Cow Creek Temperature Total Maximum Daily Loads

Addendum to the Cow Creek Subbasin Assessment and TMDL

Palouse River (Hydrologic Unit Code 17060108)

State of Idaho
Department of Environmental Quality

December 2013

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Total Maximum Daily Loads

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Prepared by

Idaho Department of Environmental Quality
Lewiston Regional Office
1118 F Street
Lewiston, Idaho 83501

Idaho Department of Environmental Quality
State Technical Services Office
1410 North Hilton
Boise, Idaho 83706

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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
AU	assessment unit
BMP	best management practice
C	Celsius
CFR	Code of Federal Regulations
CGP	Construction General Permit
CWA	Clean Water Act
DEQ	Idaho Department of Environmental Quality
EPA	United States Environmental Protection Agency
F	Fahrenheit
IDAPA	refers to citations of Idaho administrative rules
kWh	kilowatt-hour
LA	load allocation
LC	load capacity
m	meter
mi	mile
MOS	margin of safety
NB	natural background
NPDES	National Pollutant Discharge Elimination System
NREL	National Renewable Energy Laboratory
PNV	potential natural vegetation
SBA	subbasin assessment
TMDL	total maximum daily load
USGS	United States Geological Survey
WAG	watershed advisory group
WLA	wasteload allocation

Executive Summary

This addendum addresses the outstanding temperature impairment listing included in *Idaho's 2010 Integrated Report* (DEQ 2011) for Cow Creek in the Palouse River subbasin. The addendum provides a total maximum daily load (TMDL) load allocation that calls for an increase in riparian shade to restore stream temperatures to natural background conditions. Streamside vegetation and channel morphology are factors influencing shade that are most likely to have been changed by anthropogenic activities and can be most readily corrected and addressed by a TMDL.

The addendum also provides a TMDL wasteload allocation for the City of Genesee wastewater treatment facility based on the wastewater treatment facility effluent discharge data required to be reported by the City's 2005 US Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) permit.

Regulatory Requirements

This document has been prepared in accordance with federal and state regulations. The federal Clean Water Act requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. Pursuant to Section 303 of the Clean Water Act, Idaho has adopted water quality standards 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 to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). Furthermore, Idaho must periodically publish a priority list (a "§303(d) list") of impaired waters. Currently, this list must be published every 2 years and is included as the list of Category 5 waters in the Integrated Report. For waters identified on this list, a TMDL must be developed for the pollutants, set at a level to achieve water quality standards.

This document addresses temperature impairment in one water body—two assessment units (AUs)—in the Palouse River subbasin (specifically the Cow Creek watershed) that have been placed in Category 5 of Idaho's most recent federally approved Integrated Report. For more information about these watersheds and the subbasin as a whole, see the *Cow Creek Subbasin Assessment and Nutrient Total Maximum Daily Load* (DEQ 2005b). The starting point for this assessment was Idaho's current §303(d) list of water quality limited water bodies. Two segments of Cow Creek were listed on this list. The subbasin assessment portion of this addendum updates information about the watershed, the status of §303(d)-listed waters and extent of impairment, and causes of water quality limitation throughout the portion of the subbasin involved in this addendum. The TMDL analysis quantifies pollutant sources and allocates responsibility for load reductions needed to return listed waters to a condition meeting water quality standards.

Subbasin at a Glance

The Palouse River subbasin (hydrologic unit code 17060108) is located largely in Washington State, with the eastern portion crossing into north-central Idaho (Figure A). The Cow Creek subwatershed is in the southern tip of the subbasin in Idaho. Cow Creek flows into Union Flat

Creek and eventually into the Palouse River, which is a tributary to the Snake River. The uppermost 3 miles of the Cow Creek watershed experiences snow accumulation in winter. The creek flows through farmland and pasture at moderate slopes (5%) in the upper reaches to low slopes (1–4%) through the rest of the watershed where grazing and farming are common practices. The creek flows into Union Flat Creek as it enters Washington State near Uniontown. Union Flat Creek flows through the Palouse farm country toward its confluence with the Palouse River several miles west of LaCrosse, Washington. The City of Genesee owns and operates the only wastewater treatment facility permitted to discharge in the Cow Creek watershed.

Listed in Category 5 of the current Integrated Report for temperature pollution are Cow Creek AUs ID17060108CL001_02 and ID17060108CL001_03. Cow Creek was originally listed as impaired for habitat alteration, nutrients, and temperature in 1992 as WQLS 3136 and carried forward to subsequent 303(d) lists in 1994 and 1998. The nutrient TMDL was completed in December 2005 and approved by EPA. Habitat alteration is considered pollution, as opposed to a pollutant, and under EPA regulations does not receive a loading analysis and therefore a TMDL is not developed. Therefore, only the temperature listing remains outstanding from the original impaired water listings needing a TMDL.

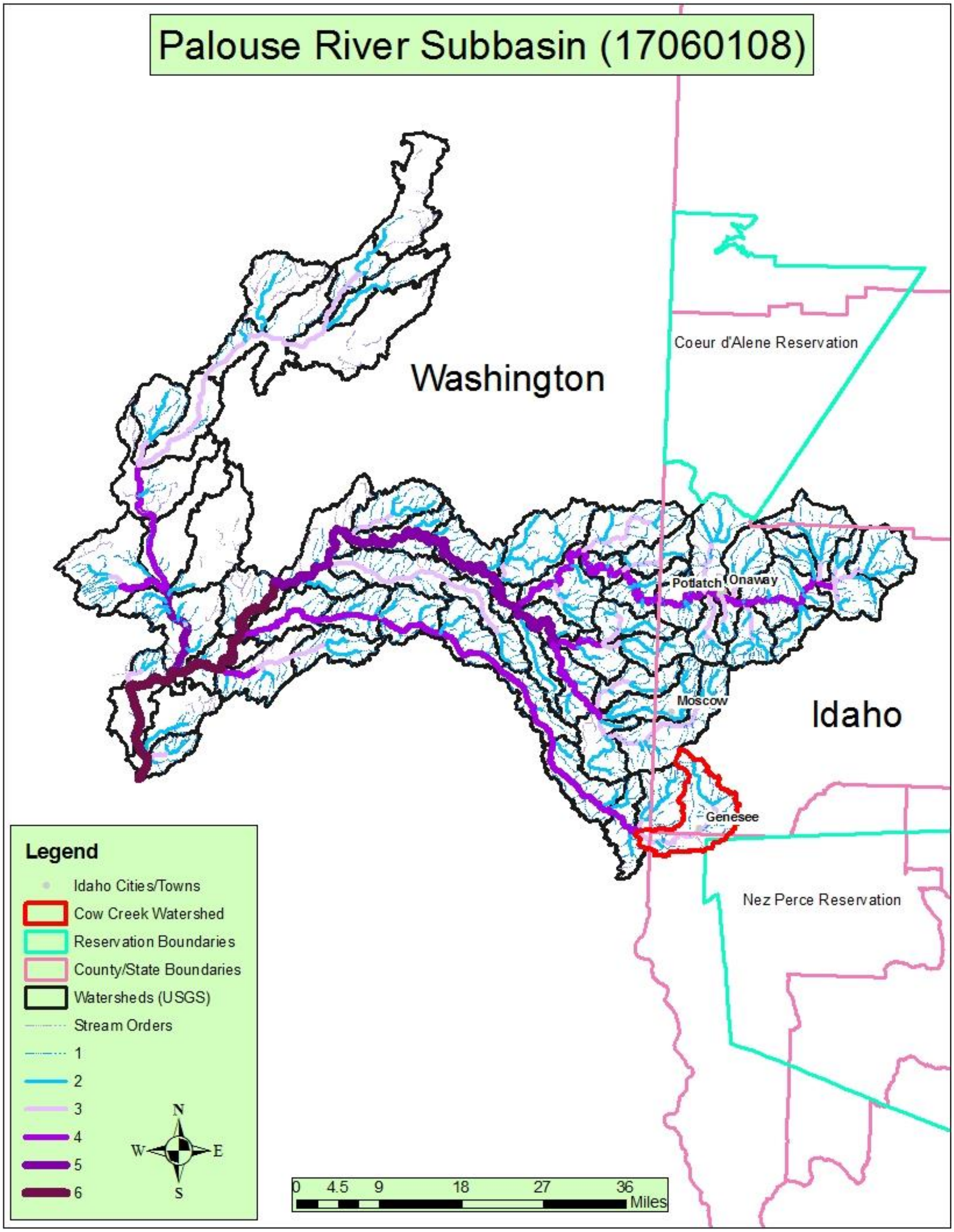

Figure A. Subbasin at a glance.

Key Findings

Two AUs of Cow Creek were originally placed on the 1998 §303(d) list of impaired waters, and subsequent lists, for reasons associated with temperature criteria violations and carried forward to the 2010 Integrated Report. The Idaho Department of Environmental Quality (DEQ) has developed temperature TMDLs for one of these AUs and has recommended delisting the other due to a lack of water in the channel during the critical time period (Table A).

Cow Creek AU ID17060108CL001_03 lacks approximately 10% shade causing an excess solar load of about 4,000 kWh/day. The upper portion of the AU lacks water, whereas the lower portion is perennial. Smaller channel widths and lack of water drive the loss of shade in this AU. Cow Creek AU ID17060108CL001_02 does not contain water during the critical time period of June through September. A BURP site on the 2nd order was established and visited in 2002. Site 2002SLEA015 could not be assessed because it was dry. On field visits to verify solar pathfinder readings in the preparation of this TMDL, DEQ has continued to observe no water in the 2nd order during the June to September time frame in the shallow swale that makes up the 2nd order. DEQ is also aware that in many locations throughout the Palouse HUC drainage tile was installed throughout the 1970's and 1980's. Most of this tile is unmapped locations and its purpose was to drain hydric soils and lands that were "cutover" timber that was placed into production for wheat when the agricultural prices were quite high during those two decades. Until DEQ has sufficient data available to make a beneficial use support determination DEQ recommends moving the 2nd order to Category 3 as unassessed.

Effective target shade levels were established for AU ID17060108CL001_03 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 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's water quality standards (IDAPA 58.01.02).

The City of Genesee owns and operates the only wastewater treatment facility permitted to discharge in the Cow Creek watershed. In February 2005, EPA issued an NPDES permit to the City of Genesee, effective April 2005, allowing discharge year-round. In June 2009, DEQ issued a municipal wastewater reuse permit to the City of Genesee allowing land application of wastewater from May through October. This TMDL provides a temperature wasteload allocation for the City of Genesee's effluent discharge to Cow Creek, incorporating provisions associated with their NPDES and reuse permits.

Table A. Summary of assessment outcomes.

Water Body/ Assessment Unit	Pollutant	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Cow Creek ID17060108CL001_02	Temperature	No	Delist Temperature and Move to Category 3 as unassessed	No excess solar load occurring during the critical time period (dry June–September). Dry during June-September. Unassessed
Cow Creek ID17060108CL001_03	Temperature	Yes	Delist temperature and Move to Category 4a	Excess solar load from a lack of existing shade

Introduction

This total maximum daily load (TMDL) is an addendum to the *Cow Creek Subbasin Assessment and Nutrient Total Maximum Daily Load* and is based, in part, on the original subbasin assessment (SBA) contained in that document (DEQ 2005b). The 2005 TMDL identified a critical flow season of June through September when Cow Creek is temperature impaired. This addendum addresses the temperature impairment by providing a load and wasteload allocation for nonpoint sources and the point source in the watershed.

This document was prepared in compliance with both federal and state regulatory requirements. The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to Section 303 of the CWA, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the nation's waters whenever possible.

Section 303(d) of the CWA 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. 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.

This document addresses two assessment units (AUs) of Cow Creek in the Palouse River subbasin that have been placed on Idaho's current §303(d) list for temperature impairment.

1 Subbasin Assessment—Watershed Characterization

Cow Creek is located in the Palouse River subbasin (hydrologic unit code 17060108) in north Idaho. This document addresses water bodies in two AUs of the Cow Creek watershed that have been placed in Category 5 on *Idaho's 2010 Integrated Report* (DEQ 2011): AUs ID17060108CL001_02 and ID17060108CL001_03, commonly referred to as Cow Creek. Cow Creek flows southeast for approximately 50% of its length from its headwaters on Paradise Ridge in the Palouse Range. The creek then turns southwest for approximately 20% of its length, through the City of Genesee. The City of Genesee owns and operates a wastewater treatment facility, permitted to discharge into the creek, immediately downstream of the city. The creek then turns west for the remainder of its length, before entering Union Flat Creek near Uniontown, Washington.

Effective shade targets were established for the lower 3rd-order section of Cow Creek (AU ID17060108CL001_03) based on the concept of maximum shading under potential natural vegetation (PNV) resulting in natural background temperatures. No shade targets were developed for the upper watershed as these swales and drainages do not contain water during the critical flow season of June through September and have no riparian community development.

A wasteload allocation has been developed for the City of Genesee wastewater treatment facility based on its 2005 National Pollutant Discharge Elimination System (NPDES) permit effluent discharge data, Idaho's numeric temperature criteria, and the critical flow season identified in the 2005 TMDL.

1.1 Physical and Biological Characteristics

AUs ID17060108CL001_02 and ID17060108CL001_03, commonly referred to as Cow Creek, are located in the Palouse River subbasin south of Moscow, Idaho (Figure 1). Cow Creek flows southeast (140 degrees from north) for 50% of its length from its headwaters south of Moscow on Paradise Ridge in the Palouse Range. The creek then turns southwest (200 degrees from north) for 20% of its length, through the City of Genesee before turning west (260 degrees from north) for the remaining 30% of its length before entering Union Flat Creek near Uniontown, Washington.

The watershed elevation varies from approximately 3,000 feet above sea level at the headwaters to just under 2,500 feet near Uniontown. The drainage area of the Cow Creek watershed is approximately 51.1 square miles (Figure 1). The creek's main stem is approximately 40 miles long and its tributaries are a combined 29 miles long.

