Coeur d'Alene Lake Tributaries Temperature Total Maximum Daily Loads:

Addendum to the Coeur d'Alene Lake Subbasin Assessment and TMDL

"Draft"

Department of Environmental Quality

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Coeur d’Alene Lake Tributaries Temperature TMDLs

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Acknowledgments

Cover Photo: 2005 BURP crew on Fernan Creek (DEQ).

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Abbreviations, Acronyms, and Symbols

§303(d)	Refers to section 303 subsection (d) of the Clean Water Act, or a list of impaired water bodies required by this section
AU	assessment unit
BMP	best management practice
BURP	Beneficial Use Reconnaissance Program
C	Celsius
CWA	Clean Water Act
CWE	cumulative watershed effects
DEQ	Department of Environmental Quality
EPA	United States Environmental Protection Agency
FPA	Idaho Forest Practices Act
FWS	U.S. Fish and Wildlife Service
GIS	Geographical Information Systems
HUC	Hydrologic Unit Code
I.C.	Idaho Code
IDAPA	Refers to citations of Idaho administrative rules
IDFG	Idaho Department of Fish and Game
IDL	Idaho Department of Lands
IDWR	Idaho Department of Water Resources
LA	load allocation
LC	load capacity
m	meter
mi	mile
mi^2	square miles
MOS	margin of safety
MWMT	maximum weekly maximum temperature
n.a.	not applicable
NA	not assessed
NB	natural background
nd	no data (data not available)
NPDES	National Pollutant Discharge Elimination System
PNV	potential natural vegetation
SBA	subbasin assessment
STATSGO	State Soil Geographic Database
TMDL	total maximum daily load

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U.S. United States

U.S.C. United States Code

USDA United States Department of Agriculture

USDI United States Department of the Interior

USFS United States Forest Service

USGS United States Geological Survey

WAG Watershed Advisory Group

WLA wasteload allocation

WQLS water quality limited segment

WQMP water quality management plan

WQRP water quality restoration plan

WQS water quality standard

Executive Summary

Elevated stream temperatures can be harmful to fish at all life stages, especially if they occur in combination with other habitat limitations such as low dissolved oxygen or poor food supply. Acceptable temperature ranges vary for different species of fish, with cold water species being the least tolerant of high water temperatures. Temperature as a chronic stressor to adult fish can result in reduced body weight, reduced oxygen exchange, increased susceptibility to disease, and reduced reproductive capacity. Acutely high temperatures can result in death if they persist for an extended length of time. Juvenile fish are even more sensitive to temperature variations than adult fish, and can experience negative impacts at a lower threshold value than the adults, manifesting in retarded growth rates. High temperatures also affect embryonic development of fish before they even emerge from the substrate. Similar kinds of affects may occur to aquatic invertebrates, amphibians and mollusks, although less is known about them.

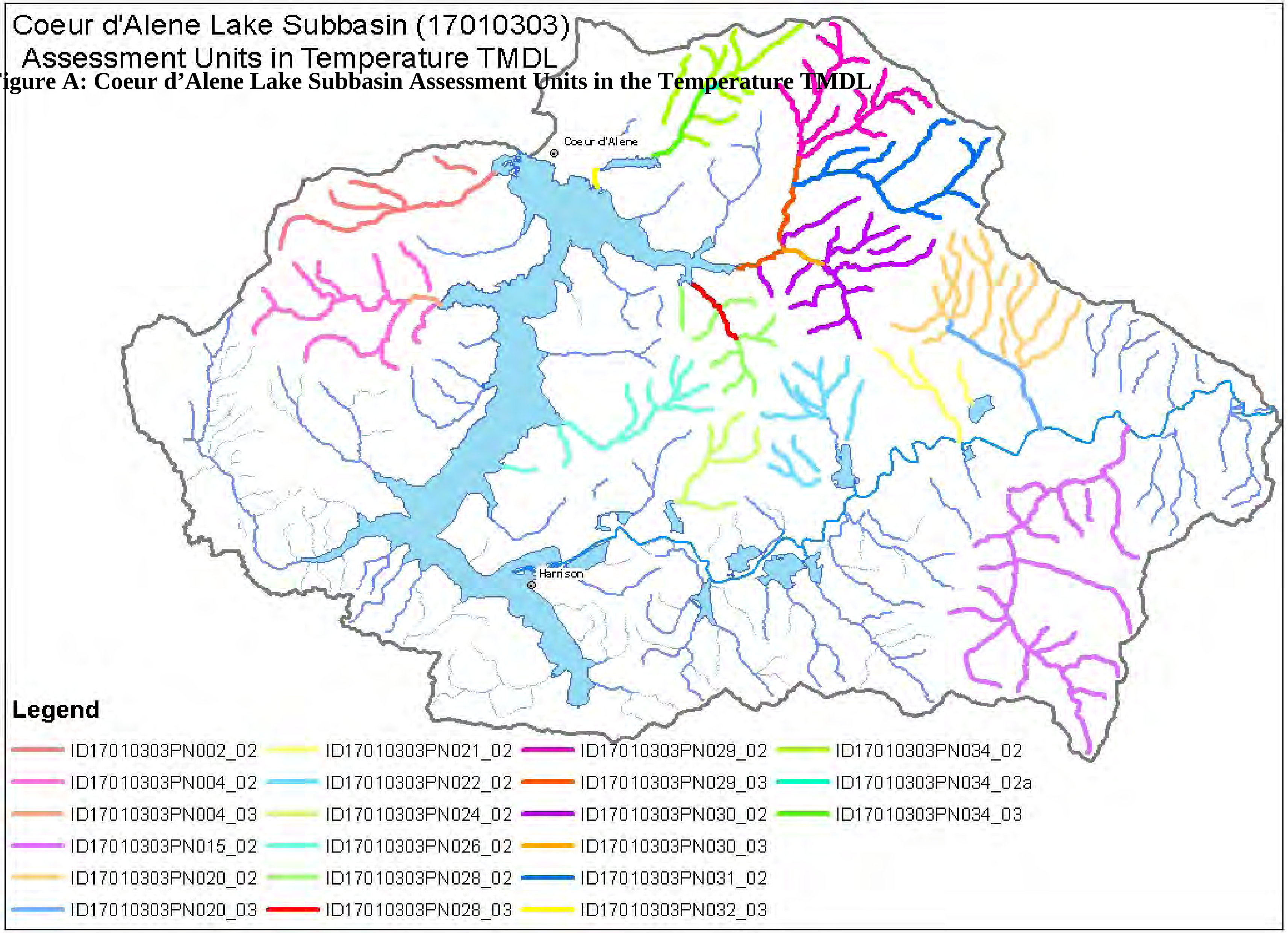
The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to Section 303 of the CWA, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife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

This document addresses streams within the Coeur d'Alene Lake subbasin hydrologic unit code (HUC) 17010303. The Coeur d'Alene Lake Subbasin is located in northern Idaho and includes the Coeur d'Alene River from its confluence with the South Fork to Coeur d'Alene Lake, as well as tributaries to both the lake and the river. Idaho Water Quality Standards for temperature were exceeded in 13 streams and their tributaries (21 Assessment Units) (Figure A). This TMDL analysis has been developed to comply with Idaho's TMDL requirements. The TMDL analysis quantifies pollutant sources and allocates the responsibility for load reductions needed to return §303(d)-listed waters to a condition that meets water quality standards. For more information about these watersheds and the subbasin as a whole see the *Coeur d'Alene Lake and River (17010303) Sub-basin Assessment and Proposed Total Maximum Daily Loads* (IDEQ, 1999).

The Coeur d'Alene River itself is not included in this document. The primary cause for the temperature impairment on the lower reaches of the Coeur d'Alene River has been determined to be flow alteration as a result of water elevations in Lake Coeur d'Alene being held up to 7.5 feet higher by the Post Falls dam during the months of June to mid-September. Temperature impairments on the river will be addressed by implementation of temperature TMDLs on tributaries to the Coeur d'Alene River and through implementation of the Water Quality Improvement and Erosion Control Plan developed by AVISTA under the Settlement

Agreement with DEQ and Idaho Department of Fish and Game concerning the Relicensing of the Post Falls Hydroelectric Project.

Figure A: Coeur d'Alene Lake Subbasin Assessment Units in the Temperature TMDL



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Key Findings

Twenty-one assessment units (AU) involving 13 major watersheds were identified as having temperature related impairment, most of which have been placed on the 303d list of impaired waters by EPA or the State for reasons associated with temperature criteria violations (Table A). Figure B shows all the streams examined in this temperature TMDL document.

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

Stream	Assessment Units
Latour Creek and tributaries	ID17010303PN15_02
Rose Creek and tributaries	ID17010303PN21_02
Killarney Lake tributaries	ID17010303PN22_02
Blue Lake Creek and tributaries	ID17010303PN24_02
Carlin Creek and tributaries	ID17010303PN26_02
Cedar Creek and tributaries	ID17010303PN30_02 ID17010303PN30_03
4th of July Creek and tributaries	ID17010303PN20_02 ID17010303PN20_03
Fernan Creek and tributaries	ID17010303PN32_03 ID17010303PN34_02 ID17010303PN34_02a ID17010303PN34_03
Beauty Creek and tributaries	ID17010303PN28_02 ID17010303PN28_03
Cougar Creek and tributaries	ID17010303PN02_02
Mica Creek and tributaries	ID17010303PN04_02 ID17010303PN04_03
Marie Creek and tributaries	ID17010303PN31_02
Wolf Lodge Creek and tributaries	ID17010303PN29_02 ID17010303PN29_03

Effective shade targets were established for all 21 AU based on the concept of maximum shading under potential natural vegetation equals natural background temperature levels. Shade targets were actually derived from effective shade curves developed for Idaho Panhandle vegetation types by EPA. Existing shade was determined from aerial photo interpretation field verified with solar pathfinder data.

Most streams examined in this TMDL lacked shade and had excess solar loads. Latour Creek and Wolf Lodge Creek AU had the largest excess loads, but not necessarily the highest proportion in excess. The Cougar Creek and Carlin Creek AU had the lowest levels of excess load and lack of shade. Most remaining AU examined had similar levels of disturbance mostly occurring in lower elevation sections that are affected by land clearing activities.

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

Table B. Summary of assessment outcomes.

Water Body Segment/ AU	Pollutant	TMDL(s) Completed	Recommended Changes to §303(d) List	Justification
Cougar Creek/ ID17010303PN002_02	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
Mica Creek/ ID17010303PN004_03	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
NF & SF Mica Creek/ ID17010303PN004_02	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
Latour, Baldy, Larch Creeks/ ID17010303PN015_02	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
4th of July Creek/ ID17010303PN020_02 ID17010303PN020_03	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
Rose Creek/ ID17010303PN021_02	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
Killarney Lake Tributaries/ ID17010303PN022_02	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
Blue Lake Creek/ ID17010303PN024_02	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
Carlin Creek/ ID17010303PN026_02	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
Beauty Creek/ ID17010303PN028_03 ID17010303PN028_02	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
Wolf Lodge Creek/ ID17010303PN029_03 ID17010303PN029_02	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
Cedar Creek/ ID17010303PN030_02 ID17010303PN030_03	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
Marie Creek/ ID17010303PN031_02	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
Fernan Creek/ ID17010303PN032_03 ID17010303PN034_03 ID17010303PN034_02a ID17010303PN034_02	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade

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Subbasin at a Glance

The Coeur d'Alene Lake Subbasin (in hydrologic unit code [HUC] 17010303) drains 650.5 square miles, which includes the Coeur d'Alene Lake, the Coeur d'Alene River, and the waters which drain directly to the river and the lake (Figure 1). The Coeur d'Alene Lake Subbasin is located in Benewah, Bonner, Kootenai and Shoshone counties of northern Idaho. It lies within the Northern Rocky Mountain physiographic region to the west of the Bitterroot Mountains.

