properties or conditions of some medium of interest, such as monitoring a waterbody.
Mouth	The location where flowing water enters into a larger waterbody.
National Pollution Discharge Elimination System (NPDES)	A national program established by the Clean Water Act for permitting point sources of pollution. Discharge of pollution from point sources is not allowed without a permit.
Natural Condition	A condition indistinguishable from that without human-caused disruptions.

Nitrogen	An element essential to plant growth, and thus is considered a nutrient.
Nodal	Areas that are separated from focal and adjunct habitats, but serve critical life history functions for individual native fish.
Nonpoint Source	A dispersed source of pollutants, generated from a geographical area when pollutants are dissolved or suspended in runoff and then delivered into waters of the state. Nonpoint sources are without a discernable point or origin. They include, but are not limited to, irrigated and non-irrigated lands used for grazing, crop production, and silviculture; rural roads; construction and mining sites; log storage or rafting; and recreation sites.
Not Assessed (NA)	A concept and an assessment category describing waterbodies that have been studied, but are missing critical information needed to complete an assessment.
Not Attainable	A concept and an assessment category describing waterbodies that demonstrate characteristics that make it unlikely that a beneficial use can be attained (e.g., a stream that is dry but designated for salmonid spawning).
Not Fully Supporting	Not in compliance with water quality standards or not within the range of biological reference conditions for any beneficial use as determined through the *Water Body Assessment Guidance* (DEQ 2002).
Not Fully Supporting Cold Water	At least one biological assemblage has been significantly modified beyond the natural range of its reference condition (EPA 1997).
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	Any substance required by living things to grow. An element or its chemical forms essential to life, such as carbon, oxygen, nitrogen, and phosphorus. Commonly refers to those elements in short supply, such as nitrogen and phosphorus, which usually limit growth.
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	The Greek term for "poorly nourished." This describes a body of water in which productivity is low and nutrients are limiting to algal growth, as typified by low algal density and high clarity.
Organic Matter	Compounds manufactured by plants and animals that contain principally carbon.

Orthophosphate	A form of soluble inorganic phosphorus most readily used for algal growth.
Oxygen-Demanding Materials	Those materials, mainly organic matter, in a waterbody that consume oxygen during decomposition.
Parameter	A variable, measurable property whose value is a determinant of the characteristics of a system, such as temperature, dissolved oxygen, and fish populations are parameters of a stream or lake.
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. Also the separation of a chemical into two or more phases, such as partitioning of phosphorus between the water column and sediment.
Pathogens	Disease-producing organisms (e.g., bacteria, viruses, parasites).
Perennial Stream	A stream that flows year-around in most years.
Periphyton	Attached microflora (algae and diatoms) growing on the bottom of a waterbody or on submerged substrates, including larger plants.
Pesticide	Substances or mixtures of substances intended for preventing, destroying, repelling, or mitigating any pest. Also, any substance or mixture intended for use as a plant regulator, defoliant, or desiccant.
pH	The negative $\log_{10}$ of the concentration of hydrogen ions, a measure which in water ranges from very acid (pH=1) to very alkaline (pH=14). A pH of 7 is neutral. Surface waters usually measure between pH 6 and 9.
Phased TMDL	A total maximum daily load (TMDL) that identifies interim load allocations and details further monitoring to gauge the 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, a refinement of load allocations, wasteload allocations, and the margin of safety is planned at the outset.
Phosphorus	An element essential to plant growth, often in limited supply, and thus considered a nutrient.
Physiochemical	In the context of bioassessment, the term is commonly used to mean the physical and chemical factors of the water column that relate to aquatic biota. Examples in bioassessment usage include saturation of dissolved gases, temperature, pH, conductivity, dissolved or suspended solids, forms of nitrogen, and phosphorus. This term is used interchangeable with the terms “physical/chemical” and “physicochemical.”

Plankton	Microscopic algae (phytoplankton) and animals (zooplankton) that float freely in open water of lakes and oceans.
Point Source	A source of pollutants characterized by having a discrete conveyance, such as a pipe, ditch, or other identifiable "point" of discharge into a receiving water. Common point sources of pollution are industrial and municipal wastewater.
Pollutant	Generally, any substance introduced into the environment that adversely affects the usefulness of a resource or the health of humans, animals, or ecosystems.
Pollution	A very broad concept that encompasses human-caused changes in the environment which alter the functioning of natural processes and produce undesirable environmental and health effects. This includes human-induced alteration of the physical, biological, chemical, and radiological integrity of water and other media.
Population	A group of interbreeding organisms occupying a particular space; the number of humans or other living creatures in a designated area.
Pretreatment	The reduction in the amount of pollutants, elimination of certain pollutants, or alteration of the nature of pollutant properties in wastewater prior to, or in lieu of, discharging or otherwise introducing such wastewater into a publicly owned wastewater treatment plant.
Primary Productivity	The rate at which algae and macrophytes fix carbon dioxide using light energy. Commonly measured as milligrams of carbon per square meter per hour.
Protocol	A series of formal steps for conducting a test or survey.
Qualitative	Descriptive of kind, type, or direction.
Quality Assurance (QA)	A program organized and designed to provide accurate and precise results. Included are the selection of proper technical methods, tests, or laboratory procedures; sample collection and preservation; the selection of limits; data evaluation; quality control; and personnel qualifications and training. The goal of QA is to assure the data provided are of the quality needed and claimed (Rand 1995, EPA 1996).
Quality Control (QC)	Routine application of specific actions required to provide information for the quality assurance program. Included are standardization, calibration, and replicate samples. QC is implemented at the field or bench level (Rand 1995, EPA 1996).
Quantitative	Descriptive of size, magnitude, or degree.
Reach	A stream section with fairly homogenous physical characteristics.

Reconnaissance	An exploratory or preliminary survey of an area.
Reference	A physical or chemical quantity whose value is known, and thus is used to calibrate or standardize instruments.
Reference Condition	1) A condition that fully supports applicable beneficial uses with little affect from human activity and represents the highest level of support attainable. 2) A benchmark for populations of aquatic ecosystems used to describe desired conditions in a biological assessment and acceptable or unacceptable departures from them. The reference condition can be determined through examining regional reference sites, historical conditions, quantitative models, and expert judgment (Hughes 1995).
Reference Site	A specific locality on a waterbody that is minimally impaired and is representative of reference conditions for similar waterbodies.
Representative Sample	A portion of material or water that is as similar in content and consistency as possible to that in the larger body of material or water being sampled.
Resident	A term that describes fish that do not migrate.
Respiration	A process by which organic matter is oxidized by organisms, including plants, animals, and bacteria. The process converts organic matter to energy, carbon dioxide, water, and lesser constituents.
Riffle	A relatively shallow, gravelly area of a streambed with a locally fast current, recognized by surface choppiness. Also an area of higher streambed gradient and roughness.
Riparian	Associated with aquatic (stream, river, lake) habitats. Living or located on the bank of a waterbody.
Riparian Habitat Conservation Area (RHCA)	A U.S. Forest Service description of land within the following number of feet up-slope of each of the banks of streams: - 300 feet from perennial fish-bearing streams - 150 feet from perennial non-fish-bearing streams - 100 feet from intermittent streams, wetlands, and ponds in priority watersheds.
River	A large, natural, or human-modified stream that flows in a defined course or channel, or a series of diverging and converging channels.
Runoff	The portion of rainfall, melted snow, or irrigation water that flows across the surface, through shallow underground zones (interflow), and through ground water to creates streams.
Sediments	Deposits of fragmented materials from weathered rocks and organic material that were suspended in, transported by, and eventually deposited by water or air.

Settleable Solids	The volume of material that settles out of one liter of water in one hour.
Species	1) A reproductively isolated aggregate of interbreeding organisms having common attributes and usually designated by a common name. 2) An organism belonging to such a category.
Spring	Ground water seeping out of the earth where the water table intersects the ground surface.
Stagnation	The absence of mixing in a waterbody.
Stenothermal	Unable to tolerate a wide temperature range.
Stratification	A Department of Environmental Quality classification method used to characterize comparable units (also called classes or strata).
Stream	A natural water course containing flowing water, at least part of the year. Together with dissolved and suspended materials, a stream normally supports communities of plants and animals within the channel and the riparian vegetation zone.
Stream Order	Hierarchical ordering of streams based on the degree of branching. A first-order stream is an unforked or unbranched stream. Under Strahler's (1957) system, higher order streams result from the joining of two streams of the same order.
Storm Water Runoff	Rainfall that quickly runs off the land after a storm. In developed watersheds the water flows off roofs and pavement into storm drains that may feed quickly and directly into the stream. The water often carries pollutants picked up from these surfaces.
Stressors	Physical, chemical, or biological entities that can induce adverse effects on ecosystems or human health.
Subbasin	A large watershed of several hundred thousand acres. This is the name commonly given to 4th field hydrologic units (also see Hydrologic Unit).
Subbasin Assessment (SBA)	A watershed-based problem assessment that is the first step in developing a total maximum daily load in Idaho.
Sub-watershed	A smaller watershed area delineated within a larger watershed, often for purposes of describing and managing localized conditions. Also proposed for adoption as the formal name for 6th field hydrologic units.
Surface Fines	Sediments of small size deposited on the surface of a streambed or lake bottom. The upper size threshold for fine sediment for fisheries purposes varies from 0.8 to 605 mm depending on the observer and methodology used. Results are typically expressed as a percentage of observation points with fine sediment.

Surface Runoff	Precipitation, snow melt, or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions; a major transporter of nonpoint source pollutants in rivers, streams, and lakes. Surface runoff is also called overland flow.
Surface Water	All water naturally open to the atmosphere (rivers, lakes, reservoirs, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other collectors that are directly influenced by surface water.
Suspended Sediments	Fine material (usually sand size or smaller) that remains suspended by turbulence in the water column until deposited in areas of weaker current. These sediments cause turbidity and, when deposited, reduce living space within streambed gravels and can cover fish eggs or alevins.
Taxon	Any formal taxonomic unit or category of organisms (e.g., species, genus, family, order). The plural of taxon is taxa (Armantrout 1998).
Tertiary	An interval of geologic time lasting from 66.4 to 1.6 million years ago. It constitutes the first of two periods of the Cenozoic Era, the second being the Quaternary. The Tertiary has five subdivisions, which from oldest to youngest are the Paleocene, Eocene, Oligocene, Miocene, and Pliocene epochs.
Thalweg	The center of a stream's current, where most of the water flows.
Threatened Species	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.
Total Maximum Daily Load (TMDL)	A TMDL is a waterbody's loading capacity after it has been allocated among pollutant sources. It can be expressed on a time basis other than daily if appropriate. Sediment loads, for example, are often calculated on an annual bases. TMDL = Loading Capacity = Load Allocation + Wasteload Allocation + Margin of Safety. In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several waterbodies and/or pollutants within a given watershed.
Total Dissolved Solids	Dry weight of all material in solution in a water sample as determined by evaporating and drying filtrate.

Total Suspended Solids (TSS) The dry weight of material retained on a filter after filtration. Filter pore size and drying temperature can vary. American Public Health Association Standard Methods (Greenborg, Clescevi, and Eaton 1995) call for using a filter of 2.0 micron or smaller; a 0.45 micron filter is also often used. This method calls for drying at a temperature of 103-105 °C.

Toxic Pollutants Materials that cause death, disease, or birth defects in organisms that ingest or absorb them. The quantities and exposures necessary to cause these effects can vary widely.

Tributary A stream feeding into a larger stream or lake.

Trophic State The level of growth or productivity of a lake as measured by phosphorus content, chlorophyll *a* concentrations, amount (biomass) of aquatic vegetation, algal abundance, and water clarity.

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Trophic State The level of growth or productivity of a lake as measured by phosphorus content, chlorophyll *a* concentrations, amount (biomass) of aquatic vegetation, algal abundance, and water clarity.

Turbidity A measure of the extent to which light passing through water is scattered by fine suspended materials. The effect of turbidity depends on the size of the particles (the finer the particles, the greater the effect per unit weight) and the color of the particles.

Vadose Zone The unsaturated region from the soil surface to the ground water table.

Wasteload Allocation (WLA) The portion of receiving water’s loading capacity that is allocated to one of its existing or future point sources of pollution. Wasteload allocations specify how much pollutant each point source may release to a waterbody.

Waterbody	A stream, river, lake, estuary, coastline, or other water feature, or portion thereof.
Water Column	Water between the interface with the air at the surface and the interface with the sediment layer at the bottom. The idea derives from a 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; to fish and wildlife; or to domestic, commercial, industrial, recreational, aesthetic, or other beneficial uses.
Water Quality	A term used to describe the biological, chemical, and physical characteristics of water with respect to its suitability for a beneficial use.
Water Quality Criteria	Levels of water quality expected to render a body of water suitable for its designated uses. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, or industrial processes.
Water Quality Limited	A label that describes waterbodies for which one or more water quality criterion is not met or beneficial uses are not fully supported. Water quality limited segments may or may not be on a §303(d) list.
Water Quality Limited Segment (WQLS)	Any segment placed on a state's §303(d) list for failure to meet applicable water quality standards, and/or is not expected to meet applicable water quality standards in the period prior to the next list. These segments are also referred to as "§303(d) listed."
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 prediction of the response of some characteristics of lake or stream water based on mathematical relations of input variables such as climate, stream flow, and inflow water quality.
Water Quality Standards	State-adopted and EPA-approved ambient standards for waterbodies. The standards prescribe the use of the waterbody and establish the water quality criteria that must be met to protect designated uses.
Water Table	The upper surface of ground water; below this point, the soil is saturated with water.

Watershed	1) All the land which contributes runoff to a common point in a drainage network, or to a lake outlet. Watersheds are infinitely nested, and any large watershed is composed of smaller “sub-watersheds.” 2) The whole geographic region which contributes water to a point of interest in a waterbody.
Waterbody Identification Number (WBID)	A number that uniquely identifies a waterbody in Idaho ties in to the Idaho Water Quality Standards and GIS information.
Wetland	An area that is at least some of the time saturated by surface or ground water so as to support with vegetation adapted to saturated soil conditions. Examples include swamps, bogs, fens, and marshes.
Young of the Year	Young fish born the year captured, evidence of spawning activity.

Appendix A. SNOTEL Snow Water Content Graphs

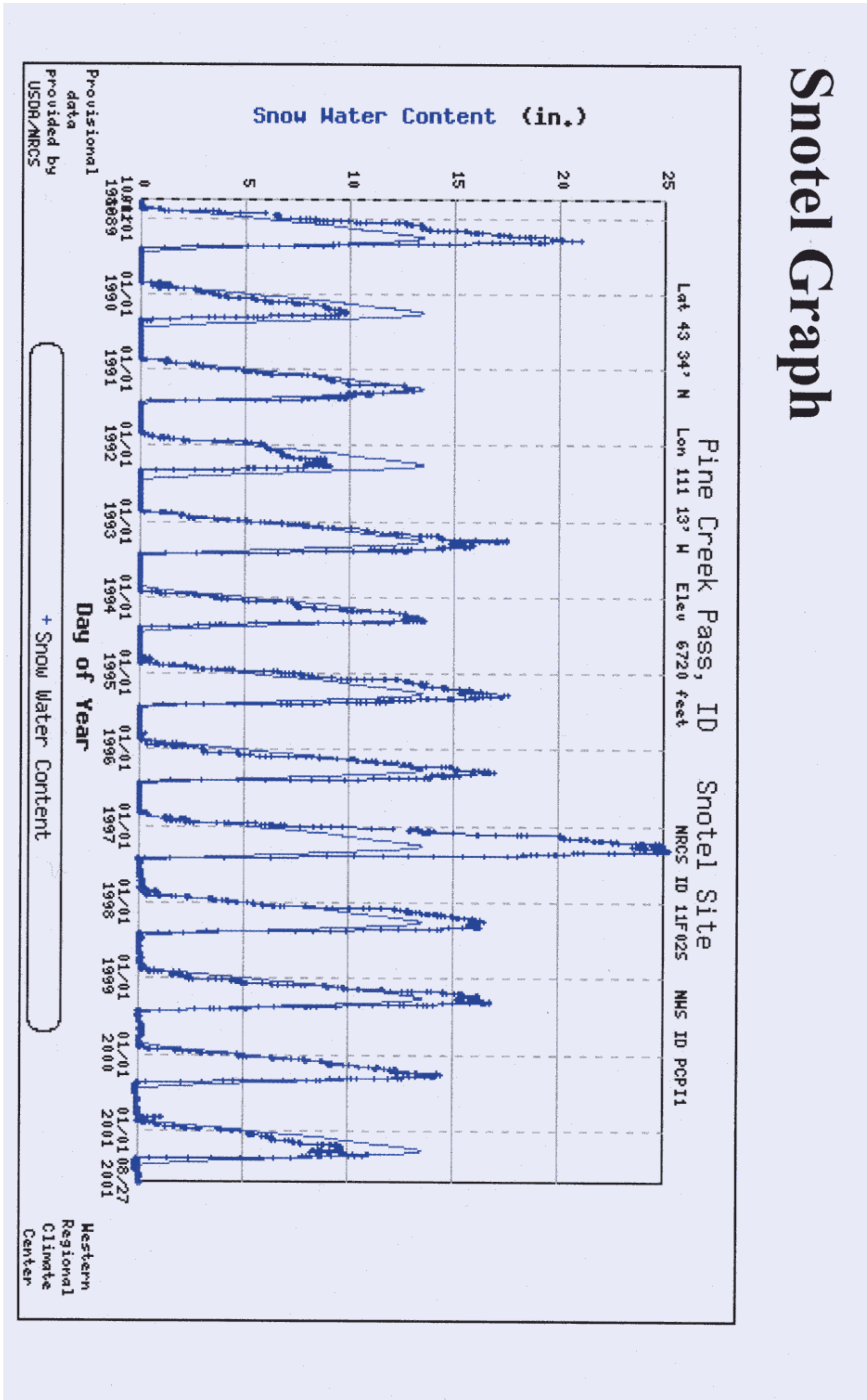

Figure A-1. Snotel Graph for Pine Creek Pass, ID.

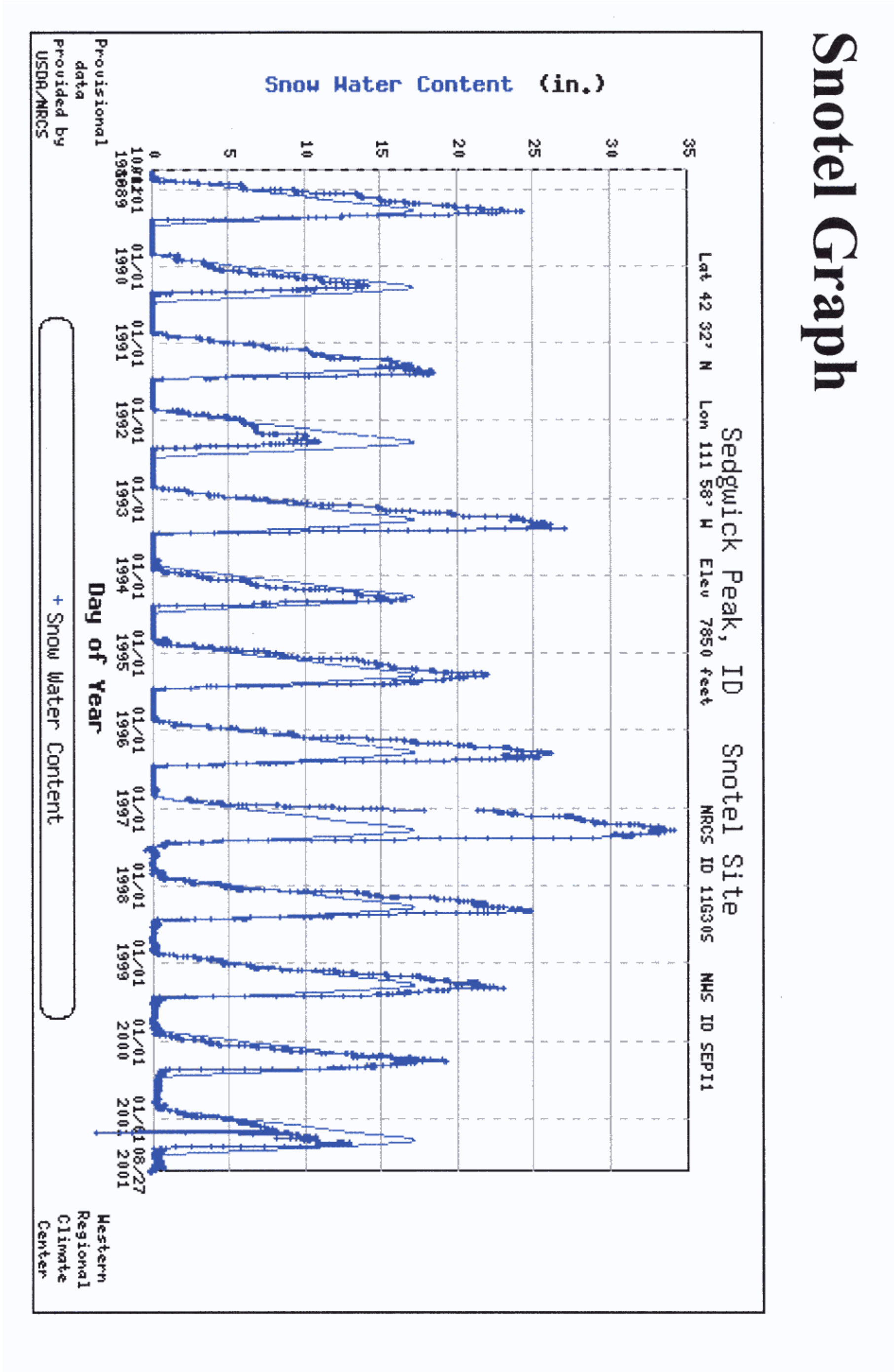

Figure A-2. Snotel Graph for Sedgewick Peak, ID.