Cow Creek experiences low flows during the late summer and early fall months and high flows in the spring and early summer months. Most of the wetlands and flood plains in the Palouse have been drained or eliminated by agricultural land use, urbanization, and transportation infrastructure affecting channel sinuosity and diversity. These areas retained water during high flow periods and released water during the lower flow periods. Without these water storage areas, peak flows are higher and for a shorter period of time, creating instream channel erosion, flooding, and deeply incised channels.

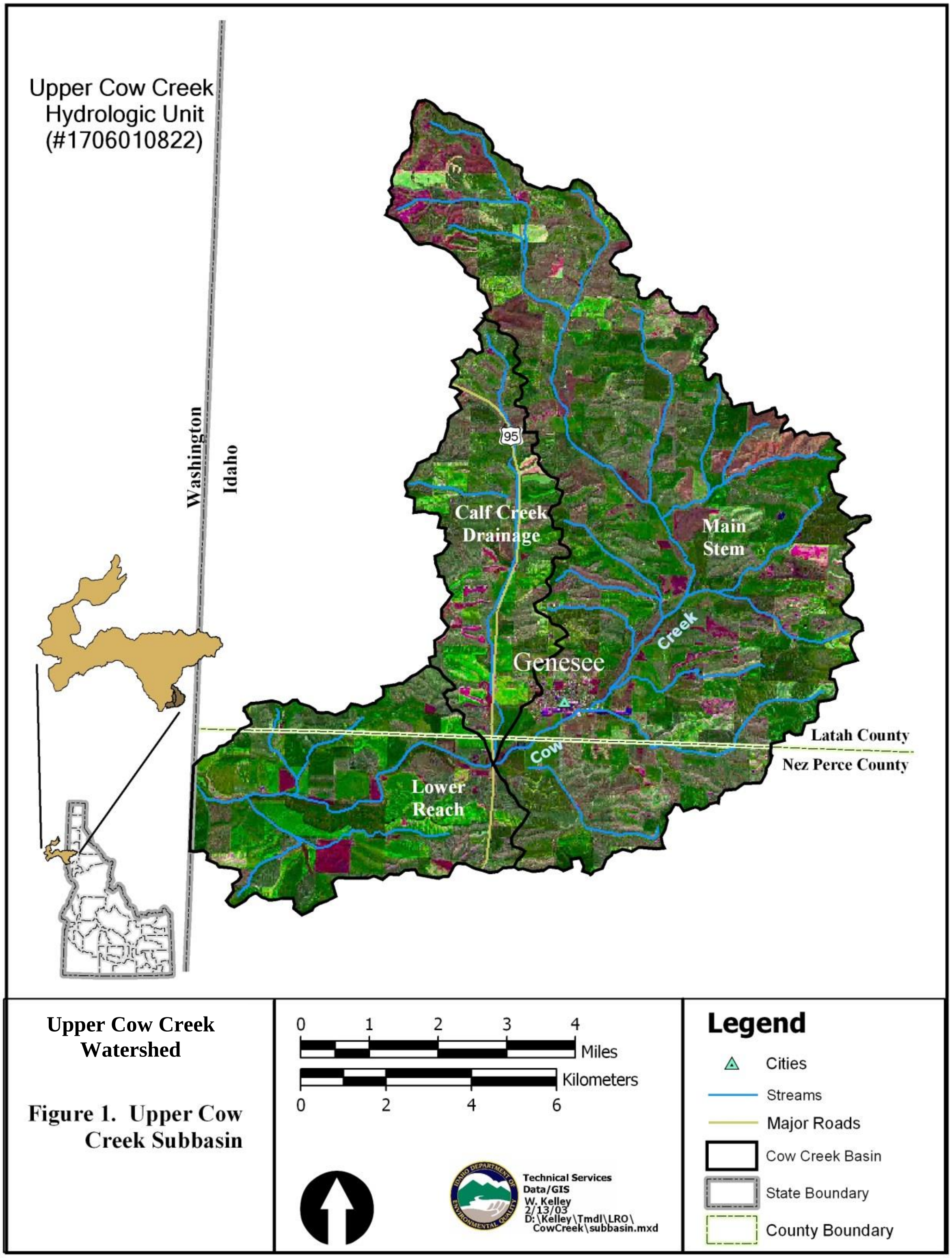

Figure 1. Cow Creek watershed in the Palouse River subbasin.

1.1.1 Climate

The climate within the Cow Creek watershed—as classified using the Köppen Climate Classification system, which characterizes a region based on 30-year averages of temperature and precipitation—is placed in class "Dfb," described as humid continental with moderate summers and year-round precipitation. However, precipitation in the summer months is typically limited to showers and occasional thunderstorms. Temperature and precipitation averages for Genesee are presented in Table 1.

Table 1. Average monthly maximum and minimum air temperatures and total precipitation for Genesee, Idaho.

Month	Average Maximum Temperature (°F)	Average Minimum Temperature (°F)	Average Total Precipitation (inches)
January	34	22	3.1
February	41	26	2.3
March	47	30	2.4
April	56	34	2.2
May	65	40	2.2
June	73	45	1.8
July	83	48	0.9
August	83	48	1.2
September	73	43	1.3
October	60	36	1.9
November	43	30	3.3
December	35	23	3.0

The watershed averages 25.6 inches of precipitation annually; an average of 48.1 inches of snow falls between November and April. At nearby Moscow, Idaho, the mean pan evaporation—a measurement of evaporation that takes into account multiple climatic factors such as wind and solar radiation—ranges from 1.94 inches in October to 8.79 inches in July. Soil-water storage occurs from October through March when precipitation is high and evaporative losses are low. During this period, the soil surface will often go through a freeze and thaw process that decreases soil stability and water infiltration, leaving it susceptible to erosion.

Air temperature and precipitation for spring/summer 2002—during the most recent water quality sampling events—are reported in Table 2. These data indicate a near-normal season: June and August experienced higher than average precipitation, which recharged the shallow ground water and enabled some tile drains to begin flowing again.

Table 2. Maximum and minimum monthly air temperatures and precipitation for Genesee from April 2002 through August 2002 compared to averages.

Month	Maximum Temperature (°F)		Minimum Temperature (°F)		Precipitation (inches)	
	2002	Average	2002	Average	2002	Average
April	57	57	34	36	1.86	1.88
May	64	65	39	41	1.58	2.00
June	75	73	46	46	2.05	1.66
July	86	83	51	50	0.40	0.73
August	82	82	44	50	1.94	0.79

1.1.2 Watershed Characteristics

Flow and vegetation within the watershed change substantially through the four seasons. During snowmelt in early spring, the riparian area in this section of the stream has substantial water and no aboveground vegetation. As spring turns to summer, flow decreases and grass begins to grow to the point where flow is miniscule and herbaceous vegetation dominates through the fall until heavy snow returns to higher elevations and cold weather suppresses vegetation.

Cow Creek begins on the southern side of Paradise Ridge approximately 8 miles south of Moscow, Idaho. The uppermost 3 miles of the watershed accumulates snow in winter. The creek flows through farmland and pasture at moderate slopes (5%) in the upper reaches to low slopes (1–4%) through the rest of the watershed, where grazing and farming are common practices. The creek flows into Union Flat Creek as it enters Washington State near Uniontown. Union Flat Creek flows through the Palouse farm country toward its confluence with the Palouse River several miles west of LaCrosse, Washington. The Palouse River is a tributary to the Snake River.

The Cow Creek watershed has three distinct sections—Calf Creek, and the upper and lower mainstem (Figure 1). Upper Cow Creek is intermittent and drains an area approximately 37 square miles that is 99% annual cropland. This reach meets the lower Cow Creek drainage just above where the Calf Creek drainage drains into the main stem and where Idaho Highway 95 crosses Cow Creek. The Calf Creek drainage is approximately 8 square miles and runs along Idaho Hwy 95 for most of its length. The upper main stem is dominated by annual cropland and other rural activities near the City of Genesee. Lower Cow Creek starts just above where Calf Creek enters the main stem and encompasses an area of approximately 11 square miles. The lower reach is dominated by annual crop production and some pastures. Numerous ephemeral creeks within the watershed contribute flow to Cow Creek in the winter and spring. These creeks, including Calf Creek, contribute flow from November through May, but are generally dry all summer.

1.2 Cultural Characteristics

The following discussion of cultural characteristics of the Cow Creek watershed is from the *Cow Creek Subbasin Assessment and Nutrient Total Maximum Daily Load* (DEQ 2005b).

1.2.1 Land Use

The Cow Creek watershed consists of mostly rural area. Agricultural crops, such as wheat and barley, and legume crops, such as peas, lentils, and garbanzo beans, dominate land use within the watershed. Some land is used as pasture for grazing animals, generally less than 100 head per pasture.

1.2.2 Land Ownership, Cultural Features, and Population

The majority of the watershed (upper reach and Calf Creek) is in Latah County. The lower reach is primarily in Nez Perce County. The City of Genesee is the only incorporated city in the watershed and was once a fairly active town with many businesses that supported local farmers. The town has since become a community with nearby larger cities on the Palouse (Lewiston and Moscow) and has a population of approximately 1,000 residents. The City of Genesee treats its municipal wastewater with a facultative lagoon located southwest of town and just north of Cow Creek. The rural residents treat their wastewater with septic systems and drain fields.

1.2.3 History and Economics

Native Americans lived in the Palouse region and grazed horses in the grassy Palouse prairie country. The first known Europeans to enter the area were fur trappers and the Lewis and Clark expedition in 1805. The expedition camped in the Weippe prairie to the east and in Lewiston to the south. Gold was discovered in 1860 in Idaho, which created opportunities for miners and others to move into and settle in the prairie country. Latah County was established at its present size and configuration on May 14, 1888, with its county seat at Moscow, just north of the Cow Creek drainage. Likewise, the University of Idaho and Washington State University were established as land-grant colleges in the 1880s. By 1890, when Idaho became the 43rd state in the Union, homesteaders were likely clamoring to get a piece of the prairie for farming. Logging and mining in the surrounding hills were reaching their peak of activity. Today, farming, grazing, and home residences are the primary land uses in and around the Cow Creek drainage.

2 Subbasin Assessment—Water Quality Concerns and Status

This section outlines the water quality concerns in AUs ID17060108CL001_02 and ID17060108CL001_03, commonly referred to as Cow Creek, including their beneficial uses and the criteria used to assess support of those uses. This section also presents existing water quality data and data gaps identified during this TMDL analysis.

2.1 Water Quality Limited Assessment Units Occurring in the Subbasin

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

2.1.1 Additional Waters Listed Since TMDL Approval

No additional waters in the Cow Creek Watershed have been added to Idaho's §303(d) list since the US Environmental Protection Agency (EPA) approved the TMDL in 2006.

2.2 Applicable Water Quality Standards and Beneficial Uses

Idaho water quality standards, defined in IDAPA 58.01.02, designate beneficial uses and set water quality goals for 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) provides a more detailed description of beneficial use identification for use assessment purposes. Beneficial uses for Cow Creek are presented in Table 3.

Table 3. Beneficial uses of §303(d)-listed streams.

Water Body/ Assessment Unit	Beneficial Uses	Type of Use
Cow Creek ID17060108CL001_02	Cold water, secondary contact recreation	Designated
Cow Creek ID17060108CL001_03	Cold water, secondary contact recreation	Designated

2.2.1 Existing Uses

Existing uses under the CWA are "those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards" (40 CFR 131.3). The existing instream water uses and water quality necessary to protect the uses shall be maintained and protected (IDAPA 58.01.02.050.02 and .02.051.01). Existing uses include uses actually occurring, whether or not the water quality to fully support the uses exists. A practical application of this concept would be to apply the existing use of salmonid spawning to a water body that has supported salmonid spawning in the past but does not currently due to other factors, such as dams blocking migration.

2.2.2 Designated Uses

Designated uses under the CWA are "those uses specified in water quality standards for each water body or segment, whether or not they are being attained" (40 CFR 131.3). Designated uses are simply uses officially recognized by the state. In Idaho, these designated uses include aquatic life support, recreation in and on the water, domestic water supply, and agricultural uses. Water quality must be sufficiently maintained to meet the most sensitive use.

Designated uses may be added or removed using specific procedures provided for in state law, but the effect must not be to preclude protecting an existing higher quality use such as cold water aquatic life or salmonid spawning.

Designated uses are specifically listed for Cow Creek water bodies in the Idaho water quality standards (see IDAPA 58.01.02.120.01).

2.2.3 Presumed Uses

In Idaho, most water bodies do not yet have specific use designations in the water quality standards. These undesignated uses are to be designated. In the interim, and absent information on existing uses, the Idaho Department of Environmental Quality (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 existing use (e.g., salmonid spawning) exists, the CWA requires states to protect water quality for existing uses, and the additional numeric criteria for salmonid spawning would also apply (e.g., intergravel dissolved oxygen, temperature).

2.3 Criteria to Support Beneficial Uses

Beneficial uses are protected by a set of criteria, which includes *narrative* criteria for pollutants such as sediment and nutrients, and *numeric* criteria for pollutants such as bacteria, dissolved oxygen, pH, ammonia, temperature, and turbidity (IDAPA 58.01.02.200). Table 4 includes the most common numeric criteria used in TMDLs.

Figure 2 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 4. Selected numeric criteria supportive of beneficial uses in Idaho water quality standards.

Parameter	Primary Contact Recreation	Secondary Contact Recreation	Cold Water Aquatic Life	Salmonid Spawning[a]
Water Quality Standards: IDAPA 58.01.02.250–251				
Bacteria				
Geometric mean	<126 *E. coli*/100 mL[b]	<126 *E. coli*/100 mL	—	—
Single sample	≤406 *E. coli*/100 mL	≤576 *E. coli*/100 mL	—	—
pH	—	—	Between 6.5 and 9.0	Between 6.5 and 9.5
Dissolved oxygen (DO)	—	—	DO exceeds 6.0 milligrams/liter (mg/L)	**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
Temperature[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 nephelometric turbidity units (NTU) 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 Part 131				
Temperature	—	—	—	7-day moving average of 10 °C or less maximum daily temperature for June–September

[a] During spawning and incubation periods for inhabiting species
[b] *Escherichia coli* per 100 milliliters
[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.