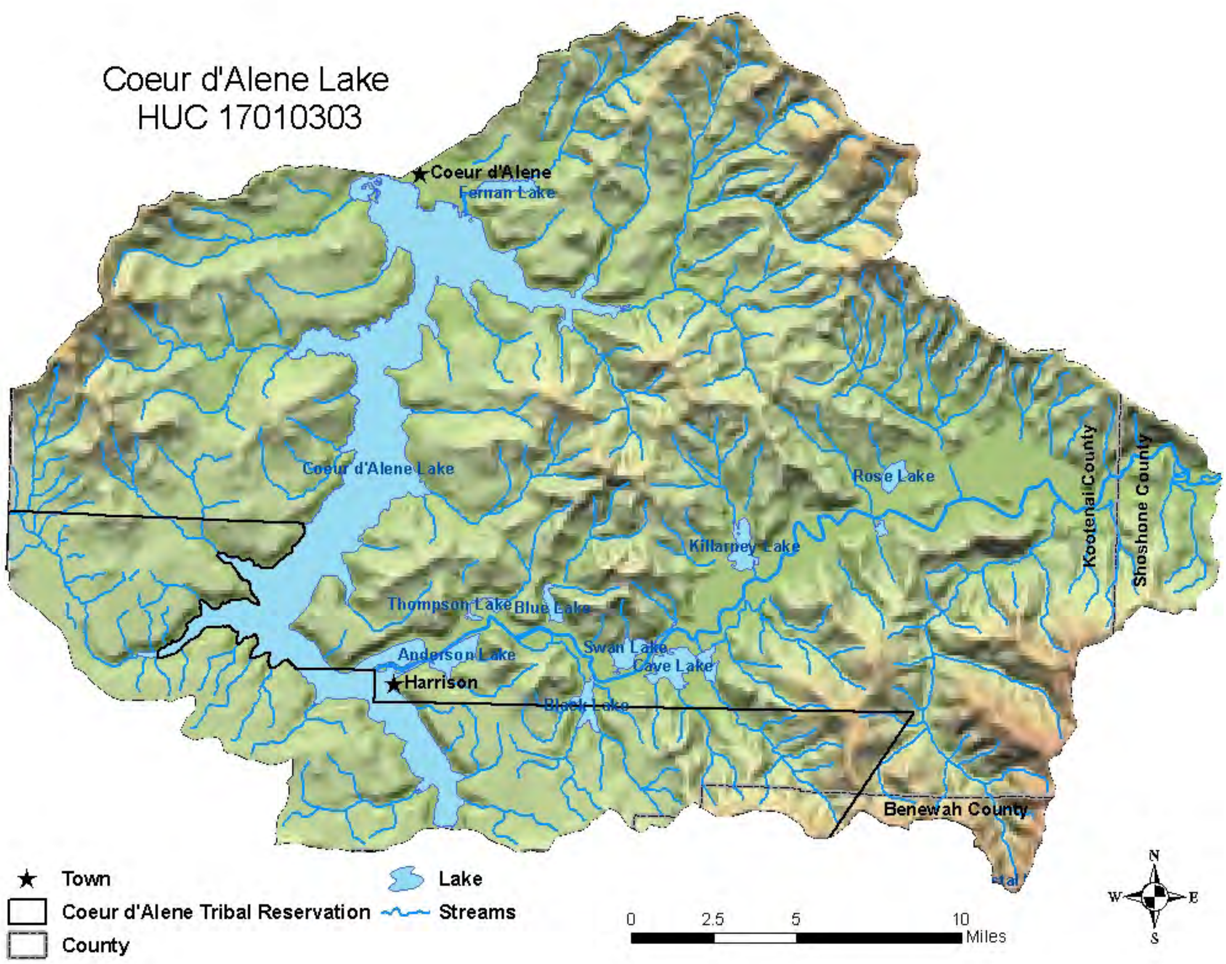

Figure 1. Extent of Coeur d'Alene Lake Watershed (HUC 17010303)

The tributary contributing the largest flow to Coeur d'Alene Lake is the St. Joe River. The Coeur d'Alene River is the second largest tributary contributing flow to Coeur d'Alene Lake. It flows from the confluence of the North and South Forks of the Coeur d'Alene River near Enaville, Idaho westward to its mouth at Lake Coeur d'Alene near Harrison, Idaho. The river's tributaries flow from the Coeur d'Alene Mountains on the north and by the St. Joe Mountains on the south. Tributaries to the lake from the west flow either from the Palouse Hills or from the most southerly mountains of the Selkirk Range.

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The Coeur d'Alene River flows through a generally broad floodplain ranging from ¼ to 1 ¾ miles in width. Eleven lakes and numerous wetlands are located laterally to the river below Rose Lake. The lakes and wetlands are extensions of the high water table of the lower river valley. The lakes are hydrologically connected to the river by natural and man-made surface channels in all but three cases, where the connection is through the valley ground water.

Streams from the mountains have watersheds predominantly in the elevation range between 3,000 – 4,500 feet and are subject to winter "rain on snow" discharge events. The relative low elevation of these watersheds causes earlier maximum discharge than from the majority of the watersheds of the North and South Forks of the Coeur d'Alene River. Backwater conditions exist during May through September on the Coeur d'Alene River from Cataldo to the mouth due to control of surface elevation of Coeur d'Alene Lake at Post Falls Dam. The inundated channel during May through September attracts seasonal recreational boaters. Backwater conditions during spring high flows are from a natural sill at the lake outlet, not due to Post Falls Dam.

Most of the watershed is primarily underlain by Schist and Gneiss of the Belt supergroup metasediments. On the lower floodplain toward the mouth of the Coeur d'Alene River, it is underlain by alluvium and lacustrine deposits. Many of the tributaries to the lake have a wedge of water-deposited alluvium (deltaic sediments) at the lowest portions of the watershed between the 2128 and 2182 feet elevations (Figure 2). These wedges influence the hydrologic characteristics, and they result in subsurface flow into Coeur d'Alene Lake during the summer months. The length of the wedge varies in length. Perennial flow exists upstream of the deltaic sediments on most tributaries to the lake.

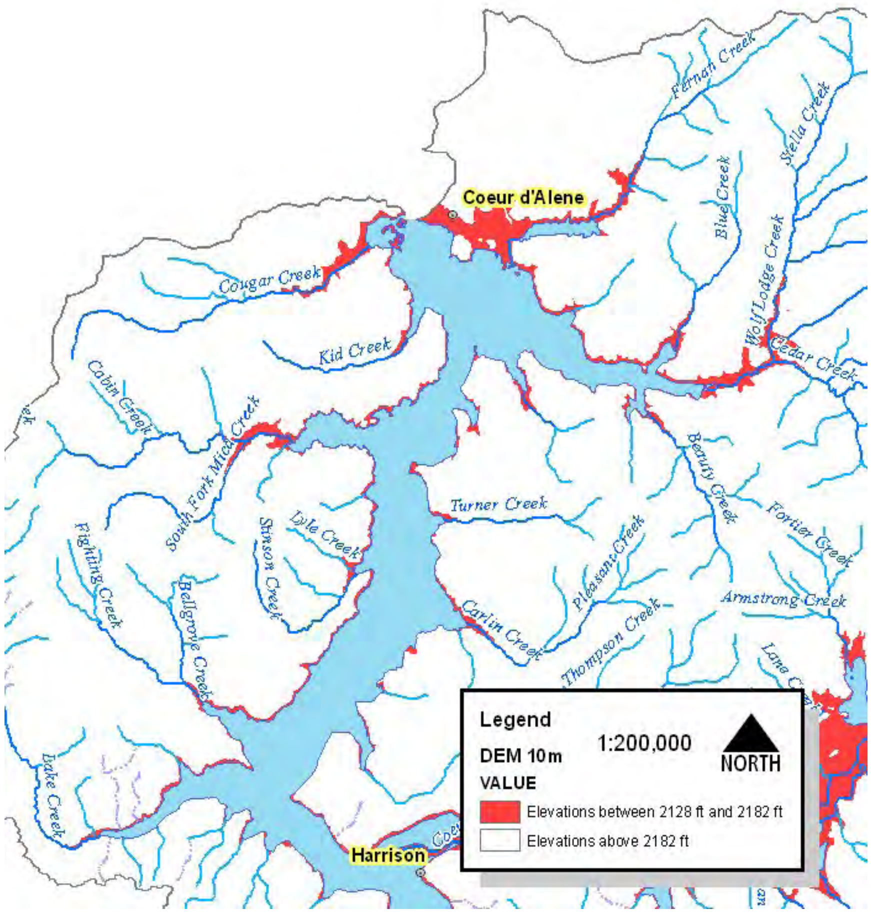

Figure 2. Map of deltaic sediment deposits around Coeur d'Alene Lake.

Native fishes of the subbasin streams are westslope cutthroat trout, bull trout, largescale sucker, longnose dace, mountain whitefish, northern pikeminnow, redside shiner, and mottled, torrent and shorthead sculpin (Jim Fredericks and Ryan Hardy (IDFG), Chris James (USFS), Ed Lider (retired USFS)). Population numbers of westslope cutthroat trout and bull trout have severely declined, and they occupy a fraction of their historic range (May 2009). Since 2005, the mainstem Coeur d'Alene River has been designated as critical habitat for bull trout. The Coeur d'Alene River was identified as a migratory corridor which provides the primary constituent elements of critical habitat necessary for seasonal use for migrating bull trout (US Fish and Wildlife Service 2010). The Coeur d'Alene River is not part of this assessment; therefore, bull trout criteria were not utilized in this assessment.

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Water Quality Listing History

Listed on the Idaho 1998 303d list for temperature pollution were Latour Creek and its tributaries Baldy Creek and Larch Creek, as well as a small portion of the Coeur d'Alene River from Thompson Lake to Coeur d'Alene Lake (Table 1). The Environmental Protection Agency (EPA) added Fernan Creek to Idaho's 1998 303(d) list of impaired waters that exceeded Idaho's temperature criteria. In Additional streams in the Coeur d'Alene Lake Subbasin were added to the 303d list for temperature in 2002 and in 2010. The new temperature listings in 2010 were based on data collected from 1999 to 2008 by the U.S. Forest Service and Idaho Fish and Game. Results from the analysis indicate temperature data from all of the assessment units exceeded one or more temperature criteria (Appendix C). These assessment units and those from Idaho's 1998 303(d) list of temperature-impaired waters are included in this TMDL document.