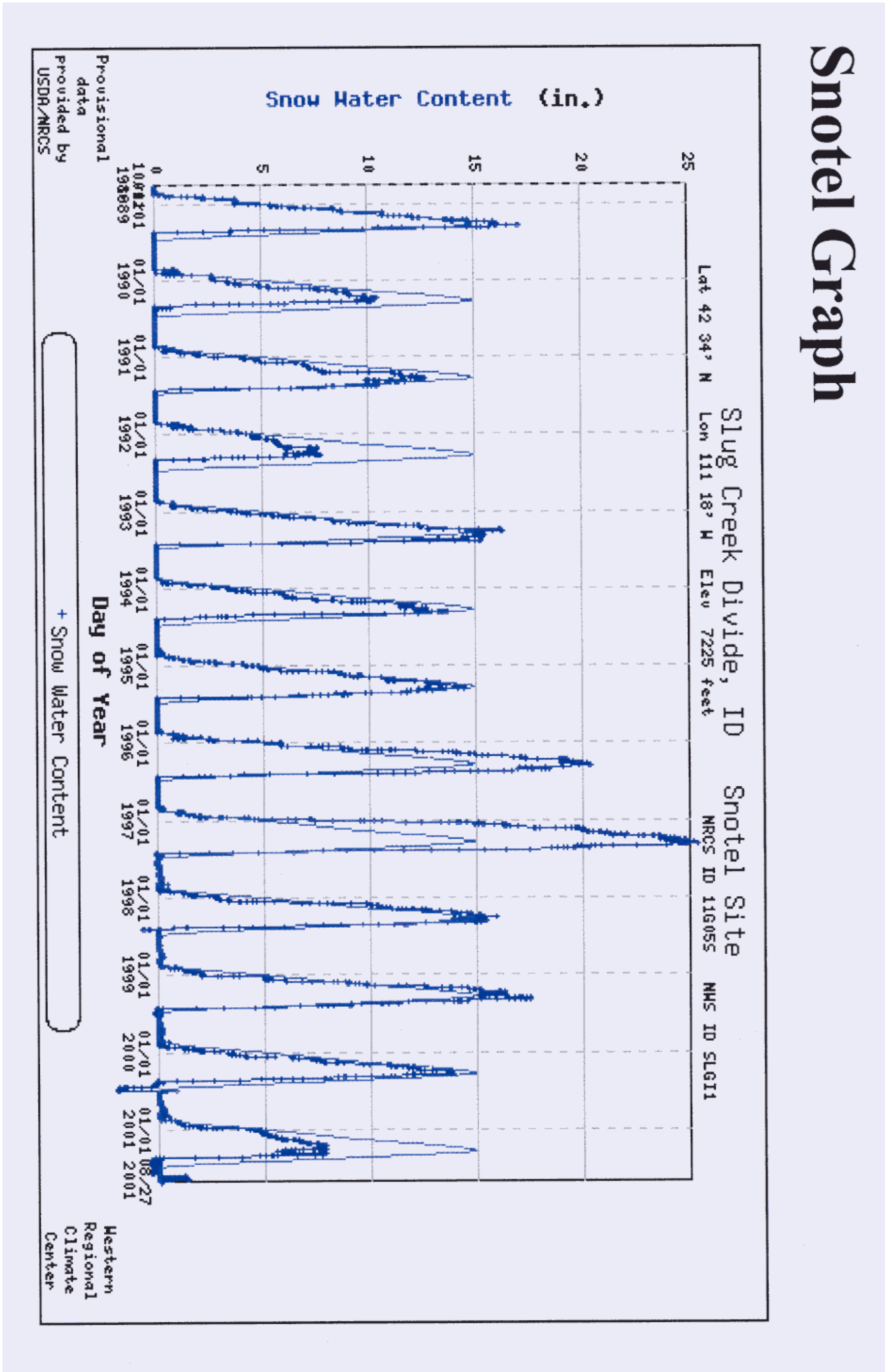

Figure A-3. Snotel Graph for Slug Creek Divide, ID.

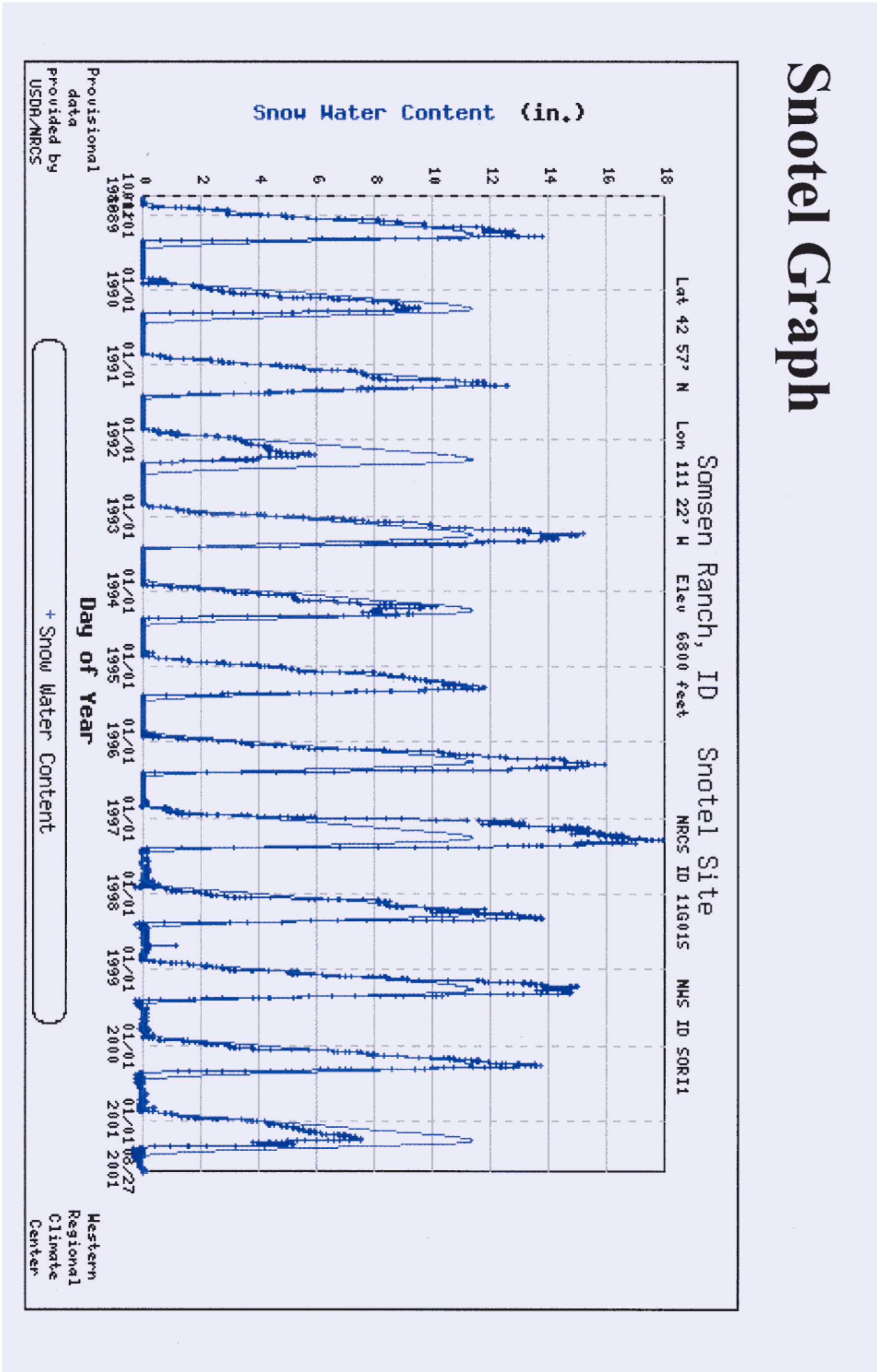

Figure A-4. Snotel Graph for Somsen Ranch, ID.

Appendix B. Stream Characteristics from BURP field data.

Table B-1. Stream Characteristics from BURP field data.

Stream Name	BURP Site ID #	Elevation (ft)	Rosgen Channel Type	Valley Type	Sinuosity	Stream Order	Stream Gradient (%)	% Fines	Width/Depth Ratio
Birch Creek	96-Z041	6120	B	U-Shaped	Moderate	2	3.0	84	15.9
	01-A036*	5920	F	Trough-Like	Low	2	1.5	34	52.6
	96-Z038*	5900	B	U-Shaped	Moderate	2	1.0	71	17.2
	96-Z037	5640	B	Trough-Like	Moderate	2	3.0	97	7.6
Brockman Creek	98-C002	6590	E	V-Shaped	Moderate	1	1.0	80	6.2
	94-17	6420	C	Trough-Like	Moderate	2	2.0	27	11.2
	94-18	6180	C	Trough-Like	Moderate	2	1.0	24	12.7
Bridge Creek	98-D001	6520	G	U-Shaped	Moderate	1	1.5	82	2.7
Buck Creek	96-Y002*	6360	C	U-Shaped	Moderate	1	1.0	70	9.7
	01-A042*	6360	E	Trough-Like	Moderate	1	1.0	74	25.6
Bulls Fork Creek	97-M001	6320	E	U-Shaped	Moderate	2	1.0	99	4.5
	97-L001	5950	F	U-Shaped	Moderate	2	0.5	93	3.2
Canyon Creek	97-L010	6050	C	U-Shaped	Low	1	1.0	83	6.6
Cattle Creek	97-L006	6140	F	Trough-Like	Low	1	1.0	100	15
Clark Creek	97-M007	6440	D	Trough-Like	Braided	2	2.0	75	6.3
Corral Creek	95-A019	6680	C	Trough-Like	High	2	2.0	38	10.8
	01-A039*	6360	E	Trough-Like	Moderate	2	2.0	38	20.7
	94-84*	6360	F	Trough-Like	High	2	2.0	27	17.4
Crane Creek	98-D009	6440	E	Trough-Like	High	1	1.5	89	5.6
	97-M006	6480	E	Trough-Like	High	2	1.2	100	48.3
	97-M005	6335	E	Trough- Like	Moderate	3	1.5	34	24.2
Dan Creek	98-C001	6700	E	U-Shaped	Moderate	1	2.0	84	8.4
	96-Y126	6000	G	Trough-Like	Moderate	2	2.0	87	8.2
Deep Creek	97-L004	5245	B	V-Shaped	Moderate	2	4.0	83	6.4
Eagle Creek North Fork	98-D002	6740	C	U-Shaped	Moderate	2	2.5	38	8.1
Gravel Creek	98-D007	6615	C	U-Shaped	Moderate	1	2.0	56	10.3
	98-D008	6596	B	U-Shaped	Moderate	2	2.0	43	6.4
Grays Lake Outlet	97-M140	6375	C	Trough-Like	Moderate	3	0.3	71	47.6
	97-M141	5960	B	Flat Bottomed	Moderate	3	2.5	26	15.8
	95-B073	5600	B	Trough-Like	Moderate	3	3.5	25	16
	95-B069	5560	B	Trough-Like	Moderate	4	2.5	28	25.7
Hell Creek	94-14	6600		Trough-Like	Moderate	1	3.0	69	20.3
	95-A001	5880	B	Trough-Like	Moderate	3	4.0	42	13.2
	95-A002	5600	B	Trough-Like	Moderate	3	4.5	42	9.7
Homer Creek	95-A018	6000	B	Trough-Like	Moderate	2		22	11.2
Indian Fork Creek	97-M002	5820	E	U-Shaped	Moderate	2	0.9	100	4.3
Lava Creek	94-81	6680	F	Trough-Like	Moderate	1	1.0	32	32.3
	01-A040	6320	C	Trough-Like	Moderate	2	1.0	20	18.2
	94-82	6140	C	Trough-Like	Moderate	2	2.0	12	33.3
Long Valley Creek	97-L008	6225	F	Trough-Like	Moderate	1	1.0	100	7.4

	97-L007	6125	D	Flat Bottomed	Braided	2	1.0	97	9.5
Meadow Creek	98-D005	6180	G	V-Shaped	High	1	2.5	67	3.56
	95-A004	6100	B	Flat Bottomed	Moderate	2	2.5	67	3.7
	96-Z001	5850	B	U-Shaped	Moderate	2	2.0	90	6.4
	96-Y001	5640	B	V-Shaped	Moderate	2	2.0	57	4.5
	95-B002	5240	C	Flat Bottomed	Moderate	2	1.0	92	3.3
Mill Creek	01-A0401	6360	E	U-Shaped	High	2	2.2	50	24.9
	95-B016	6540	C	Trough-Like	High	1	1.1	62	7.7
	95-B014	6320		Trough-Like	High	2	1.9	39	17.6
Mud Creek	97-L009	6540	C	Trough-Like	Moderate	2	1.0	100	4
Mud Spring Creek	98-C003	5560	B	Trough-Like	Low	1	2.5	82	3.5
	97-L003	5250	A	V-Shaped	Low	2	8	69	7.4
Pipe Creek	98-D013	5940	F	U-Shaped	Low	1	2.5	84	11.9
	97-L002	5805	F	Trough-Like	Low	2	1.0	99	3.5
Rock Creek	97-L012	5950	B	U-Shaped	Low	1	2.0	100	8.3
Sawmill Creek	94-15	6480	B	Trough-Like	Moderate	2	3.0	66	44.3
	94-16	6360	B	Trough-Like	High	2	3.0	10	20.9
Sellars Creek	96-Z003	6600	A	U-Shaped	Moderate	1	4.5	96	6.1
	01-A034	6360	C	U-Shaped	Moderate	3	1.0	35	18
	95-B023	6120	C	Flat Bottomed	Moderate	2	1.0	32	19.5
Seventy Creek	95-B015	6640	C	Trough-Like	Moderate	1	1.9	89	8.3
	95-B013	6350	B	Trough-Like	Moderate	2	2.0	49	9.6
Shirley Creek	98-D004	6260	E	U-Shaped	High	2	1.3	51	11.8
Squaw Creek	96-Z039	6220	C	Trough-Like	Moderate	1	1.0	71	9
	96-Z040	6200	B	U-Shaped	Moderate	2	3.0	78	13.9
	01-A035	5720	G	Trough-Like	Low	2	1.0	60	18
Tex Creek	95-A107*	6000	B	Trough-Like	Moderate	3	3.0	52	15.7
	95-A003*	5940	B	Flat Bottomed	Moderate	3	2.0	42	9.5
	95-A106*	5540	B	Flat Bottomed	Moderate	3	3.0	32	24
	95-B001*	5540	C	Flat Bottomed	Moderate	3	2.0	54	7.1
Willow Creek2	97-M008*	6755	B	V-Shaped	Moderate	2	3.0	52	6.9
	98-D003*	6760	C	U-Shaped	Moderate	1	4.0	47	10.1
Willow Creek	97-M004	6525	E	Trough	Moderate	1	1.0	97	10.5
	01-A100*	6200	B	Box Canyon	Low	4	1.5	6	22.1
	97-M003*	6200	B	Box Canyon	Low	4	1.5	52	18.1
	95-B072	5900	B	Trough-Like	Low	4	4.0	20	66.4
	95-B068	5480	B	Trough-Like	Moderate	5	2.0	34	39.6
	95-B049	5300	C	Trough-Like	Moderate	5	1.5	28	19

*= In indicates same approximate location on a different year.

Appendix C. Unit Conversion Chart

Table C-1. Metric - English unit conversions.

	English Units	Metric Units	To Convert	Example
Distance	Miles (mi)	Kilometers (km)	1 mi = 1.61 km 1 km = 0.62 mi	3 mi = 4.83 km 3 km = 1.86 mi
Length	Inches (in) Feet (ft)	Centimeters (cm) Meters (m)	1 in = 2.54 cm 1 cm = 0.39 in 1 ft = 0.30 m 1 m = 3.28 ft	3 in = 7.62 cm 3 cm = 1.18 in 3 ft = 0.91 m 3 m = 9.84 ft
Area	Acres (ac) Square Feet (ft^2) Square Miles (mi^2)	Hectares (ha) Square Meters (m^2) Square Kilometers (km^2)	1 ac = 0.40 ha 1 ha = 2.47 ac 1 ft^2 = 0.09 m^2 1 m^2 = 10.76 ft^2 1 mi^2 = 2.59 km^2 1 km^2 = 0.39 mi^2	3 ac = 1.20 ha 3 ha = 7.41 ac 3 ft^2 = 0.28 m^2 3 m^2 = 32.29 ft^2 3 mi^2 = 7.77 km^2 3 km^2 = 1.16 mi^2
Volume	Gallons (g) Cubic Feet (ft^3)	Liters (L) Cubic Meters (m^3)	1 g = 3.78 l 1 l = 0.26 g 1 ft^3 = 0.03 m^3 1 m^3 = 35.32 ft^3	3 g = 11.35 l 3 l = 0.79 g 3 ft^3 = 0.09 m^3 3 m^3 = 105.94 ft^3
Flow Rate	Cubic Feet per Second (ft^3/sec)[1]	Cubic Meters per Second (m^3/sec)	1 ft^3/sec = 0.03 m^3/sec 1 m^3/sec = ft^3/sec	3 ft^3/sec = 0.09 m^3/sec 3 m^3/sec = 105.94 ft^3/sec
Concentration	Parts per Million (ppm)	Milligrams per Liter (mg/L)	1 ppm = 1 mg/L[2]	3 ppm = 3 mg/L
Weight	Pounds (lbs)	Kilograms (kg)	1 lb = 0.45 kg 1 kg = 2.20 lbs	3 lb = 1.36 kg 3 kg = 6.61 kg
Temperature	Fahrenheit (°F)	Celsius (°C)	°C = 0.55 (F - 32) °F = (C x 1.8) + 32	3 °F = -15.95 °C 3 ° C = 37.4 °F

[1] 1 ft^3/sec = 0.65 million gallons per day; 1 million gallons per day is equal to 1.55 ft^3/sec.
[2] The ratio of 1 ppm = 1 mg/L is approximate and is only accurate for water

Appendix D. State and Site-Specific Standards and Criteria

003. DEFINITIONS.

For the purpose of the rules contained in IDAPA 58.01.02, "Water Quality Standards and Wastewater Treatment Requirements," the following definitions apply: (4-5-00)

01. Acute. Involving a stimulus severe enough to rapidly induce a response; in aquatic toxicity tests, a response measuring lethality observed in ninety-six (96) hours or less is typically considered acute. When referring to human health, an acute effect is not always measured in terms of lethality. (3-20-97)

02. Acute Criteria. Unless otherwise specified in these rules, the maximum instantaneous or one (1) hour average concentration of a toxic substance or effluent which ensures adequate protection of sensitive species of aquatic organisms from acute toxicity resulting from exposure to the toxic substance or effluent. Acute criteria will adequately protect the designated aquatic life use if not exceeded more than once every three (3) years. The terms "acute criteria" and "criterion maximum concentration" (CMC) are equivalent. (3-15-02)

03. Acute Toxicity. The existence of mortality or injury to aquatic organisms resulting from a single or short-term (i.e., ninety-six (96) hours or less) exposure to a substance. As applied to toxicity tests, acute toxicity refers to the response of aquatic test organisms to a concentration of a toxic substance or effluent which results in a LC-50. (3-20-97)

04. Beneficial Use. Any of the various uses which may be made of the water of Idaho, 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. The beneficial use is dependent upon actual use, the ability of the water to support a non-existing use either now or in the future, and its likelihood of being used in a given manner. The use of water for the purpose of wastewater dilution or as a receiving water for a waste treatment facility effluent is not a beneficial use. (8-24-94)

05. Available. Based on public wastewater system size, complexity, and variation in raw waste, a certified wastewater operator must be on site or able to be contacted as needed to initiate the appropriate action for

050. ADMINISTRATIVE POLICY.

01. Apportionment Of Water. The adoption of water quality standards and the enforcement of such standards is not intended to conflict with the apportionment of water to the state through any of the interstate compacts or court decrees, or to interfere with the rights of Idaho appropriators, either now or in the future, in the utilization of the water appropriations which have been granted to them under the statutory procedure, or to interfere with water quality criteria established by mutual agreement of the participants in interstate water pollution control enforcement procedures. (7-1-93)

02. Protection Of Waters Of The State. (7-1-93)

a. Wherever attainable, surface waters of the state shall be protected for beneficial uses which for surface waters includes all recreational use in and on the water surface and the preservation and propagation of desirable species of aquatic life; (4-5-00)

b. In all cases, existing beneficial uses of the waters of the state will be protected. (7-1-93)

03. Annual Program. To fully achieve and maintain water quality in the state, it is the intent of the Department to develop and implement a Continuing Planning Process that describes the on-going planning requirements of the State's Water Quality Management Plan. The Department's planned programs for water pollution control comprise the State's Water Quality Management Plan. (4-5-00)

04. Program Integration. Whenever an activity or class of activities is subject to provisions of these rules, as well as other regulations or standards of either this Department or other Governmental agency, the Department will seek and employ those methods necessary and practicable to integrate the implementation, administration and enforcement of all applicable regulations through a single program. Integration will not, however, be affected to the extent that applicable provisions of these rules would fail to be achieved or maintained unless the Department's role in these cases is limited by state statute or federal law. (7-1-93)

05. Revisions. These rules are subject to amendment as technical data, surveillance programs, and technological advances require. Any revisions made to these rules shall be in accordance with Sections 39-101, et seq., and 67-5201, et seq., Idaho Code. (8-24-94)

053. BENEFICIAL USE SUPPORT STATUS.
In determining whether a water body fully supports designated and existing beneficial uses, the Department shall determine whether all of the applicable water quality standards are being achieved, including any criteria developed pursuant to these rules, and whether a healthy, balanced biological community is present. The Department shall utilize biological and aquatic habitat parameters listed below and in the current version of the "Water Body Assessment Guidance", as published by the Idaho Department of Environmental Quality, as a guide to assist in the assessment of beneficial use status. Revisions to this guidance will made after notice and an opportunity for public comment. These parameters are not to be considered or treated as individual water quality criteria or otherwise interpreted or applied as water quality standards. (4-5-00)

01. Aquatic Habitat Parameters. These parameters may include, but are not limited to, stream width, stream depth, stream shade, measurements of sediment impacts, bank stability, water flows, and other physical characteristics of the stream that affect habitat for fish, macroinvertebrates or other aquatic life; and (3-20-97)

02. Biological Parameters. These parameters may include, but are not limited to, evaluation of aquatic macroinvertebrates including Ephemeroptera, Plecoptera and Trichoptera (EPT), Hilsenhoff Biotic Index, measures of functional feeding groups, and the variety and number of fish or other aquatic life to determine biological community diversity and functionality. (3-20-97)

03. Outstanding Resource Waters. Where high quality waters constitute an outstanding national resource, such as waters of national and state parks and wildlife refuges and waters of exceptional recreational or ecological significance, that water quality shall be maintained and protected from the impacts of point and nonpoint source activities. (3-20-97)

051. ANTIDEGRADATION POLICY.

01. Maintenance Of Existing Uses For All Waters. The existing in stream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected. (7-1-93)

02. High Quality Waters. Where the quality of the waters exceeds levels necessary to support propagation of fish, shellfish and wildlife and recreation in and on the water, that quality shall be maintained and protected unless the Department finds, after full satisfaction of the intergovernmental coordination and public participation provisions of the Department's continuing planning process, that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located. In allowing such degradation or lower water quality, the Department shall assure water quality adequate to protect existing uses fully. Further, the Department shall assure that there shall be achieved the highest statutory and regulatory requirements for all new and existing point sources and cost-effective and reasonable best management practices for nonpoint source control. In providing such assurance, the Department may enter together into an agreement with other state of Idaho or federal agencies in accordance with Sections 67-2326 through 67-2333, Idaho Code. (7-1-93)

100. SURFACE WATER USE DESIGNATIONS.
Waterbodies are designated in Idaho to protect water quality for existing or designated uses. The designated use of a waterbody does not imply any rights to access or ability to conduct any activity related to the use designtion, nor does it imply that an activity is safe. For example, a designation of primary or secondary contact recreation may occur in areas where it is unsafe to enter the water due to water flows, depth or other hazardous conditions. Another example is that aquatic life uses may be designated in areas that are closed to fishing or access is not allowed by property owners. Wherever attainable, the designated beneficial uses for which the surface waters of the state are to be protected include: (3-15-02)

