Lower Payette River Subbasin Assessment and Total Maximum Daily Loads

2013 Addendum

(Hydrologic Unit Code 17050122)

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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 water bodies required by this section

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

ADB assessment database

AU assessment unit

BMP best management practice

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

cfu colony forming unit

CGP Construction General Permit

DEQ Idaho Department of Environmental Quality

DO dissolved oxygen

EPA United States Environmental Protection Agency

GIS Geographical Information Systems

HUC Hydrologic Unit Code

IDAPA Refers to citations of Idaho administrative rules

IDL Idaho Department of Lands

ISDA Idaho State Department of Agriculture

kWh kilowatt-hour

LA load allocation

lb pounds

LC load capacity

m meter

mi mile

mi^2 square miles

mg/L milligrams per liter

MOS margin of safety

MS4 municipal separate storm sewer system

MSGP Multi-Sector General Permit

NB natural background

NPDES National Pollutant Discharge Elimination System

NREL National Renewable Energy Laboratory

NTU nephelometric turbidity unit

PNV potential natural vegetation

SEV Severity of Ill Effects

SSC suspended sediment concentration

SWPPP stormwater pollution prevention plan

TMDL total maximum daily load

TSS total suspended sediment

US United States

USC United States Code

WAG Watershed Advisory Group

Executive Summary

The federal Clean Water Act 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 Clean Water Act, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the nation's waters whenever possible. Section 303(d) of the Clean Water Act establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards).

States and tribes must periodically publish a priority list (a "§303(d) list") of impaired waters. Currently this list must be published every 2 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 one water body in the lower Payette River subbasin that was placed in Category 5 of Idaho's 2010 Integrated Report as impaired. Additional pollutants were found to be impairing water quality but were not listed in Category 5. These impairments were addressed in the TMDL. This document addresses sediment, *Escherichia coli (E. coli)*, and temperature TMDLs for the impaired assessment unites (AUs). For more information about these watersheds and the subbasin as a whole, see the *Lower Payette River Subbasin Assessment and Total Maximum Daily Load* (DEQ 1999) at *www.deq.idaho.gov/media/463584_water_data_reports_surface_water_tmdls_payette_river_lower_payette_lower_entire.pdf.*

This TMDL analysis has been developed to comply with Idaho's TMDL requirements. A TMDL analysis determines instream water quality targets, calculates load capacities, estimates existing pollutant sources, and allocates responsibility for load reductions needed to return listed waters to a condition meeting water quality standards.

Subbasin at a Glance

Subbasin: Lower Payette River, hydrologic unit code (HUC) 17050122, 5th field HUC: Little Willow Creek

Key resources affected: cold water aquatic life and secondary contact recreation

Pollutants: Sediment, *E. coli*, and temperature

Little Willow Creek is a 5th field HUC located within the lower Payette River subbasin and is a tributary of the Payette River. This document presents an addendum to the 1999 *Lower Payette River Subbasin Assessment and Total Maximum Daily Load* and addresses the water bodies in the Little Willow Creek watershed that are on Idaho's current §303(d) list (Figure A) along with two unlisted pollutants causing water quality impairment.

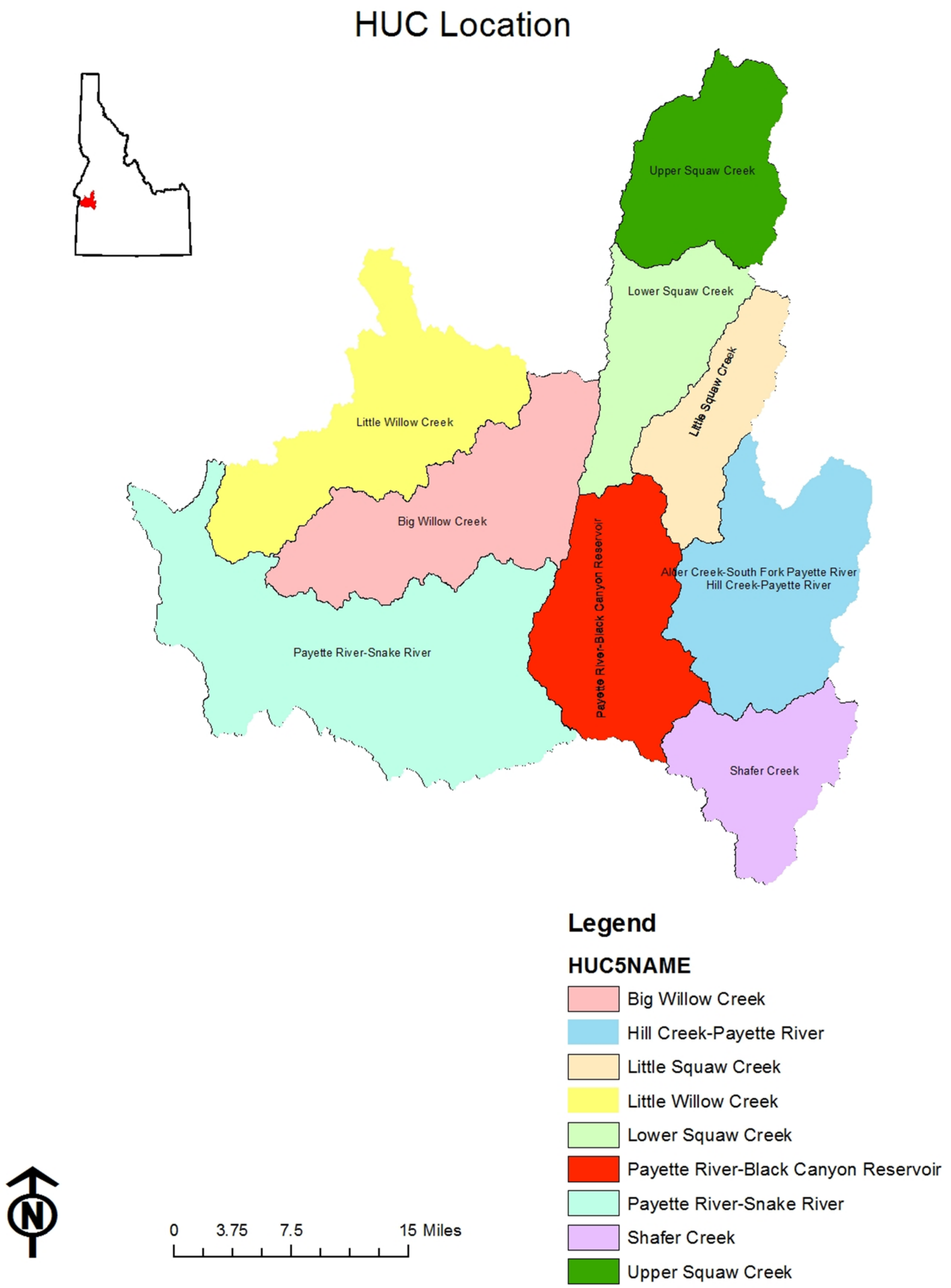

Figure A. Little Willow Creek hydrologic unit code overview.

Key Findings

In 2010, the Idaho Department of Environmental Quality (DEQ) completed a 5-year review of the original lower Payette River TMDL (DEQ 2010a) at *www.deq.idaho.gov/media/463708-_water_data_reports_surface_water_tmdls_payette_river_lower_lower_payette_five_year_review_final_0210.pdf* that indicated the beneficial uses of Little Willow Creek were impaired. In 2007, the Idaho State Department of Agriculture (ISDA) collected suspended sediment concentration data, *E. coli* data, and stream temperature data that indicated beneficial uses were impaired in Little Willow Creek. In 2012, DEQ collected additional *E. coli* and temperature data from Little Willow Creek confirming contact recreation and cold water aquatic life beneficial uses were impaired. *E. coli* levels in Little Willow Creek exceeded Idaho "Water Quality Standards" (IDAPA 58.01.02) (geometric mean calculated at 126 colony forming units (cfu)/100 milliliters (mL) for contact recreation. Temperature also exceeded water quality standards for cold water aquatic life (water temperatures of 22°C or less with a maximum daily average of 19°C or less). Both cold water aquatic life and contact recreation are impacted by nonpoint source pollutants.

Effective target shade levels were established for two AUs based on the concept of maximum shading under potential natural vegetation resulting in natural background temperature levels. Shade targets were derived from effective shade curves developed for similar vegetation types in Idaho. Existing shade was determined from aerial photo interpretation that was partially field verified with Solar Pathfinder data. Target and existing shade levels were compared to determine the amount of shade needed to bring water bodies into compliance with temperature criteria in IDAPA 58.01.02. A summary of assessment outcomes, including recommended changes to listing status in the next Integrated Report, is presented in Table A.

Both AUs lacked shade and needed solar load reductions. The 3rd order stream segment in the canyon below Paddock Valley Reservoir was in better condition than the lower 4th order stream segment where agriculture remains the dominant land use. Riparian plant community instability is likely exacerbated by flashy, high spring runoff events. Target shade levels for individual stream segments should be the goal managers strive for with future implementation plans. Managers should focus on the largest differences between existing and target shade as locations to prioritize implementation efforts.

TMDLs were developed for two AUs on Little Willow Creek. Little Willow Creek (ID17050122SW018_04) had three TMDLs developed for sediment, *E. coli*, and temperature. Little Willow Creek (ID17050122SW018_03) had one TMDL developed for temperature.

Only Little Willow Creek (ID17050122SW018_04) was listed for sediment in the 2010 Integrated Report. As water quality data suggested, beneficial uses were impaired for temperature (ID17050122SW018_03 and ID17050122SW018_04) and *E. coli* (ID17050122SW018_04) (Figure B). TMDLs were developed for these unlisted but impaired AUs and pollutants. Table A summarizes the assessment outcomes and current Integrated Report status. The 2010 Integrated Report is available at *www.deq.idaho.gov/media/725927-2010-integrated-report.pdf.*

Public Participation

During the development of the Little Willow Creek TMDL, DEQ held the following public meetings with the Watershed Advisory Group (WAG) and other groups to discuss Idaho State Department of Agriculture data, DEQ data collection and methods, TMDL options, sources of pollutants, implementation, and implications.

- WAG, November 2, 2011
- Gem Soil and Water Conservation District, May 7, 2012
- Payette Soil and Water Conservation District, May 16, 2012
- Payette Soil and Water Conservation District, July 18, 2012
- WAG, October 31, 2012
- Little Willow Creek Irrigation District, December 11, 2012
- WAG, January, 30, 2013
- WAG, 30 day comment period July 2013
- Public Comment, 30 days August 2013

Table A. Summary of assessment outcomes.

Water Body/ Assessment Unit	Most Recent Integrated Report Listing	Pollutant	TMDL(s) Completed	Recommended Changes to the next Integrated Report	Justification	TMDL Targets
Little Willow Creek ID17050122SW018_04	2010	Sediment	Sediment (TSS)	Move to Category 4a	TMDL completed	20 mg/L TSS
Little Willow Creek ID17050122SW018_04	Unlisted but impaired	Bacteria	Bacteria (*E. coli*)	Move to Category 4a	TMDL completed	126 cfu/100 mL 30-day geometric mean
Little Willow Creek ID17050122SW018_03	Unlisted but impaired	Temperature	Temperature (PNV)	Move from Category 2 to Category 4a	TMDL completed	See table 16
Little Willow Creek ID17050122SW018_04	Unlisted but impaired	Temperature	Temperature (PNV)	Move to Category 4a	TMDL completed	See table 17

Notes: Total suspended sediment (TSS); potential natural vegetation (PNV); total maximum daily load (TMDL); colony forming unit (cfu); milligram per liter (mg/L)

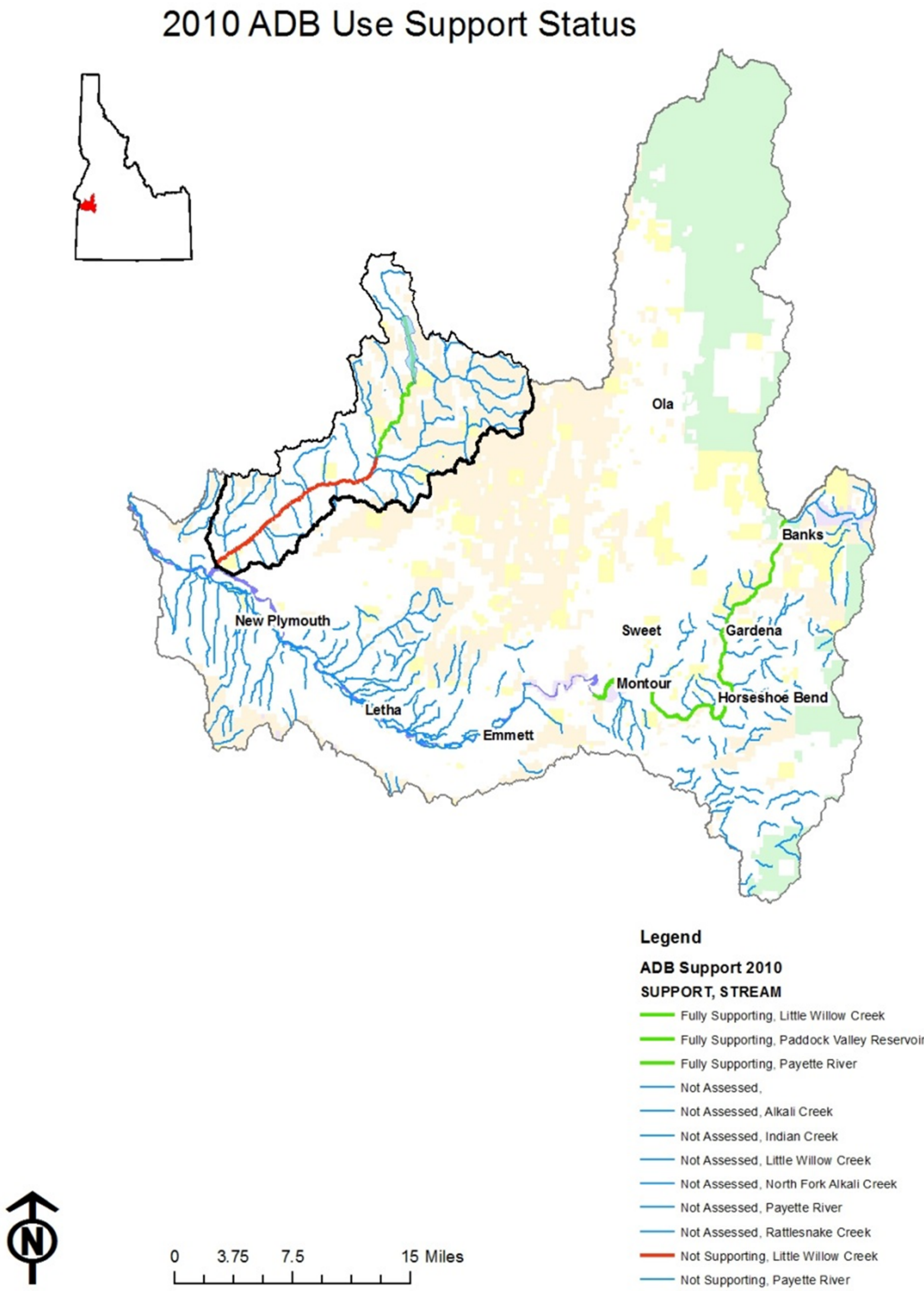

Figure B. Beneficial use support status for 2010.

Introduction

This document addresses one water body and two assessment units (AUs) in the lower Payette River subbasin that is in either Category 5 of Idaho's 2010 Integrated Report or has been identified as impaired. This document addresses sediment, *Escherichia coli (E. coli)*, and temperature total maximum daily loads (TMDLs) for these AUs. For more information about these watersheds and the subbasin as a whole, see the *Lower Payette River Subbasin Assessment and Total Maximum Daily Load* (DEQ 1999) at *www.deq.idaho.gov/media/463584-_water_data_reports_surface_water_tmdls_payette_river_lower_payette_lower_entire.pdf*. The purpose of this TMDL addendum is to characterize and document pollutant loads within the lower Payette River subbasin. The first portion of this document presents key characteristics or updated information for the subbasin assessment, which is divided into four major sections: subbasin characterization (section 1), water quality concerns and status (section 2), pollutant source inventory (section 3), and a summary of past and present pollution control efforts (section 4). While the subbasin assessment is not a requirement of the TMDL, the Idaho Department of Environmental Quality (DEQ) performs the assessment to ensure impairment listings are up-to-date and accurate.

The subbasin assessment is used to develop a TMDL for each pollutant of concern for the lower Payette River subbasin. The TMDL (section 5) 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 water body and still allow that water body to meet water quality standards (40 CFR 130). Consequently, a TMDL is water body- and pollutant-specific. The TMDL also allocates allowable discharges of individual pollutants among the various sources discharging the pollutant.

Regulatory Requirements

This document was prepared in compliance with both federal and state regulatory requirements. The federal government, through the United States Environmental Protection Agency (EPA), assumed the dominant role in defining and directing water pollution control programs across the country. DEQ implements the Clean Water Act in Idaho, while EPA oversees Idaho and certifies the fulfillment of Clean Water Act requirements and responsibilities.

Congress passed the Federal Water Pollution Control Act, more commonly called the Clean Water Act, in 1972. The goal of this act was to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (33 USC §1251). The act and the programs it has generated have changed over the years as experience and perceptions of water quality have changed. The Clean Water Act 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 ensure "swimmable and fishable" conditions. These goals relate water quality to more than just chemistry.

The Clean Water Act 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 Clean Water Act, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the nation's waters whenever possible. DEQ must review those standards every 3 years, and EPA must approve Idaho water quality standards. Idaho adopts water quality standards to protect public health and welfare, enhance water quality, and protect biological integrity. A water quality standard defines the goals of a water body 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.

Section 303(d) of the Clean Water Act establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list (a "§303(d) list") of impaired waters. Currently, this list is published every 2 years as the list of Category 5 waters in Idaho's Integrated Report. For waters identified on this list, states and tribes must develop a TMDL for the pollutants, set at a level to achieve water quality standards.

DEQ monitors waters, and for those not meeting water quality standards, DEQ must establish a TMDL for each pollutant impairing the waters. However, some conditions that impair water quality do not require TMDLs. EPA considers certain unnatural conditions—such as flow alteration, human-caused lack of flow, or habitat alteration—that are not the result of discharging a specific pollutant as "pollution." TMDLs are not required for water bodies impaired by pollution, rather than a specific pollutant. A TMDL is only required when a pollutant can be identified and in some way quantified.

1 Subbasin Assessment—Subbasin Characterization

This document presents an addendum to the *Lower Payette River Subbasin Assessment and Total Maximum Daily Load* (DEQ 1999) at *www.deq.idaho.gov/media/463584-_water_data_reports_surface_water_tmdls_payette_river_lower_payette_lower_entire.pdf.* It addresses the water bodies in the Little Willow Creek that have been placed on Idaho's current §303(d) list or have been identified as impaired and not supporting beneficial uses.

1.1 Physical and Biological Characteristics

A general discussion of the physical and biological characteristics of the lower Payette River subbasin are found in the subbasin assessment and TMDL (DEQ 1999) at *www.deq.idaho.gov/media/463584-_water_data_reports_surface_water_tmdls_payette_river_lower_payette_lower_entire.pdf* and the *Lower Payette River TMDL Five-Year Review* (DOE 2010a) at *www.deq.idaho.gov/media/463708-_water_data_reports_surface_water_tmdls_payette_river_lower_lower_payette_five_year_review_final_0210.pdf*.

While these documents provide a good overview of both physical and biological characteristics of the 4th field order Payette River hydrologic unit code (HUC), detailed data for the 5th field HUCs, including the Little Willow Creek HUC is limited.

Little Willow Creek is a highly modified system used primarily for irrigation. Numerous dams and diversions on Little Willow Creek facilitate irrigation use. Flow decreases significantly downstream as water is diverted, and during years of low flow, it is common for the stream to run dry in segments as water is fully diverted for agriculture. There are no known threatened or endangered species in Little Willow Creek.

Climate and Hydrology

Precipitation in the Little Willow Creek watershed ranges from an average of 7 to 35 inches per year and is representative of the lower Payette River HUC (Figure 1). Detailed discussion of climate is found in the subbasin assessment and TMDL (DEQ 1999) at *www.deq.idaho.gov/media/463584-_water_data_reports_surface_water_tmdls_payette_river_lower_payette_lower_entire.pdf*.

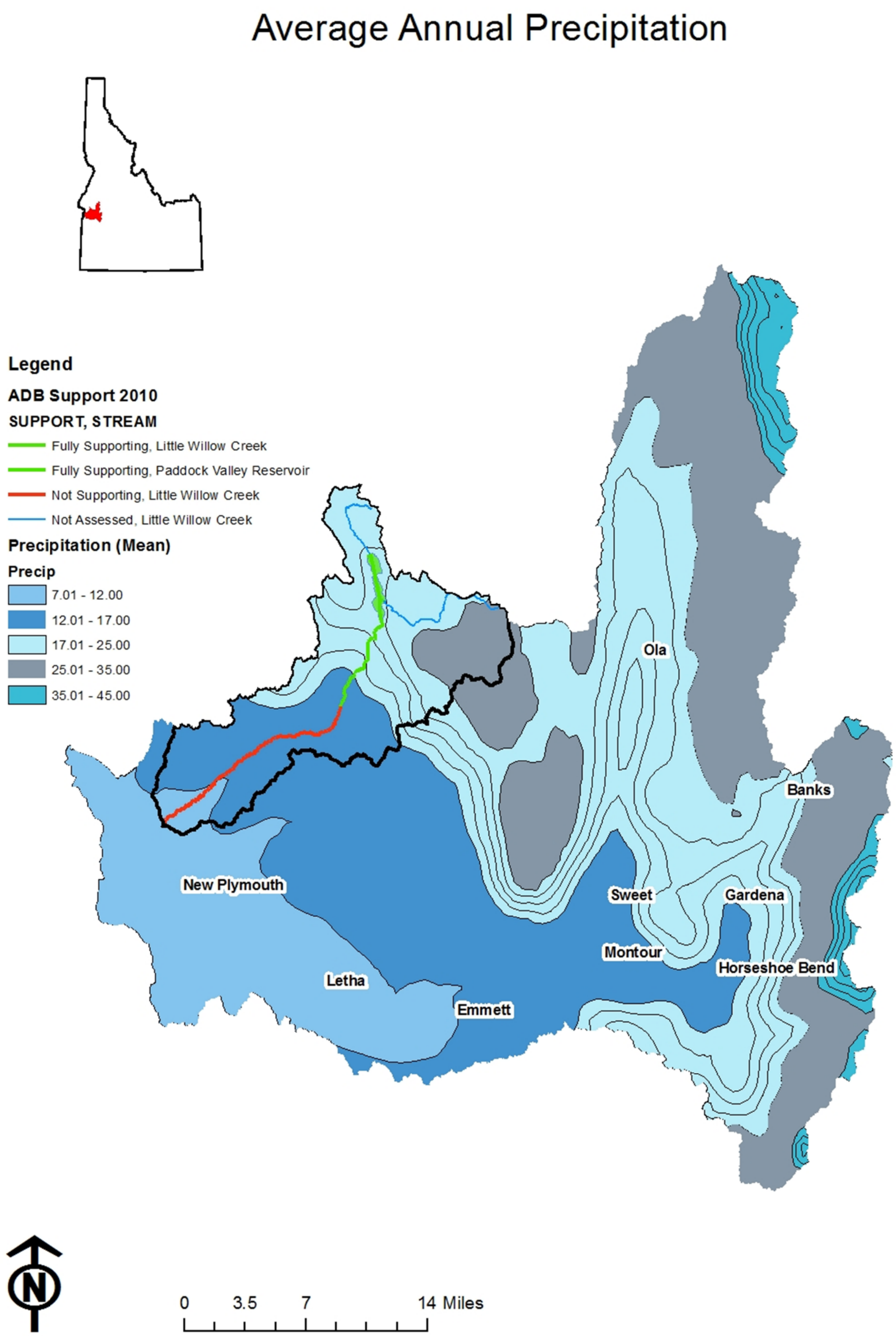

Figure 1. Average annual precipitation.