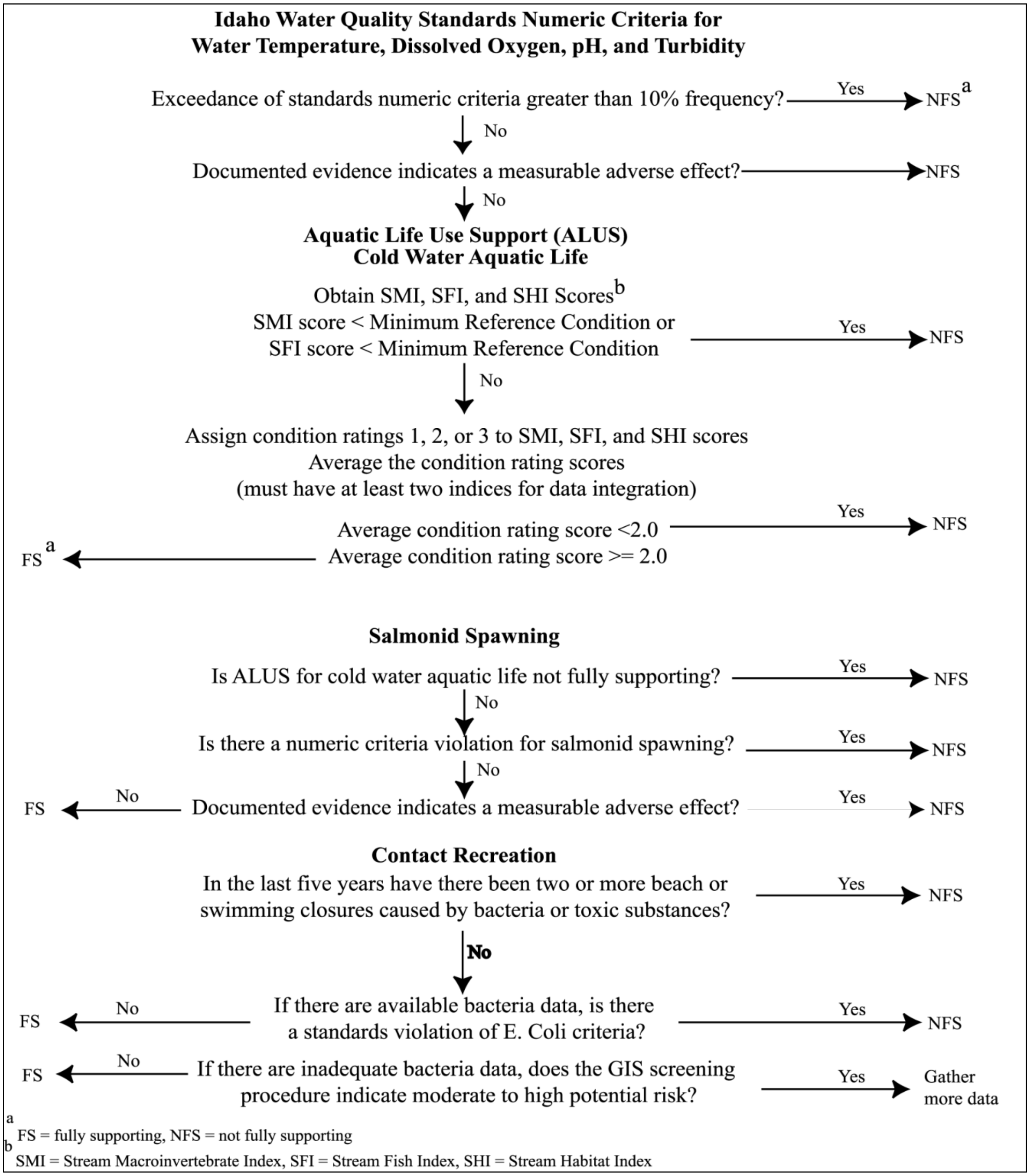

Figure 2. Determination steps and criteria for determining support status of beneficial uses in wadeable streams (Source: Grafe et al. 2002).

2.4 Summary and Analysis of Existing Water Quality Data

This TMDL establishes a load allocation for solar energy, which can cause stream temperatures to exceed natural background conditions, and a wasteload allocation for the one point source discharge to Cow Creek. Data associated with the PNV methodology used in developing the load allocation are presented and discussed in section 5.

2.4.1 Flow Characteristics

Development of the wasteload allocation in this TMDL relied on flow data generated by the City of Genesee under the requirements of their NPDES effluent discharge permit. These data are provided and discussed in section 5.

2.4.2 Water Column Data

No new or additional instream temperature data was generated for this TMDL. The most recent water quality report available for this watershed is the Idaho Association of Soil Conservation District's *Cow Creek Water Quality Monitoring Report 2006-2008* (Clark, 2008). http://www.nezperceswcd.org/Portals/2/Watersheds/Cow%20Creek%20water%20quality%20monitoring%20report%202008.pdf The report concluded, in part, that excessive stream temperature is another difficult problem to overcome, and can likely be addressed by re-establishing natural full potential canopy shade.

2.4.3 Biological and Other Data

The original listing was based on a visual evaluation of the third order reach but applied to the entire WQLS that included the second order, without actual observation made of the second order. EPA therefore listed it in 1994 when they promulgated DEQ's 1994 303(d) list, despite no actual data or assessment, including no site visit beyond one location near Genessee slightly upstream of the Washington/Idaho border. The Beneficial Use Reconnaissance Program last monitored the Cow Creek assessment unit (AU ID17060108CL001_03) in 2002. Site 2002SLEWA022 was located near the Washington border immediately upstream of Cow Creek's confluence with Union Flat Creek where flow near the border was recorded at 0.27 cubic feet per second. At site 2002SLEWA014, located upstream of Genesee, the site was found to be dry. The cold water aquatic life beneficial use was determined to be impaired for temperature and nutrients while the recreation beneficial use was determined to be fully supported. In addition, a BURP site on the 2nd order was established and visited in 2002. Site 2002SLEA015 could not be assessed because it was dry. On field visits to verify solar pathfinder readings, DEQ has continued to observe no water in the 2nd order during the June to September time frame in the shallow swale that makes up the 2nd order. There is little or no water in the upper reaches of the 3rd order, either. DEQ is also aware that in many locations throughout the Palouse HUC drainage tile was installed throughout the 1970's and 1980's. Most of this tile is unmapped locations and its purpose was to drain hydric soils and lands that were "cutover" timber that was placed into production for wheat during the agricultural prices of those two decades. Until DEQ has sufficient data available to make a beneficial use support determination DEQ recommends moving the 2nd order to Category 3 as unassessed. There are no known point sources in the 2nd order and cattle grazing and dryland agriculture are the land based uses, but limited due to lack of water in the 2nd order. DEQ has observed that these prairie locations don't have much water but do have adequate shade by and large.

2.5 Data Gaps

Because individual stream segments may not meet shade targets for a variety of reasons—including natural phenomena (e.g., beaver ponds, springs, wet meadows, and past natural disturbances) or historic land-use activities (e.g., logging, grazing, and mining)—existing shade for each stream segment should be field verified to determine if shade differences are real and result from activities that are controllable.

Several seasonal data points are missing from the NPDES discharge monitoring reports. The reported data are weekly maximums and limit consideration of daily averages and daily maximums. These limitations have been addressed in the wasteload allocation included in this TMDL but may need to be re-addressed in the future.

3 Subbasin Assessment—Pollutant Source Inventory

This TMDL provides a temperature load allocation and wasteload allocation to known sources affecting Cow Creek's water quality. Known pollutant sources listed in this section will be included in the load allocation or wasteload allocation.

The Cow Creek watershed is predominately rural, with the majority of the watershed used for cultivating annual small grains and legume crops. There is one small rural town, the City of Genesee that discharges municipal wastewater into Cow Creek. The only known heat inputs into Cow Creek are the City of Genesee's discharge and excess solar heat resulting from the lack of riparian canopy cover in areas where traditional farming practices promoted its removal.

3.1 Nonpoint Sources

Nonpoint source heat pollution in the watershed comes from excess solar heat resulting from the lack of riparian canopy cover in areas where traditional farming practices promoted its removal. The various factors influencing stream temperature are discussed in more detail in section 5.1.1.1.

3.2 Point Sources

The City of Genesee operates a wastewater treatment facility with a lagoon. The lagoon was initially developed to discharge into the creek at high flows only during winter and spring. The lagoon evaporated excess wastewater in the summer instead of discharging into the creek. Over time, the inflow increased greater than the evaporative rate during the summer months, and the facility discharged overflow into Cow Creek year-round as needed.

The city's wastewater treatment facility is the only NPDES-permitted discharge to Cow Creek (NPDES permit #ID0020125). The 2005-issued permit allows discharge to Cow Creek year-round. In June 2009, DEQ issued a municipal wastewater reuse permit (#LA-000218) to the City of Genesee allowing land application of its wastewater effluent from May through October. Although the NPDES permit allows Genesee to discharge throughout the year, available discharge monitoring reports show discharge does not typically occur during the critical low-flow, late-summer period.

4 Monitoring and Status of Water Quality Improvements

The watershed advisory group (WAG) and DEQ discussed the development of a temperature TMDL during nutrient TMDL development in 2005. At that time, the City of Genesee was working toward updating its wastewater treatment system and acquiring a land application permit for wastewater disposal during the critical flow period in late summer.

Since 2005, the City of Genesee has updated its system and operates a permitted land application system to augment wastewater disposal during the critical flow season of June through September. In June 2009, DEQ issued a municipal wastewater reuse permit to the City of Genesee, allowing land application of its wastewater effluent from May through October. Between 2008 and 2012, EPA discharge monitoring reports show the City of Genesee did not discharge during July through September. The monthly maximum temperature of the effluent discharged during the noncritical season of October through June was at, or below, the TMDL target of 22 °C established by this TMDL.

In 2004, the Latah Soil and Water Conservation District and Nez Perce Soil and Water Conservation District received a §319 grant for water quality improvement in Cow Creek. The total grant funds disbursed by DEQ were $240,966, with a match of $160,644 from the involved parties. The goal was to improve water quality conditions within the Cow Creek watershed by implementing cost-share programs designed to support individual growers' transitions from current agricultural management practices to those designed to improve water quality through erosion and sediment reduction, improved nutrient management, extended crop rotations, and incorporation of new crops designed to reduce production inputs (e.g., herbicides and fertilizers).

In 2007, the Idaho Transportation Department completed a State Highway 95 improvement project and compensated for filling in 5 acres of wetlands by creating 10 acres of floodplain wetlands adjacent to Cow Creek at a cost of $2,000,000. The mitigation project planted floodplain vegetation along Cow Creek that will restore the natural riparian canopy.

5 Total Maximum Daily Loads

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 allocates this load capacity among the various sources of the pollutant. Pollutant sources fall into two broad classes: (1) point sources, each of which receives a wasteload allocation, and (2) nonpoint sources, each of which receives a load allocation. When natural background contributions are identified, they are considered part of the load allocation. Because of uncertainties regarding quantification of loads and the relation of specific loads to attaining water quality standards, the rules regarding TMDLs (40 CFR Part 130) require a margin of safety be a part of 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 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 complicated.

Another step in a load analysis is quantifying current pollutant loads by source. This step allows 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, as is the case in this temperature TMDL. For certain pollutants, whose effects are long term, EPA allows for seasonal or annual loads instead of daily loads.

5.1 Instream Water Quality Targets

Individual instream water quality targets are provided for both the nonpoint source load and the point source wasteload.

5.1.1 Load Allocation Target

The load allocation target is based on Idaho's natural background conditions provision during the mid to late summer critical low flow season of June through September, which was established in the December 2005 Cow Creek TMDL (DEQ 2005b). The provision allows natural background conditions to supersede numeric temperature criteria. When this occurs, the numeric criteria shall not apply and instead there shall be no lowering of water quality from the natural background temperature.

For the Cow Creek temperature TMDL load allocation, DEQ applied the natural conditions provision and a PNV model. The natural levels of shade and channel widths are the TMDL targets. The instream temperature that results from attaining these conditions is consistent with the water quality standards, even if it exceeds numeric temperature criteria. See Appendix A for 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 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 discussion of shade and its effects on stream water temperature.

5.1.1.1 Factors Controlling Water Temperature in Streams

There are several important contributors of 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 can provide 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 can be measured in a number of ways. Effective shade (i.e., that 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.

5.1.1.2 Potential Natural Vegetation for Temperature TMDLs

PNV along a stream is the riparian plant community that could grow to an overall mature state, although some level of natural disturbance is 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, wildlife grazing) or anthropogenically (e.g., domestic livestock grazing, vegetation removal, erosion). The idea behind PNV as targets for temperature TMDLs is that PNV provides a natural level of solar loading to the stream with 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 additional solar input.

We can estimate PNV (and therefore target shade) from models of plant community structure (shade curves for specific riparian plant communities), and we can measure or estimate existing canopy cover or shade. Comparing the two (target and existing shade) details 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 station collecting these data, which was in Pendleton, Oregon. The difference between existing and target solar loads, assuming existing load is higher, is the load reduction necessary to bring the stream into compliance with water quality standards (see Appendix A).

PNV shade and associated solar loads are assumed to be the natural condition; thus, stream temperatures under PNV conditions are assumed to be natural and are considered to be consistent with the Idaho water quality standards, even if they exceed numeric criteria by more than 0.3 °C.

5.1.1.2.1 Existing Shade Estimates

Existing shade was estimated for Cow Creek 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 map, 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. For example, if shade for a particular stream segment was estimated somewhere 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 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 field partially verified with a Solar Pathfinder, which measures effective shade and also takes into consideration physical features, other than vegetation, 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 was field verified with a Solar Pathfinder at one site. 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, ten 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 bank-full water level. Ten traces were taken following the manufacturer’s instructions. Systematic sampling was used because it is easiest to accomplish without biasing the sampling location. For the sampled segment, the sampler started at a unique location, such as 50 to 100 meters (m) from a bridge or fence line, and proceeded upstream or downstream taking additional traces at fixed intervals (e.g., every 50 m, 50 paces, etc.).