01. Aquatic Life. (7-1-93)

a. Cold water (COLD): water quality appropriate for the protection and maintenance of a viable aquatic life community for cold water species. (4-5-00)

b. Salmonid spawning: waters which provide or could provide a habitat for active self-propagating populations of salmonid fishes. (7-1-93)

c. Seasonal cold water (SC): water quality appropriate for the protection and maintenance of a viable aquatic life community of cool and cold water species, where cold water aquatic life may be absent during, or tolerant of, seasonally warm temperatures. (4-5-00)

d. Warm water (WARM): water quality appropriate for the protection and maintenance of a viable aquatic life community for warm water species. (4-5-00)

e. Modified (MOD): water quality appropriate for an aquatic life community that is limited due to one (1) or more conditions set forth in 40 CFR 131.10(g) which preclude attainment of reference streams or conditions. (4-5-00)

02. Recreation. (7-1-93)

a. Primary contact recreation (PCR): water quality appropriate for prolonged and intimate contact by humans or for recreational activities when the ingestion of small quantities of water is likely to occur. Such activities include, but are not restricted to, those used for swimming, water skiing, or skin diving. (4-5-00)

b. Secondary contact recreation (SCR): water quality appropriate for recreational uses on or about the water and which are not included in the primary contact category. These activities may include fishing, boating, wading, infrequent swimming, and other activities where ingestion of raw water is not likely to occur. (4-5-00)

03. Water Supply. (7-1-93)

a. Domestic: water quality appropriate for drinking water supplies. (4-5-00)

b. Agricultural: water quality appropriate for the irrigation of crops or as drinking water for livestock. This use applies to all surface waters of the state. (4-5-00)

c. Industrial: water quality appropriate for industrial water supplies. This use applies to all surface waters of the state. (4-5-00)

04. Wildlife Habitats. Water quality appropriate for wildlife habitats. This use applies to all surface waters of the state. (4-5-00)

05. Aesthetics. This use applies to all surface waters of the state. (7-1-93)

101. NONDESIGNATED SURFACE WATERS.

01. Undesignated Surface Waters. Surface waters not designated in Sections 110 through 160 shall be designated according to Section 39-3604, Idaho Code, taking into consideration the use of the surface water and such physical, geological, chemical, and biological measures as may affect the surface water. Prior to designation, undesignated waters shall be protected for beneficial uses, which includes all recreational use in and on the water and the protection and propagation of fish, shellfish, and wildlife, wherever attainable. (3-23-98)

a. Because the Department presumes most waters in the state will support cold water aquatic life and primary or secondary contact recreation beneficial uses, the Department will apply cold water aquatic life and primary or secondary contact recreation criteria to undesignated waters unless Sections 101.01.b and 101.01c. are followed. (4-5-00)

b. During the review of any new or existing activity on an undesignated water, the Department may examine all relevant data or may require the gathering of relevant data on beneficial uses; pending determination in Section 101.01.c. existing activities will be allowed to continue. (3-23-98)

c. If, after review and public notice of relevant data, it is determined that beneficial uses in addition to or other than cold water aquatic life and primary or secondary contact recreation are appropriate, then the Department will: (4-5-00)

i. Complete the review and compliance determination of the activity in context with the new information on beneficial uses, and (3-23-98)

ii. Initiate rulemaking necessary to designate the undesignated water, including providing all necessary data and information to support the proposed designation. (3-23-98)

02. Man-Made Waterways. Unless designated in Sections 110 through 160, man-made waterways are to be protected for the use for which they were developed. (7-1-93)

03. Private Waters. Unless designated in Sections 110 through 160, lakes, ponds, pools, streams and springs outside public lands but located wholly and entirely upon a person's land are not protected specifically or generally for any beneficial use. (7-1-93)

250. SURFACE WATER QUALITY CRITERIA FOR AQUATIC LIFE USE DESIGNATIONS.

01. General Criteria. The following criteria apply to all aquatic life use designations. Surface waters are not to vary from the following characteristics due to human activities: (3-15-02)

a. Hydrogen Ion Concentration (pH) values within the range of six point five (6.5) to nine point zero (9.0); (3-30-01)

b. The total concentration of dissolved gas not exceeding one hundred and ten percent (110%) of saturation at atmospheric pressure at the point of sample collection; (7-1-93)

02. Cold Water. Waters designated for cold water aquatic life are not to vary from the following characteristics due to human activities: (3-15-02)

a. Dissolved Oxygen Concentrations exceeding six (6) mg/l at all times. In lakes and reservoirs this standard does not apply to: (7-1-93)

i. The bottom twenty percent (20%) of water depth in natural lakes and reservoirs where depths are thirty-five (35) meters or less. (7-1-93)

ii. The bottom seven (7) meters of water depth in natural lakes and reservoirs where depths are greater than thirty-five (35) meters. (7-1-93)

iii. Those waters of the hypolimnion in stratified lakes and reservoirs. (7-1-93)

b. Water temperatures of twenty-two (22) degrees C or less with a maximum daily average of no greater than nineteen (19) degrees C. (8-24-94)

c. Temperature in lakes shall have no measurable change from natural background conditions. Reservoirs with mean detention times of greater than fifteen (15) days are considered lakes for this purpose. (3-15-02)

d. Ammonia. The following criteria are not to be exceeded dependent upon the temperature, T (degrees C), and pH of the water body: (3-15-02)

251. SURFACE WATER QUALITY CRITERIA FOR RECREATION USE DESIGNATIONS.

01. Primary Contact Recreation. Waters designated for primary contact recreation are not to contain E.coli bacteria significant to the public health in concentrations exceeding: (4-5-00)

a. For areas within waters designated for primary contact recreation that are additionally specified as public swimming beaches, a single sample of two hundred thirty-five (235) E. coli organisms per one hundred (100) ml. For the purpose of this subsection, "specified public swimming beaches" are considered to be indicated by features such as signs, swimming docks, diving boards, slides, or the like, boater exclusion zones, map legends, collection of a fee for beach use, or any other unambiguous invitation to public swimming. Privately owned swimming docks or the like which are not open to the general public are not included in this definition. (3-15-02)

b. For all other waters designated for primary contact recreation, a single sample of four hundred six (406) E.coli organisms per one hundred (100) ml; or (3-15-02)

c. A geometric mean of one hundred twenty-six (126) E.coli organisms per one hundred (100) ml based on a minimum of five (5) samples taken every three (3) to five (5) days over a thirty (30) day period. (4-5-00)

02. Secondary Contact Recreation. Waters designated for secondary contact recreation are not to contain E.coli bacteria significant to the public health in concentrations exceeding: (4-5-00)

a. A single sample of five hundred seventy-six (576) E.coli organisms per one hundred (100) ml; or (4-5-00)

b. A geometric mean of one hundred twenty-six (126) E.coli organisms per one hundred (100) ml based on a minimum of five (5) samples taken every three (3) to five (5) days over a thirty (30) day period. (4-5-00)

Appendix E. Data Sources

Table E-1. Data sources for Willow Creek Subbasin Assessment.

Waterbody	Data Source	Type of Data	When Collected
All	Western Regional Climate Center (www.wrcc.dri.edu)	Climate	Period of Record
All	Agrimet Station Data (www.mac1.usbr.gov/agrimet/location.html)	Air	Period of Record
All	Snotel (www.wrcc.dri.edu)	Snow Water Content	Period of Record
Willow Creek and Grays Lake	USGS (www.waterdata.usgs.gov/id/nwis/peak)	Streamflow	Period of Record
All	NRCS-Idaho Falls, Elliot Traher	Land Use	2003
All	NRCS-Idaho Falls, Elliot Traher	Conservation Programs	2003
Grays Lake	USGS-Idaho Falls, Jay Bateman	Streamflow Data	2002
Grays Lake Outlet, Hell Creek, Homer Creek, Sellars Creek, Tex Creek, and Willow Creek	IDFG-Idaho Falls, Jim Fredericks	Temperature	2001
Brockman Creek and Corral Creek	USFS-Idaho Falls, Lee Left	Temperature	2000-2002
Lava Creek, Long Valley Creek, Mill Creek, Sawmill Creek, and Sellars Creek	DEQ-Idaho Falls, Melissa Thompson	Temperature	2003
Willow Creek, Tex Creek, Grays Lake Outlet, and Hell Creek	BLM-Idaho Falls, Dan Kotanski	Water Quality	1992-2000
Willow Creek, Hell Creek, and Grays Lake Outlet	BLM-Idaho Falls, Dan Kotanski	Nutrient	1994-2000
Birch Creek, Homer Creek, Meadow Creek, Sellars Creek, Grays Lake Outlet, and Willow Creek	IASCD-Pocatello, Christine Fischer	Nutrient, Water Quality	2003
All	DEQ-Idaho Falls, Steve Robinson	BURP Monitoring	1993-2002
Lava Creek, Willow Creek, Sawmill Creek, and Willow Creek	MSE-Boise Idaho for DEQ-Idaho Falls	McNeil Sediment	2001

Grays Lake Outlet, Sellars Creek, and Willow Creek	DEQ-Idaho Falls, Steve Robinson	McNeil Sediment	2003
Brockman Creek, Buck Creek, Corral Creek, Crane Creek, Grays Lake Outlet, Hell Creek, Homer Creek, Lava Creek, Meadow Creek, Sawmill Creek, Seventy Creek, and Willow Creek	MSE-Boise Idaho for DEQ-Idaho Falls	Streambank Erosion Inventory	2001
Seventy Creek, Sellars Creek, Meadow Creek, Brockman Creek, Mill Creek, and Willow Creek	DEQ-Idaho Falls, Melissa Thompson	Streambank Erosion Inventory	2003
See Appendix M	DEQ-Idaho Falls, Steve Robinson	Fish	1996, 1997, 1999, and 2001
See Appendix M	BLM-Idaho Falls, Pat Koelsch	Fish	1985
See Appendix M	USFS-Idaho Falls, Jim Capurso	Fish	2002
See Appendix M	IDFG-Idaho Falls, Jim Fredericks	Fish	2001
See Appendix K	IDL-Idaho Falls, Heath Hancock	PFC	1997
See Appendix K	BLM (www.bitterrootrestoration.org)	PFC	1999, 2001, and 2002

Appendix F. IASCD Water Quality Data

Table F-1. Meadow Creek water quality data.

DATE	D.O.(mg/L)	TEMP(C)	%SAT	COND(microS)	TDS(mg/L)	pH	TIME	Q(cfs)	NO2+NO3:N(mg/L)	NH3(mg/L)	TSS(mg/L)	TVS(mg/L)	TPHOS(mg/L)	OPHOS(mg/L)
2-Jun-03	na	10.4	na	1349	652	7.78	910	0.554	<.05	<.05	48	4	0.11	0.06
16-Jun-03	9.24	12.2	86.1	1617	790	8.05	923	0.167	<.05	<.05	7	<2	0.06	<.05
30-Jun-03	too little water													
14-Jul-03	too little water													
30-Jul-03	dry													
12-Aug-03	dry													
26-Aug-03	dry													
11-Sep-03	dry													
7-Oct-03	dry													

Table F-2. Tex Creek water quality data.

DATE	D.O.(mg/L)	TEMP(C)	%SAT	COND(microS)	TDS(mg/L)	pH	TIME	Q(cfs)	NO2+NO3:N(mg/L)	NH3(mg/L)	TSS(mg/L)	TVS(mg/L)	TPHOS(mg/L)	OPHOS(mg/L)
2-Jun-03	9.12	12.6	85.7	1085	524	8.02	9.48	1.77	<.05	<.05	8	<2	0.08	<.05
16-Jun-03	9.6	13.8	92.9	1275	622	8.12	957	0.488	<.05	<.05	2	<2	0.06	<.05
30-Jun-03	9.46	14.4	92.6	1164	567	7.6	1001	0.145	<.05	0.09	18	5	0.07	<.05
14-Jul-03	too little water													
30-Jul-03	dry													
12-Aug-03	dry													
26-Aug-03	dry													
11-Sep-03	dry													
7-Oct-03	dry													

Table F-3. Willow Creek at Kepp's Crossing water quality data.

DATE	D.O.(mg/L)	TEMP(C)	%SAT	COND(microS)	TDS(mg/L)	pH	TIME	Q(cfs)	NO2+NO3:N(mg/L)	NH3(mg/L)	TSS(mg/L)	TVS(mg/L)	TPHOS(mg/L)	OPHOS(mg/L)
2-Jun-03	7.74	16.3	79	614	294	7.84	1034	41.37	<.05	0.05	4	<2	0.06	<.05
16-Jun-03	7.84	18.3	83.4	643	309	7.9	1031	18.73	<.05	<.05	<2	<2	0.05	<.05
30-Jun-03	7.58	19.2	82.2	478	228	7.29	1043	9.747	<.05	<.05	2	<2	0.06	<.05

14-Jul-03	7.27	20.4	80.6	471	225	8.02	1055	4.934	<.05	<.05	2	<2	0.06	<.05
30-Jul-03	5.54	19.2	59.7	610	292	8	907	2.624	<.05	<.05	2	<2	0.06	<.05
12-Aug-03	7.01	20.5	77.8	504	241	8.08	1005	1.84	<.05	<.05	2	<2	0.06	<.05
26-Aug-03	4.47	16.8	46.1	1865	917	7.71	923	3.918	<.05	<.05	3	<2	<.05	<.05
11-Sep-03	6.5	11.6	59.5	460	218	8.29	836	5.892	<.05	<.05	3	<2	<.05	<.05
7-Oct-03	5.23	11.7	48.6	486	232	8.32	1001	6.4	<.05	<.05	3	2	<.05	<.05

Table F-4. Birch Creek water quality data.

DATE	D.O.(mg/L)	TEMP(C)	%SAT	COND(microS)	TDS(mg/L)	pH	TIME	Q(cfs)	NO2+NO3:N(mg/L)	NH3(mg/L)	TSS(mg/L)	TVS(mg/L)	TPHOS(mg/L)	OPHOS(mg/L)
2-Jun-03	na	13.9	na	1256	608	8.1	1102	0.326	0.88	<.05	28	4	0.5	0.48
16-Jun-03	4.87	17.6	50	1336	652	8.17	1057	0.075	<.05	<.05	53	8	0.2	0.15
30-Jun-03	too little water													
14-Jul-03	too little water													
30-Jul-03	dry													
12-Aug-03	dry													
26-Aug-03	dry													
11-Sep-03	dry													
7-Oct-03	dry													

Table F-5. Sellars Creek water quality data.

DATE	D.O.(mg/L)	TEMP(C)	%SAT	COND(microS)	TDS(mg/L)	pH	TIME	Q(cfs)	NO2+NO3:N(mg/L)	NH3(mg/L)	TSS(mg/L)	TVS(mg/L)	TPHOS(mg/L)	OPHOS(mg/L)
2-Jun-03	8.72	13.1	82.9	655	315	7.6	1135	7.475	0.79	<.05	5	<2	0.1	<.05
16-Jun-03	6.58	16.3	67.2	767	369	7.56	1128	3.3	0.79	<.05	5	2	0.09	<.05
30-Jun-03	6.84	18.1	72.4	629	302	7.29	1128	2.351	0.97	<.05	5	<2	0.1	0.06
14-Jul-03	9.61	19.4	105	612	294	7.62	1139	0.274	0.78	0.05	6	<2	0.12	0.07
30-Jul-03	6.25	16.4	64	700	338	7.66	954	2.13	0.8	<.05	5	2	0.12	0.08
12-Aug-03	6.33	16.8	65.3	558	268	7.42	1048	0.158	0.81	<.05	18	4	0.15	0.08
26-Aug-03	6.69	14.6	65.7	1908	939	7.68	1010	0.303	0.88	<.05	2	<2	0.08	0.06
11-Sep-03	7.21	9.3	62.8	492	232	7.96	909	0.46	0.89	<.05	4	<2	<.05	<.05
7-Oct-03	5.94	9.9	52.8	528	253	7.93	1051	0.081	0.93	<.05	11	3	0.07	<.05

Table F-6. Willow Creek at Pole Bridge water quality data.

DATE	D.O.(mg/L)	TEMP(C)	%SAT	COND(microS)	TDS(mg/L)	pH	TIME	Q(cfs)	NO2+NO3:N(mg/L)	NH3(mg/L)	TSS(mg/L)	TVS(mg/L)	TPHOS(mg/L)	OPHOS(mg/L)
2-Jun-03	9.04	17.2	94.5	493	235	7.94	1204	11.23	0.79	0.06	3	<2	0.08	0.06
16-Jun-03	8.78	19.2	94.8	498	239	8.06	1146	8.502	<.05	<.05	<2	<2	0.06	<.05
30-Jun-03	7.4	20.7	81.8	406	194	7.81	1151	6.302	<.05	<.05	4	2	0.08	0.05
14-Jul-03	5.43	21.2	61.2	380	180	7.89	1203	5.498	0.77	<.05	4	<2	0.1	0.06
30-Jul-03	4.45	19.6	48.3	490	212	7.7	1024	4.428	0.78	<.05	7	2	0.09	0.08
12-Aug-03	4.8	19.8	52.7	380	180	7.76	1113	4.536	0.81	<.05	3	<2	<.05	<.05
26-Aug-03	8.28	17.4	86.4	1388	680	7.9	1100	4.04	0.82	<.05	<2	<2	<.05	<.05
11-Sep-03	7.42	10.7	67.1	365	172	8.12	932	3.268	0.86	<.05	13	3	<.05	<.05
7-Oct-03	6.46	11.4	58.9	372	139	8.08	1115	2.79	0.89	<.05	7	2	<.05	<.05

Table F-7. Homer Creek water quality data.

DATE	D.O.(mg/L)	TEMP(C)	%SAT	COND(microS)	TDS(mg/L)	pH	TIME	Q(cfs)	NO2+NO3:N(mg/L)	NH3(mg/L)	TSS(mg/L)	TVS(mg/L)	TPHOS(mg/L)	OPHOS(mg/L)
2-Jun-03	8.93	18.8	95.9	743	358	8.13	1235	0.816	<.05	0.06	2	<2	<.05	<.05
16-Jun-03	9.34	18.9	101	829	400	8.12	1218	0.335	<.05	<.05	11	4	<.05	<.05
30-Jun-03	9.84	19.9	108	670	321	7.89	1219	0.267	<.05	<.05	10	3	0.1	<.05
14-Jul-03	dry													
30-Jul-03	dry													
12-Aug-03	dry													
26-Aug-03	dry													
11-Sep-03	dry													
7-Oct-03	dry													

Table F-8. Grays Lake Outlet water quality data.

DATE	D.O.(mg/L)	TEMP(C)	%SAT	COND(microS)	TDS(mg/L)	pH	TIME	Q(cfs)	NO2+NO3:N(mg/L)	NH3(mg/L)	TSS(mg/L)	TVS(mg/L)	TPHOS(mg/L)	OPHOS(mg/L)
2-Jun-03	10.92	18.1	116	554	265	8.3	1257	8.745	<.05	0.05	4	<2	<.05	<.05
16-Jun-03	10.17	20.1	112	530	255	8.17	1227	1.808	<.05	0.19	26	6	0.07	<.05

30-Jun-03	9.99	20.3	111	479	229	8.02	1237	1.206	<.05	<.05	7	2	0.05	<.05
14-Jul-03	8.45	21.4	95.7	421	201	8.22	1255	1.192	<.05	0.06	11	2	0.08	<.05
30-Jul-03	7.87	19.9	86.3	483	232	8.47	1101	1.34	<.05	<.05	5	<2	0.06	<.05
12-Aug-03	8.77	20.8	97.9	425	203	7.52	1144	0.79	<.05	<.05	6	<2	0.06	<.05
26-Aug-03	8.49	17.6	89.2	1587	776	8.5	1133	0.658	<.05	<.05	5	<2	<.05	<.05
11-Sep-03	7.9	9.9	69.9	426	201	8.48	1000	0.734	<.05	<.05	13	4	<.05	<.05
7-Oct-03	6.48	10.9	58.7	411	200	8.26	1150	0.722	<.05	<.05	3	<2	<.05	<.05

Appendix G. DEQ BURP Water Quality Data

Table G-1. DEQ BURP Water Quality Data

Stream Name	WBID	Year	Elev. (ft)	Rosgen Channel Type	% Fines	% Stable		% Covered	
						Left Bank	Right Bank	Left Bank	Right Bank
Non-303(d) Listed Streams									
Bridge Creek	US-21	1998	6520	G	82	90	92	87	92
Bulls Fork Creek	US-30	1997	6320	E	99	72	65	92	100
	US-30	1997	5950	F	93	83	95	84	89
Canyon Creek	US-8	1997	6050	C	83	77	91	57	73
Cattle Creek	US-16	1997	6140	F	100	100	100	100	0
Clark Creek	US-21	1997	6440	D	75	90	94	96	98
Dan Creek	US-29	1998	6700	E	84	89	83	89	83
	US-29	1996	6000	G	87	87	70	87	70
Deep Creek	US-32	1997	5245	B	83	94	86	94	80
Eagle Creek North Fork	US-21	1998	6740	C	38	100	22	82	89
Gravel Creek	US-23	1998	6615	C	56	100	98	100	99
	US-23	1998	6596	B	43	100	100	100	99
Indian Fork Tex Creek	US-31	1997	5820	E	100	95	94	80	83
Mud Creek	US-9	1997	6540	C	100	11	30	3	68
Mud Spring Creek	US-32	1998	5560	B	82	96	100	94	100
	US-32	1997	5250	A	69	83	83	83	83
Pipe Creek	US-31	1998	5940	F	84	96	81	82	85
	US-31	1997	5805	F	99	72	96	92	96
Shirley Creek	US-24	1998	6260	E	51	96	61	96	61
Squaw Creek	US-7	1996	6220	C	71	79	87	79	85
	US-7	1996	6200	B	78	86	75	93	85
	US-7	2001	5720	G	60	11	8	49	88
Willow Creek2	US-21	1997	6755	B	52	88	100	98	100
	US-21	1998	6760	C	47	100	100	96	96
303(d) Listed Streams									
Birch Creek	US-6	1996	6120	B	84	78	81	88	71
	US-6	2001	5920	F	34	90	86	98	100
	US-6	1996	5900	B	71	91	85	95	85
	US-6	1996	5640	B	97	0	3	67	75
Brockman Creek	US-25	1998	6590	E	80	96	94	98	100
	US-25	1994	6420	C	27	30	45	5	0
	US-24	1994	6180	C	24when	10	5	70	55
Buck Creek	US-12	1996	6360	C	70	3	4	87	96
	US-12	2001	6360	E	74	57	60	85	80
Corral Creek	US-26	1994	6680	C	38	65	50	90	75
	US-26	2001	6360	E	38	76	82	78	100
	US-26	1994	6360	F	27	45	40	60	75
Crane Creek	US-14	1998	6440	E	89	84	100	81	100
	US-14	1997	6480	E	100	100	100	100	100
	US-14	1997	6335	E	34	60	100	100	100
Grays Lake Outlet	97-M140	1997	6375	C	71	100	100	100	100
	97-M141	1997	5960	B	26	99	100	99	100
	95-B073	1995	5600	B	25	100	80	0	0
	95-B069	1995	5560	B	28	100	40	100	49
Hell Creek	US-29	1994	6600		69	51	10	85	90
	US-29	1995	5880	B	42	60	75	70	85
	US-29	1995	5600	B	42	60	45	70	55
Homer Creek	US-18	1995	6000	B	22	85	75	80	80
Lava Creek	US-28	1994	6680	F	32	10	20	30	45
	US-28	2001	6320	C	20	82	77	74	100
	US-28	1994	6140	C	12	35	50	45	55