Table 1. Data collection dates and sources used for 303(d) listing

Stream	Assessment Units	Temperature Data Dates	Temperature Data Source	Original 303(d) listing
Cougar Creek	ID17010303PN002_02	6/19/1998-11/14/1998	DEQ	2002
Mica Creek and tributaries	ID17010303PN04_02 ID17010303PN04_03	6/19/1998-11/14/1998	DEQ	2002
Latour Creek and tributaries	ID17010303PN015_02	--	--	1998
Rose Creek and tributaries	ID17010303PN021_02	2004	USFS	2010
Killarney Lake tributaries	ID17010303PN022_02	2004	USFS	2010
Blue Lake Creek and tributaries	ID17010303PN024_02	2004, 2008	USFS	2010
Carlin Creek and tributaries	ID17010303PN026_02	2004, 2008	USFS	2010
Cedar Creek and tributaries	ID17010303PN030_02 ID17010303PN030_03	200, 2001, 2004-2006	USFS	2010
4th of July Creek and tributaries	ID17010303PN020_02 ID17010303PN020_03	2004, 2006	USFS	2010
Beauty Creek and tributaries	ID17010303PN28_02	2004	USFS	2010
Beauty Creek and tributaries	ID17010303PN028_03	7/31/1999-9/29/1999 2004	DEQ USFS	2002
Wolf Lodge Creek and tributaries	ID17010303PN29_02 ID17010303PN29_03	2001, 2006	USFS	2002
Marie Creek and tributaries	ID17010303PN31_02	6/22/2001-11/18/2001	DEQ	2002
Fernan Creek and tributaries	ID17010303PN032_03 ID17010303PN034_02 ID17010303PN034_02a ID17010303PN034_03	--	--	EPA addition to 1998 303(d) list

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Total Maximum Daily Loads

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

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

Another step in a loading analysis is the quantification of current pollutant loads by source. This allows the specification of load reductions as percentages from current conditions, considers equities in load reduction responsibility, and is necessary in order for pollutant trading to occur. 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, determination of critical conditions can be more complicated than it may appear on the surface.

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

In-stream Water Quality Targets

For the Coeur d'Alene Lake subbasin assessment unit temperature TMDLs we utilized a potential natural vegetation (PNV) approach. The Idaho water quality standards include a provision (IDAPA 58.01.02.200.09) which establishes that if natural conditions exceed numeric water quality criteria, exceedance of the criteria is not considered to be a violation of water quality standards. In these situations, natural conditions essentially become the water quality standard, and the natural level of shade and channel width become the target of the TMDL. The instream temperature which results from attainment of these conditions is consistent with the water quality standards, even though it may exceed numeric temperature criteria. See Appendix B for further discussion of water quality standards and background provisions. The PNV approach is described below. Additionally, 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 affects on stream water temperature, the reader is referred to the *South Fork Clearwater Subbasin Assessment and TMDL* (IDEQ, 2004) and *The Potential Natural Vegetation (PNV) Temperature Total Maximum Daily Load (TMDL) Procedures Manual* (Shumar and De Varona, 2009).

Potential Natural Vegetation for Temperature TMDLs

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 likely to be controlled or manipulated. The parameters that affect or control 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 affects how closely riparian vegetation grows together and water storage in the alluvial aquifer. Streamside vegetation and channel morphology are factors influencing shade, which are most likely to have been influenced by anthropogenic activities, and which can be most readily corrected and addressed by a TMDL.

Depending on how much vertical elevation also surrounds the stream, vegetation further away from the riparian corridor can provide shade. However, riparian vegetation provides a substantial amount of shade on a stream by virtue of its proximity. We can measure the amount of shade that a stream enjoys in a number of ways. Effective shade, that shade provided by all objects that intercept the sun as it makes its way across the sky, can be measured in a given spot with a solar pathfinder or with 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 the stream's 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 on aerial photography. All of these methods tell us information about how much the stream is covered and how much of it is exposed to direct solar radiation.

Potential natural vegetation (PNV) along a stream is that riparian plant community that has grown to an overall mature state, although some level of natural disturbance is usually included in our development and use of shade targets. The PNV can be removed by disturbance either naturally (wildfire, disease/old age, wind-blown, wildlife grazing) or anthropogenically (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. Anything less than PNV (with the exception of natural levels of disturbance and age distribution) results in the stream heating up from anthropogenically created additional solar inputs. We can estimate PNV from models of plant community structure (shade curves for specific riparian plant communities), and we can measure existing vegetative cover or shade. Comparing the two will tell us how much excess solar load the stream is receiving, and what potential there is to decrease solar gain. Streams disturbed by wildfire, or some other natural disturbance will be at less than PNV and require their own time to recover. Streams that have been disturbed by human activity may require additional restoration above and beyond natural recovery.

Existing shade was estimated for the 21 assessment units from visual observations of aerial photos. These estimates were field verified by measuring shade with a solar pathfinder at systematically located points along the streams (see below for methodology). PNV targets were determined from an analysis of probable vegetation at the streams and comparing that to shade curves developed for similar vegetation communities. A shade curve shows the relationship between effective shade and stream width. As a stream gets wider, the shade decreases as the 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. Existing and PNV shade was converted to solar load from data collected on flat plate collectors at the nearest National Renewable Energy Laboratory (NREL) weather stations collecting these data. In this case, the Spokane, WA station was used. The difference between existing and potential solar load, assuming existing load is higher, is the load reduction necessary to bring the stream back into compliance with water quality standards (see Appendix B). PNV shade and loads are assumed to be the natural condition, thus stream temperatures under PNV conditions are assumed to be natural (so long as there are no point sources or any other anthropogenic sources of heat in the watershed), and are thus considered to be consistent with the Idaho water quality standards, even though they may exceed numeric criteria by more than 0.3°C.

Pathfinder Methodology

The solar pathfinder is a device that allows one to trace the outline of shade producing objects on monthly solar path charts. The percentage of the sun's path covered by these objects is the effective shade on the stream at the spot that the tracing is made. In order to adequately characterize the effective shade on a reach of stream, ten traces should be taken at systematic or random intervals along the length of the stream in question.

At each sampling location the solar pathfinder should be placed in the middle of the stream about the bankfull water level. Follow the manufacturer's instructions (orient to true south and level) for taking traces. Systematic sampling is easiest to accomplish and still not bias the location of sampling. Start at a unique location such as 50 m from a bridge or fence line and then proceed upstream or downstream stopping to take additional traces at fixed intervals (e.g. every 50m, every 50 paces, etc.). One can also randomly locate points of measurement by generating random numbers to be used as interval distances.

It is a good idea to measure bankfull widths and take notes while taking solar pathfinder traces, and to photograph the stream at several unique locations. Pay special attention to changes in riparian plant communities and what kinds of plant species (the large, dominant, shade producing ones) are present. Additionally or as a substitution, one can take densiometer readings at the same location as solar pathfinder traces. This provides the potential to develop relationships between canopy cover and effective shade for a given stream.

Aerial Photo Interpretation

Expectations of shade based on plant type and density are provided for natural breaks in vegetation density, marked out on a 1:100K or 1:250K hydrography. Each interval is assigned a single value representing the bottom of a 10%-shade class as described below (*adapted from the CWE process, IDL, 2000)*. For example, if we estimate that shade for a particular stretch of stream is somewhere between 50% and 59%, we assign the value of 50% to that section of stream. The estimate is based on a general intuitive observation about the kind of vegetation present, its density, and the width of the stream. Streams where the banks and water are clearly visible usually are in low shade classes (10 to 30%). Streams with dense forest or heavy brush where no portion of the stream is visible usually are in high shade classes (70 to 90%). More open canopies where portions of the stream may be visible usually fall into moderate class intervals (40 to 60%).

It is important to note that the visual estimates made from the aerial photos are strongly influenced by canopy cover. It is not always possible to visualize or anticipate shade characteristics resulting from topography and landform. We assume that canopy coverage and shade are similar based on research conducted by Oregon DEQ. The visual estimates of 'shade' in this TMDL should be field verified with a solar pathfinder. The pathfinder measures effective shade and is taking into consideration other physical features that block the sun from hitting the stream surface (e.g. hillsides, canyon walls, terraces, man-made structures). The estimate of 'shade' made visually from an aerial photo does not always take into account topography or any shading that may occur from physical features other than vegetation. However, research has shown that shade and cover measurements are remarkably similar (OWEB, 2001), reinforcing the idea that riparian vegetation and objects proximal to the stream provide the most shade.

Stream Morphology

Measures of current bankfull width or near stream disturbance zone width may not reflect widths that were present under PNV. As impacts to streams and riparian areas occur, width-to-depth ratios tend to increase such that streams become wider and shallow. Shadow length 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 been eroded away.

The only factor not developed from the aerial photo work presented above is channel width (i.e., NSDZ or Bankfull Width). Accordingly, this parameter must be estimated from available information. We use regional curves for the major basins in Idaho, data compiled by Diane Hopster of Idaho Department of Lands (Figure 1), as well as other hydrologic data available for the area to estimate natural bankfull width.

For each stream evaluated in the loading analysis, natural bankfull width is estimated based on drainage area and the Clearwater curve from Figure 1. We compared a number of the northern Idaho regional curves in Figure 1 to regional curves developed by the US Forest Service (E. Lider, pers. comm.) and Watershed Professionals Network, LLC (S. Perkins, pers. comm.) from NF Coeur d'Alene Subbasin data. The Forest Service curve provided to us was a linear function ($Y = 0.3984X + 16.529$); we also calculated a power function for the same USFS data ($Y = 5.0426X^{0.5654}$). The Watershed Professionals Network (WPN) curve was also a power function ($Y = 9.2596X^{0.4169}$). We chose the Clearwater regional curve ($Y = 5.64X^{0.52}$) as best representing a natural bankfull width scenario for the Coeur d'Alene Lake tributaries (see Table 1). Although most of the curves examined are reasonably close to each other regarding their estimates, we chose the Clearwater regional curve from Figure 1 to represent natural bankfull width because data for the Clearwater regional curve is more inclusive of a natural, wilderness type setting.

For the loading analyses, if the stream's existing width (sometimes viewed from the aerial photo, not measured in the field) is wider than that predicted by the Clearwater curve from Figure 1 displayed in Table 1, then the Figure estimate of bankfull width is used in the loading analysis for natural width. If existing width is much smaller, then existing width is used in the loading analysis for natural width. In most cases, the Clearwater Figure estimates are used for natural bankfull width in most segments of each stream's loading analysis. Most existing bankfull widths are equivalent to natural bankfull width. Exceptions, where existing widths are slightly different than predicted, include the lowest portion of Fernan Creek below the lake, Beauty Creek and Wolf Lodge Creek.

Table 1. Regional Curve Estimates and Existing Measurements of Bankfull Width.