When possible, the sampler also measured bank-full widths, took notes, and photographed the landscape of the stream at several 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.

Solar Pathfinder data were collected at one site near the town of Genesee, Idaho, where a stream restoration project is in place. The restoration site is where the Idaho Transportation Department mitigated wetland loss from the Hwy 95 expansion project. The riparian area at the restoration site is dominated by reed canary grass; however, other shrubs have been planted and will likely grow over time (Figure 3).

Figure 3. Cow Creek restoration site near Genesee, Idaho.

5.1.1.2.2 Target Shade Determination

Flow and vegetation within the watershed change substantially through the seasons. During snowmelt in early spring, the riparian area has substantial water and no aboveground vegetation. As spring turns to summer, flow decreases and grass begins to grow to the point where flow is miniscule and herbaceous vegetation dominates through the fall until heavy snow returns to higher elevations and cold weather suppresses the grass vegetation.

Numerous ephemeral creeks within the watershed contribute flow to Cow Creek in the winter and spring. These creeks, including Calf Creek, contribute flow from November through May but are generally dry all summer. The majority of the watershed, except for a portion of the 3rd-order of Cow Creek, lacks sufficient water to be perennial or to sustain channels with riparian communities. PNV targets were developed only for the 3rd-order segment of Cow Creek (AU ID17060108CL001_03) where a perennial reach is found.

PNV targets were determined from an analysis of probable historic vegetation at the stream and comparing that to shade curves developed for similar vegetation communities in Idaho (see Shumar and De Varona 2009). A shade curve shows the relationship between effective shade and stream width. As a stream gets wider, shade normally 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.

Natural Bank-full Widths

Stream width must be known to calculate target shade since the width of a stream affects the amount of shade the stream receives. Bank-full width is used because it approximates the width between the points on either side of the stream where riparian vegetation starts. Measures of current bank-full 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 bank-full width may not be discernible from aerial photo interpretation and may not reflect natural bank-full widths, this parameter must be estimated from available information. We used regional curves for the major basins in Idaho—developed from data compiled by Diane Hopster of the Idaho Department of Lands—to estimate natural bank-full width (Figure 4).

For each stream evaluated in the load analysis, natural bank-full width was estimated based on the drainage area of the Clearwater Basin curve from Figure 4. Although estimates from other curves were examined (i.e., Spokane, Kootenai, Pend Oreille), the Clearwater curve was ultimately chosen because of its proximity to the Palouse River subbasin, similarity in climate, and good R^2 value. DEQ compared these estimates to available bank-full measurements on site and bank-full widths estimated from the aerial photograph.

In general, the existing bank-full channel widths in Cow Creek were found to be narrower than those used in the Clearwater basin curve. We used the existing channel widths as the natural target channel widths to adapt the Clearwater curve model for application to Cow Creek since no information is available to suggest channel widths should be wider. The natural target bank-full channel widths used in this analysis are presented in Table 5 and applied Table 7.

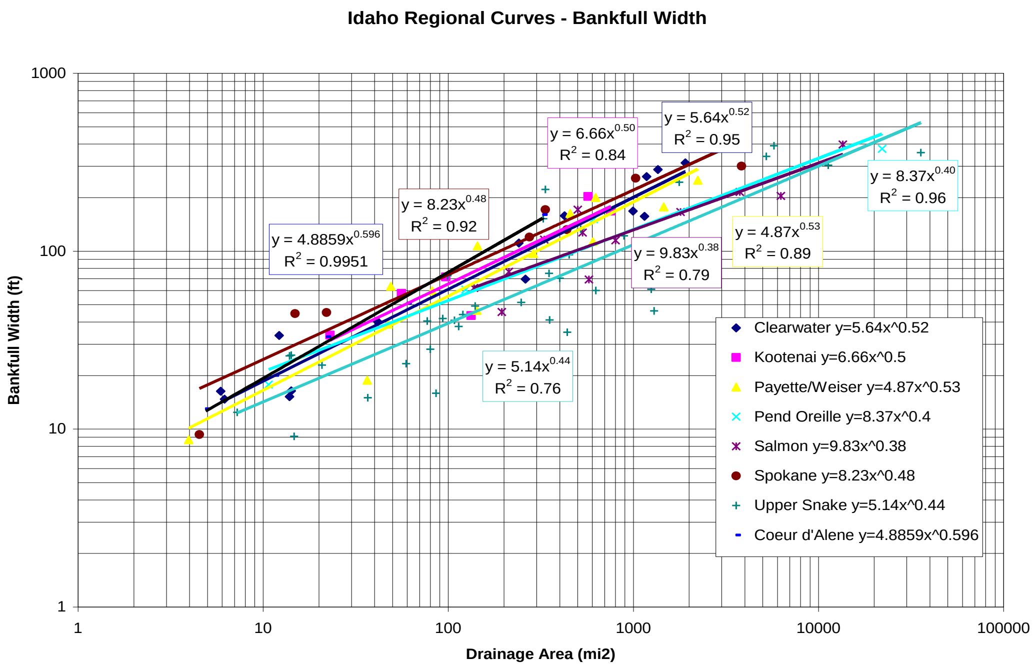

Figure 4. Bank-full width as a function of drainage area.

Table 5. Bank-full width estimates from the Clearwater regional curve and existing data.

Location	area (sq mi)	Clearwater (m)	Existing (m)
Union Flat Creek @ ID/WA border	56.44	14	9
Cow Creek @ mouth	51.78	13	8
Cow Creek @ Hwy 95	44.66	12	8
Cow Creek ab Genesee restoration	32.62	11	7
Cow Creek bl Genesee/Julietta Rd	31.98	10	7
Cow Creek ab Genesee/Juliette Rd	28.25	10	5
Cow Creek @ beginning of 3rd order	16.57	7	3

Design Conditions

The natural vegetation of the upper Palouse River region in Latah County, Idaho, can best be described as bunchgrass-dominated steppe (i.e., grassland) of the Palouse Prairie meets the conifer forest. Early botanist and explorer of the region Charles Geyer described the higher elevation grasslands of the Palouse region in 1846 as bunchgrass prairie bordered by “spacious, open, grassy woods” of large, widely spaced Ponderosa pine in “elegant parks” dotted with seasonally wet “spongy meadows” or “gamass” (camas) (Weddell 2000). Later, I.I. Stevens, while performing railroad surveys for the army in 1853–1855, wrote that the Palouse region was “very fertile rolling country…a most beautiful prairie country, the whole of it adapted to agriculture…rolling table-land…comparable to that of the prairie of Illinois” (Weddell 2000). Stevens indicated that the bottomland of the Palouse “has great resources…it is heavily timbered with pine, but with very little underbrush” (Weddell 2000). Both of these explorers captured two very important images of the Palouse River region: the prairie steppe was extensively dominated by bunchgrasses and valley bottoms and stream corridors may have been in open timber.

Rexford Daubenmire, one of the West’s best known plant ecologists, explained forest types for this region as fescue grassland meeting forest in western Latah County (1952). On the other hand, Weaver (1917) described the entire Palouse River region east of the Idaho-Washington border as coniferous woodland. Idaho fescue (*Festuca idahoensis*) /snowberry (*Symphoricarpus albus*) association (Franklin and Dyrness 1973) probably dominated western Latah County near the Idaho-Washington border. How far up the Palouse River this vegetation type existed is debatable. Most authors suggest it occurred as far as Potlatch, or even beyond according to maps in Black et al. (1998). Fescue grasslands also dominated most of the South Fork Palouse River and Cow Creek areas. This fescue/low shrub grassland met up with lower elevation Ponderosa pine (*Pinus ponderosa*) forest in an open, parkland-type setting described by the early explorers.

The native vegetation on the grasslands of the Palouse region is largely gone. Most of these lands have long since been converted to cropland, hay, and pastureland. Very few remnants of the native Palouse Prairie vegetation survive. However, it is generally recognized that these grasslands were dominated by perennial bunchgrasses, either bluebunch wheatgrass (*Psuedoregneria spicata*) in drier portions or Idaho fescue in moister parts of the prairie (Black et al. 1998; Weddell 2000, 2001). In western Latah County, covering much of the landscape from the Washington border to east of Moscow and Potlatch, the Palouse Prairie was probably dominated by the Idaho fescue/snowberry zone of Franklin and Dyrness (1973). This zone is described as the moistest of the steppe zones with a mosaic of herbaceous and woody species. Grasses included Idaho fescue, bluebunch wheatgrass, and prairie junegrass (*Koeleria cristata*), and shrubs included low-growth forms of snowberry, Wood's rose (*Rosa woodsii*), and Nootka rose (*Rosa nutkana*).

While much has been written about forest types in this region (Daubenmire 1952; Franklin and Dyrness 1973) and about the historic steppe and shrub-steppe vegetation of the Palouse Prairie (Black et al. 1998; Weddell 2000, 2001), little has been written to describe the vegetation in riparian areas of this region. Weaver included wet meadow and floodplain forest types in his "hydrosere" classification system (1917). He described dense thickets of trees and shrubs along streams. Larger streams that cut canyons into the basalt had narrow riparian forests while smaller streams that were intermittent did not cut canyons and thus, were exposed to the wind resulting in no woody vegetation in the riparian area.

Weaver described small groves of poplars where aspens (*Populus tremuloides*) or even black cottonwoods (*Populus balsamifera*) were dominant. However, the major riparian community type was one containing a mixture of alders (*Alnus* sp.), hawthorns (*Crataegus* sp.), willows, serviceberry (*Amelanchier alnifolia*), and chokecherry (*Prunus virginiana*). In some cases, alders were the dominant life form; in others, dense thickets of pure hawthorn and serviceberry became dominant. Weaver described wet meadows in the mountains and on the prairie (1917). He listed a variety of wet meadow "types" including tufted hairgrass meadows, sometimes as pure stands, and others dominated by camas (*Camassia* sp.)and cowparsnip (*Heracleum lanatum*).

Within the fescue/snowberry zone, moist draws were dominated by black hawthorn (*Crataegus douglasii*) (Black et al. 1998; Franklin and Dyrness 1973; Weaver 1917). In fact, Franklin and Dyrness describe two plant associations in these wet draws: a hawthorn/snowberry association and a hawthorn/cowparsnip association (1973). These draws were dominated by 5- to 7-m tall hawthorn and may have included other shrubs such as shiny-leaf spirea (*Spiraea betulifolia*), Columbia hawthorn (*Crataegus columbiana*), chokecherry, and serviceberry. Aspens occurred in phases in these hawthorn associations. Because aspen is short lived, aspen suckers would grow up through the hawthorns, dominate for several years, and then die back allowing hawthorns to dominate (Franklin and Dyrness 1973).

Shade Curve Selection

To determine PNV shade targets for Cow Creek, effective shade curves from the Idaho non-forest group of Shumar and De Varona were developed for the Palouse hawthorn community type (2009). These curves were produced using vegetation community modeling of Idaho plant communities (Shumar and De Varona 2009). Effective shade curves include percent shade on the vertical axis and stream width on the horizontal axis. The input parameters used to create the Palouse hawthorn community type were canopy cover (84%), weighted height (4 m), and overhang (1 m). The resulting shade curve is presented in Figure B-1 of Appendix B and corresponding target shade values are presented in Table 6.

Table 6. Shade targets for the hawthorn/grass mix vegetation type at various stream widths.

Palouse Hawthorn	1m	2m	3m	4m	5m	6m	7m	8m	9m	10m
North/South aspect	97	86	75	65	58	51	46	42	38	35
NE/SW & NW/SE aspects	97	86	73	62	54	47	42	37	34	31
East/West aspect	97	90	66	51	42	35	31	27	24	22
Average (%)	97	88	71	60	51	45	39	35	32	29

5.1.2 Wasteload Allocation Target

The wasteload allocation target is Idaho's numeric temperature criteria for cold water aquatic life: 22 °C or less daily maximum temperature with a maximum daily average of no greater than 19 °C.

5.1.2.1 Design Conditions

The City of Genesee's current NPDES permit requires only the reporting of weekly maximum temperatures and is the only readily available data characterizing the temperature of the city's effluent. The weekly maximum temperature reported by the City is a measurement more similar to Idaho's 22 °C or less criterion, based on a maximum measurement, than it is to the 19 °C daily average criterion, based on an average of all daily measurements. Therefore, to be compatible with the most applicable and readily available data, this TMDL applied a wasteload allocation target of 22 °C or less to compare the weekly maximum temperature data with the maximum allowable criteria rather than comparing the weekly maximum temperature data with the allowable daily average criteria. .

5.2 Load and Wasteload Capacity

Both a wasteload capacity for the point source and a load capacity for nonpoint sources are developed in this TMDL.

5.2.1 Load Capacity

The load capacity for Cow Creek under PNV is essentially the solar loading allowed under the shade targets specified for the segments within the 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% (or 0.4) of the load hitting the flat-plate collector under full sun.

We obtained solar load data from the NREL weather station in Pendleton, Oregon. 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 7 and Figure 5 show the PNV shade targets. The table also shows corresponding target summer loads (in kilowatt-hours per square meter per day [kWh/m^2/day] and 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 the table. The target load (i.e., load capacity) for lower Cow Creek (AU ID17060108CL001_03) was 461,000 kWh/day (Table 7).

5.2.2 Wasteload Capacity

A critical flow season of June through September was identified in the Cow Creek SBA/TMDL (DEQ 2005b). During a typical June through September, creek flow decreases substantially, ambient air temperatures increase, and creek temperatures rise. The creek can be impaired during this time with no load capacity available to assimilate a temperature wasteload. Flows increase in the fall with precipitation and peak in the spring with snowmelt. Creek temperatures are typically inverse of the flow pattern, allowing a temperature wasteload capacity for the City of Genesee's lagoon system effluent discharge during the noncritical October through May period.

