Lower North Fork Clearwater River Subbasin

Five-Year Review and TMDL Addendum

Final

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April 2013

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Acknowledgments

The Idaho Department of Environmental Quality would like to recognize the participation and dedication of the watershed advisory group in its efforts to assist in improving water quality in the Lower North Fork Clearwater River subbasin. Specifically, the Clearwater Soil Water Conservation District, the Idaho Department of Lands, Potlatch Corporation, the Clearwater National Forest, the Palouse Clearwater Environmental Institute, and the Clearwater Highway District should be recognized for their leadership in pursuing and completing projects that have led to the improvements listed in this review.

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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
µg/L	micrograms per liter
§	section (usually a section of federal or state rules or statutes)
AU	assessment unit
BMP	best management practice
BURP	Beneficial Use Reconnaissance Program
C	Celsius
CFR	Code of Federal Regulations (refers to citations in the federal administrative rules)
CGP	construction general permit
CHD	Clearwater Highway District
CNF	Clearwater National Forest
cfu	colony-forming unit
CWAL	cold water aquatic life
CWE	cumulative watershed effects
DEQ	Idaho Department of Environmental Quality
DNA	deoxyribonucleic acid
DO	dissolved oxygen
DWS	domestic water supply
EPA	United States Environmental Protection Agency
FPA	Idaho Forest Practices Act
IDAPA	refers to citations of Idaho administrative rules
IDFG	Idaho Department of Fish and Game
IDL	Idaho Department of Lands
INFISH	the federal Inland Native Fish Strategy
kWh	kilowatt-hours
LA	load allocation
LC	load capacity
mg/L	milligrams per liter
mL	milliliter
MOS	margin of safety
n/a	not applicable
NA	not assessed
NB	natural background
NPDES	National Pollutant Discharge Elimination System
NREL	National Renewable Energy Laboratory
NTU	nephelometric turbidity unit
PACFISH	the federal Pacific Anadromous Fish Strategy
PCEI	Palouse Clearwater Environmental Institute
PCR	primary contact recreation
PNV	potential natural vegetation
SCR	secondary contact recreation
SFI	DEQ's Stream Fish Index

SHI	DEQ’s Stream Habitat Index
SMI	DEQ’s Stream Macroinvertebrate Index
SPZ	Stream Protection Zone
SS	salmonid spawning
SWPPP	stormwater pollution prevention plan
TMDL	total maximum daily load
TP	total phosphorus
US	United States
USC	United States Code
WAG	watershed advisory group
WBID	water body identification number
WLA	wasteload allocation

Executive Summary

The federal Clean Water Act requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to section 303 of the Clean Water Act, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the nation's waters whenever possible. Section 303(d) of the Clean Water Act establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list (a "§303(d) list") of impaired waters. This list is currently published every 2 years as the list of Category 5 waters in the Integrated Report. For waters identified on this list, states and tribes must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve water quality standards.

Idaho Code 39-3611(7) requires a 5-year cyclic review process for Idaho TMDLs. This report is designed to meet the intent and purpose of Idaho Code 39-3611(7) by documenting the review of the 2002 *Lower North Fork Clearwater River Subbasin Assessment and TMDL* and implementation plan and provides consideration of the most current and applicable information (DEQ 2002; CSWCD 2004). This report evaluates the appropriateness of the TMDL to current watershed conditions, evaluates the implementation plan, and has resulted in further consultation with the watershed advisory group (WAG). WAG recommendations are summarized in this report and were taken into consideration in developing the temperature TMDL addendum also included in this report. Approval of the TMDL addendums is granted by the United States Environmental Protection Agency (EPA) with consultation by the Idaho Department of Environmental Quality (DEQ).

To meet a key objective identified during the 5-year review process, this document also presents an addendum to the *Lower North Fork Clearwater River Subbasin Assessment and TMDL* that addresses the water bodies in the subbasin in Category 5 of *Idaho's 2010 Integrated Report* (§303(d) list) for temperature impairment (DEQ 2011).

Subbasin at a Glance

The Lower North Fork Clearwater River subbasin is 1,145.44 square miles, which is about the same size as the state of Rhode Island. The subbasin is located in north central Idaho—primarily in Clearwater County—situated around Dworshak Reservoir, with all streams flowing directly or indirectly into the reservoir. Dworshak Dam was completed in 1971, and the reservoir attained full pool 2 years later. At full pool, the reservoir is 54 miles long, 2 miles across, and has a maximum depth of 480 feet. There is no passage for migrating fish at Dworshak Dam.

Elevations range from 1,445 feet, which is the minimum pool elevation of Dworshak Reservoir, to over 7,000 feet. Most elevations are within 3,000–5,500 feet, and most of the topography is steep terrain with greater than 50% slope gradients. The streams in the subbasin have a pattern of low flows during the late summer and early fall and high flows in the spring and early summer.

The subbasin is a very sparsely populated area with only one incorporated city, Elk River, with a population of 156 people (Idaho Department of Commerce 2002). The total population in the subbasin is estimated at 300 people with a density of 0.262 people per square mile. Federal and state government agencies and timber companies, primarily Potlatch Corporation, own or manage 95% of the subbasin.

Forestry and recreational activities dominate the land use of the subbasin, with some grazing occurring in the southern and central parts of the subbasin. Cattle are typically brought into these areas around June and then removed in October or early November. The subbasin is nearly 100% forested; hence, most of the management of nonfederal lands is for timber harvest. While timber harvesting has significantly decreased on the Clearwater National Forest, timber harvesting has been the primary land use in the subbasin. The subbasin is also a popular destination for outdoor recreation activities such as hunting, fishing, hiking, boating, and camping.

Key Findings

Since approval of the 2002 TMDL, DEQ has adopted an assessment unit (AU) identification numbering system for all streams in Idaho. The AU number functions as an extension of the water body identification number (WBID), which allows the water quality assessor to apply the necessary water quality standards for a specific stream reach to support its beneficial uses.

Escherichia coli (*E. coli*) bacteria samples collected in 2008 show that Oviatt Creek was not meeting the water quality criterion for its recreation beneficial use. Further analyses of an Oviatt Creek water sample showed that cattle-related Bacteroidetes and Enterococcus deoxyribonucleic acid (DNA) gene biomarkers were present.

Deer Creek Reservoir, created as family fishing water by the Idaho Department of Fish and Game (IDFG) in 2003, will be given a distinct AU number (ID17060308CL004_02L) by splitting off Deer Creek above East Fork Deer Creek from a tributary of Reeds Creek to a reservoir.

Water quality monitoring data collected in 2008 indicate that biological and habitat characteristics of Cranberry Creek, Breakfast Creek, and Reeds Creek supported their beneficial uses in segments near their mouths. Breakfast Creek and Reeds Creek were added to Category 5 of *Idaho's 2010 Integrated Report* for temperature violations. The monitoring data also indicate that the biological and habitat characteristics found in Swamp Creek, Elk Creek below the reservoir, Partridge Creek, and Long Meadow Creek and its tributaries did not support their beneficial uses.

Based on data included in the 2002 TMDL, 25 AUs were added to Category 5 of *Idaho's 2010 Integrated Report* due to temperature violations. This document presents an addendum to the *Lower North Fork Clearwater River Subbasin Assessment and TMDL* for those water bodies. Potential natural vegetation temperature TMDLs for the listed waters are included in section 5 of this document.

Table A lists a summary of the recommended outcomes resulting from the TMDL 5-year review and addendum.

Table A. Summary of recommended outcomes of this addendum and review.

Water Body Name	Assessment Unit	Pollutant	TMDL(s) Completed	Recommended Changes to Idaho's Integrated Report	Justification
Elkberry Creek	ID17060308CL002_02b	Temperature	Yes	Move to Category 4a	TMDL Completed
Middle Fork Robinson Creek	ID17060308CL002_02c	Temperature	Yes	Move to Category 4a	TMDL Completed
Gold Creek, Meadow Creek and Tributaries	ID17060308CL003_02	Temperature	Yes	Move to Category4a	TMDL Completed
Reeds Creek	ID17060308CL003_03, ID17060308CL003_04	Temperature	Yes	Move to Category 4a	TMDL Completed
Reeds Creek	ID17060308CL004_02	Temperature	Yes	Move to Category 4a	TMDL Completed
Reeds Creek	ID17060308CL004_03	Temperature	Yes	Move to Category 4a	TMDL Completed
Alder Creek	ID17060308CL005_02	Temperature	Yes	Move to Category 4a	TMDL Completed
Beaver Creek	ID17060308CL009_02	Temperature	Yes	Move to Category 4a	TMDL Completed
Bingo Creek	ID17060308CL009_02c	Temperature	Yes	Move to Category 4a	TMDL Completed
Beaver Creek tributaries	ID17060308CL009_02e	Temperature	Yes	Move to Category 4a	TMDL Completed
Beaver Creek	ID17060308CL009_03, ID17060308CL009_04	Temperature	Yes	Move to Category 4a	TMDL Completed
Isabella Creek	ID17060308CL010_03	Temperature	Yes	Move to Category 4a	TMDL Completed
Stony Creek and tributaries	ID17060308CL020_02, ID17060308CL020_04,	Temperature	Yes	Move to Category 4a	TMDL Completed
Floodwood Creek tributaries	ID17060308CL021_02	Temperature	Yes	Move to Category 4a	TMDL Completed
Floodwood Creek	ID17060308CL021_02a, ID17060308CL021_03a, ID17060308CL021_03	Temperature	Yes	Move to Category 4a	TMDL Completed
Stony Creek	ID17060308CL023_02, ID17060308CL023_02a, ID17060308CL023_03	Temperature	Yes	Move to Category 4a	TMDL Completed
Breakfast Creek	ID17060308CL020_04a ID17060308CL025_02	Temperature	Yes	Move to Category 4a	TMDL Completed
Deer Creek Reservoir	ID17060308CL004_02	n/a	No	Split AU to include ID170308CL004_02L	Reservoir

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Introduction

The Lower North Fork Clearwater River subbasin is located in north central Idaho and represented by hydrologic unit code 17060308. All streams in the subbasin flow directly or indirectly into Dworshak Reservoir, which is 54 miles long and 2 miles wide. The Idaho Department of Environmental Quality (DEQ) completed a total maximum daily load (TMDL) for the subbasin in 2002 addressing bacteria, sediment, and temperature impairments in Breakfast, Cranberry, lower Elk, Long Meadow, Partridge, Reeds, and Swamp Creeks (DEQ 2002). This document presents a 5-year review of that TMDL and corresponding implementation plan (CWSCD 2004).

This document also presents a TMDL addendum to address temperature-impaired streams that are listed in Category 5 of *Idaho's 2010 Integrated Report* as a result of data collected during the 2002 TMDL analysis.

1 TMDL Review

The federal Clean Water Act requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to section 303 of the Clean Water Act, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the nation's waters whenever possible. Section 303(d) of the Clean Water Act establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list (a "§303(d) list") of impaired waters. Currently, this list is published every 2 years as the list of Category 5 waters in the Integrated Report. For waters identified on this list, states and tribes must develop a TMDL for the pollutants, set at a level to achieve water quality standards.

Idaho Code 39-3611(7) requires a 5-year cyclic review process for Idaho TMDLs:

> The director shall review and reevaluate each TMDL, supporting subbasin assessment, implementation plan(s) and all available data periodically at intervals of no greater than five (5) years. Such reviews shall include the assessments required by section 39-3607, Idaho Code, and an evaluation of the water quality criteria, instream targets, pollutant allocations, assumptions and analyses upon which the TMDL and subbasin assessment were based. If the members of the watershed advisory group, with the concurrence of the basin advisory group, advise the director that the water quality standards, the subbasin assessment, or the implementation plan(s) are not attainable or are inappropriate based upon supporting data, the director shall initiate the process or processes to determine whether to make recommended modifications. The director shall report to the legislature annually the results of such reviews.

This report is intended to meet the intent and purpose of Idaho Code 39-3611(7). The report documents the review of an approved Idaho TMDL and implementation plan. It considers the most current and applicable information in conformance with Idaho Code 39-3607, evaluates the appropriateness of the TMDL and implementation plan to current watershed conditions, and includes consultation with the watershed advisory group (WAG).Final decisions for TMDL modifications are decided by the DEQ director. Approval of TMDL modifications is decided by the United States Environmental Protection Agency (EPA), with consultation by DEQ.

Since approval of the 2002 TMDL, DEQ has adopted an assessment unit (AU) identification numbering system for all streams in Idaho. AUs define all waters of the state of Idaho. These units and the methodology used to describe them can be found in the *Water Body Assessment Guidance* (Grafe et al. 2002).

An AU is a group of similar streams or stream segments that have similar land use practices, ownership, or land management. Stream order, however, is the main basis for determining AUs. Using AUs fulfills the fundamental requirement of DEQ's reporting obligation under section 305(b) of the Clean Water Act, wherein states must report on the condition of all the waters of the state. Because AU numbers are extensions of water body identification numbers (WBIDs) and WBIDs are used to identify water bodies and the water quality standards for them, AUs provide a direct tie to the water quality standards so that beneficial uses defined in the standards are tied to streams on the landscape.

1.1 Public Participation

The Lower North Fork Clearwater River Subbasin WAG was formed in January 2002 and helped develop the 2002 TMDL. The WAG has continued to meet annually since the TMDL approval. The WAG met March 30, 2009, to review and discuss this 5-year review document and how it may influence future implementation efforts in the subbasin. WAG members discussed completed and on-going implementation projects undertaken since 2002 to address the TMDL pollutant load reductions needed. During this meeting, the WAG formulated the following recommendations:

- Align TMDL 5-year review schedules with the Integrated Report schedule so the most current beneficial use support status and the most recent data are used in the reviews.
- Consider further study of the water quality conditions of Elk Creek Reservoir.
- Use the potential natural vegetation (PNV) methodology to create surrogate temperature TMDLs for the temperature-listed streams in the subbasin.
- Determine sources and seasonality of bacteria in Long Meadow Creek.

In April of 2013, the Watershed Advisory Group agreed to provide a 30-day public comment period for the draft *Lower North Fork Clearwater River Subbasin: Five Year Review and Addendum* document during March of 2013. Notice was provided to the general public through the Lewiston Morning Tribune and the Idaho Department of Environmental Quality's internet web page. The comments received were reviewed and discussed by the Watershed Advisory Group prior to submittal of the document to EPA for approval. Comments received and responses provided are included in Appendix F.

1.2 Summary of 2002 TMDLs

A detailed discussion of the physical and biological characteristics of the Lower North Fork Clearwater River subbasin is provided in the 2002 TMDL (DEQ 2002). Figures 1 and 2 display the general location of the water bodies and watersheds included in the 2002 TMDL. The following streams had TMDLs developed in 2002 for the corresponding pollutants:

- Breakfast Creek—sediment
- Cranberry Creek—sediment, temperature, and bacteria

- Lower Elk Creek—temperature
- Long Meadow Creek—sediment, temperature, and bacteria
- Partridge Creek—sediment
- Reeds Creek, including Alder—sediment
- Swamp Creek—sediment and temperature

1.2.1 TMDL Pollutant Targets

The 2002 TMDL included the following pollutant targets:

- **Bacteria**—Idaho's *Escherichia coli* (*E. coli*) bacteria water quality criterion was applied as the target for bacteria TMDLs.
- **Sediment**—Sediment TMDL targets were based on reference conditions found in comparable watersheds using cumulative watershed effects (CWE) survey data and Natural Resources Conservation Service assessment methodology (Table 1).
- **Temperature**—Modeled natural condition canopy cover was used for temperature TMDL targets.

Table 1. TMDL sediment targets.

Watershed	Reference Watershed	Reference Condition	Road Sediment (tons/mile/ year)	Mass Failure Sediment (no./mi^2)	Instream Erosion Sediment (tons/year)
Breakfast Creek	Floodwood Creek, Stony Creek	Roads, mass failures	3.4	1.0	—
Cranberry Creek	Lower Elk Creek	Roads, mass failures, instream erosion	1.86	0.12	25
Long Meadow Creek	Lower Elk Creek	Roads, mass failures, instream erosion	1.86	0.12	185
Partridge Creek	Lower Elk Creek	Roads, instream erosion	1.86	—	97
Reeds Creek	Lower Elk Creek, South Fork Beaver Creek	Roads, mass failures	1.86	0	—
Swamp Creek	Lower Elk Creek	Roads, mass failures, instream erosion	1.86	0.9	32.5

Note: A unit conversion chart is provided in Appendix A.

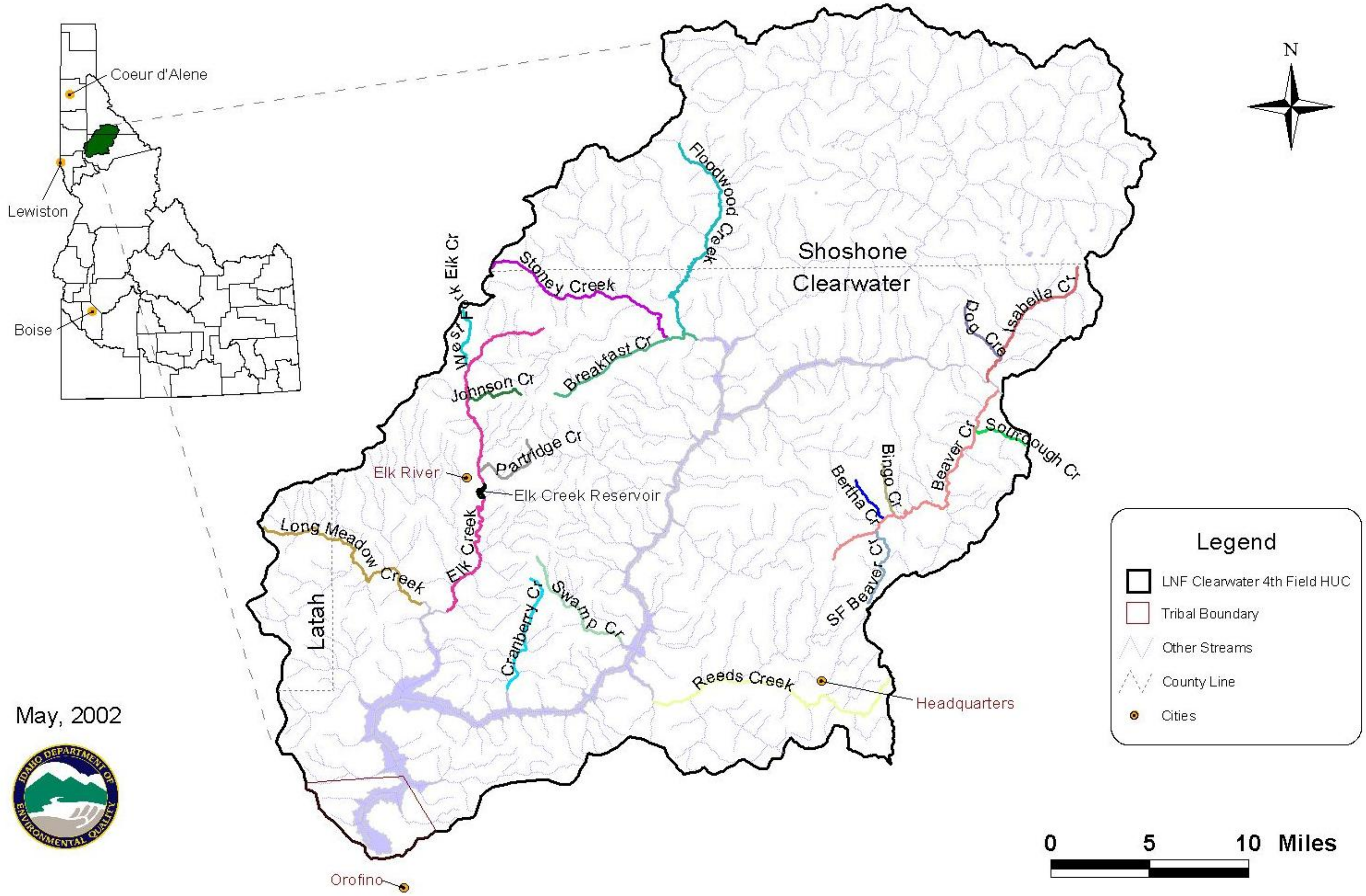

Figure 1. Water bodies included in the 2002 *Lower North Fork Clearwater River Subbasin Assessment and TMDL* (DEQ 2002).

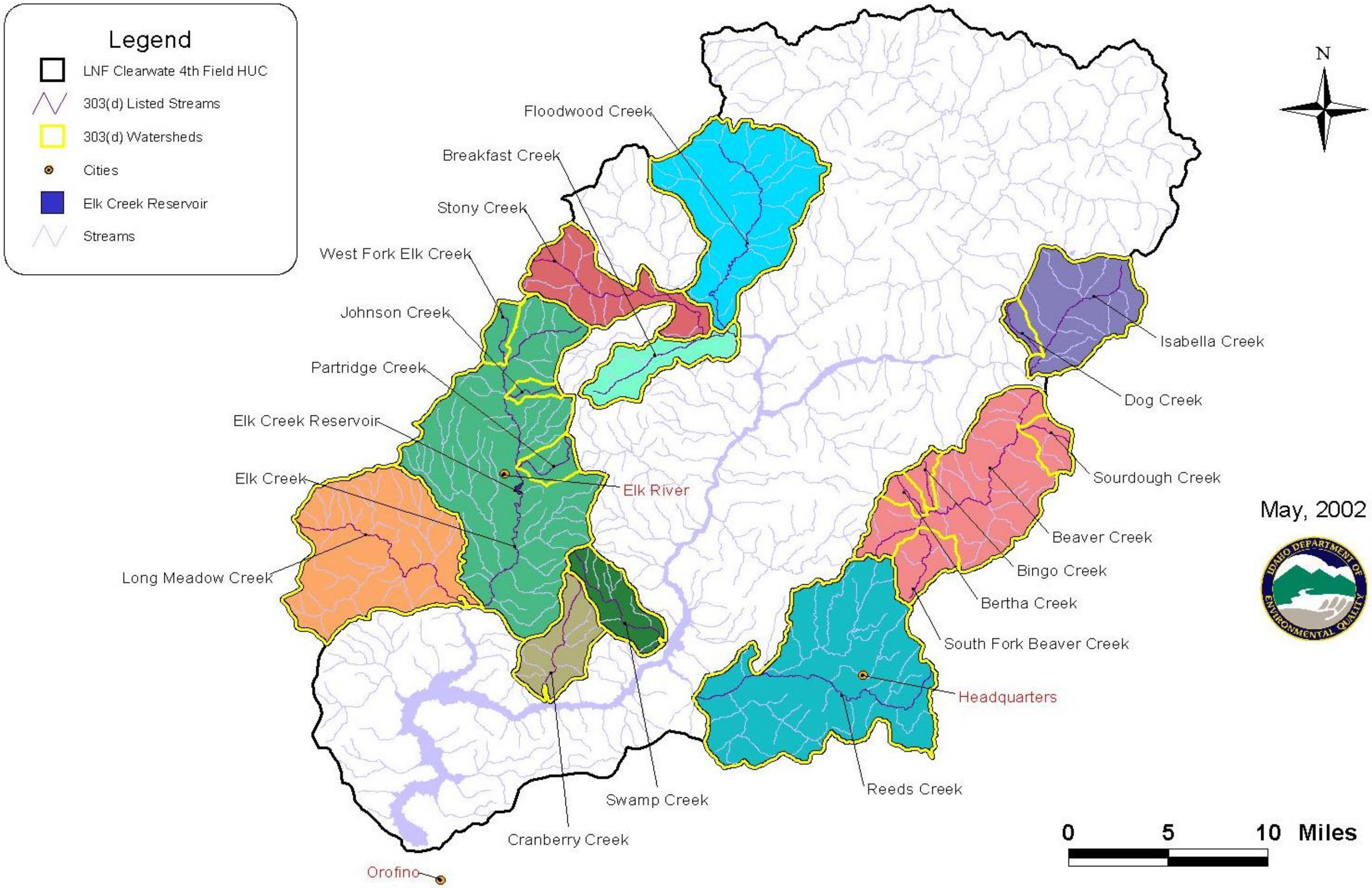

Figure 2. Watersheds included in the 2002 *Lower North Fork Clearwater River Subbasin Assessment and TMDL* (DEQ 2002).

1.2.2 Monitoring Points

Watershed monitoring was recommended in the 2002 TMDL (Table 2). Water quality protocols and land management surveys were recommended to track watershed restoration implementation success, pollutant load reductions, and compliance with water quality standards.

Table 2. Recommended monitoring in the 2002 TMDL.

TMDL Watershed	Monitoring Protocol and/or Parameter[a]	Objective
Breakfast Creek	BURP	Aquatic life beneficial use support status
	CWE road survey	Sediment load and load reduction
Cranberry Creek	BURP	Aquatic life beneficial use support status
	CWE road survey	Sediment load and load reduction
	E. coli bacteria	Recreation beneficial use support status and load reduction
	Temperature	Aquatic life criteria
	Aerial photo	Riparian canopy cover
Lower Elk Creek	Temperature	Aquatic life criteria
	Aerial photo	Riparian canopy cover
Long Meadow Creek	BURP	Aquatic life beneficial use support status
	CWE road survey	Sediment load and load reduction
	E. coli bacteria	Recreation beneficial use support status and load reduction
	Temperature	Aquatic life criteria
	Aerial photo	Riparian canopy cover
Partridge Creek	BURP	Aquatic life beneficial use support status
	CWE road survey	Sediment load and load reduction
Reeds Creek	BURP	Aquatic life beneficial use support status
	CWE road survey	Sediment load and load reduction
Swamp Creek	BURP	Aquatic life beneficial use support status
	CWE road survey	Sediment load and load reduction
	Temperature	Aquatic life criteria
	Aerial photo	Riparian canopy cover
	Bank erosion	Instream sediment

[a] Beneficial Use Reconnaissance Program (BURP); cumulative watershed effects (CWE)

1.2.3 Load Allocations and Load Reductions

The 2002 TMDL prescribed load allocations and reductions for bacteria, sediment, and temperature.

Table 3 shows the bacteria load allocations and load reductions included in the 2002 TMDL. Bacteria load allocations were based on the water quality criterion target, and reductions were calculated based on the difference between the allocated load and the measured existing load.

Table 3. Bacteria load allocations and reductions for the Lower North Fork Clearwater River subbasin 2002 TMDL.

Watershed	Source	Current Load	Load Allocation	Margin of Safety (10%)	Load Reduction
		(organisms per day)			
Cranberry Creek	Cattle, wildlife, humans (CR2)[a]	7.4×10^{10}	5.1×10^{10}	2.3×10^{9}	2.5×10^{10}
Long Meadow Creek	Cattle, wildlife, humans (LM2)[b]	2.5×10^{12}	5.5×10^{11}	1.9×10^{10}	2.1×10^{12}
Long Meadow Creek	Cattle, wildlife, humans (LM4)[c]	3.2×10^{11}	1.2×10^{11}	2.0×10^{10}	2.2×10^{11}

[a] CR2 = Cranberry Creek monitoring site # 2
[b] LM2 = Long Meadow Creek monitoring site #2
[c] LM4 = Long Meadow Creek monitoring site #4

Table 4 shows the sediment load allocations and load reductions included in the 2002 TMDL. Load allocations were determined by applying the appropriate target to each relative watershed characteristic. Existing loads were determined using the CWE evaluation. Load reductions were calculated based on the difference between load allocations and existing loads.

Table 4. Sediment load allocations and reductions in the Lower North Fork Clearwater River subbasin 2002 TMDL.

Watershed (Creek)	Source	Current Load (tons/year)	Load Allocation (tons/year)	Load Reduction (tons/year)
Breakfast	Roads	830	434	396
	Mass failures	373	75	298
Cranberry	Roads	218	161.5	56.5
	Mass failures	5	1.5	3.5
	Bank erosion	50	25	25
Long Meadow	Roads	2365	674	1691
	Mass failures	268	27	241
	Bank erosion	370	185	185
Partridge	Roads	13.8	13.5	0.3
	Bank erosion	195	97.5	97.5
Reeds—Sidewalls	Roads	328	109	219
	Mass failures	58	5	53
Reeds—Headwaters	Roads	506	455	51
	Mass failures	327	163.5	163.5
Reeds—North Fork	Roads	205	184	21
	Mass failures	1.0	0.5	0.5
Reeds—Alder[a]	Roads	727	567	160
	Mass failures	75	37.5	37.5
Reeds—GS[b]	Roads	807	484	323
	Mass failures	3.0	1.5	1.5
Swamp	Roads	417	161	256
	Mass failures	17	2.3	14.7
	Bank erosion	65	32.5	32.5

[a] Alder = Alder Creek portion of Reeds Creek
[b] GS = Gold and Snake Creek portions of Reeds Creek

The 2002 temperature TMDL load capacity, load allocations, and percent load reductions were calculated by the CWE model. Rather than load allocations and load reductions, the model calculates increases in shade necessary to meet a 100% canopy cover target. A waste load allocation was included for Elk Creek Reservoir of 5 °C for the months of May through September.

1.2.4 Margin of Safety

A 10% margin of safety was included in the load allocation and reduction calculations used in the 2002 bacteria TMDLs. An implicit margin of safety was included in the 2002 sediment and temperature TMDLs through conservative survey estimates used in the CWE model calculations.

1.2.5 Seasonality

The 2002 TMDL included the following critical time periods:

- Bacteria—May through November

- Sediment—during the high precipitation season in the spring
- Temperature—May through September depending on the water body

1.2.6 Reserve

A growth reserve was not included in the 2002 TMDLs. The load capacity was allocated to the existing sources in the watershed with the intent that any new source would need to obtain an allocation from the existing load allocations.

2 Current Water Quality Concerns and Status

This section identifies the applicable water quality standards, describes the relationship between pollutants and beneficial uses, and provides a summary and analysis of the existing water quality data.

2.1 Water Quality Limited Assessment Units Occurring in the Subbasin

Section 303(d) of the Clean Water Act states that waters that are unable to support their beneficial uses and do not meet water quality standards must be listed as water quality limited 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 the 2002 TMDL

As a result of data collected during the monitoring program associated with the development of the 2002 TMDL, 22 AUs were added to Category 5 of *Idaho's 2010 Integrated Report* as being impaired by temperature, 3AUs are listed as impaired by Combined Biota/Habitat Bioassessments. Table 5 lists these streams along with their beneficial uses. PNV temperature TMDLs were created for these waters and are included in section 5 of this document as an addendum to the 2002 TMDL.

Table 5. Assessment units listed as impaired from data included in the 2002 TMDL.

Water Body Name	Assessment Unit	Pollutant	Designated or Existing Beneficial Uses[a]
Elkberry Creek	ID17060308CL002_02b	Combined Biota/Habitat Bioassessments	CWAL, SS, PCR, DWS
Middle Fork Robinson Creek	ID17060308CL002_02c	Combined Biota/Habitat Bioassessments	CWAL, SS, PCR, DWS
Gold Creek, Meadow Creek, and tributaries	ID17060308CL003_02	Temperature	CWAL, SS, SCR
Reeds Creek and tributaries	ID17060308CL003_03 ID17060308CL003_04 ID17060308CL004_02 ID17060308CL004_03	Temperature	CWAL, SS, PCR, DWS
Alder Creek	ID17060308CL005_02	Combined Biota/Habitat Bioassessments	CWAL, SS, SCR
Beaver Creek and tributaries	ID17060308CL009_02 ID17060308CL009_02e ID17060308CL009_03 ID17060308CL009_04	Temperature	CWAL, SS, SCR
Bingo Creek	ID17060308CL009_02c	Temperature	CWAL, SS, SCR
Isabella Creek	ID17060308CL010_03	Temperature	CWAL, SS, SCR
Stony Creek and tributaries	ID17060308CL020_02 ID17060308CL020_04 ID17060308CL023_02 ID17060308CL023_02a ID17060308CL023_03	Temperature	CWAL, SS, SCR
Floodwood Creek and tributaries	ID17060308CL021_02 ID17060308CL021_02a ID17060308CL021_03 ID17060308CL021_03a	Temperature	CWAL, SS, SCR
Breakfast Creek	ID17060308CL020_04a ID17060308CL025_02	Temperature	CWAL, SS, SCR

[a] cold water aquatic life (CWAL), salmonid spawning (SS), primary contact recreation (PCR), secondary contact recreation (SCR), domestic water supply (DWS)

2.1.2 Assessment Unit Changes

Deer Creek Reservoir was created in 2004. The reservoir impounds Deer Creek (ID17060308CL004_02) above its confluence with East Fork Deer Creek and will need to be assigned its own distinct AU number (ID170308CL004_02L). The change will reflect the modification of Deer Creek above the East Fork Deer Creek to a reservoir.

2.2 Applicable Water Quality Standards and Beneficial Uses

Idaho water quality standards set water quality goals for the state and 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. For additional information about water quality standards and criteria, see Appendix B.

2.2.1 Existing Uses

Existing uses under the Clean Water Act are "those uses actually attained in the waterbody on or after November 28, 1975, whether or not they are included in the water quality standards." The existing instream water uses and the level of water quality necessary to protect the uses shall be maintained and protected (IDAPA 58.01.02.050.02). Existing uses include those uses actually occurring, whether or not the water quality to fully support the uses exists.

2.2.2 Designated Uses

Designated uses under the Clean Water Act are "those uses specified in water quality standards for each water body or segment, whether or not they are being attained." 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 are specifically listed for water bodies in Idaho in tables in the Idaho water quality standards (see IDAPA 58.01.02.09).

2.2.3 Presumed Uses

In Idaho, most water bodies listed in the tables of designated uses in the water quality standards do not yet have specific use designations. These undesignated uses are to be designated. In the interim, and absent information on existing uses, DEQ presumes that most waters in the state will support cold water aquatic life and recreation uses (IDAPA 58.01.02.101.01).

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).

Table 6 includes the numeric criteria used in this TMDL. If a numeric criterion is violated, the water body is not fully supporting the associated beneficial use.

Table 6. Numeric criteria supportive of designated beneficial uses in Idaho water quality standards.

Water Quality Parameter	Beneficial Uses: Primary Contact Recreation	Secondary Contact Recreation	Cold Water Aquatic Life	Salmonid Spawning (During Spawning and Incubation Periods for Inhabiting Species)
	Water Quality Standards: IDAPA 58.01.02			
Bacteria, pH, and dissolved oxygen (DO)	Less than 126 *E. coli*/100 mL[a] as a geometric mean of 5 samples over 30 days; no sample greater than 406 *E. coli*/ 100 mL	Less than 126 *E. coli*/100 mL as a geometric mean of 5 samples over 30 days; no sample greater than 576 *E. coli*/100 mL	• pH between 6.5 and 9.0 • DO exceeds 6.0 milligrams per liter (mg/L)	• pH between 6.5 and 9.5 • Water column DO: DO exceeds 6.0 mg/L in water column or 90% saturation, whichever is greater • Intergravel DO: DO exceeds 5.0 mg/L for a 1-day minimum and exceeds 6.0 mg/L for a 7-day average
Temperature[b]			• 22 °C or less daily maximum; 19 °C or less daily average • Seasonal cold water: Between summer solstice and autumn equinox: 26 °C or less daily maximum; 23 °C or less daily average	• 13 °C or less daily maximum; 9 °C or less daily average • Bull trout: not to exceed 13 °C maximum weekly maximum temperature over warmest 7-day period, June–August; not to exceed 9 °C daily average in September and October
Turbidity			Turbidity shall not exceed background by more than 50 NTU[c] 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: 40 CFR 131.33			
Temperature				7-day moving average of 10 °C or less maximum daily temperature for June–September

[a] *Escherichia coli* organisms per 100 milliliters (*E. coli*/100 mL)
[b] Temperature Exemption—Exceeding the temperature criteria will not be considered a water quality standard violation when the air temperature exceeds the 90th 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.
[c] Nephelometric turbidity units (NTU)

Figure 3 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.