1.2 Subbasin Characteristics

A detailed discussion of the lower Payette River subbasin characteristics is provided in the subbasin assessment and TMDL (DEQ 1999) approved by EPA in 1999.

Little Willow Creek (ID17050122SW018_04) is a 4th order north side tributary to the lower Payette River with approximately 38.2 miles of perennial stream, located in the western portion of the lower Payette River subbasin (Figure 2). Little Willow Creek drains approximately 154 square miles of agricultural and low-density rural land between the foothills of the West Mountain and the Payette River. There are over 49 miles of canals in the watershed and multiple diversions and returns along the length of Little Willow Creek. Little Willow Creek is a highly managed water body primarily used for agricultural purposes. During low water years and hot summers, it reportedly runs dry in multiple sections.

The stream flows across terrain with slopes ranging from <1% to 42%, with the steepest slopes forming the eastern half of the watershed. The soils in the watershed are described as sandy to stony loams with erosion indices (K-factors) ranging from 0.24 to 0.35 (on a scale of 0 to 1), indicating low to moderate erosive potential (Figure 3).

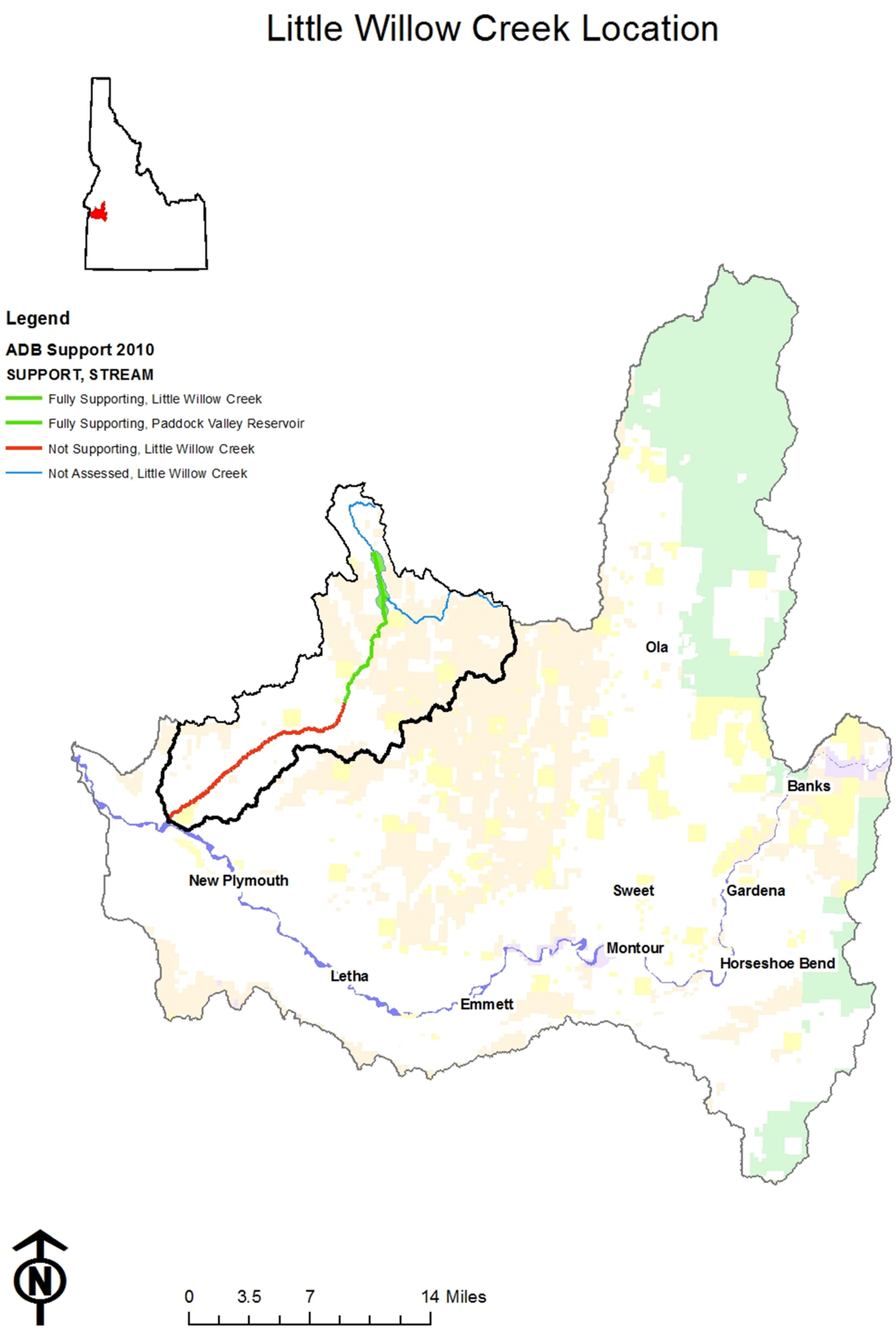

Figure 2. Little Willow Creek location.

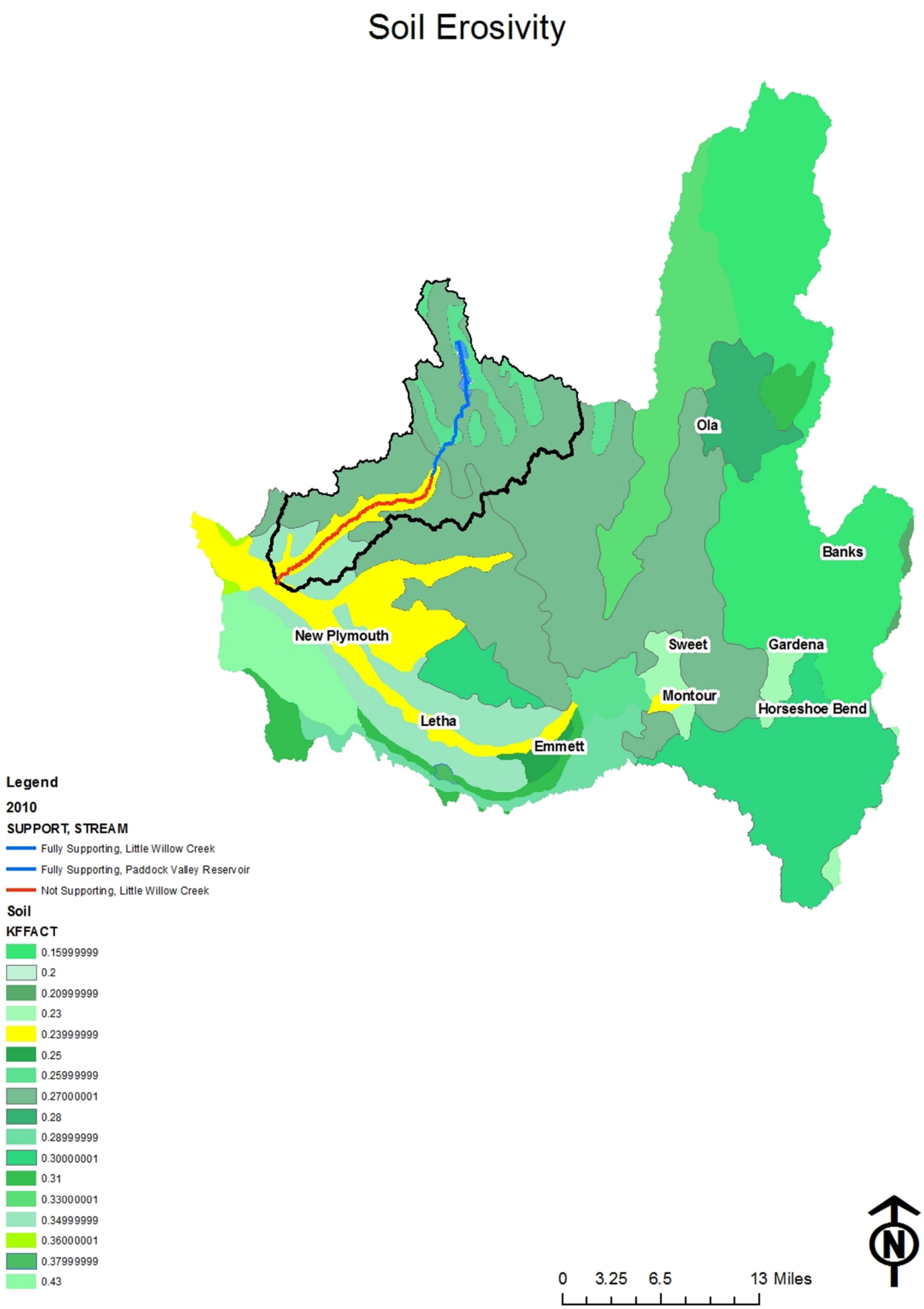

Figure 3. Soil erosivity.

The watershed includes semiarid and unwooded alkaline foothills Ecoregion IV (EPA 2011). The mainstem of Little Willow Creek (ID17050122SW018_04) has reported measured flows that range from 1.4 to 31.1 cubic feet per second (cfs). Up to 99% of the land use in the watershed is agricultural, with surface water identified as the only other land use (Figure 4).

A detailed discussion of the stream characteristics of the lower Payette River subbasin is provided in the subbasin assessment and TMDL (DEQ 1999) approved by EPA in 1999.

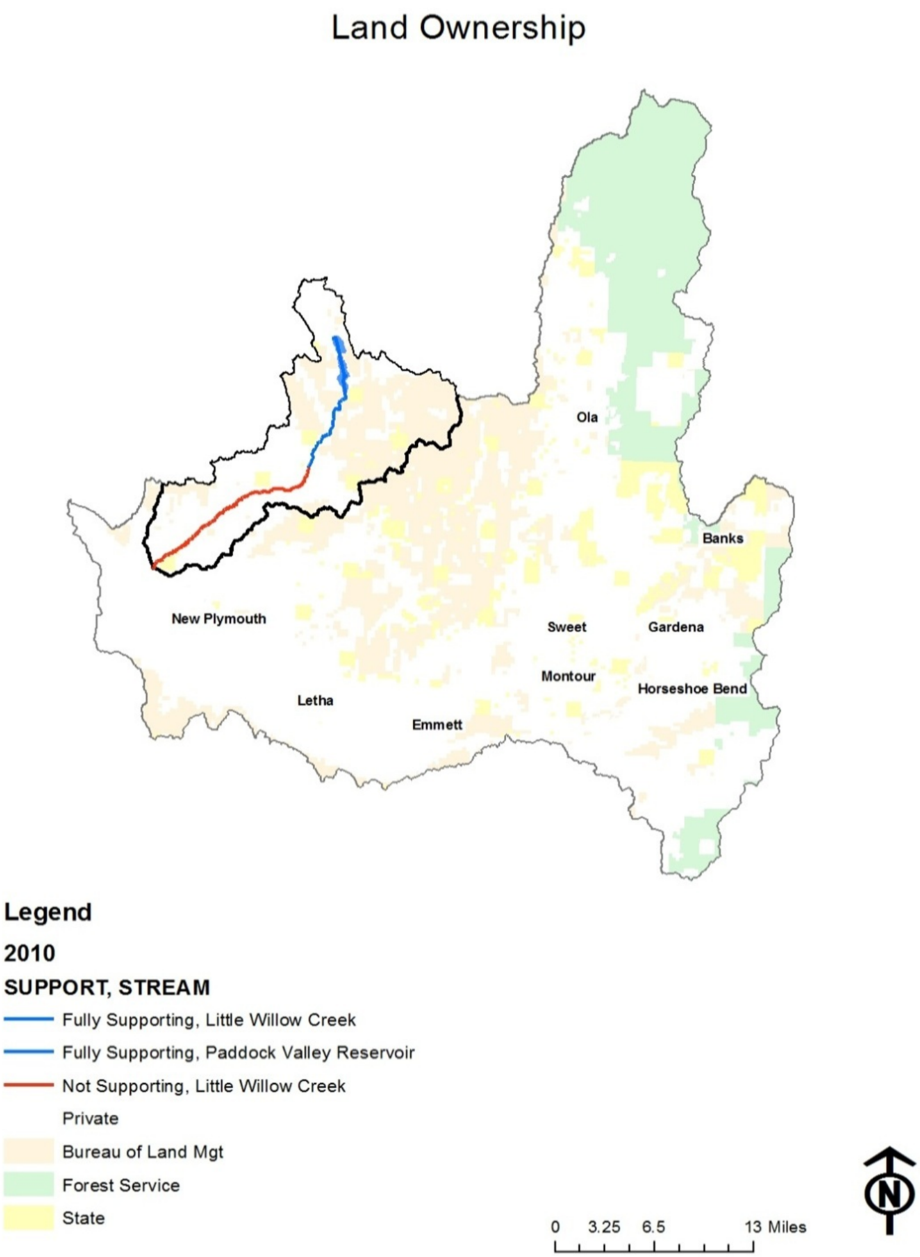

Figure 4. Landownership.

1.3 Cultural Characteristics

The Little Willow Creek watershed is a rural community and sparsely populated. Within the watershed, there are a total of 115 permitted domestic wells, which roughly correlates to number of residences, but does not account for shared wells, properties with more than one well, or historic or unknown wells. There are two chalk mines and one rock quarry.

There are two dairies and seven feedlots in the Little Willow Creek watershed, which are required to obtain permits based on size and animal numbers through the county, State of Idaho, and EPA. Only one is classified as a large operation (≥1,000 animals), the remaining operations are classified as small (<300 animals) to medium (300–999 animals). Large operations are required to have nutrient management plans, while small and medium operations operate under nutrient management plans only if they are designated a significant contributor of nutrients to the environment. None of these facilities are permitted to discharge to surface water.

There is a total of 49 miles of canals and 343 registered points of surface water diversions. The canal system is operated by the Little Willow Irrigation District. Additionally, an undetermined number of surface water impoundments and stock watering sites are used for agricultural purposes. Aside from agriculture and rangeland, surface water is identified as the only other land use (Figure 5).

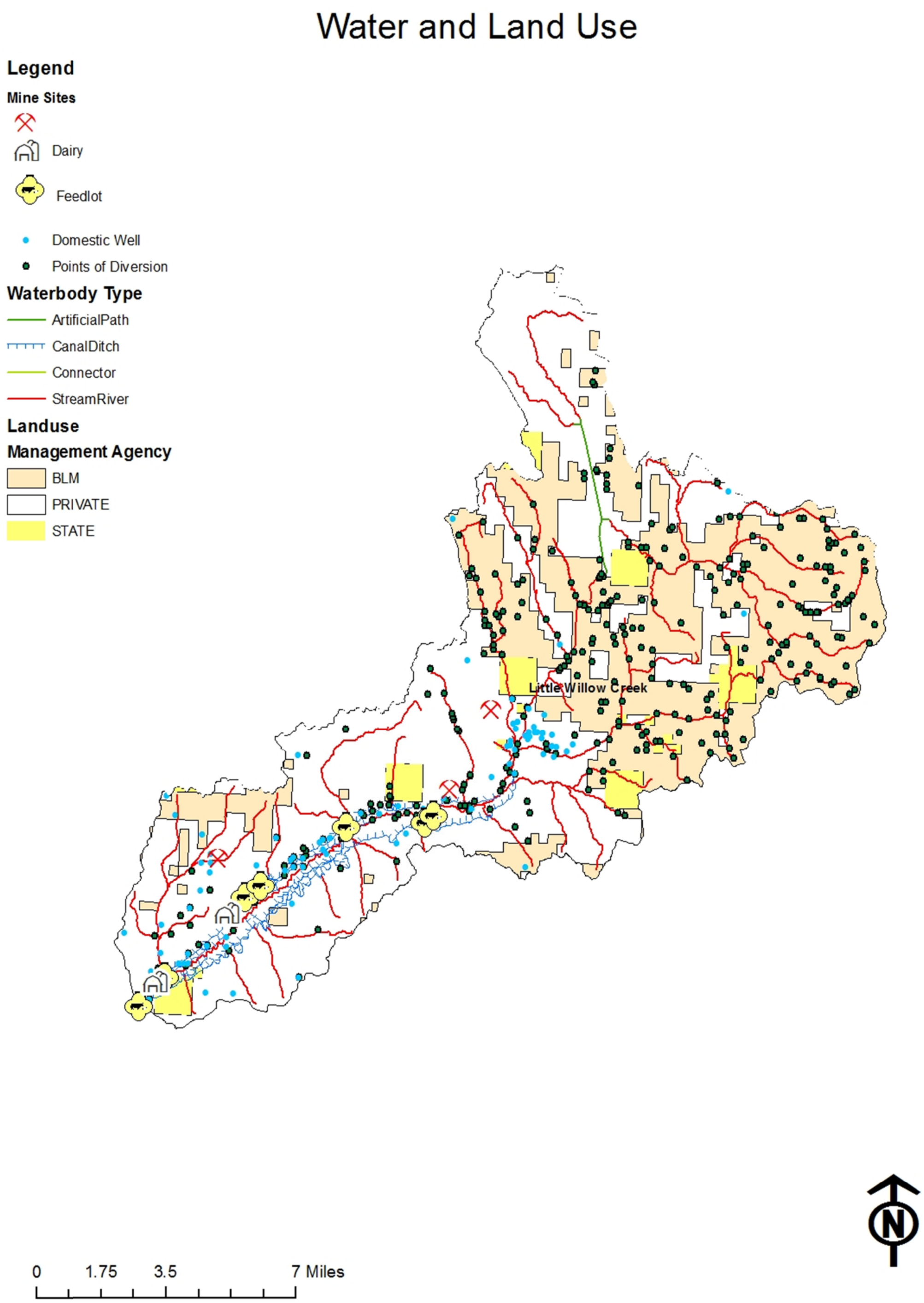

Figure 5. Water and land use.

2 Subbasin Assessment—Water Quality Concerns and Status

2.1 Water Quality Limited Assessment Units Occurring in the Subbasin

Section 303(d) of the Clean Water Act states that waters that are unable to support their beneficial uses and do not meet water quality standards must be listed as water quality limited. Subsequently, these waters are required to have TMDLs developed to bring them into compliance with water quality standards.

Additional Waters Listed Since Subbasin Assessment and TMDL Approval

Table 1 shows the pollutants listed and the basis for listing for each §303(d) listed AU in the subbasin that have been added since the subbasin assessment and TMDL approved by EPA in 1999.

Table 1. Section 303(d) listed assessment unit requiring a total daily maximum daily load.

Water Body	Assessment Unit	2010 §303(d) Boundaries	Pollutants	Listing Basis
Little Willow Creek	ID17050122SW018_04	4th order	Sediment/siltation	2007 ISDA data

Note: Idaho State Department of Agriculture (ISDA)

Not all of the water bodies will require a TMDL. However, a thorough investigation, using the available data, was performed before this conclusion was made. Additionally, TMDLs have been developed for the water body and pollutants not listed in Table 1.

2.2 Applicable Water Quality Standards and Beneficial Uses

Idaho water quality standards (IDAPA 58.01.02) list beneficial uses and set water quality goals for the waters of the state. Idaho water quality standards require that surface waters of the state be protected for beneficial uses, wherever attainable (IDAPA 58.01.02.050.02). These beneficial uses are interpreted as existing uses, designated uses, and presumed uses as briefly described in the following paragraphs. The *Water Body Assessment Guidance* (Grafe et al. 2002) gives a more detailed description of beneficial use identification for use assessment purposes.

Beneficial uses include the following:

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

2.2.1 Existing Uses

Existing uses under the Clean Water Act 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" (40 CFR 131.3). The existing instream water uses and the level of water quality necessary to protect the uses shall be maintained and protected (IDAPA 58.01.02.051.01). Existing uses need to be protected, whether or not the level of water quality to fully support the uses currently exists. A practical application of this concept would be to apply the existing use of salmonid spawning to a water that supported salmonid spawning since November 28, 1975, but does not now due to other factors, such as blockage of migration, channelization, sedimentation, or excess heat.

2.2.2 Designated Uses

Designated uses under the Clean Water Act are "those uses specified in water quality standards for each water body or segment, whether or not they are being attained" (40 CFR 131.3). Designated uses are simply uses officially recognized by the state. In Idaho, these include uses such as aquatic life support, recreation in and on the water, domestic water supply, and agricultural uses. Multiple uses often apply to the same water; in this case, water quality must be sufficiently maintained to meet the most sensitive use (designated or existing). 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 described in the Idaho water quality standards (IDAPA 58.01.02.100) and specifically listed by water body in sections 110–160.

2.2.3 Presumed Uses

In Idaho, due to a change in scale of cataloging waters in 2000, most water bodies listed in the tables of designated uses in the water quality standards do not yet have specific use designations. These undesignated waters ultimately need to be designated for appropriate uses. 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 applies the numeric cold water criteria 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, then the additional numeric criteria for salmonid spawning would also apply (e.g., intergravel dissolved oxygen, temperature) because of the requirement to protect water quality for existing uses. However, if for example, cold water aquatic life is not found to be an existing use, a use designation (rulemaking) 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).

The presumed uses for Little Willow Creek (ID17050122SW018_03 and 04) are cold water aquatic life and secondary contact recreation.

2.2.4 Beneficial Uses in the Subbasin

Cold water aquatic life and secondary contact recreation are the *presumed* beneficial uses of Little Willow Creek (Table 2).

Table 2. Lower Payette River subbasin beneficial uses of §303(d) listed streams.

Water Body	Assessment Unit	Beneficial Uses	Type of Use
Little Willow Creek	ID17050122SW018_03	Cold water aquatic life, contact recreation	Presumed
Little Willow Creek	ID17050122SW018_04	Cold water aquatic life, contact recreation	Presumed

2.2.5 Water Criteria to Support Beneficial Uses

Beneficial uses are protected by a set of water quality criteria, which include *numeric* criteria for pollutants such as bacteria, dissolved oxygen, pH, ammonia, temperature, and turbidity and narrative criteria for pollutants such as sediment and nutrients (IDAPA 58.01.02.250–251). Table 3 includes the most common numeric criteria used in TMDLs.