Long Valley Creek	US-15	1997	6225	F	100	100	100	100	100
	US-15	1997	6125	D	97	100	100	92	86
Meadow Creek	US-32	1998	6180	G	67	99	89	100	93
	US-32	1995	6100	B	67	40	55	95	80
	US-32	1996	5850	B	90	0	0	64	32
	US-32	1996	5640	B	57	0	0	62	88
	US-32	1995	5240	C	92	20	20	100	100
Mill Creek	US-12	2001	6360	E	50	69	95	99	100
	US-12	1995	6540	C	62	38	44	100	100
	US-12	1995	6320		39	100	90	100	100
Rock Creek	US-5	1997	5950	B	100	100	100	63	59
Sawmill Creek	US-27	1994	6480	B	66	30	20	85	70
	US-27	1994	6360	B	10	35	50	45	60
Sellars Creek	US-10	1996	6600	A	96	28	42	77	83
	US-10	2001	6360	C	35	60	65	75	76
	US-10	1995	6120	C	32	20	50	100	90
Seventy Creek	US-11	1995	6640	C	89	90	80	100	95
	US-11	1995	6350	B	49	100	100	100	100
Tex Creek	US-31	1995	6000	B	52	19	23	86	85
	US-31	1995	5940	B	42	65	70	80	80
	US-31	1995	5540	B	32	80	81	98	63
	US-31	1995	5540	C	54	85	95	85	95
Willow Creek	US-13	1997	6525	E	97	80	100	100	100
	US-11	2001	6200	B	6	100	100	100	100
	US-11	1997	6200	B	52	96	100	100	100
	US-8	1995	5900	B	20	100	58	55	81
	US-5	1995	5480	B	34	68	100	55	83
	US-5	1995	5300	C	28	65	68	80	83
Mean for Non-Listed Streams					76	83	80	84	83
Mean for 303(d) Listed Streams					52	64	65	80	80
Average for all Streams					64	72	71	82	82

Appendix H. Subsurface Fine Sampling Results

Table H-1. Sawmill Creek McNeil data

McNeil Sediment Core Sampling Form					
Stream	Sawmill Creek				
Sample Number Sieve Size (inches)	**1** ML	**2** ML	**3** ML		
2.5	0	650	1291		
1	576	1240	1236		
0.5	774	1080	741		
0.25	831	658	847		
1.0 - 0.25" Subtotal	2181	2978	2824		
#4	410	235	260		
#8	436	275	735		
#20	461	225	482		
#70	639	420	979		
#270	642	450	696		
<0.25" Subtotal	2588	1605	3152		
Sample Total					
W/O 2.5"	4769	4583	5976	Mean	Std. Dev.
% Fines W/O .25"	**54.27%**	**35.02%**	**52.74%**	**47.34%**	**0.106994**
Sample Total					
W 2.5"	4769	5233	7267	Mean	Std. Dev.
% Fines W .25"	**54.27%**	**30.67%**	**43.37%**	**42.77%**	**0.118097**

Table H-2. Willow Creek McNeil data

McNeil Sediment Core Sampling Form					
Stream	Kepp’s Crossing				
Sample Number Sieve Size (inches)	**1** ML	**2** ML	**3** ML		
2.5	980	178	250		
1	2621	2044	2290		
0.5	941	833	1083		
0.25	618	640	808		
1.0 - 0.25" Subtotal	4180	3517	4181		
#4	160	143	130		
#8	368	357	496		
#20	439	580	960		
#70	285	697	532		
#270	85	120	115		
<0.25" Subtotal	1337	1897	2233		
Sample Total					
W/O .25"	5517	5414	6414	Mean	Std. Dev.
% Fines W/O .25"	**24.23%**	**35.04%**	**34.81%**	**31.36%**	**0.061743**
Sample Total					
W 2.5"	6497	5592	6664	Mean	Std. Dev.

% Fines W .25"	**20.58%**	**33.92%**	**33.51%**	**29.34%**	**0.075876**

Table H-3. Willow Creek McNeil data

McNeil Sediment Core Sampling Form					
Stream	Willow Creek at Gray Lake Outlet				
Sample Number Sieve Size (inches)	**1** ML	**2** ML	**3** ML		
2.5	932	2275	2220		
1	1725	815	865		
0.5	685	400	425		
0.25	510	464	334		
1.0 - 0.25" Subtotal	2920	1679	1624		
#4	145	60	60		
#8	324	224	310		
#20	244	56	226		
#70	258	278	340		
#270	104	56	90		
<0.25" Subtotal	1075	674	1026		
Sample Total					
W/O 2.5"	3995	2353	2650	Mean	Std. Dev.
% Fines W/O 2.5"	**26.91%**	**28.64%**	**38.72%**	**31.42%**	**0.063758**
Sample Total					
W .25"	4927	4628	4870	Mean	Std. Dev.
% Fines W .25"	**21.82%**	**14.56%**	**21.07%**	**19.15%**	**0.039896**

Table H-4. Lava Creek McNeil data

McNeil Sediment Core Sampling Form			
Stream	Lava Creek		
Sample Number Sieve Size (inches)	**1** ML	**2** ML	**3** ML
2.5	975	1240	585
1	1275	900	1315
0.5	595	485	670
0.25	265	260	390
1.0 - 0.25" Subtotal	2135	1645	2375
#4	104	50	117
#8	140	126	236
#20	140	88	224
#70	186	104	222
#270	130	58	127
<0.25" Subtotal	700	426	926
Sample Total			

W/O 2.5"	2835	2071	3301	Mean	Std. Dev.
% Fines W/O .25"	**24.69%**	**20.57%**	**28.05%**	**24.44%**	**0.037476**
Sample Total					
W 2.5"	3810	3311	3886	Mean	Std. Dev.
% Fines W .25"	**18.37%**	**12.87%**	**23.83%**	**18.36%**	**0.054814**

Table H-5. Mill Creek McNeil data

McNeil Sediment Core Sampling Form					
Stream	Mill Creek Above Willow Creek				
Sample Number	**1**	**2**	**3**		
Sieve Size (inches)	ML	ML	ML		
2.5	166	0	0		
1	1675	465	690		
0.5	1125	1050	940		
0.25	825	915	660		
1.0 - 0.25" Subtotal	3625	2430	2290		
#4	274	250	250		
#8	430	755	490		
#20	318	670	595		
#70	296	965	450		
#270	125	425	95		
<0.25" Subtotal	1443	3065	1880		
Sample Total					
W/O 2.5"	5068	5495	4170	Mean	Std. Dev.
% Fines W/O .25"	**28.47%**	**55.78%**	**45.08%**	**0.431115**	**0.137590**
Sample Total					
W 2.5"	5234	5495	4170	Mean	Std. Dev.
% Fines W .25"	**27.57%**	**55.78%**	**45.08%**	**0.428105**	**0.142408**

Table H-6. Grays Lake Outlet McNeil data

McNeil Sediment Core Sampling Form			
Stream	Grays Lake Outlet		
Date	9/18/2003		
Location:	300 m upstream from Homer Creek confluence		
Lat/Lon:	N:	43	16	7.01
	W:	111	38	26.95
Site Desc:	1997SIDFM141		
Personnel:	Jack Rainey and Suzie		
Vegetation:	willows, grasses		
Flow (cfs):	1.5		
Rosgen Channel:			
Reach Gradient:	1.00%		
Geology: (Q G V S)			

Target Species	Salmonid Spawning				
Sample Number	**1**	**2**	**3**		
Ocular Est. Surf Fns					
Sieve Size (inches)	ML	ML	ML		
2.5	310	0	100		
1	1280	1360	40		
0.5	600	540	280		
0.25	120	220	250		
1.0 - 0.25" Subtotal	2000	2120	570		
#4	30	70	90		
#8	60	160	240		
#20	120	120	140		
#70	200	440	1580		
#270	100	140	440		
<0.25" Subtotal	510	930	2490		
Sample Total					
W/O 2.5"	2510	3050	3060	Mean	Std. Dev.
% Fines W/O .25"	**0.203187**	**0.304918**	**0.813725**	**0.44061**	**0.327106**
Sample Total					
W 2.5"	2820	3050	3160	Mean	Std. Dev.
% Fines W .25"	0.180851	0.304918	0.787975	0.424581	0.320764

Table H-7. Sellars Creek McNeil data

McNeil Sediment Core Sampling Form			
Stream	Sellars Creek		
Date	9/15/2003		
Location:	0.4 miles above Blackfoot Reservoir Rd.		
Lat/Lon:	N: 43	15	39.55
	W: 111	50	0.96
Site Desc:	2001STDFA034		
Personnel:	Jack Rainey and Suzie		
Vegetation:	sparse willows, grass, sedges		
Flow:	0.7cfs		
Rosgen Channel:	C		
Reach Gradient:	1.00%		
Geology: (Q G V S)			
Target Species	Salmonid Spawning		
Sample Number	**1**	**2**	**3**
Ocular Est. Surf Fns			
Sieve Size (inches)	ML	ML	ML
2.5	0	210	0
1	225	460	110
0.5	1200	2420	1550
0.25	2360	3460	2010
1.0 - 0.25" Subtotal	3785	6340	3670
#4	820	580	500
#8	2160	1440	510
#20	1500	1430	1140

#70	2240	2520	1085		
#270	230	160	280		
<0.25" Subtotal	6950	6130	3515		
Sample Total W/O 2.5"	10735	12470	7185	Mean	Std. Dev.
% Fines W/O .25"	**0.647415**	**0.49158**	**0.489214**	**0.542736**	**0.090662**
Sample Total W 2.5"	10735	12680	7185	Mean	Std. Dev.
% Fines W .25"	0.647415	0.483438	0.489214	0.540022	0.09305

Table H-8. Willow Creek McNeil data

McNeil Sediment Core Sampling Form					
Stream	Willow Creek				
Date	9/17/2003				
Location:	Kepp's Crossing on BLM ground				
Lat/Lon: N:	43	24	27.91		
W:	111	47	6.88		
Site Desc:					
Personnel:	Jack Rainey and Suzie				
Vegetation:	Juniper trees, sage brush				
Flow (cfs):	6.3				
Rosgen Channel:	C				
Reach Gradient:	2.00%				
Geology: (Q G V S)					
Target Species	Salmonid Spawning				
Sample Number	**1**	**2**	**3**		
Ocular Est. Surf Fns					
Sieve Size (inches)	ML	ML	ML		
2.5	1380	110	1100		
1	2400	610	1740		
0.5	700	220	500		
0.25	380	160	220		
1.0 - 0.25" Subtotal	3480	990	2460		
#4	160	90	70		
#8	160	180	80		
#20	410	50	90		
#70	340	70	130		
#270	90	50	70		
<0.25" Subtotal	1160	440	440		
Sample Total W/O 2.5"	4640	1430	2900	Mean	Std. Dev.
% Fines W/O .25"	**0.25**	**0.307692**	**0.151724**	**0.236472**	**0.078859**
Sample Total W 2.5"	6020	1540	4000	Mean	Std. Dev.
% Fines W .25"	0.192691	0.285714	0.11	0.196135	0.087908

Appendix I. Streambank Erosion Inventory Method

Streambank Erosion Inventory

The streambank erosion inventory used to estimate background and existing streambank erosion followed methods outlined in the proceedings from the Natural Resource Conservation Service (NRCS) Channel Evaluation Workshop (NRCS, 1983). Using the direct volume method, sub-sections of 1996 §303(d) watersheds were surveyed to determine the extent of chronic bank erosion and estimate the needed reductions.

The NRCS Stream Bank Erosion Inventory is a field based methodology, which measures streambank/channel stability, length of active eroding banks, and bank geometry (Stevenson, 1994). The streambank/channel stability inventories were used to estimate the long-term lateral recession rate. The recession rate is determined from field evaluation of streambank characteristics that are assigned a categorical rating ranging from 0 to 3. The categories of rating the factors and rating scores are:

Bank Stability:
- Do not appear to be eroding - 0
- Erosion evident - 1
- Erosion and cracking present - 2
- Slumps and clumps sloughing off - 3

Bank Condition:
- Some bare bank, few rills, no vegetative overhang - 0
- Predominantly bare, some rills, moderate vegetative overhang - 1
- Bare, rills, severe vegetative overhang, exposed roots - 2
- Bare, rills and gullies, severe vegetative overhang, falling trees - 3

Vegetation / Cover On Banks:
- Predominantly perennials or rock-covered - 0
- Annuals / perennials mixed or about 40% bare - 1
- Annuals or about 70% bare - 2
- Predominantly bare – 3

Bank / Channel Shape:
- V - Shaped channel, sloped banks - 0
- Steep V - Shaped channel, near vertical banks - 1
- Vertical Banks, U - Shaped channel - 2
- U - Shaped channel, undercut banks, meandering channel - 3

Channel Bottom:
- Channel in bedrock / noneroding - 0
- Soil bottom, gravels or cobbles, minor erosion - 1
- Silt bottom, evidence of active downcutting - 2

Deposition:
- No evidence of recent deposition - 1
- Evidence of recent deposits, silt bars - 0

Cumulative Rating

Slight (0-4) Moderate (5-8) Severe (9+)

From the Cumulative Rating, the lateral recession rate is assigned.

0.01 - 0.05 feet per year	**Slight**
0.06 - 0.15 feet per year	**Moderate**
0.16 - 0.3 feet per year	**Severe**
0.5+ feet per year	**Very Severe**

Streambank stability can also be characterized through the following definition and the corresponding streambank erosion condition rating from Bank Stability or Bank Condition above are included in italics.
Streambanks are considered stable if they do not show indications of any of the following features:

- **Breakdown** - Obvious blocks of bank broken away and lying adjacent to the bank breakage. *Bank Stability Rating 3*
- **Slumping or False Bank** - Bank has obviously slipped down, cracks may or may not be obvious, but the slump feature is obvious. *Bank Stability Rating 2*
- **Fracture** - A crack is visibly obvious on the bank indicating that the block of bank I about to slump or move into the stream. *Bank Stability Rating 2*
- **Vertical and Eroding** - The bank is mostly uncovered and the bank angle is steeper than 80 degrees from the horizontal. *Bank Stability Rating 1*

Streambanks are considered covered if they show any of the following features:

- Perennial vegetation ground cover is greater than 50%. *Vegetation/Cover Rating 0*
- Roots of vegetation cover more than 50% of the bank (deep rooted plants such as willows and sedges provide such root cover). *Vegetation/Cover Rating 1*
- At least 50% of the bank surfaces are protected by rocks of cobble size or larger. *Vegetation/Cover Rating 0*
- At least 50% of the bank surfaces are protected by logs of 4 inch diameter or larger. *Vegetation/Cover Rating 1*

Streambank stability is estimated using a simplified modification of Platts, Megahan, and Minshall (1983, p. 13) as stated in *Monitoring Protocols to Evaluate Water Quality Effects of Grazing Management on Western Rangeland Streams* (Bauer and Burton, 1993). The modification allows for measuring streambank stability in a more objective fashion. The lengths of banks on both sides of the stream throughout the entire linear distance of the representative reach are measured and proportioned into four stability classes as follows:

- **Mostly covered and stable (non-erosional).** Streambanks are Over 50% Covered as defined above. Streambanks are Stable as defined above. Banks associated with gravel bars having perennial vegetation above the scourline are in this category. *Cumulative Rating 0 - 4 (slight erosion) with a corresponding lateral recession rate of 0.01 - 0.05 feet per year.*
- **Mostly covered and unstable (vulnerable).** Streambanks are Over 50% Covered as defined above. Streambanks are Unstable as defined above. Such banks are typical of ?false banks” observed in meadows where breakdown, slumping, and/or fracture show

instability yet vegetative cover is abundant. *Cumulative Rating 5 - 8 (moderate erosion) with a corresponding lateral recession rate of 0.06 - 0.2 feet per year.*
- **Mostly uncovered and stable (vulnerable).** Streambanks are less than 50% Covered as defined above. Streambanks are Stable as defined above. Uncovered, stable banks are typical of streambanks trampled by concentrations of cattle. Such trampling flattens the bank so that slumping and breakdown do not occur even though vegetative cover is significantly reduced or eliminated. *Cumulative Rating 5 - 8 (moderate erosion) with a corresponding lateral recession rate of 0.06 - 0.2 feet per year.*
- **Mostly uncovered and unstable (erosional).** Streambanks are less than 50% Covered as defined above. They are also Unstable as defined above. These are bare eroding streambanks and include ALL banks mostly uncovered, which are at a steep angle to the water surface. *Cumulative Rating 9+ (severe erosion) with a corresponding lateral recession rate of over 0.5 feet per year.*

Streambanks were inventoried to quantify bank erosion rate and annual average erosion. These data were used to develop a quantitative sediment budget to be used for TMDL development.

Site Selection

The first step in the bank erosion inventory is to identify key problem areas. Streambank erosion tends to increase as a function of watershed area (NRCS, 1983). As a result, the lower stream segment of larger watersheds tend to be problem areas. These stream segments tend to be alluvial streams commonly classified as response reaches (Rosgen B and C channel types) (Rosgen,1996).
Because it is often unrealistic to survey every stream segment, sampled reaches were used and bank erosion rates are extrapolated over a larger stream segment. The length of the sampled reach is a function of stream type variability where streams segments with highly variable channel types need a large sample, whereas segments with uniform gradient and consistent geometry need less. Typically between 10 and 30 percent of streambank needs to be inventoried. Often, the location of some stream inventory reaches is more dependent on land ownership than watershed characteristics. For example, private land owners are sometimes unwilling to allow access to stream segments within their property.
Stream reaches are subdivided into *sites* with similar channel and bank characteristics. Breaks between sites are made where channel type and/or dominate bank characteristics change substantially. In a stream with uniform channel geometry there may be only one site per stream reach, whereas in an area with variable conditions there may be several sites. Subdivision of stream reaches is at the discretion of the field crew leader.

Field Methods

Streambank erosion or channel stability inventory field methods were originally developed by the USDA USFS (Pfankuch, 1975). Further development of channel stability inventory methods are outlined in Lohrey (1989) and NRCS (1983). As stated above, the NRCS (1983) document outlines field methods used in this inventory. However, slight modifications to the field methods were made and are documented.

Field crews typically consist of two to four people and are trained as a group to ensure quality control or consistent data collection. Field crews survey selected stream reaches measuring bank length, slope height, bankfull width and depth, and bank content. In most cases, a Global Positioning System (GPS) is used to locate the upper and lower boundaries of inventoried stream reaches. Additionally, while surveying field crews photograph key problem areas.

Bank Erosion Calculations

The direct volume method is used to calculate average annual erosion rates for a given stream segment based on bank recession rate determined in the survey (NRCS, 1983). The erosion rate (tons/mile/year) is used to estimate the total bank erosion of the selected stream corridor.

The direct volume method is summarized in the following equations:

$$E = [A_E * R_{LR} * ?_B]/2000 \text{ (lbs/ton)}$$

where:

E = bank erosion over sampled stream reach (tons/yr/sample reach)

A_E = eroding area (ft^2)

R_{LR} = lateral recession rate (ft/yr)

$?_B$ = bulk density of bank material (lps/ft^3)

The bank erosion rate (E_R) is calculated by dividing the sampled bank erosion (E) by the total stream length sampled:

$$E_R = E/L_{BB}$$

where:

E_R = bank erosion rate (tons/mile/year)

E = bank erosion over sampled stream reach (tons/yr/sample reach)

L_{BB} = bank to bank stream length over sampled reach

Total bank erosion is expressed as an annual average. However, the frequency and magnitude of bank erosion events are greatly a function of soil moisture and stream discharge (Leopold et al, 1964). Because channel erosion events typically result from above average flow events, the annual average bank erosion value should be considered a long term average. For example, a 50 year flood event might cause five feet of bank erosion in one year and over a ten year period this events accounts for the majority of bank erosion. These factors have less of an influence where bank trampling is the major cause of channel instability.

The *eroding area* (A_E) is the product of linear horizontal bank distance and average bank slope height. Bank length and slope heights are measured while walking along the stream channel. Pacing is used to measure horizontal distance, and bank slope heights are continually measured and averaged over a given reach or site. The horizontal length is the length of the right or left bank, not both. Typically, one bank along the stream channel is actively eroding. For example, the bank on the outside of a meander. However, both banks of channels with severe headcuts or gullies will be eroding and are to be measured separately and eventually summed.

Determining the *lateral recession rate* (R_{LR}) is one of the most critical factors in this methodology (NRCS, 1983). Several techniques are available to quantify bank erosion rates: for example, aerial photo interpretation, anecdotal data, bank pins, and channel cross-sections.

To facilitate consistent data collection, the NRCS developed rating factors used to estimate lateral recession rate. Similar to methods developed by Pfankuch (1975), the NRCS method measures bank and channel stability, and then uses the ratings as surrogates for bank erosion rates.

The *bulk density* (ρ_B) of bank material is measured ocularly in the field. Soil bulk density is the weight of material divided by its volume, including the volume of its pore spaces. A table of typical soil bulk densities can be used, or soil samples can be collected and soil bulk density measured in the laboratory.

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Appendix J. Proper Functioning Condition Data

Table J-1. BLM summary of Willow Creek watershed stream riparian conditions.