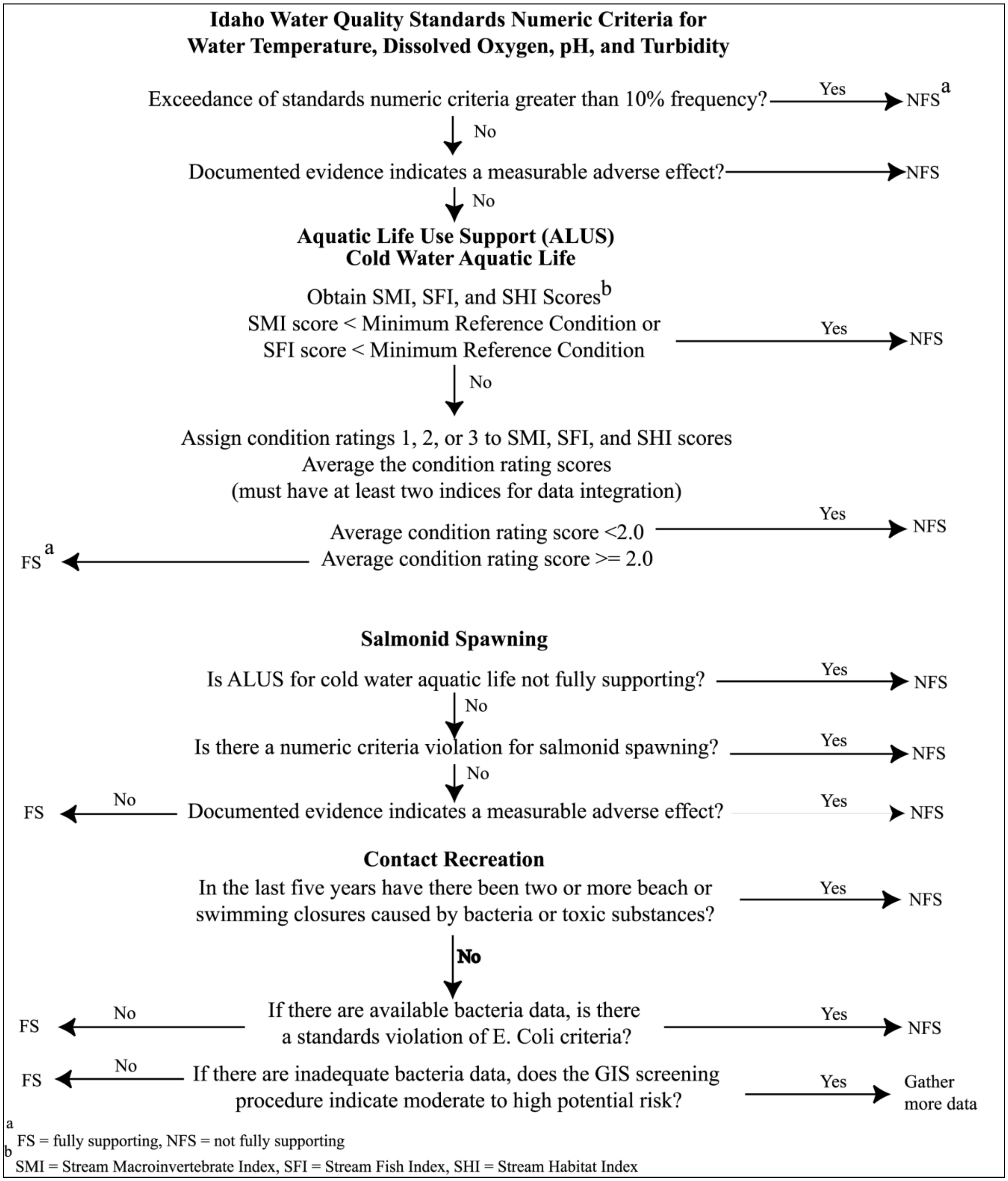

Figure 3. Determination steps and criteria for determining support status of beneficial uses in wadeable streams (Grafe et al. 2002).

2.4 Summary and Analysis of Current Water Quality Data

Assessing a water body involves analyzing and integrating multiple types of data to determine the degree of beneficial use support and biological integrity. DEQ's method for evaluating biological, physical, and chemical data to determine beneficial use support of Idaho water bodies is described in the *Water Body Assessment Guidance*, which considers data most relevant to support status determinations to be less than 5 years old (Grafe et al. 2002).

The *Lower North Fork Clearwater River Subbasin Assessment and TMDL* includes a detailed summary and analysis of water quality data used for the 2002 TMDL (DEQ 2002). Data gathered for the purpose of this review are presented and analyzed below to establish the current status of water bodies in the subbasin.

2.4.1 Flow Characteristics

The United States Geological Survey maintains a discharge gaging station near Canyon Work Center on the North Fork Clearwater River. Figure 4 shows the flow pattern recorded from 1967 through 2008. Increases and decreases in flow tend to follow the weather pattern, with high flows during spring runoff and low flows occurring in the fall.

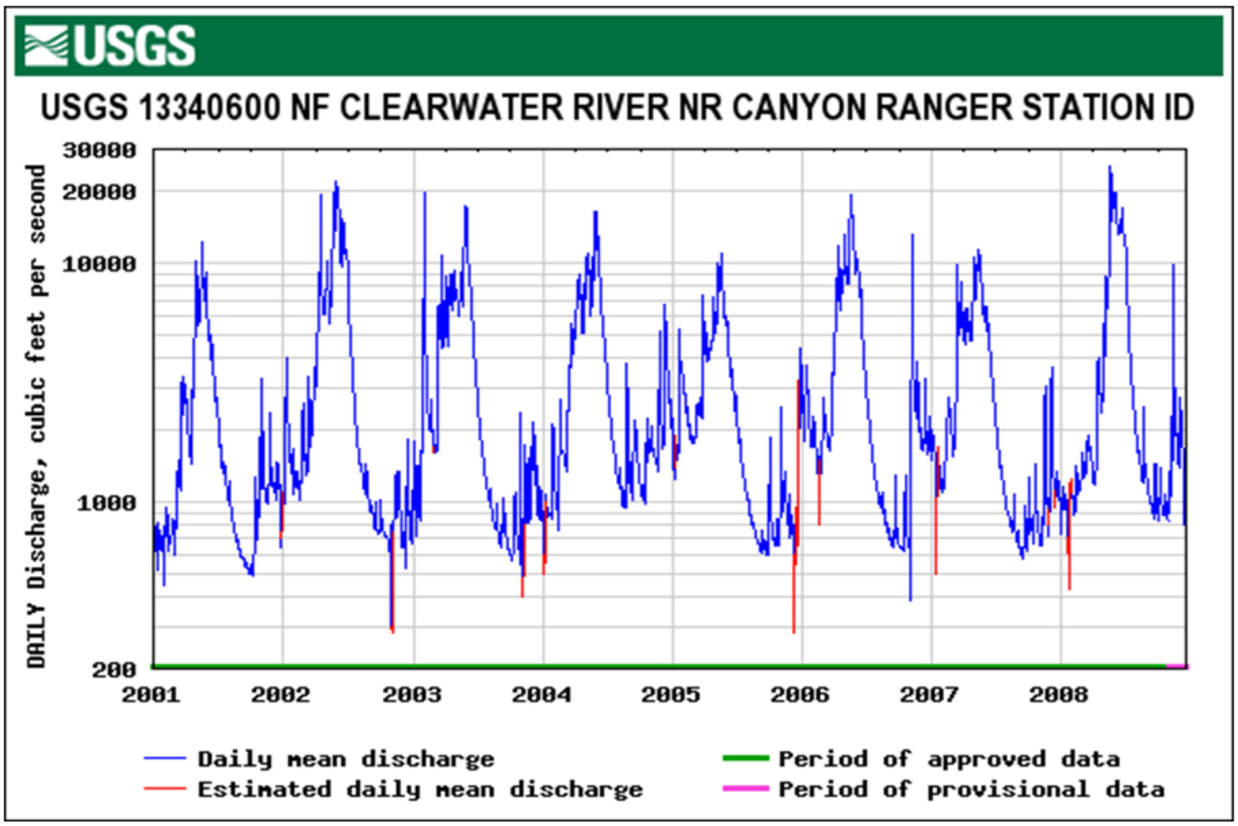

Figure 4. Daily mean discharge, lower North Fork Clearwater River near Canyon Work Center (*Source:* United States Geological Survey).

2.4.2 *E. coli* Bacteria Data

E. coli bacteria samples were collected by DEQ in 2008 to assess recreation beneficial use support in streams included in the 2002 TMDL (Appendix C). Where a single sample value above 406 colony-forming units per 100 milliliters (cfu/100 mL) was measured in waters designated for primary contact recreation or above 576 cfu/100 mL for waters designated for secondary contact recreation, additional samples were taken to determine compliance with Idaho's geometric mean criterion (IDAPA 58.01.02.251). Waters designated for recreation uses are not to contain *E. coli* bacteria in concentrations exceeding a geometric mean criterion of 126 *E. coli* organisms per 100 mL based on a minimum of 5 samples taken every 3 to 7 days during a 30-day period.[1]

Samples collected from Cedar, Oviatt, and Round Meadow Creeks exceeded the single sample value and additional samples were obtained. Additional samples were also obtained from Long Meadow Creek although the single sample value was not exceeded. Three Bear Creek, Partridge Creek, and upper and lower Elk Creek were all below the single sample value, and no additional samples were taken. The geometric mean calculated from the additional samples obtained from Oviatt Creek exceeded the criterion. The geometric means calculated for Cedar, Long Meadow, and Round Meadow Creeks were below the criterion (Table 7).

Samples were collected from Oviatt, Cedar, Round Meadow, and Long Meadow Creeks and analyzed for the presence of cattle-related Bacteroidetes and Enterococcus deoxyribonucleic acid (DNA) gene biomarkers to help identify potential sources of bacteria found in the watershed. Analysis of the Long Meadow, Oviatt, and Cedar Creek samples showed the presence of cow DNA biomarkers. The DNA biomarkers were absent from the sample collected from Round Meadow Creek.

Table 7. *E. coli* bacteria monitoring results.

Assessment Unit Number	Assessment Unit Name	*E. coli* Largest Single Sample Value (cfu/100 mL)	*E. coli* Geometric Mean (cfu/100 mL)
ID17060308CL002_02d	Cedar Creek	980	121
ID17060308CL034_02a	Oviatt Creek	2,419	360
ID17060308CL034_03	Long Meadow Creek	185	25
ID17060308CL034_02	Round Meadow Creek	2,419	107
ID17060308CL034_02	Three Bear Creek	81	Not assessed
ID17060308CL030_02d	Partridge Creek	23	Not assessed
ID17060308CL030_03b	Upper Elk Creek	115	Not assessed
ID17060308CL030_03a	Lower Elk Creek	12	Not assessed

Note: colony-forming unit per 100 milliliters (cfu/100 mL)

2.4.3 Elk Creek and Elk Creek Reservoir Watershed Data

Elk Creek Reservoir is an 81-acre, 5- to 7-meter-deep lowland reservoir managed by IDFG for recreational fishing. As part of IDFG's management program for the reservoir, dissolved oxygen profiles of the reservoir's water column were recorded in 2006 and in 2007. These profiles show

[1] Water samples analyzed for the presence of *E. coli* are reported in colony-forming units (cfu). A cfu is a measure of viable (alive, capable of living, developing, or reproducing) cells that can grow into a colony or cluster of bacterium. In this report, organisms and cfu are used interchangeably; lab analyses are usually reported in cfu, while water quality criteria are written to organisms.

that the reservoir stratifies in late summer and ranges from anoxic in the hypolimnion to supersaturated in the epilimnion (Figures 5 and 6). Idaho's 6 milligrams per liter (mg/L) dissolved oxygen criterion for waters designated for cold water aquatic life does not apply to the hypolimnion in stratified reservoirs. Figures 5 and 6 show that dissolved oxygen does not fall below the 6 mg/L criterion above the hypolimnion when the reservoir is stratified.

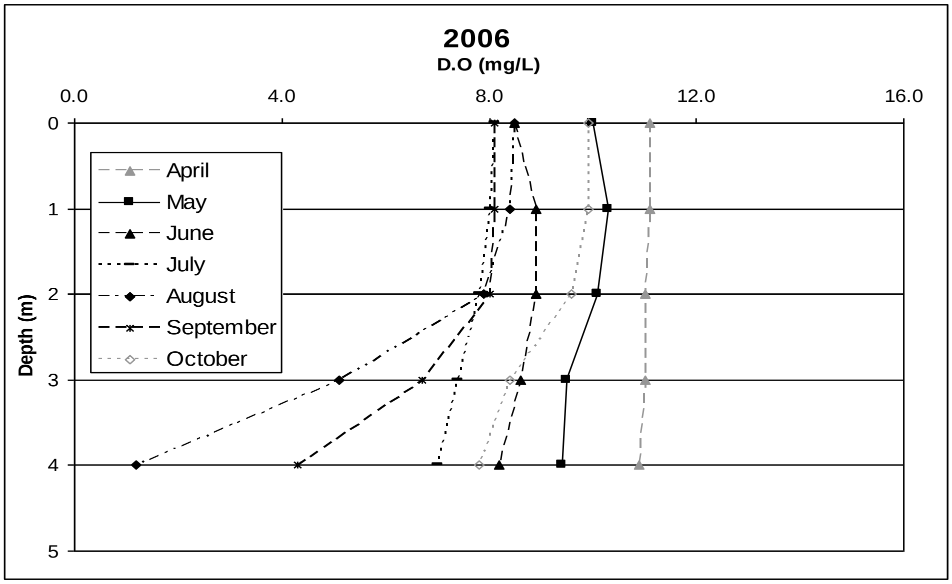

Figure 5. 2006 Elk Creek Reservoir dissolved oxygen profile by month. (Source: Idaho Department of Fish and Game.)

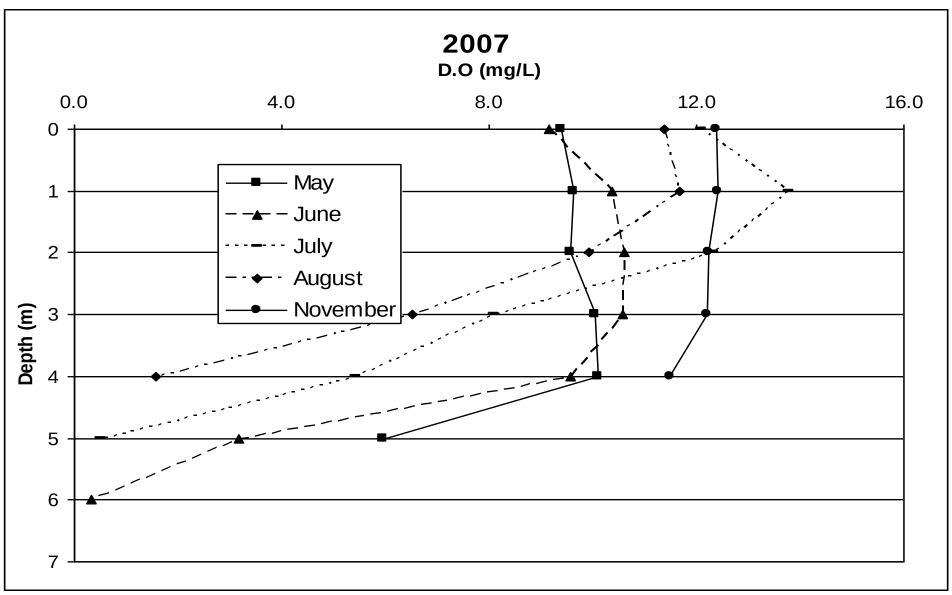

Figure 6. 2007 Elk Creek Reservoir dissolved oxygen profile by month. (Source: Idaho Department of Fish and Game.)

DEQ collected nitrogen, ammonia, and total phosphorus (TP) samples in August, September, and October 2008 from Elk Creek above and below the reservoir (Appendix C). Nitrogen (NO_2+NO_3-N) was not detected in the samples analyzed. Ammonia (NH_3-N) concentrations detected in the samples collected in Elk Creek above the reservoir in October were 0.06 mg/L; concentrations below the reservoir in October were 0.06 and 0.07 mg/L. In all cases, the concentrations measured were below levels of concern.

Except for the last set of samples collected in October, TP concentrations appear to be lower below the reservoir than above the reservoir (Table 8). The TP loss and gain pattern in the reservoir may be a reflection of the reservoir's nutrient cycling. The data show an increase in TP occurred in Elk Creek in October. The cause of the increase is unknown at this time.

Table 8. Elk Creek total phosphorus concentrations, 2008.

Sampling Date	Elk Creek Above Reservoir (µg/L)	Elk Creek Below Reservoir (µg/L)
8/19/2008	44.7	20.8
9/2/2008	24.8	24.7
9/23/2008	31.5	29.7
9/26/2008	27.9	27.6
10/1/2008	290.0	261.0
10/5/2008	405.0	285.0
10/9/2008	286.0	412.0

Note: micrograms per liter (µg/L)

2.4.4 Beneficial Use Reconnaissance Program Data

DEQ's Beneficial Use Reconnaissance Program (BURP) monitoring protocol provides three types of data: data for macroinvertebrates, fish, and habitat.

- A stream macroinvertebrate index (SMI) is generated from seven different qualities of the macroinvertebrates found at a sampling location, including species diversity, richness of species diversity, species guilds, and pollutant tolerance.
- A stream fish index (SFI) is developed based on fish species present, abundance of the different species, and the presence/absence of juveniles.
- A stream habitat index (SHI) uses both quantitative and qualitative measures of stream habitat, including substrate composition, channel structure, streamside vegetation, and streambank condition.

These index scores are compared with reference index scores and used along with available physical and chemical data to determine whether an AU supports its beneficial uses. Indices calculated for the Isabella Creek subwatershed (Goat, Dog, and Isabella Creeks) represent reference conditions for the subbasin.

Table 9 shows the multimetric index scores and average condition ratings for the streams in the Lower North Fork Clearwater River subbasin from the late 1990s through 2008. Of the 16 streams surveyed in 2008 for which multimetric scores were calculated, 12 received overall scores of 2.0 or better, and 4 received overall scores of less than 2.0. A multimetric index score of 2.0 or greater indicates that biological and habitat characteristics support aquatic life beneficial use, while scores less than 2.0 indicate that biological and habitat characteristics do not support aquatic life beneficial use.

Table 9. Multimetric index scores and average condition ratings in the Lower North Fork Clearwater River subbasin.

Assessment Unit	Stream Name	Year Sampled	SMI Index Score[a]	SFI Index Score[b]	SHI Index Score[c]	Multi-metric Index Score	Average Condition Rating
ID17060308CL002_02	Cranberry Creek at mouth	2008	1	2	3	2.0	Pass
ID17060308CL002_02d	Cedar Creek	2008	3		3	3.0	Pass
ID17060308CL002_03a	Swamp Creek	1997	3	1	3	2.33	Pass
ID17060308CL002_03a		2008	1	2	3	2.0	Pass
ID17060308CL002_04	Reeds Creek at mouth	2008	3	3	3	3.0	Pass
ID17060308CL002_04	Elk Creek at mouth	2008	2	2	3	2.33	Pass
ID17060308CL002_04a	Long Meadow Creek	2008	1	2	3	2.0	Pass
ID17060308CL003_03	Reeds Creek: Alder Creek to Gold Creek	2000	2	3	2	2.33	Pass
ID17060308CL004_02	Reeds Creek: Source to Deer Creek, including tributaries	2005 on tributary	1	1	2	1.33	Fail
ID17060308CL004_03	Reeds Creek: Deer Creek to Alder Creek	1997	3	1	3	2.33	Pass
ID17060308CL005_02	Alder Creek	2001	2		1	1.5	Fail
ID17060308CL009_02	Beaver Creek tributaries	1998	3	3	3	3.0	Pass
ID17060308CL009_02c	Bingo Creek	1997	1	3	1	1.67	Fail
ID17060308CL009_03	Beaver Creek	1997	3	3	3	3.0	Pass
ID17060308CL009_04		2000	3	3	3	3.0	Pass
ID17060308CL010_02	Isabella Creek: headwaters to Elmer/Jug Creeks	1997	3	3	3	3.0	Pass
ID17060308CL010_02a	Dog Creek	1997	3	3	3	3.0	Pass
ID17060308CL010_02b	Goat Creek	2001	1	3	3	2.3	Pass
ID17060308CL010_03	Isabella Creek: Elmer/Jug Creeks to mouth	1997	2	2	3	2.33	Pass
ID17060308CL020_04	Stony Creek: Glover to Breakfast Creek	2001	2		3	2.5	Pass
ID17060308CL020_04a	Breakfast Creek: Stony Creek to Dworshak Reservoir	1997	2	1	3	2.0	Pass
ID17060308CL020_04a		2008	3		3	3.0	Pass

Assessment Unit	Stream Name	Year Sampled	SMI Index Score[a]	SFI Index Score[b]	SHI Index Score[c]	Multi-metric Index Score	Average Condition Rating
ID17060308CL021_03	Floodwood Creek: Goat Creek to Breakfast Creek	2000	3	3	3	3.0	Pass
ID17060308CL021_03		2008	2		3	2.5	Pass
ID17060308CL021_03a	Floodwood Creek: Pinchot Creek to Goat Creek	2001	3	2	3	2.67	Pass
ID17060308CL023_02	Stony Creek tributary	2008	2	2	3	2.33	Pass
ID17060308CL023_02a	Stony Creek 2nd order	2008	3	1	3	2.33	Pass
ID17060308CL023_03	Stony Creek: unnamed tributary to Glover Creek	2000	3	2	2	2.33	Pass
ID17060308CL025_02	Breakfast Creek: source to Stony Creek	2001	3		3	3.0	Pass
ID17060308CL028_02	Swamp Creek	1997	1		1	1.0	Fail
ID17060308CL029_02	Cranberry Creek	1997	1		1	1.0	Fail
ID17060308CL030_02d	Partridge Creek	1997	1	2	1	1.33	Fail
ID17060308CL030_02d		2008	1	1	1	1.0	Fail
ID17060308CL030_03a	Elk Creek: Elk Creek Reservoir to Elk Creek Falls	1997	2	1	3	2.0	Pass
ID17060308CL030_03a		2008	1	1	3	1.67	Fail
ID17060308CL030_03b	Elk Creek: Elk Creek Falls to confluence of Deep Creek	1997	3	1	3	2.33	Pass
ID17060308CL034_02	Three Bear Creek	2008	2	2	1	1.67	Fail
ID17060308CL034_02	Oviatt Creek	2008	1	1	3	1.67	Fail
ID17060308CL034_02	Round Meadow Creek	2008	2	2	3	2.33	Pass
ID17060308CL034_03	Long Meadow Creek: McGary Creek to Three Bear Creek	2000	2	1	1	1.33	Fail
ID17060308CL034_03		2008	2	1	3	2.0	Pass

[a] Stream macroinvertebrate index (SMI)
[b] Stream fish index (SFI)
[c] Stream habitat index (SHI)

2.4.5 Analysis of AUs Impaired Due to Combined Biota/Habitat Bioassessments

Alder Creek, Middle Fork Robinson Creek, and Elkberry Creek were surveyed using DEQ's BURP monitoring protocol and subsequently assessed as impaired due to Combined Biota/Habitat Bioassessments. The BURP data was further analyzed for pollutant stressors. The analysis shows temperature as the likely pollutant in Middle Fork Robinson and Elkberry Creeks, and temperature combined with sediment as likely pollutants in Alder Creek.

Alder Creek and tributaries (ID17060308CL005_02) is forested with moderate road densities which generally follow close to Alder creek tributaries. Rock Creek is the only tributary not exposed to roads. Alder Creek is mostly shrub dominated except for the top 2000 meters of headwaters in forest. There are two BURP sites in the AU, one (1999SLEWA019) in upper Alder Creek between 1st and 2nd (un-named) tributaries. The second site (2001SLEWA002) is in mid-Alder Creek just above the confluence with Parallel Creek. The streams lack shade due to road proximity primarily, with some minor loses due to nearby forest removal. There are no nutrient sources. A sediment load analysis was completed and a load allocation was established for Alder Creek when it was considered a part of the Reeds Creek sediment allocation in the 2002 *Lower North Fork Clearwater River Subbasin Assessment and TMDL.*

Middle Fork Robinson and its tributaries (ID17060308CL002_02c) are forested, heavily roaded, and managed for timber harvest. There are two BURP sites, one (1998SLEWB005) on MF Robinson Creek midway, and the other (1998SLEWB010) on lower SF Robinson Creek just below last tributary confluence. All streams appear to lack shade due to forest harvesting and road proximity. There is insufficient evidence of sediment pollution, and there are no nutrient sources.

Elkberry Creek, Slide Creek, Chute Creek, Little Silver Creek, Little Meadow Creek, Grandad Creek, Telephone Creek, and NF Benton Creek are all included in AU ID17060308CL002_02b. These streams are all on the east side of Dworshak Reservoir. They are managed for timber harvest and heavy roaded. Most streams lack shade as a result of timber harvest activities and roads. There is insufficient evidence of sediment pollution, and there are no nutrient sources. There is one BURP site midway on Elkberry Creek (1998SLEWB007).

Table 10. BURP Data for Sites Impaired Due to Combined Biota/Habitat Assessments.

BURP Site	Temp (C)	Bank Full Width (m)	Land Use	Flow (cfs)	Canopy Cover (%)	Bank Stablity (%)	Wet Fines (%)
1999SLEWA019	12.7	1.5	Mining, Forestry Recreation, Roads	2.4	27	100	58.7
2001SLEWA002	20.3	4.5	Roads, Beaver, Forestry	6.0	26	87.5	61.6
1998SLEWB005	8	3.5	Forestry Recreation, Roads	4.0	5	70	30.2
1998SLEWB010	12.5	4.9	Forestry Recreation, Roads	5.8	0	100	30
1998SLEWB007	14	5.2	Forestry, Roads	11.1	10	5	17

2.4.6 Temperature Data

Temperature data collected for the 2002 TMDL showed daily maximum temperature criteria were exceeded, leading to 25 AUs being listed as impaired for temperature. In 2008, DEQ monitored existing shade percentages on several reaches of several streams in the subbasin. The Isabella Creek watershed was found to represent reference conditions for canopy cover and shade, remaining heavily shaded even at the widest stream segments. These data were used in developing the PNV temperature TMDLs for the streams listed in Category 5 of *Idaho's 2010 Integrated Report* as impaired by temperature (DEQ 2011). These TMDLs are presented in section 5.

2.5 Data Gaps

Water quality monitoring associated with this 5-year review included BURP and *E. coli* bacteria data and canopy cover data for the development of PNV TMDLs. These data can be found within applicable sections of the document or in Appendix C. Data to evaluate sediment loading was not collected by DEQ in 2008. The cause for the TP increase measured in Elk Creek in October 2008 is unknown at this time.

3 Review of Implementation Plan and Activities

The *Lower North Fork Clearwater River Sub-basin TMDL Implementation Plan* was completed in May 2004 (CSWCD 2004). The implementation plan focuses on the seven streams (Breakfast, Cranberry, lower Elk, Long Meadow, Partridge, Reeds, and Swamp Creeks) that received TMDLs. Most of the site-specific projects listed in the plan addressed forest road maintenance, culvert replacement, landslide repair, and road decommissioning or obliteration.

Most of the land in the subbasin is either owned by the Potlatch Corporation, state property managed by the Idaho Department of Lands (IDL), or federal property managed by the Clearwater National Forest (CNF).

Potlatch Corporation and IDL harvest timber in accordance with state Forest Practices Act regulations (IDAPA 20.02.01). The CNF harvests timber in accordance with federal regulations, including the federal Inland Native Fish Strategy and Pacific Anadromous Fish Strategy guidelines. All three entities conduct audits on their harvest activities.

Agriculture accounts for a small percentage of the land use in the subbasin. Both Potlatch Corporation and IDL manage grazing allotments on their lands. Potlatch Corporation uses riders to manage grazing livestock in order to reduce the impacts from concentrated grazing on riparian zones. Other restoration efforts include moving salt licks to places outside the riparian zone and limiting the number of cows in these allotments. Fencing, exclusion, crossings, and off-site watering for cattle are included in the implementation plan.

The Clearwater Soil and Water Conservation District and the Palouse-Clearwater Environmental Institute assist private landowners in the subbasin who voluntarily install best management practices (BMPs) on their lands. These projects can be funded through United States Department of Agriculture programs or grant programs such as the EPA Nonpoint Source Section 319 Grant Program.

3.1 Responsible Parties

Table 10 identifies the participants currently involved in implementing the TMDL. Participants include local governments, state agencies, federal agencies, private corporations, environmental interest organizations, and the general public. Specific roles for designated management agencies include the following:

- Idaho Department of Lands for forestry, minerals, and mining
- Idaho Soil and Water Conservation Commission for grazing and agriculture
- Idaho Transportation Department and local highway districts for public roads
- Federal agencies and local governments for activities occurring on lands within their jurisdiction

Table 11. Lower North Fork Clearwater River implementation plan participants.

Participants	Resource Responsibility	Type of Involvement
Idaho Soil and Water Conservation Commission and Clearwater Soil and Water Conservation District	Guide best management practice (BMP) implementation for agriculture and grazing, evaluate BMP effectiveness, administer federal §319 grants, report on project progress	Assistance, grant administration, technical support
Idaho Department of Lands	Develop site-specific Forest Practices Act (FPA) BMPs for silviculture activities, maintain and obliterate roads, implement grazing BMPs on allotments, perform DEQ/IDL FPA Quadrennial audits to assess compliance with FPA BMP's and effectiveness of the rules. Some audits include collecting instream shade data for monitoring trends.	Regulatory
Potlatch Corporation	Use BMPs for silviculture activities, maintain and obliterate roads, implement grazing BMPs on allotments, perform FPA audits	Private forest properties
Clearwater National Forest	Use INFISH/PACFISH BMPs and buffer zones for silviculture activities, maintain and obliterate roads, perform internal FPA audits[a]	Regulatory
Palouse-Clearwater Environmental Institute	Provide technical support, assistance, outreach, manpower, and coordination on stream restoration projects	Nonprofit environmental restoration
Private landowners	Implement BMPs for resource management	Voluntary
Clearwater Highway District	Road maintenance	County government

[a] Inland Native Fish Strategy (INFISH), Pacific Anadromous Fish Strategy (PACFISH)

Status of Implementation Activities

Table 11 presents several of the projects, activities, structures, and management strategies included in the TMDL implementation plan or undertaken for the TMDL. Most of the work is being carried out by Potlatch Corporation, IDL, and the Clearwater Highway District (CHD) on roads in the subbasin to address sediment load reductions. Most of the road projects were developed incrementally and funded by multiple §319 grant proposals and project work funded by cooperating participants. The initial projects have been completed by Potlatch Corporation, IDL, and CHD.

Table 12. Status of implementation activities.

Water Body or Location	Pollutant	Responsible Party[a]	Activity or Strategy	Start Schedule	Completion Status
Swamp Creek	Sediment	Potlatch	Road maintenance	9/06	Ongoing
Cranberry Creek	Sediment	Potlatch	Road maintenance.	9/06	Ongoing
Long Meadow Creek	Sediment	Potlatch	Road maintenance	9/05	Ongoing
Snake Creek	Sediment	Potlatch	Stream crossing	9/05	Ongoing
	Sediment	Potlatch	Road maintenance	10/05	Ongoing
Reeds Creek	Sediment	IDL	Road maintenance	9/06	Ongoing
Breakfast Creek	Sediment	IDL	Road maintenance	9/06	Ongoing
Cranberry Creek	Sediment, Temperature	IDL	Road maintenance	10/06	Ongoing
Long Meadow Creek	Sediment, Temperature	IDL	Road maintenance	10/06	Ongoing
	Sediment, Temperature	IDL	Riparian plantings	6/06	Ongoing
Swamp Creek	Sediment, Temperature	IDL	Road maintenance	6/06	Ongoing
N/A	Sediment	CHD	Road maintenance	Ongoing	Ongoing
Unnamed tributary	Sediment, Bacteria, Nutrients	Private landowner	Ranch/corral/septic replacement		Completed
Partridge Creek	Sediment, Temperature, Bacteria	PCEI	Stream segment restoration	10/06	Completed

[a] Idaho Department of Lands (IDL), Clearwater Highway District (CHD), Palouse-Clearwater Environmental Institute (PCEI)

3.2 Project Summaries

The WAG met March 30, 2009, to review and discuss this 5-year review. WAG members provided a description of the projects they have undertaken since 2002 to address the TMDL. Estimates of sediment load reductions provided by the WAG are included in Table 12.

Table 13. Estimated sediment load reductions

Watershed	Project Sponsor	Source	Sediment Load Reduction (tons/year)
Swamp Creek and Cranberry Creek	IDL	29 miles of roads abandoned	203
Long Meadow Creek	IDL	10 miles of road surface rocked 3 off-stream stock water ponds	55
Breakfast, Floodwood, and Brequito Creeks	IDL	38 miles of road abandoned,	466
		40 miles of road reconstructed	
Washington Creek	IDL	7 culverts replaced	3300
Snake Creek	IDL	4 bridges installed	200
Big Creek	IDL	2 bridges installed	100
North and South Forks Big Creek	IDL	2 bridges installed	100
Parallel Creek	IDL	1 bridge installed	50
Bear Creek	IDL	38 culverts replaced	1900
Silver Creek	IDL	20 culverts replaced	1000
Reeds Creek	Potlatch Corporation	Culvert removal and bridge replacement 0.37 miles abandoned roads 6.5 miles road rock surfaced	2582 2.59 35.75
Beaver Creek	Potlatch Corporation	11 miles road rock surfaced	60.5
Elk Creek	Clearwater National Forest	Discontinued grazing	

3.2.1 Idaho Department of Lands

Since the WAG was established, IDL's Ponderosa Area Office has completed many projects to enhance water quality in the Swamp, Cranberry, and Long Meadow Creek drainages. Projects have been completed both with the assistance of §319 grant monies and independently. Efforts have focused primarily on reducing sediment delivery to TMDL streams.

Approximately 29 miles of road in the Swamp and Cranberry Creek drainages that were poorly located and/or near streams were abandoned and vegetated. An estimated 5,000 to 10,000 lineal feet of culvert were removed, reducing the potential for sediment delivery as a result of pipe blockage and failure. Road upgrades including culvert cleanout and replacement, slump repair, and gravel surfacing are conducted annually throughout the area to maintain and improve IDL's road network.

Approximately 10 miles of native surface road were surfaced with rock in the Long Meadow Creek drainage. This effort has significantly reduced surface erosion on these roads. Additional surfacing projects are scheduled through the next 5 years. All three drainages support active livestock grazing leases. The Ponderosa Area Office has developed three off-site watering ponds to minimize the use of riparian areas for livestock watering. The office continually works with grazing lessees to keep livestock from concentrating in sensitive areas and to minimize impacts to the land. Riparian plantings were completed to enhance long-term shading, reduce water temperature, and decrease sediment delivery.

An extensive water sampling program was implemented within these drainages to determine if bacteria concentrations were a concern. Only three samples showed a significant presence of bacteria, indicating that bacterial loading in these streams is generally not a problem.

Through these projects and others, the Ponderosa Area Office continues to actively improve water quality and fish habitat while managing its timber resources for the greatest sustainable return.