DEQ's procedure to determine whether a water body fully supports designated and existing beneficial uses is outlined in IDAPA 58.01.02.050.02. The procedure relies heavily upon biological parameters and is presented in detail in the *Water Body Assessment Guidance* (Grafe et al. 2002). This guidance requires DEQ to use the most complete data available to make beneficial use support status determinations. Figure 6 provides an outline of the stream assessment process for determining support status of the beneficial uses of cold water aquatic life, salmonid spawning, and contact recreation.

Table 3. Selected numeric criteria supportive of designated beneficial uses in Idaho water quality standards.

Designated and Existing Beneficial Uses				
Parameter	**Primary Contact Recreation**	**Secondary Contact Recreation**	**Cold Water Aquatic Life**	**Salmonid Spawning**
Water Quality Standards: IDAPA 58.01.02.250-251				
Bacteria, pH, and dissolved oxygen (DO)	Less than 126 *E. coli*/100 mL[a] as a geometric mean of five samples over 30 days; no sample greater than 406 *E. coli* organisms/100 mL	Less than 126 *E. coli*/100 mL as a geometric mean of five samples over 30 days; no sample greater than 576 *E. coli*/100 mL	pH between 6.5 and 9.0 DO exceeds 6.0 mg/L[b]	pH between 6.5 and 9.5 **Water column DO**: DO exceeds 6.0 mg/L in water column or 90% saturation, whichever is greater **Intergravel DO**: DO exceeds 5.0 mg/L for a 1-day minimum and exceeds 6.0 mg/L for a 7-day average

Designated and Existing Beneficial Uses				
Parameter	**Primary Contact Recreation**	**Secondary Contact Recreation**	**Cold Water Aquatic Life**	**Salmonid Spawning**
Tempera-ture[c]	—	—	22°C or less daily maximum; 19°C or less daily average **Seasonal Cold Water**: Between summer solstice and autumn equinox: 26°C or less daily maximum; 23°C or less daily average	13°C or less daily maximum; 9°C or less daily average **Bull trout**: Not to exceed 13°C maximum weekly maximum temperature over warmest 7-day period, June–August; not to exceed 9°C daily average in September and October
Turbidity	—	—	Turbidity shall not exceed background by more than 50 NTU[d] instantaneously or more than 25 NTU for more than 10 consecutive days.	—
Ammonia	—	—	Ammonia not to exceed calculated concentration based on pH and temperature.	—
EPA Bull Trout Temperature Criteria: Water Quality Standards for Idaho, 40 CFR 131				
Temperature	—	—	—	7-day moving average of 10°C or less maximum daily temperature for June–September

[a] *Escherichia coli* per 100 milliliters
[b] Milligrams per liter
[c] Temperature exemption: Exceeding the temperature criteria will not be considered a water quality standard violation when the air temperature exceeds the ninetieth percentile of the 7-day average daily maximum air temperature calculated in yearly series over the historic record measured at the nearest weather reporting station.
[d] Nephelometric turbidity units

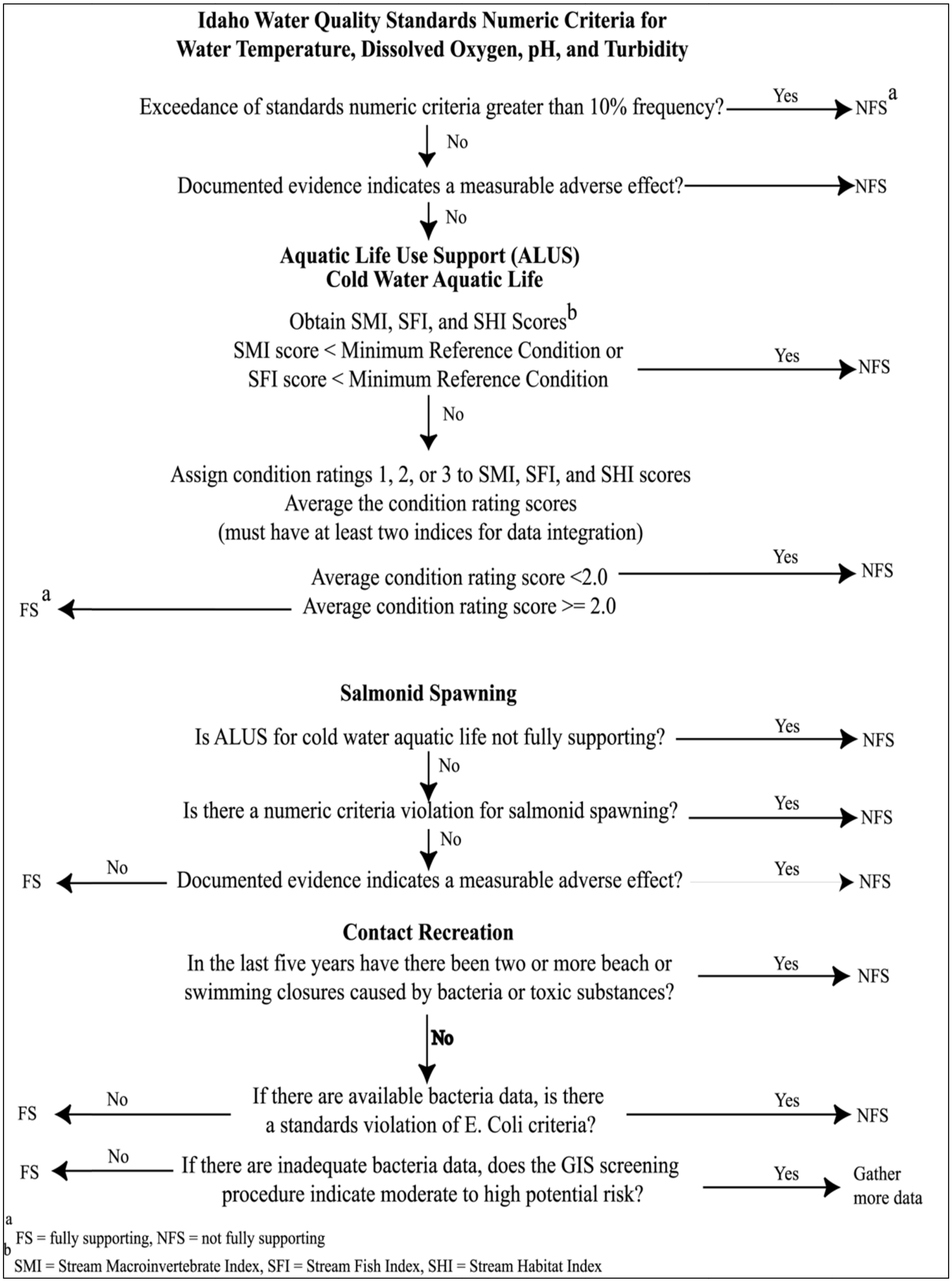

Figure 6. Determination steps and criteria for determining support status of beneficial uses in wadeable streams (Grafe et al. 2002).

2.3 Summary and Analysis of Existing Water Quality Data

A detailed summary and analysis of existing water column data, flow characteristics, and biological and habitat assessment data for the lower Payette River subbasin is provided in the 5-year review (DEQ 2010a) at *www.deq.idaho.gov/media/463708-_water_data_reports_surface_water_tmdls_payette_river_lower_lower_payette_five_year_review_final_0210.pdf*. In 2007, ISDA collected data at three sampling locations (Figure 7). Table 4 includes a description of the sample sites. ISDA data looked at dissolved oxygen, percent saturation, specific conductivity, total dissolved solids, pH, discharge, suspended sediment concentration (SSC), total phosphorus, orthophosphate, and *E. coli* (ISDA 2008). The relevant portions of this data are summarized below.

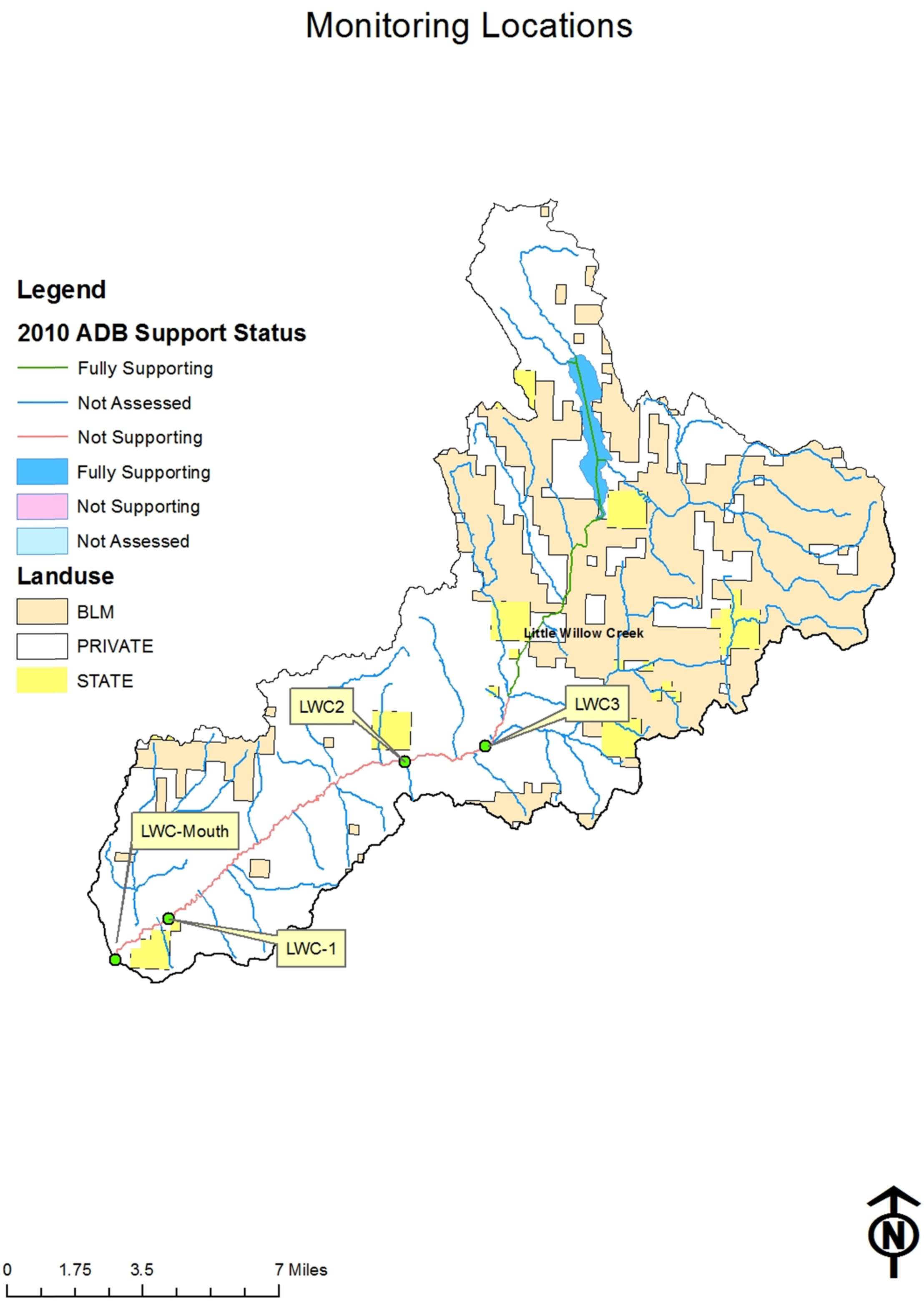

Figure 7. Monitoring locations for 2007 ISDA sites (LWC-1, LWC-2, and LWC-3) and 2012 DEQ sites (LWC-Mouth and LWC-2).

Table 4. Description of 2007 ISDA and 2012 DEQ water quality monitoring locations.

Site ID	Site Description
LWC-Mouth	Near confluence with Payette River
LWC-1	2.5 miles upstream of confluence with Payette River
LWC-2	Stone Quarry road crossing
LWC-3	Dry Creek Road

All physical parameters, including pH and dissolved oxygen, were meeting Idaho water quality standards and supporting beneficial uses.

The TMDL focuses on those parameters collected either by ISDA or DEQ that do not support beneficial uses: SSC, *E. coli*, and temperature.

2.3.1 Discharge Characteristics

ISDA measured stream discharge at all three locations during each monitoring event (Figure 8). Reported instantaneous discharge measurements range from 1.45 to 31.1 cfs (Figure 8). This decreasing flow is the result of irrigation withdrawals along Little Willow Creek. Discharge was highest at LWC-2 and lowest at LWC-1.

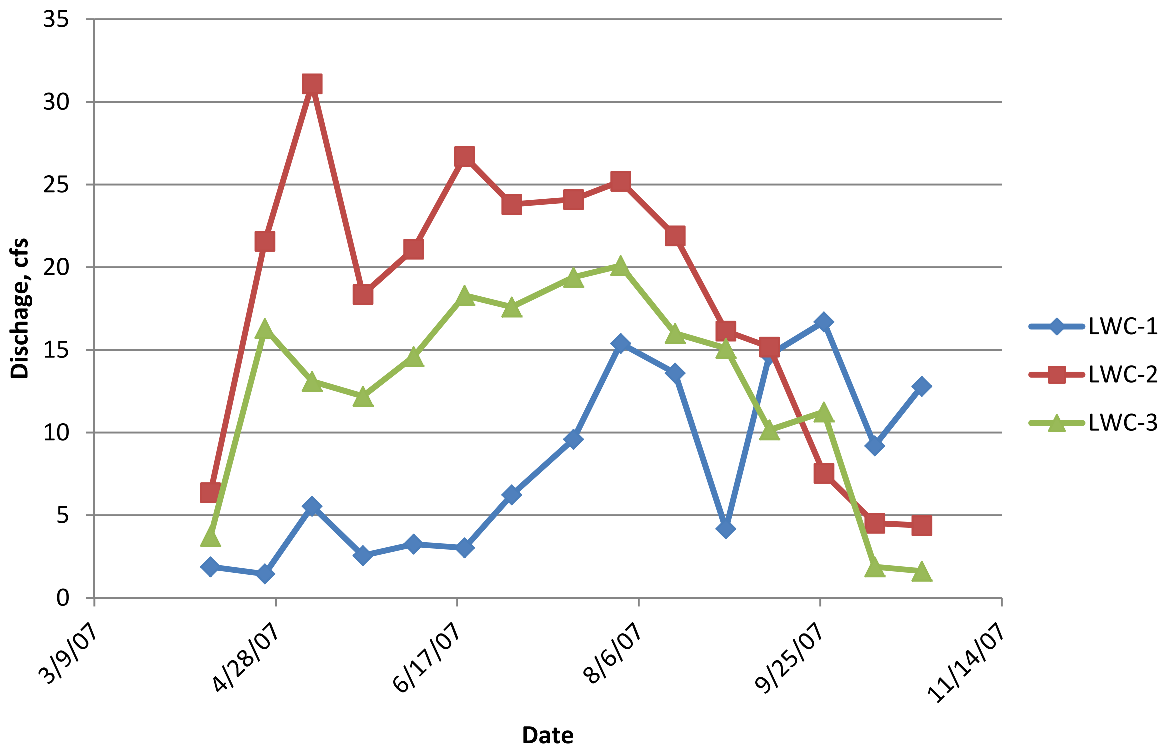

Figure 8. Discharge of Little Willow Creek in 2007, as reported by the Idaho State Department of Agriculture.

Stream discharge is measured along with sediment in order to convert a SSC into a daily load independent of flow. By converting cubic feet per second into liters per day and multiplying this by the SSC (milligrams per liter [mg/L]), we arrive at milligrams per day, which is then converted into tons of sediment per day.

Reported SSCs (Figure 9) and loads (Figure 10) increase in the downstream direction. The reported SSC values range from 3.3 to 165 mg/L, and sediment loads range from 36 to 9,000 pounds per day (lb/day) (Figure 9, Figure 10, and Table 5).

Figure 11 shows that SSC is not correlated with stream discharge; rather SSC corresponds with peak summer irrigation season. The lack of a relationship between SSC and stream discharge is indicative of sediment delivery from outside the stream channel. The most likely source of sediment to Little Willow Creek is agricultural runoff. This is consistent with the agricultural practices in the Little Willow Creek drainage. It also appears to correlate to the delivery of the sediment during the irrigation season (Figure 10).

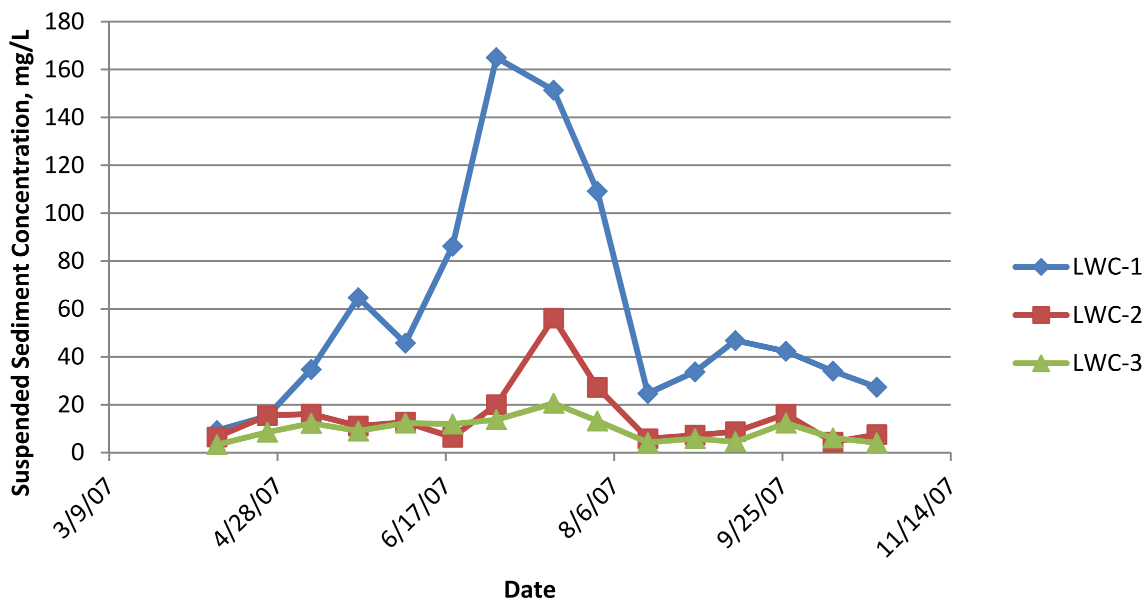

Figure 9. Suspended sediment concentrations in Little Willow Creek in 2007, as reported by the Idaho State Department of Agriculture.

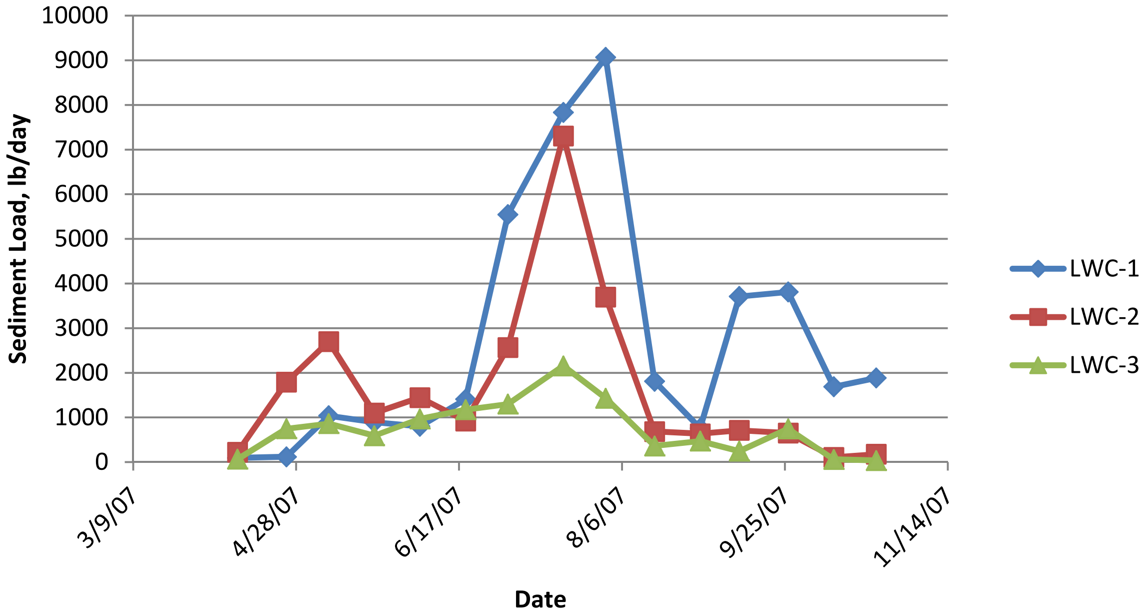

Figure 10. Suspended sediment loads in Little Willow Creek in 2007, as reported by the Idaho State Department of Agriculture.

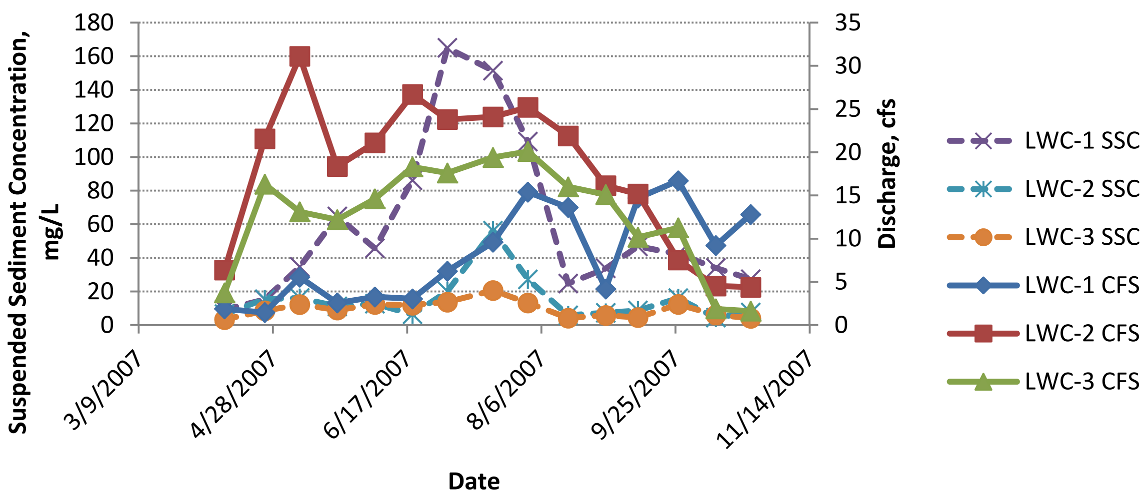

Figure 11. Discharge and suspended sediment concentrations in Little Willow Creek in 2007, as reported by the Idaho State Department of Agriculture.

Table 5. Irrigation season average suspended sediment concentrations and loads in Little Willow Creek, 2007.