Location	area (sq mi)	Clearwater (m)	CDA USFS (m)	USFS power (m)	CDA WPN (m)	Average existing (m)
CDA River below SF/NF Confluence	1200	69	151	85	54	~80
Mica Creek @ mouth	23.5	9	8	9	11	
Mica Creek bl SF/NF confluenece	22.7	9	8	9	10	
north side tributary to Mica Creek	1.25	2	5	2	3	
south side tributary to Mica Creek	0.85	2	5	1	3	
SF Mica Creek @ mouth	8.14	5	6	5	7	
SF Mica Creek ab Hwy 95	4.58	4	6	4	5	
NF Mica Creek @ mouth	14.5	7	7	7	9	
NF Mica Creek bl Cabin Creek	7.47	5	6	5	7	
Cougar Creek @ mouth	16.4	7	7	7	9	
Cougar Creek bl NF Cougar Creek	8.86	5	6	5	7	
Cougar Creek ab NF Cougar Creek	6.99	5	6	5	6	
Heine Rd tributary to Cougar Creek	1.64	2	5	2	3	
Beauty Creek @ mouth	10.9	6	6	6	8	7.3
Beauty Creek bl Varnum Creek	7.16	5	6	5	6	6.1
Beauty Creek ab Varnum Creek	4.58	4	6	4	5	
SF Beauty Creek @ mouth	1.26	2	5	2	3	
Tributary to SF Beauty Creek	0.28	1	5	1	2	
2nd tributary to Beauty Creek	0.83	2	5	1	3	
Varnum Creek @ mouth	2.58	3	5	3	4	
Varnum Creek ab Hagerman Creek	1.26	2	5	2	3	
Hagerman Creek @ mouth	0.64	1	5	1	2	
3rd tributary to Beauty Creek	0.62	1	5	1	2	
Caribou Creek @ mouth	1.11	2	5	2	3	
Un-named tributary west of Beauty Creek	1.17	2	5	2	3	
Fernan Creek bl Fernan Lake	18.8	8	7	8	10	4.4
Fernan Creek @ Fernan Lake	15.4	7	7	7	9	
Fernan Creek bl Dry Gulch	7.75	5	6	5	7	4.4
Fernan Creek ab State Creek	3.03	3	5	3	4	
Wolf Lodge Creek @ mouth	62.8	15	13	16	16	
Wolf Lodge Creek ab Cedar Creek	43.6	12	10	13	14	14
Wolf Lodge Creek ab Marie Creek	18.7	8	7	8	10	10.5
Wolf Lodge Creek ab Lonesome Creek	7.23	5	6	5	6	7
Wolf Lodge Creek ab Blue Grouse Creek	2.7	3	5	3	4	
Stella Creek @ mouth	7.06	5	6	5	6	4.3
Stella Creek ab 3rd tributary	4.48	4	6	4	5	
Stella Creek ab 1st tributary	1.03	2	5	2	3	
1st tributary to Stella Creek	0.46	1	5	1	2	
2nd tributary to Stella Creek	1.21	2	5	2	3	
3rd tributary to Stella Creek	0.99	2	5	2	3	
Lonsome Creek @ mouth	10.75	6	6	6	8	
Lonsome Creek ab un-named tributary	9.45	6	6	5	7	
Lonsome Creek ab Stella Creek	1.61	2	5	2	3	
un-named tributary to Lonsome Creek	1.05	2	5	2	3	

Table 1 continued. Regional Curve Estimates and Existing Measurements of Bankfull Width.

Location	area (sq mi)	Clearwater (m)	CDA USFS (m)	USFS power (m)	CDA WPN (m)	Average existing (m)
Phantom Creek @ mouth	1.79	2	5	2	4	
Blue Grouse Creek @ mouth	1.23	2	5	2	3	
Holliday Creek @ mouth	0.37	1	5	1	2	
Onawa Creek @ mouth	0.68	1	5	1	2	
Rutherford Gulch @ mouth	3.27	3	5	3	5	
Cedar Creek @ mouth	15.85	7	7	7	9	4.4
Cedar Creek bl Alder Creek	14.55	7	7	7	9	
Cedar Creek ab SF Cedar Creek	3.17	3	5	3	5	3.2
un-named tributary to Cedar Creek	0.75	1	5	1	3	
SF Cedar Creek @ mouth	6.73	5	6	5	6	
SF Cedar Creek bl 2nd tributary	4.31	4	6	4	5	
SF Cedar Creek bl 1st tributary	2.6	3	5	3	4	
1st tributary to SF Cedar Creek	1.41	2	5	2	3	
2nd tributary to SF Cedar Creek	0.5	1	5	1	2	
3rd tributary to SF Cedar Creek	1.93	2	5	2	4	
Alder Creek @ mouth	4.36	4	6	4	5	
Alder Creek ab 1st fork	1.33	2	5	2	3	
1st fork to Alder Creek	1.47	2	5	2	3	
Chinese Gulch @ mouth	0.33	1	5	1	2	
Un-named stream south of Wolf Lodge Creek	0.8	2	5	1	3	
Marie Creek @ mouth	17.9	8	7	8	9	6.4
Marie Creek bl Skitwish Creek	13.5	7	7	7	8	8
Marie Creek ab Skitwish Creek	9.19	5	6	5	7	8
Latour Creek @ mouth	52.2	13	11	14	15	
Latour Creek ab Little Baldy Creek	46.4	13	11	13	14	12.5
Latour Creek ab Baldy Creek	25.1	9	8	10	11	8
Latour Creek ab Butler Creek	14.6	7	7	7	9	7.9
Larch Creek @ mouth	0.77	2	5	1	3	1.7
Baldy Creek @ mouth	8.6	5	6	5	7	
Pleasant Creek @ mouth	4.11	4	6	3	5	
Pleasant Creek bl No Creek	2.68	3	5	3	4	
1st tributary to Pleasant Creek	0.17	1	5	1	1	
No Creek @ mouth	0.83	2	5	1	3	
Carrill Creek @ mouth	1.21	2	5	2	3	
Carlin Creek @ mouth	11.95	6	6	6	8	
Carlin Creek ab 2nd tributary	6.59	5	6	4	6	3.5
Carlin Creek ab Pleasant Creek	1	2	5	2	3	
2nd tributary to Carlin Creek	1.3	2	5	2	3	
Un-named stream south of Carlin Creek	1.56	2	5	2	3	
Hungry Hollow @ mouth	1.71	2	5	2	4	
Blue Lake Creek @ mouth	7.62	5	6	5	7	
Blue Lake Creek ab 1st tributary	1.43	2	5	2	3	
1st tributary to Blue Lake Creek	0.65	1	5	1	2	
Cottonwood Creek @ mouth	2.93	3	5	3	4	

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Table 1 continued. Regional Curve Estimates and Existing Measurements of Bankfull Width.

Location	area (sq mi)	Clearwater (m)	CDA USFS (m)	USFS power (m)	CDA WPN (m)	Average existing (m)
un-named stream south of Blue Lake Creek	1.71	2	5	2	4	
Lane Creek @ mouth	2.46	3	5	3	4	
Lane Creek ab McGinnis Creek	0.96	2	5	2	3	
McGinnis Creek @ mouth	1.15	2	5	2	3	
Chatfield Creek @ mouth	0.79	2	5	1	3	
Armstrong Creek @ mouth	3.08	3	5	3	5	
Armstrong Creek ab tributary	1.05	2	5	2	3	
tributary to Armstrong Creek	1.86	2	5	2	4	
Fortier Creek ab Armstrong Creek	4.51	4	6	4	5	3.9 (ab WF)
Fortier Creek ab 1st tributary	0.94	2	5	1	3	
1st tributary to Fortier Creek	0.57	1	5	1	2	
2nd tributary to Fortier Creek	1.75	2	5	2	4	
WF Fortier Creek @ mouth	0.72	1	5	1	2	
Killarney Creek @ mouth	2.48	3	5	3	4	
Rose Creek @ mouth	11.37	6	6	6	8	
Rose Creek ab marsh	7.09	5	6	5	6	
Rose Creek ab tributary	3.07	3	5	3	5	
tributary to Rose Creek	1.46	2	5	2	3	
Un-named stream to Rose Lake	0.99	2	5	2	3	
4th of July Creek @ mouth	28.32	10	8	10	11	
4th of July Creek bl Bentley Creek	23.76	9	8	9	11	
4th of July Creek ab Bentley Creek	16.44	7	7	7	9	5.17
4th of July Creek ab Curran Creek	9.74	6	6	6	7	4.43
4th of July Creek ab Mason Creek	5.59	4	6	4	6	
4th of July Creek ab Rooney Draw	2.1	3	5	2	4	
Rooney Draw @ mouth	0.55	1	5	1	2	
Boyle Draw @ mouth	0.83	2	5	1	3	
Mill Creek @ mouth	1.92	2	5	2	4	
Mason Creek @ mouth	2.51	3	5	3	4	
Mason Creek ab tributary	1.58	2	5	2	3	
tributary to Mason Creek	0.9	2	5	1	3	
Terrill Draw @ mouth	0.68	1	5	1	2	
Curran Creek @ mouth	4.76	4	6	4	5	
Curran Creek ab 1st tributary	1.25	2	5	2	3	
1st tributary to Curran Creek	0.8	2	5	1	3	
2nd tributary to Curran Creek	0.73	1	5	1	2	
Service Creek @ mouth	0.76	1	5	1	3	
Bentley Creek @ 4th of July Creek	7.3	5	6	5	6	
Bentley Creek ab Fern Creek	2.25	3	5	2	4	
Fern Creek @ mouth	5	4	6	4	6	
Fern Creek ab Ranienan Creek	2.64	3	5	3	4	
Fern Creek ab 1st tributary	0.74	1	5	1	2	
1st tributary to Fern Creek	1.31	2	5	2	3	
Ranienan Creek @ mouth	1.99	2	5	2	4	

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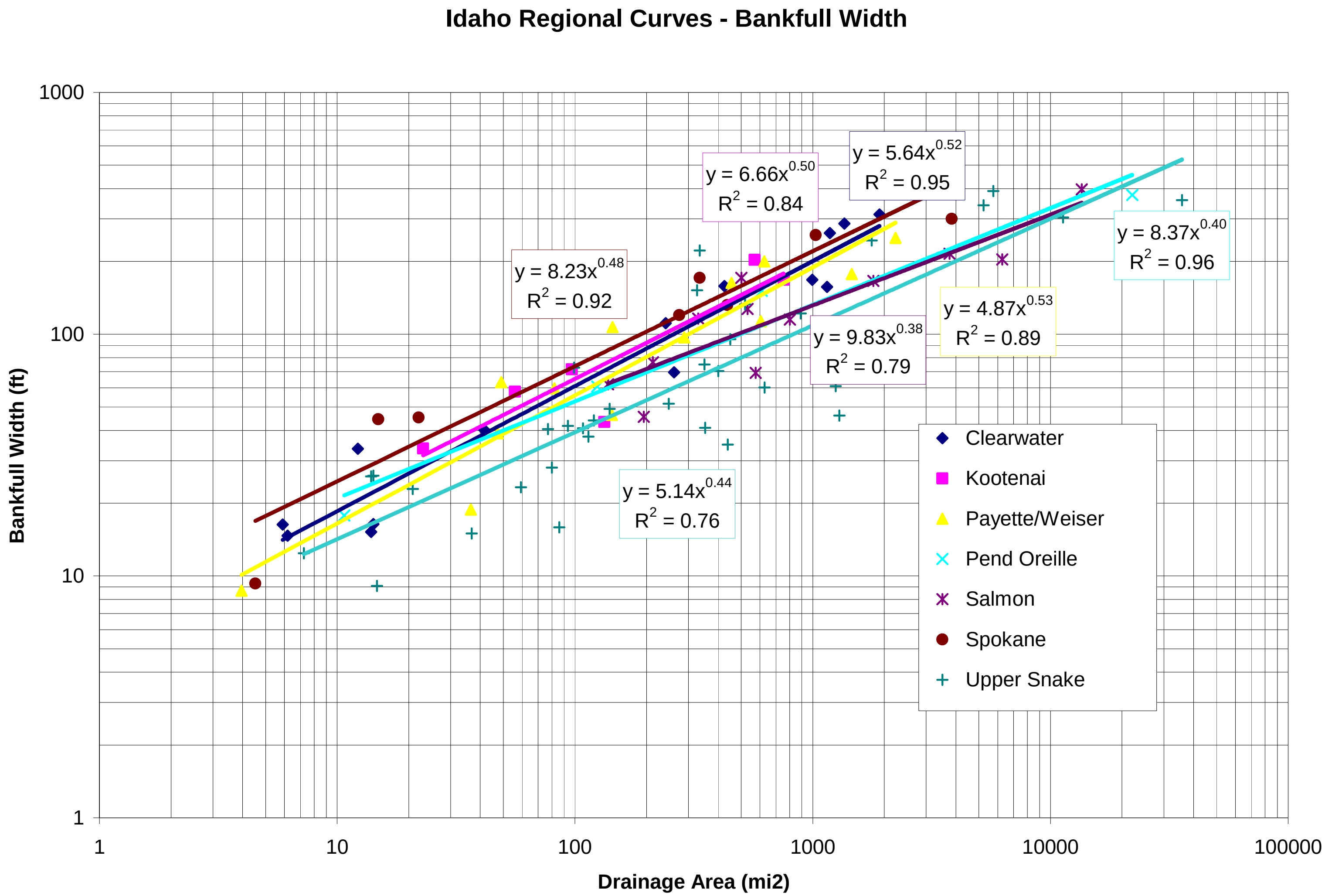
Figure 1. Bankfull Width as a Function of Drainage Area