The St. Joe Area Office projects include approximately 38 miles of road in Stony Cr., Breakfast Cr., Floodwood Cr., and Brequito Cr. that have been abandoned or obliterated; and 40 miles reconstructed (including culvert upgrades)/surfaced/re-surfaced to mitigate sediment loads. These projects were accomplished using CWA Section 319 Grant monies and project funds from timber sale activities. Work includes new culverts (both for flows and fish passage), adding surface drainage (dips), mass failure repairs (Hot spots) and aggregate surface in some locations. The 3000 road is being reconstructed as a main timber haul road so that logs will be hauled up and out the main ridge versus various stream adjacent roads in lower drainages.

During the last eight years, the Clearwater Area Office used a combination of CWA Section 319 grant funds and agency project funds to; install 7 culverts on Washington Creek, removed 16 old log structures and abandoned 3 miles of road on Reeds Creek, replaced nine old culverts with bridges on Snake Creek, Big Creek, the North and South Forks of Big Creek, and Parallel Cr. An additional 58 culverts were upgraded in the Bear Cr. and Silver Creek drainages. These projects reduced future sediment loading by approximately 12,000 tons.

The Area Offices perform annual maintenance on primary and secondary roads including grading, rolling dip maintenance/construction, culvert cleaning/replacement, grass seeding and mulching, and gating of roads to control access. The Snake River Adjudication, Idaho Forestry Program standards have been implemented on IDL managed lands since 2003. This is a program of stream riparian protection standards and enhanced road construction and maintenance standards designed to protect water quality.

3.2.2 Potlatch Corporation

Potlatch Corporation manages approximately 241,183 acres of land in the subbasin, including the Reeds Creek watershed. Potlatch's Clearwater District has reduced sediment by 2,582 tons/year for the review period of 2004–2008. Potlatch has replaced two undersized culverts with bridges, reducing sediment by 2,814 tons/year. Potlatch abandoned 0.37 miles of road for 2.59 tons/year, resurfaced 6.5 miles of road for 35.75 tons/year, and removed several culverts and one old log crossing and replaced several undersized culverts for a reduction of 624 tons/year. Three undersized culverts were replaced in 2010 with bridges, for a reduction of 894 tons/year. The only other sediment reductions calculated are in the Beaver Creek drainage on 11 miles of rocking for a reduction of 60.5 tons/year.

Along with the reductions above, Potlatch continues to perform routine maintenance on all primary and secondary roads on its ownership. Routine maintenance includes graveling dirt roads; spot rocking over stream crossings; reconstructing older roads to meet current criteria; improving drainage structures; replacing old pipes; roller dipping; grass seeding and mulching; relocating, abandoning, or obliterating roads that are located in the stream protection zones; and gating roads to control access. Sediment reductions have not been calculated for all of these activities outside of the Reeds Creek drainage.

3.2.3 Clearwater National Forest

In addition to the activities listed in Table 10, the CNF discontinued all grazing allotments in the Elk Creek watershed. The Elk Creek watershed continues to be managed as a popular recreation destination. In 2010, the CNF implemented its Robo-Elk project in the watershed, concentrating on wildfire fuel reduction, vegetation, and recreation management.

3.2.4 Palouse-Clearwater Environmental Institute

The Palouse-Clearwater Environmental Institute completed a restoration project in Christianson Meadows on Partridge Creek. The project was designed to stabilize banks and restore riparian vegetation along a degraded segment of Partridge Creek, addressing sediment, temperature, and potentially bacteria pollutants. Since Partridge Creek flows into Elk Creek above the City of Elk River's drinking water inlet, the project was intended to have a positive impact on drinking water and surface water quality.

3.3 Future Strategy

The WAG assisted in developing this review and was solicited for its input and recommendations on the condition of the watershed and developing a future strategy to continue water quality improvements in the subbasin. The WAG will continue to seek opportunities to develop and implement future projects to reduce pollutant loads on streams in the subbasin that are most in need of pollutant load reductions. Designated management agencies will continue to seek opportunities to implement BMPs and to show progress toward meeting water quality objectives.

3.4 Planned Time Frame

Excess sediment from roads is the primary pollutant currently being addressed by implementation efforts. Pollutant load reductions for temperature and bacteria require additional efforts. Bacteria load reductions can be accomplished through livestock management with riparian exclusions, off-site watering, hardened stream crossings, and riparian buffer plantings.

It takes more time to meet load reductions for temperature through increases in stream shade. However, undertaking riparian planting projects to decrease stream temperature will have the added benefit of providing a buffer for sediment and bacteria in run-off as well. See section 5.5 for information regarding implementation strategies for the temperature TMDLs included in this addendum.

4 Pollutant Source Inventory

This section identifies and discusses pollutant sources affecting water quality in subbasin streams listed in Category 5 of the 2010 Integrated Report as impaired by temperature (DEQ 2011).

Sources may occur as point sources, regulated by National Pollutant Discharge Elimination System (NPDES) permits, or as nonpoint sources, which are not subject to the permitting program. Point sources convey pollutants directly into waters through a pipe, ditch, or other identifiable point of discharge. Nonpoint sources have no exact point of discharge to receiving waters, instead conveying their associated pollutants over the landscape.

4.1 Point Sources

There are no known point sources that discharge a temperature wasteload directly to the subbasin streams listed in Category 5 of *Idaho's 2010 Integrated Report* as impaired by temperature (DEQ 2011).

4.2 Nonpoint Sources

The PNV TMDLs in section 5 identify stream segments affected by reductions in riparian canopy cover. The lack of shade found in each stream segment indicates excess solar radiation is reaching the stream and warming the water. Completion of the PNV temperature TMDLs has resulted in the quantification of nonpoint source solar heat loading to the Lower North Fork Clearwater River subbasin streams listed in Category 5 of *Idaho's 2010 Integrated Report* as impaired by temperature (DEQ 2011).

4.3 Data Gaps

The number of water withdrawals and diversion ponds is unknown, although aerial photo interpretation suggests that a significant number of diversions and ponds exist in the subbasin, especially where they were used on and around logging roads.

There may be a variety of reasons that individual reaches do not meet shade targets, including natural occurrences (e.g., beaver ponds, springs, wet meadows, past natural disturbances) and/or historic land use activities (e.g., logging, grazing, mining). Existing shade in each reach should be field verified to determine if differences in existing shade and target shade levels are real and result from activities that are controllable. Information within this TMDL (maps and load analysis tables) should be used to guide and prioritize implementation investigations. The information within this TMDL may need further adjustment to reflect new information and conditions in the future.

5 Total Maximum Daily Loads

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

Load capacity can be summarized by the following equation:

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

Where:

LC = load capacity
MOS = margin of safety
NB = natural background
LA = load allocation
WLA = wasteload allocation

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

The load capacity must be based on critical conditions—the conditions when water quality standards are most likely to be violated. If protective under critical conditions, a TMDL will be more than protective under other conditions. Because both load capacity and pollutant source loads vary, and not necessarily in concert, determining critical conditions can be more complicated than it may appear on the surface.

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. 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, such as in the case of this temperature TMDL. For certain pollutants whose effects are long term, such as sediment and nutrients, EPA allows for seasonal or annual loads.

5.1 Instream Water Quality Targets

For the Lower North Fork Clearwater River subbasin temperature TMDLs, we used a PNV approach. The Idaho water quality standards include a provision (IDAPA 58.01.02.200.09) that if natural conditions exceed numeric water quality criteria, exceedance of the criteria is not considered a violation of water quality standards. In these situations, natural conditions essentially become the water quality standard, and for temperature TMDLs, the natural level of shade and channel width become the TMDL target. The instream temperature that results from attaining these conditions is consistent with the water quality standards, even if it exceeds numeric temperature criteria.

The PNV approach is described briefly below. The procedures and methodologies to develop PNV target shade levels and to estimate existing shade levels are described in Shumar and De Varona (2009). For a more complete discussion of shade and its effects on stream water temperature, see the *South Fork Clearwater River Subbasin Assessment and Total Maximum Daily Loads* (DEQ and EPA 2003) and *The Potential Natural Vegetation (PNV) Temperature Total Maximum Daily Load (TMDL) Procedures Manual* (Shumar and De Varona 2009).

5.1.1 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 human activities and can be most readily corrected and addressed by a TMDL.

Riparian vegetation provides a substantial amount of shade on a stream by virtue of its proximity. However, depending on how much vertical elevation surrounds the stream, vegetation further away from the riparian corridor can also provide shade. We can measure the amount of shade that a stream receives in a number of ways. Effective shade (i.e., that shade provided by all objects—not just vegetation—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.

5.1.2 Potential Natural Vegetation for Temperature TMDLs

PNV along a stream is that riparian plant community that could grow to an overall mature state, although some level of natural disturbance is usually included in the development and use of shade targets.

Vegetation can be removed by disturbance either naturally (e.g., wildfire, disease/old age, wind damage, 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 without any anthropogenic removal of shade-producing vegetation. Vegetation levels less than PNV (with the exception of natural levels of disturbance and age distribution) result in the stream heating up from anthropogenically created additional solar inputs.

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) tells us 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 target shade values were converted to solar loads based on data recorded on flat-plate collectors at the nearest National Renewable Energy Laboratory (NREL) weather stations collecting these data. In this case, the Missoula, Montana, station was used. The difference between existing and target solar load, assuming existing load is higher, is the load reduction necessary to bring the stream back into compliance with water quality standards (IDAPA 58.01.02.200.09).

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

5.1.2.1 Existing Shade Estimates

Existing shade was estimated for the Lower North Fork Clearwater River tributaries from visual interpretation of National Agricultural Imagery Program 2009 aerial photos. Estimates of existing shade based on plant type and density were marked out as stream segments on a 1:100,000 or 1:250,000 hydrography taking into account natural breaks in vegetation density. Stream segment length for each estimate of existing shade varies depending on the land use or landscape that has affected that shade level. Each segment was assigned a single value representing the bottom of a 10% shade class (adapted from the cumulative watershed effects process, IDL 2000). For example, if shade for a particular stream segment was estimated 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 are in low shade classes (10%, 20%, or 30%). Streams with dense forest or heavy brush where no portion of the stream is visible are usually in high shade classes (70%, 80%, or 90%). More open canopies where portions of the stream may be visible usually fall into moderate shade classes (40%, 50%, or 60%).

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

Solar Pathfinder Field Verification

The accuracy of the aerial photo interpretations was partially field-verified with a Solar Pathfinder at systematically located points along the streams. The Solar Pathfinder is a device that allows one to trace the outline of shade-producing objects on specialized monthly charts called 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 (i.e., making sure the Solar Pathfinder is level and oriented to the south). Systematic sampling was used because it is easiest to accomplish without biasing the sampling locations. For each sampled segment, the sampler started at a unique location, such as 50 to 100 meters from a bridge or fence line, and proceeded upstream or downstream taking additional traces at fixed intervals (e.g., every 50 meters, every 50 paces, etc.). Alternatively, one can randomly locate points of measurement by generating random numbers to be used as interval distances.

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

The accuracy of estimated existing shade values based on the aerial photo interpretations was field-verified with a Solar Pathfinder at six sites. Although limited, we were able to use the results of these measurements to recalibrate our estimates by reexamining the original aerial photo interpretations of existing shade. The Solar Pathfinder-measured values in Table 13 revealed that the original photo interpretations overestimated shade by an average of 2% ± 3.22 (mean ± 95% confidence interval).

Table 14. Solar Pathfinder results for sites on the Lower North Fork Clearwater River subbasin tributaries.

Aerial Photo–Based Shade Class (%)	Pathfinder-Measured Actual Shade Value (%)	Pathfinder Measurement-Based Shade Class (%)	Difference	Site
80	67	60	20	Beaver 1
80	76	70	10	Bingo
80	77	70	10	Isabella
30	30	30	0	Beaver 2
40	48	40	0	Alder
20	31	30	-10	Reeds
			2	**average**
			6.36	**standard deviation**
			3.22	**95% confidence interval**

5.1.2.2 Target Shade Determination

PNV targets were determined by analyzing probable vegetation communities at the streams and comparing those 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 decreases as vegetation has less ability to shade the center of wide streams. As the vegetation gets taller, the more shade the plant community is able to provide at any given channel width.

5.1.2.3 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 best 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 IDL—to estimate natural bank-full width (Figure 7).

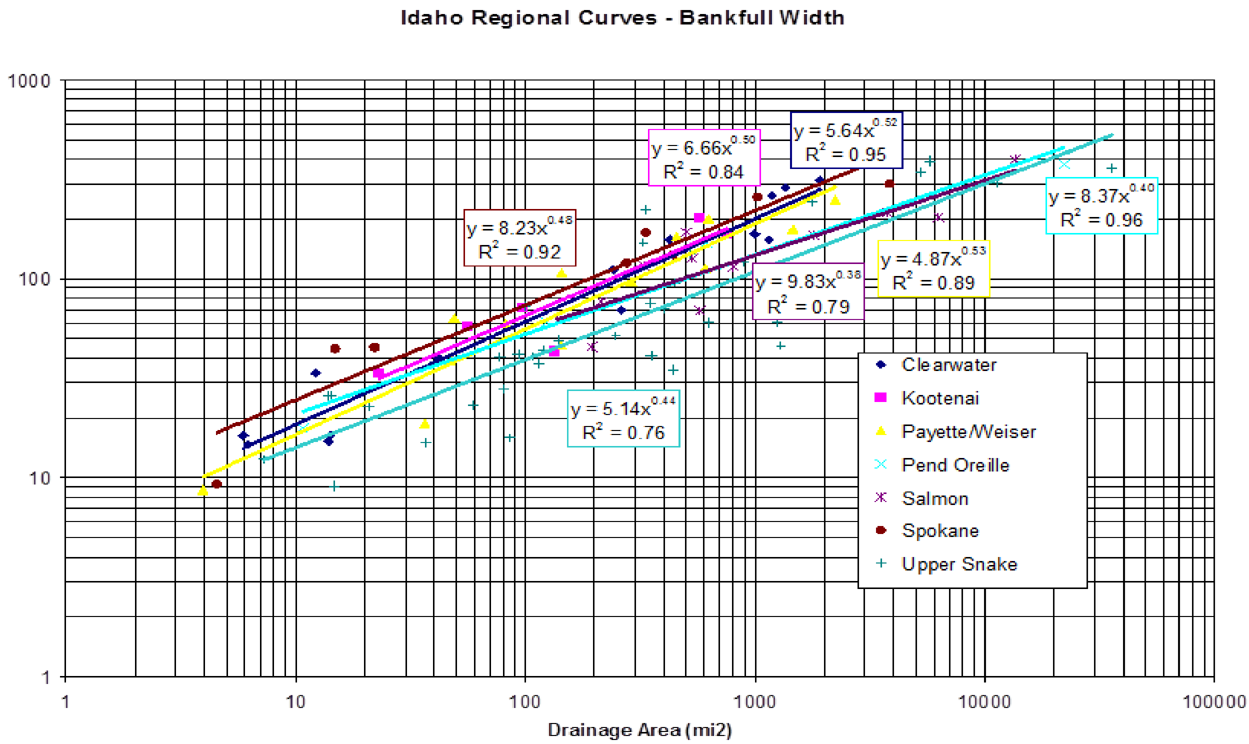

Figure 7. Bank-full width as a function of drainage area for major river basins.

For each stream evaluated in the load analysis, natural bank-full width was estimated based on the Clearwater basin curve (Table 14; Figure 7). 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 Lower North Fork Clearwater River subbasin. Existing width data should also be evaluated and compared to these curve estimates if such data are available. However, for these watersheds, only a few BURP-surveyed and Solar Pathfinder-measured sites exist, and bank-full width data from those sites represent only spot data (i.e., three to five measured widths in a reach only several hundred meters long) that are not always representative of the stream as a whole.

In general, we found the measured existing bank-full width values from BURP and Solar Pathfinder data to be slightly greater than bank-full width estimates from the Clearwater basin curve and chose not to make the natural widths used in this analysis any different than the Clearwater basin curve-based estimates. Every stream segment in the load analysis tables has a natural bank-full width and an existing bank-full width derived from either measured existing bank-full widths or Clearwater curve estimates. Table 14 contains examples of measured bank-full width values and the corresponding Clearwater curve values for selected stream segments in the Lower North Fork Clearwater River subbasin.

Table 15. Bank-full width estimates based on drainage area and existing measurements.

Stream	Area (square miles)	Clearwater Curve (meters)	Existing Bank-full Width (meters)
Beaver (upper)	9	5.5	6
Beaver (lower)	62.24	15.2	17
Bingo	2.65	2.7	2.9
Isabella	30.85	10.4	15.5

5.1.2.4 Design Conditions

The Lower North Fork Clearwater River subbasin lies within both the “High Northern Rockies” and the “Clearwater Mountains and Breaks” level IV ecoregions of the “Northern Rockies” level III ecoregion delineated by McGrath et al. (2001). This region is exposed to substantial maritime influence resulting in moist coniferous forests that are transitional in species composition between northern Idaho panhandle forests and the drier forests of the southern Idaho Batholith.

The CNF identifies three broad groups of forest type based on its landtype associations classification system:

- Breaklands—forests on steep slopes at lower elevations with warmer temperature regimes
- Uplands—forests generally above the breaklands in elevation that have more rolling topography and tend to be cooler and more mesic than breaklands
- Subalpine—forests higher than the uplands with mixed topography and generally colder temperatures

The shade curves (described below) provide shade values to be used as targets for PNV temperature TMDLs in Idaho and were developed by DEQ and EPA from information about these land type groups (see Shumar and De Varona 2009).

5.1.2.5 Shade Curve Selection

To determine PNV shade targets for the Lower North Fork Clearwater River subbasin tributaries, effective shade curves from the CNF section of DEQ’s PNV TMDL procedures manual (Shumar and De Varona 2009) were examined. These curves were produced using vegetation community modeling of Idaho plant communities. Effective shade curves include percent shade on the vertical axis and stream width on the horizontal axis. For the Lower North Fork Clearwater River subbasin tributaries, the curve for the most similar vegetation type was selected for each target shade determination.

First, an overlay of CNF landtypes grouped as breaklands, uplands, and subalpine areas was placed over the stream being examined. The upper portions of these streams are predominantly in the upland type, although occasional sections of stream are in the breakland type. Moving downstream, streams leave the forest groups and enter a region where other nonforest landtypes occur. Visual observations of these regions revealed that stream valleys widened, alder communities tended to dominate the streamside vegetation, and the forest was further away from the stream.

We developed a new shade curve for this region that is based on the CNF upland forest type and the mountain alder (*Alnus incana*) nonforest community as described in Shumar and De Varona (2009). We split the 41-meter buffer width in the model such that the first five zones adjacent to the stream are based on the mountain alder community dimensions (55% canopy cover and 5.1 meter weighted average height), and the four remaining zones furthest from the stream utilize the CNF uplands forest dimensions (81% canopy cover and 21 meter weighted average height). The resulting shade curve, called the CNF Upland-Alder Mixed curve (Appendix D). This shade curve is used for shade targets on those portions of streams in this TMDL where the valley has widened and the forest no longer dominates the streamside vegetation.

The alder community is described the USDA Fire Effects Information System (USDA, 2013) as:

> Thinleaf alder (*Alnus incana*) is most common on wet to moist sites. It is a frequent component of streamside vegetation throughout mountainous regions of western North America. It is considered an indicator of riparian or subirrigated sites on the Shoshone National Forest, Wyoming; of moist, well-drained sites—especially streambanks and springs at low elevations—in central Oregon; and of moist to wet soils in subboreal spruce (*Abies* spp.) and pine (*Pinus* spp.)-spruce ecosystems of British Columbia. Riparian sites with thinleaf alder may experience frequent flooding and/or scouring.
>
> Elevation and topography: In the conterminous United States, thinleaf alder is primarily restricted to mid- to high-elevation mountains, mountain valleys, and mesic canyons, although it grows on low-elevation sites in Alaska and Canada. In the United States, thinleaf alder ranges in elevation from near sea level in Alaska to over 10,000 feet (3,000 m) in Colorado and Arizona. Thinleaf alder populations apparently do not have exacting elevational requirements.
>
> Pacific Northwest: Thinleaf alder is a component of and sometimes forms glades within coniferous forests of the Pacific Northwest; it is also important to dominant in riparian corridors. Thinleaf alder is prevalent in ponderosa pine (*Pinus ponderosa*), Douglas-fir (*Pseudotsuga menziesii*), lodgepole pine (*Pinus contorta*), and fir-spruce (*Abies-Picea* spp.) communities. Thinleaf alder glade openings generally occur on wet to mesic sites where thinleaf alder outcompetes conifers for soil moisture.

The IDL analyzed the construction of the TMDL Clearwater Mesic shade curves and believe it creates an artificially high standard. They found that development of the shade curves did not account for the natural levels of disturbance that occurred in the Clearwater basin (approximately 23% of the Clearwater Mesic Upland area was non-stocked historically), and the setting of modeling parameters was skewed to larger trees, unrepresentative of what is generally encountered on the landscape. Shumar and De Varona (2009) considered natural disturbances in the development of the Mesic Upland shade curves and 19% of the area of the Clearwater was assumed non-stocked on a weighted average condition. Vegetation information used to develop the shade curves was obtained from the USFS's Historic Range of Variability Analysis for the Clearwater National Forest. As a result, the tree height used was determined to be 69 feet tall. The 2012 Forest Practice Act audit observed the average height for conifers in the Mesic Uplands was 77 feet tall. A recent TMDL audit investigation by DEQ found all observed current shade measurements with the Clearwater National Forest were above the targeted shade condition associated with the shade curve.

5.2 Load Capacity

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

DEQ obtained solar load data from flat-plate collectors at the NREL weather station in Missoula, Montana. 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.

Appendix E, Tables E1–E17, and Figures 8, 11, 14, 17, and 20 show the PNV shade targets. The tables also show corresponding target summer load on an area basis (in kilowatt-hours per square meter per day [kWh/m^2/day]) and as a total load (in kWh/day) that serve as the load capacities for the streams. Existing and target loads in kWh/day can be summed for the entire stream or portion of stream examined in a single load analysis table. These total loads are shown at the bottom of their respective columns in each table.

5.3 Estimates of Existing Pollutant Loads

Regulations allow that loads "...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; however, there are no point sources discharging to the water bodies included in this addendum. Nonpoint sources are typically estimated based on the type of source (land use) and area (such as a subwatershed) but may be aggregated by type of source or land area. To the extent possible, background loads are distinguished from human-caused increases in nonpoint loads.

Existing loads in this temperature TMDL come from estimates of existing shade as determined from aerial photo interpretations. Like target shade, existing shade was converted to a solar load by multiplying the fraction of open stream by the solar radiation measured on a flat-plate collector at the Missoula NREL weather station. Existing shade values are presented in Figures 9, 12, 15, 18, 21, and 23. Like load capacities (target loads), existing loads in Appendix E, Tables E1–E17, 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. If existing load exceeds target load, this difference becomes the excess load (i.e., lack of shade) to be discussed next in the load allocation section and as shown in the lack-of-shade figures (Figures 10, 13, 16, 19, and 22).

As data is collected, such as from the DEQ/IDL FPA Quadrennial Audits, it can demonstrate what actual shade/temperature relationships exist in the field and can be included in future reviews.

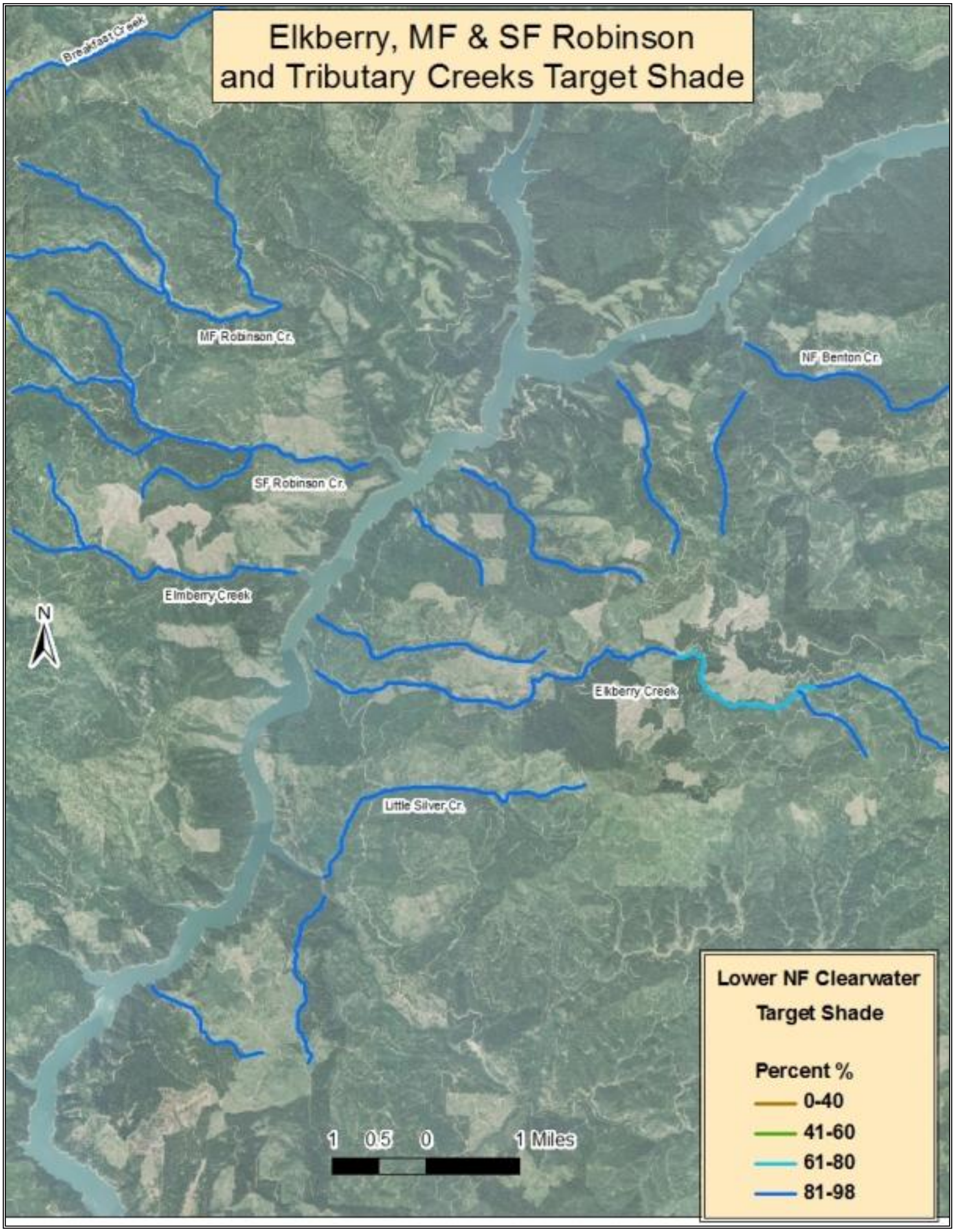

Figure 8. Target shade: Elkberry and Middle and South Fork Robinson Creeks.

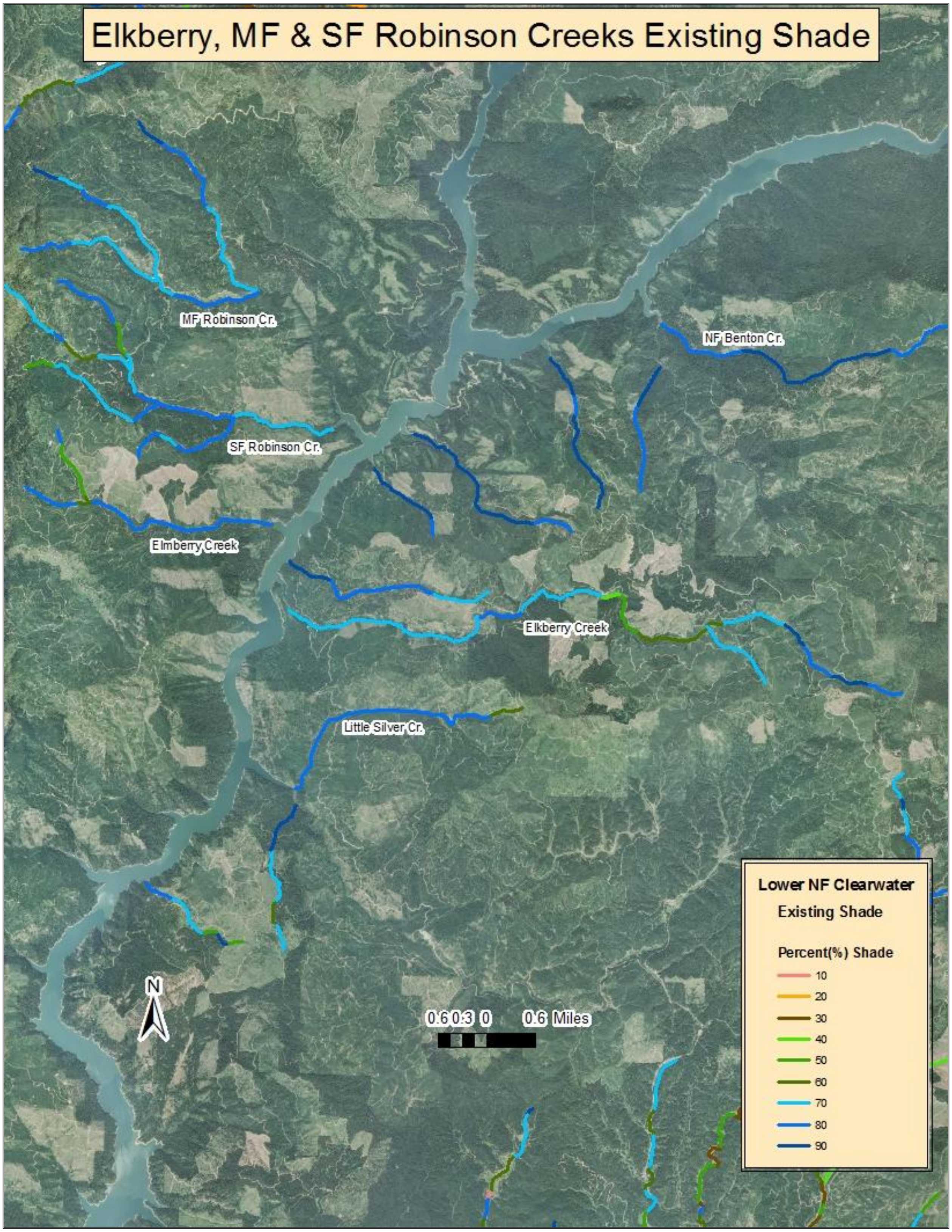

Figure 9. Existing shade: Elkberry and Middle and South Fork Robinson Creeks.

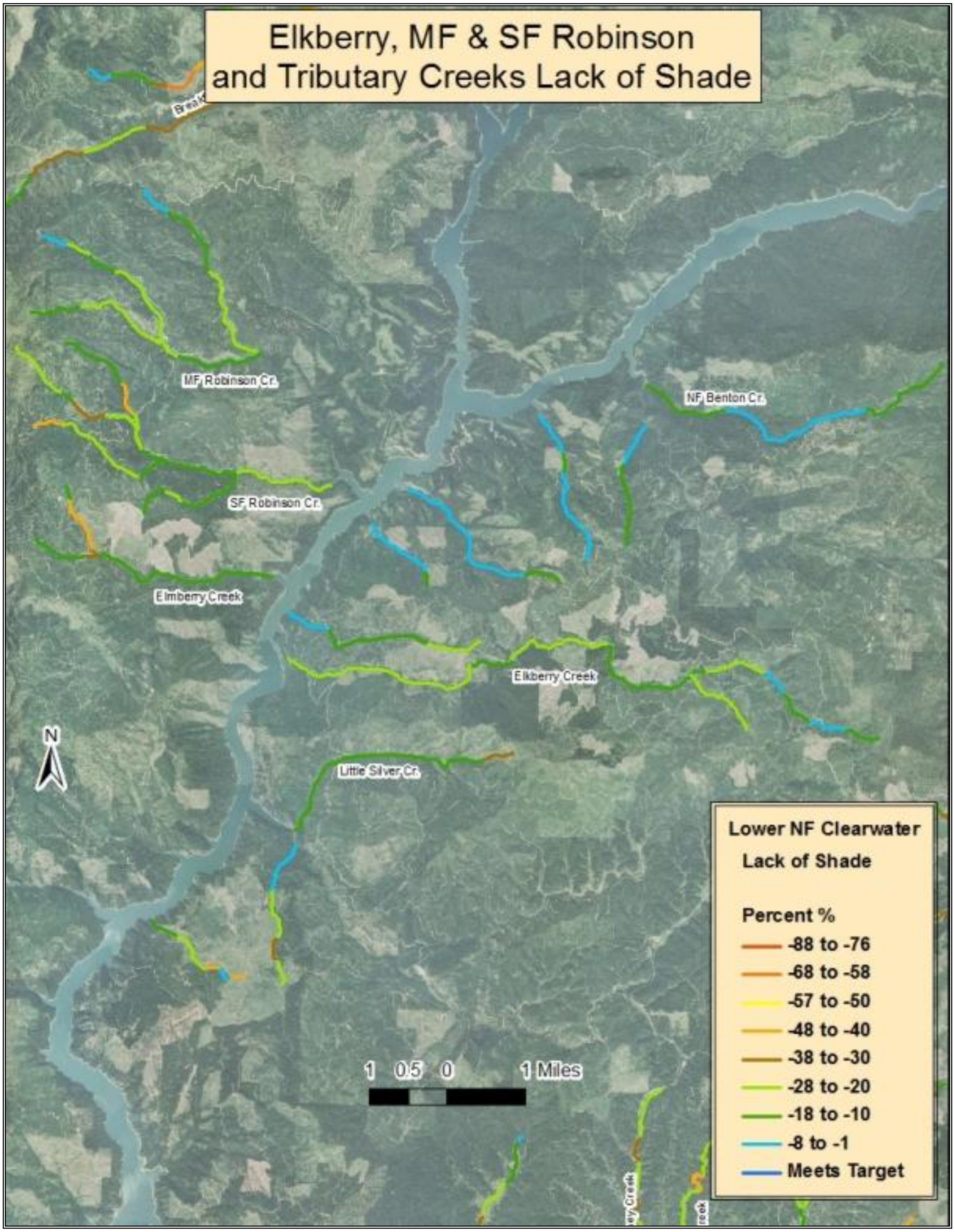

Figure 10. Lack of shade: Elkberry and Middle and South Fork Robinson Creeks.