Locations	Season Average Flow (cfs)	Season Average SSC Concentration (mg/L)	Season Average SSC Load (lb/day)[a]	Season Average SSC Load (tons/day)
LWC-1	8.6	73.1	3,394.8	1.7
LWC-2	21.0	17.0	1,927.8	1.0
LWC-3	15.3	10.9	900.6	0.5

Notes: suspended sediment concentration (SSC); cubic feet per second (cfs); pounds per day (lb/day); milligram per liter (mg/L).

2.3.2 Bacteria

Bacteria concentrations that support secondary contact recreation beneficial uses are defined in Idaho water quality standards (IDAPA 58.01.02.250) by dual numeric criteria. If a single sample exceeds a concentration of 576 cfu per 100 milliliters (mL), then five samples must be collected at 3- to 7-day intervals within a 30-day timeframe. The results must be calculated using a statistical method referred to as a geometric mean. The geometric mean value that is supportive of recreational uses in Idaho is 126 cfu/100 mL. Bacteria data were collected at the same ISDA water quality sampling locations (Table 6).

Bacteria data collected from Little Willow Creek in 2007 by ISDA indicate that bacteria concentrations increase in the downstream direction, rarely exceeding the single sample threshold criteria at the most upstream location but more frequently exceeding the threshold at downstream locations (Table 6 and Figure 12). In Table 6, single sample exceedances are highlighted in **bold**. While 2007 bacteria sampling by ISDA did not follow DEQ protocol for *E. coli* sampling, it illustrated the extent of *E. coli* levels in Little Willow Creek and triggered follow-up sampling. DEQ requires that *E. coli* samples follow strict sampling guidelines described in IDAPA 58.01.02 251.01.a. Specifically *E. coli* water samples must be based on a minimum of five samples taken every 3 to 7 days over 30 days.

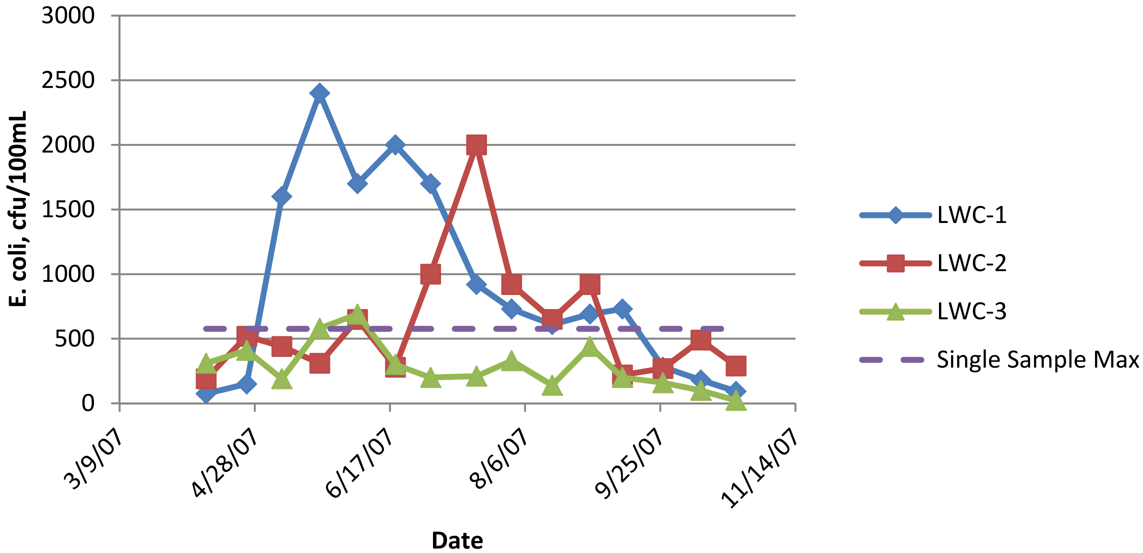

Figure 12. Bacteria concentrations in Little Willow Creek in 2007, as reported by the Idaho State Department of Agriculture.

Table 6. Analysis of bacteria data from Little Willow Creek collected in 2007 by the Idaho State Department of Agriculture.

Date	LWC-1 (cfu/100 mL)	LWC-2 (cfu/100 mL)	LWC-3 (cfu/100 mL)
4/10/2007	75	190	310
4/25/2007	150	**520**	410
5/8/2007	**1,600**	440	190
5/22/2007	**2,400**	310	**580**
6/5/2007	**1,700**	**650**	**690**
6/19/2007	**2,000**	280	300
7/2/2007	**1,700**	**1,000**	200
7/19/2007	**920**	**2,000**	210
8/1/2007	**730**	**920**	330
8/16/2007	**610**	**650**	140
8/30/2007	**690**	**920**	440
9/11/2007	**730**	220	200
9/26/2007	280	270	160
10/10/2007	180	490	100
10/23/2007	93	290	23
Site geometric mean	574	490.3	224.2
Total geometric mean	398.1		

Notes: Single sample exceedances are shown in bold; colony forming unit per milliliter (cfu/mL)

In 2012, DEQ performed additional *E. coli* monitoring according to DEQ's *E. coli* monitoring protocol, which confirmed the impairment. DEQ monitored *E. coli* on Little Willow Creek above the confluence with the Payette River and at LWC-2, the same sampling location used by ISDA in 2007. The results of the 2012 *E. coli* monitoring are reported in Table 7 along with the geometric mean. Both sites were above the Idaho water quality standard for secondary contact recreation.

Table 7. Analysis of bacteria data from Little Willow Creek collected in 2012 by DEQ to calculate a geometric mean in comparison to water quality standard criterion for recreation beneficial uses.

Date	LWC-Mouth *E. coli* (cfu)	LWC-2 *E. coli* (cfu)
6/1/2012	797.6	613.1
6/7/2012	613.1	1,515
6/13/2012	959.4	1,332.7
6/20/2012	1,075.8	727.3
6/26/2012	816.4	1,012.2
Geometric mean	837.5	981.6

Notes: *Escherichia coli* (*E.coli*); colony forming unit (cfu); total geometric mean for Little Willow Creek (combined sites) is 906.7 cfu.

2.3.3 Temperature

Idaho water quality standards for cold water aquatic life beneficial use support (IDAPA 58.01.02.250.02.b) is a dual numeric standard: a maximum daily average of no greater than 19°C, and maximum water temperatures of 22°C or less. Instantaneous data collected from Little Willow Creek in 2007 indicated that during the hottest month of the summer at least two locations in Little Willow Creek (LWC-1 and LWC-2) exceeded the daily maximum standard (Figure 13). However, these data were insufficient to determine if water temperature conditions were of a frequency or duration to cause impairment of beneficial uses in Little Willow Creek. DEQ conducted continuous temperature monitoring from June 2012 to September 2012 (Figure 14).

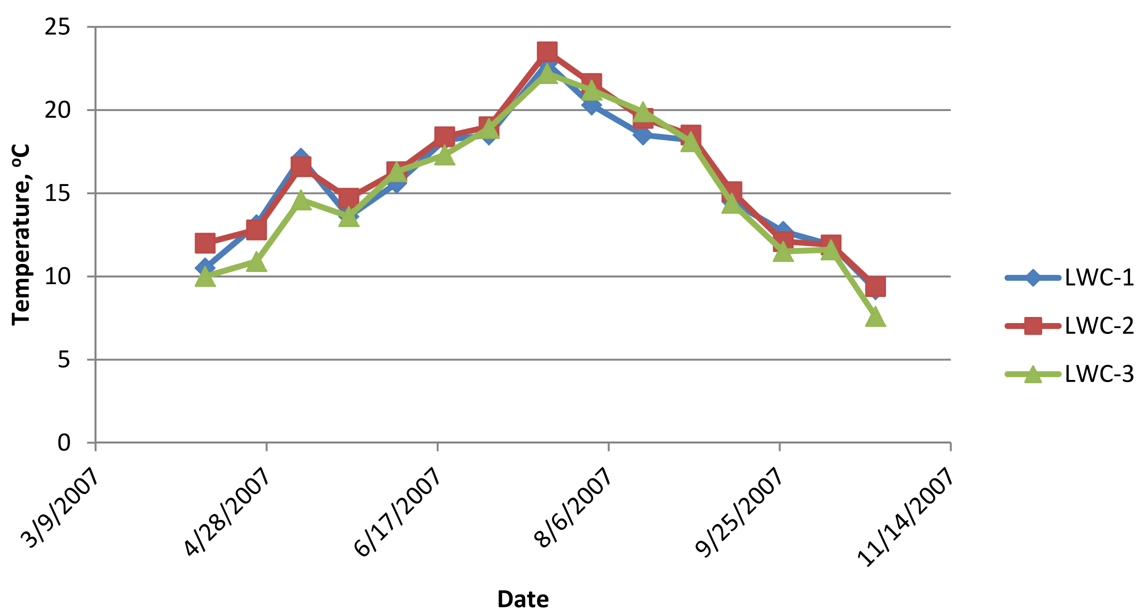

Figure 13. Temperature of Little Willow Creek in 2007, as reported by the Idaho State Department of Agriculture.

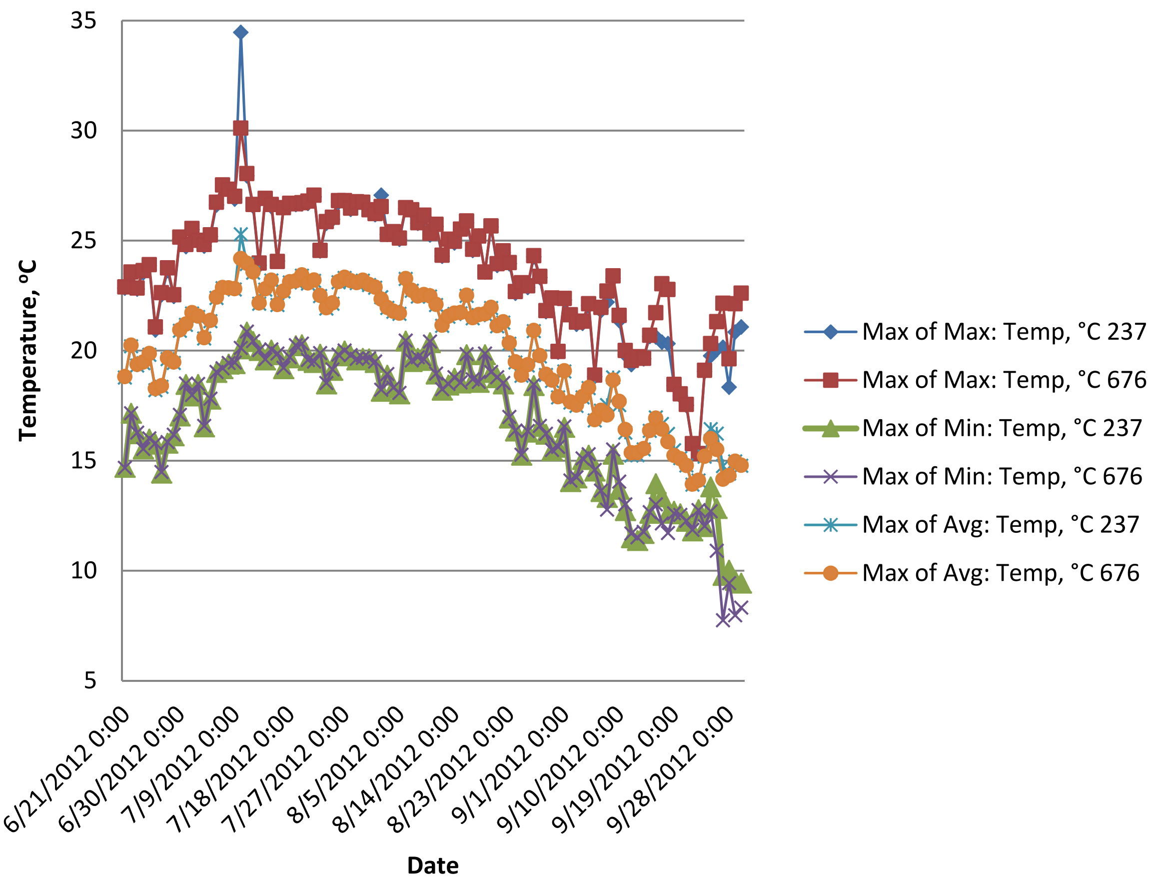

Figure 14. Daily maximum, daily average, and daily minimum temperatures in Little Willow Creek in 2012, as collected by DEQ.

In 2012, DEQ deployed two Tidbit v2 UTBI-001 Water Temperature Data Loggers (#237, #676), manufactured by Onset Computer Corporation into Little Willow Creek at LWC-2. The temperature data loggers were deployed on June 21, 2012, and removed on October 12, 2012. The mean air temperature for 2012 was similar to the maximum mean monthly air temperature for the period from 1892 to April 2013 (Table 8).

Table 8. Mean air temperature.

Mean Max Temperature (F)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2013	36.5	45	57.1	64.7	73.2	81.1	90.7	89	79.5	66.8	49.7	37.4	64.3
1892 thru Apr 2013	36.58	44.67	56.24	66.32	74.99	82.8	92.85	91.21	80.67	67.55	50.85	39.09	65.34

Table 9 contains the historic monthly and annual mean precipitation, minimum and maximum precipitation, and 2012 data. It is unknown whether 2012 was either a high, low, or average precipitation year because 90 days are missing from the record (Table 9). Precipitation in the watershed is variable, and a comparison of 2012 with the historic record is inconclusive. There is no historic record of flow for Little Willow Creek.

Table 9. Mean precipitation.

Precipitation (inches)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual
MEAN (1892 -2013)	1.5	1.13	1.03	0.82	0.95	0.82	0.25	0.27	0.42	0.81	1.2	1.5	10.89
MAX	4.43	4.76	4.63	3.47	5.47	3.27	2.45	2.55	2.76	3.75	3.19	4.44	20.03
MIN	0	0.02	0	0	0	0	0	0	0	0	0	0.06	5.27
2012	1.78	0.49	1.58	1.21	1.31	0.23	0	0.04	0	0.89	0.99	1.84	3.72
Days missing in 2012 record	11	8	7	9	9	10	6	13	17	0	0	0	90
data not included in average if more than 5 days are missing													

Deployment and retrieval were conducted according to *DEQ's Protocol for Placement and Retrieval of Temperature Data Loggers in Idaho Streams* (DEQ, 2013). Following retrieval in the fall, data were downloaded and reviewed using Hobo Ware 3.0, supplied by the thermograph manufacturer.

The data indicate that water temperature conditions are of both frequency and duration to cause impairment of cold water aquatic life in Little Willow Creek (Figure 14). Specifically, Little Willow Creek exceeded the Idaho water quality standards daily maximum temperature of 22˚C for 72 days (84%), and exceeded the maximum daily average of 19˚C for 65 days (76%) during the sample period. Data were only analyzed through September 15, 2012, due to large differences in recorded temperatures between the two thermographs after that date. The differences are attributed to one of the thermographs residing above the waterline as stream levels decreased. Additionally, the July 10, 2012, data point was disregarded as an outlier of unknown cause.

2.4 Assessment Unit Summary

Data collection and analysis performed by ISDA in 2007 at three locations on Little Willow Creek (ID17050122SW018_04) indicated sediment was impairing cold water aquatic life. Additionally, ISDA data indicated that temperature may be impairing cold water aquatic life and *E. coli* may be impairing secondary contact recreation. In 2012, DEQ confirmed that *E. coli* and temperature were impairing cold water aquatic life and secondary contact recreation in addition to sediment. The impairments are the result of nonpoint source pollution.

3 Subbasin Assessment–Pollutant Source Inventory

Since the lower Payette River TMDL was approved, DEQ has collected data, requested data from other agencies and organizations, searched external databases, and reviewed university publications and municipal or regional resource management plans for additional and recent water quality data. The results of that effort were compiled in the 5-year review (DEQ 2010a) and recommendation for an impairment listing in Little Willow Creek (based on that data) was made.

Pollutants of concern for this review are limited to constituents for which numeric criteria are established in Idaho water quality standards or have been identified as current or potential limiting factors for attainment of designated, existing, or presumed beneficial uses in the lower Payette River subbasin. Those constituents are sediment, bacteria, and temperature.

A review of identified or observed sources of impairment to surface water in the subbasin, including review of potential permitted point sources, nonpoint sources, natural events, and documented or otherwise known accidental releases was completed in 2009 and is included in the 5-year review (DEQ 2010a).

3.1 Point Sources

No individually permitted point sources are in the Little Willow Creek watershed. The EPA published a new Multi Sector General Permit (MSGP) (2008) on September 29, 2008, to replace the 2000 MSGP. This permit covers industrial facility stormwater management in areas where EPA has National Pollutant Discharge Elimination System (NPDES) authority, such as the lower Payette River subbasin. The 2008 MSGP applies to all new and existing facilities and requires that stormwater be controlled in accordance with terms and conditions of the permit. No facilities were identified in the watershed. A permit search can be performed at *http://cfpub.epa.gov/npdes/stormwater/msgp.cfm*. An online database allows the public to view information about the MSGP entities under EPA's authority and can be accessed at *http://cfpub.epa.gov/npdes/stormwater/indust.cfm.*

3.2 Nonpoint Sources

A detailed discussion of nonpoint sources in the lower Payette River subbasin is provided in the subbasin assessment and TMDL approved by EPA in 1999 (DEQ 1999) and in the 5-year review (DEQ 2010a).

Little Willow Creek is highly managed for agricultural irrigation and is solely impacted by nonpoint sources. Nonpoint sources are often difficult to pinpoint and have unknown individual impact on water quality. To facilitate irrigation, a number of small-scale dams, diversion structures, and return drains are found Little Willow Creek. Additionally, runoff from agricultural fields, pasture land, and dairies contribute to water quality impairments. Southwest District Health reports 49 registered septic systems associated with Little Willow Creek road, although the county assessor's office reports a total of 59 addresses along the same road. The total number of septic systems in the watershed is likely greater than the registered 49 septic systems. The functional state of these systems is unknown, and their impact on water quality is not quantified. It is also unknown how much sediment is contributed to Little Willow Creek from nearby roads.

3.3 Pollutant Transport

A detailed discussion of pollution transport in the lower Payette River subbasin is provided in the subbasin assessment and TMDL approved by EPA in 1999 (DEQ 1999) and the 5-year review (DEQ 2010a).

3.4 Data Gaps

Uncertainty in TMDLs is largely the result of insufficient or limited data. However, while it is easier to develop and refine loading analyses and models with adequate data, data from Little Willow Creek is sufficient to identify likely pollution sources and develop reasonable loading analyses to reduce pollutant loads. Issues arising from these data gaps include the following:

- Spatial data sets for land use, hydrology, and channel morphology are sparse.
- Detailed analysis of instream flow conditions, water column chemistry, and stream and riparian characteristics are lacking due to access.
- Mass-balance and load calculations are based on low-resolution information.
- Quantification of subsurface or shallow ground water influence is impractical.
- Statistically valid representation of natural, undisturbed, or background stream conditions is unavailable.
- Dynamic or highly variable conditions are not evaluated.
- Small-scale processes are not evaluated.
- Water returns and withdrawals are not quantified.
- Short-term variations are unknown.
- Contribution of other nonpoint sources (roads and septic systems) to water quality are unknown.

4 Monitoring and Status of Water Quality Improvements

The TMDL implementation plan for the lower Payette River TMDL (1999) was published in 2003 and addresses the approved bacteria TMDL for stream segments of the lower Payette River listed on the 1994 and 1996 §303(d) list (DEQ 2003). The implementation plan designates pollution control efforts for point sources, storm water, agricultural, and other nonpoint sources. The implementation plan (DEQ 2003) can be accessed at *http://www.deq.idaho.gov/media/463615-_water_data_reports_surface_water_tmdls_payette_river_lower_payette_lower_implementation_plan.pdf* and includes a watershed implementation schedule with milestones and an estimate of the date that water quality standards are expected to be met. A summary of the implementation plan and the progress made on achieving the milestones and goals is provided in the 5-year review (DEQ 2010a) at *http://www.deq.idaho.gov/media/463708-_water_data_reports_surface_water_tmdls_payette_river_lower_lower_payette_five_year_review_final_0210.pdf)* (Table 20, page 141). While the original implementation plan ranked Little Willow Creek as a medium priority and included potential improvements, no documented implementation has occurred in this watershed. The TMDL implementation plan will be updated to include the TMDLs in this document and will recommend and prioritize activities to improve water quality in the Little Willow Creek watershed. Additional water quality monitoring will be conducted after sufficient best management practices (BMPs) have been implemented and as resources allow.

5 Total Maximum Daily Load(s)

A TMDL prescribes an upper limit (i.e., load capacity) on discharge of a pollutant from all sources to ensure water quality standards are met. It further allocates this load capacity among the various sources of the pollutant. Pollutant sources fall into two broad classes: point sources, each of which receives a wasteload allocation, and nonpoint sources, each of which receives a load allocation. Natural background contributions, when present, are considered part of the load allocation but are often treated separately because they represent a part of the load not subject to control. Because of uncertainties about quantifying loads and the relation of specific loads to attaining water quality standards, the rules regarding TMDLs (40 CFR 130) require a margin of safety be included in the TMDL. Practically, the margin of safety and natural background are both reductions in the load capacity available for allocation to pollutant sources.

Load capacity can be summarized by the following equation:

$$LC = MOS + NB + LA + WLA = TMDL$$

Where:

LC = load capacity

MOS = margin of safety

NB = natural background

LA = load allocation

WLA = wasteload allocation

The equation is written in this order because it represents the logical order in which a load analysis is conducted. First, the load capacity is determined. Then the load capacity is broken down into its components. After the necessary margin of safety and natural background, if relevant, are quantified, the remainder is allocated among pollutant sources (i.e., the load allocation and wasteload allocation). When the breakdown and allocation are complete, the result is a TMDL, which must equal the load capacity.

The load capacity must 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 load capacity and pollutant source loads vary, and not necessarily in concert, determining critical conditions can be more complicated than it may initially appear.

Another step in a load analysis is quantifying current pollutant loads by source. This step allows for the specification of load reductions as percentages from current conditions, considers equities in load reduction responsibility, and is necessary for pollutant trading to occur. A load is fundamentally a quantity of 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 (40 CFR 130.2). 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 Sediment TMDL

5.1.1 Instream Water Quality Targets

Sediment conditions as they relate to water quality standards are assessed through the interpretation of the narrative criteria based on impacts to aquatic life. Guidelines established by previous and developing TMDLs (for example the Lower Boise River Sediment TMDL 1998, the developing Mid-Snake River/Succor Creek TMDL, and Lower Boise River Tributary Sediment TMDL) efforts are based on the work of Newcombe and Jensen (1996). These established sediment concentrations are likely to support designated beneficial uses based on a severity of ill effects (SEV) of 8, which Newcombe and Jensen (1996) identified as sublethal, and DEQ and EPA (pers. comm. 2012) identified as protective of aquatic life, water quality, and meeting the requirements of the Clean Water Act.