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Design Conditions

Streams examined in this document are found in two subecoregions in the Northern Rockies Level III Ecoregion of McGrath et al. (2001). Streams on the western side of Coeur d'Alene Lake (Mica Creek, Cougar Creek and tributaries) as well as the lowest portions of Fernan Creek, Beauty Creek, Carlin Creek, and Wolf Lodge Creek are found in the Northern Idaho Hills and Low Relief Mountains Level IV Ecoregion. Common forest trees include grand fir, western redcedar, Douglas fir, and ponderosa pine. Western hemlock is uncommon in this Ecoregion.

The upper portions of Fernan Creek and Wolf Lodge Creek, as well as Marie Creek, Cedar Creek, 4th of July Creek, Blue Lake Creek, Killarney Lake tributaries, Rose Creek, and Latour Creek and their tributaries are in the Coeur d'Alene Metasedimentary Zone Level IV Ecoregion (McGrath et al., 2001), which contains forests of Douglas fir, grand fir, western redcedar, and western hemlock with mountain hemlock, subalpine fir, Engelmann spruce, and whitebark pine at higher elevations.

The Panhandle National Forest has grouped this wide variety of forests into habitat types which form the basis for eleven vegetation response units (VRUs) that are further explained in the procedures manual for PNV-style temperature TMDLs (Shumar and De Varona, 2009). These VRUs were used as the basis for developing shade curves used to set target shade levels for the various streams examined. Most streams examined occur in the warm/dry forests of Group A (VRUs 1, 2, and 3) or the moderately warm and moderately cool/moist (Group B) assemblage of forests, which include VRUs 4, 5, and 6. Latour Creek has a small portion of its headwaters that extend into Group C, the cool/wet to moist forests of VRUs 7 and 8. In addition to these forest groups, Shumar and De Varona (2009) show shade curves developed for two lower elevation hardwood-conifer mix forests that occur at lower elevation, wider floodplains. The labels for these groups, although identified as Nonforest Group 1 and 2, are perhaps a misnomer because they are a mix of both coniferous and hardwood species and have a substantial tree component.

Target Selection

To determine potential natural vegetation shade targets for the Coeur d'Alene Lake tributaries, effective shade curves developed for the Panhandle region of Idaho based on VRUs (see Shumar and De Varona, 2009) were examined. Effective shade curves include percent shade on the vertical axis and stream width on the horizontal axis. As a stream becomes wider, a given vegetation type loses its ability to shade wider and wider streams. Shumar and De Varona (2009) provide an explanation of how shade curves were developed for the Panhandle region of Idaho.

The effective shade calculations are based on a six month period from April through September. This time period coincides with the critical time period when temperatures affect beneficial uses such as spring and fall salmonids spawning and when cold water aquatic life criteria may be exceeded during summer months. Late July and early August typically represent a period of highest stream temperatures. Solar gains can begin early in the spring and affect not only the highest temperatures reached later on in the summer, but solar loadings affect salmonids spawning temperatures in spring and fall. Thus, solar loading in these streams is evaluated from spring (April) to early fall (September).

Shade Curves

The use of the various shade curves described below is based on an aquatic response unit (ARU) filter (see Shumar and De Varona, 2009). If the stream order is between 1st and 4th and the gradient is ≥ 3%, then one of the Forest Group shade curves is used for that section of stream. The decision on which Forest Group shade curve to use for a particular section of stream depends on the predominant VRUs surrounding the stream in that section. Forest Groups encountered in this analysis include A (Table 2), B (Table 3) and C (Table 4), with Forest Groups A and B predominant. Forest Group D did not occur on any streams in this analysis. Target values in tables result from the averaging of three aspect-based shade curves, one for each cardinal direction (N-S and E-W) and one for the 45 degree angles (see Shumar and De Varona, 2009).

Table 2. Shade Targets for Forest Group A Vegetation Type at Various Stream Widths.

Group A Forest - VRUs 1, 2, 3	1m	2m	3m	4m	5m	6m	7m	8m	9m
0/180 aspect	94	93	87	76	69	63	58	54	51
45/135/225/315 aspect	94	94	88	79	71	65	61	57	53
90/270 aspect	95	95	92	83	76	70	64	59	52
Target (%)	**95**	**94**	**89**	**80**	**72**	**66**	**61**	**56**	**52**

Table 3. Shade Targets for Forest Group B Vegetation Type at Various Stream Widths.

Group B Forest - VRUs 4,5,6	1m	2m	3m	4m	5m	6m	7m	8m	9m
0/180 aspect	98	98	97	95	93	91	89	86	82
45/135/225/315 aspect	98	98	97	95	94	92	89	86	82
90/270 aspect	98	98	98	97	96	95	94	92	87
Target (%)	**98**	**98**	**97**	**96**	**94**	**93**	**91**	**88**	**84**

Group B Forest - VRUs 4,5,6	10m	11m	12m	13m	14m	15m	20m	24m	25m
0/180 aspect	79	75	72	69	66	64	53	47	45
45/135/225/315 aspect	78	75	72	69	66	63	52	45	44
90/270 aspect	81	74	68	64	59	55	43	37	35
Target (%)	**79**	**75**	**71**	**67**	**64**	**61**	**49**	**43**	**41**

Table 4. Shade Targets for Forest Group C Vegetation Type at Various Stream Widths.

Group C Forest - VRUs 7, 8	1m	2m	3m	4m	5m	6m	7m	8m	9m
0/180 aspect	97	97	95	93	91	88	84	79	75
45/135/225/315 aspect	98	97	96	94	91	88	84	79	75
90/270 aspect	98	98	97	96	95	93	89	83	74
Target (%)	**98**	**97**	**96**	**94**	**92**	**90**	**86**	**80**	**75**

If stream orders are between 1st and 4th, but the gradient is < 3%, then the stream falls into the Nonforest Group 1 category from the ARU filter (Shumar and De Varona, 2009). Stream gradients are presented in Figure 2. Generally, the lower portions of most streams fall into the <3% slope class. Shade curves developed for this group includes a variety of coniferous and deciduous vegetation (see Shumar and De Varona, 2009). Shade curves were developed

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for even numbered channel widths only. Targets for odd numbered widths are extrapolated by averaging the even numbered width targets from above and below. Because this is the only non-forest group used in the analysis, a large number of stream width/target combinations were needed (Table 5).

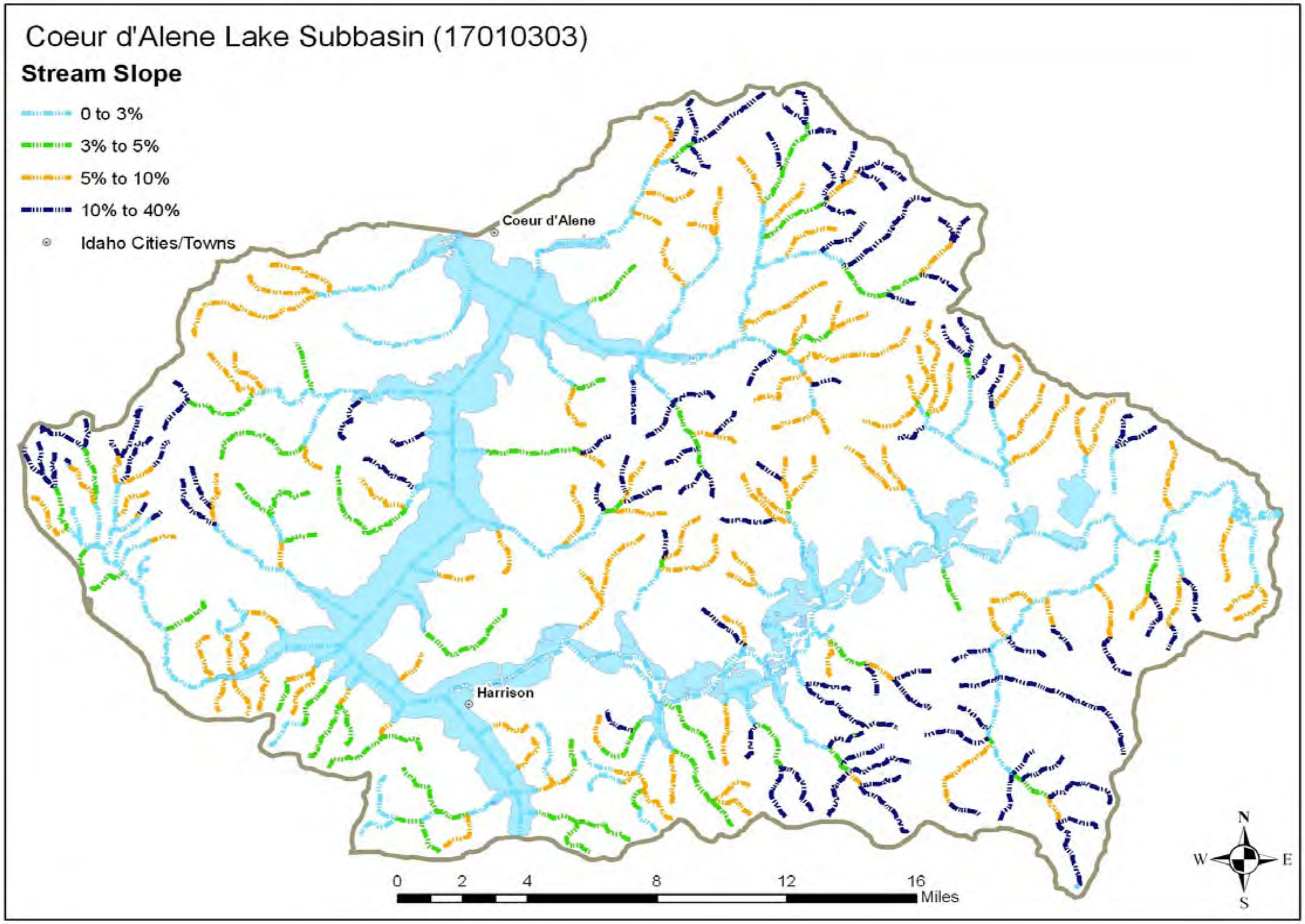
Table 5. Shade Targets for Nonforest Group 1 Vegetation Type at Various Stream Widths.