Stream	WBID	Date of Data Collection	Health	Miles	Location				
					Township	Range	Section	1/4 Section	1/4 1/4 Section
Bear Creek	4	10/13/99	NF	0.5	2N	40E	35	SE	SE
Bear Creek	4	10/13/99	NF	0.65	2N	40E	35	SE	NW
Bear Creek	4	10/13/99	NF	0.55	2N	40E	35	SW	SW
Cattle Creek	16	10/10/99	FAR	0.6	1S	40E	11	NE	NE
Cove Creek	31	7/21/97	FAR	0.61	1N	41E	21	NE	SE
Cove Creek	31	7/22/97	FAR	0.74	1N	41E	23	NW	NW
Grays Lake Outlet*	16	8/6/96	FAR	0.79	1N	40E	33	SW	NE
Grays Lake Outlet*	13	7/7/98	FAR	0.79	1N	40E	33	SW	NE
Grays Lake Outlet*	16	8/1/96	PFC	0.25	1S	40E	13	NW	SE
Grays Lake Outlet*	16	8/1/96	PFC	0.37	1S	40E	13	NW	NE
Grays Lake Outlet*	17	8/1/96	PFC	0.75	1S	40E	24	SE	NW
Grays Lake Outlet*	17	8/2/96	PFC	1.03	1S	41E	30	NE	SE
Grays Lake Outlet*	17	8/2/96	PFC	0.18	1S	41E	19	SW	SW
Grays Lake Outlet*	17	8/2/96	PFC	0.63	1S	40E	24	SE	NW
Grays Lake Outlet*	16	8/5/96	NF	0.88	1S	40E	11	SE	NW
Grays Lake Outlet*	16	8/5/96	NF	0.73	1S	40E	11	NE	SW
Grays Lake Outlet*	16	8/5/96	FAR	0.97	1S	40E	2	SW	NW
Grays Lake Outlet*	16	8/6/96	FAR	0.66	1S	40E	3	NE	NW
Grays Lake Outlet*	16	10/8/99	PFC	0.38	1S	41E	17	SE	NE
Grays Lake Outlet*	17	7/19/00	PFC	1.03	1S	41E	30	NE	SE
Grays Lake Outlet*	17	7/27/00	PFC	0.63	1S	40E	24	SE	NW
Grays Lake Outlet*	16	6/20/01	NF	0.88	1S	40E	11	SE	NW
Hell Creek*	29	8/1/96	NF	0.33	1S	41E	18	SW	NW
Hell Creek*	29	8/1/96	NF	0.64	1S	40E	13	NE	SW
Hell Creek*	29	8/1/96	NF	0.1	1S	40E	13	NW	SE
Hell Creek*	29	10/9/99	NF	0.5	1S	42E	18	SE	SE
Hell Creek*	29	10/9/99	FAR	0.5	1S	42E	18	NE	SW
Hell Creek*	29	6/13/02	FAR	0.64	1S	40E	13	NE	SW
Hell Creek*	29	6/13/02	FAR	0.33	1S	41E	18	SW	NW
Meadow Creek*	32	7/22/97	FAR	0.32	2N	41E	35	NW	SE
Pipe Creek	31	7/23/97	FAR	0.42	1N	41E	7	SW	NW
Tex Creek*	31	7/21/97	FAR	0.52	1N	41E	26	SW	NE
Tex Creek*	31	7/21/97	FAR	0.33	1N	41E	27	NW	SE
Tex Creek	31	7/23/97	FAR	0.86	1N	41E	7	SW	SE
Twin Creek	8	5/31/01	PFC	0.5	1S	40E	28	SW	NE
Unnamed Tributary to Tex Creek	31	7/23/97	FAR	0.18	1N	40E	12	NE	NE
Willow Creek*	5	7/31/96	PFC	0.7	1N	40E	20	NW	NW
Willow Creek*	5	7/31/96	PFC	0.37	1N	40E	19	NE	NE

Willow Creek*	5	8/6/96	FAR	0.64	1N	40E	28	SW	NE
Willow Creek*	5	8/6/96	NF	0.61	1N	40E	32	SE	SE
Willow Creek*	5	8/6/96	NF	0.77	1N	40E	32	NE	SE
Willow Creek*	5	8/6/96	FAR	0.55	1N	40E	33	NW	SW
Willow Creek*	5	8/6/96	FAR	0.6	1N	40E	33	NW	NE
Willow Creek*	5	8/7/96	FAR	0.25	1N	40E	28	NW	NW
Willow Creek*	5	8/7/96	PFC	0.64	1N	40E	29	NE	NE
Willow Creek*	5	8/7/96	NF	0.67	1N	40E	29	NW	NW
Willow Creek*	5	7/24/97	FAR	0.65	1N	40E	5	NW	SW
Willow Creek*	5	7/24/97	FAR	0.79	1N	40E	5	SW	NE
Willow Creek*	5	7/24/97	FAR	0.58	1N	40E	8	NE	NE
Willow Creek*	5	7/7/98	FAR	0.64	1N	40E	28	SW	NE
Willow Creek*	5	7/7/98	FAR	0.55	1N	40E	33	NW	SW
Willow Creek*	5	9/20/98	PFC	0.55	1N	40E	20	NW	NE
Willow Creek*	5	9/20/98	PFC	0.5	1N	40E	17	SW	SE
Willow Creek*	5	9/21/98	PFC	0.8	1N	40E	17	NW	NE
Willow Creek*	5	9/21/98	FAR	0.65	1N	40E	7	SE	SE
Willow Creek*	5	8/11/99	PFC	0.5	1N	40E	10	NE	NE
Willow Creek*	4	10/10/99	PFC	0.8	1N	40E	3	SE	NE
Willow Creek*	4	10/11/99	PFC	0.68	1N	40E		NW	NW
Willow Creek*	5	6/20/01	FAR	0.25	1N	40E	28	NW	NW

Note: * = 303(d) listed reach
Source: (www.bitterrootrestoration.com)

Table J-2. IDL 1999 PFC data.

1999			
Stream	**WBID**	**Miles**	**Health**
Brockman Creek	24	0.33	PFC
Brockman Creek	24	2.09	FAR
Brockman Creek	24	0.16	PFC
Brockman Creek	24	0.63	PFC
Brockman Creek	24	0.71	PFC
Chicken Creek	18	0.61	FAR
Chicken Creek	18	1.43	FAR
Chicken Creek	18	0.89	PFC
Dan Creek	29	0.26	FAR
Dan Creek	29	0.41	NF
Dan Creek	29	0.25	PFC
Grays Lake Outlet	17	0.66	FAR
Grays Lake Outlet	19	0.17	FAR
Grays Lake Outlet	19	0.48	FAR
Grays Lake Outlet	19	0.81	FAR
Grays Lake Outlet	19	0.66	PFC
Grays Lake Outlet	20	0.19	FAR

Grays Lake Outlet	17	0.43	NF
Grays Lake Outlet	19	0.28	FAR
Grays Lake Outlet	19	0.29	FAR
Grays Lake Outlet	19	0.56	FAR
Grays Lake Outlet	19	1.11	FAR
Grays Lake Outlet	19	1.07	PFC
Grays Lake Outlet	20	1.19	FAR
Grays Lake Outlet	20	1.57	PFC
Hell Creek	29	0.96	FAR
Homer Creek	18	0.46	FAR
Homer Creek	18	1.74	PFC
Homer Creek	18	0.19	FAR
Homer Creek	18	0.67	FAR
Homer Creek	18	2.32	FAR
Homer Creek	18	0.54	FAR
Homer Creek	18	0.21	NF
Homer Creek	18	0.48	NF
Homer Creek	18	0.00	PFC
Homer Creek	18	0.28	PFC
Homer Creek	18	1.10	PFC
Homer Creek	18	0.22	PFC
Homer Creek	18	1.74	PFC
Homer Creek	18	0.50	PFC
Homer Creek	18	0.86	PFC
Jim Creek	19	0.35	FAR
Jim Creek	19	0.40	FAR
Jim Creek	19	0.68	NF
Jim Creek	19	0.41	FAR
Jim Creek	19	0.84	FAR
Jim Creek	19	0.90	NF
Jim Creek	19	0.62	NF
Lava Creek	28	0.72	FAR
Lava Creek	28	0.27	PFC
Lava Creek	28	0.12	FAR
Lava Creek	28	0.41	FAR
Lava Creek	28	0.18	PFC
Lava Creek	28	0.59	PFC
Lava Creek	28	0.74	PFC
Lava Creek	28	0.42	FAR
Lava Creek	28	1.27	PFC
Long Valley Creek	15	3.31	FAR
Long Valley Creek	15	0.32	PFC
M Fk Sawmill Ck	27	0.62	PFC
M Fk Sawmill Ck	27	0.56	FAR

N Fk Sawmill Ck	27	0.93	FAR
N Fork Lava Creek	28	1.32	PFC
S Fk Sawmill	27	0.62	PFC
S Fk Sawmill	27	0.83	PFC
S Fork Jim Creek	19	1.01	FAR
S Fork Lava Creek	28	0.32	PFC
S Fork Lava Creek	28	0.58	PFC
Sawmill	27	0.61	PFC
Sawmill Creek	27	0.44	FAR
Shirley Creek	24	0.29	PFC
Shirley Creek	24	0.40	PFC
Shirley Creek	24	0.68	NF
Shirley Creek	24	0.06	PFC
Shirley Creek	24	0.29	PFC

Table J-3. IDL 2001 PFC data.

2001			
Stream	**WBID**	**Miles**	**Health**
Buck Creek	11	0.26	PFC
Buck Creek	11	0.39	PFC
Chicken Creek	18	0.72	PFC
Cranes Creek	14	0.01	FAR
Cranes Creek	14	0.06	FAR
Cranes Creek	14	0.07	FAR
Cranes Creek	14	0.10	FAR
Cranes Creek	14	0.16	FAR
Cranes Creek	14	0.36	FAR
Cranes Creek	14	0.37	FAR
Cranes Creek	14	0.67	FAR
Deep Creek	32	0.54	NF
Deep Creek	32	0.58	PFC
Hancock Creek	11	0.02	FAR
Hancock Creek	11	0.03	FAR
Hancock Creek	11	0.04	FAR
Hancock Creek	11	0.06	FAR
Hancock Creek	11	0.10	FAR
Hancock Creek	11	0.20	FAR
Hancock Creek	11	1.42	FAR
Mill Creek	12	0.15	FAR
Mill Creek	12	0.37	FAR
Mill Creek	12	0.08	PFC
Mill Creek	12	0.19	PFC
Mill Creek	12	0.29	PFC

Mill Creek	12	0.42	PFC
Mill Creek	12	0.88	PFC
Willow Creek	11	0.04	FAR
Willow Creek	11	0.11	FAR
Willow Creek	11	0.13	FAR
Willow Creek	11	0.07	PFC
Willow Creek	11	0.10	PFC
Willow Creek	11	0.31	PFC
Willow Creek	11	0.43	PFC
Willow Creek	11	0.45	PFC
Willow Creek	11	0.73	PFC
Willow Creek	11	1.03	PFC
Willow Creek	11	1.25	PFC

Table J-4. IDL 2002 PFC data.

2002			
Stream	**WBID**	**Miles**	**Health**
MillCr	12	0.26	PFC
MillCrTrib2	12	0.08	FAR
MillCrTrib3	12	0.50	FAR
SeventyCr	13	0.07	FAR
SeventyCr	13	0.29	FAR
CraneCr Seg1	14	0.91	FAR
CraneCr Seg1	14	0.15	FAR
CraneCr Seg1	14	0.03	FAR
CraneCr Seg2	14	1.10	FAR
CraneCr Seg2	14	0.02	FAR
CraneCr Seg3	14	0.81	PFC
CraneCr Upper	14	0.08	FAR
CraneCr Upper	14	0.03	FAR
CraneCr Upper	14	0.06	FAR
CraneCr Upper	14	0.00	FAR
CraneCrTrib #2 Seg1	14	1.14	PFC
CraneCrTrib #2 Seg2	14	0.16	FAR
CranesCr Seg4	14	0.96	FAR
UpperCranesCr	14	0.37	FAR
HomerCr EastFk	18	0.29	FAR
HomerCr EastFk	18	0.37	FAR
HomerCr EastFk	18	0.09	FAR
HomerCr EastFk	18	0.13	FAR
HomerCr Main	18	0.30	FAR
HomerCr Main	18	0.06	FAR
HomerCr MiddleFk	18	0.17	FAR

HomerCr MiddleFk	18	0.11	FAR
HomerCr MiddleFk	18	0.09	FAR
HomerCr Trib1	18	0.12	FAR
HomerCr Trib2	18	0.10	PFC
HomerCr Trib2	18	0.39	PFC
HomerCr Trib3	18	0.37	PFC
HomerCr Trib4	18	0.32	PFC
HomerCr WestFk	18	0.34	FAR
Meadow Cr Trib3	32	0.46	PFC
MeadowCr Lower	32	0.38	PFC
MeadowCr Lower	32	0.04	PFC
MeadowCr Lower	32	0.03	PFC
MeadowCr Trib1	32	0.19	PFC
MeadowCr Trib1	32	0.63	PFC
MeadowCr Trib2 Seg1	32	0.35	FAR
MeadowCr Trib2 Seg2	32	0.35	PFC
Meadowcr Trib2 Seg3	32	0.37	PFC
MeadowCr Trib2 Seg4	32	0.67	FAR
MeadowCr Upper	32	0.04	FAR
MeadowCr Upper	32	0.01	FAR
MeadowCr Upper	32	0.06	FAR
MeadowCr Upper	32	0.09	FAR
MeadowCr Upper	32	0.25	FAR
MeadowCr Upper	32	1.14	FAR
MeadowCr Upper	32	1.30	FAR
MeadowCrTrib1	32	0.14	PFC

Appendix K. Stream Macroinvertebrate Index

Table K-1. Stream Macroinvertebrate Index (SMI) data.

BURPID	STREAM	DATE SAMPLING	SMI	SMI Ranking
1996SIDFZ037	BIRCH CREEK	6/24/1996	32	0
1996SIDFZ038	BIRCH CREEK	6/24/1996	45	2
1996SIDFZ041	BIRCH CREEK	6/25/1996	25	0
1997SIDFL005	BLUE CREEK	6/9/1997	43	2
1998SIDFB001	BRIDGE CREEK	6/3/1998	55	2
1994SIDFA018	BROCKMAN (L)	7/8/1994	34	1
1994SIDFA017	BROCKMAN (U)	7/8/1994	16	0
1998SIDFA002	BROCKMAN CREEK	6/3/1998	34	1
1996SIDFY002	BUCK CREEK	5/23/1996	10	0
1993SIDFA027	BULLS FORK #1 LOWER	8/3/1993		
1993SIDFA028	BULLS FORK #2 UPPER	8/3/1993	20	0
1997SIDFL001	BULLS FORK CREEK	6/5/1997	35	1
1997SIDFM001	BULLS FORK CREEK	6/5/1997	23	0
1997SIDFL010	CANYON CREEK	6/11/1997	18	0
1997SIDFL006	CATTLE CREEK	6/9/1997	13	0
1997SIDFM007	CLARK CREEK	6/10/1997	39	1
1994SIDFA084	CORRAL (L)	8/16/1994	51	2
1994SIDFA083	CORRAL (U)	8/16/1994		
1995SIDFA019	CORRAL CREEK (UPPER)	5/20/1995	39	2
1997SIDFM005	CRANE CREEK	6/9/1997	42	2
1997SIDFM006	CRANE CREEK	6/9/1997	21	0
1998SIDFB009	CRANE CREEK	6/9/1998	24	0
1995SIDFB018	CRANE CREEK (LOWER)	6/26/1995		
1995SIDFB020	CRANE CREEK (UPPER)	6/26/1995		
1998SIDFA001	DAN CREEK	6/3/1998	28	0
1996SIDFY126	DAN CREEK (2)	8/21/1996	58	3
1997SIDFL004	DEEP CREEK	6/9/1997	24	0
1998SIDFB002	EAGLE CREEK NORTH FORK	6/4/1998	50	2
1996SPOCA037	GRAVEL CREEK	7/15/1996	66	3
1998SIDFB007	GRAVEL CREEK	6/9/1998	57	3
1998SIDFB008	GRAVEL CREEK	6/9/1998	56	3
1997SIDFM140	GRAYS LAKE OUTLET	9/11/1997	5	0
1997SIDFM141	GRAYS LAKE OUTLET	9/11/1997	47	2
1995SIDFB067	GRAYS LAKE OUTLET (LOWER)	8/7/1995		
1995SIDFB069	GRAYS LAKE OUTLET (LOWER)	8/8/1995	48	2
1995SIDFB073	GRAYS LAKE OUTLET (UPPER)	8/10/1995	41	1
1995SIDFB080	GRAYS LAKE OUTLET (UPPER)	8/21/1995		
1995SIDFA017	HANCOCK CREEK (LOWER)	6/19/1995	36	1
1995SIDFB019	HANCOCK CREEK (UPPER)	6/26/1995		
1994SIDFA080	HELL (L)	8/15/1994		
1994SIDFA014	HELL (U)	7/6/1994	26	0
1995SIDFA002	HELL CREEK (LOWER)	5/26/1995	13	0
1995SIDFA001	HELL CREEK (MIDDLE)	5/25/1995	24	0
1995SIDFA018	HOMER CREEK (LOWER)	6/19/1995	30	0
1995SIDFB021	HOMER CREEK (UPPER)	6/26/1995		
1997SIDFM002	INDIAN FORK CREEK	6/5/1997	35	0
1994SIDFA082	LAVA (L)	8/16/1994	53	3
1994SIDFA081	LAVA (U)	8/15/1994	69	3
1996SIDFY134	LAVA CREEK (WEST FORK)	9/3/1996	65	3
1997SIDFL007	LONG VALLEY CREEK	6/10/1997	25	0
1997SIDFL008	LONG VALLEY CREEK	6/10/1997	14	0
1995SIDFB022	LONG VALLEY CREEK (LOWER)	6/26/1995		

1995SIDFB027	LONG VALLEY CREEK (UPPER)	7/5/1995		
1993SIDFA030	MEADOW CK #1 LOWER	8/4/1993	15	0
1993SIDFA029	MEADOW CK #2 UPPER	8/5/1993		
1996SIDFY001	MEADOW CREEK	5/22/1996	28	0
1996SIDFZ001	MEADOW CREEK	5/22/1996	29	0
1998SIDFB005	MEADOW CREEK	6/8/1998	50	2
1995SIDFB002	MEADOW CREEK (LOWER)	6/2/1995	16	0
1995SIDFA004	MEADOW CREEK (UPPER)	6/2/1995	45	2
1996SIDFY003	MILL CREEK	5/23/1996	33	1
1995SIDFB014	MILL CREEK (LOWER)	6/19/1995	31	0
1995SIDFB016	MILL CREEK (UPPER)	6/20/1995	28	0
1997SIDFL009	MUD CREEK	6/10/1997	14	0
1997SIDFL003	MUD SPRING CREEK	6/9/1997	59	3
1998SIDFA003	MUD SPRING CREEK	6/4/1998	33	1
1998SIDFA004	NORTH FORK MEADOW CREEK	6/4/1998	60	3
1998SIDFB011	PETERSON CREEK	6/10/1998	36	1
1997SIDFL002	PIPE CREEK	6/5/1997	9	0
1998SIDFB013	PIPE CREEK	6/11/1998	13	0
1998SIDFB012	RIGHT CREEK	6/11/1998	44	2
1997SIDFL012	ROCK CREEK	6/11/1997	25	0
1994SIDFA016	SAWMILL (L)	7/7/1994	20	0
1994SIDFA015	SAWMILL (U)	7/7/1994	29	0
1996SIDFZ003	SELLARS CREEK	5/23/1996	77	3
1995SIDFB023	SELLARS CREEK (LOWER)	6/26/1995	34	1
1995SIDFB017	SELLARS CREEK (UPPER)	6/21/1995	37	1
1995SIDFB013	SEVENTY CREEK (LOWER)	6/19/1995	42	1
1995SIDFB015	SEVENTY CREEK (UPPER)	6/20/1995	25	0
1998SIDFB004	SHIRLEY CREEK	6/4/1998	34	1
1996SIDFZ002	SOUTH FORK SELLARS CREEK	5/23/1996	45	2
1996SIDFZ039	SQUAW CREEK	6/24/1996	22	0
1996SIDFZ040	SQUAW CREEK	6/24/1996	18	0
1993SIDFA026	TEX CK #1 LOWER	8/2/1993	26	0
1995SIDFA106	TEX CREEK (LOWER)	9/5/1995	68	3
1995SIDFB001	TEX CREEK (LOWER)	6/2/1995	32	0
1995SIDFA003	TEX CREEK (UPPER)	6/2/1995	25	0
1995SIDFA107	TEX CREEK (UPPER)	9/5/1995	38	1
1997SIDFL011	TWIN CREEK	6/11/1997	21	0
1998SIDFB006	WAYAN CREEK	6/9/1998	23	0
1994SIDFA079	WILLOW (L)	8/15/1994		
1993SIDFA031	WILLOW CK #1 LOWER	8/4/1993	11	0
1993SIDFA032	WILLOW CK #2 UPPER	8/5/1993	23	0
1997SIDFM003	WILLOW CREEK	6/9/1997	57	3
1997SIDFM004	WILLOW CREEK	6/9/1997	17	0
1997SIDFM008	WILLOW CREEK	6/11/1997	65	3
1998SIDFB003	WILLOW CREEK	6/4/1998	59	3
1995SIDFB049	WILLOW CREEK (LOWER)	8/2/1995	46	2
1995SIDFB066	WILLOW CREEK (LOWER)	8/2/1995		
1995SIDFB070	WILLOW CREEK (LOWER)	8/8/1995	46	2
1995SIDFB068	WILLOW CREEK (UPPER)	8/8/1995	45	2
1995SIDFB071	WILLOW CREEK (UPPER)	8/9/1995		
1995SIDFB072	WILLOW CREEK (UPPER)	8/9/1995	52	3
1995SIDFB081	WILLOW CREEK (UPPER)	8/21/1995		

Appendix L. Distribution List

Idaho Falls Public Library 457 Broadway Idaho Falls, ID 83402	William Stewart Idaho Operations Office Environmental Protection Agency 1435 N. Orchard St. Boise, ID 83706
Richard A. Passey, Co-Chairman Willow Creek Watershed Advisory Group	Lee Leffert, Hydrologist James Capurso, Fisheries Biologist Caribou-Targhee National Forest 1405 Hollipark Dr, Idaho Falls, ID 83401
Heath Hancock, Range Conservationist Idaho Department of Lands 3563 Ririe Hwy Idaho Falls, ID 83401	Dan Kotansky, Hydrologist Pat Koelsch, Fisheries Bureau of Land Management 1405 Hollipark Dr. Idaho Falls, ID 83401
Ivalou O'Dell, Information Specialist USGS Water Resources of Idaho 230 Collins Road Boise, ID 83702	Water Quality Conservationist Idaho Association of Soil Conservation Districts 315 East 5th North St. Anthony, ID 83445
James P. Fredericks, Regional Fisheries Manager Gary Vecillio, Environmental Specialist Idaho Department of Fish and Game Upper Snake Region 4279 Commerce Circle Idaho Falls, ID 83401 – 2198	Christine Fischer, Water Quality Analyst Idaho Association of Soil Conservation Districts 1551 Baldy Ave., Ste. #2 Pocatello, ID 83201
Bonneville County NRCS Office Dennis Hadley, District Conservationist 1120 Lincoln Rd. Idaho Falls, ID 83401	Gary Dixon, CO-Chair Willow Creek WAG
Alicia Lane Boyd Snake River Area Office - East Bureau of Reclamation 1359 Hansen Avenue Burley, ID 83318	Kevin Meyer Idaho Department of Fish and Game 1414 East Locust Lane Nampa, ID 83686
Soil Conservation Commission Kathy Weaver, District Operations Manager 3563 Ririe Hwy Idaho Falls, ID 83402	Soil Conservation Commission Tony Bennett P.O. Box 790 Boise, ID 83701-0790
Environmental Protection Agency	Ron Mitchell

Tracy Chellis, Biologist 1200 6th Avenue OW-134 Seattle, WA 98101	Idaho Sporting Congress P.O. Box 1136 Boise, ID 83702
Rick Johnson Idaho Conservation League 710 North Sixth St Boise, ID 83702	

Appendix M. Public Comments

Public Comments and Responses

Several public meetings were held throughout the process of the development of this TMDL. Meetings were coordinated to facilitate participation by the Willow Creek WAG, landowners, and land management agencies.