An SEV of 8, or any other level for that matter, can result from specific combinations of sediment concentration and exposure duration that is believed to be supportive of fish and other aquatic life. As identified in Newcombe and Jensen (1996), a constant SEV can be maintained by either increasing or decreasing the level of instream sediment concentration, while doing the opposite with exposure duration (Figure 15). For example, juvenile salmonids are likely to experience an SEV of 8 under sediment concentrations of 403 mg/L over 2 days (a high dose over a short time period) but also under sediment concentrations of 20 mg/L over 4 months (a low dose over a long time period).

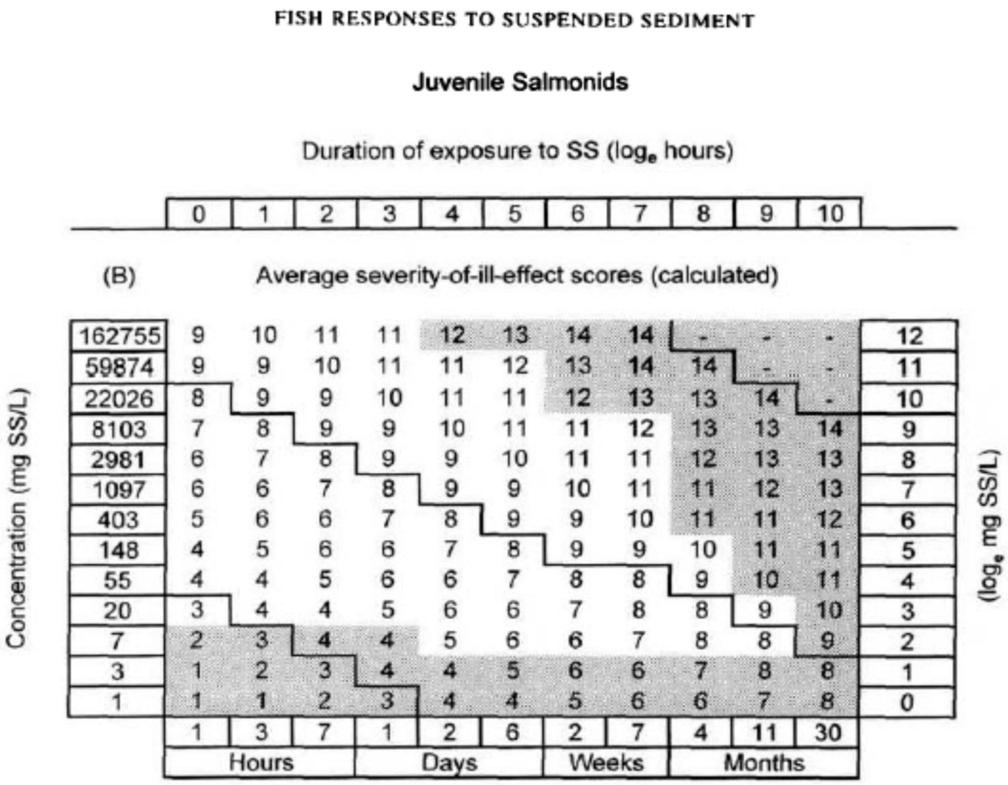

Figure 15. Observed and expected responses of juvenile salmonids under varying sediment concentrations and periods of exposure (Newcombe and Jensen 1996).

5.1.1.1 Target Selection

Little Willow Creek (ID17050122SW018_04) is not supporting cold water aquatic life because of a sediment impairment. The source of sediment is likely irrigation return water. The available site-specific data and scientific literature indicate that the total suspended sediment (TSS) target value of 20 mg/L for a maximum average of 4 months, applied continuously throughout the irrigation season (April 1–September 30), for Little Willow Creek will restore beneficial uses. The TSS target was derived in combination from watersheds that have similar land use, geomorphology, and hydrology characteristics (Bissel Creek, Succor Creek, and Lower Boise River tributaries), and by referencing the extensive metadata analysis conducted by Newcombe and Jensen (1996).

5.1.1.2 Water Quality Monitoring Points

The monitoring locations for the 2007 data collected by ISDA and the 2012 data collected by DEQ are illustrated in Figure 7. Samples were collected at the most upstream accessible data collection location in the AU, at an accessible mid-AU location, and at the most accessible location near the mouth of Little Willow Creek. Future monitoring and data collection should occur at these same locations for access purposes and for data comparability.

5.1.2 Load Capacity

The load capacity is the amount of a pollutant that can be delivered to a stream without limiting beneficial uses or exceeding water quality standards. A sediment load capacity is complicated by the fact that the state's water quality standard is narrative rather than numerical. When sediment is found to be impairing beneficial uses, a site-specific target is developed to represent the numeric interpretation of that site.

To protect beneficial uses and meet water quality standards, load capacities are calculated for the most sensitive species during the most critical time period when stream conditions are most susceptible to impairment. The load capacity for Little Willow Creek lies between an SEV 8 and SEV 9. A target selection of 20 mg/L TSS (SEV 8) for 4 months is therefore conservative and protective during critical time periods.

Adequate quantitative measurements of the effect of excess sediment on aquatic life uses in Little Willow Creek have not been developed. Given this reality, a sediment load capacity can be developed using literature-based values from effects-based studies (empirical). The sediment load capacity value for the Little Willow Creek TMDL is based the following assumptions:

- Natural background concentrations of suspended sediment are fully supportive of cold water aquatic life beneficial uses.
- All streams have some finite ability to process (transport) suspended sediment at concentrations greater than background values without impairing beneficial uses. This ability is proportionally related to slope and discharge.
- As suspended sediment approaches a more natural level, the measured response in the stream will be a trend towards full support of beneficial uses.

The load capacity for sediment is based on the instream load that would be present when an average concentration of 20 mg/L is met. The load capacity for Little Willow Creek is based on maintaining an average of 20 mg/L TSS throughout the stream over 4 months throughout the entire critical flow (April 1–September 30) period.

5.1.3 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" (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 subwatershed) 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.

While bankfull and flood events are common in the lower Payette River subbasin, Little Willow Creek is a highly modified system. The creek's flow is regulated by Paddock Reservoir upstream and most of its flow is diverted for agriculture. It is unknown to DEQ whether mass wasting of streambanks is contributing significant amounts of sediment to Little Willow Creek because access is extremely limited due to private landownership. This is a known data gap and future data collection will seek to close this gap.

Existing loads are calculated based on reported flow and SSC values from data collection efforts in 2007. However, the target load is based on Newcombe and Jensen (1996) SEV, which is reported as TSS. Sediment values reported as SSC are typically higher than sediment values reported in TSS when there is more fine sediment present in the system; however, SSC and TSS values are often interchanged when data are limited without significant implication. A target load of 20 mg/L averaged over 4 months during the irrigation season will be protective of cold water aquatic life. Table 10 lists the flows, existing sediment concentrations, and corresponding loads for the three sites monitored by ISDA in 2007. Table 11 shows cold water aquatic life load capacity, load allocation, and required reduction in sediment that must occur to meet the load allocation that is believed to support beneficial uses.

5.1.4 Load and Wasteload Allocations

Load allocations have not been developed for specific sources. An instream allocation has been developed for Little Willow Creek, based on water quality monitoring conducted by ISDA in 2007. The load was calculated during the irrigation season when nonpoint source loading is greatest to ensure the load allocations are protective year-round.

The sediment TMDL for Little Willow Creek allocates an average of 20 mg/L of suspended sediment averaged over 4 months (an SEV of 8), and is to be applied during the irrigation season (April 1–September 30) to ensure water quality standards are met and cold water aquatic life beneficial uses are fully supported.

Table 10. Total suspended sediment load calculations.

Location	Average Flow (cfs)	Current Average SSC (mg/L)	Current Average SSC Load (tons/day)
LWC-1	8.6	73.1	1.7
LWC-2	21.0	17.0	1.0
LWC-3	15.3	10.9	0.5

Notes: suspended sediment concentration (SSC); cubic feet per second (cfs); milligrams per liter (mg/L)

Table 11. Total suspended sediment load allocations for Little Willow Creek (ID17050122SW018_04).

Location	Current Average SSC Load (tons/day)[a]	Load Capacity (tons/day)	Load Allocation (tons/day)	Load Reduction (tons/day)	Percent Reduction (%)
LWC-1	1.7	0.5	0.2	1.2	70.5
LWC-2	1.0	1.1 [b]	1.0	0	0 [a]
LWC-3	0.5	0.9 [b]	0.5	0	0 [a]

a. No reduction is necessary because the existing load is less than the loading capacity. However, no additional sediment is allowed to be discharged to the stream and the load allocation is set to reflect this.
Note: suspended sediment concentration (SSC)

5.1.4.1 Margin of Safety

The margin of safety (MOS) is implicit when selecting a Newcombe and Jensen (1996) SEV of 8. Lethal effects begin to occur at an SEV of 9 and with sediments concentrations above 55 mg/L sustained for a period of 4 months. The actual maximum sublethal sediment concentration is some value above 20 mg/L and under 55 mg/L. Thus, using 20 mg/L for 4 months is a conservative target for Little Willow Creek.

5.1.4.2 Seasonal Variation

The limited data presented by ISDA suggest that high sediment concentrations are related to agricultural irrigation practices and therefore are likely seasonal. This is a known data gap and future monitoring should focus on further defining sediment delivery.

Seasonal variability is taken into account for the TSS target by specifically applying the target when the loads are the highest, during the irrigation season (April–September). The target is applied during irrigation season because data indicate this is when sediment loading is occurring. Because the TMDL is designed to be protective during the most critical time period, Little Willow Creek will benefit year-round. Additionally, nonpoint source pollutant reduction and implementation will benefit the water body year-round and provide additional sediment reduction benefits.

5.1.4.3 Reasonable Assurance

Because land use is almost exclusively agricultural, all reductions are directed at nonpoint sources. Idaho water quality standards assign specific agencies to be responsible for implementing, evaluating, and modifying BMPs to restore and protect impaired water bodies. The State of Idaho is committed to developing implementation plans within 18 months of EPA approval of TMDLs. DEQ, the WAG, and the designated agencies will develop implementation plans, and DEQ will incorporate them into the state's water quality management plan. DEQ will periodically reassess the beneficial use support status of water bodies to determine support status. Implementation or revision of BMPs will continue until full beneficial use support status is documented and the TMDL is considered to be achieved.

5.1.4.4 Natural Background

Natural background for sediment is considered to be nearly equivalent to the SSC reported at locations in similar ecoregions (Ecoregion III) or that are documented to be the least impacted locations in the watershed. Natural background is less than the proposed target of 20 mg/L sediment over 4 months. The SEV 8 and 20 mg/L over 4 months is a combination of natural background and nonpoint source load allocations.

5.1.4.5 Reserve for Growth

A growth reserve is not included in this TMDL, which includes additional removal of riparian zone vegetation and increases in suspended sediment loads or concentrations. The load capacity has been allocated to the existing sources currently in the watershed. Any new source would need to be assigned a portion of the existing load allocation.

5.2 Bacteria TMDL

5.2.1 Instream Water Quality Targets

The Idaho water quality standard for *E. coli* bacteria, used as the target for developing the TMDL, is a geometric mean concentration of 126 cfu/100 mL, derived from five sample concentrations taken at evenly spaced intervals over a 30-day period (IDAPA 58.01.02.251.01). A single water sample in which either the primary or secondary recreation use criterion is exceeded does not in itself constitute a violation of water quality standards; rather, it requires that additional samples be taken every 3 to 7 days over a 30-day period. Those 5 sample concentrations are then used to calculate a geometric mean concentration to compare against the criterion. A geometric mean is applied to minimize random variability in data associated with surface waters prone to short-term episodic spikes in bacteria concentrations.

5.2.1.1 Target Selection

E. coli bacteria concentrations in Little Willow Creek are currently above the concentration allowed by Idaho water quality standards during the summer, based on the data collected by DEQ in 2012 (Table 6). Little Willow Creek has presumed beneficial uses secondary contact recreation. This TMDL is meant to be protective of secondary contact recreation by regulating the instream bacteria load. The *E. coli* target is based upon the water quality standard of 126 cfu/100 mL.

5.2.1.2 Water Quality Monitoring Points

The monitoring locations for the 2007 data collected by ISDA and the 2012 data collected by DEQ are illustrated in Figure 7. Samples were collected at the most upstream accessible data collection location in the AU, at an accessible mid-AU location, and at the most accessible location near the mouth of Little Willow Creek. Future monitoring is recommended at this location since it will provide an historical benchmark to compare future data and to measure progress.

The source of *E. coli* to Little Willow Creek is nonpoint in nature and is likely input along its length in its entirety. The instream *E. coli* concentrations are likely highly variable and depend on land use. Landownership along Little Willow Creek is entirely private, and therefore, monitoring locations are limited to landowner access and permission. Because land use is similar across the length of Little Willow Creek and these sites are accessible as well as an historic point of reference, it is recommended that all future *E. coli* monitoring occur in the same monitoring locations.

5.2.2 Load Capacity

The *E. coli* bacteria load capacity for Little Willow Creek is based on the Idaho water quality standards and is expressed as the geometric mean concentration of 126 cfu/100 mL. The load capacity is expressed as a concentration (cfu/100 mL) because it is difficult to calculate a mass load due to several variables (i.e., temperature, moisture conditions, and flow) that influence the die-off rate of *E. coli* bacteria in the environment.

5.2.3 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," (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 subwatershed) 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.

No point sources are in the watershed, thus no wasteload allocation were calculated. Load allocations have not been developed for specific sources. An instream allocation has been developed for Little Willow Creek, based on bacteriological data collected in 2012, rather than 2007 ISDA data because it followed DEQ *E. coli* sampling protocol. The 2012 data are more recent and likely to be more accurate because *E. coli* loading is extremely variable. The 2012 geometric mean was assessed against Idaho's numeric criterion set forth to protect the secondary contact recreation beneficial use. The load was calculated based on the time of year in which the highest concentrations were found to ensure that the loading estimates are conservative.

5.2.4 Load and Wasteload Allocation

Table 12 lists the existing *E. coli* bacteria concentrations found in 2012 at the monitoring station. Table 13 shows the secondary contact recreation geometric mean capacity (load capacity), load allocation, and reduction in *E. coli* bacteria concentrations that must occur to meet the load allocation.

The *E. coli* bacteria TMDL for Little Willow Creek allocates a geometric mean concentration calculated from five samples taken over any 30-day period to all nonpoint sources of *E. coli* bacteria within the assessment unit and adds a 10% MOS to the required load reduction to ensure the secondary contact beneficial use is supported throughout the year (Table 13). As such, sources must be managed to reduce the instream *E. coli* bacteria concentrations by 794.6 cfu/100 mL, or 87%. To ensure that the criterion is not exceeded, this allocation will apply daily throughout the year.

Table 12. Little Willow Creek (ID17050122SW018_04) 2012 *E. coli* results.

Date	LWC-Mouth *E. coli* (cfu)	LWC-2 *E. coli* (cfu)
6/1/2012	797.6	613.1
6/7/2012	613.1	1,515
6/13/2012	959.4	1,332.7
6/20/2012	1,075.8	727.3
6/26/2012	816.4	1,012.2
Geometric mean	837.5	981.6

Note: colony forming unit (cfu); total geometric mean for Little Willow Creek (combined sites) is 906.7 cfu.

Table 13. Little Willow Creek (ID17050122SW018_04) *E. coli* load allocation.

Location	Existing Load (cfu/100 mL)	30-day Load Capacity (cfu/100 mL)	30-day Load Allocation (cfu/100 mL)	Explicit Margin of Safety (%)	Required Load Reduction (cfu/100 mL)
Little Willow Creek	907.6	126	113	10	87% or 794.6

Note: colony forming units (cfu); milliliters (mL); total geometric mean for Little Willow Creek (combined sites) is 906.7 cfu.

5.2.4.1 Margin of Safety

Establishing a TMDL requires that a MOS be identified to account for uncertainty. A MOS is expressed as either an implicit or explicit portion of a water body's loading capacity that is reserved to allow for uncertainty about the relationship between the pollutant loads and the quality of the receiving water body. The MOS is not allocated to any sources of a pollutant. DEQ has added an explicit MOS (10%) to the required load reduction to ensure the secondary contact beneficial use is supported throughout the year.

5.2.4.2 Seasonal Variation

The *E. coli* bacteria allocations apply on a daily basis throughout the year, since secondary contact recreation (i.e., wading) may occur at any time of year. *E. coli* concentrations tend to be at their highest during warm, summer months due to decreased flows and increased temperatures, so this TMDL was developed based on summer monitoring data.

Meeting this allocation ensures water quality standards are attained for the protection of public health. Additional sampling is needed to better characterize bacteria loading.

5.2.4.3 Reasonable Assurance

Reasonable assurances are not required because land use in the Little Willow Creek watershed is overwhelmingly agricultural and all reductions are directed at nonpoint sources. However, Idaho water quality standards assign specific agencies to be responsible for implementing, evaluating, and modifying BMPs to restore and protect impaired water bodies. The State of Idaho is committed to developing implementation plans within 18 months of EPA approval of TMDLs. DEQ, the WAG, and the designated agencies will develop implementation plans, and DEQ will incorporate them into the state's water quality management plan. DEQ will periodically reassess the beneficial use support status of water bodies to determine support status. Implementation or revision of BMPs will continue until full beneficial use support status is documented and the TMDL is considered to be achieved.

5.2.4.4 Natural Background

Background levels of *E. coli* are incorporated into Idaho water quality standards for *E. coli* (126 cfu/100 mL).

5.2.4.5 Reserve for Growth

A growth reserve is not included in this TMDL. The load capacity has been allocated to the existing sources currently in the watershed. Any new source will be required to meet the requirements of this TMDL.

5.3 Temperature TMDL

5.3.1 Instream Water Quality Targets

For two of the Little Willow Creek AUs with temperature TMDLs, we used a potential natural vegetation (PNV) approach. The Idaho water quality standards include a provision (IDAPA 58.01.02.200.09) that if natural conditions exceed numeric water quality criteria, exceedance of the criteria is not considered a violation of water quality standards. In these situations, natural conditions essentially become the water quality standard, and for temperature TMDLs, the natural level of shade and channel width become the TMDL target. The instream temperature that results from attaining these conditions is consistent with the water quality standards, even if it exceeds numeric temperature criteria. Appendix A provides further discussion of water quality standards and natural background provisions.

The PNV approach is described briefly below. The procedures and methodologies to develop PNV target shade levels and to estimate existing shade levels are described in detail in *The Potential Natural Vegetation (PNV) Temperature Total Maximum Daily Load (TMDL) Procedures Manual* (Shumar and De Varona 2009). The manual also provides a more complete discussion of shade and its effects on stream water temperature.

5.3.1.1 Factors Controlling Water Temperature in Streams

Several important factors contribute heat to a stream, including ground water temperature, air temperature, and direct solar radiation (Poole and Berman 2001). Of these, direct solar radiation is the source of heat that is most controllable. The parameters that affect the amount of solar radiation hitting a stream throughout its length are shade and stream morphology. Shade is provided by the surrounding vegetation and other physical features such as hillsides, canyon walls, terraces, and high banks. Stream morphology (i.e., structure) affects riparian vegetation density and water storage in the alluvial aquifer. Riparian vegetation and channel morphology are the factors influencing shade that are most likely to have been influenced by anthropogenic activities and can be most readily corrected and addressed by a TMDL.

Riparian vegetation provides a substantial amount of shade on a stream by virtue of its proximity. However, depending on how much vertical elevation surrounds the stream, vegetation further away from the riparian corridor can also provide shade. The amount of shade that a stream receives is measured in a number of ways. Effective shade (i.e., shade provided by all objects that intercept the sun as it makes its way across the sky) can be measured in a given location with a Solar Pathfinder or with other optical equipment similar to a fish-eye lens on a camera. Effective shade can also be modeled using detailed information about riparian plants and their communities, topography, and stream aspect.

In addition to shade, canopy cover is a similar parameter that affects solar radiation. Canopy cover is the vegetation that hangs directly over the stream and can be measured using a densiometer or estimated visually either on site or using aerial photography. All of these methods provide information about how much of the stream is covered and how much is exposed to direct solar radiation.

5.3.1.2 Potential Natural Vegetation for Temperature TMDLs

PNV along a stream is that riparian plant community that could grow to an overall mature state, although some level of natural disturbance is usually included in the development and use of shade targets. Vegetation can be removed by disturbance either naturally (e.g., wildfire, disease/old age, wind damage, and wildlife grazing) or anthropogenically (e.g., domestic livestock grazing, vegetation removal, and erosion). The idea behind PNV as targets for temperature TMDLs is that PNV provides a natural level of solar loading to the stream without any anthropogenic removal of shade-producing vegetation. Vegetation levels less than PNV (with the exception of natural levels of disturbance and age distribution) result in the stream heating up from anthropogenically created additional solar inputs.

DEQ estimates PNV (and therefore target shade) from models of plant community structure (shade curves for specific riparian plant communities), and measures or estimates existing canopy cover or shade. Comparing the two (target and existing shade) indicates how much excess solar load the stream is receiving and what potential exists to decrease solar gain. Streams disturbed by wildfire, flood, or some other natural disturbance will be at less than PNV and require time to recover. Streams that have been disturbed by human activity may require additional restoration above and beyond natural recovery.

Existing and PNV shade was converted to solar loads from data collected on flat-plate collectors at the nearest National Renewable Energy Laboratory (NREL) weather stations collecting these data. The Boise, Idaho, station was used. The difference between existing and target solar loads, assuming existing load is higher, is the load reduction necessary to bring the stream back into compliance with water quality standards (Appendix A).

PNV shade and the associated solar loads are assumed to be the natural condition; thus, stream temperatures under PNV conditions are assumed to be natural (so long as no point sources or other anthropogenic sources of heat exist in the watershed) and are considered to be consistent with the Idaho water quality standards, even if they exceed numeric criteria by more than 0.3°C.

5.3.1.2.1 Existing Shade Estimates

Existing shade was estimated for two AUs from visual interpretation of aerial photos. Estimates of existing shade based on plant type and density were marked out as stream segments on a 1:100,000 or 1:250,000 hydrography taking into account natural breaks in vegetation density. Stream segment length for each estimate of existing shade varies depending on the land use or landscape that has affected that shade level. Each segment was assigned a single value representing the bottom of a 10% shade class (adapted from the cumulative watershed effects process, IDL 2000). For example, if shade for a particular stream segment was estimated between 50% and 59%, we assigned a 50% shade class to that segment. The estimate is based on a general intuitive observation about the kind of vegetation present, its density, and stream width.

Streams where the banks and water are clearly visible are usually in low shade classes (10%, 20%, or 30%). Streams with dense forest or heavy brush where no portion of the stream is visible are usually in high shade classes (70%, 80%, or 90%). More open canopies where portions of the stream may be visible usually fall into moderate shade classes (40%, 50%, or 60%).