5.3 Estimates of Existing Pollutant Loads

Regulations allow that pollutant loading "...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.

5.3.1 Estimates of Existing Nonpoint Source Loads

Existing loads in this temperature TMDL come from estimates of existing shade as determined from aerial photo interpretations (Figure 6). Like target shade, existing shade was converted to a solar load by multiplying the fraction of open stream by the solar radiation measured at the NREL weather station. Existing shade data are presented in Table 7. Like load capacities (target loads), existing loads in Table 7 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 7). The existing load for lower Cow Creek (AU ID17060108CL001_03) was 465,000 kWh/day (Table 7).

Table 7. Existing and target solar loads for lower Cow Creek (AU ID17060108CL001_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
001_03	Cow Creek	1	1100	Palouse	51%	2.98	5	6,000	20,000	30%	4.26	5	6,000	30,000	10,000	-21%
001_03	Cow Creek	2	1100	Hawthorn	51%	2.98	5	6,000	20,000	20%	4.86	5	6,000	30,000	10,000	-31%
001_03	Cow Creek	3	640		51%	2.98	5	3,000	9,000	30%	4.26	5	3,000	10,000	1,000	-21%
001_03	Cow Creek	4	130		51%	2.98	5	700	2,000	40%	3.65	5	700	3,000	1,000	-11%
001_03	Cow Creek	5	280		51%	2.98	5	1,000	3,000	40%	3.65	5	1,000	4,000	1,000	-11%
001_03	Cow Creek	6	220		51%	2.98	5	1,000	3,000	30%	4.26	5	1,000	4,000	1,000	-21%
001_03	Cow Creek	7	230		51%	2.98	5	1,000	3,000	30%	4.26	5	1,000	4,000	1,000	-21%
001_03	Cow Creek	8	590		51%	2.98	5	3,000	9,000	40%	3.65	5	3,000	10,000	1,000	-11%
001_03	Cow Creek	9	960		51%	2.98	5	5,000	10,000	30%	4.26	5	5,000	20,000	10,000	-21%
001_03	Cow Creek	10	500		51%	2.98	5	3,000	9,000	40%	3.65	5	3,000	10,000	1,000	-11%
001_03	Cow Creek	11	110		39%	3.71	7	800	3,000	20%	4.86	7	800	4,000	1,000	-19%
001_03	Cow Creek	12	220		39%	3.71	7	2,000	7,000	30%	4.26	7	2,000	9,000	2,000	-9%
001_03	Cow Creek	13	54		39%	3.71	7	400	1,000	20%	4.86	7	400	2,000	1,000	-19%
001_03	Cow Creek	14	240		39%	3.71	7	2,000	7,000	50%	3.04	7	2,000	6,000	(1,000)	0%
001_03	Cow Creek	15	230		39%	3.71	7	2,000	7,000	30%	4.26	7	2,000	9,000	2,000	-9%
001_03	Cow Creek	16	740		35%	3.95	8	6,000	20,000	40%	3.65	8	6,000	20,000	0	0%
001_03	Cow Creek	17	600		35%	3.95	8	5,000	20,000	30%	4.26	8	5,000	20,000	0	-5%
001_03	Cow Creek	18	1100		35%	3.95	8	9,000	40,000	40%	3.65	8	9,000	30,000	(10,000)	0%
001_03	Cow Creek	19	610		35%	3.95	8	5,000	20,000	30%	4.26	8	5,000	20,000	0	-5%
001_03	Cow Creek	20	960		35%	3.95	8	8,000	30,000	40%	3.65	8	8,000	30,000	0	0%
001_03	Cow Creek	21	340		35%	3.95	8	3,000	10,000	30%	4.26	8	3,000	10,000	0	-5%
001_03	Cow Creek	22	490		35%	3.95	8	4,000	20,000	40%	3.65	8	4,000	10,000	(10,000)	0%
001_03	Cow Creek	23	220		35%	3.95	8	2,000	8,000	20%	4.86	8	2,000	10,000	2,000	-15%
001_03	Cow Creek	24	1100		35%	3.95	8	9,000	40,000	50%	3.04	8	9,000	30,000	(10,000)	0%
001_03	Cow Creek	25	340		35%	3.95	8	3,000	10,000	30%	4.26	8	3,000	10,000	0	-5%
001_03	Cow Creek	26	2700		35%	3.95	8	20,000	80,000	40%	3.65	8	20,000	70,000	(10,000)	0%
001_03	Cow Creek	27	900		32%	4.13	9	8,000	30,000	30%	4.26	9	8,000	30,000	0	-2%
001_03	Cow Creek	28	490		32%	4.13	9	4,000	20,000	10%	5.47	9	4,000	20,000	0	-22%
							Totals		461,000					465,000	4,000	

Note: All assessment unit (AU) numbers start with ID17060108CL.
Note: Load data are rounded to two significant figures, which may present rounding errors.

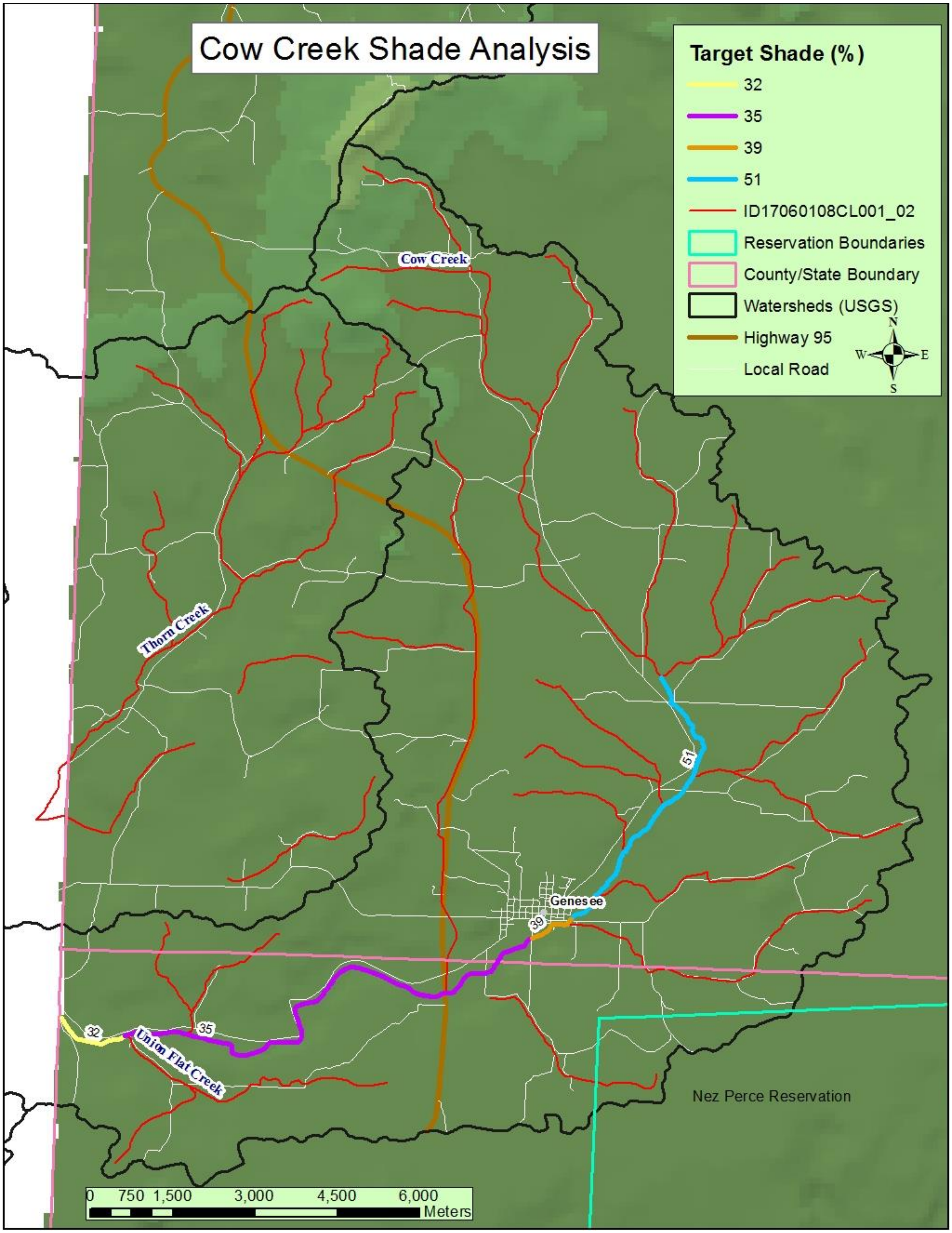

Figure 5. Target shade for lower Cow Creek.

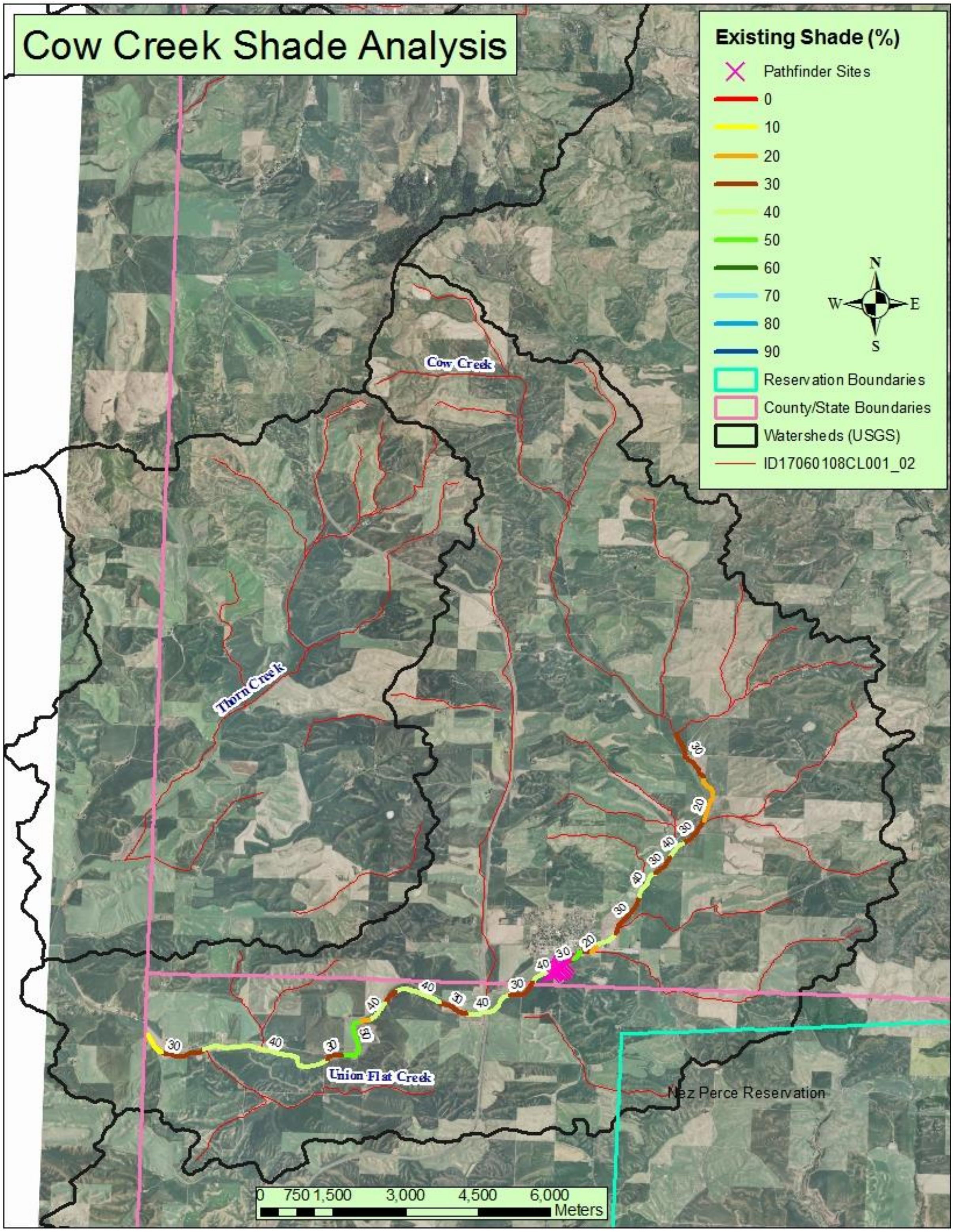

Figure 6. Existing shade estimated for lower Cow Creek by aerial photo interpretation.