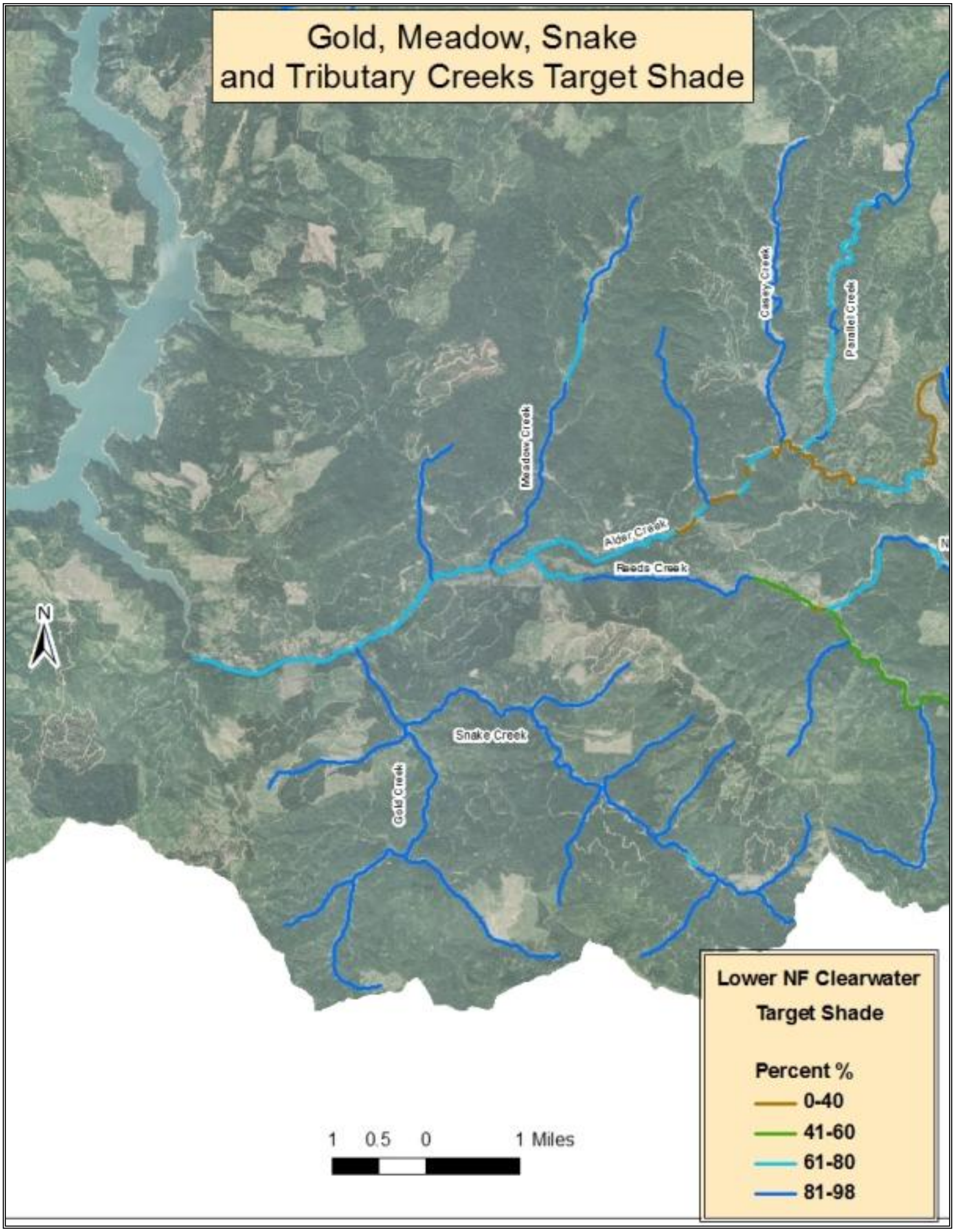

Figure 11. Target shade: Gold, Meadow, and Snake Creeks.

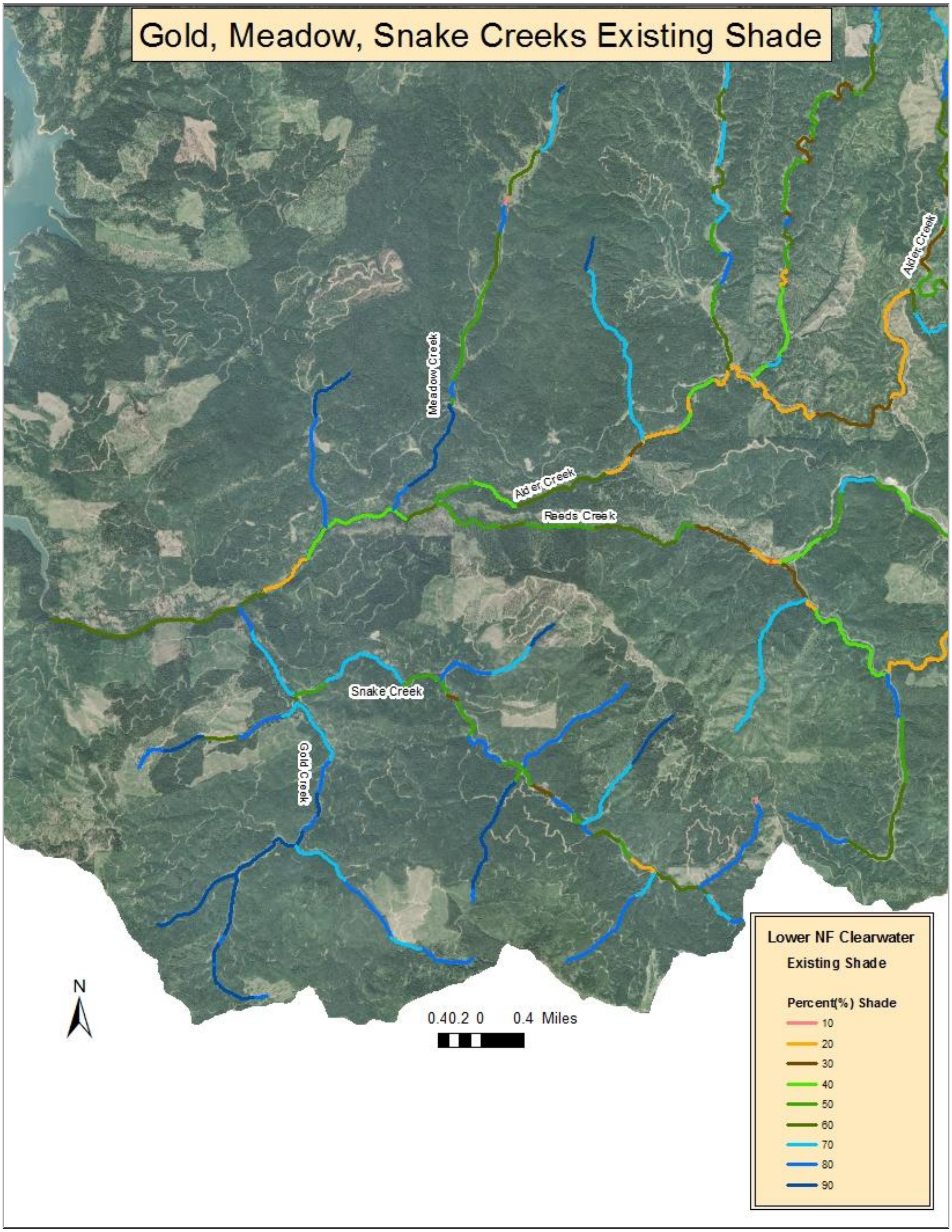

Figure 12. Existing shade: Gold, Meadow, and Snake Creeks.

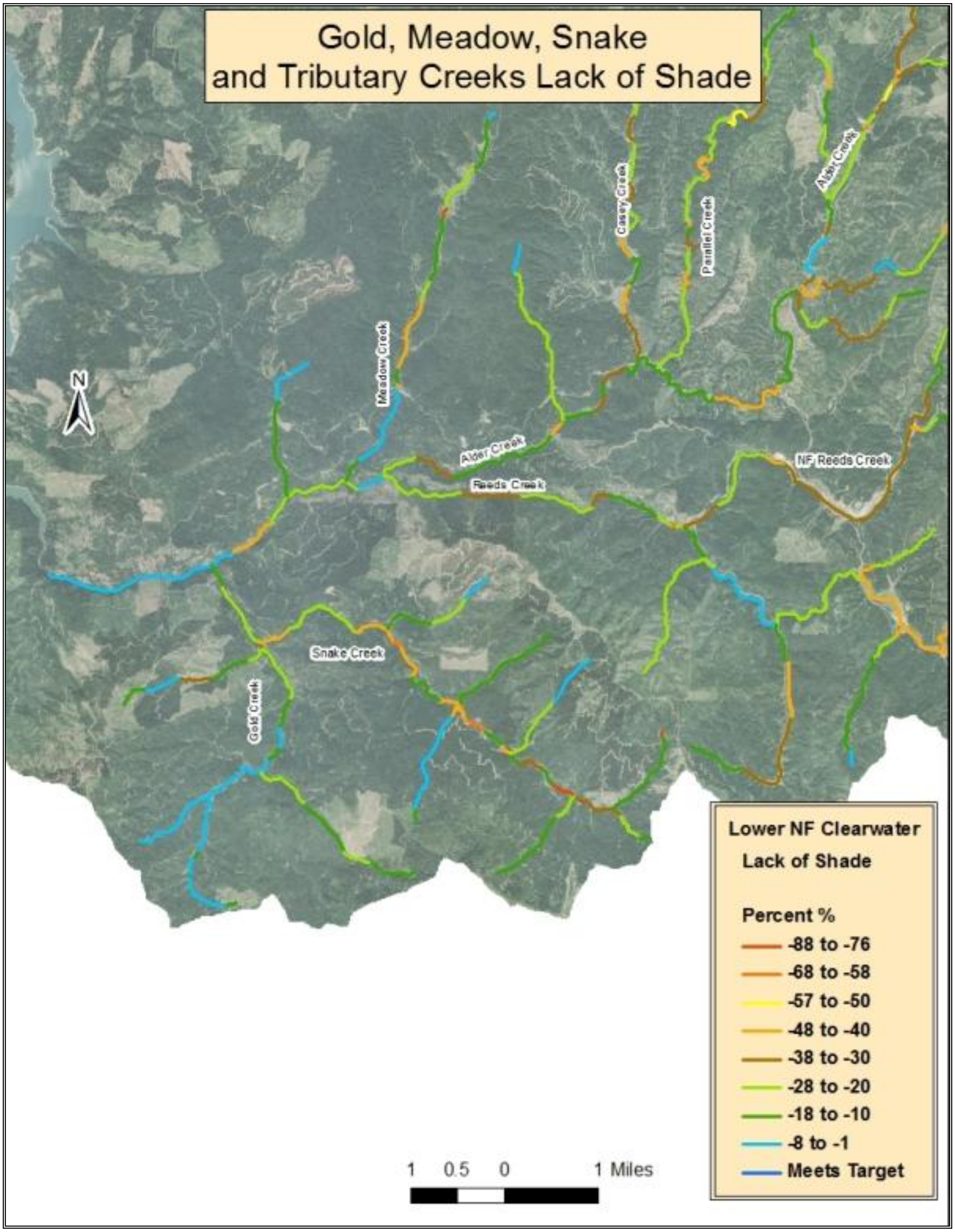

Figure 13. Lack of shade: Gold, Meadow, and Snake Creeks.

Figure 14. Target shade: Reeds Creek, Alder Creek, and tributaries.

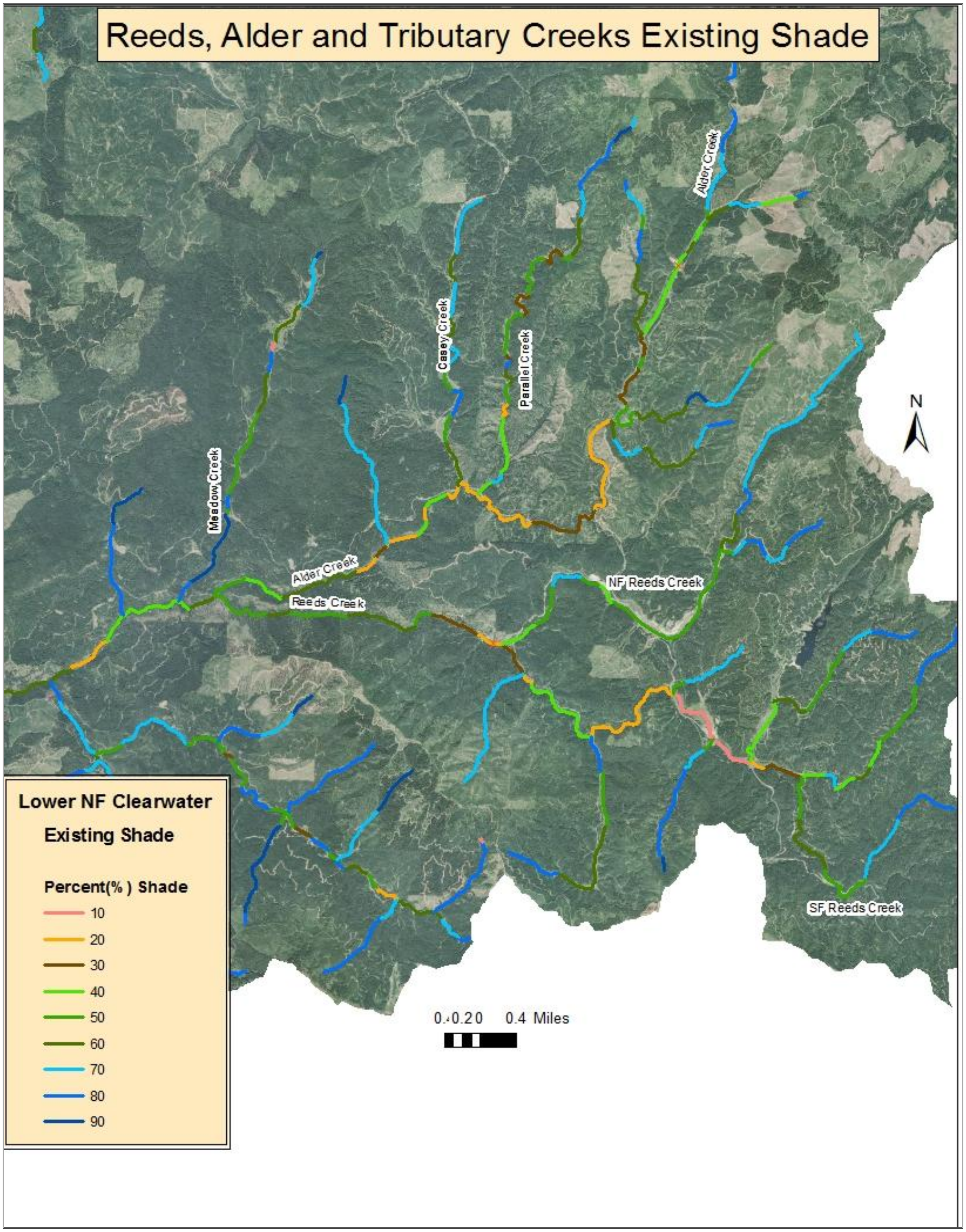

Figure 15. Existing shade: Reeds Creek, Alder Creek, and tributaries.

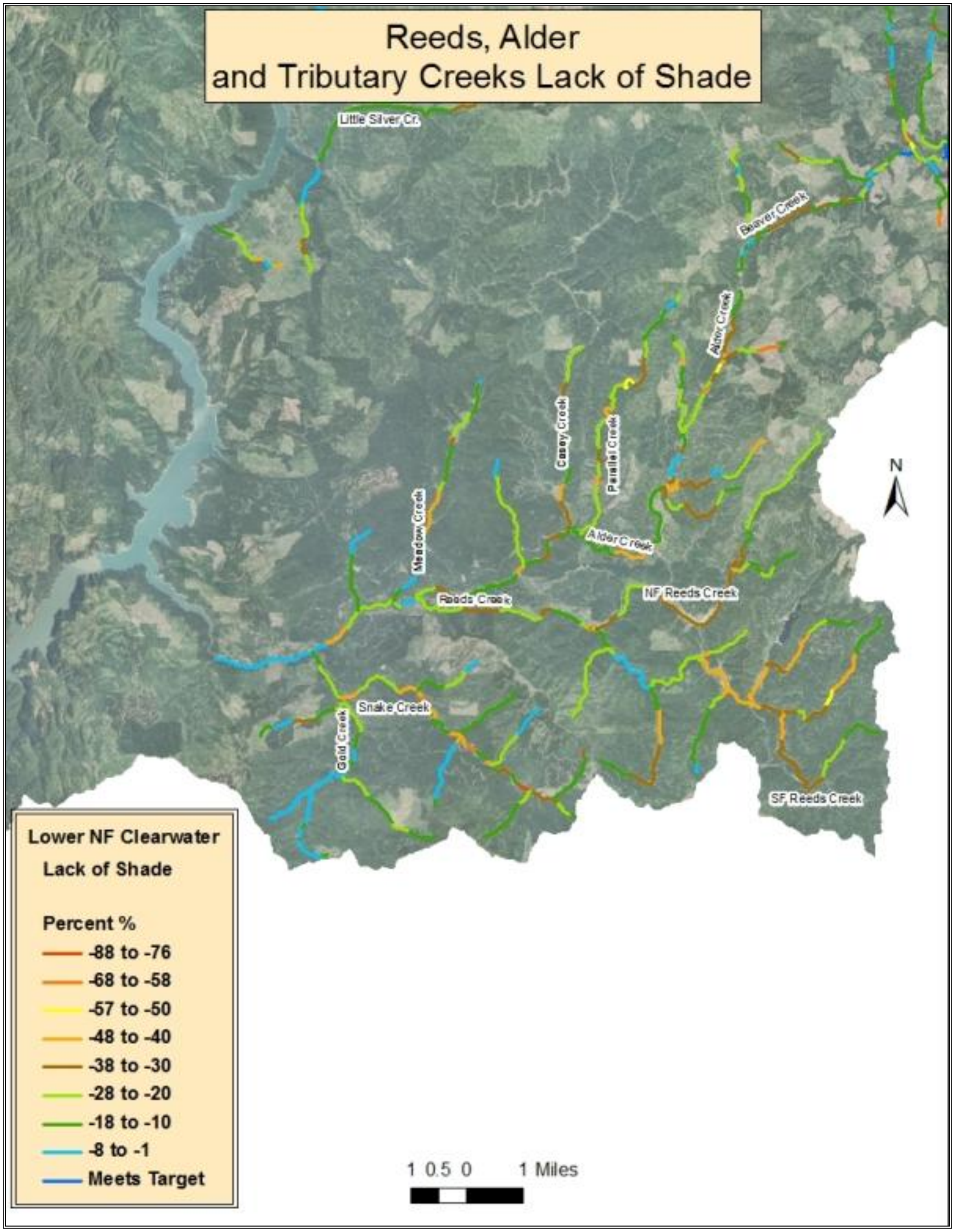

Figure 16. Lack of shade: Reeds Creek, Alder Creek, and tributaries.

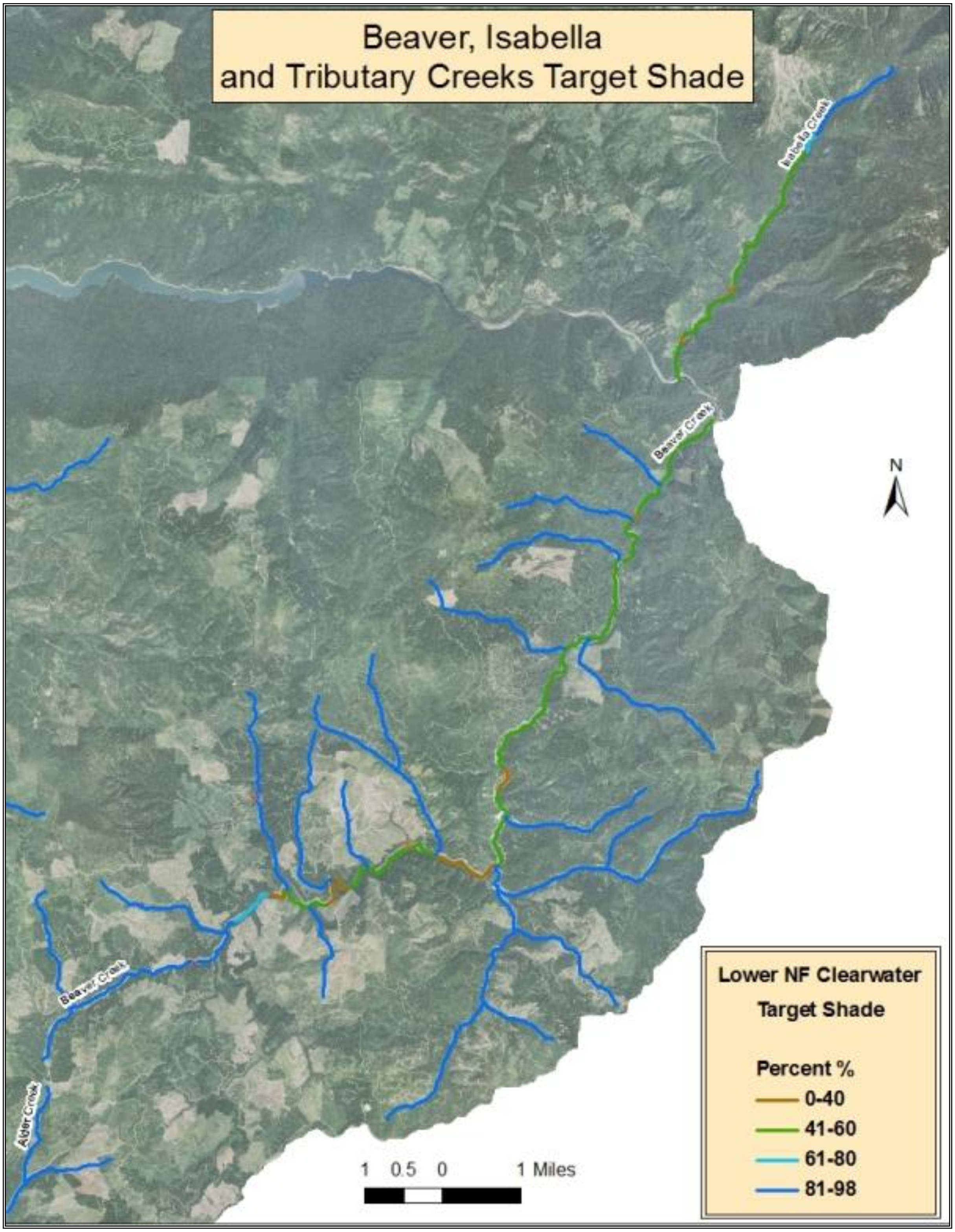

Figure 17. Target shade: Beaver Creek, Isabella Creek, and tributaries.

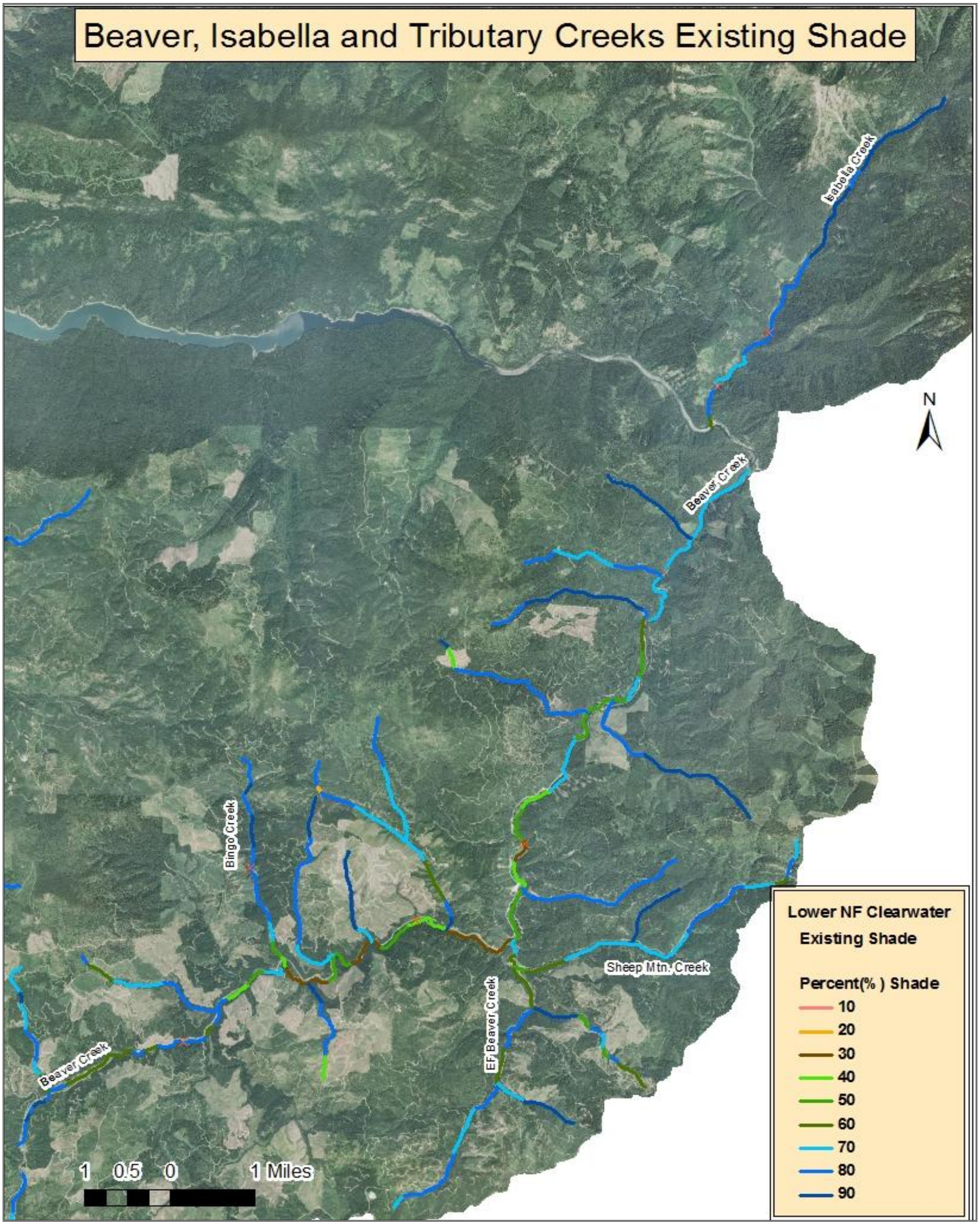

Figure 18. Existing shade: Beaver Creek, Isabella Creek, and tributaries.

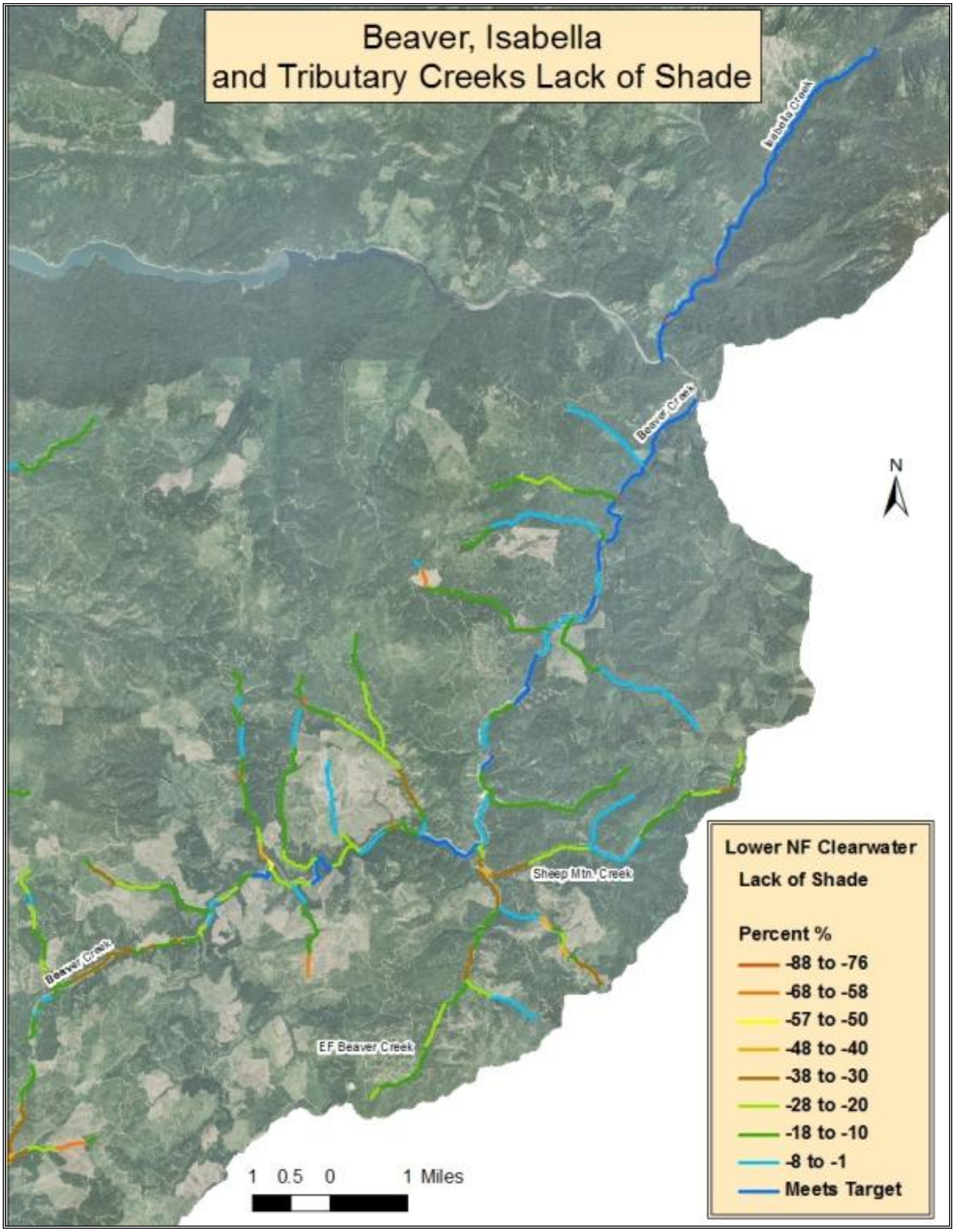

Figure 19. Lack of shade: Beaver Creek, Isabella Creek, and tributaries.

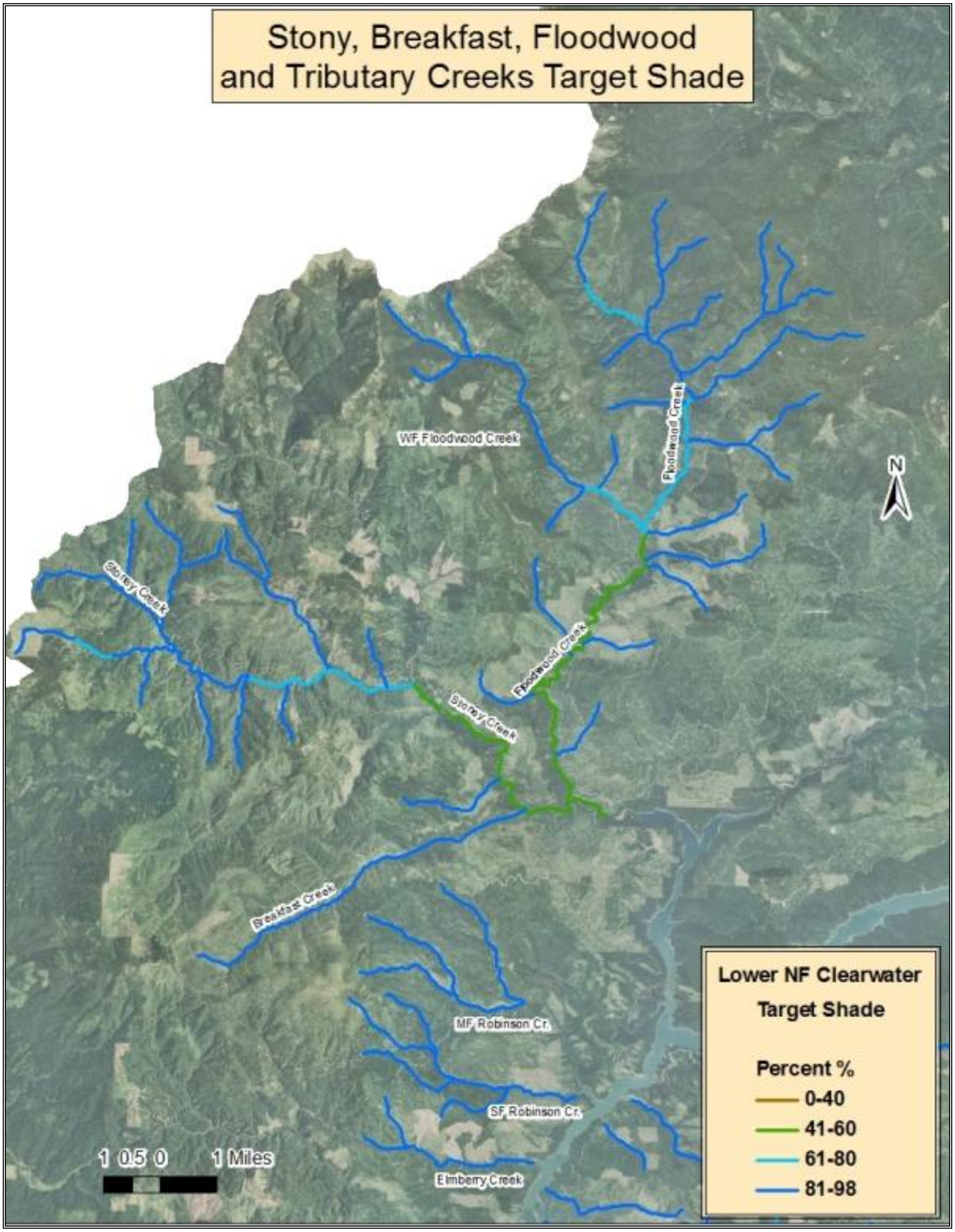

Figure 20. Target shade: Stony Creek, Breakfast Creek, Floodwood Creek, and tributaries.

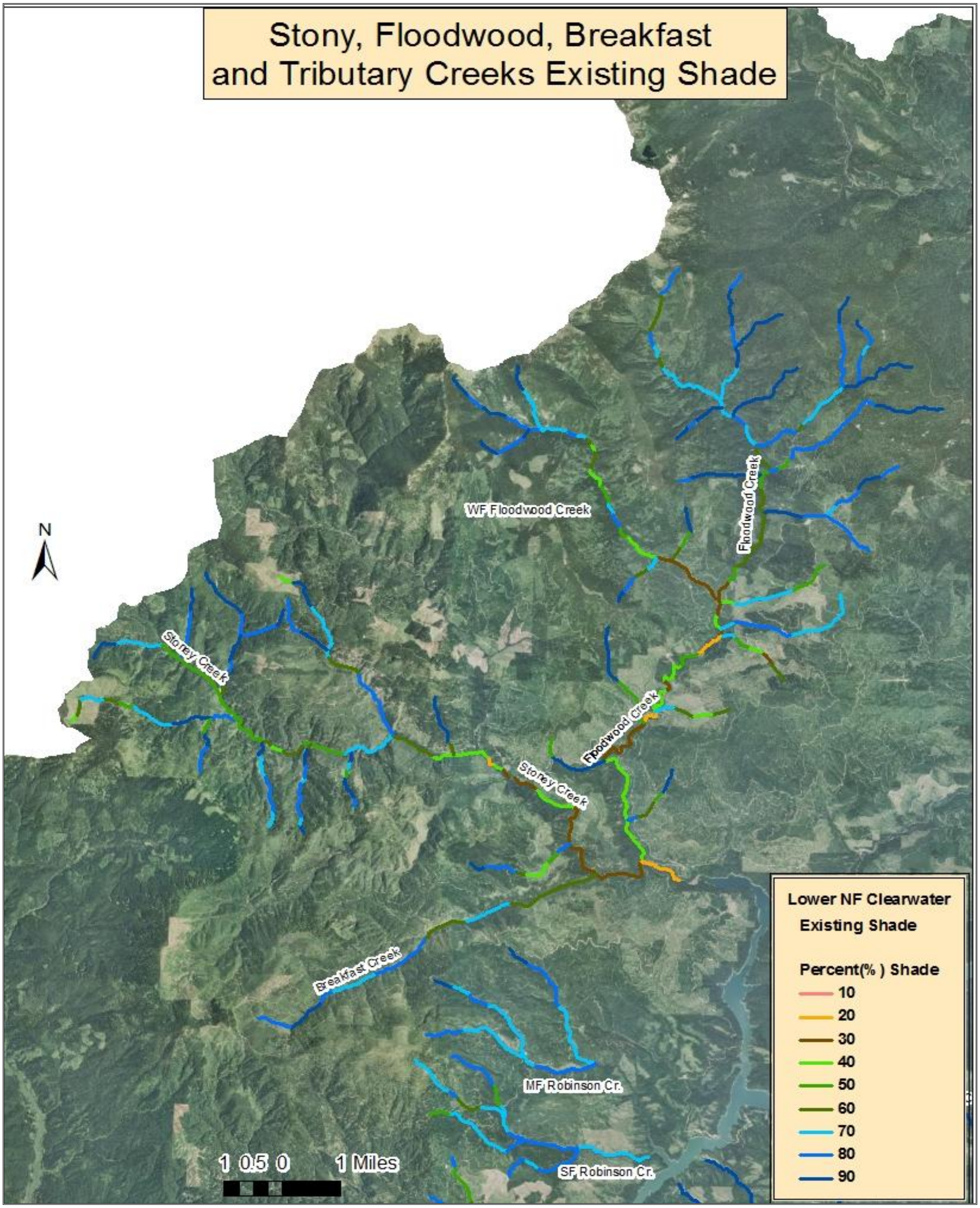

Figure 21. Existing shade: Stony Creek, Breakfast Creek, Floodwood Creek, and tributaries.