Visual estimates made from aerial photos are strongly influenced by canopy cover and do not always take into account topography or any shading that may occur from physical features other than vegetation. It is not always possible to visualize or anticipate shade characteristics resulting from topography and landform. However, research has shown that shade and canopy cover measurements are remarkably similar (OWEB 2001), reinforcing the idea that riparian vegetation and objects proximal to the stream provide the most shade. The visual estimates of shade in this TMDL were partially field verified with a Solar Pathfinder, which measures effective shade and takes into consideration other physical features that block the sun from hitting the stream surface (e.g., hillsides, canyon walls, terraces, and man-made structures).

Solar Pathfinder Field Verification

The accuracy of the aerial photo interpretations will be field verified with a Solar Pathfinder at a number of sites in spring 2013. The Solar Pathfinder is a device that allows one to trace the outline of shade-producing objects on monthly solar path charts. The percentage of the sun's path covered by these objects is the effective shade on the stream at the location where the tracing is made. To adequately characterize the effective shade on a stream segment, 10 traces are taken at systematic or random intervals along the length of the stream in question.

At each sampling location, the Solar Pathfinder was placed in the middle of the stream at about the bankfull water level. Ten traces were taken following the manufacturer's instructions (i.e., orient to south and level). Systematic sampling was used because it is easiest to accomplish without biasing the sampling location. For each sampled segment, the sampler started at a unique location, such as 50 to 100 meters from a bridge or fence line, and proceeded upstream or downstream taking additional traces at fixed intervals (e.g., every 50 meters, 50 paces, etc.). Alternatively, one can randomly locate points of measurement by generating random numbers to be used as interval distances.

When possible, the sampler also measured bankfull widths, took notes, and photographed the landscape of the stream at several unique locations while taking traces. Special attention was given to changes in riparian plant communities and what kinds of plant species (the large, dominant, shade-producing ones) were present. One can also take densiometer readings at the same location as Solar Pathfinder traces. These readings provide the potential to develop relationships between canopy cover and effective shade for a given stream.

Eight (8) pathfinder sites were established on Little Willow Creek in the 4th order AU (Table 14). Sites were located in the lower agricultural region where historic land use activities and hydrology have caused significant changes to stream banks and riparian vegetation. Pathfinder sites were used to verify the accuracy of aerial interpretations of existing shade. Of the eight sites, three showed that the interpretation was accurate whereas five sites were off by one shade class. The average difference between original interpretation class and pathfinder class was -4 ± 5.16 (average ± 95% C.I.) suggesting that the tendency was to underestimate actual shade (Table 14). Although non-wadeable due to high flows, the upper portion of Little Willow Creek on

BLM land below Paddock Valley Reservoir (3rd order AU) was visually evaluated in the field to enhance the visual estimate of shade in that region. These data were used to re-evaluate the original aerial interpretation and repeat the process with a “calibrated eye.” Existing shade data presented in this TMDL are the result of this re-evaluation.

Table 14. Solar Pathfinder results for Little Willow Creek (ID17050122SW018_04).

aerial class	pathfinder actual	pathfinder class	delta		
10	20.5	20	-10		site 1
10	8.7	0	10		site 2
0	12	10	-10		site 3
0	8.5	0	0		site 7
0	15.8	10	-10		site 8
0	5.3	0	0		site 4
0	10.2	10	-10		site 5
0	8.8	0	0		site 6
			-4	average	
			7.44	std dev	
			5.16	95%CI	

Target Shade Determination

PNV targets were determined from an analysis of probable vegetation at the streams and comparing that to shade curves developed for similar vegetation communities in Idaho (Shumar and De Varona 2009). A shade curve shows the relationship between effective shade and stream width. As a stream gets wider, shade decreases as vegetation has less ability to shade the center of wide streams. As the vegetation gets taller, the more shade the plant community is able to provide at any given channel width.

5.3.1.2.2 Natural Bankfull Widths

Stream width must be known to calculate target shade since the width of a stream affects the amount of shade the stream receives. Bankfull width is used because it best approximates the width between the points on either side of the stream where riparian vegetation starts. Measures of current bankfull width may not reflect widths present under PNV (i.e., natural widths). As impacts to streams and riparian areas occur, width-to-depth ratios tend to increase such that streams become wider and shallower. Shade produced by vegetation covers a lower percentage of the water surface in wider streams, and widened streams can also have less vegetative cover if shoreline vegetation has eroded away.

Since, existing bankfull width may not reflect natural bankfull widths, this parameter must be estimated from available information. Regional curves were used for the major basins in Idaho—developed from data compiled by Diane Hopster of the Idaho Department of Lands—to estimate natural bankfull width (Figure 16).

For each stream evaluated in the load analysis, natural bankfull width was estimated based on the drainage area of the Upper Snake Basin, Payette/Weiser Basin, and Salmon Basin curves from Figure 16. Although estimates from these curves were examined, no curve estimate was considered to be a good predictor of channel width for the Little Willow Creek watershed. Existing width data, as measured on aerial photographs, were evaluated and compared to these curve estimates (Table 15). Ideally, field measurements of channel width should be used. However, for the Little Willow Creek watershed, only a few Beneficial Use Reconnaissance Program (BURP) sites exist, and bankfull width data from those sites represent only spot data (e.g., only three measured widths in a reach just several hundred meters long) that are not always representative of the stream as a whole.

In general, DEQ found aerial photo measurements and BURP bankfull width data disagreed with natural bankfull width estimates from the basin curves, and we chose not to make natural widths any larger than these aerial estimates. The load analysis tables (Table 14 and Table 15) present a natural bankfull width and an existing bankfull width for every stream segment in the analysis and are based on the *aerial* bankfull width results presented in Table 15. Existing widths and natural widths are the same in load tables when there are no data to support making them differ.

Table 15. Estimates of channel width in meters from drainage area relationships and aerial photo interpretation.

Location	Area (square mile)	Upper Snake (meter)	Salmon (meter)	Payette/Weiser (meter)	Aerial (meter)
Little Willow Creek at mouth	153.67	14	20	21	12
Little Willow Creek above McIntyre Gulch	119.23	13	18	19	10
Little Willow Creek above Indian Creek	67.83	10	15	14	8
Little Willow Creek above Linsom Creek	50	9	13	12	7
Little Willow Creek at Paddock Reservoir Dam	45.37	8	13	11	5

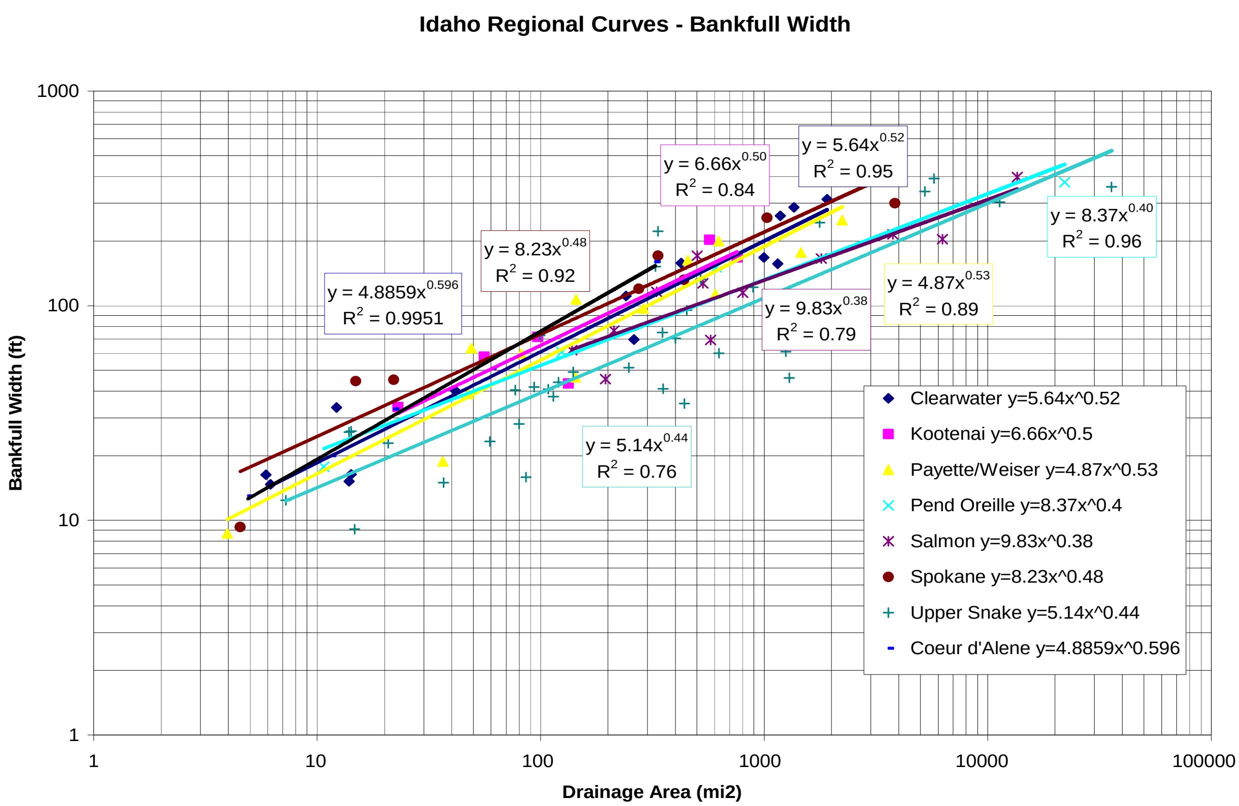

Figure 16. Bankfull width as a function of drainage area.

5.3.1.2.3 Design Conditions

The Little Willow Creek watershed is located in the Snake River Plain Level III Ecoregion of McGrath et al. (2001), largely sagebrush/steppe country that has been converted to exotic annual grasslands. The Paddock Valley Reservoir region of the watershed is in the Semiarid Foothills Level IV Ecoregion where shallow, clayey soils are common and often support medusahead wildrye, cheatgrass, and scattered shrubs. The majority of Little Willow Creek under examination in this document is in the Unwooded Alkaline Foothills Level IV Ecoregion. Here sandy alkaline lacustrine deposits that once supported unique flora in saltbush/greasewood and sagebrush/steppe communities is now largely cheatgrass and crested wheatgrass communities or has been converted to agriculture.

Perennial streams are rare in these ecoregions. Where the streams occur, riparian corridors can be dominated by willow or other riparian shrubs and white alder or black cottonwood communities. Lower Little Willow Creek below Paddock Valley Reservoir alternates through white alder and willow communities as it winds through narrow canyon country. Once Little Willow Creek extends below the canyon into wider valleys, black cottonwood communities emerge along its banks.

5.3.1.2.4 Shade Curve Selection

To determine PNV shade targets for Little Willow Creek, effective shade curves from the southern Idaho Nonforest Group were examined (Shumar and De Varona 2009). These curves were produced using vegetation community modeling of Idaho plant communities. Effective shade curves include percent shade on the vertical axis and stream width on the horizontal axis. For Little Willow Creek, curves for the most similar vegetation type were selected for shade target determinations. For the canyon zone, the yellow willow shade curve (canopy cover = 50%, weighted height = 5.6 meters) was selected to represent the shrub-dominated communities along the creek. Where white alder was thought to exist, a similarly sized plant community was selected for shade target representation. White alder is a small tree that averages 16 meters in height, however, due to its rarity in Idaho, no shade curve has been produced for white alder riparian communities. The water birch shade curve (canopy cover = 50%, weighted height = 13.5 meters) was selected to represent white alder areas because water birch is also a small tree approximately 15 meters in height. Below the canyon where floodplains have developed in wider valleys, the western Idaho black cottonwood shade curve was selected for target determinations. This cottonwood shade curve was developed recently from vegetation data collected in Boise, Payette, and Weiser basins and is not in Shumar and De Verona (2009). Data used to generate this black cottonwood shade curve include an average canopy cover of 79% and a weighted average height of 10 meters. There is a large cattail marsh in the middle of the 3rd order AU where the canyon opens up into a wider valley type. The graminoid shade curve of Shumar and De Varona (2009) was used to represent targets for this cattail area.

5.3.2 Load Capacity

The load capacity for a stream under PNV is essentially the solar loading allowed under the shade targets specified for the segments within that stream. These loads are determined by multiplying the solar load measured by a flat-plate collector (under full sun) for a given period of time by the fraction of the solar radiation that is not blocked by shade (i.e., the percent open or 100% minus percent shade). In other words, if a shade target is 60% (or 0.6), the solar load hitting the stream under that target is 40% of the load hitting the flat-plate collector under full sun.

DEQ obtained solar load data from flat-plate collectors at the NREL weather station in Boise, Idaho. The solar load data used in this TMDL analysis are spring/summer averages (i.e., an average load for the 6-month period from April through September). As such, load capacity calculations are also based on this 6-month period, which coincides with the time of year when stream temperatures are increasing, deciduous vegetation is in leaf, and fall spawning is occurring. During this period, temperatures may affect beneficial uses such as spring and fall salmonid spawning and cold water aquatic life criteria may be exceeded during summer months. Late July and early August typically represent the period of highest stream temperatures. However, solar gains can begin early in the spring and affect not only the highest temperatures reached later in the summer but also salmonid spawning temperatures in spring and fall.

Table 16, Table 17, and Figure 17 show the PNV shade targets. The tables also show corresponding target summer loads (in kilowatt-hours per square meter per day [kWh/m^2/day] and kilowatt-hours per day [kWh/day]) that serve as the load capacities for the streams. Existing and target loads in kWh/day can be summed for the entire stream or portion of stream examined in a single load analysis table. These total loads are shown at the bottom of their respective columns in each table. Because load calculations involve stream segment area calculations, the segments channel width, which typically only has one or two significant figures, dictates the level of significance of the corresponding loads. One significant figure in the resulting load can create rounding errors when existing and target loads are subtracted. The totals row of each load table represents total loads with two significant figures in an attempt to reduce apparent rounding errors.

The AU with the largest target load (i.e., load capacity) was AU ID 17050122SW018_04 with 740,000 kWh/day (Table 17). The smallest target load was in the AU ID 17050122SW018_03 with 190,000 kWh/day (Table 16).

5.3.3 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" (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 subwatershed) but may be aggregated by type of source or area. To the extent possible, background loads should be distinguished from human-caused increases in nonpoint loads.

Existing loads in this temperature TMDL come from estimates of existing shade as determined from aerial photo interpretations. There are currently no permitted point sources in the affected AUs. Like target shade, existing shade was converted to a solar load by multiplying the fraction of open stream by the solar radiation measured on a flat-plate collector at the NREL weather station. Existing shade data are presented in Table 16 and Table 17. Like load capacities (target loads), existing loads in Table 16 and Table 17 are presented on an area basis (kWh/m^2/day) and as a total load (kWh/day). Existing loads in kWh/day are also summed for the entire stream or portion of stream examined in a single load analysis table. The difference between target and existing load is also summed for the entire table. Should existing load exceed target load, this difference becomes the excess load (i.e., lack of shade) to be discussed next in the load allocation section and as depicted in the lack of shade figure (Figure 18).

The AU with the largest existing load was AU ID 17050122SW018_04 with 1.6 million kWh/day (Table 17). Existing shade estimates for Little Willow Creek are provided in Figure 19. The smallest existing load was in the AU ID 17050122SW018_03 with 250,000 kWh/day (Table 16).

Table 16. Existing and target solar loads for Little Willow Creek (ID17050122SW018_03).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
018_03	Little Willow Creek	1	60	yellow willow	39%	3.89	5	300	1,000	50%	3.19	5	300	1,000	0	0%
018_03	Little Willow Creek	2	760	yellow willow	39%	3.89	5	4,000	20,000	50%	3.19	5	4,000	10,000	(10,000)	0%
018_03	Little Willow Creek	3	260	yellow willow	39%	3.89	5	1,000	4,000	20%	5.10	5	1,000	5,000	1,000	-19%
018_03	Little Willow Creek	4	120	yellow willow	39%	3.89	5	600	2,000	50%	3.19	5	600	2,000	0	0%
018_03	Little Willow Creek	5	120	yellow willow	39%	3.89	5	600	2,000	40%	3.83	5	600	2,000	0	0%
018_03	Little Willow Creek	6	90	yellow willow	39%	3.89	5	500	2,000	20%	5.10	5	500	3,000	1,000	-19%
018_03	Little Willow Creek	7	190	yellow willow	39%	3.89	5	1,000	4,000	40%	3.83	5	1,000	4,000	0	0%
018_03	Little Willow Creek	8	120	yellow willow	39%	3.89	5	600	2,000	20%	5.10	5	600	3,000	1,000	-19%
018_03	Little Willow Creek	9	260	yellow willow	39%	3.89	5	1,000	4,000	30%	4.47	5	1,000	4,000	0	-9%
018_03	Little Willow Creek	10	500	yellow willow	34%	4.21	6	3,000	10,000	10%	5.74	6	3,000	20,000	10,000	-24%
018_03	Little Willow Creek	11	210	yellow willow	34%	4.21	6	1,000	4,000	40%	3.83	6	1,000	4,000	0	0%
018_03	Little Willow Creek	11	240	yellow willow	34%	4.21	6	1,000	4,000	30%	4.47	6	1,000	4,000	0	-4%
018_03	Little Willow Creek	12	340	yellow willow	34%	4.21	6	2,000	8,000	0%	6.38	6	2,000	10,000	2,000	-34%
018_03	Little Willow Creek	13	120	yellow willow	34%	4.21	6	700	3,000	40%	3.83	6	700	3,000	0	0%
018_03	Little Willow Creek	14	50	yellow willow	34%	4.21	6	300	1,000	0%	6.38	6	300	2,000	1,000	-34%
018_03	Little Willow Creek	15	150	yellow willow	34%	4.21	6	900	4,000	20%	5.10	6	900	5,000	1,000	-14%
018_03	Little Willow Creek	16	430	yellow willow	34%	4.21	6	3,000	10,000	0%	6.38	6	3,000	20,000	10,000	-34%
018_03	Little Willow Creek	17	71	cattail	9%	5.81	7	500	3,000	10%	5.74	7	500	3,000	0	0%
018_03	Little Willow Creek	18	170	cattail	9%	5.81	7	1,000	6,000	10%	5.74	7	1,000	6,000	0	0%
018_03	Little Willow Creek	19	300	cattail	9%	5.81	7	2,000	10,000	0%	6.38	7	2,000	10,000	0	-9%
018_03	Little Willow Creek	20	410	white alder	58%	2.68	7	3,000	8,000	50%	3.19	7	3,000	10,000	2,000	-8%
018_03	Little Willow Creek	21	160	yellow willow	30%	4.47	7	1,000	4,000	30%	4.47	7	1,000	4,000	0	0%
018_03	Little Willow Creek	22	450	white alder	58%	2.68	7	3,000	8,000	40%	3.83	7	3,000	10,000	2,000	-18%
018_03	Little Willow Creek	23	430	white alder	58%	2.68	7	3,000	8,000	50%	3.19	7	3,000	10,000	2,000	-8%
018_03	Little Willow Creek	24	330	white alder	53%	3.00	8	3,000	9,000	40%	3.83	8	3,000	10,000	1,000	-13%
018_03	Little Willow Creek	25	37	white alder	53%	3.00	8	300	900	0%	6.38	8	300	2,000	1,000	-53%
018_03	Little Willow Creek	26	78	white alder	53%	3.00	8	600	2,000	40%	3.83	8	600	2,000	0	-13%
018_03	Little Willow Creek	27	120	white alder	53%	3.00	8	1,000	3,000	0%	6.38	8	1,000	6,000	3,000	-53%
018_03	Little Willow Creek	28	410	white alder	53%	3.00	8	3,000	9,000	60%	2.55	8	3,000	8,000	(1,000)	0%
018_03	Little Willow Creek	29	140	white alder	53%	3.00	8	1,000	3,000	40%	3.83	8	1,000	4,000	1,000	-13%
018_03	Little Willow Creek	30	49	white alder	53%	3.00	8	400	1,000	0%	6.38	8	400	3,000	2,000	-53%
018_03	Little Willow Creek	31	210	cottonwood	69%	1.98	8	2,000	4,000	60%	2.55	8	2,000	5,000	1,000	-9%
018_03	Little Willow Creek	32	230	cottonwood	69%	1.98	8	2,000	4,000	30%	4.47	8	2,000	9,000	5,000	-39%
018_03	Little Willow Creek	33	120	cottonwood	69%	1.98	8	1,000	2,000	10%	5.74	8	1,000	6,000	4,000	-59%
018_03	Little Willow Creek	34	480	cottonwood	69%	1.98	8	4,000	8,000	60%	2.55	8	4,000	10,000	2,000	-9%
018_03	Little Willow Creek	35	120	cottonwood	69%	1.98	8	1,000	2,000	10%	5.74	8	1,000	6,000	4,000	-59%
018_03	Little Willow Creek	36	66	cottonwood	69%	1.98	8	500	1,000	40%	3.83	8	500	2,000	1,000	-29%
018_03	Little Willow Creek	37	260	cottonwood	69%	1.98	8	2,000	4,000	30%	4.47	8	2,000	9,000	5,000	-39%
018_03	Little Willow Creek	38	110	cottonwood	69%	1.98	8	900	2,000	50%	3.19	8	900	3,000	1,000	-19%
018_03	Little Willow Creek	39	35	cottonwood	69%	1.98	8	300	600	0%	6.38	8	300	2,000	1,000	-69%
018_03	Little Willow Creek	40	170	cottonwood	69%	1.98	8	1,000	2,000	50%	3.19	8	1,000	3,000	1,000	-19%
018_03	Little Willow Creek	41	140	cottonwood	69%	1.98	8	1,000	2,000	40%	3.83	8	1,000	4,000	2,000	-29%
018_03	Little Willow Creek	42	110	cottonwood	69%	1.98	8	900	2,000	50%	3.19	8	900	3,000	1,000	-19%
							Totals		190,000					250,000	58,000	

Note: Significant figures are controlled by the lowest level in the calculation, typically that of the channel width. Some rounding errors may result.