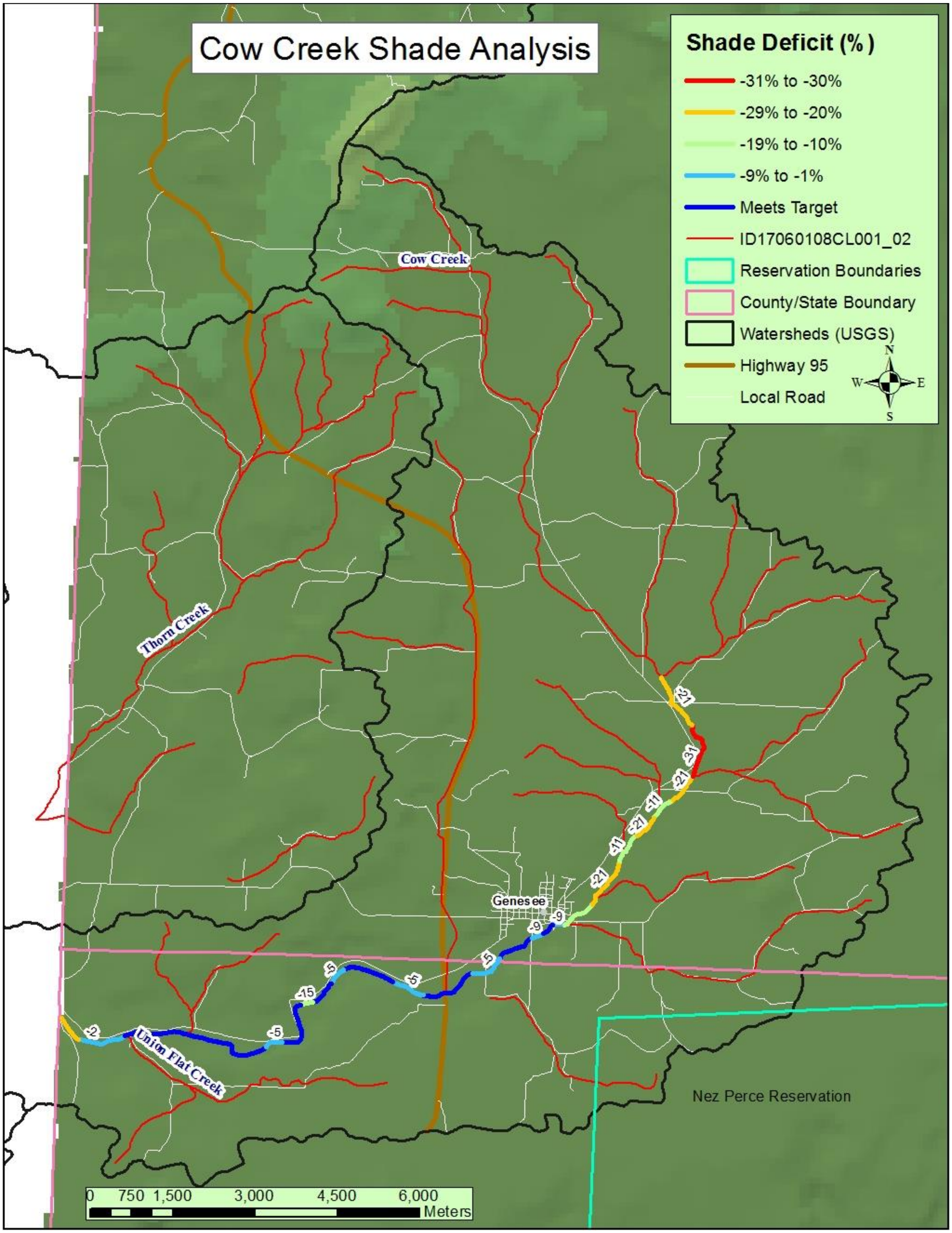

Figure 7. Lack of shade (difference between existing and target) for lower Cow Creek.

5.3.2 Estimates of Existing Point Source Wasteloads

The City of Genesee owns and operates the only wastewater treatment facility permitted to discharge in the Cow Creek watershed. The permit, issued in 2005, allows discharge to Cow Creek year-round. In June 2009, DEQ issued a municipal wastewater reuse permit to the City of Genesee, allowing land application of its wastewater effluent during May through October.

Although the NPDES permit allows Genesee to discharge throughout the year, available discharge monitoring reports show discharge does not typically occur during the critical low-flow, late-summer period. Monitoring required by the City of Genesee's current NPDES permit requires the City to record maximum effluent temperatures once per week. Table 8 lists the monthly maximum effluent temperatures reported by the City of Genesee between 2008 and 2012 under their current NPDES permit.

Table 8. Maximum monthly effluent temperature (°C) reported for the City of Genesee, 2008–2012.

Year	November	December	January	February	March	April	May	June
2008	7	7	—	—	—	—	—	—
2009	—	—	4	5	7	10	19	21
2010	—	—	—	4	12	16	—	22
2011	—	—	4	5	11	11	15	19
2012	—	—	4	6	9	—	—	—

The wasteload target for this TMDL is 22 °C or less. Figure 8 shows that the effluent temperature discharged under the current permit during the October and June flow seasons was at or below the TMDL wasteload target. Discharge did not occur during the summer low-flow period of Mid-June through September, when the effluent has the potential to exceed the target.

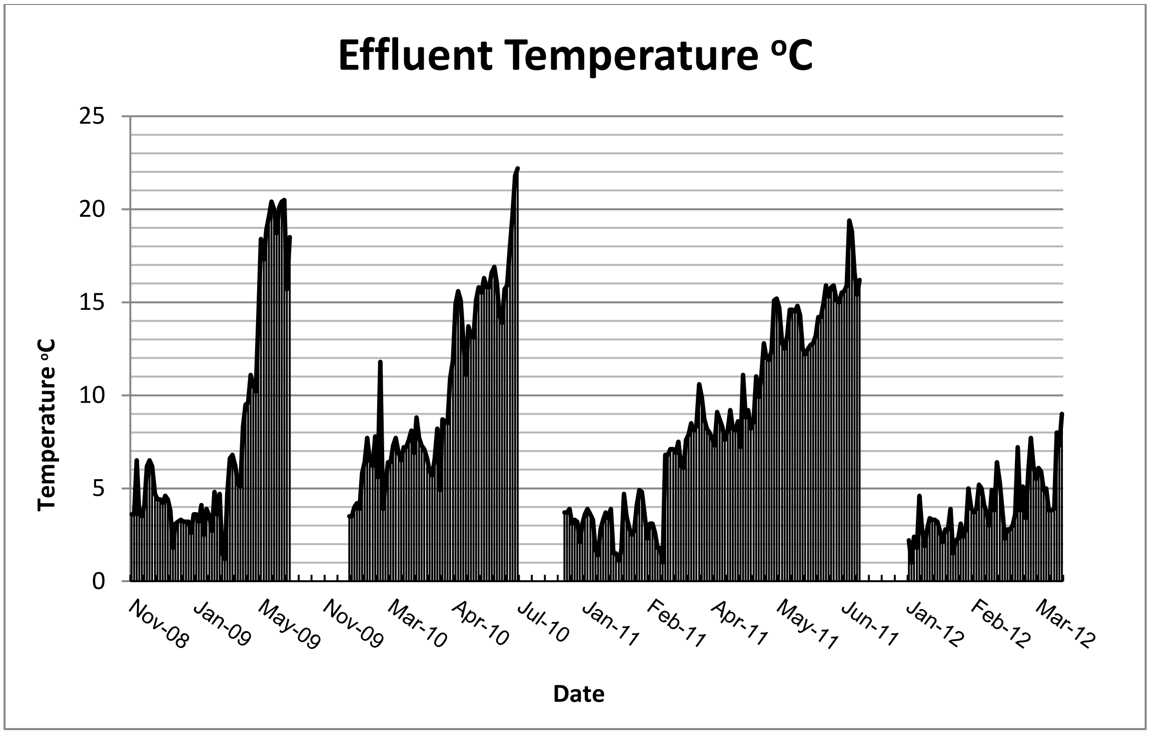

Figure 8. City of Genesee effluent discharge temperature.

5.4 Load Allocation and Wasteload Allocation

The load allocation is the portion of a water body's pollutant load capacity that can be assigned to nonpoint sources without causing or contributing to an exceedance of water quality standards in the receiving water. The wasteload allocation is the concentration or loading of a point source pollutant that a permittee may discharge without causing or contributing to an exceedance of water quality standards in the receiving water.

5.4.1 Load Allocation

The load allocation for this TMDL is essentially background conditions. However, in order 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 dependent upon the target load for a given segment. Table 7 shows 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 is dependent upon background conditions for achieving water quality standards, all tributaries to the waters examined here must be in natural conditions to prevent excess heat loads to the system. Currently, these tributaries are not in natural conditions.

Table 9 shows the total existing, target, and excess loads and the average lack of shade for lower Cow Creek. 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 lack-of-shade figure (Figure 7), 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. The load analysis table (Table 7) 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. Table 9 lists the 10% average lack of shade for the entire reach.

Table 9. 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)		
Lower Cow Creek (ID17060108CL001_03)	465,000	461,000	4,000 (1%)	-10

Note: Load data are rounded to two significant figures, which may present rounding errors.

Lower Cow Creek (AU ID17060108CL001_03) has an excess load that represents approximately 1% of its total existing load. Thus, the necessary reductions to achieve target loads are 1%. The upper end of the AU above the Genesee-Julietta Road appears to lack shade by 11% to 31%. The lower section, below the road, is in relatively good condition with average shade deficits of less than 6% (Figure 7). This difference is likely due to a major change in moisture regime at the road crossing where the stream essentially becomes perennial below the road. Above the road, the channel is smaller, resulting in a higher target value, but the lack of summer water inhibits riparian development.

A certain amount of excess load is potentially created by the existing shade/target shade difference inherent in the loading analysis. Because existing shade is reported in 10% increments and target shade can be any number 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 bank-full 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. This automatic difference of 6% could be attributed to the margin of safety.

5.4.1.1 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 CWA 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.

Cow Creek wetlands and flood plain are drained by subsurface tile drains to allow agricultural production. The potential effects of subsurface tile drains on Cow Creek water temperatures were not quantified for this TMDL. The average flow rate from subsurface tile drains measured by DEQ in 27 known tile drains between February and March of 2003 was 0.01 cfs (DEQ, 2003). The flood plain soils have a high water holding capacity but not a high water yield. Flow from these subsurface tile drains was inconsistent, limited to the early spring season, or only occurred in direct response to unusually high precipitation events.

5.4.2 Wasteload Allocation

The City of Genesee operates a wastewater treatment facility that is permitted to discharge to Cow Creek year-round. Between 2008 and 2012, EPA discharge monitoring reports show the City of Genesee did not discharge effluent at temperatures greater than the TMDL target during the critical season of June through September. The monthly maximum temperature of the effluent discharged during the noncritical season of October through May was at or below the TMDL target of 22 °C.

Comparing Cow Creek water temperature data—as reported by the Idaho Association of Soil Conservation Districts in the *Cow Creek Water Quality Monitoring Report 2006–2008*—with the EPA discharge monitoring report data posted on their web site for the same monitoring period during the noncritical season in 2006 shows creek water temperature was within 2 °C of the reported discharged effluent temperature, 11 and 13 °C respectively, during periods when effluent temperatures were below the target temperature (IASCD 2008). Therefore, it is reasonable to conclude that the open exposure of the wastewater treatment system lagoon to ambient temperature conditions and its proximity to Cow Creek will cause effluent discharge temperatures to approximate Cow Creek receiving water temperatures, and effluent discharges are not expected to cause the receiving water to exceed the TMDL target during the noncritical season.

Based on the information discussed above, this TMDL provides a temperature wasteload allocation to the City of Genesee of 19 °C or less daily average and 22 °C or less for the critical season of June through September. Effluent temperatures approximate receiving water temperatures during the noncritical season and no wasteload reductions are required. Therefore, the noncritical season of October through May wasteload allocation will also be 19 °C or less daily average and 22 °C or less (Table 10).

Table 10. Temperature wasteload allocation for City of Genesee wastewater treatment facility.

Effective Period	Daily Average Temperature (°C)	Maximum Daily Temperature (°C)
Year-Round	19	22

5.4.3 Margin of Safety

The margin of safety applied in this TMDL is considered implicit in the design of both the load and wasteload allocations. The load allocation target is essentially background conditions and 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 load analysis. Although the load analysis used in this TMDL involves gross estimations that vary, 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.

The wasteload allocation target is the water quality temperature criteria for the aquatic life beneficial use, and the wasteload allocated to the discharger will not exceed the criteria. The discharge is restricted during periods when the effluent and receiving water temperature is greater than the criteria and only allowed when the effluent temperatures and receiving water are at or below the criteria.

5.4.4 Seasonal Variation

This TMDL is based on average summer loads. All loads have been calculated to be inclusive of the critical low flow season from June through September, when the combination of increasing air and water temperatures coincide with increasing solar inputs and vegetative shade. During this season, maximum temperatures may exceed cold water aquatic life criteria. 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.

5.4.5 Stormwater

The CWA requires operators of construction sites to obtain permit coverage to discharge stormwater to a water body or municipal storm sewer. In the past, stormwater was treated as a nonpoint source of pollutants. However, because stormwater can be managed on site through management practices or when discharged through a discrete conveyance such as a storm sewer, it now requires an NPDES permit.

In Idaho, EPA has issued a general permit for stormwater discharges from construction sites. 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 Construction General Permit (CGP) from EPA after developing a site-specific Stormwater Pollution Prevention Plan. Operators must document the erosion, sediment, and pollution controls they intend to use; inspect the controls periodically; and maintain best management practices (BMPs) throughout the life of the project.

When a stream is in Category 5 of the Integrated Report and DEQ develops a TMDL, DEQ may incorporate a gross wasteload allocation for anticipated construction stormwater activities. TMDLs developed in the past that did not have a wasteload allocation for construction stormwater activities or new TMDLs will also be considered in compliance with provisions of the TMDL if they obtain a CGP under the NPDES program and implement appropriate BMPs.

Typically, there are specific requirements operators must follow to be consistent with any local pollutant allocations. Many communities throughout Idaho are currently developing rules for post construction stormwater management. Sediment is usually the main pollutant of concern in stormwater from construction sites. Applying BMPs from Idaho's *Catalog of Stormwater Best Management Practices for Idaho Cities and Counties* is generally sufficient to meet the standards and requirements of the CGP, unless local ordinances have more stringent and site-specific standards that are applicable (DEQ 2005a).

An industrial facility stormwater discharge into waters of the U.S. must be permitted under EPA's most recent Multi-Sector General Permit and may receive a TMDL wasteload allocation for any pollutants of concern. There are currently no known facilities in this watershed required to be covered by EPA's most recent Multi-Sector General Permit and EPA's Notice of Intent Stormwater data base lists no active facilities.

5.4.6 Reserve for Growth

No reserve for growth is included in this TMDL. Any assignment of additional load allocations or wasteload allocations made in the future will need to be proportionate to allocation reductions assigned to existing sources included in this TMDL.

5.5 Implementation Strategies

This TMDL focuses on a solar load allocation and a wastewater treatment facility wasteload allocation for temperature. 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. 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. Pollutant load allocations will be reassessed accordingly.