Group 1 Nonforest - Hardwoods	1m	2m	3m	4m	5m	6m	7m	8m	9m	10m	11m
0/180 aspect		93		75		61		53		47	
45/135/225/315 aspect		93		77		64		55		49	
90/270 aspect		95		82		69		57		47	
Target (%)	**97**	**94**	**86**	**78**	**71**	**65**	**60**	**55**	**52**	**48**	**45**

Group 1 Nonforest - Hardwoods	12m	13m	14m	15m	16m	17m	18m	19m	20m	21m	22m
0/180 aspect	42		38		35		32		30		28
45/135/225/315 aspect	43		39		35		32		30		27
90/270 aspect	39		34		30		27		25		23
Target (%)	**41**	**39**	**37**	**35**	**33**	**32**	**30**	**29**	**28**	**27**	**26**

When stream orders increase to the 5th and 6th level, streams and their associated floodplains become wider and a second group of non-forest vegetation is needed for describing shade targets (Nonforest Group 2). However, none of the streams examined in this TMDL exceeded 4th order.

Figure 2. Stream Slope Categories for the Coeur d’Alene Lake Subbasin.


Coeur d'Alene Lake Subbasin (17010303)
Stream Slope
0 to 3%
3% to 5%
5% to 10%
10% to 40%
Idaho Cities/Towns
Coeur d'Alene
Harrison
0 2 4 8 12 16
Miles
N
S
E
W

Monitoring Points

The accuracy of the aerial photo interpretations was field verified with a solar pathfinder during the summer of 2007 at 19 sites on three streams, and again at 20 sites on 14 streams in 2010. The results of these field observations are presented in Appendix C (Tables C-2 & C-3). Overall, our original photo interpretations were often correct (18 of 39 sites), or slightly under-estimated existing shade with an average difference of 4% ± 5.2 (mean ± 95% C.I.) in 2007 and 4% ± 9.8 in 2010. If we examine these data for an individual stream, sites on Beauty Creek were slightly over-estimated by 4% ± 4.8 (mean ± 95% C.I.) whereas sites on Marie Creek (3% ± 6.5) and Latour Creek (8% ± 7.4) were under-estimated. These results were used to calibrate our eye and aerial photo interpretations were corrected accordingly. Existing shade levels presented in this document reflect those corrections.

Effective shade monitoring can take place on any reach throughout the streams in this TMDL and compared to estimates of existing shade seen on Figure 4 and more detailed figures found in Appendix C (see Figures C-1 through C-27), and described in Tables 6 through 26. Those areas with the largest disparity between existing shade estimates and shade targets should be monitored with solar pathfinders to verify the existing shade levels and to determine progress towards meeting shade targets. It is important to note that many existing shade estimates have not been field verified, and may require adjustment during the implementation process. Stream segments for each change in existing shade vary in length depending on 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 towards target levels. Ten equally spaced solar pathfinder measurements within that segment averaged together should suffice to determine new shade levels in the future.

Load Capacity

The loading capacity for a stream under PNV is essentially the solar loading allowed under the shade targets (shown in Figures 3 and in Appendix C) specified for the reaches within that stream. These loads are determined by multiplying the solar load to a flat plat 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 1-percent shade). In other words, if a shade target is 60% (or 0.6), then the solar load hitting the stream under that target is 40% of the load hitting the flat plate collector under full sun.

We obtained solar load data for flat plate collectors from National Renewable Energy Laboratory (NREL) weather stations near by. In this case, data from the Spokane, WA station was used. The solar loads used in this TMDL are spring/summer averages, thus, we use an average load for the six month period from April through September. These months coincide with time of year that stream temperatures are increasing and when deciduous vegetation is in leaf. Tables 6 through 26 show the PNV shade targets (identified as Target or Potential Shade) and their corresponding potential summer load (in $kWh/m^2/day$ and kWh/day) that serve as the loading capacities for the streams.

Load capacities vary from 3,312 kWh/day on Beauty Creek Tributaries (Table 19) to 9,480,183 kWh/day on Fernan Creek including the lake (Table 25).

Estimates of Existing Pollutant Loads

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

Existing loads in this temperature TMDL come from estimates of existing shade as determined from aerial photo interpretations (shown in Figures 4 and in Appendix C). Like target shade, existing shade was converted to a solar load by multiplying the fraction of open stream by the solar radiation measured on a flat plate collector at the NREL weather stations. Existing shade data are presented in Tables 6 through 26. Like loading capacities (potential loads), existing loads in Tables 6 through 26 are presented on an area basis (kWh/m^2/day) and as a total load (kWh/day).

Existing and potential loads in kWh/day can be summed for the entire stream or portion of stream examined in a single loading table. These total loads are shown at the bottom of their respective columns in each table. The difference between potential load and existing load is also summed for the entire table. Should existing load exceed potential load, this difference becomes the excess load to be discussed next in the load allocation section. The percent reduction shown in the lower right corner of each table represents how much total excess load there is in relation to total existing load.

Existing loads vary from 16,024 kWh/day on Beauty Creek Tributaries (Table 19) to 9,628,259 kWh/day on Fernan Creek including lake (Table 25).

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Table 6. Existing and Potential Solar Loads for South Fork Mica Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
004_02	3rd to Mica	1	1800	Group A	95%	0.29	1	2,000	600	70%	1.71	1	2,000	3,000	2,000	-25%
004_02	SF Mica Creek	1	2300	Group A	95%	0.29	1	2,000	600	90%	0.57	1	2,000	1,000	400	-5%
004_02	SF Mica Creek	2	330	Group A	94%	0.34	2	700	200	80%	1.14	2	700	800	600	-14%
004_02	SF Mica Creek	3	270	Group A	89%	0.63	3	800	500	70%	1.71	3	800	1,000	500	-19%
004_02	SF Mica Creek	4	920	Group A	89%	0.63	3	3,000	2,000	80%	1.14	3	3,000	3,000	1,000	-9%
004_02	SF Mica Creek	5	890	Group A	80%	1.14	4	4,000	5,000	70%	1.71	4	4,000	7,000	2,000	-10%
004_02	SF Mica Creek	6	460	Group A	80%	1.14	4	2,000	2,000	50%	2.85	4	2,000	6,000	4,000	-30%
004_02	SF Mica Creek	7	200	Group A	80%	1.14	4	800	900	60%	2.28	4	800	2,000	1,000	-20%
004_02	SF Mica Creek	8	250	Group A	72%	1.60	5	1,000	2,000	70%	1.71	5	1,000	2,000	0	-2%
004_02	SF Mica Creek	9	180	Hardwoods 1	72%	1.60	5	900	1,000	60%	2.28	5	900	2,000	1,000	-12%
004_02	SF Mica Creek	10	500	Hardwoods 1	72%	1.60	5	3,000	5,000	70%	1.71	5	3,000	5,000	0	-2%
004_02	SF Mica Creek	11	860	Hardwoods 1	72%	1.60	5	4,000	6,000	60%	2.28	5	4,000	9,000	3,000	-12%
004_02	SF Mica Creek	12	260	Hardwoods 1	72%	1.60	5	1,000	2,000	50%	2.85	5	1,000	3,000	1,000	-22%
004_02	SF Mica Creek	13	660	Hardwoods 1	72%	1.60	5	3,000	5,000	60%	2.28	5	3,000	7,000	2,000	-12%
004_02	SF Mica Creek	14	880	Hardwoods 1	72%	1.60	5	4,000	6,000	50%	2.85	5	4,000	10,000	4,000	-22%
							Totals		39,000					62,000	23,000	

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Table 7. Existing and Potential Solar Loads for North Fork Mica Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
004_02	NF Mica Creek	1	410	Group B	98%	0.11	2	800	90	90%	0.57	2	800	500	400	-8%
004_02	NF Mica Creek	2	3400	Group B	97%	0.17	3	10,000	2,000	80%	1.14	3	10,000	10,000	8,000	-17%
004_02	NF Mica Creek	3	1500	Group A	80%	1.14	4	6,000	7,000	70%	1.71	4	6,000	10,000	3,000	-10%
004_02	1st to NF Mica	1	2000	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
004_02	Cabin Creek	1	2200	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
004_02	Cabin Creek	2	1500	Group A	89%	0.63	3	5,000	3,000	80%	1.14	3	5,000	6,000	3,000	-9%
004_02	2nd to NF Mica	1	2000	Group A	95%	0.29	1	2,000	600	90%	0.57	1	2,000	1,000	400	-5%
004_02	2nd to NF Mica	2	840	Group A	94%	0.34	2	2,000	700	70%	1.71	2	2,000	3,000	2,000	-24%
004_02	Rock Creek	1	940	Group A	95%	0.29	1	900	300	90%	0.57	1	900	500	200	-5%
004_02	Rock Creek	2	210	Group A	94%	0.34	2	400	100	80%	1.14	2	400	500	400	-14%
004_02	Rock Creek	3	440	Group A	94%	0.34	2	900	300	90%	0.57	2	900	500	200	-4%
004_02	Rock Creek	4	760	Group A	89%	0.63	3	2,000	1,000	60%	2.28	3	2,000	5,000	4,000	-29%
004_02	Rock Creek	5	320	Group A	89%	0.63	3	1,000	600	80%	1.14	3	1,000	1,000	400	-9%
004_02	NF Mica Creek	4	740	Hardwoods 1	72%	1.60	5	4,000	6,000	80%	1.14	5	4,000	5,000	(1,000)	0%
004_02	NF Mica Creek	5	270	Hardwoods 1	72%	1.60	5	1,000	2,000	70%	1.71	5	1,000	2,000	0	-2%
004_02	NF Mica Creek	6	1110	Hardwoods 1	72%	1.60	5	6,000	10,000	80%	1.14	5	6,000	7,000	(3,000)	0%
004_02	NF Mica Creek	7	770	Hardwoods 1	65%	2.00	6	5,000	10,000	70%	1.71	6	5,000	9,000	(1,000)	0%
004_02	NF Mica Creek	8	1200	Hardwoods 1	65%	2.00	6	7,000	10,000	80%	1.14	6	7,000	8,000	(2,000)	0%
004_02	NF Mica Creek	9	1270	Hardwoods 1	60%	2.28	7	9,000	20,000	50%	2.85	7	9,000	30,000	10,000	-10%
							Totals		74,000					100,000	27,000	