Table 17.Existing and target solar loads for Little Willow Creek (ID17050122SW018_04).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
018_04	Little Willow Creek	1	230	cottonwood	63%	2.36	9	2,000	5,000	40%	3.83	9	2,000	8,000	3,000	-23%
018_04	Little Willow Creek	2	130	cottonwood	63%	2.36	9	1,000	2,000	10%	5.74	9	1,000	6,000	4,000	-53%
018_04	Little Willow Creek	3	280	cottonwood	63%	2.36	9	3,000	7,000	40%	3.83	9	3,000	10,000	3,000	-23%
018_04	Little Willow Creek	4	130	cottonwood	63%	2.36	9	1,000	2,000	10%	5.74	9	1,000	6,000	4,000	-53%
018_04	Little Willow Creek	5	280	cottonwood	63%	2.36	9	3,000	7,000	0%	6.38	9	3,000	20,000	10,000	-63%
018_04	Little Willow Creek	6	200	cottonwood	63%	2.36	9	2,000	5,000	0%	6.38	9	2,000	10,000	5,000	-63%
018_04	Little Willow Creek	7	260	cottonwood	63%	2.36	9	2,000	5,000	50%	3.19	9	2,000	6,000	1,000	-13%
018_04	Little Willow Creek	8	130	cottonwood	63%	2.36	9	1,000	2,000	20%	5.10	9	1,000	5,000	3,000	-43%
018_04	Little Willow Creek	9	300	cottonwood	63%	2.36	9	3,000	7,000	40%	3.83	9	3,000	10,000	3,000	-23%
018_04	Little Willow Creek	10	190	cottonwood	63%	2.36	9	2,000	5,000	0%	6.38	9	2,000	10,000	5,000	-63%
018_04	Little Willow Creek	11	110	cottonwood	63%	2.36	9	1,000	2,000	0%	6.38	9	1,000	6,000	4,000	-63%
018_04	Little Willow Creek	12	220	cottonwood	63%	2.36	9	2,000	5,000	20%	5.10	9	2,000	10,000	5,000	-43%
018_04	Little Willow Creek	13	250	cottonwood	63%	2.36	9	2,000	5,000	10%	5.74	9	2,000	10,000	5,000	-53%
018_04	Little Willow Creek	14	180	cottonwood	63%	2.36	9	2,000	5,000	30%	4.47	9	2,000	9,000	4,000	-33%
018_04	Little Willow Creek	15	200	cottonwood	63%	2.36	9	2,000	5,000	10%	5.74	9	2,000	10,000	5,000	-53%
018_04	Little Willow Creek	16	620	cottonwood	63%	2.36	9	6,000	10,000	0%	6.38	9	6,000	40,000	30,000	-63%
018_04	Little Willow Creek	17	200	cottonwood	63%	2.36	9	2,000	5,000	10%	5.74	9	2,000	10,000	5,000	-53%
018_04	Little Willow Creek	18	1100	cottonwood	63%	2.36	9	10,000	20,000	10%	5.74	9	10,000	60,000	40,000	-53%
018_04	Little Willow Creek	18	180	cottonwood	63%	2.36	9	2,000	5,000	20%	5.10	9	2,000	10,000	5,000	-43%
018_04	Little Willow Creek	18	130	cottonwood	63%	2.36	9	1,000	2,000	10%	5.74	9	1,000	6,000	4,000	-53%
018_04	Little Willow Creek	19	1000	cottonwood	63%	2.36	9	9,000	20,000	0%	6.38	9	9,000	60,000	40,000	-63%
018_04	Little Willow Creek	20	260	cottonwood	59%	2.62	10	2,600	6,800	0%	6.38	10	2,600	17,000	10,000	-59%
018_04	Little Willow Creek	21	270	cottonwood	59%	2.62	10	2,700	7,100	10%	5.74	10	2,700	16,000	8,900	-49%
018_04	Little Willow Creek	22	550	cottonwood	59%	2.62	10	5,500	14,000	0%	6.38	10	5,500	35,000	21,000	-59%
018_04	Little Willow Creek	23	890	cottonwood	59%	2.62	10	8,900	23,000	0%	6.38	10	8,900	57,000	34,000	-59%
018_04	Little Willow Creek	24	270	cottonwood	59%	2.62	10	2,700	7,100	10%	5.74	10	2,700	16,000	8,900	-49%
018_04	Little Willow Creek	25	630	cottonwood	59%	2.62	10	6,300	16,000	0%	6.38	10	6,300	40,000	24,000	-59%
018_04	Little Willow Creek	26	310	cottonwood	59%	2.62	10	3,100	8,100	10%	5.74	10	3,100	18,000	9,900	-49%
018_04	Little Willow Creek	27	50	cottonwood	59%	2.62	10	500	1,300	30%	4.47	10	500	2,200	900	-29%
018_04	Little Willow Creek	27	250	cottonwood	59%	2.62	10	2,500	6,500	10%	5.74	10	2,500	14,000	7,500	-49%
018_04	Little Willow Creek	28	450	cottonwood	59%	2.62	10	4,500	12,000	0%	6.38	10	4,500	29,000	17,000	-59%
018_04	Little Willow Creek	28	50	cottonwood	59%	2.62	10	500	1,300	20%	5.10	10	500	2,600	1,300	-39%
018_04	Little Willow Creek	29	750	cottonwood	59%	2.62	10	7,500	20,000	10%	5.74	10	7,500	43,000	23,000	-49%
018_04	Little Willow Creek	29	440	cottonwood	59%	2.62	10	4,400	12,000	0%	6.38	10	4,400	28,000	16,000	-59%
018_04	Little Willow Creek	29	280	cottonwood	59%	2.62	10	2,800	7,300	10%	5.74	10	2,800	16,000	8,700	-49%
018_04	Little Willow Creek	30	600	cottonwood	59%	2.62	10	6,000	16,000	0%	6.38	10	6,000	38,000	22,000	-59%
018_04	Little Willow Creek	31	390	cottonwood	54%	2.93	11	4,300	13,000	10%	5.74	11	4,300	25,000	12,000	-44%
018_04	Little Willow Creek	32	130	cottonwood	54%	2.93	11	1,400	4,100	0%	6.38	11	1,400	8,900	4,800	-54%
018_04	Little Willow Creek	33	140	cottonwood	54%	2.93	11	1,500	4,400	30%	4.47	11	1,500	6,700	2,300	-24%
018_04	Little Willow Creek	34	240	cottonwood	54%	2.93	11	2,600	7,600	0%	6.38	11	2,600	17,000	9,400	-54%
018_04	Little Willow Creek	34	40	cottonwood	54%	2.93	11	440	1,300	40%	3.83	11	440	1,700	400	-14%
018_04	Little Willow Creek	34	100	cottonwood	54%	2.93	11	1,100	3,200	10%	5.74	11	1,100	6,300	3,100	-44%
018_04	Little Willow Creek	34	1500	cottonwood	54%	2.93	11	17,000	50,000	0%	6.38	11	17,000	110,000	60,000	-54%
018_04	Little Willow Creek	34	660	cottonwood	54%	2.93	11	7,300	21,000	0%	6.38	11	7,300	47,000	26,000	-54%
018_04	Little Willow Creek	35	550	cottonwood	54%	2.93	11	6,100	18,000	0%	6.38	11	6,100	39,000	21,000	-54%
018_04	Little Willow Creek	36	650	cottonwood	54%	2.93	11	7,200	21,000	0%	6.38	11	7,200	46,000	25,000	-54%
018_04	Little Willow Creek	37	370	cottonwood	54%	2.93	11	4,100	12,000	0%	6.38	11	4,100	26,000	14,000	-54%
018_04	Little Willow Creek	38	1200	cottonwood	54%	2.93	11	13,000	38,000	0%	6.38	11	13,000	83,000	45,000	-54%
018_04	Little Willow Creek	39	2200	cottonwood	51%	3.13	12	26,000	81,000	0%	6.38	12	26,000	170,000	89,000	-51%
018_04	Little Willow Creek	40	2800	cottonwood	51%	3.13	12	34,000	110,000	0%	6.38	12	34,000	220,000	110,000	-51%
018_04	Little Willow Creek	41	1700	cottonwood	51%	3.13	12	20,000	63,000	0%	6.38	12	20,000	130,000	67,000	-51%
018_04	Little Willow Creek	42	95	cottonwood	51%	3.13	12	1,100	3,400	0%	6.38	12	1,100	7,000	3,600	-51%
							Totals		740,000					1,600,000	890,000	

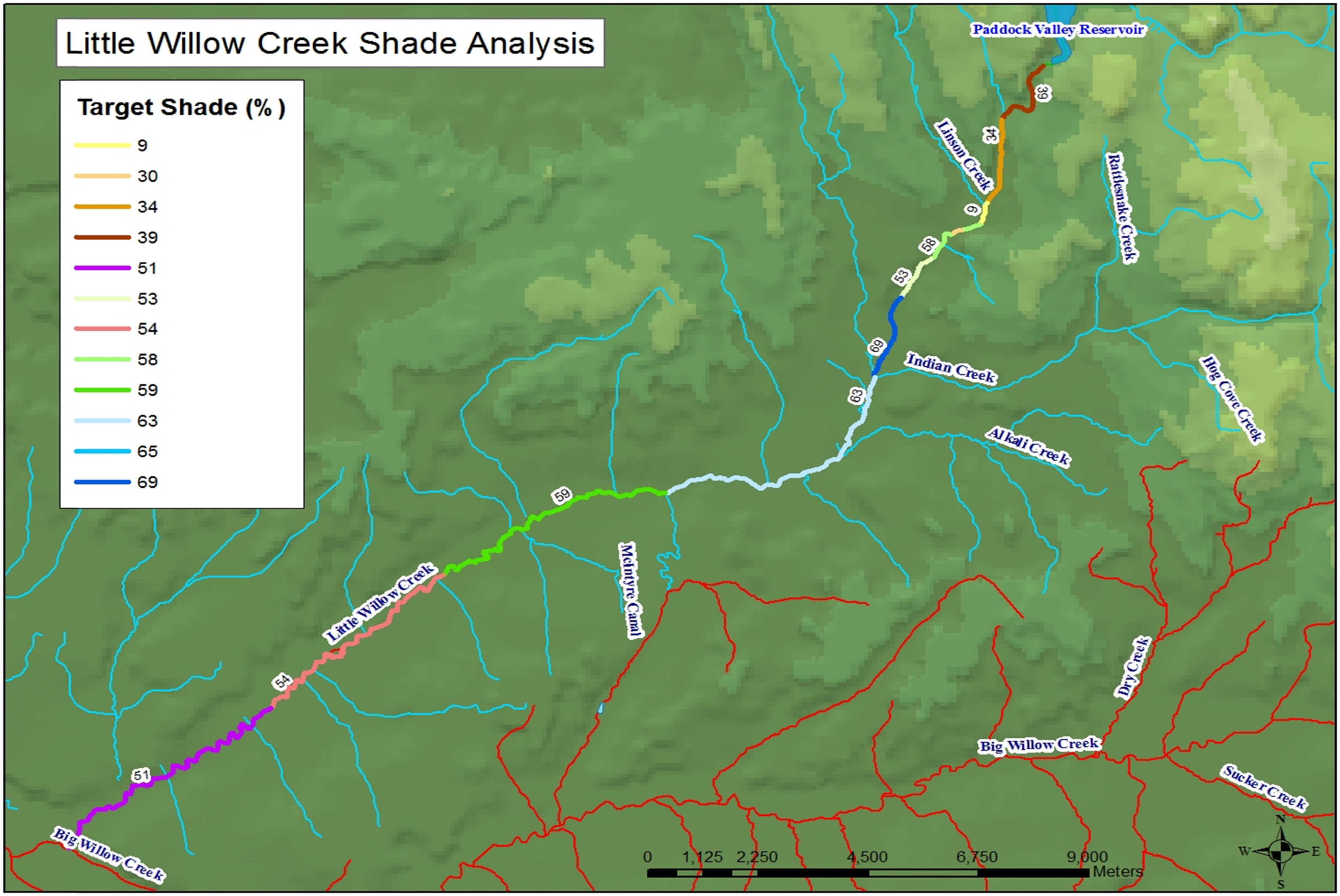

Figure 17. Target shade for Little Willow Creek.

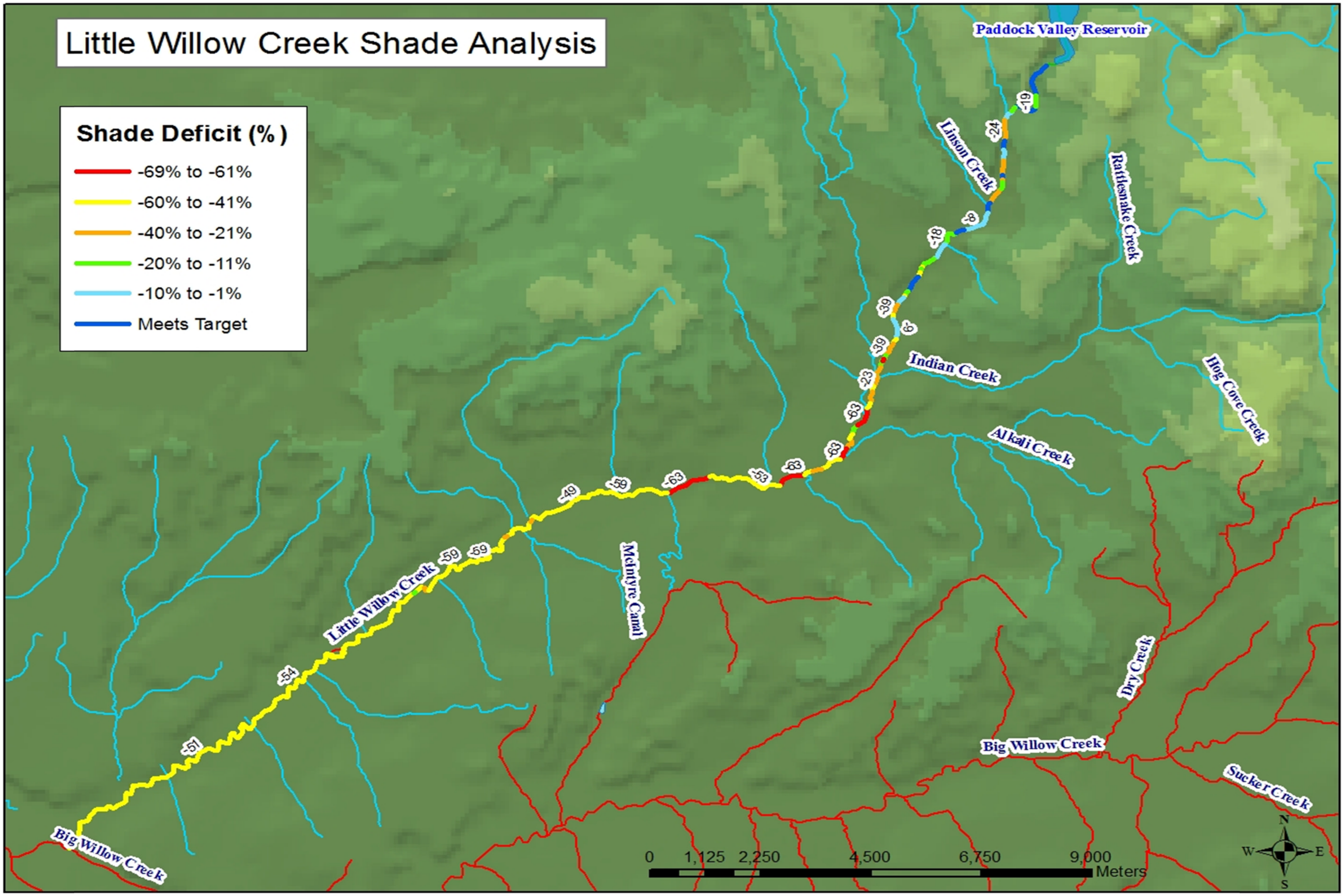

Figure 18. Lack of shade (difference between existing and target) for Little Willow Creek.

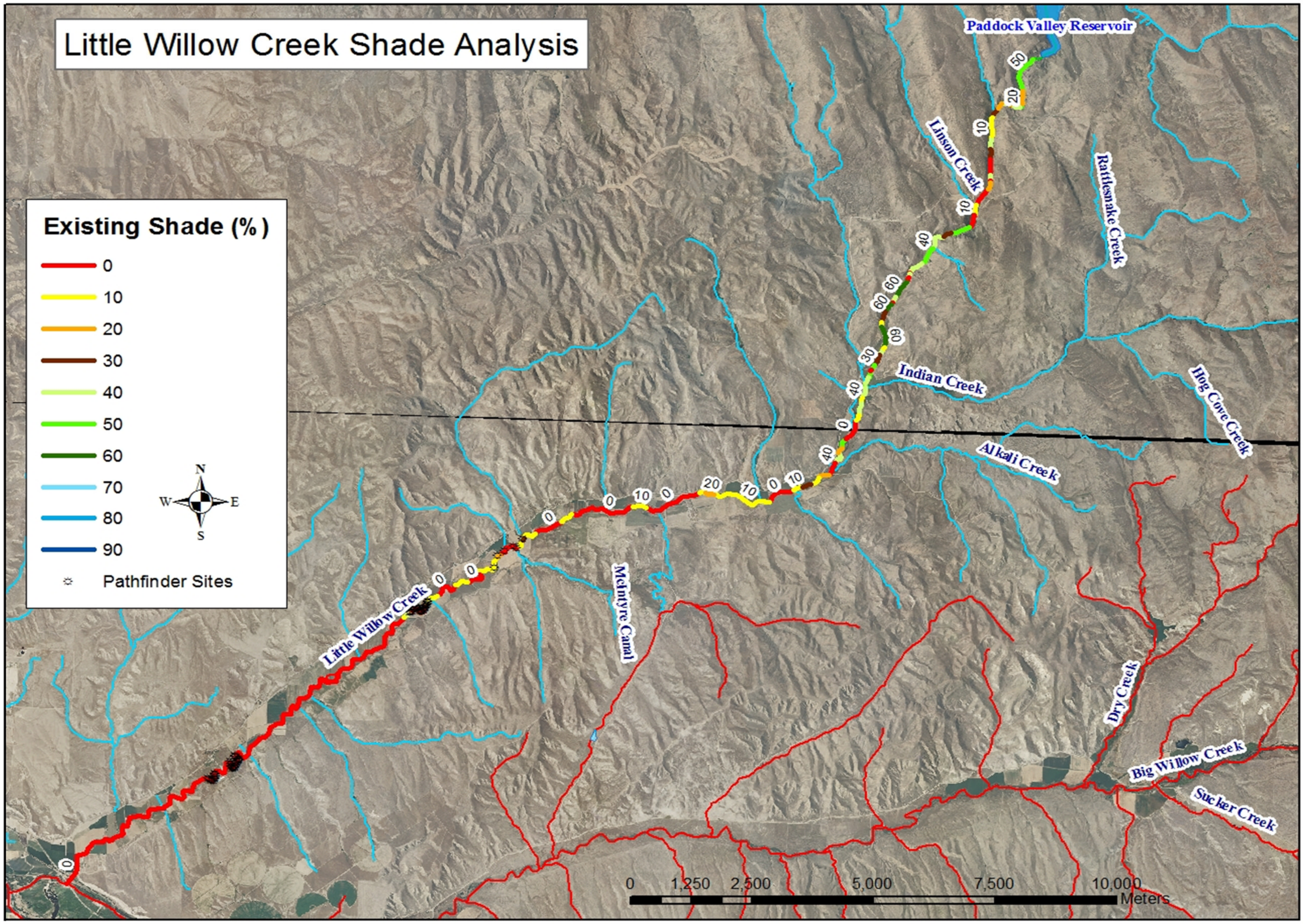

Figure 19. Existing shade estimated for Little Willow Creek by aerial photo interpretation.

5.3.4 Load and Wasteload Allocation

Because this TMDL is based on PNV, which is equivalent to background loading, the load allocation is essentially the desire to achieve background conditions. However, to reach that objective, load allocations are assigned to nonpoint source activities that have affected or may affect riparian vegetation and shade as a whole. Therefore, load allocations are stream segment specific and depend upon the target load for a given segment. Table 16 and Table 17 show the target shade and corresponding target summer load. This target load (i.e., load capacity) is necessary to achieve background conditions. There is no opportunity to further remove shade from the stream by any activity without exceeding its load capacity. Additionally, because this TMDL depends upon background conditions for achieving water quality standards, all tributaries to the waters examined here need to be in natural conditions to prevent excess heat loads to the system.

Table 18 shows the total existing, target, and excess loads and the average lack of shade for each water body examined. The size of a stream influences the size of the excess load. Large streams have higher existing and target loads by virtue of their larger channel widths. Although this TMDL analysis focuses on total solar loads, it is important to note that differences between existing and target shade, as depicted in the shade deficit figure (Figure 18), are the key to successfully restoring these waters to achieving water quality standards. Target shade levels for individual reaches should be the goal managers strive for with future implementation plans. Managers should focus on the largest differences between existing and target shade as locations to prioritize implementation efforts. Each load analysis table contains a column that lists the lack of shade on the stream segment. This value is derived from subtracting target shade from existing shade for each segment. Thus, stream segments with the largest lack of shade are in the worst shape. The average lack of shade derived from the last column in each load analysis table is listed in Table 18 and provides a general level of comparison among streams.

Table 18. Total solar loads and average lack of shade for all waters.

Water Body/ Assessment Unit	Total Existing Load	Total Target Load	Excess Load (% Reduction)	Average Lack of Shade (%)
	(kWh/day)			
Little Willow Creek (ID17050122SW018_03)	250,000	190,000	58,000 (23%)	-20
Little Willow Creek (ID17050122SW018_04)	1,600,000	740,000	890,000 (56%)	-49

Note: Load data are rounded to two significant figures, which may present rounding errors; kilowatt-hours per day (kWh/day).

Both AUs of Little Willow Creek lack shade. The 3rd order AU that is primarily the canyon segment below Paddock Valley Reservoir had an excess load that was greater than its target load requiring a 23% reduction. Whereas, the 4th order AU had considerably higher excess load (56% needed reduction). The 3rd order unit benefits from canyon seclusion and the smaller canopies of willow and alder when compared to the cottonwood communities in the wider valley of the 4th order segment. Little Willow Creek is consistent with other agricultural valleys in southwestern Idaho where historically stream corridor vegetation was likely disturbed during early agricultural development. Little Willow Creek is likely similar to other low elevation streams in the lower Payette and Weiser basins that are flashy, with early spring runoff generating large volumes of water that can destroy riparian plant communities in a single large runoff event. Cottonwood communities disturbed by agriculture can then be quickly eliminated in high flow events.

A certain amount of excess load is potentially created by the existing shade and target shade difference inherent in the loading analysis. Because existing shade is reported as a 10% shade class and target shade a unique integer between 0 and 100%, there is usually a difference between the two. For example, say a particular stream segment has a target shade of 86% based on its vegetation type and natural bankfull width. If existing shade on that segment were at target level, it would be recorded as 80% in the loading analysis because it falls into the 80% existing shade class. There is an automatic difference of 6%, which could be attributed to the MOS.

5.3.4.1 Water Diversion

Stream temperature may be affected by diversions of water for water rights purposes. Diversion of flow reduces the amount of water exposed to a given level of solar radiation in the stream channel, which can result in increased water temperature in that channel. Loss of flow in the channel also affects the ability of the near-stream environment to support shade-producing vegetation, resulting in an increase in solar load to the channel.

Although these water temperature effects may occur, nothing in this TMDL supersedes any water appropriation in the affected watershed. Section 101(g), the Wallop Amendment, was added to the Clean Water Act as part of the 1977 amendments to address water rights. It reads as follows:

> It is the policy of Congress that the authority of each State to allocate quantities of water within its jurisdiction shall not be superseded, abrogated or otherwise impaired by this chapter. It is the further policy of Congress that nothing in this chapter shall be construed to supersede or abrogate rights to quantities of water which have been established by any State. Federal agencies shall co-operate with State and local agencies to develop comprehensive solutions to prevent, reduce and eliminate pollution in concert with programs for managing water resources.