Implementation of the load allocations produced using PNV-based shade and solar loads in this TMDL should incorporate the load analysis table presented in this TMDL (Table 7). This table needs to be updated, first to field verify the remaining existing shade levels and second to monitor progress toward achieving shade targets and temperature load reductions. Using the

Solar Pathfinder to measure existing shade levels in the field is important to achieving both objectives. Further field verification will likely find discrepancies with reported existing shade levels in the load analysis table. Due to the inexact nature of the aerial photo interpretation technique, this table 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.

Individual stream segments may not meet shade targets for a variety of reasons, including natural phenomena (e.g., beaver ponds, springs, wet meadows, and past natural disturbances) 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 in this TMDL (maps and the load analysis table) 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.

Implementation of the wasteload allocation assigned to the City of Genesee's wastewater discharge will be enacted by EPA in association with the issuance of the next scheduled NPDES permit for the City of Genesee.

5.5.1 Time Frame

Implementation of the load allocation relies on riparian area management practices that will provide a mature canopy cover to shade the stream and prevent excess solar loading. Because implementation is dependent on mature riparian communities to substantially improve stream temperatures, shade targets will not be immediately achieved. DEQ believes 10–20 years may be a reasonable amount time for achieving water quality standards.

Implementation of the wasteload allocation included in this TMDL relies on the issuance of the next scheduled NPDES permit for the City of Genesee's wastewater effluent discharge.

5.5.2 Approach

The Cow Creek WAG recommends that the implementation plan developed for this TMDL identify properties and property owners willing to participate in restoration and remediation of the needed riparian shading to manage the load allocation. The wasteload allocation implementation relies on EPA's NPDES permit for the discharge of the City of Genesee's wastewater effluent.

5.5.3 Responsible Parties

Idaho Code 39-3612 states that 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 pollutant sources they identify as priority. DEQ also recognizes the authorities and responsibilities of local city and county governments as well as applicable state and federal agencies and will enlist their involvement and authorities for protecting water quality by implementing IDAPA 58.01.02 and CWA §401.

5.5.4 Monitoring Strategy

Effective shade monitoring can take place on any segment throughout the Cow Creek watershed and be compared to existing shade estimates seen in Figure 6 and described in Table 7. Those areas with the largest disparity between existing and target shade should be monitored with Solar Pathfinders to verify existing shade levels and to determine progress toward meeting shade targets. Ten equally spaced Solar Pathfinder measurements averaged together within a segment will be used to monitor shade levels.

EPA’s NPDES permit for the City of Genesee’s wastewater effluent discharge should include reportable monitoring requirements to effectively manage the wasteload allocation.

5.6 Public Participation

The WAG and DEQ discussed the development of a temperature TMDL during the nutrient TMDL effort in 2005. The Cow Creek WAG met again in April 2013 to discuss the draft temperature TMDL and provide input and advice to DEQ. During its meeting, the WAG advised DEQ on issues related to the document and to issue it for a 30-day public comment period. Notice was provided to the general public through the Lewiston Morning Tribune and the Idaho Department of Environmental Quality’s internet web page. Copies of the document were made available online and through the Lewiston Office of the Idaho Department of Environmental Quality. The comment period ended on June 21, 2013. Comments received are listed in Appendix D. The comments and responses listed in Appendix D were provided to the Cow Creek Watershed Advisory Group prior to finalizing the document.

5.7 Conclusions

Temperature loads and waste loads have been allocated to the existing sources currently in the watershed. A growth reserve is not included in the TMDLs. Future sources will need to acquire an allocation from existing allocations unless the load capacity is increased.

Effective shade targets were established for lower Cow Creek (AU ID17060108CL001_03) 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 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’s 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 11.

Cow Creek AU ID17060108CL001_03 lacks approximately 10% shade causing an excess solar load that requires an approximate 1% reduction. The upper portion of the AU lacks water, whereas the lower portion is perennial. Smaller channel widths and lack of water drive the loss of shade.

Upper Cow Creek (AU ID17060108CL001_02) does not contain water during the critical time period of June through September and does not support a riparian plant community; DEQ therefore recommends delisting this AU for temperature impairment and moving it to Category 3 as unassessed, as the original listing was based solely upon a visual evaluation on the 3rd order reach of Cow Creek..

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.

A year-round temperature wasteload allocation has been provided to the City of Genesee for its wastewater discharge to Cow Creek. Based on current NPDES discharge monitoring reports, no effluent is discharged to Cow Creek during the critical flow season above the allowable allocation and therefore no wasteload reduction is required.

Table 11. Summary of assessment outcomes.

Water Body/ Assessment Unit	Pollutant	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Cow Creek ID17060108CL001_02	Temperature	No	Delist Temperature and move to Category 3	No excess solar load occurring during the critical time period (dry June–September).No water during June – September. Unassessed.
Cow Creek ID17060108CL001_03	Temperature	Yes	Delist temperature and Move to Category 4a	Excess solar load from a lack of existing shade

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Glossary

Ambient

General conditions in the environment (Armantrout 1998). In the context of water quality, ambient waters are those representative of general conditions, not associated with episodic perturbations or specific disturbances such as a wastewater outfall (EPA 1996).

Anthropogenic

Relating to, or resulting from, the influence of human beings on nature.

Aquifer

An underground, water-bearing layer or stratum of permeable rock, sand, or gravel capable of yielding water to wells or springs.

Assessment Unit (AU)

A segment of a water body that is treated as a homogenous unit, meaning that any designated uses, the rating of these uses, and any associated causes and sources must be applied to the entirety of the unit.

Beneficial Use

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

Best Management Practices (BMPs)

Structural, nonstructural, or managerial techniques that are effective and practical means to control nonpoint source pollutants.

Biological Integrity

1) The condition of an aquatic community inhabiting unimpaired water bodies of a specified habitat as measured by an evaluation of multiple attributes of the aquatic biota (EPA 1996). 2) The ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to the natural habitats of a region (Karr 1991).

Clean Water Act (CWA)

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

Community

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

Criteria

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

Disturbance

Any event or series of events that disrupts ecosystem, community, or population structure and alters the physical environment.

Effluent

A discharge of untreated, partially treated, or treated wastewater into a receiving water body.

Environment

The complete range of external conditions, physical and biological, that affect a particular organism or community.

Erosion

The wearing away of areas of the earth's surface by water, wind, ice, and other forces.

Exceedance

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

Flow

The amount of water flowing in the stream channel at the time of measurement. Usually expressed as cubic feet per second (cfs).

Ground Water

Water found beneath the soil surface saturating the layer in which it is located. Most ground water originates as rainfall, is free to move under the influence of gravity, and emerges again as streamflow.

Habitat

The living place of an organism or community.

Headwater

The origin or beginning of a stream.

Hydrologic Unit

One of a nested series of numbered and named watersheds arising from a national standardization of watershed delineation. The initial 1974 effort (USGS 1987) described four levels (region, subregion, accounting unit, and cataloging unit) of watersheds throughout the United States. The fourth level is uniquely identified by an eight-digit code built of two-digit fields for each level in the classification. Originally termed a cataloging unit, 4th-field hydrologic units have been more commonly called subbasins; 5th- and 6th-field hydrologic units have since been delineated for much of the country and are known as watersheds and subwatersheds, respectively.

Hydrologic Unit Code (HUC)

The number assigned to a hydrologic unit. Often used to refer to 4th-field hydrologic units.

Load Allocation (LA)

A portion of a water body's load capacity for a given pollutant that is allocated 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(ing) 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.

Monitoring

A periodic or continuous measurement of the properties or conditions of some medium of interest, such as monitoring a water body.

National Pollutant Discharge Elimination System (NPDES)

A national program established by the Clean Water Act for permitting point sources of pollution. Discharge of pollution from point sources is not allowed without a permit.

Natural Condition

The condition that exists with little or no anthropogenic influence.

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 of 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.

Point Source

A source of pollutants characterized by having a discrete conveyance, such as a pipe, ditch, or other identifiable "point" of discharge into a receiving water. Common point sources of pollution are industrial and municipal wastewater.

Pollutant

Generally, any substance introduced into the environment that adversely affects the usefulness of a resource or the health of humans, animals, or ecosystems.

Pollution

A very broad concept that encompasses human-caused changes in the environment that alter the functioning of natural processes and produce undesirable environmental and health effects. These changes include human-induced alterations of the physical, biological, chemical, and radiological integrity of water and other media.

Population

A group of interbreeding organisms occupying a particular space; the number of humans or other living creatures in a designated area.

Potential Natural Vegetation (PNV)

A.U. Küchler (1964) defined potential natural vegetation as vegetation that would exist without human interference and if the resulting plant succession were projected to its climax condition while allowing for natural disturbance processes such as fire. Our use of the term reflects Küchler's definition in that riparian vegetation at PNV would produce a system potential level of shade on streams and includes recognition of some level of natural disturbance.

Reach

A stream section with fairly homogenous physical characteristics.

Riparian

Associated with aquatic (stream, river, lake) habitats. Living or located on the bank of a water body.

Runoff

The portion of rainfall, melted snow, or irrigation water that flows across the surface, through shallow underground zones (interflow), and through ground water to create streams.

Species

1) A reproductively isolated aggregate of interbreeding organisms having common attributes and usually designated by a common name. 2) An organism belonging to such a category.

Spring

Ground water seeping out of the earth where the water table intersects the ground surface.

Stream

A natural water course containing flowing water at least part of the year. Together with dissolved and suspended materials, a stream normally supports communities of plants and animals within the channel and the riparian vegetation zone.

Subbasin

A large watershed of several hundred thousand acres. This is the name commonly given to 4th-field hydrologic units (also see Hydrologic Unit).

Subbasin Assessment (SBA)

A watershed-based problem assessment that is the first step in developing a total maximum daily load in Idaho. Also refers to the written document that contains the assessment.

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.

Tributary

A stream feeding into a larger stream or lake.

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 Pollution

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

Water Quality	A term used to describe the biological, chemical, and physical characteristics of water with respect to its suitability for a beneficial use.
Water Quality Criteria	Levels of water quality expected to render a water body suitable for its designated uses. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, or industrial processes.
Water Quality Limited	A label that describes water bodies for which one or more water quality criteria are not met or beneficial uses are not fully supported (i.e., impaired waters). Water quality limited segments may or may not be on a §303(d) list.
Water Quality Standards	State-adopted and US 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.
Watershed	1) All the land that contributes runoff to a common point in a drainage network or to a lake outlet. Watersheds are infinitely nested, and any large watershed is composed of smaller "subwatersheds." 2) The whole geographic region that contributes water to a point of interest in a water body.
Wetland	An area that is at least some of the time saturated by surface or ground water so as to support vegetation adapted to saturated soil conditions. Examples include swamps, bogs, fens, and marshes.

Appendix A. State and Site-Specific Water Quality Standards and Criteria

Water Quality Standards Applicable to Salmonid Spawning Temperature

Water quality standards for temperature are specific numeric values not to be exceeded during the salmonid spawning and egg incubation period, which varies by species. For spring-spawning salmonids, the default spawning and incubation period recognized by the Idaho Department of Environmental Quality (DEQ) is generally March 15 to July 15 (Grafe et al. 2002). Fall spawning can occur as early as September 1 and continue with incubation into the following spring up to June 1. As per IDAPA 58.01.02.250.02.f.ii., the following water quality criteria need to be met during that time period:

- 13 °C as a daily maximum water temperature
- 9 °C as a daily average water temperature

For the purposes of a temperature TMDL, the highest recorded water temperature in a recorded data set (excluding any high water temperatures that may occur on days when air temperatures exceed the 90th percentile of the highest annual maximum weekly maximum air temperatures) is compared to the daily maximum criterion of 13 °C. The difference between the two water temperatures represents the temperature reduction necessary to achieve compliance with temperature standards.

Natural Background Provisions

For potential natural vegetation temperature TMDLs, it is assumed that natural temperatures may exceed these criteria during certain time periods. If potential natural vegetation targets are achieved yet stream temperatures are warmer than these criteria, it is assumed that the stream's temperature is natural (provided there are no point sources or human-induced ground water sources of heat) and natural background provisions of Idaho water quality standards apply:

> When natural background conditions exceed any applicable water quality criteria set forth in Sections 210, 250, 251, 252, or 253, the applicable water quality criteria shall not apply; instead, there shall be no lowering of water quality from natural background conditions. Provided, however, that temperature may be increased above natural background conditions when allowed under Section 401. (IDAPA 58.01.02.200.09)

Section 401 relates to point source wastewater treatment requirements. In this case, if temperature criteria for any aquatic life use are exceeded due to natural conditions, then a point source discharge cannot raise the water temperature by more than 0.3 °C (IDAPA 58.01.02.401.01.c).