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Table 8. Existing and Potential Solar Loads for Mica Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
004_02	northside trib	1	240	Group A	95%	0.29	1	200	60	90%	0.57	1	200	100	40	-5%
004_02	northside trib	2	400	Hardwoods 1	97%	0.17	1	400	70	90%	0.57	1	400	200	100	-7%
004_02	northside trib	3	130	Hardwoods 1	97%	0.17	1	100	20	70%	1.71	1	100	200	200	-27%
004_02	northside trib	4	350	Hardwoods 1	97%	0.17	1	400	70	40%	3.42	1	400	1,000	900	-57%
004_02	northside trib	5	780	Hardwoods 1	97%	0.17	1	800	100	80%	1.14	1	800	900	800	-17%
004_02	northside trib	6	60	Hardwoods 1	97%	0.17	1	60	10	90%	0.57	1	60	30	20	-7%
004_02	northside trib	7	350	Hardwoods 1	94%	0.34	2	700	200	70%	1.71	2	700	1,000	800	-24%
004_02	northside trib	8	1100	Hardwoods 1	94%	0.34	2	2,000	700	80%	1.14	2	2,000	2,000	1,000	-14%
004_02	northside trib	9	200	Hardwoods 1	94%	0.34	2	400	100	10%	5.13	2	400	2,000	2,000	-84%
004_02	northside trib	10	160	Hardwoods 1	94%	0.34	2	300	100	0%	5.70	2	300	2,000	2,000	-94%
004_02	northside trib	11	150	Hardwoods 1	94%	0.34	2	300	100	10%	5.13	2	300	2,000	2,000	-84%
004_02	southside trib	1	280	Group A	95%	0.29	1	300	90	80%	1.14	1	300	300	200	-15%
004_02	southside trib	2	2200	Group A	94%	0.34	2	4,000	1,000	90%	0.57	2	4,000	2,000	1,000	-4%
004_02	southside trib	3	330	Group A	94%	0.34	2	700	200	80%	1.14	2	700	800	600	-14%
004_03	Mica Creek	1	250	Hardwoods 1	52%	2.74	9	2,000	5,000	50%	2.85	9	2,000	6,000	1,000	-2%
004_03	Mica Creek	2	260	Hardwoods 1	52%	2.74	9	2,000	5,000	0%	5.70	9	2,000	10,000	5,000	-52%
004_03	Mica Creek	3	150	Hardwoods 1	52%	2.74	9	1,000	3,000	10%	5.13	9	1,000	5,000	2,000	-42%
004_03	Mica Creek	4	450	Hardwoods 1	52%	2.74	9	4,000	10,000	0%	5.70	9	4,000	20,000	10,000	-52%
004_03	Mica Creek	5	160	Hardwoods 1	52%	2.74	9	1,000	3,000	10%	5.13	9	1,000	5,000	2,000	-42%
001_02	Mica Creek	6	240	Hardwoods 1	52%	2.74	9	2,000	5,000	10%	5.13	9	2,000	10,000	5,000	-42%
001_02	Mica Creek	7	300	Hardwoods 1	52%	2.74	9	3,000	8,000	0%	5.70	9	3,000	20,000	10,000	-52%
							Totals		42,000					91,000	47,000	

Table 9. Existing and Potential Solar Loads for Cougar Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
002_02	NF Cougar Cr	1	4140	Group A	94%	0.34	2	8,000	3,000	90%	0.57	2	8,000	5,000	2,000	-4%
002_02	1st to Cougar	1	1700	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
002_02	1st to Cougar	2	390	Group A	94%	0.34	2	800	300	70%	1.71	2	800	1,000	700	-24%
002_02	1st to Cougar	3	1800	Group A	89%	0.63	3	5,000	3,000	90%	0.57	3	5,000	3,000	0	0%
002_02	2nd to Cougar	1	70	Group A	95%	0.29	1	70	20	80%	1.14	1	70	80	60	-15%
002_02	2nd to Cougar	2	600	Group A	95%	0.29	1	600	200	90%	0.57	1	600	300	100	-5%
002_02	2nd to Cougar	3	340	Group A	95%	0.29	1	300	90	70%	1.71	1	300	500	400	-25%
002_02	2nd to Cougar	4	680	Group A	95%	0.29	1	700	200	90%	0.57	1	700	400	200	-5%
002_02	2nd to Cougar	5	50	Group A	94%	0.34	2	100	30	80%	1.14	2	100	100	70	-14%
002_02	2nd to Cougar	6	730	Group A	94%	0.34	2	1,000	300	90%	0.57	2	1,000	600	300	-4%
002_02	2nd to Cougar	7	480	Group A	94%	0.34	2	1,000	300	60%	2.28	2	1,000	2,000	2,000	-34%
002_02	Cougar Creek	1	3800	Group B	98%	0.11	2	8,000	900	90%	0.57	2	8,000	5,000	4,000	-8%
002_02	Cougar Creek	2	1800	Group B	89%	0.63	3	5,000	3,000	80%	1.14	3	5,000	6,000	3,000	-9%
002_02	Cougar Creek	3	410	Group A	89%	0.63	3	1,000	600	90%	0.57	3	1,000	600	0	0%
002_02	Cougar Creek	4	500	Group A	80%	1.14	4	2,000	2,000	60%	2.28	4	2,000	5,000	3,000	-20%
002_02	Cougar Creek	5	1810	Group A	80%	1.14	4	7,000	8,000	93%	0.40	4	7,000	3,000	(5,000)	0%
002_02	Cougar Creek	6	1340	Hardwoods 1	72%	1.60	5	7,000	10,000	70%	1.71	5	7,000	10,000	0	-2%
002_02	Cougar Creek	7	400	Hardwoods 1	72%	1.60	5	2,000	3,000	60%	2.28	5	2,000	5,000	2,000	-12%
002_02	Cougar Creek	8	1100	Hardwoods 1	65%	2.00	6	7,000	10,000	50%	2.85	6	7,000	20,000	10,000	-15%
002_02	Cougar Creek	9	760	Hardwoods 1	65%	2.00	6	5,000	10,000	60%	2.28	6	5,000	10,000	0	-5%
002_02	Cougar Creek	10	430	Hardwoods 1	65%	2.00	6	3,000	6,000	50%	2.85	6	3,000	9,000	3,000	-15%
002_02	Cougar Creek	11	730	Hardwoods 1	60%	2.28	7	5,000	10,000	40%	3.42	7	5,000	20,000	10,000	-20%
002_02	Cougar Creek	12	310	Hardwoods 1	60%	2.28	7	2,000	5,000	50%	2.85	7	2,000	6,000	1,000	-10%
002_02	Cougar Creek	13	340	Hardwoods 1	60%	2.28	7	2,000	5,000	40%	3.42	7	2,000	7,000	2,000	-20%
001_02	Cougar Creek	14	380	Hardwoods 1	60%	2.28	7	3,000	7,000	40%	3.42	7	3,000	10,000	3,000	-20%
							Totals		88,000					130,000	43,000	

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Table 10. Existing and Potential Solar Loads for Latour Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
015_02	Latour Creek	1	580	Group B	98%	0.11	1	600	70	80%	1.14	1	600	700	600	-18%
015_02	Latour Creek	2	1200	Group C	97%	0.17	2	2,000	300	80%	1.14	2	2,000	2,000	2,000	-17%
015_02	Latour Creek	3	270	Group C	97%	0.17	2	500	90	90%	0.57	2	500	300	200	-7%
015_02	Latour Creek	4	240	Group B	98%	0.11	2	500	60	80%	1.14	2	500	600	500	-18%
015_02	Latour Creek	5	1330	Group B	97%	0.17	3	4,000	700	90%	0.57	3	4,000	2,000	1,000	-7%
015_02	Latour Creek	6	1480	Group B	96%	0.23	4	6,000	1,000	80%	1.14	4	6,000	7,000	6,000	-16%
015_02	Latour Creek	7	280	Group B	96%	0.23	4	1,000	200	90%	0.57	4	1,000	600	400	-6%
015_02	Latour Creek	8	180	Group B	96%	0.23	4	700	200	80%	1.14	4	700	800	600	-16%
015_02	Latour Creek	9	920	Group B	94%	0.34	5	5,000	2,000	70%	1.71	6	6,000	10,000	8,000	-24%
015_02	Latour Creek	10	180	Group B	94%	0.34	5	900	300	50%	2.85	7	1,000	3,000	3,000	-44%
015_02	Latour Creek	11	390	Group B	93%	0.40	6	2,000	800	50%	2.85	7	3,000	9,000	8,000	-43%
015_02	Latour Creek	12	470	Group B	93%	0.40	6	3,000	1,000	70%	1.71	7	3,000	5,000	4,000	-23%
015_02	Latour Creek	13	590	Hardwoods 1	65%	2.00	6	4,000	8,000	80%	1.14	7	4,000	5,000	(3,000)	0%
015_02	Latour Creek	14	680	Hardwoods 1	60%	2.28	7	5,000	10,000	60%	2.28	7	5,000	10,000	0	0%
015_02	Latour Creek	15	380	Hardwoods 1	60%	2.28	7	3,000	7,000	70%	1.71	7	3,000	5,000	(2,000)	0%
015_02	Latour Creek	16	420	Hardwoods 1	55%	2.57	8	3,000	8,000	70%	1.71	8	3,000	5,000	(3,000)	0%
015_02	Latour Creek	17	790	Hardwoods 1	55%	2.57	8	6,000	20,000	70%	1.71	8	6,000	10,000	(10,000)	0%
015_02	Latour Creek	18	1840	Hardwoods 1	55%	2.57	8	10,000	30,000	40%	3.42	8	10,000	30,000	0	-15%
015_02	Latour Creek	19	460	Hardwoods 1	55%	2.57	8	4,000	10,000	20%	4.56	8	4,000	20,000	10,000	-35%
015_02	Latour Creek	20	540	Hardwoods 1	55%	2.57	8	4,000	10,000	30%	3.99	8	4,000	20,000	10,000	-25%
015_02	Latour Creek	21	110	Hardwoods 1	52%	2.74	9	1,000	3,000	20%	4.56	9	1,000	5,000	2,000	-32%
015_02	Latour Creek	22	490	Hardwoods 1	52%	2.74	9	4,000	10,000	30%	3.99	9	4,000	20,000	10,000	-22%
015_02	Latour Creek	23	280	Hardwoods 1	52%	2.74	9	3,000	8,000	20%	4.56	9	3,000	10,000	2,000	-32%
015_02	Latour Creek	24	360	Hardwoods 1	52%	2.74	9	3,000	8,000	30%	3.99	9	3,000	10,000	2,000	-22%
015_02	Latour Creek	25	800	Hardwoods 1	52%	2.74	9	7,000	20,000	50%	2.85	9	7,000	20,000	0	-2%
015_02	Latour Creek	26	150	Hardwoods 1	48%	2.96	10	1,500	4,400	20%	4.56	10	1,500	6,800	2,400	-28%
015_02	Latour Creek	27	560	Hardwoods 1	48%	2.96	10	5,600	17,000	10%	5.13	10	5,600	29,000	12,000	-38%
015_02	Latour Creek	28	860	Hardwoods 1	48%	2.96	10	8,600	25,000	30%	3.99	10	8,600	34,000	9,000	-18%
015_02	Latour Creek	29	270	Hardwoods 1	48%	2.96	10	2,700	8,000	50%	2.85	10	2,700	7,700	(300)	0%
015_02	Latour Creek	30	230	Hardwoods 1	45%	3.14	11	2,500	7,800	60%	2.28	11	2,500	5,700	(2,100)	0%
015_02	Latour Creek	31	430	Hardwoods 1	45%	3.14	11	4,700	15,000	50%	2.85	11	4,700	13,000	(2,000)	0%
015_02	Latour Creek	32	340	Hardwoods 1	45%	3.14	11	3,700	12,000	60%	2.28	11	3,700	8,400	(3,600)	0%
015_02	Latour Creek	33	370	Hardwoods 1	45%	3.14	11	4,100	13,000	20%	4.56	11	4,100	19,000	6,000	-25%
015_02	Latour Creek	34	250	Hardwoods 1	45%	3.14	11	2,800	8,800	50%	2.85	11	2,800	8,000	(800)	0%
015_02	Latour Creek	35	190	Hardwoods 1	45%	3.14	11	2,100	6,600	20%	4.56	11	2,100	9,600	3,000	-25%
015_02	Latour Creek	36	170	Hardwoods 1	45%	3.14	11	1,900	6,000	10%	5.13	11	1,900	9,700	3,700	-35%
015_02	Latour Creek	37	930	Hardwoods 1	41%	3.36	12	11,000	37,000	0%	5.70	12	11,000	63,000	26,000	-41%
015_02	Latour Creek	38	210	Hardwoods 1	41%	3.36	12	2,500	8,400	10%	5.13	12	2,500	13,000	4,600	-31%
015_02	Latour Creek	39	750	Hardwoods 1	41%	3.36	12	9,000	30,000	20%	4.56	12	9,000	41,000	11,000	-21%
015_02	Latour Creek	40	1440	Hardwoods 1	39%	3.48	13	19,000	66,000	20%	4.56	13	19,000	87,000	21,000	-19%
015_02	Latour Creek	41	1030	Hardwoods 1	39%	3.48	13	13,000	45,000	10%	5.13	13	13,000	67,000	22,000	-29%
015_02	Latour Creek	42	540	Hardwoods 1	39%	3.48	13	7,000	24,000	0%	5.70	13	7,000	40,000	16,000	-39%
015_02	Latour Creek	43	1110	Hardwoods 1	39%	3.48	13	14,000	49,000	20%	4.56	13	14,000	64,000	15,000	-19%
015_02	Latour Creek	44	390	Hardwoods 1	39%	3.48	13	5,100	18,000	0%	5.70	13	5,100	29,000	11,000	-39%
015_02	Latour Creek	45	320	Hardwoods 1	39%	3.48	13	4,200	15,000	30%	3.99	13	4,200	17,000	2,000	-9%
015_02	Latour Creek	46	150	Hardwoods 1	39%	3.48	13	2,000	7,000	20%	4.56	13	2,000	9,100	2,100	-19%
							Totals		580,000					790,000	210,000	