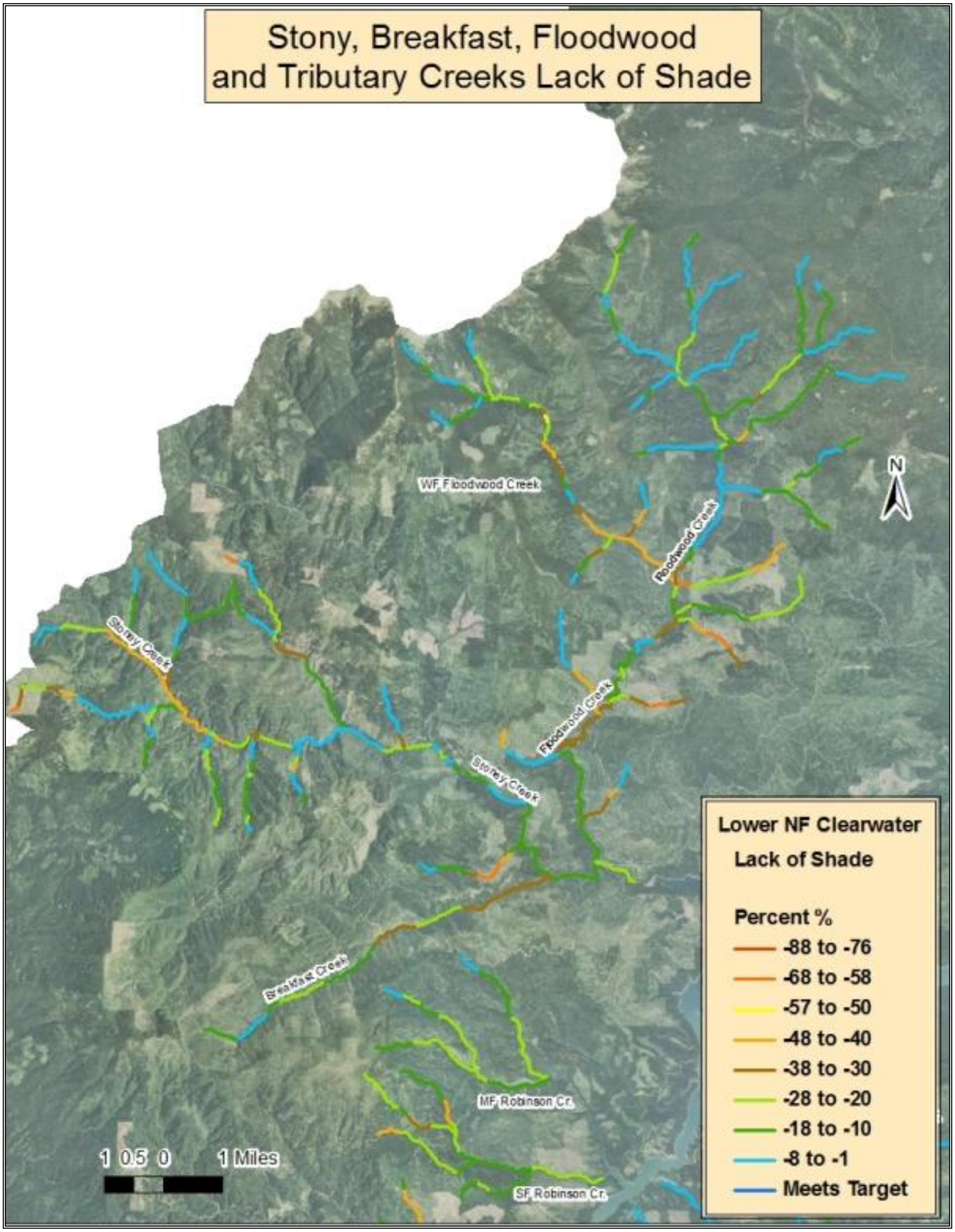

Figure 22. Lack of shade: Stony Creek, Breakfast Creek, Floodwood Creek, and tributaries.

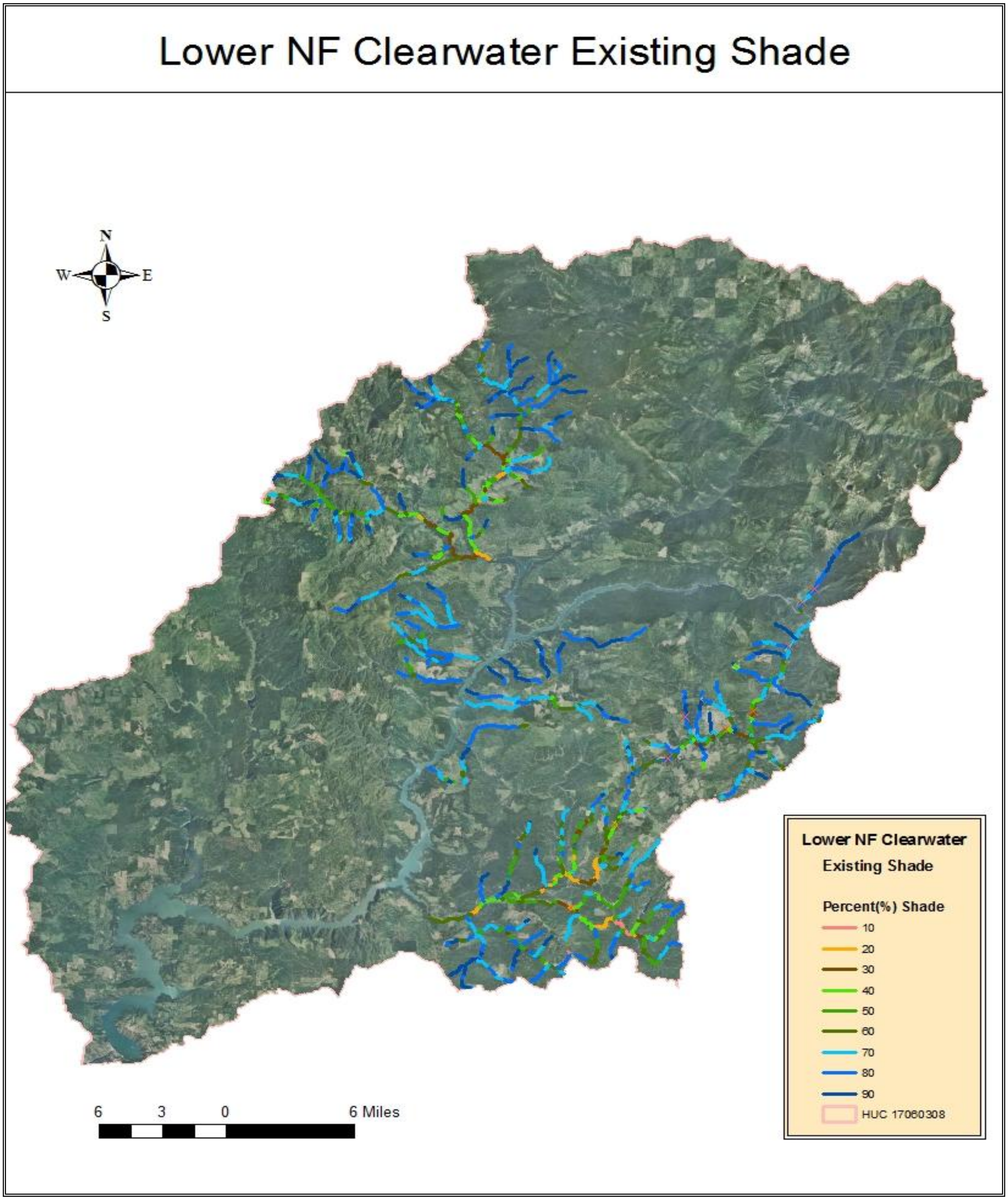

Figure 23. Existing shade: Lower North Fork Clearwater River subbasin.

5.4 Load Allocation

Because this TMDL is based on PNV, which is equivalent to background loading, the load allocation is essentially the desire to achieve background conditions. However, 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. Tables D1–D17 in Appendix D show the target shade and corresponding target summer load. This target load (i.e., load capacity) is necessary to achieve background conditions. There is no opportunity to further remove shade from the stream by any activity without exceeding this load capacity. Additionally, because this TMDL is dependent upon background conditions for achieving water quality standards, all tributaries to the waters examined here need to be in natural conditions in order to prevent excess heat loads to the system.

Tables D1–D17 in Appendix D show the total existing, target, and excess heat load (in kWh/day) and the average lack of shade for each water body examined. The size of a stream influences the size of the excess load. Large streams have higher existing and target loads by virtue of their larger channel widths.

Although this TMDL analysis focuses on total heat loads, it is important to note that differences between existing and target shade, as depicted in Table 15 and the lack-of-shade figures (Figures 10, 13, 16, 19, and 22), are the key to successfully restoring these waters to achieving water quality standards. Target shade levels for individual reaches should be the goal managers strive for with future implementation plans. Managers should focus on the largest differences between existing and target shade as locations to prioritize implementation efforts. Each load analysis table in Appendix D (Tables D1–D17) contains a final column that lists the lack of shade on the stream segment. This value is derived from subtracting target shade from existing shade for each segment. Thus, stream segments with the largest lack of shade are in the worst shape. The lack of shade listed for each segment was averaged for the entire AU (or AUs) and listed in Table 15 to provide a general level of comparison among streams.

Table 16. Overall average lack of shade for TMDL streams.

Stream Name	Assessment Unit	Average Lack of Shade
Elkberry Creek	ID17060308CL002_02b	-19%
Middle Fork Robinson Creek	ID17060308CL002_02c	-25%
Gold Creek, Meadow Creek and Tribs	ID17060308CL003_02	-24%
Reeds Creek	ID17060308CL003_03, ID17060308CL003_04	-16%
Reeds Creek and tributaries	ID17060308CL004_02	-31%
Reeds Creek	ID17060308CL004_03	-23%
Alder Creek	ID17060308CL005_02	-29%
Beaver Creek	ID17060308CL009_02	-25%
Bingo Creek	ID17060308CL009_02c	-24%
Beaver Creek tributaries	ID17060308CL009_02e	-20%
Beaver Creek	ID17060308CL009_03, ID17060308CL009_04	-10%
Isabella Creek	ID17060308CL010_03	+16% (exceeds target)
Stony Creek and tributaries	ID17060308CL020_02, ID17060308CL020_04,	-21%
Floodwood Creek tributaries	ID17060308CL021_02	-24%
Floodwood Creek	ID17060308CL021_02a, ID17060308CL021_03a, ID17060308CL021_03	-16%
Stony Creek	ID17060308CL023_02, ID17060308CL023_02a, ID17060308CL023_03	-22%
Breakfast Creek	ID17060308CL025_02 ID17060308CL020_04a	-21%

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 as a 10% shade class and target shade is a unique integer from 0 through 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 stream segment were at target level, it would be recorded as 80% in the load 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 Wasteload Allocation

There are no known NPDES-permitted point sources in the affected watersheds and no wasteload allocations. If a new point source is proposed that would have thermal consequence on these waters, then background provisions in Idaho water quality standards addressing such discharges (IDAPA 58.01.02.200.09 and .02.401.01) should be involved.

Construction Stormwater

The Clean Water Act requires operators of construction sites to obtain permit coverage to discharge stormwater to a water body or municipal storm sewer. In 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 (SWPPP). Operators must document the erosion, sediment, and pollution controls they intend to use; inspect the controls periodically; and maintain 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 operators obtain a CGP under the NPDES program and implement appropriate BMPs.

Typically, operators must follow specific requirements 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 2005).

Multi-Sector Stormwater

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.

5.4.2 Margin of Safety

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

5.4.3 Seasonal Variation

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

5.5 Implementation Strategies

Implementation strategies for TMDLs produced using PNV-based shade and solar loads should incorporate the load analysis tables presented in this TMDL (Appendix E). These tables need to be updated, first to field-verify (or adjust) the existing shade levels (those that have not yet been field-verified) and second to monitor progress toward achieving reductions and TMDL goals. Using a Solar Pathfinder to measure existing shade levels in the field is important to achieving both objectives. Further field verification will likely find discrepancies between field-verified shade levels and reported existing shade levels used in the load analysis tables. Due to the inexact nature of the aerial photo interpretation technique, these tables should not be viewed as complete until verified. Implementation strategies should include Solar Pathfinder monitoring to simultaneously field-verify the TMDL and monitor progress toward achieving desired load reductions.

As mentioned earlier, shade monitoring is being conducted as part of DEQ/IDL FPA Quadrennial Audits and other monitoring projects. This work is informing the Idaho Forest Practices Act Advisory Committee which is promulgating revised Stream Protection Zone (SPZ) vegetation standards. These standards are based on extensive modeling of stream side vegetation data collected in the region. This process is part of the ongoing adaptive management built into the Forest Practices Act, the BMP authority for regulating forest practices BMPs on state and private land in Idaho.

In addition, for all streams in this subbasin, the IDL on endowment lands is implementing additional stream Riparian Protection Zone (RPZ) standards as part of the Snake River Basin Adjudication Idaho Forestry Program. These standards include more stringent retention requirements for both Class I and Class IIa (class I adjacent portions of class II streams). These include no harvest zones, extended buffer (partial cut) zones with higher tree retention, and a suite of more restrictive road management practices.Of the factors influencing shade, streamside vegetation and channel morphology are the ones that have been altered by anthropogenic activities and can be most readily corrected. If implemented successfully, projects designed to increase shade may also have a positive impact on channel and streambank restoration, which can eliminate certain sources of pollution and reduce other pollutant concentrations in the subbasin while simultaneously reducing stream temperature.

Additionally, along Floodwood, Isabella, Stoney and Glover Creeks, due to the difficult terrain and hazardous soils, the state has designated a wider SPZ and moved more acres (than otherwise required by standard FPA rules) into Secondary Base land use designation (R1 and R2) along the stream. This requires more management flexibility as to timing and intensity of management activities. R1 is restricted harvest (little or no removals). R2 is part of secondary management base where occasional amounts of high value products may be removed (such as cedar utility poles).

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 those goals.

5.5.1 Time Frame

A schedule for implementing BMPs, pollution control strategies, assessment reporting dates, and progress evaluations will be developed with appropriate designated management agencies and the WAG. Based on such assessments and evaluations, implementation strategies for TMDLs may need to be modified if monitoring shows that the water quality standards are not being met.

5.5.2 Approach

The TMDLs presented in this section focus on excess heat loading to the tributaries in the Lower North Fork Clearwater River subbasin and express this excess load as a lack of riparian shade along these streams. Nonpoint source BMPs designed to reduce excess heat loading to the streams should be applied within the watershed by the designated management agencies responsible for such activities. Restoration projects designed to increase riparian shade and restore streambanks should be undertaken.

The WAG will play a valuable role in identifying private landowners within the watershed who wish to voluntarily participate in restoration projects aimed at reducing stream temperature and restoring altered stream segments.

5.5.3 Responsible Parties

Idaho Code 39-3612 states that designated management agencies are to use the TMDL processes for achieving water quality standards. DEQ relies 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 and applicable state and federal agencies and will enlist their involvement and authorities for protecting water quality through implementing Idaho water quality standards and the Clean Water Act §401.

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

- Idaho Soil and Water Conservation Commission for grazing and agriculture
- Idaho State Department of Agriculture for aquaculture and animal feeding operations
- Idaho Transportation Department for public roads

- Idaho Department of Lands for timber harvest, oil and gas exploration, and mining
- Idaho Department of Water Resources for stream channel alteration activities
- Idaho Department of Environmental Quality for all other activities

5.5.4 Monitoring Strategy

Idaho Code 39-3611 requires DEQ to review and evaluate each Idaho TMDL, subbasin assessment, implementation plan, and all available data periodically, at intervals no greater than 5 years. Such reviews are to be conducted using the BURP protocol and the *Water Body Assessment Guidance* methodology to determine beneficial use attainability and status and determine whether state water quality standards are being achieved (Grafe et al. 2002).

Water quality monitoring stations should be established at the mouth and at the AU boundary of TMDL streams. These stations would be used for long-term monitoring to assess trends in cumulative pollutant loading identified by this TMDL. Beneficial use support status monitoring and assessment will be conducted within each AU and evaluated using the *Water Body Assessment Guidance* for compliance with Idaho state water quality standards.

Idaho Code 39-3621 requires designated agencies, in cooperation with the appropriate land management agency, ensure BMPs are monitored for their effect on water quality. The monitoring results should be presented to DEQ on a schedule agreed to between the designated agency and DEQ. The designated management agency should report to DEQ the effectiveness of the measures or practices implemented, including load reductions applicable to the TMDL.

Pollutant load reductions gained by applying pollutant controls and BMPs will be monitored by DEQ through reports provided by designated management agencies. Information reported will be compiled and tracked over time to determine measurable pollutant load reductions relative to the TMDL allocations.

To determine the accuracy of effective shade estimates, monitoring can be conducted on any segment throughout the subbasin and be compared to estimates of existing shade seen in Figures 9, 12, 15, 18, 21, and 23. Those areas with the largest disparity between existing and target shade should be monitored with Solar Pathfinders to verify or adjust the existing shade levels and to determine progress toward meeting shade targets. Since many existing shade estimates have not been field-verified, they may require adjustment during the TMDL implementation process. Stream segment length for each estimate of existing shade varies depending on the land use or landscape that has affected that shade level. It is appropriate to monitor within a given existing shade segment to see if that segment has increased its existing shade toward target levels. Ten equally spaced Solar Pathfinder measurements averaged together within that segment should suffice to determine new shade levels in the future.

Table 17. Summary of assessment outcomes.

Water Body Name	Assessment Unit	Pollutant	TMDL(s) Completed	Recommended Changes to Idaho's Integrated Report	Justification
Elkberry Creek	ID17060308CL002_02b	Temperature	Yes	Move to Category 4a	TMDL Completed
Middle Fork Robinson Creek	ID17060308CL002_02c	Temperature	Yes	Move to Category 4a	TMDL Completed
Gold Creek,, Meadow Creek and Tribs	ID17060308CL003_02	Temperature	Yes	Move to Category4a	TMDL Completed
Reeds Creek	ID17060308CL003_03, ID17060308CL003_04	Temperature	Yes	Move to Category 4a	TMDL Completed
Reeds Creek and tributaries	ID17060308CL004_02	Temperature	Yes	Move to Category 4a	TMDL Completed
Reeds Creek	ID17060308CL004_03	Temperature	Yes	Move to Category 4a	TMDL Completed
Alder Creek	ID17060308CL005_02	Temperature	Yes	Move to Category 4a	TMDL Completed
Beaver Creek	ID17060308CL009_02	Temperature	Yes	Move to Category 4a	TMDL Completed
Bingo Creek	ID17060308CL009_02c	Temperature	Yes	Move to Category 4a	TMDL Completed
Beaver Creek tributaries	ID17060308CL009_02e	Temperature	Yes	Move to Category 4a	TMDL Completed
Beaver Creek	ID17060308CL009_03, ID17060308CL009_04	Temperature	Yes	Move to Category 4a	TMDL Completed
Isabella Creek	ID17060308CL010_03	Temperature	Yes	Move to Category 4a	TMDL Completed
Stony Creek and tributaries	ID17060308CL020_02, ID17060308CL020_04	Temperature	Yes	Move to Category 4a	TMDL Completed
Floodwood Creek tributaries	ID17060308CL021_02	Temperature	Yes	Move to Category 4a	TMDL Completed
Floodwood Creek	ID17060308CL021_02a, ID17060308CL021_03a, ID17060308CL021_03	Temperature	Yes	Move to Category 4a	TMDL Completed
Stony Creek	ID17060308CL023_02, ID17060308CL023_02a, ID17060308CL023_03	Temperature	Yes	Move to Category 4a	TMDL Completed
Breakfast Creek	ID17060308CL020_04a ID17060308CL025_02	Temperature	Yes	Move to Category 4a	TMDL Completed
Deer Creek Reservoir	ID17060308CL004_02	n/a	No	Split AU to ID170308CL004_02L	Reservoir

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Glossary

§305(b)

Refers to section 305 subsection “b” of the Clean Water Act. The term “305(b)” generally describes a report of each state’s water quality and is the principle means by which the US Environmental Protection Agency, Congress, and the public evaluate whether US waters meet water quality standards, the progress made in maintaining and restoring water quality, and the extent of the remaining problems.

§303(d)

Refers to section 303 subsection “d” of the Clean Water Act. Section 303(d) requires states to develop a list of water bodies that do not meet water quality standards. This section also requires total maximum daily loads (TMDLs) be prepared for listed waters. Both the list and the TMDLs are subject to US Environmental Protection Agency approval.

Anoxia

The condition of oxygen absence or deficiency.

Anthropogenic

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

Aquatic

Occurring, growing, or living in water.

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 pollutant 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.

Beneficial Use Reconnaissance Program (BURP)

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

Best Management Practices (BMPs)

Structural, nonstructural, and 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).

Biota

The animal and plant life of a given region.

Clean Water Act

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 on, 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.

Cubic Feet per Second (cfs)

A unit of measure for the rate of flow or discharge of water. One cubic foot per second is the rate of flow of a stream with a cross-section of one square foot flowing at a mean velocity of one foot per second. At a steady rate, 1 cubic foot per second is equal to 448.8 gallons per minute and 10,984 acre-feet per day.

Designated Uses

Those water uses identified in state water quality standards that must be achieved and maintained as required under the Clean Water Act.

Discharge

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

Dissolved Oxygen (DO)

The oxygen dissolved in water. Adequate DO is vital to fish and other aquatic life.

Disturbance

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

E. coli

Short for *Escherichia coli*, *E. coli* are a subspecies of coliform bacteria. Most *E. coli* are essential to the healthy life of all warm-blooded animals, including humans, but their presence in water is often indicative of fecal contamination. *E. coli* are used by the State of Idaho as the indicator for the presence of pathogenic microorganisms.

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.

Existing Beneficial Use or Existing Use

A beneficial use actually attained in waters on or after November 28, 1975, whether or not the use is designated for the waters in Idaho's water quality standards (IDAPA 58.01.02).

Fully Supporting

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

Fully Supporting Cold Water

Reliable data indicate functioning, sustainable cold water biological assemblages (e.g., fish, macroinvertebrates, or algae), none of which have been modified significantly beyond the natural range of reference conditions.

Geographic Information Systems (GIS)

A georeferenced database.

Geometric Mean

A back-transformed mean of the logarithmically transformed numbers often used to describe highly variable, right-skewed data (a few large values), such as bacterial data.

Gradient

The slope of the land, water, or streambed surface.

Ground Water

Water found beneath the soil surface saturating the layer in which it is located. Most ground water originates as rainfall, is free to move under the influence of gravity, and 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, 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 and often used to refer to the land area encompassed by the 4th-field hydrologic units.

Instantaneous

A condition or measurement at a moment (instant) in time.

Load Allocation (LA)

A portion of a water body’s load capacity for a given pollutant that is given to a particular nonpoint source (by class, type, or geographic area).

Load(ing)

The quantity of a substance entering a receiving stream, usually expressed in pounds or kilograms per day or tons per year. A load is the product of flow (discharge) and concentration.

Load Capacity (LC)

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

Macroinvertebrate

An invertebrate animal (without a backbone) large enough to be seen without magnification and retained by a 500 micrometer mesh (U.S. #30) screen.

Margin of Safety (MOS)

An implicit or explicit portion of a water body's loading capacity set aside to allow for uncertainty about the relationship between the pollutant loads and the quality of the receiving water body. The margin of safety is a required component of a total maximum daily load (TMDL) and is often incorporated into conservative assumptions used to develop the TMDL (generally within the calculations and/or models). The margin of safety is not allocated to any sources of pollution.

Mean

Describes the central tendency of a set of numbers. The arithmetic mean (calculated by adding all items in a list, then dividing by the number of items) is the statistic most familiar to most people.

Milligrams per Liter (mg/L)

A unit of measure for concentration. In water, it is essentially equivalent to parts per million (ppm).

Monitoring

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

Mouth

The location where flowing water enters into a larger 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.

Nitrogen

An element essential to plant growth and thus considered a nutrient.

Nonpoint Source

A dispersed source of pollutants generated from a geographical area when pollutants are dissolved or suspended in runoff and then delivered into waters of the state. Nonpoint sources are without a discernable point or origin and include, but are not limited to, irrigated and nonirrigated lands used for grazing, crop production, and silviculture; rural roads; construction and mining sites; log storage or rafting; and recreation sites.

Not Assessed (NA)

A concept and an assessment category describing water bodies that have been studied but are missing critical information needed to complete an assessment.

Not Attainable

A concept and an assessment category describing water bodies with characteristics that make it unlikely that a beneficial use can be attained (e.g., a stream that is dry but designated for salmonid spawning).

Not Fully Supporting

Not in compliance with water quality standards or not within the range of biological reference conditions for any beneficial use as determined through the *Water Body Assessment Guidance* (Grafe et al. 2002).

Not Fully Supporting Cold Water

At least one biological assemblage has been significantly modified beyond the natural range of its reference condition.

Nutrient	Any substance required by living things to grow. An element or its chemical forms essential to life, such as carbon, oxygen, nitrogen, and phosphorus. Commonly refers to those elements in short supply, such as nitrogen and phosphorus, which usually limit growth.
Nutrient Cycling	The flow of nutrients from one component of an ecosystem to another, as when macrophytes die and release nutrients that become available to algae (organic to inorganic phase and return).
Parameter	A variable, measurable property whose value is a determinant of the characteristics of a system (e.g., temperature, dissolved oxygen, and fish populations are parameters of a stream or lake).
Pathogens	A small subset of microorganisms (e.g., certain bacteria, viruses, and protozoa) that can cause sickness or death. Direct measurement of pathogen levels in surface water is difficult. Consequently, indicator bacteria that are often associated with pathogens are assessed. *E. coli*, a type of fecal coliform bacteria, are used by the State of Idaho as the indicator for the presence of pathogenic microorganisms.
pH	The negative $\log_{10}$ of the concentration of hydrogen ions—a measure which in water ranges from very acid (pH = 1) to very alkaline (pH = 14). A pH of 7 is neutral. Surface waters usually measure between pH 6 and 9.
Phosphorus	An element essential to plant growth, often in limited supply, and thus considered a nutrient.
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. Pollution includes human-induced alteration of the physical, biological, chemical, and radiological integrity of water and other media.
Protocol	A series of formal steps for conducting a test or survey.
Qualitative	Descriptive of kind, type, or direction.
Quantitative	Descriptive of size, magnitude, or degree.
Reach	A stream section with fairly homogenous physical characteristics.
Reconnaissance	An exploratory or preliminary survey of an area.

Reference	A physical or chemical quantity whose value is known and is used to calibrate or standardize instruments.
Reference Condition	1) A condition that fully supports applicable beneficial uses with little effect from human activity and represents the highest level of support attainable. 2) A benchmark for populations of aquatic ecosystems used to describe desired conditions in a biological assessment and acceptable or unacceptable departures from them. The reference condition can be determined through examining regional reference sites, historical conditions, quantitative models, and expert judgment (Hughes 1995).
Reference Site	A specific locality on a water body that is minimally impaired and is representative of reference conditions for similar water bodies.
Riparian	Associated with aquatic (stream, river, lake) habitats. Living or located on the bank of a water body.
River	A large natural or human-modified stream that flows in a defined course or channel or in a series of diverging and converging channels.
Runoff	The portion of rainfall, melted snow, or irrigation water that flows across the land surface, through shallow underground zones (interflow), and through ground water to create streams.
Sediments	Deposits of fragmented materials from weathered rocks and organic material that were suspended in, transported by, and eventually deposited by water or air.
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.
Stratification	An Idaho Department of Environmental Quality classification method used to characterize comparable units (also called classes or strata).
Stream	A natural water course containing flowing water at least part of the year. Together with dissolved and suspended materials, a stream normally supports communities of plants and animals within the channel and the riparian vegetation zone.
Stream Order	Hierarchical ordering of streams based on the degree of branching. A 1st-order stream is an unforked or unbranched stream. Under Strahler's (1957) system, higher-order streams result from two streams of the same order joining.
Stormwater Runoff	Rainfall that quickly runs off the land after a storm. In developed watersheds, the water flows off roofs and pavement into storm drains that may feed quickly and directly into the stream. The water often carries pollutants picked up from these surfaces.

Subbasin
A large watershed of several hundred thousand acres, and 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.

Subwatershed
A smaller watershed area delineated within a larger watershed, often for purposes of describing and managing localized conditions. Also proposed for adoption as the formal name for 6th-field hydrologic units.

Surface Runoff
Precipitation, snow melt, or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions; a major transporter of nonpoint source pollutants in rivers, streams, and lakes. Surface runoff is also called overland flow.

Surface Water
All water naturally open to the atmosphere (e.g., rivers, lakes, reservoirs, streams, impoundments, seas, estuaries) and all springs, wells, or other collectors that are directly influenced by surface water.

Total Maximum Daily Load (TMDL)
A TMDL is a water body’s load capacity after it has been allocated among pollutant sources, a margin of safety, and natural background contributions. 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.

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

Wasteload Allocation (WLA)
The portion of a 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 Column
Water between the interface with the air at the surface and the sediment layer at the bottom. The idea derives from a vertical series of measurements (oxygen, temperature, phosphorus) used to characterize water.

Water Pollution
Any alteration of the physical, thermal, chemical, biological, or radioactive properties of any waters of the state, or the discharge of any pollutant into the waters of the state, which will or is likely to create a nuisance or 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. 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.

Water Table

The upper surface of ground water; below this point, the soil is saturated with water.

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.

Water Body Identification Number (WBID)

A number that uniquely identifies a water body in Idaho and ties in to the Idaho water quality standards and GIS information.

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Appendix A. Unit Conversion Chart

Table A1. Metric–English unit conversions.

	English Units	Metric Units	To Convert	Example
Distance	Miles (mi)	Kilometers (km)	1 mi = 1.61 km 1 km = 0.62 mi	3 mi = 4.83 km 3 km = 1.86 mi
Length	Inches (in) Feet (ft)	Centimeters (cm) Meters (m)	1 in = 2.54 cm 1 cm = 0.39 in 1 ft = 0.30 m 1 m = 3.28 ft	3 in = 7.62 cm 3 cm = 1.18 in 3 ft = 0.91 m 3 m = 9.84 ft
Area	Acres (ac) Square feet (ft^2) Square miles (mi^2)	Hectares (ha) Square meters (m^2) Square kilometers (km^2)	1 ac = 0.40 ha 1 ha = 2.47 ac 1 ft^2 = 0.09 m^2 1 m^2 = 10.76 ft^2 1 mi^2 = 2.59 km^2 1 km^2 = 0.39 mi^2	3 ac = 1.20 ha 3 ha = 7.41 ac 3 ft^2 = 0.28 m^2 3 m^2 = 32.29 ft^2 3 mi^2 = 7.77 km^2 3 km^2 = 1.16 mi^2
Volume	Gallons (gal) Cubic feet (ft^3)	Liters (L) Cubic meters (m^3)	1 gal = 3.78 L 1 L= 0.26 gal 1 ft^3 = 0.03 m^3 1 m^3 = 35.32 ft^3	3 gal = 11.35 L 3 L = 0.79 gal 3 ft^3 = 0.09 m^3 3 m^3 = 105.94 ft^3
Flow Rate	Cubic feet per second (cfs)[a]	Cubic meters per second (m^3/sec)	1 cfs = 0.03 m^3/sec 1 m^3/sec = 35.31 cfs	3 cfs = 0.09 m^3/sec 3 m^3/sec = 105.94 cfs
Concentration	Parts per million (ppm)	Milligrams per liter (mg/L)	1 ppm = 1 mg/L[b]	3 ppm = 3 mg/L
Weight	Pounds (lb)	Kilograms (kg)	1 lb = 0.45 kg 1 kg = 2.20 lb	3 lb = 1.36 kg 3 kg = 6.61 lb
Temperature	Fahrenheit (°F)	Celsius (°C)	°C = 0.55 (F - 32) °F = (C x 1.8) + 32	3 °F = -15.95 °C 3 °C = 37.4 °F

[a] 1 cfs = 0.65 million gallons per day; 1 million gallons per day = 1.55 cfs.
[b] The ratio of 1 ppm = 1 mg/L is approximate and is only accurate for water.

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Appendix B. 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 with species. For spring spawning salmonids, the default spawning and incubation period recognized by the Idaho Department of Environmental Quality (DEQ) is generally from March 15 to July 15 each year (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. Per IDAPA 58.01.02.250.02.f.ii., the water quality criteria that need to be met during those time periods are as follows:

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

For the purposes of a temperature total maximum daily load (TMDL), the highest recorded water temperature in a recorded data set (excluding any high water temperatures that occurred on days when air temperatures exceeded 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 warmer 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 C. Water Quality Data

Table C1. Cedar Creek (ID17060308CL002_02d) *E. coli* data.

Sample Date	Sample Time	E. coli (cfu/100 mL)
8/19/2008	10:40	980.4
9/23/2008	1:15	157.6
9/26/2008	10:15	22.1
10/1/2008	12:00	21.3
10/5/2008	10:45	461.1
10/9/2008	1:50	95.9
	Geometric Mean	**121.4**

Table C2. Elk Creek above reservoir (ID17060308CL030_03a) data.

Sample Date	Sample Time	E. coli (cfu/100 mL)	NO_2+NO_3-N (mg/L)	TP (mg/L)	NH_3-N (mg/L)
8/19/2008	11:30	114.5	ND	0.0447	ND
9/2/2008	11:40	—	ND	0.0248	ND
9/23/2008	2:00	—	ND	0.0315	ND
9/26/2008	11:00	—	ND	0.0279	ND
10/1/2008	11:30	—	ND	0.29	0.056
10/5/2008	12:00	—	ND	0.405	ND
10/9/2008	3:00	—	ND	0.286	0.067

Table C3. Elk Creek below reservoir (ID17060308CL030_03b) data.

Sample Date	Sample Time	E. coli cfu/100 mL)	NO_2+NO_3-N (mg/L)	TP (mg/L)	NH_3-N (mg/L)
8/19/2008	11:15	12	ND	0.0208	ND
9/2/2008	11:10	—	ND	0.0247	ND
9/23/2008	12:30	—	ND	0.0297	0.062
9/26/2008	10:45	—	ND	0.0276	ND
10/1/2008	11:40	—	ND	0.261	0.069
10/5/2008	11:30	—	ND	0.285	ND
10/9/2008	2:50	—	ND	0.412	0.061

Table C4. Long Meadow Creek (ID17060308CL034_03) *E. coli* data.