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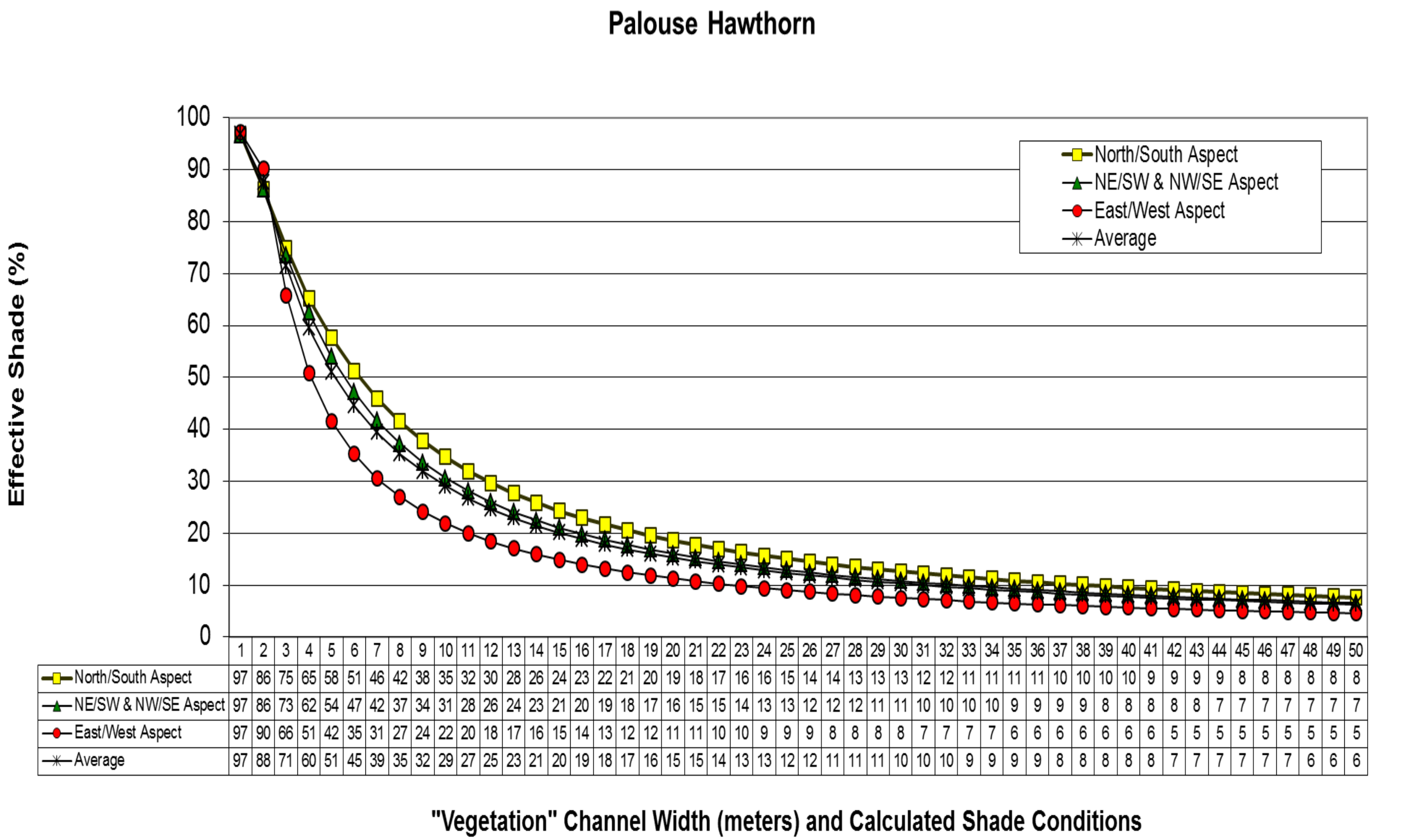
Appendix B. Data Sources and Shade Curve Data

Table B-1. Data sources for Cow Creek.

Water Body	Data Source	Type of Data	Collection Date
Cow Creek	DEQ Lewiston Regional Office and DEQ State Technical Services Office	Solar Pathfinder effective shade and stream width	October 2011
Cow Creek	DEQ State Technical Services Office	Aerial photo interpretation of existing shade and stream width estimation	September 2011



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
North/South Aspect	97	86	75	65	58	51	46	42	38	35	32	30	28	26	24	23	22	21	20	19	18	17	16	16	15
NE/SW & NW/SE Aspect	97	86	73	62	54	47	42	37	34	31	28	26	24	23	21	20	19	18	17	16	15	15	14	13	13
East/West Aspect	97	90	66	51	42	35	31	27	24	22	20	18	17	16	15	14	13	12	12	11	11	10	10	9	9
Average	97	88	71	60	51	45	39	35	32	29	27	25	23	21	20	19	18	17	16	15	15	14	13	13	12

	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
North/South Aspect	14	14	13	13	13	12	12	11	11	11	11	10	10	10	10	9	9	9	9	8	8	8	8	8	8
NE/SW & NW/SE Aspect	12	12	12	11	11	10	10	10	10	9	9	9	9	8	8	8	8	8	7	7	7	7	7	7	7
East/West Aspect	9	8	8	8	8	7	7	7	7	6	6	6	6	6	6	6	5	5	5	5	5	5	5	5	5
Average	12	11	11	11	10	10	10	9	9	9	9	8	8	8	8	8	7	7	7	7	7	7	6	6	6

Figure B-1. Target shade curve for Palouse hawthorn riparian community.

Appendix C. Distribution List

Idaho Department of Environmental Quality, State Office—
1410 North Hilton, Boise, Idaho 83706

US Environmental Protection Agency, Idaho Operations Office—
Boise, Idaho

Cow Creek Watershed Advisory Group

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Appendix D. Public Comments

The Watershed Advisory Group agreed to provide a 30-day public comment period for the draft *Cow Creek Temperature Total Maximum Daily Load: Addendum to the Cow Creek Subbasin Assessment and TMDL* document during their April 2013 meeting. Notice was provided to the general public through the Lewiston Morning Tribune and the Idaho Department of Environmental Quality's internet web page. Copies of the document were made available online and through the Lewiston Office of the Idaho Department of Environmental Quality. The comment period ended on June 21, 2013. Comments received were reviewed and discussed with the Cow Creek Watershed Advisory Group prior to finalizing the document.

Written comments were received from:

- Ken Clark, Water Resources Division, Nez Perce Tribe, Lapwai, Idaho.
- William Stewart, U.S. Environment Protection Agency, Region 10, Boise Idaho.

Comment: p.x,2nd paragraph states: "Cow Creek AU ID17060108CL001_03 lacks approximately 10% shade causing an excess solar load of that requires an approximate 1% reduction." You should clarify that a 1% reduction in solar loading is equivalent to 4,000 kWh/day.

Response: The sentence has been revised to read: "Cow Creek AU ID17060108CL001_03 lacks approximately 10% shade causing an excess solar load of approximately 4,000 kWh/day."

Comment: p.11, 2.4.2 states: No new or additional instream data has been generated for this TMDL. The most recent water quality data available for this TMDL are included in the Cow Creek Watershed Total Maximum Daily Load Implementation Plan for Agriculture (ISCC 2008) and the Cow Creek SBA/TMDL (DEQ 2005b). The Idaho Association of Soil Conservation Districts (IASCD) collected water quality data April 2006 to April 2008, from the same five locations that were sampled by IDEQ in 2002, during TMDL development (Clark, 2008). Ninety eight water quality samples were collected by IASCD staff during this time period, along with associated instantaneous parameters.

Response: The reference has been corrected to read: "No new or additional instream temperature data was generated for this TMDL. The most recent water quality report available for this watershed is the Idaho Association of Soil Conservation District's *Cow Creek Water Quality Monitoring Report 2006-2008* (Clark, 2008). The report concluded, in part, that excessive stream temperature is another difficult problem to overcome, and can likely be addressed by re-establishing natural full potential canopy shade."

Comment: p.11, 2.4.3 states: The Beneficial Use Reconnaissance Program monitoring of Cow Creek (AU ID17060108CL001_03) has not been conducted since 2002, at a site near the Washington border immediately upstream of Cow Creek's confluence with Union Flat Creek. The site was determined to have a flow of 0.0 cubic feet per second and no biological sampling occurred. According to the Integrated Report Interactive Map feature on the IDEQ website, a BURP site (2002SLEWA022) was sampled in 2002, at the state line on Union Flat Creek. There was flow in the creek and a full BURP survey was completed. The data indicated that Beneficial Uses were not being met. There was also another monitoring site surveyed in 1995, immediately upstream of the confluence of Cow Creek and Union Flat Creek. This site also had a flow and a full BURP survey was conducted; Beneficial Uses were not being met at that time either. One other BURP site was evaluated in 2002 (2002SLEWA014), and had no flow, but the site was located upstream of the City of Genesee, not at the confluence of Cow Cr. and Union Flat Cr., as indicated in the TMDL addendum.

Response: The paragraph has been corrected to read “The Beneficial Use Reconnaissance Program last monitored the Cow Creek assessment unit (AU ID17060108CL001_03) in 2002. Site 2002SLEWA022 was located near the Washington border immediately upstream of Cow Creek’s confluence with Union Flat Creek and at site 2002SLEWA014 was located upstream of Genesee. Flow near the border was recorded at 0.27 cubic feet per second while the upstream site was determined to be dry. The cold water aquatic life beneficial use was determined to be impaired while the recreation beneficial use was determined to be fully supported.”

Comment: p.16 & 17: Why was only one field verification of the aerial photo interpretation done with a solar pathfinder? And why was the one field verification done at a restoration site, rather than at a site that was more representative of existing conditions in the Cow Creek watershed? Additional field verification sites would provide more confidence in the aerial photo interpretation technique.

Response: The majority of the watershed is private property and the restoration site provided unrestricted access. The solar pathfinder only calibrates the photo interpretation technique, it does not produce outcomes. Completing the calibration at the restoration site had no influence on actual outcome of the final product.

Comment: p. 18, last paragraph states: In general, the existing bank-full width data were narrower than the natural bank-full width estimates from the Clearwater basin curve and we chose to make natural widths equivalent to existing estimates. Tables containing natural bank-full width estimates for each stream in this analysis are presented in Table 5. The load analysis table contains a natural (target) bank-full width and an existing bank-full width for every stream segment in the analysis based on the bank-full width results presented in Table 5. Existing widths and natural widths are the same since no data supported making them differ. Some clarification is needed for this paragraph. In the 1st sentence it states that existing bank-full widths are narrower than the Clearwater curve model predicts, but in the last sentence of the paragraph says that existing widths and natural widths are the same since no data supported making them differ. Also, if existing bank-full widths are narrower than the model predicts, and you “chose to make natural widths equivalent to existing estimates”, why did you set a width target based on the wider widths shown in the Clearwater model? Where existing widths used when setting the shade targets?

Response: The existing bank-full channel widths found in Cow Creek are used as the natural target channel widths to adapt the Clearwater curve model for application to Cow Creek since no information is available to suggest channel widths should be wider. The paragraph has been revised to read: “In general, the existing bank-full channel widths in Cow Creek were found to be narrower than those used in the Clearwater basin curve. We used the existing channel widths as the natural target channel widths to adapt the Clearwater curve model for application to Cow Creek since no information is available to suggest channel widths should be wider. The natural target bank-full channel widths used in this analysis are presented in Table 5 and applied Table 7.”

Comment: p.30 & 31 Water Diversion. 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. 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. While the impact of diversions may not be quantified in this TMDL, it would be useful to quantify the effect of drain tiles, which are ubiquitous in this watershed, are having on flow rates in the stream. Lack of water storage in stream banks and adjacent fields, due to drain tiles and lack of riparian vegetation, should be considered a major driver of elevated stream temperatures in the Cow Creek watershed, as well as potentially being the cause of dry summer conditions in the upper reaches of the watershed.

Response: The following paragraph has been added to page 31, Section 5.4.1.1.

"Cow Creek wetlands and flood plain are drained by subsurface tile drains to allow agricultural production. The potential effects of subsurface tile drains on Cow Creek water temperatures were not quantified for this TMDL. The average flow rate from subsurface tile drains measured by DEQ in 27 known tile drains between February and March of 2003 was 0.01 cfs (DEQ, 2003). The flood plain soils have a high water holding capacity but not a high water yield. Flow from these subsurface tile drains was inconsistent, limited to the early spring season, or only occurred in direct response to unusually high precipitation events."

Comment: In section 2.4.3 of the document you refer to a site used by the BURP monitoring in 2002 as being by the Washington border and having no flow. In reality, the site identified as 2002SLEWA022, is within the state of Idaho near the border on Union Flat Creek and did have flow. The SMI was 0, SFI was 1 and the SHI was 1. This appears to be part of the Cow Creek Watershed.

Response: The paragraph has been corrected to read "The Beneficial Use Reconnaissance Program last monitored the Cow Creek assessment unit (AU ID17060108CL001_03) in 2002. Site 2002SLEWA022 was located near the Washington border immediately upstream of Cow Creek's confluence with Union Flat Creek and at site 2002SLEWA014 was located upstream of Genesee. Flow near the border was recorded at 0.27 cubic feet per second while the upstream site was determined to be dry. The cold water aquatic life beneficial use was determined to be impaired while the recreation beneficial use was determined to be fully supported."

Comment: On page 16 of the document, in the section titled Solar Pathfinder Field Verification, it is stated that the aerial photo interpretations were field verified at one site. It seems like a watershed of this size should really have field verification and a larger number of sites than just one.

Response: The solar pathfinder only calibrates the photo interpretation technique, it does not produce outcomes. Completing the calibration at the restoration site had no influence on actual outcome of the final product.

Comment: The site selected for the field verification was also a site where ITD had done a stream restoration project near the town of Genesee where riparian restoration had taken place and had recent plantings in place. How would this effect the field verification compared to other locations on Cow Creek? This is one reason why multiple locations would have made sense for the field verifications.

Response: The majority of the watershed is private property and the restoration site provided unrestricted access. The solar pathfinder only calibrates the photo interpretation technique, it does not produce outcomes. Completing the calibration at the restoration site had no influence on actual outcome of the final product.

Comment: While it is true that traditional farming practices have resulted in the removal of riparian vegetation along Cow Creek, I can't help but wonder about other effects of agriculture that have not been discussed in the TMDL. Could over-grazing, tile drains, or channelization play a role in the temperature exceedence in Cow Creek? Understanding that Idaho does not do TMDLs for hydraulic flow alterations or habitat, there are many factors leading to impairment of Cow Creek that could be described in the TMDL for the sake of fully understanding the impairment.

Response: The following paragraph has been added to Section 1.1 on page 2. "Cow Creek experiences low flows during the late summer and early fall months and high flows in the spring and early summer months. Most of the wetlands and flood plains in the Palouse have been drained or eliminated by agricultural land use, urbanization, and transportation infrastructure affecting channel sinuosity and diversity. These areas retained water during high flow periods and released water during the lower flow periods. Without these water storage areas, peak flows are higher and for a shorter period of time, creating instream channel erosion, flooding, and deeply incised channels."

Comment: The photo on the cover of the draft report shows a deeply incised channel with virtually no natural riparian cover. This stream seems to need more work than can be achieved by a PNV shade effort.

Response: This TMDL is expected to result in a natural and healthy stream side riparian area. A healthy riparian area can provide a buffer protecting the stream from adjacent land uses and help maintain the channel and stability of its banks.