The public comment period for the Willow Creek Subbasin Assessment and TMDL was held during March and April 2004. Originally the public comment period was for the duration of 30 days, ending on March 22, 2004 however, at the request of the Willow Creek Watershed Advisory Group and the Idaho Department of Lands (IDL) the DEQ extended the public comment period an additional 30 days, with the period ending on April 24, 2004.

Comments received from agencies, Willow Creek Watershed Advisory Group (WAG), Greater Yellowstone Coalition (GYC), and the public during the comment period are included with responses. Responses to comments are in bold print following the individual comment.

Comments by Idaho Department of Lands

The Idaho Department of Lands appreciates the opportunity to comment on the Willow Creek Subbasin Assessment and TMDLs and thanks you for the extended comment period that was granted. Idaho Department of Lands fully supports comments provided by East & West Side Soil & Water Conservation Districts (SWCDs) and the Willow Creek WAG. We offer the following comments for your consideration.

Executive Summary

In several places pollutant loading targets are referenced as based on literature. This "literature" is not referenced and should be.

The literature reference to loading targets for streambank erosion is referenced in section 5.1, Target Selection (heading), Sediment (subheading), third paragraph, which states that, "It is assumed that natural background sediment loading rates from bank erosion equate to 80% bank stability as described in Overton and others (1995)…"

The above paragraph will be inserted into section 2.3, Biological Data (heading), Streambank Assessments (subheading) for further clarification.

Literature values for the 28% target for subsurface fines are referenced in section 2.3 under Biological Data (heading), Subsurface Fines (subheading).

IDL also feels that the loading estimates should be identified in the executive summary as a gross allotment (per definition on pg 89).

It is not necessary to identify the exact nature of load estimates as "gross allocations" in the executive summary. The mention of "gross allocations" in section 5.3 (page 89) is sufficient.

Beaver Influence in the Willow Creek Subbasin – Little to no mention of beaver and their influence occurs in the Willow Creek Subbasin Assessment and TMDLs. This, despite the fact that beaver have and continue to substantially impact stream morphology and hydrology as well as influence water quality and quantity on listed streams. Significant discussion should be added into the document detailing historical and current beaver influence on listed streams.

A section on beaver and their influence on stream morphology, hydrology, and water quality has been added in section 1.2, Subbasin Characteristics (heading), Beaver (subheading).

It is difficult to discuss historic and current beaver influences on listed streams in specific terms because data providing this level of detail is unavailable. The only information supplied to DEQ, regarding beaver in the subbasin, was anecdotal in nature so beaver influences are discussed in general terms.

<u>Sediment Loading Estimates –</u> We do not have alternative data to offer. However, statements should be included in the document that identify limitations that we believe have skewed estimated sediment loading rates and resulted in an overestimation of those rates. Specifically:

1) Sampling Locations – Sites with high potential for streambank erosion were targeted for sampling by MSE (firm contracted by DEQ to perform inventories), rather than representative reaches. With respect to pre site selection, the report developed by MSE and provided to DEQ states, "MSE examined…7.5-minute maps and digital ortho quad aerial photographs to identify stream areas most susceptible to erosion." The report goes on to explain how the inventory reach was selected once MSE was on site. Specifically it states, "In accordance with DEQ instructions, MSE selected a reach with evident erosion or with evident potential for erosion based primarily upon land use and practices and the presence of roads." This lack of representative sampling is corroborated in the MSE document on page six. It states, "It is important to note that our site selection methods were designed to inventory eroding sections of the stream; therefore, the *reaches chosen for the stream erosion inventory were not representative of the streams as a whole."*

As outlined in Appendix I, the NRCS Stream Bank Erosion Inventory, used in the MSE study, is a field-based methodology, which measures streambank/channel stability, length of active eroding banks, and bank geometry. When developing sediment load allocations (gross allocations) from streambank erosion it is important to measure and evaluate the sources of sediment. Erosion from streambanks more than 80% stable was not computed into the streambank sediment load allocation.

In 2003 DEQ staff field verified the MSE sites and conducted supplemental erosion inventories. From the additional field inspections and inventories, the DEQ determined that MSE field observations were representative of general bank conditions in the inventoried areas.

> In USDA-NRCS Technical Note 99-1 of the Stream Visual Assessment Protocol it states, “The reach should be representative of the stream through that area. If conditions change dramatically along the stream, you should identify additional assessment reaches and conduct separate assessments for each.”

While Stream Visual Assessment Protocol was collected by MSE, that data was not considered for the load allocation.

> DEQ did request input from IDL on potential sampling sites in an effort to find areas that were accessible and representative. Many of the sites that IDL specifically pointed out as not being representative, due to road/culvert placement or fence locations were sampled anyway.

IDL input was considered when sample locations were selected. Sites were moved to the best practical locations. DEQ is aware of the limitations in site selection and we corrected them where possible.

> If a representative inventory was the intent, IDL questions the validity of using any data obtained by MSE due to its biased nature. If DEQ chooses to use this data as the basis for determining estimated loading rates, even though it is clearly biased, IDL feels that statements should be inserted into the Subbasin Assessment and TMDLs that outline how sampling sites were selected, and point out that loading estimates are likely high because of it.

Answered above. DEQ and MSE data was used in the development of load allocations. The data is not biased and is part of the data considered for load allocations. As stated in section 5.3, regulations allow that loadings “…may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading,”

2) Small sampling size – The 2001 MSE survey inventoried less than 10% of most subject streams, and in most cases was closer to 5%. As an example, only 1.3% of Grays Lake Outlet was inventoried. In Appendix I (page 163) it states, “The length of the sampled reach is a function of stream type variability where stream segments with highly variable channel types need a large sample, whereas segments with uniform gradient and consistent geometry need less.” Streams in the Willow Creek Subbasin are highly variable as stated on page 36. It is clear that the sampling size was inadequate to provide representative results. While time and budgetary restraints make sufficient sampling difficult, it should be stated in the document that sampling size was not in line with the 10-30%

outlined on page 163. With larger sampling sizes, a more representative survey would have been completed.

One individual MSE inventory may have included less than 10% of most subject streams because inventories were done in reaches, which are segments of a stream. Stream "segments" are most often distinct sections of the stream with differing landuse and stream morphology. Reaches were extrapolated to make segments. Breaks in segments were made where landuse and channel geometry differed from the inventoried reach. In addition, to further supplement the MSE inventories, DEQ conducted additional inventories in summer 2003. Between the DEQ and MSE inventories, on average, 25% of the segment (more than one segment per stream) was inventoried before extrapolations were made. So, sample sizes were adequate and well within the range of what would be a statistically valid sample size to represent the overall stream segment's conditions.

Concerning Grays Lake Outlet, the accessible areas of Grays Lake Outlet were inventoried or evaluated by DEQ staff in 2003. Erosion rates were not tabulated from inventories on Grays Lake Outlet because it was not listed for sediment.

3) SVAP/SECI Method – It does not appear that MSE used this NRCS developed system appropriately. IDL fully supports the SWCD's comments, which explain this concern in greater detail. IDL questions whether training for MSE staff was adequate and asks what levels of quality control were utilized by DEQ to ensure that data collected by MSE was accurate and representative. IDL also asks why DEQ did not utilize NRCS staff to train MSE technicians.

DEQ staff has completed nine subbasins using these techniques, inventorying over 100 miles of streams. This familiarity with the methodology enables DEQ to efficiently conduct the inventories. To ensure accurate work and a level of consistency, DEQ conducted inspections (field and document) of contractor work for quality assurance. In all occasions, DEQ staff determined that contracted employees conducted work in accordance with DEQ prescribed methods. DEQ did not deem it necessary to solicit contractor training assistance from NRCS. DEQ was not aware that NRCS was interested in partnering for TMDL development.

4) Total Suspended Sediment – Data collected in 2003 by IASCD is not included or referenced in the Subbasin Assessment on page 62, but should be. It should also be noted, that there were no major exceedances documented. While IDL understands that bank and channel sediment contributions to TSS cannot be differentiated, it can be inferred by the very low TSS readings that streambank erosion at the levels estimated was not occurring. Further discussion should be added explaining the relationship of streambank erosion to TSS and the impact of drought/low flows on these two things. IDL fully supports comments provided by the SWCDs on this issue.

Language to summarize IASCD water quality monitoring data, specifically TSS data, has been added to section 2.3, Water Column Data (heading), Total Suspended Sediment (Subheading). As stated in section 2.3, TSS is a measurement of sediment suspended in the water column. TSS is not a measure of surface sediment or the actual deposition of sediment in important fish spawning gravels. Because of this, TSS is not a target in the TMDL, nor were the load allocations based on instream TSS measurements. The presence and quantity of fine materials in fish spawning gravels is a better measure of the impact that sediment is having on a stream's ability to support beneficial uses.

5) BURP, Total Suspended Sediment, PFC, Natural Sensitivity and Geomorphic Risk data does not corroborate SECI data. If BURP data was used, lateral recession rates applied to determine loading estimates would be much less and more in line with actual conditions. This lack of corroboration puts into question the validity of the estimated loading rates. DEQ should give serious consideration to reevaluating the SECI data and adjust the estimated loading rates to appropriate levels.

A recession rate cannot be extrapolated from a percentage of bank stability from BURP data. To determine a recession rate, field observations must be made pertaining to overall bank stability, bank condition, vegetative cover on banks, channel shape, channel bottom, and deposition. This information can only be gained in the field, observing the stream conditions at the time of the erosion inventory. In addition, BURP data is used as a tool to measure overall stream health whereas the function of an erosion inventory is to measure active and potential streambank erosion.

As stated earlier in the subbasin assessment, the geomorphic risk assessment is a preliminary assessment of the potential for geomorphic activity in areas of the watershed. The geomorphic risk assessment is based on geographic data sets and spatial analysis. Field measurements that are collected during streambank erosion inventories are a quantitative method for measuring streambank erosion.

As with the GRA, PFC data is not quantitative and is therefore not useful in the development of load allocations.

6) On page 163, "Field Methods", it states that modifications to the NRCS system were made and documented. What were these modifications? Did these modifications bias data in any way? These modifications should be clearly outlined in this document as well as any potential data bias that may have occurred.

DEQ modifications to the NRCS system are quantitative and do not bias the data in any way. We make estimates of overall streambank stability by determining percent stability from length of stable and unstable banks. The percentage is then compared to the 80% stability target, as documented in section 5.1 of the document.

7) Extrapolation Method – A small percentage of listed streams was inventoried. It is unclear what method was used to extrapolate these inventories to determine estimated loading rates along stream reaches that were not inventoried. Further discussion should be added explaining how this extrapolation was done.

As outlined in Appendix I, Site Selection (heading), stream reaches are inventoried and then specific stream segments, representative of the inventoried reach are established. Segment breaks are made where there is a change in landuse and stream morphology from the inventoried reach. To represent the different morphology and landuse, where possible a reach is inventoried varying segments. Since the inventoried reach is representative of the segment, it can be extrapolated that the entire segment will have the same erosion as the inventoried reach. As stated earlier, between the DEQ and MSE inventories, on average, 25% of the segment (more than one segment per stream) was inventoried before extrapolations were made. Sample sizes were adequate and well within the range of a statistically valid sample size to represent the overall stream segment's conditions.

<u>Temperature Loading Estimates –</u>Temperature TMDLs developed for most streams in the Subbasin are inappropriate given that the data which showed temperature exceedances were collected during some of the lowest flows ever recorded. Specifically:

1) The MSE document provided to DEQ in January of 2002 discusses how temperature loggers were going to be placed in 15 locations throughout the watershed in 2001 (page 1 of the MSE document). It goes on to state that this was cancelled by DEQ due to extended drought and low flows, "because of concerns that any data obtained in these tasks would not be representative of ordinary stream conditions." Despite this, DEQ used data collected by IDFG and USFS in 2001 and developed TMDLs for nearly every stream despite flows that were among the lowest ever recorded. The same conditions that led DEQ to cancel their efforts still existed. Serious consideration should be given to eliminating the temperature TMDLs, because the data collected showing temperature exceedances is not representative of ordinary stream conditions.

Due to the court-mandated schedule associated with TMDLs in the state of Idaho, temperature data is collected and used in all types of climatic conditions; this includes both ends of the climatic spectrum. The schedule will not be abandoned because climatic conditions are not producing what one would consider "ordinary" or optimal stream conditions.

2) Geothermal influences are mentioned on page 11. Geothermal influence on Brockman Creek is evident near the Brockman Creek/Dan Creek intersection. There are two additional geothermally influenced springs on Idaho Endowment Land just upstream from this intersection. If temperature TMDLs are included in the final document, IDL feels that a statement saying "Elevated temperatures on Brockman Creek may be partly influenced by springs that are geothermally heated," should be included in the discussion.

The presence of geothermal springs on Brockman Creek has not been documented through analytical data however, based on your statement, language discussing the possible presence of geothermal springs on Brockman Creek has been added in section 5.4, Load Allocation (heading), Brockman Creek (subheading).

With the possible presence of geothermal springs on Brockman Creek, it becomes even more important to protect riparian vegetation since Brockman Creek has two documented salmonid spawning tributaries, Sawmill and Corral Creek.

3) On page xviii of the Executive Summary, it is stated that “Streambank erosion and reduced riparian vegetation <u>are</u> the causes of increased water temperatures in the subbasin.” IDL believes that low flows were the primary cause of elevated temperatures for the year the sampling occurred. While IDL recognizes that erosion and lack of shading also impact stream temperatures, it is a gross overstatement to say they are the only causes. Discussion should be added in the Executive Summary detailing the impact of drought and low flows on stream temperatures.

The above-mentioned sentence has been changed to say, “Streambank erosion, reduced riparian vegetation, and low flow conditions are the causes of increased water temperatures in the subbasin.”

The following statement has been added to the executive summary to address the ongoing drought conditions: “Elevated temperatures from reduced riparian vegetation and accelerated streambank erosion have been exacerbated by an ongoing drought in the subbasin.”

4) On page 58, stream temperatures are again discussed, with no reference to extended drought conditions and low flows. Discussion should be added detailing the impact of drought and low flows on stream temperature.

This section of the document is strictly for presenting data and summarizing the findings. All of the flow data for the subbasin is presented in the prior section where one can see that flows are lower than average.

<u>Clarks Cut</u>

1) There is no mention of Clarks Cut’s historical impact on fisheries or the geomorphology of Grays Lake Outlet. Discussion should be added into the document pointing this out.

The DEQ does agree that the addition of Clark’s Cut did have a historical impact on the fishery and overall hydrology and geomorphology of Grays Lake Outlet, however fisheries trend data collected and used in this document was collected after the

construction of the Clark's Cut canal, circa 1906. The declining trend in the fishery, observed in the data, cannot be attributed to the addition of the Clark's Cut canal.

IDL's Conclusion

Clearly, there are problems with most, if not all, of the data collected for the Willow Creek Subbasin Assessment. These problems can be partly attributed to budgetary restraints and limited time frames that prevented more thorough data collection. Possibly the single biggest contributor to the questionable data, was the drought, which made sampling more difficult. Regardless, data limitations that exist are not clearly identified anywhere in the document and should be.

The palatability of the results of the analytical data to land management agencies is the issue in question here. It is known that with all large-scale projects, especially ones with court ordered deadlines, there are unavoidable time and resource constraints. With acceptance and acknowledgement of such constraints the Willow Creek TMDLs were developed utilizing the best available data. DEQ solicited supplemental and more precise data from your agency and none was provided.

Most importantly the document, and specifically the loading estimates and temperature data, lack a foundation based on good science.

The techniques used in the Willow Creek Subbasin Assessment and TMDL are significantly more accurate, scientifically based and robust than any streambank work conducted in the subbasin. Given the size of the watershed, DEQ is certain any refutation of the work will not be undertaken by any entity. If the values reported here are ever validated through the implementation phase, DEQ is confident similar values will result.

The purpose of the TMDL is to address non-point sources of pollution and it is clearly stated in the regulations (40 CFR 130.2(I)) that where data is limited, gross allocations may be made.

IDL is encouraged to provide quantitative data which would allow DEQ to revise the load allocations identified in the document. The TMDL implementation phase allows all Designated Management Agencies the freedom to support or refute land management issues discussed in the document. As IDL progresses through the implementation phase of the TMDL, they will be the only entity deciding any potential land use changes on endowment land. If IDL chooses to participate in long-term water quality characterization and improvement, the watershed stands to reap the benefit.

Sincerely,

L.D. Benedick
Area Supervisor – Eastern Idaho

Comments by Greater Yellowstone Coalition

GYC appreciates the opportunity to submit comments regarding the Willow Creek TMDL. We believe that there are several issues related to the general TMDL process that should be addressed in future work.

The data presented in the TMDL document is quite telling regarding the overall condition of stream health in the Willow Creek Subbasin. It appears that most streams are in “fair to poor” condition and that the characteristics needed to support beneficial uses have been dramatically degraded. The fish data presented in the document shows that native fish populations are down significantly, or in some cases, gone altogether. Both temperature and sediment are dramatically affecting much of the aquatic habitat located in the subbasin. It appears that the streams located throughout the subbasin are in generally poor condition. The degraded state of water quality in the Willow Creek Subbasin is unfortunate, and it should be the focus of future agency/landowner efforts to restore these streams to proper function condition.

One factor that does deserve attention when reviewing the TMDL document is the ongoing drought. Conditions throughout the subbasin have been exacerbated by the drought and have led to lower flows and less vegetation. Recognizing that the drought does play a role is important in assessing current condition. However, the drought should not be used as an excuse to explain the widespread problems in the subbasin. The document identifies land uses throughout the subbasin as being generally homogenous – mostly cattle and sheep production. GYC believes that an important step in the TMDL process is the recognition that certain land uses, in this case sheep and cattle grazing, can have a large impact on stream health. Working in a collaborative way with landowners and other agencies needs to be an integral part of the TMDL process.

We believe that in order for the assessment and TMDL to be worth anything, some sort of regulatory function needs to come after the document has been completed. We realize that an implementation plan will be created, but because of its “voluntary” nature we doubt that much rehabilitation and restoration will actually take place. We suggest that DEQ be more actively involved in the process of working towards improving water quality and stream health. The assessment is a necessary part of the process, but real results come during implementation and enforcement. Simply documenting the “on the ground” problems and then walking away is not an effective way to deal with these issues.

Thank you again for the opportunity to provide comments in this process. Please keep us informed as this process moves forward.

Comments noted.

Sincerely,

Scott Christensen

Greater Yellowstone Coalition

Comments By US Environmental Protection Agency

Thank you for the opportunity to review the draft Willow Creek Subbasin Assessment and TMDLs dated February 2, 2004. EPA would like to acknowledge the large amount of work that went into developing these TMDLs. The following are suggestions which would help to clarify the TMDLs.

Page xxv, Key Findings

For Brockman Creek it states that the TMDL is prescribing an annual loading of 351 tons/mile/year, however Table 43 on page 92 shows that the Load Capacity for Brockman Creek is 25 tons/mile/year with a Load Allocation of -359 tons/mile/year.

Corrected. The prescribed annual loading for Brockman Creek is 25 tons/mile/year.

Buck Creek is left out of the Key Findings section.

Buck Creek is a tributary of Mill Creek and it is located in the Mill Creek assessment unit therefore, Mill Creek load allocations apply to Buck Creek. This language has been added to the Key Findings section of the document.

There is a discrepancy in the current estimated sediment load for Corral Creek between the Key Finding section and the Current Load listed in Table 43.

Corrected. The current estimated erosion rate for Corral Creek is 226 tons/mile/year.

For Willow Creek it states that the TMDL is prescribing an annual loading of 199 tons/mile/year, however Table 43 on page 92 shows a Loading Capacity for Willow Creek is 14 tons/mile/year with a Load Allocation of -199 tons/mile/year.

Corrected. The prescribed annual loading for Willow Creek is 14 tons/mile/year.

Page xxxi, Table B

It is being recommended that Ririe Lake be de-listed for sediment because it has not been assessed. Justifications for de-listings need to follow the guidelines in 40 CFR 130.7(b)(6)(iv).

Statements made in the Key Finding section of this document justify the desisting in accordance with 40 CFR 130.7(b)(6)(iv) which states that…"flaws in the original analysis that led to the water being listed" is a legitimate reason for delisting a water.

Aquatic conditions in the reservoir environment differ from that of streams. Current

biological indices for cold water aquatic life apply to streams, not reservoirs. Given this, the Ririe Reservoir listing for sediment should be delisted, because there was insufficient data to compile an accurate assessment.

Page 50, 2.2 Applicable Water Quality Standards

The Water Quality Standards for temperature, sediment and nutrients should be listed in this section.

Corrected. Language with regards to temperature, sediment, and nutrient water quality standards has been added in section 2.2 of the document.

Page 65, Total Suspended Sediment

The first paragraph on page 65 states that based on Table 31 all but one of the TSS samples meet the best conditions rating of <25 mg/L, however Hell Creek had a TSS reading of 36 and Tex Creek had readings of 59 and 62.

Corrected. Language added to eliminate discrepancy.

Page 66, Nutrient Data

It is noted that at the Pole Bridge sampling site on Willow Creek six samples exceeded the nitrogen criteria and that of all the locations sampled nutrient levels were highest on Sellers Creek with nitrate + nitrite levels elevated on every occasion and phosphorous levels that were above criteria on three occasions. Based on the data provided in Appendix F, for both Sellers Creek and Willow Creek at Pole Bridge, a nutrient TMDL should be completed.

Corrected. Nutrient TMDLs for total Phosphorus and nitrite + nitrate nitrogen were completed and added to the TMDL portion of the document.

Page 89, Sediment

An 80% bank stability target is selected for this Subbasin. Please provide more detail as to why this target works for this Subbasin. Are the specific reference streams in other Subbasins that are similar to streams in the Willow Creek Subbasin?

The 80% stability target works for this subbasin because reference streams were located in Idaho's Salmon River Basin in Rosgen A, B, and C channel types with plutonic, volcanic, metamorphic, and sedimentary geology types. The Willow Creek Subbasin's geology is sedimentary and volcanic in nature and geologic conditions are similar to reference stream geology.

Page 93, Load Allocation

Several streams, including Birch and Long Valley are listed in the TMDL Load Allocation section even though no TMDL was developed for them.

Corrected. Language on Long Valley Creek and Birch Creek has been removed from the TMDL section of the document.

EPA appreciates the opportunity to comment on the draft Willow Creek Subbasin Assessment and TMDLs and we look forward to the final submission. If you have any questions regarding the comments, please contact me at 206-553-6326.

Sincerely,

Tracy Chellis
TMDL Project Manager

Comments from Willow Creek Advisory Group

As chairmen for the Willow Creek WAG we would like to thank the DEQ for the extended time period for the comments. We hope that the extra time may enable a few more landowners to comment about the streams on their private property.

As spokesmen for the WAG we have attended several meetings in regard to the TMDLs and Sub-basin Assessments. We do not profess to be experts in any of the fields that is covered in this document, however we do not concur with all agency technical advisers and their comments on this document. With that in mind we have a few comments also.