Sample Date	Sample Time	E. coli (cfu/100 mL)
8/19/2008	8:30	62
9/23/2008	11:30	41.6
9/26/2008	9:30	3.1
10/1/2008	10:00	17.3
10/5/2008	9:25	185
10/9/2008	12:30	9.7
	Geometric Mean	**25.1**

Table C5. Oviatt Creek (ID17060308CL034_02) *E. co*li data.

Sample Date	Sample Time	E. coli (cfu/100 mL)
8/19/2008	9:20	2419.2
9/23/2008	11:00	365.4
9/26/2008	9:00	46.7
10/1/2008	9:30	151.5
10/5/2008	9:00	1413.6
10/9/2008	1:00	248.1
	Geometric Mean	**360.4**

Table C6. Partridge Creek (ID17060308CL030_02d) *E. coli* data.

Sample Date	Sample Time	E. coli (cfu/100 mL)
8/19/2008	10:00	23.3

Table C7. Round Meadow Creek (ID17060308CL034_02) *E. coli* data.

Sample Date	Sample Time	E. coli (cfu/100 mL)
8/19/2008	9:00	59.1
9/23/2008	11:20	93.4
9/26/2008	9:20	26.2
10/1/2008	9:40	19.3
10/5/2008	9:15	2419.2
10/9/2008	12:40	218.7
	Geometric Mean	**106.7**

Table C8. Three Bear Creek (ID17060308CL034_02) *E. coli* data.

Sample Date	Sample Time	E. coli (cfu/100 mL)
8/19/2008	8:00	81.3

Appendix D. Mesic Shade Curves

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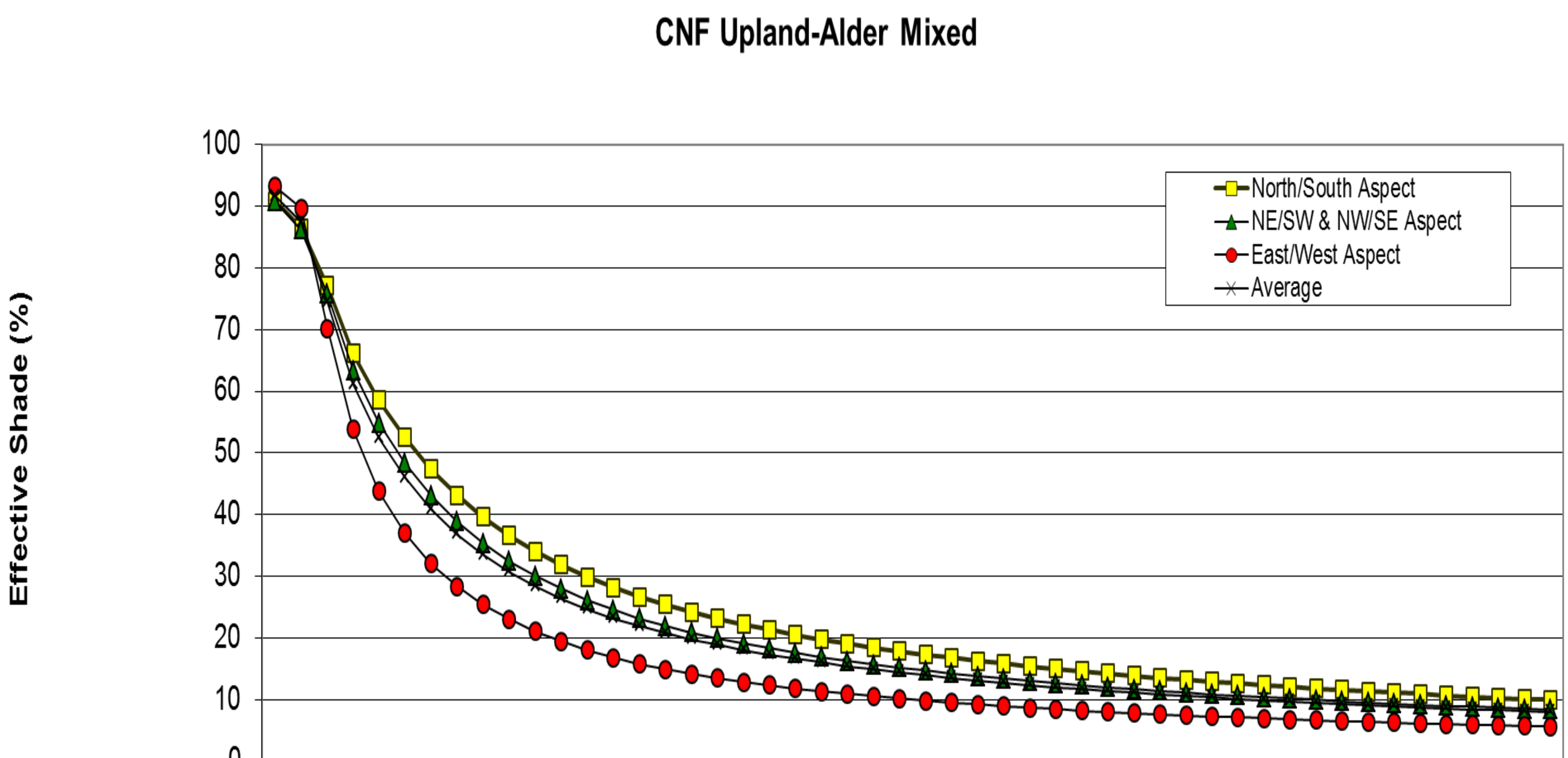
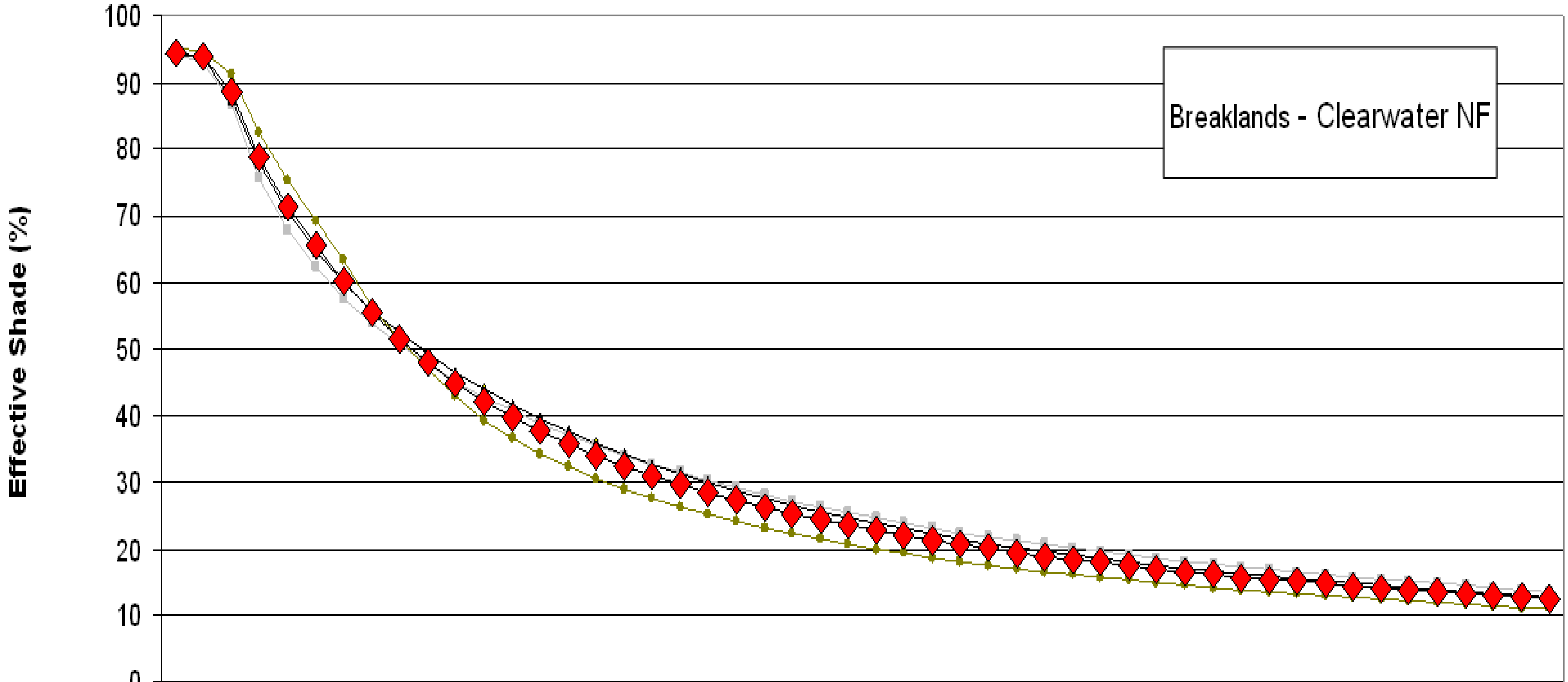


	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
North/South Aspect	91	86	77	66	59	52	47	43	40	37	34	32	30	28	27	25	24	23	22	21	21	20	19	18	18
NE/SW & NW/SE Aspect	91	86	76	63	55	48	43	39	35	32	30	28	26	25	23	22	21	20	19	18	18	17	16	16	15
East/West Aspect	93	90	70	54	44	37	32	28	25	23	21	19	18	17	16	15	14	13	13	12	12	11	11	10	10
Average	92	87	74	61	52	46	41	37	33	31	28	26	25	23	22	21	20	19	18	17	17	16	15	15	14

	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	17	17	16	16	15	15	15	14	14	13	13	13	13	12	12	12	12	11	11	11	11	10	10	10	10
NE/SW & NW/SE Aspect	15	14	14	13	13	13	12	12	12	11	11	11	11	10	10	10	10	10	9	9	9	9	9	8	8
East/West Aspect	10	9	9	9	9	8	8	8	8	8	7	7	7	7	7	7	6	6	6	6	6	6	6	6	6
Average	14	13	13	13	12	12	12	11	11	11	11	10	10	10	10	9	9	9	9	9	9	8	8	8	8

Figure A1. System Potential Effective Shade at Various Stream Aspect and Stream Width Conditions.

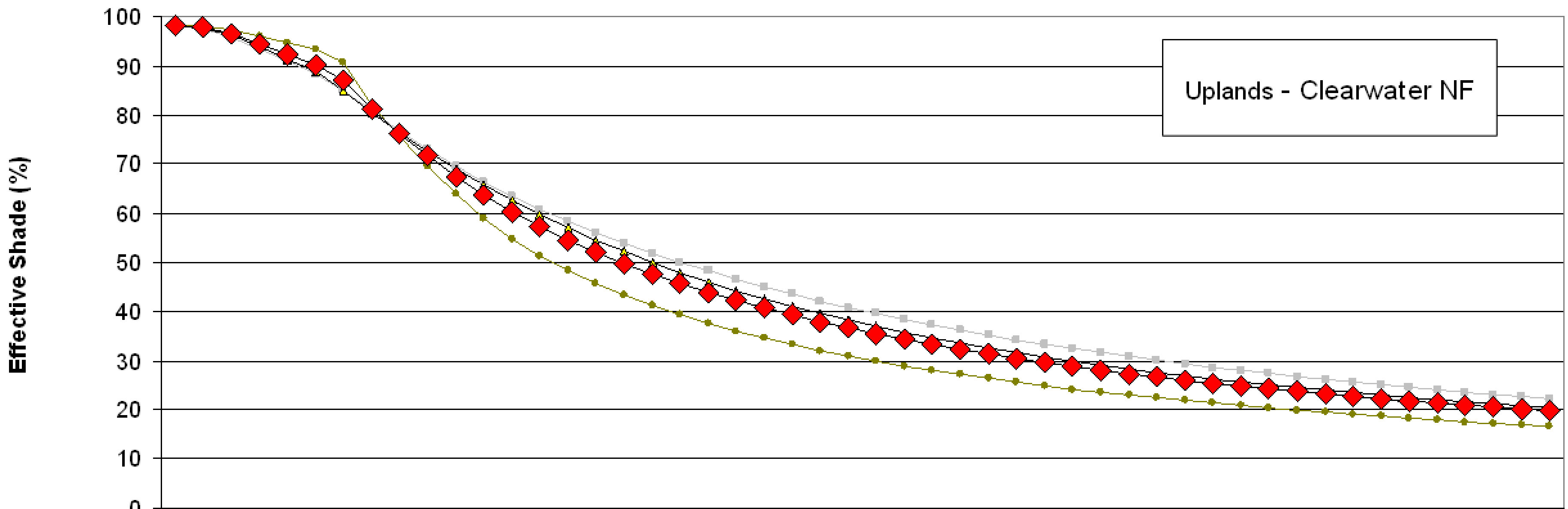


	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
North - South	94	93	87	76	68	62	58	54	51	48	45	43	41	39	37	36	34	33	31	30	29	28	27	26	25
Northeast/Southwest	94	94	88	78	70	65	60	56	52	49	47	44	42	40	38	36	34	33	31	30	29	28	27	26	25
East - West	95	95	91	82	75	69	63	56	51	47	43	39	37	34	32	31	29	28	26	25	24	23	22	21	21
Average	95	94	89	79	71	65	60	55	51	48	45	42	40	38	36	34	32	31	30	28	27	26	25	24	24

	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	25	24	23	22	22	21	21	20	20	19	19	18	18	17	17	16	16	16	15	15	15	14	14	14	14
Northeast/Southwest	24	23	22	22	21	20	20	19	19	18	18	17	17	16	16	16	15	15	15	14	14	14	13	13	13
East - West	20	19	19	18	18	17	17	16	16	15	15	15	14	14	14	13	13	13	12	12	12	12	11	11	11
Average	23	22	21	21	20	19	19	18	18	17	17	17	16	16	15	15	15	14	14	14	14	13	13	13	12

"Vegetation" Channel Width (meters) and Calculated Shade Conditions

Figure A2. System Potential Effective Shade at Various Stream Aspect and Stream Width Conditions.

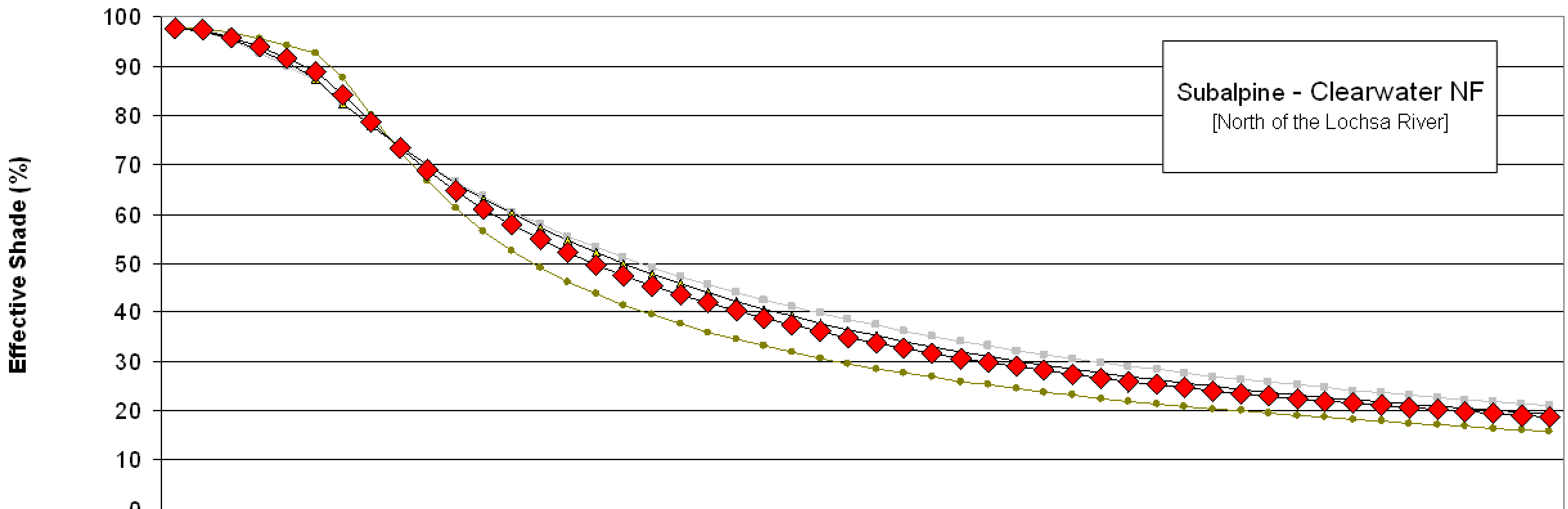


	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
North - South	98	98	96	93	91	88	85	81	77	73	70	66	64	61	58	56	54	52	50	48	47	45	44	42	41
Northeast/Southwest	98	98	96	94	91	89	85	80	76	73	69	66	63	60	57	55	52	50	48	46	44	43	41	40	38
East - West	98	98	97	96	95	93	91	82	76	70	64	59	55	51	48	46	43	41	39	38	36	35	33	32	31
Average	98	98	96	94	92	90	87	81	76	72	68	64	60	57	55	52	50	48	46	44	42	41	39	38	37

	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	40	38	37	36	35	34	33	32	32	31	30	29	29	28	27	27	26	26	25	25	24	24	23	23	22
Northeast/Southwest	37	36	35	34	33	32	31	30	29	28	28	27	26	26	25	25	24	23	23	22	22	22	21	21	20
East - West	30	29	28	27	26	26	25	24	24	23	22	22	21	21	20	20	19	19	19	18	18	18	17	17	17
Average	35	34	33	32	31	30	30	29	28	27	27	26	25	25	24	24	23	23	22	22	21	21	21	20	20

"Vegetation" Channel Width (meters) and Calculated Shade Conditions

Figure A3. System Potential Effective Shade at Various Stream Aspect and Stream Width Conditions.



"Vegetation" Channel Width (meters)	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	98	97	95	93	90	87	82	78	74	70	67	63	61	58	55	53	51	49	47	46	44	43	41	40	39
Northeast/Southwest	98	97	96	93	91	87	82	78	74	70	66	63	60	57	55	52	50	48	46	44	42	41	39	38	36
East - West	98	98	97	96	94	93	88	80	73	67	61	56	52	49	46	44	41	39	38	36	35	33	32	31	30
Average	98	97	96	94	92	89	84	79	73	69	65	61	58	55	52	50	48	45	44	42	40	39	37	36	35

"Vegetation" Channel Width (meters)	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	37	36	35	34	33	32	31	31	30	29	28	28	27	26	26	25	25	24	24	23	23	22	22	21	21
Northeast/Southwest	35	34	33	32	31	30	29	28	28	27	26	26	25	24	24	23	23	22	22	21	21	20	20	20	19
East - West	29	28	27	26	25	24	24	23	23	22	21	21	20	20	19	19	19	18	18	17	17	17	16	16	16
Average	34	33	32	31	30	29	28	27	27	26	25	25	24	24	23	23	22	22	21	21	20	20	19	19	19

"Vegetation" Channel Width (meters) and Calculated Shade Conditions

Figure A4. System Potential Effective Shade at Various Stream Aspect and Stream Width Conditions.

Appendix E. Load Analysis Tables

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Table E1. Elkberry Creek load analysis (AU ID17060308CL002_02b).

Segment Details				Target					Existing					Summary	
Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
AU CL002_02b															
Slide Cr.	1	310	Mesic	98%	0.11	1	300	30	50%	2.75	1	300	800	800	-48%
Slide Cr.	2	355	Mesic	98%	0.11	1	400	40	90%	0.55	1	400	200	200	-8%
Slide Cr.	3	260	Mesic	98%	0.11	1	300	30	50%	2.75	1	300	800	800	-48%
Slide Cr.	4	1035	Mesic	98%	0.11	1	1,000	100	70%	1.65	1	1,000	2,000	2,000	-28%
Slide Cr.	5	585	Mesic	98%	0.11	2	1,000	100	80%	1.10	2	1,000	1,000	900	-18%
Chute Cr.	6	595	Mesic	98%	0.11	1	600	70	70%	1.65	1	600	1,000	900	-28%
Chute Cr.	7	465	Mesic	98%	0.11	1	500	60	60%	2.20	1	500	1,000	900	-38%
Chute Cr.	8	1135	Mesic	98%	0.11	1	1,000	100	70%	1.65	1	1,000	2,000	2,000	-28%
Chute Cr.	9	1085	Mesic	98%	0.11	1	1,000	100	90%	0.55	1	1,000	600	500	-8%
LittleSilver Cr.	10	645	Mesic	98%	0.11	1	600	70	60%	2.20	1	600	1,000	900	-38%
LittleSilver Cr.	11	5025	Mesic	98%	0.11	1	5,000	600	80%	1.10	1	5,000	6,000	5,000	-18%
LittleMeadow Cr.	12	1140	Mesic	98%	0.11	1	1,000	100	70%	1.65	1	1,000	2,000	2,000	-28%
LittleMeadow Cr.	13	2295	Mesic	98%	0.11	1	2,000	200	80%	1.10	1	2,000	2,000	2,000	-18%
LittleMeadow Cr.	14	895	Mesic	98%	0.11	1	900	100	90%	0.55	1	900	500	400	-8%
ElkberryTrib1	15	1745	Mesic	98%	0.11	1	2,000	200	70%	1.65	1	2,000	3,000	3,000	-28%
Gyppo Cr.	16	285	Mesic	98%	0.11	1	300	30	80%	1.10	1	300	300	300	-18%
Gyppo Cr.	17	1565	Mesic	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
Grandad Cr.	18	815	Mesic	98%	0.11	1	800	90	80%	1.10	1	800	900	800	-18%
Grandad Cr.	19	3350	Mesic	98%	0.11	1	3,000	300	90%	0.55	1	3,000	2,000	2,000	-8%
Telephone Cr.	20	2070	Mesic	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
Telephone Cr.	21	415	Mesic	98%	0.11	1	400	40	80%	1.10	1	400	400	400	-18%
Telephone Cr.	22	895	Mesic	98%	0.11	1	900	100	90%	0.55	1	900	500	400	-8%
BentonTrib1	23	1735	Mesic	98%	0.11	1	2,000	200	80%	1.10	1	2,000	2,000	2,000	-18%
BentonTrib1	24	885	Mesic	98%	0.11	1	900	100	90%	0.55	1	900	500	400	-8%
NFBenton Cr.	25	2045	Mesic	98%	0.11	1	2,000	200	80%	1.10	1	2,000	2,000	2,000	-18%
NFBenton Cr.	26	3445	Mesic	98%	0.11	2	7,000	800	90%	0.55	2	7,000	4,000	3,000	-8%
NFBenton Cr.	27	1825	Mesic	98%	0.11	2	4,000	400	80%	1.10	2	4,000	4,000	4,000	-18%

Table E1. Elkberry Creek load analysis (AU ID17060308CL002_02b) (cont.).

Segment Details				Target					Existing					Summary	
Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
AU CL002_02b															
Elkberry Cr.	28	760	Mesic	98%	0.11	1	800	90	80%	1.10	1	800	900	800	-18%
Elkberry Cr.	29	785	Mesic	98%	0.11	1	800	90	90%	0.55	1	800	400	300	-8%
Elkberry Cr.	30	840	Mesic	98%	0.11	2	2,000	200	80%	1.10	2	2,000	2,000	2,000	-18%
Elkberry Cr.	31	560	Mesic	98%	0.11	2	1,000	100	90%	0.55	2	1,000	600	500	-8%
Elkberry Cr.	32	1330	Mesic	96%	0.22	3	4,000	900	70%	1.65	3	4,000	7,000	6,000	-26%
Elkberry Cr.	33	890	UpAlder	74%	1.43	3	3,000	4,000	60%	2.20	3	3,000	7,000	3,000	-14%
Elkberry Cr.	34	1060	UpAlder	74%	1.43	3	3,000	4,000	60%	2.20	4	4,000	9,000	5,000	-14%
Elkberry Cr.	35	900	UpAlder	61%	2.15	4	4,000	9,000	50%	2.75	5	5,000	10,000	1,000	-11%
Elkberry Cr.	36	400	UpAlder	61%	2.15	4	2,000	4,000	40%	3.30	6	2,000	7,000	3,000	-21%
Elkberry Cr.	37	1900	Mesic	92%	0.44	5	10,000	4,000	70%	1.65	5	10,000	20,000	20,000	-22%
Elkberry Cr.	38	890	Mesic	92%	0.44	5	4,000	2,000	80%	1.10	5	4,000	4,000	2,000	-12%
Elkberry Cr.	39	4425	Mesic	90%	0.55	6	30,000	20,000	70%	1.65	6	30,000	50,000	30,000	-20%
						Totals		53,000					160,000	110,000	

Table E2. Middle Fork Robinson Creek load analysis (AU ID17060308CL002_02c).

Segment Details				Target					Existing					Summary	
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
AU CL002_02c															
Elmberry Cr.	1	1140	Mesic	98%	0.11	1	1,000	100	80%	1.10	1	1,000	1,000	900	-18%
Elmberry Cr.	2	240	Mesic	98%	0.11	1	200	20	60%	2.20	1	200	400	400	-38%
Elmberry Cr.	3	4000	Mesic	98%	0.11	2	8,000	900	80%	1.10	2	8,000	9,000	8,000	-18%
ElmberryTrib	4	280	Mesic	98%	0.11	1	300	30	80%	1.10	1	300	300	300	-18%
ElmberryTrib	5	1205	Mesic	98%	0.11	1	1,000	100	50%	2.75	1	1,000	3,000	3,000	-48%
ElmberryTrib	6	140	Mesic	98%	0.11	1	100	10	60%	2.20	1	100	200	200	-38%
SFRobinsonTrib	7	1560	Mesic	98%	0.11	1	2,000	200	80%	1.10	1	2,000	2,000	2,000	-18%
SFRobinsonTrib	8	695	Mesic	98%	0.11	1	700	80	50%	2.75	10	7,000	20,000	20,000	-48%
SFRobinsonTrib	9	340	Mesic	98%	0.11	1	300	30	70%	1.65	1	300	500	500	-28%
SFRobinsonTrib	10	585	Mesic	98%	0.11	1	600	70	50%	2.75	10	6,000	20,000	20,000	-48%
SFRobinsonTrib	11	2065	Mesic	98%	0.11	1	2,000	200	70%	1.65	1	2,000	3,000	3,000	-28%
SFRobinsonTrib	12	590	Mesic	98%	0.11	1	600	70	80%	1.10	1	600	700	600	-18%
SFRobinsonTrib	13	745	Mesic	98%	0.11	1	700	80	80%	1.10	1	700	800	700	-18%
SFRobinsonTrib	14	360	Mesic	98%	0.11	1	400	40	70%	1.65	1	400	700	700	-28%
SFRobinsonTrib	15	1180	Mesic	98%	0.11	1	1,000	100	80%	1.10	1	1,000	1,000	900	-18%
SFRobinson Cr.	16	1375	Mesic	98%	0.11	1	1,000	100	70%	1.65	1	1,000	2,000	2,000	-28%
SFRobinson Cr.	17	240	Mesic	98%	0.11	2	500	60	80%	1.10	2	500	600	500	-18%
SFRobinson Cr.	18	870	Mesic	98%	0.11	2	2,000	200	60%	2.20	2	2,000	4,000	4,000	-38%
SFRobinson Cr.	19	1215	Mesic	98%	0.11	2	2,000	200	70%	1.65	2	2,000	3,000	3,000	-28%
SFRobinson Cr.	20	2085	Mesic	96%	0.22	3	6,000	1,000	80%	1.10	3	6,000	7,000	6,000	-16%
SFRobinson Cr.	21	2000	Mesic	94%	0.33	4	8,000	3,000	70%	1.65	4	8,000	10,000	7,000	-24%
MFRobinsonTrib	22	1055	Mesic	98%	0.11	1	1,000	100	80%	1.10	1	1,000	1,000	900	-18%
MFRobinsonTrib	23	2090	Mesic	98%	0.11	2	4,000	400	70%	1.65	2	4,000	7,000	7,000	-28%
MFRobinson Cr	24	550	Mesic	98%	0.11	1	600	70	90%	0.55	1	600	300	200	-8%
MFRobinson Cr	25	530	Mesic	98%	0.11	2	1,000	100	70%	1.65	2	1,000	2,000	2,000	-28%
MFRobinson Cr	26	605	Mesic	98%	0.11	1	600	70	80%	1.10	1	600	700	600	-18%

Table E2. Middle Fork Robinson Creek load analysis (AU ID17060308CL002_02c) (cont.).

Segment Details				Target					Existing					Summary	
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
AU CL002_02c															
MFRobinson Cr	27	1965	Mesic	98%	0.11	2	4,000	400	70%	1.65	2	4,000	7,000	7,000	-28%
MFRobinson Cr	28	445	Mesic	98%	0.11	2	900	100	70%	1.65	2	900	1,000	900	-28%
MFRobinson Cr	29	1835	Mesic	94%	0.33	4	7,000	2,000	80%	1.10	4	7,000	8,000	6,000	-14%
NFRobinson Cr.	30	650	Mesic	98%	0.11	1	700	80	90%	0.55	1	700	400	300	-8%
NFRobinson Cr.	31	1145	Mesic	98%	0.11	2	2,000	200	80%	1.10	2	2,000	2,000	2,000	-18%
NFRobinson Cr.	32	535	Mesic	98%	0.11	2	1,000	100	80%	1.10	2	1,000	1,000	900	-18%
NFRobinson Cr.	33	2300	Mesic	96%	0.22	3	7,000	2,000	70%	1.65	3	7,000	10,000	8,000	-26%
						Totals		12,000					130,000	120,000	

Table E3. Gold, Meadow, and Snake Creeks load analysis (AU ID17060308CL003_02).

Segment Details				Target					Existing					Summary	
Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
AU CL003_02															
Gold Cr.	1	205	Mesic	98%	0.11	1	200	20	80%	1.10	1	200	200	200	-18%
Gold Cr.	2	855	Mesic	98%	0.11	1	900	100	90%	0.55	1	900	500	400	-8%
Gold Cr.	3	200	Mesic	98%	0.11	1	200	20	80%	1.10	1	200	200	200	-18%
Gold Cr.	4	1200	Mesic	98%	0.11	1	1,000	100	90%	0.55	1	1,000	600	500	-8%
Gold Cr.	5	1130	Mesic	98%	0.11	2	2,000	200	90%	0.55	2	2,000	1,000	800	-8%
Gold Cr.	6	270	Mesic	98%	0.11	2	500	60	90%	0.55	2	500	300	200	-8%
Gold Cr.	7	300	Mesic	98%	0.11	2	600	70	80%	1.10	2	600	700	600	-18%
Gold Cr.	8	375	Mesic	98%	0.11	2	800	90	90%	0.55	2	800	400	300	-8%
Gold Cr.	9	495	Mesic	96%	0.22	3	1,000	200	80%	1.10	3	1,000	1,000	800	-16%
Gold Cr.	10	1115	Mesic	96%	0.22	3	3,000	700	70%	1.65	3	3,000	5,000	4,000	-26%
Gold Cr.	11	125	Mesic	96%	0.22	3	400	90	60%	2.20	3	400	900	800	-36%
GoldTrib1	12	1470	Mesic	98%	0.11	1	1,000	100	90%	0.55	1	1,000	600	500	-8%
Ruby Cr.	13	875	Mesic	98%	0.11	1	900	100	80%	1.10	1	900	1,000	900	-18%
Ruby Cr.	14	495	Mesic	98%	0.11	1	500	60	70%	1.65	1	500	800	700	-28%
Ruby Cr.	15	1115	Mesic	98%	0.11	2	2,000	200	80%	1.10	2	2,000	2,000	2,000	-18%
Ruby Cr.	16	1000	Mesic	98%	0.11	2	2,000	200	70%	1.65	2	2,000	3,000	3,000	-28%
Christmas Cr	17	535	Mesic	98%	0.11	1	500	60	80%	1.10	1	500	600	500	-18%
Christmas Cr	18	645	Mesic	98%	0.11	1	600	70	90%	0.55	1	600	300	200	-8%
Christmas Cr	19	505	Mesic	98%	0.11	1	500	60	60%	2.20	1	500	1,000	900	-38%
Christmas Cr	20	760	Mesic	98%	0.11	1	800	90	80%	1.10	1	800	900	800	-18%
Christmas Cr	21	305	Mesic	98%	0.11	1	300	30	70%	1.65	1	300	500	500	-28%
Snake Cr.	22	715	Mesic	98%	0.11	1	700	80	90%	0.55	1	700	400	300	-8%
Snake Cr.	23	605	Mesic	98%	0.11	1	600	70	70%	1.65	1	600	1,000	900	-28%
Snake Cr.	24	830	Mesic	98%	0.11	1	800	90	80%	1.10	1	800	900	800	-18%
Snake Cr.	25	530	Mesic	98%	0.11	2	1,000	100	70%	1.65	2	1,000	2,000	2,000	-28%
Snake Cr.	26	910	UpAlder	87%	0.72	2	2,000	1,000	60%	2.20	2	2,000	4,000	3,000	-27%
Snake Cr.	27	466	UpAlder	87%	0.72	2	900	600	20%	4.40	25	10,000	40,000	40,000	-67%

Table E3. Gold, Meadow, and Snake Creeks load analysis (AU ID17060308CL003_02) (cont.)

Segment Details				Target					Existing					Summary	
Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
AU CL003_02															
Snake Cr.	28	285	UpAlder	61%	2.15	4	1,000	2,000	50%	2.75	4	1,000	3,000	1,000	-11%
Snake Cr.	29	500	Mesic	94%	0.33	4	2,000	700	60%	2.20	4	2,000	4,000	3,000	-34%
Snake Cr.	30	355	Mesic	94%	0.33	4	1,000	300	80%	1.10	4	1,000	1,000	700	-14%
Snake Cr.	31	410	UpAlder	61%	2.15	4	2,000	4,000	30%	3.85	9	4,000	20,000	20,000	-31%
Snake Cr.	32	630	Mesic	94%	0.33	4	3,000	1,000	50%	2.75	4	3,000	8,000	7,000	-44%
Snake Cr.	33	755	Mesic	94%	0.33	4	3,000	1,000	80%	1.10	4	3,000	3,000	2,000	-14%
Snake Cr.	34	655	Mesic	92%	0.44	5	3,000	1,000	50%	2.75	5	3,000	8,000	7,000	-42%
Snake Cr.	35	180	Mesic	87%	0.72	7	1,000	700	30%	3.85	7	1,000	4,000	3,000	-57%
Snake Cr.	36	890	Mesic	92%	0.44	5	4,000	2,000	50%	2.75	5	4,000	10,000	8,000	-42%
Snake Cr.	37	1560	Mesic	92%	0.44	5	8,000	4,000	70%	1.65	5	8,000	10,000	6,000	-22%
Snake Cr.	38	495	Mesic	92%	0.44	5	2,000	900	50%	2.75	5	2,000	6,000	5,000	-42%
SnakeTrib1	39	75	Mesic	98%	0.11	1	80	9	10%	4.95	17	1,000	5,000	5,000	-88%
SnakeTrib1	40	1660	Mesic	98%	0.11	1	2,000	200	80%	1.10	1	2,000	2,000	2,000	-18%
SnakeTrib2	41	1480	Mesic	98%	0.11	1	1,000	100	80%	1.10	1	1,000	1,000	900	-18%
SnakeTrib2	42	470	Mesic	98%	0.11	1	500	60	70%	1.65	1	500	800	700	-28%
SnakeTrib3	43	950	Mesic	98%	0.11	1	1,000	100	90%	0.55	1	1,000	600	500	-8%
SnakeTrib3	44	1200	Mesic	98%	0.11	1	1,000	100	70%	1.65	1	1,000	2,000	2,000	-28%
SnakeTrib4	45	2075	Mesic	98%	0.11	1	2,000	200	80%	1.10	1	2,000	2,000	2,000	-18%
SnakeTrib5	46	170	Mesic	98%	0.11	1	200	20	80%	1.10	1	200	200	200	-18%
SnakeTrib5	47	1815	Mesic	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
SnakeTrib5	48	220	Mesic	98%	0.11	1	200	20	50%	2.75	1	200	600	600	-48%
SnakeTrib6	49	500	Mesic	98%	0.11	1	500	60	90%	0.55	1	500	300	200	-8%
SnakeTrib6	50	705	Mesic	98%	0.11	1	700	80	70%	1.65	1	700	1,000	900	-28%
SnakeTrib6	51	945	Mesic	98%	0.11	1	900	100	80%	1.10	1	900	1,000	900	-18%
Meadow Cr.	52	170	Mesic	98%	0.11	1	200	20	90%	0.55	1	200	100	80	-8%
Meadow Cr.	53	960	UpAlder	87%	0.72	2	2,000	1,000	70%	1.65	2	2,000	3,000	2,000	-17%

Table E3. Gold, Meadow, and Snake Creeks load analysis (AU ID17060308CL003_02) (cont.).