Additionally, Idaho water quality standards indicate the following:

> The adoption of water quality standards and the enforcement of such standards is not intended 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… (IDAPA 58.01.02.050.01)

In this TMDL, we have not quantified what impact, if any, diversions are having on stream temperature. Water diversions are allowed for in state statute, and it is possible for a water body to be 100% allocated. Diversions notwithstanding, reaching shade targets as discussed in the TMDL will protect what water remains in the channel and allow the stream to meet water quality standards for temperature. This TMDL will lead to cooler water by achieving shade that would be expected under natural conditions and water temperatures resulting from that shade. DEQ encourages local landowners and holders of water rights to voluntarily do whatever they can to help instream flow for the purpose of keeping channel water cooler for aquatic life.

5.3.4.2 Margin of Safety

The MOS in this TMDL is considered implicit in the design. Because the target is essentially background conditions, loads (shade levels) are allocated to lands adjacent to these streams at natural background levels. Because shade levels are established at natural background or system potential levels, it is unrealistic to set shade targets at higher, or more conservative, levels. Additionally, existing shade levels are reduced to the next lower 10% shade class, which likely underestimates actual shade in the loading analysis. Although the loading analysis used in this TMDL involves gross estimations that are likely to have large variances, load allocations are applied to the stream and its riparian vegetation rather than specific nonpoint source activities and can be adjusted as more information is gathered from the stream environment.

5.3.4.3 Seasonal Variation

This PNV TMDL is based on average summer loads. All loads have been calculated to be inclusive of the 6-month period from April through September. This time period is when the combination of increasing air and water temperatures coincide with increasing solar inputs and vegetative shade. The critical time periods are April through June when spring salmonid spawning occurs, July and August when maximum temperatures may exceed cold water aquatic life criteria, and September when fall salmonid spawning is most likely to be affected by higher temperatures. Water temperature is not likely to be a problem for beneficial uses outside of this time period because of cooler weather and lower sun angle.

5.3.4.4 Wasteload Allocation

There are no known NPDES-permitted point sources in the affected watersheds and thus no wasteload allocations. Should a point source be proposed that would have thermal consequences on these waters, background provisions in Idaho water quality standards addressing such discharges (IDAPA 58.01.02.200.09; IDAPA 58.01.02.401.01) should be involved (Appendix A).

5.4 Construction Storm Water and TMDL Waste Load Allocations

Stormwater runoff is water from rain or snowmelt that does not immediately infiltrate into the ground and flows over or through natural or man-made storage or conveyance systems. When undeveloped areas are converted to land uses with impervious surfaces—such as buildings, parking lots, and roads—the natural hydrology of the land is altered and can result in increased surface runoff rates, volumes, and pollutant loads. Certain types of stormwater runoff are considered point source discharges for Clean Water Act purposes, including stormwater that is associated with municipal separate storm sewer systems (MS4s), industrial stormwater covered under the Multi-Sector General Permit (MSGP), and construction stormwater covered under the Construction General Permit (CGP).

5.4.1 Municipal Separate Storm Sewer Systems

Polluted stormwater runoff is commonly transported through MS4s, from which it is often discharged untreated into local water bodies. An MS4, according to (40 CFR 122.26(b)(8)), is a conveyance or system of conveyances that meets the following criteria:

- Owned by a state, city, town, village, or other public entity that discharges to waters of the United States
- Designed or used to collect or convey stormwater (including storm drains, pipes, ditches, etc.)
- Not a combined sewer
- Not part of a publicly owned treatment works (sewage treatment plant)

To prevent harmful pollutants from being washed or dumped into an MS4, operators must obtain an NPDES permit from EPA, implement a comprehensive municipal stormwater management program, and use BMPs to control pollutants in stormwater discharges to the maximum extent practicable.

5.4.2 Industrial Stormwater Requirements

Stormwater runoff picks up industrial pollutants and typically discharges them into nearby water bodies directly or indirectly via storm sewer systems. When facility practices allow exposure of industrial materials to stormwater, runoff from industrial areas can contain toxic pollutants (e.g., heavy metals and organic chemicals) and other pollutants such as trash, debris, and oil and grease. This increased flow and pollutant load can impair water bodies, degrade biological habitats, pollute drinking water sources, and cause flooding and hydrologic changes, such as channel erosion, to the receiving water body.

5.4.2.1 Multi-Sector General Permit and Stormwater Pollution Prevention Plans

In Idaho, if an industrial facility discharges industrial stormwater into waters of the United States, the facility must be permitted under EPA's most recent MSGP. To obtain an MSGP, the facility must prepare a stormwater pollution prevention plan (SWPPP) before submitting a notice of intent for permit coverage. The SWPPP must document the site description, design, and installation of control measures; describe monitoring procedures; and summarize potential pollutant sources. A copy of the SWPPP must be kept on site in a format that is accessible to workers and inspectors and be updated to reflect changes in site conditions, personnel, and stormwater infrastructure.

5.4.2.2 Industrial Facilities Discharging to Impaired Water Bodies

Any facility that discharges to an impaired water body must monitor all pollutants for which the water body is impaired and for which a standard analytical method exists (40 CFR 136).

Also, because different industrial activities have sector-specific types of material that may be exposed to stormwater, EPA grouped the different regulated industries into 29 sectors, based on their typical activities. Part 8 of EPA's MSGP details the stormwater management practices and monitoring that are required for the different industrial sectors. EPA anticipates issuing a new MSGP in December 2013. DEQ anticipates including specific requirements for impaired waters as a condition of the 401 certification. The new MSGP will detail the specific monitoring requirements.

5.4.2.3 TMDL Industrial Stormwater Requirements

When a stream is on Idaho's §303(d) list and has a TMDL developed, DEQ may incorporate a wasteload allocation for industrial stormwater activities under the MSGP. However, most load analyses developed in the past have not identified sector-specific numeric wasteload allocations for industrial stormwater activities. Industrial stormwater activities are considered in compliance with provisions of the TMDL if operators obtain an MSGP under the NPDES program and implement the appropriate BMPs. Typically, operators must also follow specific requirements to be consistent with any local pollutant allocations. The next MSGP will have specific monitoring requirements that must be followed.

5.4.3 Construction Stormwater

The Clean Water Act requires operators of construction sites to obtain permit coverage to discharge stormwater to a water body or municipal storm sewer. In Idaho, EPA has issued a general permit for stormwater discharges from construction sites.

5.4.3.1 Construction General Permit and Stormwater Pollution Prevention Plans

If a construction project disturbs more than 1 acre of land (or is part of a larger common development that will disturb more than 1 acre), the operator is required to apply for a CGP from EPA after developing a site-specific SWPPP. The SWPPP must provide for the erosion, sediment, and pollution controls they intend to use; inspection of the controls periodically; and maintenance of BMPs throughout the life of the project. Operators are required to keep a current copy of their SWPPP on site or at an easily accessible location.

5.4.3.2 TMDL Construction Stormwater Requirements

When a stream is on Idaho's §303(d) list and has a TMDL developed, DEQ may incorporate a gross wasteload allocation for anticipated construction stormwater activities. Most loads developed in the past did not have a numeric wasteload allocation for construction stormwater activities. Construction stormwater activities are considered in compliance with provisions of the TMDL if operators obtain a CGP under the NPDES program and implement the appropriate BMPs. Typically, operators must also follow specific requirements to be consistent with any local pollutant allocations. The CGP has monitoring requirements that must be followed.

5.4.3.3 Postconstruction Stormwater Management

Many communities throughout Idaho are currently developing rules for postconstruction stormwater management. Sediment is usually the main pollutant of concern in construction site stormwater. DEQ's *Catalog of Stormwater Best Management Practices for Idaho Cities and Counties* (DEQ 2005) should be used to select the proper suite of BMPs for the specific site, soils, climate, and project phasing in order to sufficiently meet the standards and requirements of the CGP to protect water quality. Where local ordinances have more stringent and site-specific standards, those are applicable.

5.5 Implementation Strategies

Implementation strategies for TMDLs produced using PNV-based shade and solar loads should incorporate the load analysis tables presented in this TMDL (Table 16 and Table 17). These tables need to be updated, first to field verify the remaining existing shade levels and second to monitor progress toward achieving reductions and TMDL goals. Using the Solar Pathfinder to measure existing shade levels in the field is important to achieving both objectives. It is likely that further field verification will find discrepancies with reported existing shade levels in the load analysis tables. Due to the inexact nature of the aerial photo interpretation technique, these tables should not be viewed as complete until verified. Implementation strategies should include Solar Pathfinder monitoring to simultaneously field verify the TMDL and mark progress toward achieving desired load reductions.

DEQ recognizes that implementation strategies for TMDLs may need to be modified if monitoring shows that TMDL goals are not being met or significant progress is not being made toward achieving the goals. There may be a variety of reasons that individual stream segments do not meet shade targets, including natural phenomena (e.g., beaver ponds, springs, wet meadows, and past natural disturbances) and/or historic land-use activities (e.g., logging, grazing, and mining). It is important that existing shade for each stream segment be field verified to determine if shade differences are real and result from activities that are controllable. Information within this TMDL (maps and load analysis tables) should be used to guide and prioritize implementation investigations. The information in this TMDL may need further adjustment to reflect new information and conditions in the future.

5.5.1 Time Frame

A schedule for implementing BMPs, pollution control strategies, assessment reporting dates, and progress evaluation will be developed with appropriate designated management agencies. The expected time frame for meeting TMDL objectives, water quality standards, and beneficial uses is within 5–15 years. Temperature impairments often take the longest time to implement; 20 years or more dependent upon active or passive restoration. This time frame depends on how quickly implementation projects are put on the ground. Participation is voluntary so implementation can take longer if participation is limited.

Implementation of the PNV TMDL relies on riparian area management practices that will provide a mature canopy cover to shade the stream and prevent excess solar loading. Because implementation depends on mature riparian communities to substantially improve stream temperatures, DEQ believes 10 years may be a reasonable amount time for achieving sediment and bacteria water quality standards. Shade targets will not be achieved all at once. Given their smaller bankfull widths, targets for smaller streams may be reached sooner than those for larger streams.

DEQ and the designated WAG will continue to re-evaluate TMDLs on a 5-year cycle. During the 5-year review, implementation actions completed, in progress, and planned will be reviewed, and pollutant load allocations will be reassessed accordingly.

5.5.2 Approach

The TMDLs developed in this document will focus on implementation of load allocations for sediment, bacteria, and temperature. DEQ will work with its appropriate sister agencies and willing landowners to develop a strategy to implement BMPs and riparian plantings.

Nonpoint sources of sediment related to agricultural irrigation runoff is remedied by implementing appropriate BMPs and establishing a healthy riparian plant community to serve as a filter; slowing return runoff and filtering sediment.

Determining the sources of bacteria will help determine the approach used to reduce bacteria concentrations in Little Willow Creek. Additionally, BMPs aimed at reducing sediment and the establishment of a healthy riparian area will help reduce *E. coli* loading to Little Willow Creek.

5.5.3 Responsible Parties

Idaho Code 39-3612 states designated management agencies are to use TMDL processes for achieving water quality standards. DEQ will rely on the designated management agencies to implement pollution control measures or BMPs for those pollutant sources identified as priorities.

DEQ also recognizes the authorities and responsibilities of city and county governments as well as applicable state and federal agencies and will enlist their involvement and authorities for protecting water quality.

The designated state agencies listed below are responsible for assisting and providing technical support for developing specific implementation plans as well as other appropriate support for water quality projects. General responsibilities for Idaho-designated management agencies are as follows:

- Idaho Soil and Water Conservation Commission: grazing and agriculture
- Idaho State Department of Agriculture: aquaculture and animal feeding operations
- Idaho Transportation Department: public roads
- Idaho Department of Lands: timber harvest, oil and gas exploration, and mining
- Idaho Department of Water Resources: stream channel alteration activities
- Idaho Department of Environmental Quality: all other activities

5.5.4 Implementation Monitoring Strategy

Under Idaho Code 39-3611 DEQ is to review and evaluate each Idaho TMDL, supporting assessment, implementation plan, and all available data periodically, at intervals no greater than 5 years.

It is recommended that Little Willow Creek be targeted for monitoring in the future. Additionally, a review of BMPs, riparian health improvement, and TSS monitoring of Little Willow Creek should be performed to support the next 5-year review.

Effective shade monitoring can take place on any segment throughout both Little Willow Creek AUs and be compared to existing shade estimates seen in Figure 19 and described in Table 16 and Table 17. Those areas with the largest disparity between existing and target shade should be monitored with Solar Pathfinders to verify existing shade levels and determine progress toward meeting shade targets. Since many existing shade estimates have not been field verified, they may require adjustment during the implementation process. Stream segment length for each estimate of existing shade varies depending on the land use or landscape that has affected that shade level. It is appropriate to monitor within a given existing shade segment to see if that segment has increased its existing shade toward target levels. Ten equally spaced Solar Pathfinder measurements averaged together within that segment should suffice to determine new shade levels in the future.

5.5.5 Pollutant Trading

Pollutant trading (also known as *water quality trading*) is a contractual agreement to exchange pollution reductions between two parties. Pollutant trading is a business-like way of helping to solve water quality problems by focusing on cost-effective local solutions to problems caused by pollutant discharges to surface waters.

The appeal of trading emerges when pollutant sources face substantially different pollutant reduction costs. Typically, a party facing relatively high pollutant reduction costs compensates another party to achieve an equivalent, though less costly, pollutant reduction.

Pollutant trading is voluntary. Parties trade only if both are better off because of the trade, and trading allows parties to decide how to best reduce pollutant loadings within the limits of certain requirements.

Pollutant trading is recognized in Idaho water quality standards (IDAPA 58.01.02.054.06). Currently, DEQ's policy is to allow for pollutant trading as a means to meet TMDLs, thus restoring water quality limited water bodies to compliance with water quality standards. The *Water Quality Pollutant Trading Guidance* (DEQ 2010b) sets forth the procedures to be followed for pollutant trading at *www.deq.idaho.gov/media/488798-water_quality_pollutant_trading_guidance_0710.pdf*

5.5.5.1 Trading Components

The major components of pollutant trading are *trading parties* (buyers and sellers) and *credits* (the commodity being bought and sold). Additionally, *ratios* are used to ensure environmental equivalency of trades on water bodies covered by a TMDL. All trading activity must be recorded in the trading database through the Idaho Clean Water Cooperative, Inc.

Both point and nonpoint sources may create marketable credits, which are a reduction of a pollutant beyond a level set by a TMDL:

- Point sources create credits by reducing pollutant discharges below NPDES effluent limits set initially by the waste load allocation.
- Nonpoint sources create credits by implementing approved BMPs that reduce the amount of pollutant runoff. Nonpoint sources must follow specific design, maintenance, and monitoring requirements for that BMP, apply discounts to credits generated if required, and provide a water quality contribution to ensure a net environmental benefit. The water quality contribution also ensures the reduction (the marketable credit), is surplus to the

reductions the TMDL assumes the nonpoint source is achieving to meet the water quality goals of the TMDL.

5.5.5.2 Watershed-Specific Environmental Protection

Trades must be implemented so that the overall water quality of the water bodies covered by the TMDL are protected. To do this, hydrologically based ratios are developed to ensure trades between sources distributed throughout TMDL water bodies result in environmentally equivalent or better outcomes at the point of environmental concern. Moreover, localized adverse impacts to water quality are not allowed.

5.5.5.3 Trading Framework

For pollutant trading to be authorized, it must be specifically mentioned within a TMDL document. After adoption of an EPA-approved TMDL, DEQ, in concert with the WAG, must develop a pollutant trading framework document as part of an implementation plan for the watershed that is the subject of the TMDL.

The elements of a trading document are described in DEQ's *Water Quality Pollutant Trading Guidance* (DEQ 2010b) at *www.deq.idaho.gov/media/488798-water_quality_pollutant_trading_guidance_0710.pdf.*

6 Conclusions

Effective shade targets were established for two Little Willow Creek AUs based on the concept of maximum shading under PNV resulting in natural background temperature levels. Shade targets were derived from effective shade curves developed for similar vegetation types in Idaho. Existing shade was determined from aerial photo interpretation and partially field verified with Solar Pathfinder data. Target and existing shade levels were compared to determine the amount of shade needed to bring water bodies into compliance with temperature criteria in Idaho water quality standards (IDAPA 58.01.02). A summary of assessment outcomes, including recommended changes to listing status in the next Integrated Report, is presented in Table 19.

Both AUs lacked shade and needed solar load reductions. The 3rd order segment in the canyon below Paddock Valley Reservoir was in better condition than the lower 4th order segment where agriculture remains the dominant land use. Riparian plant community instability is likely exacerbated by flashy, high spring runoff events.

Target shade levels for individual stream segments should be the goal managers strive for with future implementation plans. Managers should focus on the largest differences between existing and target shade as locations to prioritize implementation efforts.

The TMDLs developed as part of this report are shown in Table 19. Depending on the pollutant reduction strategies implemented, the streams may take 5–15 years to meet water quality standards and support beneficial uses. PNV targets may take substantially longer; on a range of 25-50 years.

Table 19. Total maximum daily load summary.

Water Body/ Assessment Unit	Pollutant	TMDL(s) Completed	Reduction Required (%)	Recommended Changes to the Next Integrated Report
Little Willow Creek (ID17050122SW018_04)	Sediment	Sediment (TSS)	70.5 [a]	Move Little Willow Creek to Category 4a for sediment.
Little Willow Creek (ID17050122SW018_04)	Bacteria	Bacteria (*E. coli*)	87	Move Little Willow Creek to Category 4a for bacteria.
Little Willow Creek (ID17050122SW018_03)	Temperature	Temperature (PNV)	23	Move Little Willow Creek from Category 2 to Category 4a for temperature.
Little Willow Creek (ID17050122SW018_04)	Temperature	Temperature (PNV)	56	Move Little Willow Creek to Category 4a for temperature.

Notes: total suspended sediment (TSS); *Escherichia coli* (*E. coli*); potential natural vegetation (PNV)
[a] Reduction at LWC-1

Public Participation

During the development of the Little Willow Creek TMDL, DEQ held the following public meetings with the WAG and other groups to discuss ISDA data, DEQ data collection and methods, TMDL options, sources of pollutants, implementation, and implications.

- WAG, November 2, 2011
- Gem Soil and Water Conservation District, May 7, 2012
- Payette Soil and Water Conservation District, May 16, 2012
- Payette Soil and Water Conservation District, July 18, 2012
- WAG, October 31, 2012
- Little Willow Creek Irrigation District, December 11, 2012
- WAG, January, 30, 2013
- WAG, 30 day comment period July 2013
- Public Comment, 30 days August 2013

The development of this lower Payette River subbasin TMDL addendum included a 30 day public comment period on the draft document. After all interested parties had an opportunity to review and comment on the water quality issues impacting this subbasin, DEQ responded to the comments by amending the document or clarifying issues as necessary. The distribution list is provided in Appendix B, and details of public participation are included in Appendix C.

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GIS Coverages

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Glossary

§303(d)

Refers to section 303 subsection "d" of the Clean Water Act. Section 303(d) requires states to develop a list of water bodies 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 United States Environmental Protection Agency approval.

Assessment Unit (AU)

A group of similar streams that have similar land use practices, ownership, or land management. However, stream order is the main basis for determining AUs. All the waters of the state are defined using AUs, and because AUs are a subset of water body identification numbers, they tie directly to the water quality standards so that beneficial uses defined in the water quality standards are clearly tied to streams on the landscape.

Beneficial Use

Any of the various uses of water that are recognized in water quality standards, including, but not limited to, aquatic life, recreation, water supply, wildlife habitat, and aesthetics.

Beneficial Use Reconnaissance Program (BURP)

A program for conducting systematic biological and physical habitat surveys of water bodies in Idaho. BURP protocols address lakes, reservoirs, and wadeable streams and rivers.

Exceedance

A violation (according to DEQ policy) of the pollutant levels permitted by water quality criteria.

Fully Supporting

In compliance with water quality standards and within the range of biological reference conditions for all designated and existing beneficial uses as determined through the *Water Body Assessment Guidance* (Grafe et al. 2002).

Load Allocation (LA)

A portion of a water body'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.

Load Capacity (LC)
: How much pollutant a water body can receive over a given period without causing violations of state water quality standards. Upon allocation to various sources, a margin of safety, and natural background contributions, it becomes a total maximum daily load.

Margin of Safety (MOS)
: An implicit or explicit portion of a water body's load capacity set aside to allow for uncertainly about the relationship between the pollutant loads and the quality of the receiving water body. The margin of safety 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 margin of safety is not allocated to any sources of pollution.

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 nonirrigated 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 water bodies that have been studied but are missing critical information needed to complete an assessment.

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* (Grafe et al. 2002).

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 plants.

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 that alter the functioning of natural processes and produce undesirable environmental and health effects. Pollution

includes human-induced alteration of the physical, biological, chemical, and radiological integrity of water and other media.

Stream Order

Hierarchical ordering of streams based on the degree of branching. A 1st-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.

Total Maximum Daily Load (TMDL)

A TMDL is a water body's load 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 basis. A TMDL is equal to the load capacity, such that load capacity = margin of safety + natural background + load allocation + wasteload allocation = TMDL. 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 water bodies and/or pollutants within a given watershed.

Wasteload Allocation (WLA)

The portion of receiving water's load 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 water body.

Water Body

A stream, river, lake, estuary, coastline, or other water feature, or portion thereof.

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, aquatic habitat, or industrial processes.

Water Quality Standards

State-adopted and United States Environmental Protection Agency-approved ambient standards for water bodies. The standards prescribe the use of the water body and establish the water quality criteria that must be met to protect designated uses.

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Appendix A. Data Sources

Table A-1. Data sources for Lower Payette River subbasin assessment.

Water Body	Data Source	Type of Data	When Collected
Little Willow Creek	Little Willow Creek Water Quality Monitoring Report: April through October, 2007 Idaho State Department of Agriculture	Flow, bacteria, sediment, temperature	2007

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Appendix B. Distribution List

Little Willow Creek WAG

Adams County Soil and Water

Allan Tarter

Blake Tubbs

Dar Olberding

Doug Arge

Johna Gabiola

Gem County commissioner

George McClelland

JoAnne Smith

Karie Pappani

Lance Holloway

Loretta Stickland

Mark Shumar

Mike Raymond

Ron Shurtleff

Scott Koberg

Tim Shelton

USBR

Wendy Green

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Appendix C. Response to Public Comments

The Soil and Water Conservation provided two comments on the Little Willow Creek Addendum to the Lower Payette River Subbasin during the 30 day comment period provided for the WAG in July 2013. No other comments were received during the public comment period in August of 2013.

1. On Page 28 under Monitoring and Status of Water Quality Improvements-Please note that Table 20, Page 141 of the Lower Payette River 5 year review describes implementation that has occurred in the Little Willow Creek watershed.

    The document has been updated to reflect this reference.

2. On Page 60 under Conclusions-Please consider that 5-15 years is a very short time frame for restoring beneficial uses considering federal and state funding has declined significantly and also considering the water regime and the water management of the system.

    Duly noted, additionally language has been added for PNV targets with the expectation that they may take 25-50 years to be fully implemented.