The Executive Summary under Key findings on pages xxv-xxix you have listed each stream with a current estimated erosion rate, and then a TMDL prescribed sediment-loading rate. (i.e. Corral Creek 854 tons/mile/year, 18 tons/mile/year). However on page 90 under sediment paragraph four it is stated there is a large degree of uncertainty as to the percentage of sediment loading available before beneficial uses are no longer supported. That indicates to us that DEQ does not know the natural erosion rate, so how can DEQ prescribe a sediment loading rate.

It is true that there is a large degree of uncertainty as to the percentage of sediment loading available before beneficial uses are no longer supported. In the absence of long term and extensive studies in this subbasin it is extremely difficult to know the assimilative capacity of the stream and the actual natural background sediment loading rates. In the absence of extensive data, literature values must be used to make the best and most accurate estimate of natural background loading in the subbasin. The DEQ is required by federal mandate and litigation to develop a sediment-loading rate (TMDL) for streams impaired by sediment and regulations clearly state that loadings "…may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading."

As to the equation for calculation the erosion rate we believe it to be viable for finding the rates, however we feel the results should state what percent of the stream is in that condition. We believe that when and if the TMDLs are developed some of the goals will not be feasible or attainable.

Publishing large-scale generalizations with regards to stream conditions is problematic. TMDLs were developed for several streams where conditions varied considerably and blanket percentages do not fully characterize the conditions over the entire stream length.

In regards to the temperature data that has been gathered for this report, we realize that it is just one point in time, but due to the severe drought conditions over the past three to five years we feel that any data that was collected is not representative of the watershed.

Comment noted.

As spokesmen for the WAG, concerning the site selection (pg 177) it states that typically between 10 and 30 percent of the stream needs to be inventoried. If that was the case, there should be a lot more references to the jobs that the beaver are doing. We believe there should be much more data concerning the beaver complexes in this drainage.

A section on beaver and their influence on stream morphology, hydrology, and water quality has been added in section 1.2, Subbasin Characteristics (heading), Beaver (subheading).

In conclusion as chairmen of the WAG, and after many hour of studying this document, because of the severe drought conditions over the last three to five years we do not agree with most of the data in this report, and cannot except it at this time. We believe that a lot more data needs to be collected in all fairness to the watershed it self.

The DEQ understands your concerns regarding the impact of severe drought conditions on the outcome of the Willow Creek Subbasin Assessment and TMDL. Unfortunately the Subbasin Assessment and TMDL process must continue despite climatic conditions. The opportunity to collect additional data and further characterize the subbasin exists in the implementation phase of the TMDL, as administered by designated land management agencies.

Thank You,

Richard A. Passey	Gary Dixon
Co-Chairman	Co-Chairman
(208) 523-1596	(208) 523-5486

Comments from Rick Passey, Private Landowner

As a landowner in this drainage (Seventy Creek) I would like to thank you for the opportunity to comment on this document.

On 10-26-01 I had the opportunity to not only walk Seventy Creek with the crew of MSE (Johnna Evans and Tony May) and Sheryl Hill (DEQ water quality specialist) but to also observe MSE as they assessed the reach in their document. We started down stream at an old beaver complex about 1 mile from the reach. There was no assessment completed on any of the stream including the beaver complex until we arrived where the cows were drinking. As stated in their report the timing was a typical for that part of the stream.

Comment noted.

Last year I believe that Melissa Thompson (DEQ water quality specialist) also walked portions of this stream. I do not know the exact date, but I believe the only place that she assessed the stream for stream bank erosion was the old beaver complex. As we all know the natural cycles of most streams are, some portions are depository and some are transport. When in that cycle eventually the depositor becomes the transport.

Melissa Thompson preformed assessments below the Beaver Complex (just above road to Passey residence) therefore, the old beaver complex was not included in the TMDL.

As a landowner my greatest concern for the stream is erosion. I also know that when a beaver complex goes out is has to erode. If I count every beaver complex on Seventy Creek there are four old ones (not holding water) and four new ones. If one considers the fact that we are still in a sever drought that is amazing.

Comment noted.

In conclusion, because of all the beaver complexes in Seventy Creek, I do not believe that the erosion rate (288 tons/mile/year) is accurate. I also do not believe that the prescribed loading rate (11 tons/mile/year) is attainable or feasible at all.

Comment noted.

Thank You

Comments from East & West Side Soil and Water Conservation Districts (E&W SWCD) NRCS and IASCD

<u>Participants:</u>
Willow Creek Watershed Advisory Group (WAG)
Natural Resources Conservation Service (NRCS)
East & West Side Soil and Water Conservation Districts (E&W SWCD)
Idaho Department of Lands (IDL)
Idaho Association of Soil Conservation Districts (IASCD)

Purpose: To comment on the Willow Creek Subbasin Assessment and TMDL. Provide assistance to DEQ in commenting on the data, describing concerns, and making subsequent recommendations.

Accomplishments:
> Reviewed: "Final Streambank Erosion and Subsurface Sediment Monitoring Report Willow Creek Watershed" (Referred to as "Report") prepared by Millennium Science and Engineering, Inc., (MSE) for the Idaho Department of Environmental Quality (DEQ) for use in Willow Creek TMDL.
> Reviewed: "Willow Creek Geomorphic Risk Assessment" prepared by Spatial Dynamics for IDEQ for the Willow Creek TMDL.
> Reviewed: SVAP scoring sheets and the Streambank Erosion Condition Inventory (SECI) worksheets from the TMDL.

The following comments, questions and recommendations are submitted in response to the request by the Idaho Department of Environmental Quality (IDEQ) for comments regarding the Willow Creek TMDL and Subbasin Assessment. These comments are divided into two sections. Section A contains general feedback from the East & West Side Soil and Water Conservation Districts, NRCS and IASCD. Section B contains specific comments and concerns in the document. The above participants appreciate the opportunity to submit the following comments for your consideration and recognize the challenges of developing cost effective and defensible TMDLs. Because of time constraints in reviewing the TMDL, we would like to thank you for the extended comment period that was granted. We also value the efforts that have been set forth by the Department of Environmental Quality in assembling and analyzing the information contained in the Document. We look forward to continuing this partnership throughout the TMDL process.

Section A. General Comments:

Temperature Loading Estimates:

Referring to the Key Findings section (xxii), it is stated that temperature TMDLs were developed in all streams where temperature data has been collected and shows an exceedance of temperature criteria in greater than 10% of observation days during spring or fall spawning periods. It is further stated that thermograph data collected established that temperature TMDLs were necessary to meet the numeric salmonid spawning criteria.

1. The MSE document (Pg.1) provided to DEQ in January of 2002 discusses how temperature loggers were to be placed in 15 locations throughout the watershed in 2001. MSE further states that this course of action was cancelled by DEQ due to extended drought and low flows, "because of concerns that any data obtained in these tasks would not be representative of ordinary stream conditions." Contrary to this statement, DEQ used temperature data collected by IDFG and USFS in 2001 for the development of temperature TMDLs on nearly every stream listed. It should be noted in regards to temperature, that the last three years combined are considered the driest periods ever recorded (Appendix 1). These conditions of low flow and drought that

led DEQ to cancel their efforts of logger installation still currently persist. These conditions warrant thorough explanations and serious discussion throughout the Document; specifically in the Key Findings section because the data collected showing subsequent temperature exceedances is not representative of ordinary stream conditions.

The MSE statement is not accurate. Due to the court-mandated deadline associated with TMDLs in the state of Idaho, temperature data is collected and used in all types of climatic conditions; this includes both ends of the climatic spectrum. Deadlines cannot be ignored because climatic conditions are not producing what one would consider "ordinary" or optimal stream conditions.

2. Additionally, it is stated in the Key Findings section (xxiii) that "Streambank erosion and reduced riparian vegetation are the causes of increased water temperatures in the subbasin." Although erosion and lack of shading are certainly factors involved in temperature increases, it would be advantageous to also recognize that record low flows and extended drought conditions during the year that sampling occurred have compounded these exceedances, which consequently may skew ordinary stream conditions; refer to website for supplemental data: (*http://nwis.waterdata.usgs.gov/id/nwis/annual*). Grays Lake should also be mentioned as a possible cause of temperature increase in the watershed considering the Lakes low water levels and that Willow Creek is its natural outlet via Grays Lake Outlet. Further discussion should be outlined in the Executive Summary or Subbasin Assessment detailing the effects of drought and low flows on stream temperatures as well as throughout the Document whenever discussing temperature.

The above-mentioned sentence has been changed to say, "Streambank erosion, reduced riparian vegetation, and low flow conditions are the causes of increased water temperatures in the subbasin."

The following statement has been added to the executive summary to address the ongoing drought conditions: "Elevated temperatures from reduced riparian vegetation and accelerated streambank erosion have been exacerbated by an ongoing drought in the subbasin."

Flow data indicating that controlled flows from Grays Lake Outlet vary is not available. It is clear however, there is limited flow from Grays Lake to Grays Lake Outlet because of the Clarks Cut diversion. The elevated temperatures in the Willow Creek subbasin cannot be attributed to low flows from Grays Lake when the entire drainage is below that point. The tributary influences are much more significant than such a small flow contributed by Grays Lake.

Section 2.3, Flow Characteristics (heading) clearly presents flow data in the Willow Creek subbasin. It is not necessary to explicitly discuss flow regimes in every section of the document. The reader should be able to make judgments based on the data presented in the document.

3. On (Pg.58), stream temperature data is again discussed in regards to Cold Water Aquatic Life (CWAL) and Salmonid Spawning (SS). There is no reference to the extended drought conditions and prolonged low flows; refer to website: (*http://water.usgs.gov/pubs/wdr/wdr-id-03-1/*). The support status of cold water aquatic life and salmonid spawning beneficial uses are influenced by physical factors such as water quality and habitat structure, as well as water quantity. We feel discussion should be added detailing potential impacts of stream temperature exceedances with consideration to the impacts on CWAL and SS. Also, on (Pg.78), observed elevated stream temperatures are discussed that warrant load allocations for all temperature listed streams in the watershed and the development of temperature TMDLs on four non-listed streams. Specifically, "Temperature data showed elevated stream temperatures are common throughout the watershed." There is no reference to extended drought or low flows as a possible cause except for mention of Seventy Creek. However, under the next section of Data Gaps, "extremely dry conditions experienced in the watershed over the past several years" are mentioned for the absence of depth fine data. Low flow conditions certainly are prevalent throughout the watershed and should be noted as such in reference to stream temperature data.

Section 2.3. Water Column Data (heading), Stream Temperature Data (subheading) is a section for presenting raw data not drawing conclusions about data.

The following sentence has been added to section 2.3, Conclusions (heading), "Low flow conditions from continuous low water years may be partly responsible for elevated stream temperatures."

Section 2.3, Flow Characteristics (heading) clearly presents flow data in the Willow Creek subbasin. It is not necessary to explicitly discuss flow regimes in every section of the document. The reader should be able to make judgments based on the data presented in the document

<u>Site Selection: Sampling Size and Locations</u>

1. Under Site Selection (Pg.177) it states that sample reaches were used and "Typically between 10 to 30 percent of the streambank needs to be inventoried." There is question as to where these percentages are derived from. Percentage guidelines are not stated in the SVAP Document as part of the protocol. SVAP states that "The length of the assessment reach should be 12 times the active channel width." Additionally, it states "The length of the sampled reach is a function of stream type variability where stream segments with highly variable channel types need a large sample, whereas segments with uniform gradient and consistent geometry need less." Many of the streams in the Willow Creek Subbasin are highly variable. This is supported on (Pg.36) with, "Geomorphic characteristics of the streams in Willow Creek subbasin vary considerably." Moreover, the MSE Report shows that less than 10% of most selected streams were inventoried. It is evident that the sampling size was inadequate to provide representative results. This may partially

explain some of the discrepancies noted between observed conditions, notes and ratings in the TMDL Document and MSE Report. Overall, larger sample sizes are recommended. Nonetheless, there is awareness that time and budget restraints make sufficient sampling difficult.

The streambank erosion inventory method used in this TMDL is not the SVAP method. DEQ does not see how this statement applies to the guidelines presented in Appendix I, Streambank Erosion Inventory Method.

One individual MSE inventory may have included less than 10% of most subject streams because inventories were done in reaches, which are segments of a stream. Stream "segments" are most often distinct sections of the stream with differing landuse and stream morphology. Reaches were extrapolated to make segments. Breaks in segments were made where landuse and channel geometry differed from the inventoried reach. In addition, to further supplement the MSE inventories, DEQ conducted additional inventories in summer 2003. Between the DEQ and MSE inventories, on average, 25% of the segment (more than one segment per stream) was inventoried before extrapolations were made. So, sample sizes were adequate and well within the range of what would be a statistically valid sample size to represent the overall stream segment's conditions.

2. In the Final Streambank Erosion and Subsurface Sediment Monitoring Report produced by MSE, it states on (Pg.2) that MSE was instructed to identify stream areas most susceptible to stream erosion with no indication of reference sites. Basically, sites with high potential for streambank erosion were targeted for sampling by MSE, rather than representative reaches. "MSE examined… 7.5 minute maps and digital ortho quad aerial photographs to identify stream areas most susceptible to erosion." Specifically it states, "In accordance with DEQ instructions, MSE selected a reach with evident erosion or with evident potential for erosion based primarily upon land use and practices and the presence of roads." The selected reaches included in the inventory do not appear to be representative of the watershed as a whole. There is also a corroborative statement of this on (Pg.6) of the MSE Report. Furthermore, stream reaches immediately adjacent to such channel disturbances (roads) are rarely indicative of watershed channel conditions. In Tech Note 29 of SVAP it is stated that "The reach should be representative of the stream through the area. If conditions change dramatically along the stream, you should identify additional assessment reaches and conduct separate assessments for each." The site selection process brings about questions of the precision of data obtained by MSE on the basis of its non-random nature.

As outlined in Appendix I, the NRCS Stream Bank Erosion Inventory, utilized in the MSE study, is a field-based methodology, which measures streambank/channel stability, length of active eroding banks, and bank geometry. When developing sediment load allocations (gross allocations) from streambank erosion it is important to measure and evaluate the sources of sediment. Erosion from streambanks more than 80% stable was not computed into the streambank sediment load allocation.

In 2003 DEQ staff field verified the MSE sites and conducted supplemental erosion inventories. From the additional field inspections and inventories, the DEQ determined that MSE field observations were representative of general bank conditions in the inventoried areas.

Reach breaks and extrapolation breaks were made where channel morphology and landuses changed.

Streambank Assessment and Data:

The SVAP (Stream Visualization Assessment Protocol) ratings shown in the MSE Report seem to be inappropriate due to the drought conditions and insufficient water in the channel at the time of rating. Some of the scored parameters do not apply when there is no water flowing in the channel such as distinguishing what bankfull height is, channel condition or bank stability. IASCD stated that there has not been a bankfull condition in the last two to three years; refer to: (http://id.water.usgs.gov/public/h2odata.html). Additionally, the difficulty in recognizing the difference between unstable, bare eroding banks and the bare banks normally below the water surface would lead to scores for “channel condition” and “bank stability” being not representative of “normal conditions.” Furthermore, “undercut vegetation” noted may have actually been good quality “overhanging vegetation” but due to drought conditions and beaver activity it was not seen as such.

1. SVAP – The Document (Pg.70,71) states that all streams assessed by MSE received primarily a ‘poor’ to ‘fair’ rating for stream health yet there was no mention of drought or record low flows as a possible cause. The BLM and IDL conducted PFC (Proper Functioning Condition) surveys and results show that the vast majority of stream miles assessed were considered healthy (PFC) and healthy but at risk (FAR). This comparison seems to suggest that the streams are actually “proper” to “functioning” in condition despite the ‘poor’ to ‘fair’ SVAP rating. We suggest that there be some mention of this variance in the Document. Similar studies in the Medicine Lodge Creek Streambank Assessment Summary (Appendix 2) show comparative results between the PFC range and SVAP ratings. The majority of PFC (94.6%) was rated as PFC to FAR and parallel SVAP ratings (81.4%) in Good to Fair condition. Additionally, Streambank Erosion Condition Inventory (SECI) percentages were in support of this correlation with primarily Slight to Moderate (98%) erosion problems. These comparisons lead us to believe that SVAP ratings conducted by MSE for the Willow Creek TMDL are low. Of all streams listed on (Table 36) of the Document, 80% were listed in ‘poor’ condition, which leads to the question; is there really that great of a difference between the PFC and SVAP ratings in the Willow Creek watershed? The table in the Medicine Lodge Report also assigned the PFC ratings with each of the corresponding Reaches sampled, which gave a more precise and visual correlation between SVAP and PFC. This type of table would also be a beneficial tool in the Willow Creek Document on (Pg.70).

The PFC results from IDL and BLM may show that the majority of the streams were PFC and FAR however, the majority of those streams are functional at risk.

Since reaches other than those inventoried by MSE and DEQ were inventoried for PFC and SVAP it is difficult to say that there is a variance or that one inventory is inaccurate. In addition, PFC and SVAP inventories were conducted at different times in different years therefore it is additionally difficult to draw across the board comparisons between the two methods.

2. According to SVAP, "To assess stream health, we need a benchmark of what the healthy condition is." There is question of what, if any, streams in Willow Creek were used as benchmark or reference reaches to determine potential conditions of 303d listed streams. Because of this, how can SVAP, which is used by MSE, indicate what is poor, fair or good? In order for this protocol to work, there needs to be assessments done on a couple of reference or representative stream reaches. These reference reaches and corresponding data indicate what the health of the stream is to judge the rest of the sampled streams by.

Comment noted. SVAP ratings were used as a general characterization of stream conditions and data was not used in the development of TMDLs

3. SVAP Method – Furthermore, it does not appear that MSE used the SVAP system developed by NRCS appropriately. MSE data shows that SVAP is 'poor' to 'fair' on all listed streams. SVAP ratings seem to be low compared to observed conditions. This would show discrepancies in field operations that could indicate a general lack of understanding of how the observed channel conditions fit within the various assessment methods and how SVAP is utilized to depict those conditions. This seems to be true of most of the inventory completed during the 2001 field season in the Willow Creek watershed. This creates the question on whether training for MSE staff was adequate. It states on (Pg.2) of MSE, that Pocket Water, Inc. conducted a one-day training session for all field staff prior to field activities. This training was based on the "Monitoring Protocols to Evaluate Water Quality Effects of Grazing Management on Western Rangeland Streams" (Bauer and Burton, 1993), which MSE followed for conducting Streambank Stability Inventories. It would then seem logical that the inventory field methods for SVAP would be conducted by and/or training provided by the corresponding agency that developed them. The NRCS was not the responsible agency for evaluating stream health in this case. Additionally, each selected site was rated for erosion using the SECI (Stream Erosion Condition Inventory) worksheet originally developed for local use only with training as approved by the NRCS state geologist. NRCS did not participate in any training of the work crews using the worksheet. In the Medicine Lodge Watershed Subbasin Assessment, the Soil Conservation Commission in cooperation with the NRCS conducted a complete stream bank assessment on private land(s) using SVAP, SECI and PFC. We would like to have seen this type of collaboration for data collection in the Willow Creek TMDL. Also, the question arises as to what levels of quality

control were utilized and implemented by DEQ to ensure that data collected by MSE was accurate and representative of the reaches sampled.

Comment noted. DEQ did extend an invitation to NRCS and the SWCD to participate in 2003 erosion inventory work and no staff participated or expressed interest in participating. DEQ conducted inspections (field and document) of contractor work for quality assurance. In all occasions, DEQ staff determined that contracted employees conducted work in accordance with DEQ prescribed methods.

<u>Recession Rates, Sediment, etc:</u>

1. BURP, Natural Sensitivity and Geomorphic Risk data does not seem to corroborate SECI data. If BURP data was used, lateral recession rates applied to determine loading estimates would be much less and more in line with actual conditions. This lack of correlation puts into question the validity of the estimated loading rates and as to why lateral recession rates were so skewed in the Willow Creek Subbasin Assessment. The trends should be similar on what direction the watershed is moving. For instance, in the Medicine Lodge Streambank Erosion Inventory lateral recession rates are comparatively lower and more in line with observed conditions. Subsequently, the Willow Creek field inventory represents an atypical rather than a more representative "annualized" condition due to drought and low flows with the stream being essentially dry. Because discrepancies were so prevalent, this would suggest that the sediment loads that DEQ arrived at could be considerably lower. Assignment of erosion rates using the existing inventory results for even the individual sites described would be difficult due to the discrepancies. DEQ should give serious consideration to reevaluating the SECI data and adjust the estimated loading rates to appropriate levels.

A recession rate cannot be extrapolated from a percentage of bank stability from BURP data. To determine a recession rate, field observations must be made pertaining to overall bank stability, bank condition, vegetative cover on banks, channel shape, channel bottom, and deposition. This information can only be gained in the field, observing the stream conditions at the time of the erosion inventory. In addition, BURP data is purely a reconnaissance level investigation used for water quality assessments. Alternately the function of an erosion inventory is to measure active and potential streambank erosion.

The geomorphic risk assessment is just a preliminary assessment of the potential for geomorphic activity in areas of the watershed. The geomorphic risk assessment is based on geographic data sets and spatial analysis. Field measurements that are collected during streambank erosion inventories are a quantitative method for measuring streambank erosion.

The load allocations are based on an annual loading rate from streambank erosion inventories (not SVAP) therefore; the TMDL is based on an "annualized" condition. The conditions observed in the fall represent some of the potential sediment delivery in

the spring, during high flow conditions, when sediment transport is greatest. The DEQ does not share the opinion that there are discrepancies, therefore, the loading rates are appropriate and will not be altered at this time.

2. Total Suspended Sediment: On (Pg.63) it is stated that all of the TSS samples, except one, meet the best condition criteria (<25 mg/L). This is based on TSS data collected by the BLM. On the other hand, IASCD water quality data (Appendix F, Pg.155) shows that all but two TSSediment samples (Meadow & Birch Creek) met best condition criteria (<25mg.L) and had four exceedences when looking at TSSolids. Furthermore, the IASCD Water Quality Data is not referenced in this section. It would seem to be that sediment loads would be <u>lower</u> due to a low TSS combined with high temperature and low flows caused by drought conditions. If the TSS is very high and total SECI is very high this would suggest that the stream is eroding tremendously. TSS and SECI should be fairly comparable. Low TSS levels reflect that the flows in the subbasin were not significant. TSS levels, temp levels, drought and low flows all point to insufficient water in channel to get significantly high sediment loads. There has to be substantial flows in order for erosion to take place. Mention of low flows and drought with regard to TSS and SECI needs to be addressed in the Findings Section. In general, through stream inventories suggesting very high sediment loads, natural background sediment loads could possibly be lower, due mainly in part to low flows, high temps, and low TSS. Because the water quality samples collected by DEQ were obtained during continuing dry weather conditions, results should not be considered indicative of "the true potential for agricultural impacts on water quality."

Language to summarize IASCD water quality monitoring data, specifically TSS data, has been added to section 2.3, Water Column Data (heading), Total Suspended Sediment (Subheading). As stated in section 2.3, TSS is a measurement of sediment suspended in the water column. TSS is not a measure of surface sediment or the actual deposition of sediment in important fish spawning gravels. Because of this, TSS is not a target in the TMDL, nor were the load allocations based on instream TSS measurements. The presence and quantity of fine materials in fish spawning gravels is a better measure of the impact that sediment is having on a stream's ability to support beneficial uses.