Segment Details				Target					Existing					Summary	
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
AU CL003_02															
Meadow Cr.	54	890	UpAlder	87%	0.72	2	2,000	1,000	60%	2.20	2	2,000	4,000	3,000	-27%
Meadow Cr.	55	170	UpAlder	87%	0.72	2	300	200	0%	5.50	60	10,000	60,000	60,000	-87%
Meadow Cr.	56	410	Mesic	98%	0.11	2	800	90	80%	1.10	2	800	900	800	-18%
Meadow Cr.	57	745	UpAlder	74%	1.43	3	2,000	3,000	60%	2.20	3	2,000	4,000	1,000	-14%
Meadow Cr.	58	325	UpAlder	74%	1.43	3	1,000	1,000	50%	2.75	3	1,000	3,000	2,000	-24%
Meadow Cr.	59	1335	Mesic	92%	0.44	5	7,000	3,000	50%	2.75	5	7,000	20,000	20,000	-42%
Meadow Cr.	60	245	Mesic	94%	0.33	4	1,000	300	80%	1.10	4	1,000	1,000	700	-14%
Meadow Cr.	61	75	Mesic	94%	0.33	4	300	100	50%	2.75	4	300	800	700	-44%
Meadow Cr.	62	1575	Mesic	92%	0.44	5	8,000	4,000	90%	0.55	5	8,000	4,000	0	-2%
Meadow Cr.	63	425	Mesic	92%	0.44	5	2,000	900	80%	1.10	5	2,000	2,000	1,000	-12%
ReedsTrib	64	925	Mesic	98%	0.11	1	900	100	90%	0.55	1	900	500	400	-8%
ReedsTrib	65	1800	Mesic	98%	0.11	1	2,000	200	80%	1.10	1	2,000	2,000	2,000	-18%
						Totals		38,000					270,000	240,000	

Table E4. Reeds Creek load analysis (AU ID17060308CL003_03 and _04).

Segment Details				Target					Existing					Summary	
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
AU CL003_03, 04															
Reeds Cr.	1	539	Mesic	68%	1.76	11	5,900	10,000	60%	2.20	11	5,900	13,000	3,000	-8%
Reeds Cr.	2	1900	Mesic	68%	1.76	11	21,000	37,000	40%	3.30	11	21,000	69,000	32,000	-28%
Reeds Cr.	3	895	Mesic	64%	1.98	12	11,000	22,000	20%	4.40	12	11,000	48,000	26,000	-44%
Reeds Cr.	4	440	Mesic	64%	1.98	12	5,300	10,000	60%	2.20	12	5,300	12,000	2,000	-4%
Snake Cr.	5	1200	Mesic	90%	0.55	6	7,000	4,000	70%	1.65	6	7,000	10,000	6,000	-20%
Snake Cr.	6	380	Mesic	90%	0.55	6	2,000	1,000	80%	1.10	6	2,000	2,000	1,000	-10%
Reeds Cr.	7	2960	Mesic	57%	2.37	14	41,000	97,000	60%	2.20	14	41,000	90,000	(7,000)	3%
						Totals		180,000					240,000	63,000	

Table E5. Reeds Creek load analysis (AU ID17060308CL004_02).

Segment Details				Target					Existing					Summary	
Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
AU CL004_02															
Reeds Cr.	1	1405	Mesic	98%	0.11	1	1,000	100	80%	1.10	1	1,000	1,000	900	-18%
Reeds Cr.	2	1280	Mesic	98%	0.11	2	3,000	300	50%	2.75	2	3,000	8,000	8,000	-48%
Reeds Cr.	3	515	Mesic	96%	0.22	3	2,000	400	40%	3.30	3	2,000	7,000	7,000	-56%
Reeds Cr.	4	370	Mesic	96%	0.22	3	1,000	200	60%	2.20	3	1,000	2,000	2,000	-36%
Reeds Cr.	5	425	UpAlder	74%	1.43	3	1,000	1,000	40%	3.30	3	1,000	3,000	2,000	-34%
Reeds Cr.	6	325	Mesic	96%	0.22	3	1,000	200	70%	1.65	3	1,000	2,000	2,000	-26%
Reeds Cr.	7	445	UpAlder	74%	1.43	3	1,000	1,000	40%	3.30	3	1,000	3,000	2,000	-34%
Reeds Cr.	8	725	UpAlder	61%	2.15	4	3,000	6,000	30%	3.85	4	3,000	10,000	4,000	-31%
Reeds Cr.	9	300	UpAlder	61%	2.15	4	1,000	2,000	20%	4.40	4	1,000	4,000	2,000	-41%
SFReeds Cr.	10	1220	Mesic	98%	0.11	1	1,000	100	80%	1.10	1	1,000	1,000	900	-18%
SFReeds Cr.	11	1285	Mesic	98%	0.11	2	3,000	300	70%	1.65	2	3,000	5,000	5,000	-28%
SFReeds Cr.	12	1230	UpAlder	87%	0.72	2	2,000	1,000	50%	2.75	3	4,000	10,000	9,000	-37%
SFReeds Cr.	13	1310	Mesic	96%	0.22	3	4,000	900	60%	2.20	3	4,000	9,000	8,000	-36%
SFReeds Cr.	14	780	Mesic	96%	0.22	3	2,000	400	50%	2.75	3	2,000	6,000	6,000	-46%
EFDeer Cr.	15	890	Mesic	98%	0.11	1	900	100	80%	1.10	1	900	1,000	900	-18%
EFDeer Cr.	16	615	Mesic	98%	0.11	1	600	70	70%	1.65	1	600	1,000	900	-28%
EFDeer Cr.	17	1350	UpAlder	92%	0.44	1	1,000	400	50%	2.75	1	1,000	3,000	3,000	-42%
EFDeer Cr.	18	680	UpAlder	92%	0.44	1	700	300	60%	2.20	1	700	2,000	2,000	-32%
Deer Cr.	19	1295	UpAlder	87%	0.72	2	3,000	2,000	40%	3.30	2	3,000	10,000	8,000	-47%
ReedsTrib1	20	240	Mesic	98%	0.11	1	200	20	90%	0.55	1	200	100	80	-8%
ReedsTrib1	21	1750	Mesic	98%	0.11	1	2,000	200	80%	1.10	1	2,000	2,000	2,000	-18%
ReedsTrib1	22	500	Mesic	98%	0.11	1	500	60	70%	1.65	1	500	800	700	-28%
ReedsTrib1	23	240	UpAlder	92%	0.44	1	200	90	50%	2.75	1	200	600	500	-42%
ReedsTrib2	24	1315	Mesic	98%	0.11	1	1,000	100	70%	1.65	1	1,000	2,000	2,000	-28%
ReedsTrib2	25	320	UpAlder	92%	0.44	1	300	100	50%	2.75	1	300	800	700	-42%
Calhoun Cr.	26	1000	Mesic	98%	0.11	1	1,000	100	80%	1.10	1	1,000	1,000	900	-18%
Calhoun Cr.	27	1880	UpAlder	92%	0.44	1	2,000	900	60%	2.20	1	2,000	4,000	3,000	-32%

Table E5. Reeds Creek load analysis (AU ID17060308CL004_02) (cont.).

Segment Details				Target					Existing					Summary	
Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
AU CL004_02															
Calhoun Cr.	28	1010	UpAlder	87%	0.72	2	2,000	1,000	50%	2.75	2	2,000	6,000	5,000	-37%
Calhoun Cr.	29	670	Mesic	98%	0.11	2	1,000	100	80%	1.10	2	1,000	1,000	900	-18%
ReedTrib3	30	2485	Mesic	98%	0.11	1	2,000	200	70%	1.65	1	2,000	3,000	3,000	-28%
NFReeds Cr.	31	3700	Mesic	98%	0.11	1	4,000	400	70%	1.65	1	4,000	7,000	7,000	-28%
NFReeds Cr.	32	600	Mesic	98%	0.11	1	600	70	80%	1.10	1	600	700	600	-18%
NFReeds Cr.	33	890	UpAlder	92%	0.44	1	900	400	60%	2.20	1	900	2,000	2,000	-32%
NFReeds Cr.	34	3190	UpAlder	87%	0.72	2	6,000	4,000	50%	2.75	2	6,000	20,000	20,000	-37%
NFReeds Cr.	35	410	UpAlder	74%	1.43	3	1,000	1,000	40%	3.30	7	3,000	10,000	9,000	-34%
NFReeds Cr.	36	360	Mesic	96%	0.22	3	1,000	200	50%	2.75	3	1,000	3,000	3,000	-46%
NFReeds Cr.	37	640	Mesic	96%	0.22	3	2,000	400	70%	1.65	3	2,000	3,000	3,000	-26%
NFReeds Cr.	38	825	UpAlder	74%	1.43	3	2,000	3,000	50%	2.75	3	2,000	6,000	3,000	-24%
NFReeds Cr.	39	695	UpAlder	74%	1.43	3	2,000	3,000	40%	3.30	3	2,000	7,000	4,000	-34%
NFReedsTrib	40	820	Mesic	98%	0.11	1	800	90	80%	1.10	1	800	900	800	-18%
NFReedsTrib	41	545	Mesic	98%	0.11	1	500	60	70%	1.65	1	500	800	700	-28%
NFReedsTrib	42	565	Mesic	98%	0.11	1	600	70	80%	1.10	1	600	700	600	-18%
NFReedsTrib	43	325	Mesic	98%	0.11	1	300	30	70%	1.65	1	300	500	500	-28%
NFReedsTrib	44	215	UpAlder	92%	0.44	1	200	90	50%	2.75	1	200	600	500	-42%
						Totals		32,000					170,000	150,000	

Table E6. Reeds Creek load analysis (AU ID17060308CL004_03).

Segment Details				Target					Existing					Summary	
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
AU CL004_03															
Reeds Cr.	1	2100	UpAlder	52%	2.64	5	10,000	30,000	10%	4.95	5	10,000	50,000	20,000	-42%
Reeds Cr.	2	2310	UpAlder	46%	2.97	6	10,000	30,000	20%	4.40	6	10,000	40,000	10,000	-26%
Reeds Cr.	3	1775	UpAlder	46%	2.97	6	10,000	30,000	40%	3.30	6	10,000	30,000	0	-6%
Reeds Cr.	4	210	UpAlder	46%	2.97	6	1,000	3,000	20%	4.40	6	1,000	4,000	1,000	-26%
Reeds Cr.	5	695	UpAlder	41%	3.25	7	5,000	20,000	30%	3.85	7	5,000	20,000	0	-11%
Reeds Cr.	6	540	UpAlder	41%	3.25	7	4,000	10,000	20%	4.40	7	4,000	20,000	10,000	-21%
Reeds Cr.	7	940	UpAlder	41%	3.25	7	7,000	20,000	30%	3.85	7	7,000	30,000	10,000	-11%
Reeds Cr.	8	430	Mesic	87%	0.72	7	3,000	2,000	50%	2.75	7	3,000	8,000	6,000	-37%
Reeds Cr.	9	1320	Mesic	87%	0.72	7	9,000	6,000	60%	2.20	7	9,000	20,000	10,000	-27%
Reeds Cr.	10	1051	Mesic	81%	1.05	8	8,000	8,000	50%	2.75	8	8,000	20,000	10,000	-31%
Reeds Cr.	11	400	Mesic	81%	1.05	8	3,000	3,000	60%	2.20	8	3,000	7,000	4,000	-21%
Reeds Cr.	12	1140	Mesic	72%	1.54	10	11,000	17,000	50%	2.75	10	11,000	30,000	13,000	-22%
						Totals		180,000					280,000	94,000	

Table E7. Alder Creek load analysis (AU ID17060308CL005_02).

Segment Details				Target					Existing					Summary	
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
AU CL005_02															
Alder Creek	1	840	Mesic	98%	0.11	1	800	90	80%	1.10	1	800	900	800	-18%
Alder Creek	2	1190	Mesic	98%	0.11	1	1,000	100	70%	1.65	1	1,000	2,000	2,000	-28%
Alder Creek	3	350	Mesic	98%	0.11	2	700	80	50%	2.75	2	700	2,000	2,000	-48%
Alder Creek	4	305	Mesic	96%	0.22	3	900	200	40%	3.30	3	900	3,000	3,000	-56%
Alder Creek	5	225	Mesic	96%	0.22	3	700	200	60%	2.20	3	700	2,000	2,000	-36%
Alder Creek	6	785	UpAlder	61%	2.15	4	3,000	6,000	40%	3.30	4	3,000	10,000	4,000	-21%
Alder Creek	7	750	UpAlder	46%	2.97	6	5,000	10,000	40%	3.30	6	5,000	20,000	10,000	-6%
Alder Creek	8	500	UpAlder	41%	3.25	7	4,000	10,000	30%	3.85	7	4,000	20,000	10,000	-11%
Alder Creek	9	185	Mesic	87%	0.72	7	1,000	700	50%	2.75	7	1,000	3,000	2,000	-37%
Alder Creek	10	890	UpAlder	37%	3.47	8	7,000	20,000	30%	3.85	8	7,000	30,000	10,000	-7%
Alder Creek	11	280	Mesic	81%	1.05	8	2,000	2,000	50%	2.75	8	2,000	6,000	4,000	-31%
Alder Creek	12	1975	UpAlder	33%	3.69	9	20,000	70,000	20%	4.40	9	20,000	90,000	20,000	-13%
Alder Creek	13	220	UpAlder	33%	3.69	9	2,000	7,000	20%	4.40	30	7,000	30,000	20,000	-13%
Alder Creek	14	1475	Mesic	76%	1.32	9	10,000	10,000	30%	3.85	9	10,000	40,000	30,000	-46%
Alder Creek	15	1975	UpAlder	33%	3.69	9	20,000	70,000	20%	4.40	9	20,000	90,000	20,000	-13%
Alder Creek	16	430	UpAlder	33%	3.69	9	4,000	10,000	20%	4.40	9	4,000	20,000	10,000	-13%
Alder Creek	17	485	Mesic	76%	1.32	9	4,000	5,000	40%	3.30	9	4,000	10,000	5,000	-36%
Alder Creek	18	230	UpAlder	33%	3.69	9	2,000	7,000	20%	4.40	9	2,000	9,000	2,000	-13%
Alder Creek	19	300	Mesic	76%	1.32	9	3,000	4,000	40%	3.30	9	3,000	10,000	6,000	-36%
Alder Creek	20	600	UpAlder	33%	3.69	9	5,000	20,000	20%	4.40	9	5,000	20,000	0	-13%
Alder Creek	21	285	Mesic	76%	1.32	9	3,000	4,000	30%	3.85	9	3,000	10,000	6,000	-46%
Alder Creek	22	440	UpAlder	33%	3.69	9	4,000	10,000	20%	4.40	10	4,000	20,000	10,000	-13%
Alder Creek	23	1475	Mesic	81%	1.05	8	10,000	10,000	60%	2.20	8	10,000	20,000	10,000	-21%
Alder Creek	24	790	Mesic	81%	1.05	8	6,000	6,000	40%	3.30	8	6,000	20,000	10,000	-41%
Alder Creek	25	695	Mesic	76%	1.32	9	6,000	8,000	50%	2.75	9	6,000	20,000	10,000	-26%
AlderTrib1	26	235	Mesic	98%	0.11	1	200	20	80%	1.10	1	200	200	200	-18%
AlderTrib1	27	645	Mesic	98%	0.11	1	600	70	40%	3.30	1	600	2,000	2,000	-58%

Table E7. Alder Creek load analysis (AU ID17060308CL005_02) (cont.).

Segment Details				Target					Existing					Summary	
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
AU CL005_02															
AlderTrib1	28	635	Mesic	98%	0.11	1	600	70	70%	1.65	1	600	1,000	900	-28%
AlderTrib1	29	430	Mesic	98%	0.11	1	400	40	60%	2.20	1	400	900	900	-38%
AlderTrib2	30	200	Mesic	98%	0.11	1	200	20	80%	1.10	1	200	200	200	-18%
AlderTrib2	31	525	Mesic	98%	0.11	1	500	60	70%	1.65	1	500	800	700	-28%
AlderTrib2	32	290	Mesic	98%	0.11	1	300	30	50%	2.75	1	300	800	800	-48%
AlderTrib2	33	595	Mesic	98%	0.11	1	600	70	80%	1.10	1	600	700	600	-18%
AlderTrib2	34	1570	UpAlder	87%	0.72	2	3,000	2,000	60%	2.20	2	3,000	7,000	5,000	-27%
Parallel Cr.	35	215	Mesic	98%	0.11	1	200	20	70%	1.65	1	200	300	300	-28%
Parallel Cr.	36	415	Mesic	98%	0.11	1	400	40	90%	0.55	1	400	200	200	-8%
Parallel Cr.	37	1150	Mesic	98%	0.11	1	1,000	100	80%	1.10	1	1,000	1,000	900	-18%
Parallel Cr.	38	520	Mesic	98%	0.11	1	500	60	70%	1.65	1	500	800	700	-28%
Parallel Cr.	39	770	Mesic	98%	0.11	2	2,000	200	60%	2.20	1	800	2,000	2,000	-38%
Parallel Cr.	40	200	UpAlder	87%	0.72	2	400	300	50%	2.75	2	400	1,000	700	-37%
Parallel Cr.	41	600	UpAlder	87%	0.72	2	1,000	700	30%	3.85	13	8,000	30,000	30,000	-57%
Parallel Cr.	42	955	UpAlder	74%	1.43	3	3,000	4,000	50%	2.75	3	3,000	8,000	4,000	-24%
Parallel Cr.	43	690	UpAlder	74%	1.43	3	2,000	3,000	30%	3.85	20	10,000	40,000	40,000	-44%
Parallel Cr.	44	950	UpAlder	74%	1.43	3	3,000	4,000	50%	2.75	3	3,000	8,000	4,000	-24%
Parallel Cr.	45	115	UpAlder	74%	1.43	3	300	400	30%	3.85	10	1,000	4,000	4,000	-44%
Parallel Cr.	46	180	Mesic	96%	0.22	3	500	100	80%	1.10	3	500	600	500	-16%
Parallel Cr.	47	375	Mesic	96%	0.22	3	1,000	200	60%	2.20	3	1,000	2,000	2,000	-36%
Parallel Cr.	48	380	UpAlder	74%	1.43	3	1,000	1,000	50%	2.75	3	1,000	3,000	2,000	-24%
Parallel Cr.	49	335	UpAlder	61%	2.15	4	1,000	2,000	20%	4.40	8	3,000	10,000	8,000	-41%
Parallel Cr.	50	1120	UpAlder	61%	2.15	4	4,000	9,000	40%	3.30	4	4,000	10,000	1,000	-21%
Parallel Cr.	51	270	Mesic	94%	0.33	4	1,000	300	70%	1.65	4	1,000	2,000	2,000	-24%
Parallel Cr.	52	305	UpAlder	61%	2.15	4	1,000	2,000	40%	3.30	4	1,000	3,000	1,000	-21%
AlderTrib3	53	560	Mesic	98%	0.11	1	600	70	50%	2.75	1	600	2,000	2,000	-48%
AlderTrib3	54	1170	Mesic	98%	0.11	1	1,000	100	70%	1.65	1	1,000	2,000	2,000	-28%

Table E7. Alder Creek load analysis (AU ID17060308CL005_02) (cont.).

Segment Details				Target					Existing					Summary	
Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
AU CL005_02															
AlderTrib3	55	455	Mesic	98%	0.11	1	500	60	90%	0.55	1	500	300	200	-8%
AlderTrib3	56	1325	Mesic	98%	0.11	2	3,000	300	60%	2.20	2	3,000	7,000	7,000	-38%
AlderTrib3	57	605	Mesic	98%	0.11	2	1,000	100	50%	2.75	2	1,000	3,000	3,000	-48%
AlderTrib4	58	505	Mesic	98%	0.11	1	500	60	80%	1.10	1	500	600	500	-18%
AlderTrib4	59	410	Mesic	98%	0.11	1	400	40	70%	1.65	1	400	700	700	-28%
AlderTrib4	60	1370	Mesic	98%	0.11	1	1,000	100	60%	2.20	1	1,000	2,000	2,000	-38%
AlderTrib4	61	680	Mesic	98%	0.11	2	1,000	100	70%	1.65	2	1,000	2,000	2,000	-28%
AlderTrib4	62	340	Mesic	98%	0.11	2	700	80	60%	2.20	2	700	2,000	2,000	-38%
Casey Cr.	63	1200	Mesic	98%	0.11	1	1,000	100	70%	1.65	1	1,000	2,000	2,000	-28%
Casey Cr.	64	535	Mesic	98%	0.11	1	500	60	60%	2.20	1	500	1,000	900	-38%
Casey Cr.	65	675	Mesic	98%	0.11	1	700	80	70%	1.65	1	700	1,000	900	-28%
Casey Cr.	66	550	Mesic	98%	0.11	2	1,000	100	60%	2.20	2	1,000	2,000	2,000	-38%
Casey Cr.	67	620	Mesic	98%	0.11	2	1,000	100	70%	1.65	2	1,000	2,000	2,000	-28%
Casey Cr.	68	510	Mesic	98%	0.11	2	1,000	100	50%	2.75	2	1,000	3,000	3,000	-48%
Casey Cr.	69	630	Mesic	98%	0.11	2	1,000	100	80%	1.10	2	1,000	1,000	900	-18%
Casey Cr.	70	510	Mesic	98%	0.11	2	1,000	100	50%	2.75	2	1,000	3,000	3,000	-48%
Casey Cr.	71	890	Mesic	96%	0.22	3	3,000	700	60%	2.20	3	3,000	7,000	6,000	-36%
AlderTrib5	72	495	Mesic	98%	0.11	1	500	60	90%	0.55	1	500	300	200	-8%
AlderTrib5	73	2840	Mesic	98%	0.11	1	3,000	300	70%	1.65	1	3,000	5,000	5,000	-28%
						Totals		320,000					700,000	370,000	

Table E8. Beaver Creek tributaries load analysis (AU ID17060308CL009_02).

Segment Details				Target					Existing					Summary	
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
AL CU009_02															
Flume Cr.	1	200	Mesic	98%	0.11	1	200	20	80%	1.10	1	200	200	200	-18%
Flume Cr.	2	605	Mesic	98%	0.11	1	600	70	60%	2.20	1	600	1,000	900	-38%
Flume Cr.	3	935	Mesic	98%	0.11	1	900	100	70%	1.65	1	900	1,000	900	-28%
Flume Cr.	4	1335	Mesic	98%	0.11	2	3,000	300	80%	1.10	2	3,000	3,000	3,000	-18%
Beaver Tribs	5	445	Mesic	98%	0.11	1	400	40	40%	3.30	1	400	1,000	1,000	-58%
Beaver Tribs	6	1170	Mesic	98%	0.11	1	1,000	100	80%	1.10	1	1,000	1,000	900	-18%
Beaver Tribs	7	415	Mesic	98%	0.11	1	400	40	90%	0.55	1	400	200	200	-8%
Falls Cr.	8	770	Mesic	98%	0.11	1	800	90	90%	0.55	1	800	400	300	-8%
Falls Cr.	9	2360	Mesic	98%	0.11	1	2,000	200	80%	1.10	1	2,000	2,000	2,000	-18%
Falls Cr.	10	950	Mesic	98%	0.11	2	2,000	200	70%	1.65	2	2,000	3,000	3,000	-28%
Beaver Tribs	11	1585	Mesic	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
Beaver Tribs	12	375	Mesic	98%	0.11	1	400	40	70%	1.65	1	400	700	700	-28%
Harlan Cr.	13	505	Mesic	98%	0.11	1	500	60	80%	1.10	1	500	600	500	-18%
Harlan Cr.	14	140	Mesic	98%	0.11	1	100	10	20%	4.40	32	4,000	20,000	20,000	-78%
Harlan Cr.	15	665	Mesic	98%	0.11	2	1,000	100	80%	1.10	2	1,000	1,000	900	-18%
Harlan Cr.	16	1205	Mesic	98%	0.11	2	2,000	200	70%	1.65	2	2,000	3,000	3,000	-28%
Harlan Cr.	17	495	Mesic	98%	0.11	2	1,000	100	70%	1.65	2	1,000	2,000	2,000	-28%
Harlan Cr.	18	950	Mesic	98%	0.11	2	2,000	200	60%	2.20	2	2,000	4,000	4,000	-38%
Harlan Cr.	19	350	Mesic	98%	0.11	2	700	80	80%	1.10	2	700	800	700	-18%
Harlan Cr.	20	250	Mesic	98%	0.11	2	500	60	50%	2.75	2	500	1,000	900	-48%
Lightning Cr.	21	1000	Mesic	98%	0.11	1	1,000	100	80%	1.10	1	1,000	1,000	900	-18%
Lightning Cr.	22	1425	Mesic	98%	0.11	1	1,000	100	70%	1.65	1	1,000	2,000	2,000	-28%
EF Beaver	23	260	Mesic	98%	0.11	1	300	30	70%	1.65	1	300	500	500	-28%
EF Beaver	24	1460	Mesic	98%	0.11	1	1,000	100	80%	1.10	1	1,000	1,000	900	-18%
EF Beaver	25	940	Mesic	98%	0.11	1	900	100	70%	1.65	1	900	1,000	900	-28%
EF Beaver	26	725	Mesic	98%	0.11	1	700	80	80%	1.10	1	700	800	700	-18%
EF Beaver	27	720	Mesic	96%	0.22	3	2,000	400	60%	2.20	3	2,000	4,000	4,000	-36%

Table E8. Beaver Creek tributaries load analysis (AU ID17060308CL009_02) (cont.).

Segment Details				Target					Existing					Summary	
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
AL CU009_02															
EF Beaver	28	1075	Mesic	96%	0.22	3	3,000	700	80%	1.10	3	3,000	3,000	2,000	-16%
EF Beaver	29	925	Mesic	96%	0.22	3	3,000	700	60%	2.20	3	3,000	7,000	6,000	-36%
EF Beaver	30	290	Mesic	94%	0.33	4	1,000	300	60%	2.20	4	1,000	2,000	2,000	-34%
EF Beaver	31	330	Mesic	94%	0.33	4	1,000	300	70%	1.65	4	1,000	2,000	2,000	-24%
EF Trib	32	1105	Mesic	98%	0.11	1	1,000	100	90%	0.55	1	1,000	600	500	-8%
EF Trib	33	570	Mesic	98%	0.11	1	600	70	70%	1.65	1	600	1,000	900	-28%
EF Trib 2	34	760	Mesic	98%	0.11	1	800	90	60%	2.20	1	800	2,000	2,000	-38%
EF Trib 2	35	200	Mesic	98%	0.11	1	200	20	80%	1.10	1	200	200	200	-18%
EF Trib 2	36	235	Mesic	98%	0.11	1	200	20	50%	2.75	1	200	600	600	-48%
EF Trib 2	37	310	Mesic	98%	0.11	1	300	30	70%	1.65	1	300	500	500	-28%
EF Trib 2	38	225	Mesic	98%	0.11	1	200	20	80%	1.10	1	200	200	200	-18%
EF Trib 2	39	310	Mesic	98%	0.11	1	300	30	50%	2.75	1	300	800	800	-48%
EF Trib 2	40	930	Mesic	98%	0.11	1	900	100	90%	0.55	1	900	500	400	-8%
Sheep Mtn.	41	400	Mesic	98%	0.11	1	400	40	70%	1.65	1	400	700	700	-28%
Sheep Mtn.	42	395	Mesic	98%	0.11	1	400	40	80%	1.10	1	400	400	400	-18%
Sheep Mtn.	43	280	Mesic	98%	0.11	1	300	30	60%	2.20	1	300	700	700	-38%
Sheep Mtn.	44	555	Mesic	98%	0.11	1	600	70	70%	1.65	1	600	1,000	900	-28%
Sheep Mtn.	45	1510	Mesic	98%	0.11	2	3,000	300	80%	1.10	2	3,000	3,000	3,000	-18%
Sheep Mtn.	46	2710	Mesic	98%	0.11	2	5,000	600	70%	1.65	2	5,000	8,000	7,000	-28%
Sheep Mtn.	47	810	Mesic	98%	0.11	2	2,000	200	60%	2.20	2	2,000	4,000	4,000	-38%
Sheep Mtn.	48	205	Mesic	98%	0.11	2	400	40	50%	2.75	2	400	1,000	1,000	-48%
ShpMtnTrib	49	1540	Mesic	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
Bonner Cr.	50	3340	Mesic	98%	0.11	1	3,000	300	80%	1.10	1	3,000	3,000	3,000	-18%
Wht. Pine C	51	235	Mesic	98%	0.11	1	200	20	90%	0.55	1	200	100	80	-8%
Wht. Pine C	52	380	Mesic	98%	0.11	1	400	40	40%	3.30	1	400	1,000	1,000	-58%
Wht. Pine C	53	2960	Mesic	98%	0.11	1	3,000	300	80%	1.10	1	3,000	3,000	3,000	-18%
Sousie Cr.	54	2530	Mesic	98%	0.11	1	3,000	300	90%	0.55	1	3,000	2,000	2,000	-8%

Table E8. Beaver Creek tributaries load analysis (AU ID17060308CL009_02) (cont.).

Segment Details				Target					Existing					Summary	
Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
AL CU009_02															
Sousie Cr.	55	1560	Mesic	98%	0.11	1	2,000	200	80%	1.10	1	2,000	2,000	2,000	-18%
Idaho Cr.	56	705	Mesic	98%	0.11	1	700	80	80%	1.10	1	700	800	700	-18%
Idaho Cr.	57	2425	Mesic	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
Idaho Cr.	58	200	Mesic	98%	0.11	1	200	20	80%	1.10	1	200	200	200	-18%
MT Cr.	59	595	Mesic	98%	0.11	1	600	70	80%	1.10	1	600	700	600	-18%
MT Cr.	60	935	Mesic	98%	0.11	1	900	100	70%	1.65	1	900	1,000	900	-28%
MT Cr.	61	1280	Mesic	98%	0.11	1	1,000	100	80%	1.10	1	1,000	1,000	900	-18%
Steep Cr.	62	2055	Mesic	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
						Totals		9,100					110,000	110,000	

Table E9. Bingo Creek load analysis (AU ID17060308CL009_02c).

Segment Details				Target					Existing					Summary	
Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
AL CU 009_02c															
Bingo Cr.	1	635	Mesic	98%	0.11	1	600	70	80%	1.10	1	600	700	600	-18%
Bingo Cr.	2	240	Mesic	98%	0.11	1	200	20	90%	0.55	1	200	100	80	-8%
Bingo Cr.	3	475	Mesic	98%	0.11	2	1,000	100	80%	1.10	2	1,000	1,000	900	-18%
Bingo Cr.	4	610	Mesic	98%	0.11	2	1,000	100	90%	0.55	2	1,000	600	500	-8%
Bingo Cr.	5	1565	Mesic	96%	0.22	3	5,000	1,000	80%	1.10	3	5,000	6,000	5,000	-16%
Bingo Cr.	6	395	Mesic	96%	0.22	3	1,000	200	70%	1.65	3	1,000	2,000	2,000	-26%
Bingo Cr.	7	375	Mesic	96%	0.22	3	1,000	200	50%	2.75	3	1,000	3,000	3,000	-46%
Bingo Cr.	8	175	Mesic	94%	0.33	4	700	200	40%	3.30	4	700	2,000	2,000	-54%
						Totals		1,900					15,000	14,000	

Table E10. Beaver Creek headwaters load analysis (AU ID17060308CL09_02e).

Segment Details				Target					Existing					Summary	
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
AL CU09_02e															
Beaver Creek Head	1	560	Mesic	98%	0.11	1	600	70	80%	1.10	1	600	700	600	-18%
Beaver Creek Head	2	180	Mesic	98%	0.11	1	200	20	90%	0.55	1	200	100	80	-8%
Beaver Creek Head	3	100	Mesic	98%	0.11	1	100	10	90%	0.55	1	100	60	50	-8%
Beaver Creek Head	4	320	Mesic	98%	0.11	2	600	70	90%	0.55	2	600	300	200	-8%
Beaver Creek Head	5	560	Mesic	96%	0.22	3	2,000	400	80%	1.10	3	2,000	2,000	2,000	-16%
Beaver Creek Head	6	1580	Mesic	94%	0.33	4	6,000	2,000	60%	2.20	4	6,000	10,000	8,000	-34%
Beaver Creek Head	7	275	Mesic	92%	0.44	5	1,000	400	80%	1.10	5	1,000	1,000	600	-12%
Beaver Creek Head	8	255	Mesic	92%	0.44	5	1,000	400	60%	2.20	5	1,000	2,000	2,000	-32%
Beaver Creek Head	9	1025	Mesic	90%	0.55	6	6,000	3,000	80%	1.10	6	6,000	7,000	4,000	-10%
Beaver Cr. Head Trib	10	660	Mesic	98%	0.11	1	700	80	70%	1.65	1	700	1,000	900	-28%
Beaver Cr. Head Trib	11	225	Mesic	98%	0.11	1	200	20	90%	0.55	1	200	100	80	-8%
Beaver Cr. Head Trib	12	490	Mesic	98%	0.11	1	500	60	70%	1.65	1	500	800	700	-28%
Beaver Cr. Head Trib	13	760	Mesic	98%	0.11	1	800	90	80%	1.10	1	800	900	800	-18%
Beaver Cr. Head Trib	14	300	Mesic	98%	0.11	2	600	70	70%	1.65	2	600	1,000	900	-28%
Beaver Cr. Head Trib	15	365	Mesic	98%	0.11	2	700	80	60%	2.20	2	700	2,000	2,000	-38%
						Totals		6,800					29,000	23,000	

Table E11. Beaver Creek load analysis (AU ID17060308CL009_03 and _04)

Segment Details				Target					Existing					Summary	
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
AL CU009_03_04															
Beaver Cr.	1	255	Mesic	81%	1.05	8	2,000	2,000	60%	2.20	8	2,000	4,000	2,000	-21%
Beaver Cr.	2	625	Mesic	81%	1.05	8	5,000	5,000	80%	1.10	8	5,000	6,000	1,000	-1%
Beaver Cr.	3	550	Mesic	72%	1.54	11	6,100	9,400	40%	3.30	11	6,100	20,000	11,000	-32%
Beaver Cr.	4	390	Mesic	72%	1.54	11	4,300	6,600	50%	2.75	11	4,300	12,000	5,400	-22%
Beaver Cr.	5	520	Mesic	64%	1.98	12	6,200	12,000	70%	1.65	12	6,200	10,000	(2,000)	6%
Beaver Cr.	6	680	Mesic	64%	1.98	12	8,200	16,000	30%	3.85	14	9,500	37,000	21,000	-34%
Beaver Cr.	7	420	Mesic	64%	1.98	12	5,000	9,900	30%	3.85	16	6,700	26,000	16,000	-34%
Beaver Cr.	8	1055	Mesic	64%	1.98	12	13,000	26,000	50%	2.75	15	16,000	44,000	18,000	-14%
Beaver Cr.	9	880	Mesic	64%	1.98	12	11,000	22,000	30%	3.85	15	13,000	50,000	28,000	-34%
Beaver Cr.	10	675	Mesic	64%	1.98	12	8,100	16,000	50%	2.75	15	10,000	28,000	12,000	-14%
Beaver Cr.	11	905	Mesic	64%	1.98	12	11,000	22,000	40%	3.30	15	14,000	46,000	24,000	-24%
Beaver Cr.	12	1583	Mesic	64%	1.98	12	19,000	38,000	30%	3.85	16	25,000	96,000	58,000	-34%
Beaver Cr.	13	1165	Mesic	52%	2.64	16	19,000	50,000	50%	2.75	16	19,000	52,000	2,000	-2%
Beaver Cr.	14	660	Mesic	52%	2.64	16	11,000	29,000	40%	3.30	17	11,000	36,000	7,000	-12%
Beaver Cr.	15	500	Mesic	52%	2.64	16	8,000	21,000	30%	3.85	17	8,500	33,000	12,000	-22%
Beaver Cr.	16	770	Mesic	52%	2.64	16	12,000	32,000	50%	2.75	18	14,000	39,000	7,000	-2%
Beaver Cr.	17	610	Mesic	52%	2.64	16	9,800	26,000	40%	3.30	19	12,000	40,000	14,000	-12%
Beaver Cr.	18	1255	Mesic	52%	2.64	16	20,000	53,000	70%	1.65	18	23,000	38,000	(15,000)	18%
Beaver Cr.	19	1570	Mesic	52%	2.64	16	25,000	66,000	50%	2.75	20	31,000	85,000	19,000	-2%
Beaver Cr.	20	475	Mesic	52%	2.64	16	7,600	20,000	50%	2.75	22	10,000	28,000	8,000	-2%
Beaver Cr.	21	700	Mesic	52%	2.64	16	11,000	29,000	60%	2.20	21	15,000	33,000	4,000	8%
Beaver Cr.	22	1180	Mesic	52%	2.64	16	19,000	50,000	70%	1.65	18	21,000	35,000	(15,000)	18%
Beaver Cr.	23	1000	Mesic	52%	2.64	16	16,000	42,000	70%	1.65	15	15,000	25,000	(17,000)	18%
Beaver Cr.	24	1830	Mesic	52%	2.64	16	29,000	77,000	70%	1.65	16	29,000	48,000	(29,000)	18%
						Totals		680,000					870,000	190,000	

Table E12. Isabella Creek load analysis (AU ID17060308CL010_03).