Erosion can take place in both high and low flow conditions; spring runoff has a significant ability to transport sediment. Some of the BURP assessments for the 303(d) listed streams were conducted in wetter than average years and beneficial use support was not attained during high flow events. Given this, it cannot be said that the streams are impaired due to drought conditions.

3. Extrapolation Method: From looking at the inventory data, between 10 and 20 percent of streams were inventoried. What data analysis was used to extrapolate total stream sediment loads?

As outlined in Appendix I, Site Selection (heading), stream reaches are inventoried and then specific stream segments, representative of the inventoried reach are established. Segment breaks are made where there is a change in landuse and stream morphology from the inventoried reach. To represent the different morphology and landuse, where possible a reach is inventoried varying segments. Since the inventoried reach is representative of the segment, it can be extrapolated that the entire segment will have the same erosion as the inventoried reach. Between the DEQ and MSE inventories, on average, 25% of the segment (more than one segment per stream) was inventoried before extrapolations were made. So, sample sizes were adequate and well within the range of what would be a statistically valid sample size to represent the overall stream segment's conditions.

4. Beaver Activity: Due to drought and low flows, more discussion needs to be directed towards the relationship between sediment loads, shift in hydrology and the impacts on stream morphology due to beaver influence in the Willow Creek watershed. Beavers significantly affect fluvial geomorphology of a stream. Active-established beaver complexes are noted in the Report with ratings of severe channel instability and erosion. That combination would be highly unusual as beaver do not usually persevere in highly unstable streams. Beaver dams normally serve as sediment retention or storage areas rather than an erosion or sediment producing area. More discussion needs to be mentioned in the document on these effects, encompassing historical and current beaver influences under the Hydrology Section (Pg.7) or wherever you see fit.

A section on beaver and their influence on stream morphology, hydrology, and water quality has been added in section 1.2, Subbasin Characteristics (heading), Beaver (subheading).

5. Under Field Methods, (Pg.177) it states that the NRCS document (1983) outlines field methods used in this inventory. "However, slight modifications to the field methods were made and are documented." There is no reference to these modifications. There should be some outlined discussion of these modifications following this statement. There is further question as to how these changes may have biased streambank erosion or channel stability inventories. This should also be clearly documented accordingly.

DEQ modifications to the NRCS system are quantitative and do not bias the data in any way. We make estimates of overall streambank stability by determining percent stability from length of stable and unstable banks. The percentage is then compared to the 80% stability target, as documented in section 5.1 of the document.

<u>Section B. Specific Comments:</u>

1. Under Key findings (section xxiii), Brockman Creek has a prescribed sediment-loading rate of 351 tons/mile/year. On Table 43 (Pg.92), under Sediment Load Allocation findings, there is a prescribed load of 25 t/mi/y. There's a discrepancy

between the prescribed annual loading rate of 351 t/mi/y and the tables load capacity erosion rate of 25 t/mi/y, which is presumed to be the prescribed annual loading rate. This is also the case of Willow Creek with a prescribed loading rate of 199 t/mi/y and a contradictory load capacity of 14 t/mi/y listed in the table. Furthermore, under (section xxiii), Corral Creek is stated to have a current erosion rate of 854 t/mi/y, yet on (Pg.92) Table 43 it is stated to have a current load of 226 t/mi/y. After reviewing all other streams listed and comparing estimated and prescribed loading rates to the data listed in Table 43, there are inconsistencies with only these three streams. There also seems to be some confusion between sediment yields and sediment loads.

Corrected in the document. Brockman Creek's prescribed sediment loading rate is 25 tons/mile/year, Willow Creek's load capacity is 14 tons/mile/year. The current erosion rate for Corral Creek is 226 tons/mile/year.

2. Clark's Cut should be mentioned in the "Key Findings" section relating to its contribution to temperature increases, historic impact on fisheries and sediment loading versus background levels. Also, reference to its relationship with Grays Lake Outlet.

The DEQ does agree that the addition of Clark's Cut did have a historical impact on the fishery and overall hydrology and geomorphology of Grays Lake Outlet, however fisheries trend data collected and used in this document was collected after the construction of the Clark's Cut canal, circa 1906. The declining trend in the fishery, observed in the data, cannot be attributed to the addition of the Clark's Cut canal.

3. Sediment loads were also established for Sellars, Mill and Tex Creeks (Pg.92), which are corroborated under the "Key Findings" section for each creek. However, under streambank assessment data, (Pg.70) inventories of these creeks are not listed. How can there be an established load when there is no inventory for these streams?

Streambank assessments were not conducted on Tex Creek since banks met the 80% stability target. The sediment TMDL for Tex Creek was based on road erosion modeling. Erosion inventory data for Mill Creek is already located in the section on streambank assessment data. Erosion inventory summary data for Sellars Creek will be added to the table.

4. General grazing trends should be noted in the document where applicable on the Willow Creek watershed. It should be indicated here that reaches would look different in the later fall during or following the grazing period, with noticeable impacts to vegetation and water clarity due to grazing and water access. These impacts may not be long-term.

DEQ is unaware of what the grazing trends are in the subbasin. Grazing trend information was not provided by the land management agencies for the Subbasin Assessment. Sediment deposition in spawning gravels is one of the final indicators of the impacts of sediment on beneficial use support, regardless of water clarity impacts

from grazing access. Reduced vegetative cover contributes to elevated stream temperatures at critical times.

5. Under water quality standard Sec 2.2 (last sentence of first paragraph). The appendix was mislabeled and should be appendix D instead of appendix C. (Appendix C is the Unit Conversion Chart)

Corrected.

Conclusion Statement:

Overall, we feel inventory discrepancies and the lack of consistency in observed conditions and data collection may cause difficulties in the extrapolation procedures used to evaluate the watershed as a whole. Furthermore, using the existing inventory for assignment of erosion rates for the various sites listed would be difficult due to these discrepancies. Using the current erosion rates derived from these sites as being “representative” of the watershed would be flawed. We recommend reevaluation of erosion rates as well as temperature TMDLs, TSS samples and SECI/SVAP data as stated in the above comments. Also, we would like to see reference throughout the Document in regards to drought and low flow conditions as well as subsequent consequences. It would be difficult to base future management decisions on interpretations from this extreme condition without amendment towards a more typical condition.

Through the process of implementation, land management agencies will be able to field truth and re-evaluate DEQ’s field data and overall assessment of water quality. At that time, perceived discrepancies and inconsistencies may come to light.

The ongoing drought is a perplexing issue and the DEQ does not dispute the fact that dry climatic conditions have occurred in the Willow Creek Subbasin for several years. That said, the drought is not the sole reason for the lack of beneficial use support in the 303(d) listed streams. Streams were assessed as impaired prior to the drought conditions, some during high water years.

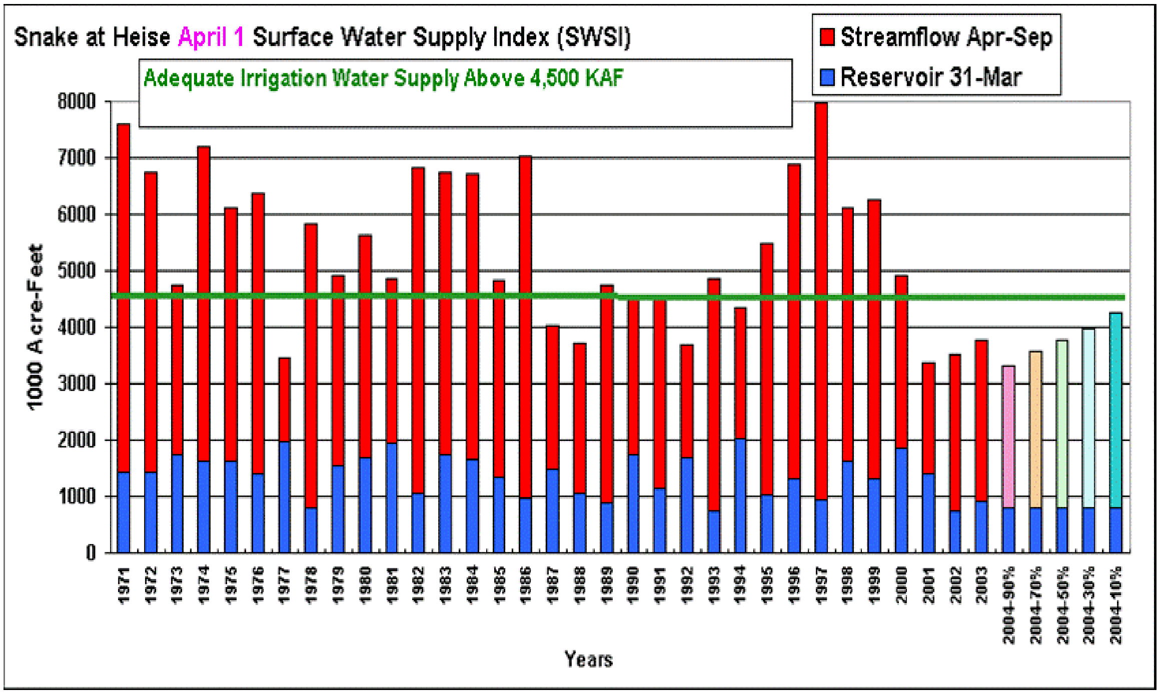
The above listed participants certainly appreciate the opportunity to comment on the Willow Creek TMDL and Subbasin Assessment and again thank you for the extended comment period. We recognize that many of these problematic issues can be partially attributed to limited time frames within the TMDL process and subsequent budget restraints that do occur. We are aware that these factors may also be impediments in the data collection process. We hope our continuing partnership throughout the TMDL process, now and in the future, will endure as a joint venture allowing progress to move forward and management decisions to be carried out. Questions or further information that you may require in regards to the above comments can be referred to the NRCS field office in Idaho Falls.

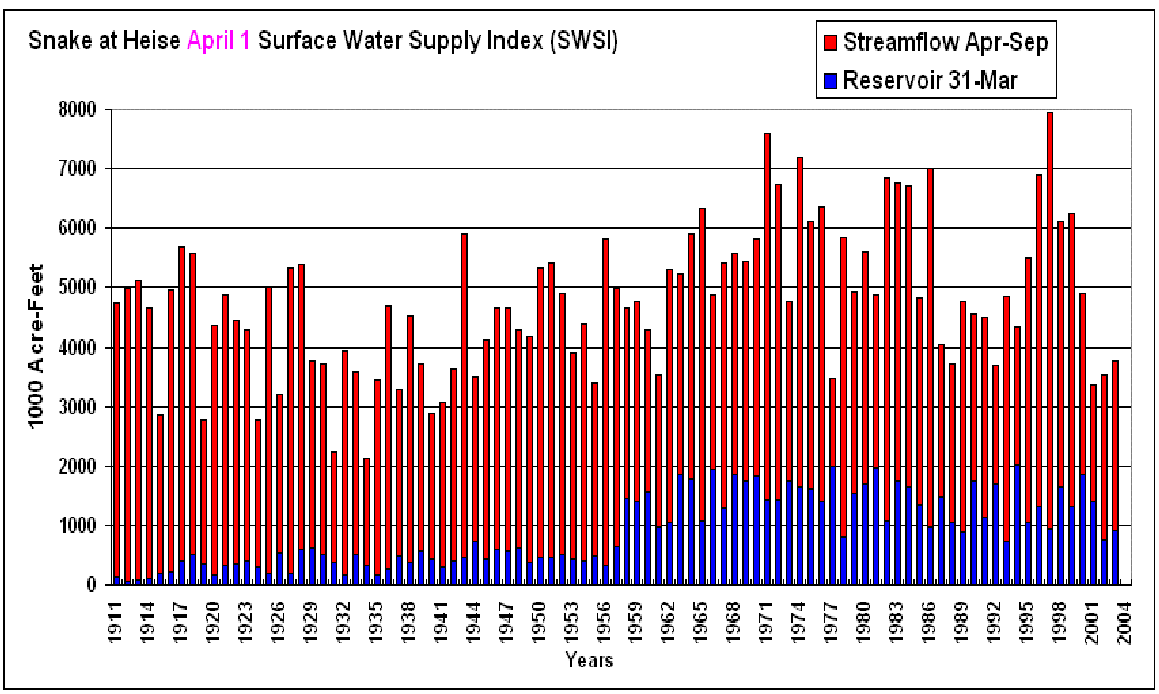
Thank you.

Sincerely,

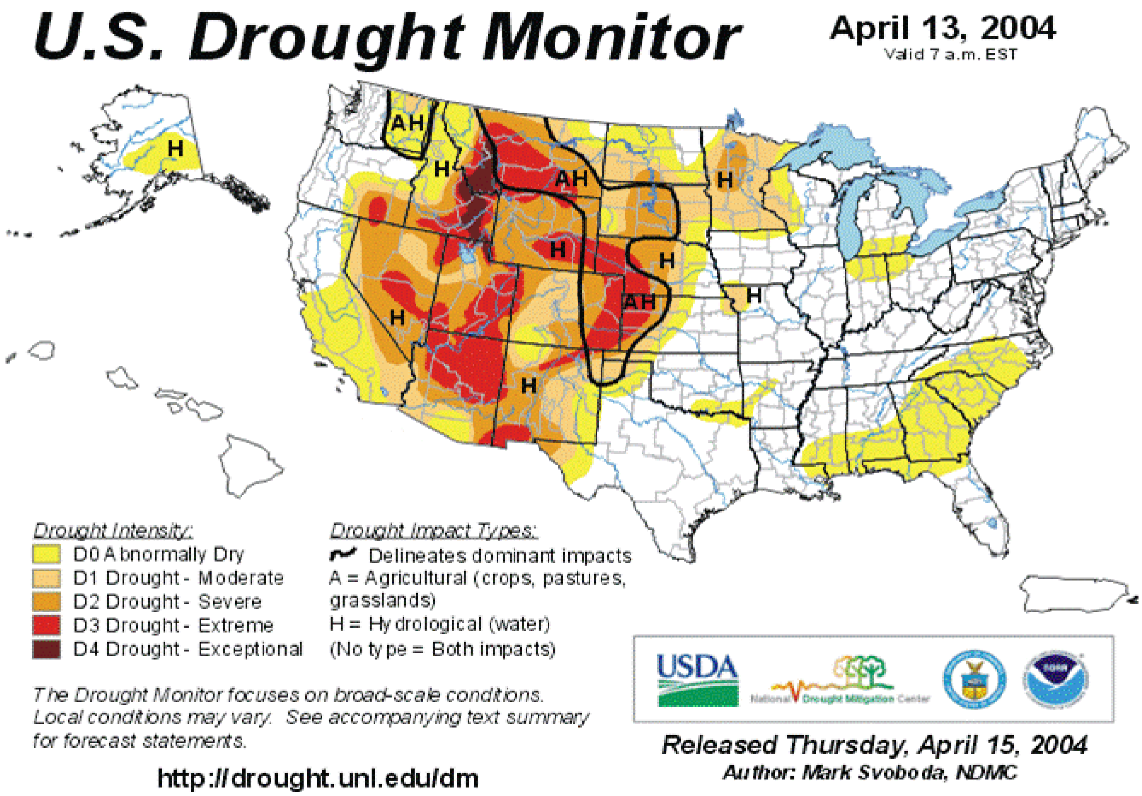
East & West Side SWCD
NRCS
IASCD

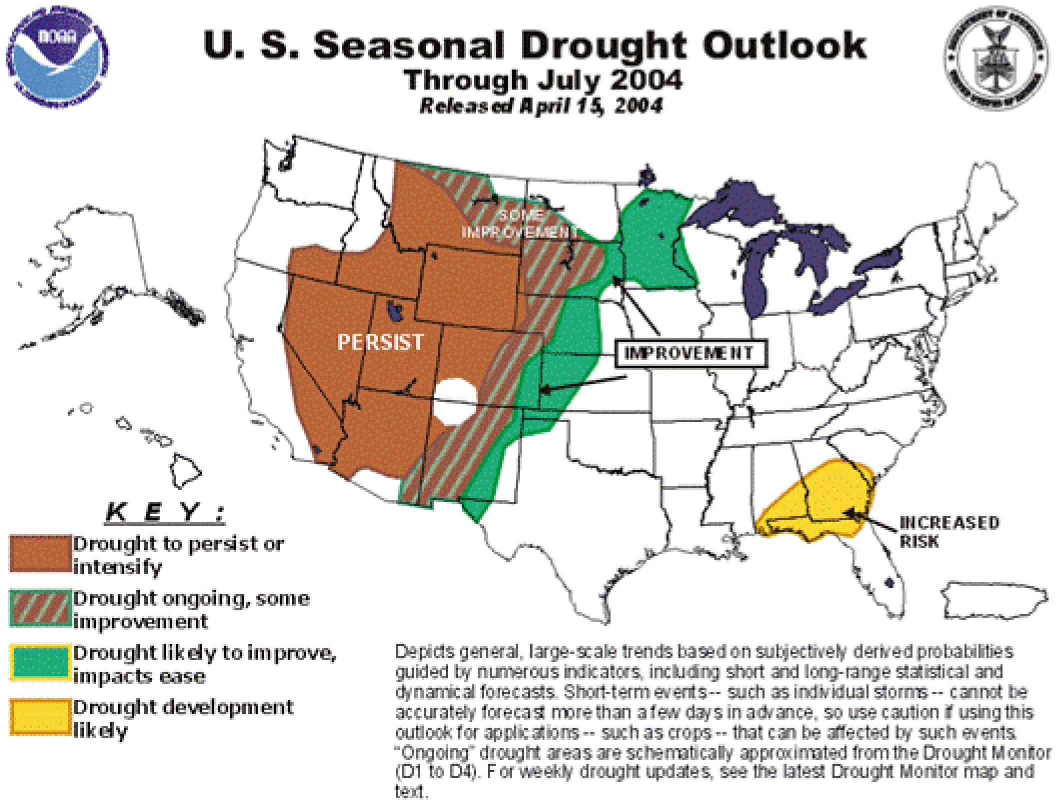
Appendix 1


Snake at Heise April 1 Surface Water Supply Index (SWSI)
Streamflow Apr-Sep
Reservoir 31-Mar
Adequate Irrigation Water Supply Above 4,500 KAF
1000 Acre-Feet
Years


Snake at Heise April 1 Surface Water Supply Index (SWSI)
Streamflow Apr-Sep
Reservoir 31-Mar
1000 Acre-Feet
Years

Appendix 1


U.S. Drought Monitor
April 13, 2004
Valid 7 a.m. EST
Drought Intensity:
D0 Abnormally Dry
D1 Drought - Moderate
D2 Drought - Severe
D3 Drought - Extreme
D4 Drought - Exceptional
Drought Impact Types:
Delineates dominant impacts
A = Agricultural (crops, pastures, grasslands)
H = Hydrological (water)
(No type = Both impacts)
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.
http://drought.unl.edu/dm
USDA
National Drought Mitigation Center
Released Thursday, April 15, 2004
Author: Mark Svoboda, NDMC


U. S. Seasonal Drought Outlook
Through July 2004
Released April 15, 2004
SOME IMPROVEMENT
PERSIST
IMPROVEMENT
INCREASED RISK
KEY:
Drought to persist or intensify
Drought ongoing, some improvement
Drought likely to improve, impacts ease
Drought development likely
Depicts general, large-scale trends based on subjectively derived probabilities guided by numerous indicators, including short and long-range statistical and dynamical forecasts. Short-term events -- such as individual storms -- cannot be accurately forecast more than a few days in advance, so use caution if using this outlook for applications -- such as crops -- that can be affected by such events. "Ongoing" drought areas are schematically approximated from the Drought Monitor (D1 to D4). For weekly drought updates, see the latest Drought Monitor map and text.

Appendix 2

Medicine Lodge Creek Subwatershed Stream/Riparian Assessment Summary

Reach	Remainder Length	Erodible Bank	SVAP	PFC/ Range	SECI Remainder	RemainderTons/Year	SECI Erodible	Erodible Bank Tons/Y	Tons/ Mile
M1& M2	1.7	0.1	Poor	FAR/High	Slight	69	Moderate	31	55
M3	1.7	0.1	Fair	PFC/Mid	Slight	59	Moderate	22	44
M4-A	0.4	0.05	Poor	FAR/Mid	Severe	142	Severe	15	342
M4-B&M5-A	1.1	0.05	Fair	PFC/Mid	Slight	61	Slight	2	57
M5-B	0.7		Fair	FAR/Mid	Slight	10			15
M6-A	1.3	0.03	Fair	PFC/Mid	Moderate	87	Moderate	2	67
M6-B	1.6	0.1	Fair	FAR/High	Slight	93	Severe	53	84
M7	1.4	0.09	Good	PFC/High	Slight	23	Moderate	11	22
M8-A	0.9	0.4	Poor	FAR/Mid	Moderate	130	Severe	139	203
M8-C	1.5	0.1	Good	FAR/Mid	Slight	69	Severe	34	64
M9	1.7	0.02	Good	PFC/Mid	Slight	58	Moderate	4	37
M10-A	0.9	0.1	Fair	PFC/Low	Slight	36	Severe	36	71
M10-B	1.3	0.5	Fair	FAR/Mid	Slight	61	Severe	156	122
M11	2.1	0.2	Good	PFC/Low	Slight	52	Severe	41	40
M12-A	1.5	0.09	Fair	FAR/High	Slight	86	Severe	31	74
M12-B	1.3	0.3	Poor	N/Mid	Moderate	177	Severe	125	190
M13	1.1	0.2	Fair	FAR/Mid	Slight	50	Severe	74	94
M14	0.6	0.05	Fair	FAR/High	Slight	17	Moderate	11	43
M15	0.7		Good	PFC/Mid	Moderate	18			27
M16	1.0		Fair	PFC/Low	Slight	17			16
M17	1.5		Fair	PFC/Mid	Moderate	41			27
M18	0.2		Poor	FAR/Mid	Moderate	12			55
Total	**26.3**	**2.6**				**1368**		**719**	**###**

Streambank Erosion Condition Inventory-Remainder

Percent of stream with a Slight Erosion Problem	75%
Percent of stream with a Moderate Erosion Probl	23%
Percent of stream with a Severe Erosion Problem	2%
Total Percent of Stream asses:	100%

Streambank Erosion Condition Inventory-Eroding Banks

Percent of stream with a Slight Erosion Problem	2%
Percent of stream with a Moderate Erosion Probl	18%
Percent of stream with a Severe Erosion Problem	80%
Total Percent of Stream asses:	100%

Stream Visual Assessment Protocol

Percent of stream in Poor Condition	18.5%
Percent of stream in Fair Condition	54.9%
Percent of stream in Good Condition	26.5%
Percent of stream in Excellent Condition	0.0%
Total Percent of Stream assessed	100.0%

Proper Functioning Condition Checklist

Percent of stream rated Proper Functioning Cond	47.5%
Percent of stream rated Functional at Risk (FAR)	47.1%
Percent of stream rated Nonfunctional (N)	5.4%
Total Percent of Stream assessed	100.0%