Segment Details				Target					Existing					Summary	
Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
AU CL010_03															
Isabella Creek	1	2250	Mesic	90%	0.55	6	10,000	6,000	90%	0.55	6	10,000	6,000	0	0%
Isabella Creek	2	371	Mesic	72%	1.54	10	3,700	5,700	80%	1.10	10	3,700	4,100	(1,600)	8%
Isabella Creek	3	1635	Mesic	72%	1.54	10	16,000	25,000	90%	0.55	10	16,000	8,800	(16,000)	18%
Isabella Creek	4	2534	Mesic	57%	2.37	14	35,000	83,000	80%	1.10	14	35,000	39,000	(44,000)	23%
Isabella Creek	5	976	Mesic	52%	2.64	16	16,000	42,000	70%	1.65	16	16,000	26,000	(16,000)	18%
Isabella Creek	6	602	Mesic	48%	2.86	18	11,000	31,000	80%	1.10	18	11,000	12,000	(19,000)	32%
Isabella Creek	7	210	Mesic	48%	2.86	18	3,800	11,000	60%	2.20	18	3,800	8,400	(2,600)	12%
						Totals		200,000					100,000	-99,000	

Table E13. Stony Creek load analysis (AU ID17060308CL020_02, _04, and _04a)

Segment Details				Target					Existing					Summary	
Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/ day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/ day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
AU CL020_02															
StonyTrib	1	535	Mesic	98%	0.11	1	500	60	90%	0.55	1	500	300	200	-8%
StonyTrib	2	930	Mesic	98%	0.11	1	900	100	80%	1.10	1	900	1,000	900	-18%
StonyTrib	3	255	Mesic	98%	0.11	2	500	60	60%	2.20	2	500	1,000	900	-38%
StonyTrib	4	780	Mesic	98%	0.11	2	2,000	200	40%	3.30	2	2,000	7,000	7,000	-58%
StonyTrib	5	460	Mesic	98%	0.11	2	900	100	50%	2.75	2	900	2,000	2,000	-48%
StonyTrib	6	405	Mesic	96%	0.22	3	1,000	200	80%	1.10	3	1,000	1,000	800	-16%
Stony Cr.	7	265	Mesic	48%	2.86	18	4,800	14,000	40%	3.30	18	4,800	16,000	2,000	-8%
Stony Cr.	8	265	Mesic	44%	3.08	20	5,300	16,000	20%	4.40	20	5,300	23,000	7,000	-24%
Stony Cr.	9	325	Mesic	44%	3.08	20	6,500	20,000	40%	3.30	20	6,500	21,000	1,000	-4%
Stony Cr.	10	1135	Mesic	44%	3.08	20	23,000	71,000	30%	3.85	20	23,000	89,000	18,000	-14%
Stony Cr.	11	1285	Mesic	48%	2.86	18	23,000	66,000	40%	3.30	18	23,000	76,000	10,000	-8%
Stony Cr.	12	1220	Mesic	48%	2.86	18	22,000	63,000	30%	3.85	18	22,000	85,000	22,000	-18%
Stony Cr.	13	1355	Mesic	44%	3.08	20	27,000	83,000	30%	3.85	20	27,000	100,000	17,000	-14%
Breakfast Cr.	14	1800	Mesic	44%	3.08	20	36,000	110,000	30%	3.85	20	36,000	140,000	30,000	-14%
Breakfast Cr.	15	1300	Mesic	44%	3.08	20	26,000	80,000	20%	4.40	20	26,000	110,000	30,000	-24%
						Totals		520,000					670,000	150,000	

Table E14. Floodwood Creek load analysis (AU ID17060308CL021_02).

Segment Details				Target					Existing					Summary	
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
AU CL021_02															
WFFloodwood	1	705	Mesic	98%	0.11	1	700	80	90%	0.55	1	700	400	300	-8%
WFFloodwood	2	445	UpAlder	92%	0.44	1	400	200	80%	1.10	2	900	1,000	800	-12%
WFFloodwood	3	830	Mesic	98%	0.11	2	2,000	200	90%	0.55	2	2,000	1,000	800	-8%
WFFloodwood	4	685	Mesic	98%	0.11	2	1,000	100	80%	1.10	2	1,000	1,000	900	-18%
WFFloodwood	5	330	Mesic	96%	0.22	3	1,000	200	80%	1.10	3	1,000	1,000	800	-16%
WFFloodwood	6	830	Mesic	94%	0.33	4	3,000	1,000	70%	1.65	4	3,000	5,000	4,000	-24%
WFFloodwood	7	295	Mesic	94%	0.33	4	1,000	300	80%	1.10	4	1,000	1,000	700	-14%
WFFloodwood	8	300	Mesic	94%	0.33	4	1,000	300	70%	1.65	4	1,000	2,000	2,000	-24%
WFFloodwood	9	230	Mesic	90%	0.55	6	1,000	600	60%	2.20	6	1,000	2,000	1,000	-30%
WFFloodwood	10	235	Mesic	90%	0.55	6	1,000	600	40%	3.30	8	2,000	7,000	6,000	-50%
WFFloodwood	11	540	Mesic	87%	0.72	7	4,000	3,000	60%	2.20	7	4,000	9,000	6,000	-27%
WFFloodwood	12	615	Mesic	87%	0.72	7	4,000	3,000	40%	3.30	9	6,000	20,000	20,000	-47%
WFFloodwood	13	620	Mesic	87%	0.72	7	4,000	3,000	50%	2.75	7	4,000	10,000	7,000	-37%
WFFloodwood	14	345	Mesic	87%	0.72	7	2,000	1,000	70%	1.65	7	2,000	3,000	2,000	-17%
WFFloodwood	15	445	Mesic	87%	0.72	7	3,000	2,000	80%	1.10	7	3,000	3,000	1,000	-7%
WFFloodwood	16	320	Mesic	81%	1.05	8	3,000	3,000	50%	2.75	8	3,000	8,000	5,000	-31%
WFFloodwood	17	1085	Mesic	81%	1.05	8	9,000	9,000	40%	3.30	8	9,000	30,000	20,000	-41%
WFFloodwood	18	455	Mesic	76%	1.32	9	4,000	5,000	30%	3.85	11	5,000	20,000	20,000	-46%
WFFloodwood	19	1795	Mesic	72%	1.54	10	18,000	28,000	30%	3.85	10	18,000	69,000	41,000	-42%
WFTrib1	20	570	Mesic	98%	0.11	1	600	70	90%	0.55	1	600	300	200	-8%
WFTrib1	21	905	Mesic	98%	0.11	1	900	100	80%	1.10	1	900	1,000	900	-18%
WFTrib1	22	285	Mesic	98%	0.11	2	600	70	90%	0.55	2	600	300	200	-8%
WFTrib2	23	730	Mesic	98%	0.11	1	700	80	90%	0.55	1	700	400	300	-8%
WFTrib2	24	1340	Mesic	98%	0.11	2	3,000	300	70%	1.65	2	3,000	5,000	5,000	-28%
WFTrib3	25	340	Mesic	98%	0.11	1	300	30	90%	0.55	1	300	200	200	-8%
WFTrib3	26	480	Mesic	98%	0.11	1	500	60	80%	1.10	1	500	600	500	-18%
WFTrib3	27	490	Mesic	98%	0.11	2	1,000	100	60%	2.20	2	1,000	2,000	2,000	-38%

Table E14. Floodwood Creek load analysis (AU ID17060308CL021_02) (cont.).

Segment Details				Target					Existing					Summary	
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
AU CL021_02															
WFTrib3	28	400	Mesic	98%	0.11	2	800	90	70%	1.65	2	800	1,000	900	-28%
WFTrib4	29	760	Mesic	98%	0.11	1	800	90	90%	0.55	1	800	400	300	-8%
WFTrib4	30	450	Mesic	98%	0.11	1	500	60	50%	2.75	1	500	1,000	900	-48%
WFTrib4	31	480	Mesic	98%	0.11	1	500	60	60%	2.20	1	500	1,000	900	-38%
FloodwoodTrib1	32	520	Mesic	98%	0.11	1	500	60	90%	0.55	1	500	300	200	-8%
FloodwoodTrib1	33	225	UpAlder	92%	0.44	1	200	90	80%	1.10	1	200	200	100	-12%
FloodwoodTrib1	34	895	Mesic	98%	0.11	1	900	100	90%	0.55	1	900	500	400	-8%
FloodwoodTrib2	35	2520	Mesic	98%	0.11	1	3,000	300	90%	0.55	1	3,000	2,000	2,000	-8%
TimberTrib1	36	835	Mesic	98%	0.11	1	800	90	90%	0.55	1	800	400	300	-8%
TimberTrib1	37	1965	Mesic	98%	0.11	1	2,000	200	80%	1.10	1	2,000	2,000	2,000	-18%
TimberTrib2	38	1720	Mesic	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
Timber Cr.	39	325	Mesic	98%	0.11	1	300	30	90%	0.55	1	300	200	200	-8%
Timber Cr.	40	625	UpAlder	92%	0.44	1	600	300	80%	1.10	1	600	700	400	-12%
Timber Cr.	41	265	UpAlder	87%	0.72	2	500	400	70%	1.65	2	500	800	400	-17%
Timber Cr.	42	845	Mesic	98%	0.11	2	2,000	200	80%	1.10	2	2,000	2,000	2,000	-18%
Timber Cr.	43	490	Mesic	96%	0.22	3	1,000	200	90%	0.55	3	1,000	600	400	-6%
Timber Cr.	44	1660	Mesic	94%	0.33	4	7,000	2,000	70%	1.65	4	7,000	10,000	8,000	-24%
Timber Cr.	45	250	Mesic	94%	0.33	4	1,000	300	60%	2.20	4	1,000	2,000	2,000	-34%
Timber Cr.	46	1325	Mesic	94%	0.33	4	5,000	2,000	80%	1.10	4	5,000	6,000	4,000	-14%
Goat Cr.	47	1960	Mesic	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
Goat Cr.	48	3315	Mesic	98%	0.11	2	7,000	800	80%	1.10	2	7,000	8,000	7,000	-18%
Goat Cr.	49	445	Mesic	96%	0.22	3	1,000	200	50%	2.75	3	1,000	3,000	3,000	-46%
Goat Cr.	50	240	Mesic	96%	0.22	3	700	200	80%	1.10	3	700	800	600	-16%
FloodwoodTrib3	51	270	Mesic	98%	0.11	1	300	30	80%	1.10	1	300	300	300	-18%
FloodwoodTrib3	52	2085	Mesic	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
O'DonnellTrib	53	605	Mesic	98%	0.11	1	600	70	80%	1.10	1	600	700	600	-18%
O'DonnellTrib	54	740	Mesic	98%	0.11	1	700	80	90%	0.55	1	700	400	300	-8%

Table E14. Floodwood Creek load analysis (AU ID17060308CL021_02) (cont.).

Segment Details				Target					Existing					Summary	
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
AU CL021_02															
O'DonnellTrib	55	940	Mesic	98%	0.11	1	900	100	80%	1.10	1	900	1,000	900	-18%
O'DonnellTrib	56	365	Mesic	98%	0.11	1	400	40	70%	1.65	1	400	700	700	-28%
O'Donnell Cr.	57	1630	Mesic	98%	0.11	1	2,000	200	80%	1.10	1	2,000	2,000	2,000	-18%
O'Donnell Cr.	58	615	Mesic	98%	0.11	2	1,000	100	80%	1.10	2	1,000	1,000	900	-18%
O'Donnell Cr.	59	1145	Mesic	98%	0.11	2	2,000	200	90%	0.55	2	2,000	1,000	800	-8%
FloodwoodTrib4	60	1285	Mesic	98%	0.11	1	1,000	100	50%	2.75	1	1,000	3,000	3,000	-48%
FloodwoodTrib4	61	1690	Mesic	98%	0.11	1	2,000	200	70%	1.65	1	2,000	3,000	3,000	-28%
FloodwoodTrib4	62	385	Mesic	98%	0.11	1	400	40	40%	3.30	1	400	1,000	1,000	-58%
Trail Cr.	63	2210	Mesic	98%	0.11	1	2,000	200	70%	1.65	1	2,000	3,000	3,000	-28%
Trail Cr.	64	1660	Mesic	98%	0.11	1	2,000	200	80%	1.10	1	2,000	2,000	2,000	-18%
Trail Cr.	65	415	Mesic	98%	0.11	2	800	90	70%	1.65	2	800	1,000	900	-28%
FloodwoodTrib5	66	640	Mesic	98%	0.11	1	600	70	60%	2.20	1	600	1,000	900	-38%
FloodwoodTrib5	67	380	Mesic	98%	0.11	1	400	40	30%	3.85	1	400	2,000	2,000	-68%
FloodwoodTrib5	68	415	Mesic	98%	0.11	1	400	40	40%	3.30	1	400	1,000	1,000	-58%
FloodwoodTrib5	69	445	Mesic	98%	0.11	1	400	40	50%	2.75	1	400	1,000	1,000	-48%
FloodwoodTrib5	70	490	Mesic	98%	0.11	1	500	60	70%	1.65	1	500	800	700	-28%
FloodwoodTrib6	71	1680	Mesic	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
FloodwoodTrib6	72	1485	Mesic	98%	0.11	1	1,000	100	50%	2.75	1	1,000	3,000	3,000	-48%
FloodwoodTrib7	73	520	Mesic	98%	0.11	1	500	60	50%	2.75	1	500	1,000	900	-48%
FloodwoodTrib7	74	1635	Mesic	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
FloodwoodTrib8	75	755	Mesic	98%	0.11	1	800	90	90%	0.55	1	800	400	300	-8%
FloodwoodTrib8	76	300	Mesic	98%	0.11	1	300	30	50%	2.75	1	300	800	800	-48%
FloodwoodTrib8	77	760	Mesic	98%	0.11	1	800	90	60%	2.20	1	800	2,000	2,000	-38%
FloodwoodTrib8	78	265	Mesic	98%	0.11	1	300	30	80%	1.10	1	300	300	300	-18%
						Totals		72,000					280,000	220,000	

Table E15. Floodwood Creek load analysis (AU ID17060308CL021_02a, _03a, and _03).

Segment Details				Target					Existing					Summary	
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
AU CL021_02a,_03a,_03															
Floodwood Cr.	1	890	UpAlder	92%	0.44	1	900	400	80%	1.10	1	900	1,000	600	-12%
Floodwood Cr.	2	1215	UpAlder	87%	0.72	2	2,000	1,000	60%	2.20	2	2,000	4,000	3,000	-27%
Floodwood Cr.	3	435	UpAlder	87%	0.72	2	900	600	80%	1.10	2	900	1,000	400	-7%
Floodwood Cr.	4	400	UpAlder	87%	0.72	2	800	600	70%	1.65	2	800	1,000	400	-17%
Floodwood Cr.	5	2065	UpAlder	74%	1.43	3	6,000	9,000	70%	1.65	3	6,000	10,000	1,000	-4%
Pinchot Cr.	6	495	UpAlder	92%	0.44	1	500	200	80%	1.10	1	500	600	400	-12%
Pinchot Cr.	7	1210	Mesic	98%	0.11	1	1,000	100	90%	0.55	1	1,000	600	500	-8%
Pinchot Cr.	8	635	Mesic	98%	0.11	2	1,000	100	80%	1.10	2	1,000	1,000	900	-18%
Pinchot Cr.	9	565	Mesic	96%	0.22	3	2,000	400	90%	0.55	3	2,000	1,000	600	-6%
Pinchot Cr.	10	1175	Mesic	94%	0.33	4	5,000	2,000	70%	1.65	4	5,000	8,000	6,000	-24%
PinchotTrib	11	1720	Mesic	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
Floodwood Cr.	12	225	Mesic	92%	0.44	5	1,000	400	70%	1.65	5	1,000	2,000	2,000	-22%
Floodwood Cr.	13	480	Mesic	90%	0.55	6	3,000	2,000	70%	1.65	6	3,000	5,000	3,000	-20%
Floodwood Cr.	14	475	Mesic	90%	0.55	6	3,000	2,000	80%	1.10	6	3,000	3,000	1,000	-10%
Floodwood Cr.	15	645	Mesic	87%	0.72	7	5,000	4,000	70%	1.65	7	5,000	8,000	4,000	-17%
Floodwood Cr.	16	855	Mesic	81%	1.05	8	7,000	7,000	60%	2.20	8	7,000	20,000	10,000	-21%
Floodwood Cr.	17	315	Mesic	72%	1.54	10	3,200	4,900	50%	2.75	10	3,200	8,800	3,900	-22%
Floodwood Cr.	18	300	Mesic	64%	1.98	12	3,600	7,100	50%	2.75	12	3,600	9,900	2,800	-14%
Floodwood Cr.	19	865	Mesic	64%	1.98	12	10,000	20,000	60%	2.20	12	10,000	22,000	2,000	-4%
Floodwood Cr.	20	1975	Mesic	64%	1.98	12	24,000	48,000	60%	2.20	12	24,000	53,000	5,000	-4%
Floodwood Cr.	21	515	Mesic	64%	1.98	12	6,200	12,000	50%	2.75	12	6,200	17,000	5,000	-14%
Floodwood Cr.	22	950	Mesic	64%	1.98	12	11,000	22,000	30%	3.85	14	13,000	50,000	28,000	-34%
Floodwood Cr.	23	480	Mesic	57%	2.37	14	6,700	16,000	40%	3.30	14	6,700	22,000	6,000	-17%
Floodwood Cr.	24	210	Mesic	55%	2.48	15	3,200	7,900	30%	3.85	15	3,200	12,000	4,100	-25%
Floodwood Cr.	25	855	Mesic	55%	2.48	15	13,000	32,000	20%	4.40	15	13,000	57,000	25,000	-35%
Floodwood Cr.	26	790	Mesic	52%	2.64	16	13,000	34,000	50%	2.75	16	13,000	36,000	2,000	-2%
Floodwood Cr.	27	990	Mesic	52%	2.64	16	16,000	42,000	40%	3.30	16	16,000	53,000	11,000	-12%

Table E15. Floodwood Creek load analysis (AU ID17060308CL021_02a, _03a, and _03) (cont.).

Segment Details				Target					Existing					Summary	
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
AU CL021_02a,_03a,_03															
Floodwood Cr.	28	300	Mesic	52%	2.64	16	4,800	13,000	30%	3.85	16	4,800	18,000	5,000	-22%
Floodwood Cr.	29	970	Mesic	50%	2.75	17	16,000	44,000	40%	3.30	17	16,000	53,000	9,000	-10%
Floodwood Cr.	30	575	Mesic	50%	2.75	17	9,800	27,000	20%	4.40	20	12,000	53,000	26,000	-30%
Floodwood Cr.	31	2060	Mesic	50%	2.75	17	35,000	96,000	30%	3.85	17	35,000	130,000	34,000	-20%
Floodwood Cr.	32	2300	Mesic	50%	2.75	17	39,000	110,000	40%	3.30	17	39,000	130,000	20,000	-10%
Floodwood Cr.	33	1375	Mesic	50%	2.75	17	23,000	63,000	40%	3.30	17	23,000	76,000	13,000	-10%
						Totals		630,000					870,000	240,000	

Table E16. Stony Creek load analysis (AU ID17060308CL023_02, _02a, and _03).

Segment Details				Target					Existing					Summary	
Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
AU CL023_02a															
Stony Cr.	1	898	Mesic	98%	0.11	1	900	100	90%	0.55	1	900	500	400	-8%
Stony Cr.	2	1320	Mesic	98%	0.11	2	3,000	300	70%	1.65	2	3,000	5,000	5,000	-28%
Stony Cr.	3	688	Mesic	98%	0.11	2	1,000	100	50%	2.75	2	1,000	3,000	3,000	-48%
StonyTrib1	4	615	Mesic	98%	0.11	1	600	70	90%	0.55	1	600	300	200	-8%
StonyTrib1	5	1485	Mesic	98%	0.11	2	3,000	300	80%	1.10	1	1,000	1,000	700	-18%
Cedar Cr.	6	1640	Mesic	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
Cedar Cr.	7	575	Mesic	98%	0.11	2	1,000	100	80%	1.10	2	1,000	1,000	900	-18%
Cedar Cr.	8	895	Mesic	96%	0.22	3	3,000	700	90%	0.55	3	3,000	2,000	1,000	-6%
Cedar Cr.	9	505	Mesic	94%	0.33	4	2,000	700	80%	1.10	4	2,000	2,000	1,000	-14%
Cedar Cr.	10	565	Mesic	94%	0.33	4	2,000	700	60%	2.20	4	2,000	4,000	3,000	-34%
CedarTrib	11	495	Mesic	98%	0.11	1	500	60	90%	0.55	1	500	300	200	-8%
CedarTrib	12	1080	Mesic	98%	0.11	1	1,000	100	80%	1.10	1	1,000	1,000	900	-18%
WFStony	13	250	Mesic	98%	0.11	1	300	30	40%	3.30	1	300	1,000	1,000	-58%
WFStony	14	480	Mesic	98%	0.11	1	500	60	60%	2.20	1	500	1,000	900	-38%
WFStony	15	715	Mesic	98%	0.11	2	1,000	100	70%	1.65	2	1,000	2,000	2,000	-28%
WFStony	16	385	Mesic	98%	0.11	2	800	90	60%	2.20	2	800	2,000	2,000	-38%
WFStony	17	426	Mesic	96%	0.22	3	1,000	200	50%	2.75	3	1,000	3,000	3,000	-46%
WFStony	18	1300	UpAlder	74%	1.43	3	4,000	6,000	70%	1.65	3	4,000	7,000	1,000	-4%
WFStony	19	1135	Mesic	94%	0.33	4	5,000	2,000	90%	0.55	4	5,000	3,000	1,000	-4%
WFStony	20	780	Mesic	90%	0.55	6	5,000	3,000	80%	1.10	6	5,000	6,000	3,000	-10%
WFTrib	21	760	UpAlder	92%	0.44	1	800	400	80%	1.10	1	800	900	500	-12%
WFTrib	22	470	Mesic	98%	0.11	1	500	60	90%	0.55	1	500	300	200	-8%
WFTrib	23	450	Mesic	98%	0.11	2	900	100	50%	2.75	2	900	2,000	2,000	-48%
StonyTrib2	24	490	Mesic	98%	0.11	1	500	60	70%	1.65	1	500	800	700	-28%
StonyTrib2	25	1035	Mesic	98%	0.11	2	2,000	200	80%	1.10	2	2,000	2,000	2,000	-18%
StonyTrib2	26	675	Mesic	98%	0.11	2	1,000	100	70%	1.65	2	1,000	2,000	2,000	-28%
StonyTrib2	27	430	Mesic	98%	0.11	2	900	100	90%	0.55	2	900	500	400	-8%

Table E16. Stony Creek load analysis (AU ID17060308CL023_02, _02a, and _03) (cont.).

Segment Details				Target					Existing					Summary	
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
AU CL023_02a															
StonyTrib3	28	240	Mesic	98%	0.11	1	200	20	90%	0.55	1	200	100	80	-8%
StonyTrib3	29	235	Mesic	98%	0.11	1	200	20	70%	1.65	1	200	300	300	-28%
StonyTrib3	30	1140	Mesic	98%	0.11	2	2,000	200	80%	1.10	2	2,000	2,000	2,000	-18%
StonyTrib3	31	140	Mesic	98%	0.11	2	300	30	70%	1.65	2	300	500	500	-28%
StonyTrib3	32	360	Mesic	96%	0.22	3	1,000	200	80%	1.10	3	1,000	1,000	800	-16%
StonyTrib3	33	125	Mesic	96%	0.22	3	400	90	60%	2.20	3	400	900	800	-36%
StonyTrib4	34	270	Mesic	98%	0.11	1	300	30	80%	1.10	1	300	300	300	-18%
StonyTrib4	35	690	Mesic	98%	0.11	2	1,000	100	90%	0.55	2	1,000	600	500	-8%
StonyTrib4	36	260	Mesic	98%	0.11	2	500	60	50%	2.75	2	500	1,000	900	-48%
StonyTrib4	37	150	Mesic	98%	0.11	2	300	30	70%	1.65	2	300	500	500	-28%
StonyTrib4	38	390	Mesic	98%	0.11	2	800	90	90%	0.55	2	800	400	300	-8%
StonyTrib5	39	1465	Mesic	98%	0.11	1	1,000	100	90%	0.55	1	1,000	600	500	-8%
StonyTrib5	40	400	Mesic	98%	0.11	2	800	90	60%	2.20	2	800	2,000	2,000	-38%
Camp40 Cr.	41	415	Mesic	98%	0.11	1	400	40	40%	3.30	1	400	1,000	1,000	-58%
Camp40 Cr.	42	995	Mesic	98%	0.11	1	1,000	100	90%	0.55	1	1,000	600	500	-8%
Camp40 Cr.	43	1510	Mesic	98%	0.11	2	3,000	300	70%	1.65	2	3,000	5,000	5,000	-28%
Camp40 Cr.	44	250	Mesic	96%	0.22	3	800	200	70%	1.65	3	800	1,000	800	-26%
Camp40 Cr.	45	965	Mesic	96%	0.22	3	3,000	700	60%	2.20	3	3,000	7,000	6,000	-36%
Camp40 Cr.	46	2150	Mesic	94%	0.33	4	9,000	3,000	80%	1.10	4	9,000	10,000	7,000	-14%
Camp40Trib	47	1165	Mesic	98%	0.11	1	1,000	100	80%	1.10	1	1,000	1,000	900	-18%
Camp40Trib	48	915	Mesic	98%	0.11	1	900	100	90%	0.55	1	900	500	400	-8%
						Totals		22,000					91,000	70,000	

Table E17. Breakfast Creek load analysis (AU ID17060308CL025_02).

Segment Details				Target					Existing					Summary	
Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
AU CL025_02															
Breakfast	1	940	Mesic	98%	0.11	1	900	100	80%	1.10	1	900	1,000	900	-18%
Breakfast	2	1175	Mesic	98%	0.11	2	2,000	200	90%	0.55	2	2,000	1,000	800	-8%
Breakfast	3	485	Mesic	98%	0.11	2	1,000	100	80%	1.10	2	1,000	1,000	900	-18%
Breakfast	4	1300	Mesic	96%	0.22	3	4,000	900	70%	1.65	3	4,000	7,000	6,000	-26%
Breakfast	5	1865	Mesic	94%	0.33	4	7,000	2,000	80%	1.10	4	7,000	8,000	6,000	-14%
Breakfast	6	1270	Mesic	92%	0.44	5	6,000	3,000	60%	2.20	5	6,000	10,000	7,000	-32%
Breakfast	7	1420	Mesic	92%	0.44	5	7,000	3,000	70%	1.65	6	9,000	10,000	7,000	-22%
Breakfast	8	2635	Mesic	90%	0.55	6	20,000	10,000	60%	2.20	6	20,000	40,000	30,000	-30%
						Totals		19,000					78,000	59,000	

Appendix F. Public Comments

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The Watershed Advisory Group agreed to provide a 30-day public comment period for the draft *Lower North Fork Clearwater River Subbasin: Five Year Review and Addendum* document during March of 2013. 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, Grangeville and State Offices of the Idaho Department of Environmental Quality. The comments received were reviewed and discussed by the Lower North Fork Clearwater Watershed Advisory Group. Comments received are summarized and addressed below.

Written comments were received from:

a) Lynn B. Card, Orofino, Idaho.
b) Helen Rueda, US Environmental Protection Agency, Region 10, Portland Oregon.

Comment: Let me say up front that I am against this project as a waste of money, waste of time and will end up costing me money by increasing my electrical rates or spending my taxes unwisely. I came to this area in 1975 and have worked at Kelly Creek, Canyon, Potlatch and Orofino. I have worked, hunted, fished and explored all the streams you listed in the newspaper article. I am well aware of water temperature and how it effects fish. I have noted how the fish migrate downstream each fall and spend the winter in the deep holes then migrate back upstream during the spring and summer where the water temperature is cooler. I was there with my fish-pole. When fishing on the Dworshack I keep a eye on the water temperature as well as the fish finder. Over the years I have seen many projects studied, planned and implemented. Many of these projects were costly and did little to benefit the intended animals. Anything man does affects the environment often in departmental ways. The Corps of Engineers improves elk habitat by logging, browse burning and cutting brush with a Spider (back-hoe). This increases the water temperature when it is done in the riparian zone along streams. The improved elk habitat was largely wasted when the next clown turned wolves loose and destroyed the largest elk herd in the world. For years loggers were required to pick logs, sticks and other debris out of streams when they were finished logging. They even hired a crew of stick pickers. This was a joke at the time until the next Fishery Biologist came along and require the logger to put the logs back in the stream. They even hauled logs from the mill yard to use on these projects. I could go on and on describing these failures but you should have the idea by now. If you want cooler temperatures in the streams let "Mother Nature" accomplish it in her time and way. With Global Warming increasing each year your streams will probably dry up in spite of you efforts. I have noticed that projects like this buy a lot of toys for the biologist working on them put their kids through college and give them bragging rights to worthless work.

Response: This TMDL attempts to mirror "Mother Nature" as much as possible by applying the Idaho water quality standard's natural background provision; "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." (IDAPA 58.01.02.200.09). When stream temperatures exceed criteria and natural vegetation targets are achieved, it is assumed that the stream's temperature is natural.

Comment: There are three AU's that are on category 5 of the Integrated Report for Combined Biota/ Habitat Bioassessment: Alder Creek (ID17060308CL005_02), Middle Fork Robinson Creek (ID17060308CL002_02c) and Elkberry Creek (ID17060308CL002_02b). There is no analysis in the TMDL document to support that temperature is the only pollutant causing these impairments. Without additional information on sources affecting these waterbodies and data showing that other pollutants are not an issue, these waterbodies cannot be removed from category 5 of the Integrated Report.

Response: Section 2.4.5 entitled *Analysis of AUs Impaired by Combined Biota/Habitat Impairment* has been inserted on page 20 to provide the analysis requested.

Comment: Shade curves used for this TMDL are not presented in the document. It would be helpful to add all of the shade curves used in the development of this TMDL, and it is necessary to include the shade curve associated with the newly designated "CNF Upland-Alder Mixed" land cover classification.

Response: Shade curves including the newly designated CNF Upland-Alder Mixed have been included in Appendix D.

Comment: On page 30 the TMDL states that the IDL found the development of "the shade curve did not account for natural levels of disturbance that occur in the Clearwater basin (approximately 23% of the Clearwater Mesic Upland area was non-stocked historically)". This finding is not accurate because "natural disturbance" was included when developing stand conditions used in the development of these shade curves (see Shumar and Verona, 2009). In addition, it is also important to point out that 19% of the Mesic Upland area in the Clearwater was assumed to be 'non-stocked' on a weighted average condition during the development of shade curve, which is very similar to levels outlined in the quoted sentence listed above.

Response: The information provided by IDL on page 30 and the information provided by the comment has been added to the discussion on the development of the shade curve on page 35.

Comment: Also on page 30 the TMDL states that the IDL found that the model input parameters used to develop the shade curve were "unrepresentative of what is generally encountered on the landscape." Vegetation information used to develop the shade curves was obtained from the USFS's Historical Range of Variability Analysis (HRV) for the Clearwater National Forests (CNF). As a result of this analysis, the tree height condition used in the shade model for the CNF Mesic Uplands region was determined to be 69 feet tall. It is important to point out that during the 2012 IFPA audit, the average height for conifers trees observed in the CNF Mesic Uplands was 77 feet tall, which is taller than the modeled condition listed above. In addition, a recent TMDL audit investigation by IDEQ found that all observed current shade measurements within the CNF were above the targeted shade condition associated with the shade curve. Accordingly, this information indicates that vegetation conditions used to develop the shade curves for the CNF are representative of expected forest conditions, and that shade targets associated with the shade curves are achievable.

Response: The information provided by IDL on page 30 and the information provided by the comment has been added to the discussion on the development of the shade curve on page 35.

Comment: On page 34 the document states that visual observations of the lower elevation areas of the TMDL watersheds show alder communities dominating the streamside vegetation, with the forest located farther from the riparian area. A new shade curve was developed for this vegetation type. Please describe in more detail why you think that these areas still represent “natural” conditions.

Response: A more detailed description on the referenced alder community provided by the USDA Fire Effects Information System has been included in the discussion on development of the shade curve on page 35.

Comment: Page 30, third paragraph, last sentence: A word seems to be missing in this sentence between “skewed” and “larger”. Page 56, last paragraph, first sentence: The acronym “SPZ” is not defined.

Response: The last sentence of the third paragraph on page 30 has been corrected. The acronym SPZ has been defined in the text and included in the Abbreviations, Acronyms, and Symbols list on page viii.

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Appendix G. Distribution List

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Distribution List

- Idaho Department of Environmental Quality, Lewiston Regional Office—1118 F Street, Lewiston, Idaho 83501
- Idaho Department of Environmental Quality, State Office—1410 North Hilton, Boise, Idaho 83706
- US Environmental Protection Agency, Idaho Operations Office—1435 North Orchard, Boise, Idaho 83706
- Lower North Fork Clearwater River Watershed Advisory Group

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