Table 11. Existing and Potential Solar Loads for Latour Creek Tributaries.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
015_02	Larch Creek	1	2300	Group B	98%	0.11	2	5,000	600	90%	0.57	2	5,000	3,000	2,000	-8%
015_02	1st to Latour	1	2100	Group A	94%	0.34	2	4,000	1,000	90%	0.57	2	4,000	2,000	1,000	-4%
015_02	2nd to Latour	1	790	Group B	98%	0.11	1	800	90	80%	1.14	1	800	900	800	-18%
015_02	2nd to Latour	2	870	Group B	98%	0.11	1	900	100	90%	0.57	1	900	500	400	-8%
015_02	2nd to Latour	3	190	Group B	98%	0.11	2	400	50	80%	1.14	2	400	500	500	-18%
015_02	2nd to Latour	4	690	Group B	98%	0.11	2	1,000	100	90%	0.57	2	1,000	600	500	-8%
015_02	2nd to Latour	5	240	Group B	98%	0.11	2	500	60	80%	1.14	2	500	600	500	-18%
015_02	2nd to Latour	6	230	Group B	97%	0.17	3	700	100	90%	0.57	3	700	400	300	-7%
015_02	2nd to Latour	7	150	Group B	97%	0.17	3	500	90	80%	1.14	3	500	600	500	-17%
015_02	2nd to Latour	8	930	Group B	97%	0.17	3	3,000	500	90%	0.57	3	3,000	2,000	2,000	-7%
015_02	3rd to Latour	1	1520	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
015_02	3rd to Latour	2	430	Group B	98%	0.11	2	900	100	80%	1.14	2	900	1,000	900	-18%
015_02	3rd to Latour	3	400	Group B	98%	0.11	2	800	90	90%	0.57	2	800	500	400	-8%
015_02	3rd to Latour	4	220	Group B	98%	0.11	2	400	50	80%	1.14	2	400	500	500	-18%
015_02	4th to Latour	1	450	Group B	98%	0.11	1	500	60	90%	0.57	1	500	300	200	-8%
015_02	4th to Latour	2	80	Group B	98%	0.11	1	80	9	80%	1.14	1	80	90	80	-18%
015_02	4th to Latour	3	1100	Group B	98%	0.11	2	2,000	200	90%	0.57	2	2,000	1,000	800	-8%
015_02	5th to Latour	1	910	Group B	98%	0.11	1	900	100	80%	1.14	1	900	1,000	900	-18%
015_02	5th to Latour	2	1800	Group B	97%	0.17	3	5,000	900	90%	0.57	3	5,000	3,000	2,000	-7%
015_02	6th to Latour	1	180	Group B	98%	0.11	1	200	20	80%	1.14	1	200	200	200	-18%
015_02	6th to Latour	2	1900	Group B	98%	0.11	2	4,000	500	90%	0.57	2	4,000	2,000	2,000	-8%
015_02	6th to Latour	3	500	Group B	97%	0.17	3	2,000	300	80%	1.14	3	2,000	2,000	2,000	-17%
015_02	6th to Latour	4	370	Group B	97%	0.17	3	1,000	200	90%	0.57	3	1,000	600	400	-7%
015_02	6th to Latour	5	2700	Group B	96%	0.23	4	10,000	2,000	80%	1.14	4	10,000	10,000	8,000	-16%
015_02	6th to Latour	6	540	Group B	96%	0.23	4	2,000	500	90%	0.57	4	2,000	1,000	500	-6%

Table 11 (cont.). Existing and Potential Solar Loads for Latour Creek Tributaries.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
015_02	7th to Latour	2	3300	Group B	98%	0.11	2	7,000	800	90%	0.57	2	7,000	4,000	3,000	-8%
015_02	8th to Latour	1	870	Group B	98%	0.11	1	900	100	80%	1.14	1	900	1,000	900	-18%
015_02	8th to Latour	2	350	Group B	98%	0.11	2	700	80	90%	0.57	2	700	400	300	-8%
015_02	8th to Latour	3	860	Group B	98%	0.11	2	2,000	200	80%	1.14	2	2,000	2,000	2,000	-18%
015_02	9th to Latour	1	350	Group B	98%	0.11	1	400	50	60%	2.28	1	400	900	900	-38%
015_02	9th to Latour	2	1700	Group B	98%	0.11	2	3,000	300	80%	1.14	2	3,000	3,000	3,000	-18%
015_02	10th to Latour	1	1600	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
015_02	10th to Latour	2	530	Group B	98%	0.11	2	1,000	100	80%	1.14	2	1,000	1,000	900	-18%
015_02	11th to Latour	1	1900	Group B	98%	0.11	1	2,000	200	80%	1.14	1	2,000	2,000	2,000	-18%
015_02	12th to Latour	1	2400	Group A	94%	0.34	2	5,000	2,000	80%	1.14	2	5,000	6,000	4,000	-14%
015_02	13th to Latour	1	2000	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
015_02	13th to Latour	2	1100	Group A	89%	0.63	3	3,000	2,000	70%	1.71	3	3,000	5,000	3,000	-19%
015_02	14th to Latour	1	1800	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
015_02	Little Baldy Cr	1	720	Group B	98%	0.11	1	700	80	90%	0.57	1	700	400	300	-8%
015_02	Little Baldy Cr	2	480	Group B	98%	0.11	1	500	60	20%	4.56	1	500	2,000	2,000	-78%
015_02	Little Baldy Cr	3	2900	Group B	98%	0.11	2	6,000	700	90%	0.57	2	6,000	3,000	2,000	-8%
015_02	Little Baldy Cr	4	1230	Group B	96%	0.23	4	5,000	1,000	80%	1.14	4	5,000	6,000	5,000	-16%
015_02	Little Baldy Cr	5	50	Group B	96%	0.23	4	200	50	40%	3.42	4	200	700	700	-56%
015_02	Little Baldy Cr	6	280	Group B	96%	0.23	4	1,000	200	80%	1.14	4	1,000	1,000	800	-16%
015_02	Baldy Creek	1	2100	Group A	95%	0.29	1	2,000	600	90%	0.57	1	2,000	1,000	400	-5%
015_02	Baldy Creek	2	610	Group B	98%	0.11	2	1,000	100	80%	1.14	2	1,000	1,000	900	-18%
015_02	Baldy Creek	3	3300	Group B	97%	0.17	3	10,000	2,000	90%	0.57	3	10,000	6,000	4,000	-7%
015_02	Baldy Creek	4	590	Group B	96%	0.23	4	2,000	500	80%	1.14	4	2,000	2,000	2,000	-16%
015_02	Baldy Creek	5	540	Group B	96%	0.23	4	2,000	500	70%	1.71	4	2,000	3,000	3,000	-26%
015_02	Baldy Creek	6	520	Group A	72%	1.60	5	3,000	5,000	80%	1.14	5	3,000	3,000	(2,000)	0%
015_02	Baldy Creek	7	650	Group A	72%	1.60	5	3,000	5,000	70%	1.71	5	3,000	5,000	0	-2%
							Totals		30,000					98,000	70,000	

Remove for final version

Table 12. Existing and Potential Solar Loads for 4th of July Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
020_02	4th of July Creek	1	220	Group B	98%	0.11	1	200	20	80%	1.14	1	200	200	200	-18%
020_02	4th of July Creek	2	370	Group B	98%	0.11	1	400	50	90%	0.57	1	400	200	200	-8%
020_02	4th of July Creek	3	170	Group B	98%	0.11	1	200	20	80%	1.14	1	200	200	200	-18%
020_02	4th of July Creek	4	1400	Group B	98%	0.11	2	3,000	300	90%	0.57	2	3,000	2,000	2,000	-8%
020_02	4th of July Creek	5	150	Group B	97%	0.17	3	500	90	70%	1.71	3	500	900	800	-27%
020_02	4th of July Creek	6	190	Group B	97%	0.17	3	600	100	80%	1.14	3	600	700	600	-17%
020_02	4th of July Creek	7	270	Group B	97%	0.17	3	800	100	90%	0.57	3	800	500	400	-7%
020_02	4th of July Creek	8	580	Group B	97%	0.17	3	2,000	300	80%	1.14	3	2,000	2,000	2,000	-17%
020_02	4th of July Creek	9	190	Group B	96%	0.23	4	800	200	80%	1.14	4	800	900	700	-16%
020_02	4th of July Creek	10	220	Group B	96%	0.23	4	900	200	70%	1.71	4	900	2,000	2,000	-26%
020_02	4th of July Creek	11	600	Hardwoods 1	78%	1.25	4	2,000	3,000	80%	1.14	4	2,000	2,000	(1,000)	0%
020_02	4th of July Creek	12	100	Hardwoods 1	78%	1.25	4	400	500	70%	1.71	4	400	700	200	-8%
020_03	4th of July Creek	13	330	Hardwoods 1	72%	1.60	5	2,000	3,000	70%	1.71	5	2,000	3,000	0	-2%
020_03	4th of July Creek	14	540	Hardwoods 1	72%	1.60	5	3,000	5,000	90%	0.57	5	3,000	2,000	(3,000)	0%
020_03	4th of July Creek	15	1780	Hardwoods 1	65%	2.00	6	10,000	20,000	80%	1.14	6	10,000	10,000	(10,000)	0%
020_03	4th of July Creek	16	730	Hardwoods 1	65%	2.00	6	4,000	8,000	70%	1.71	6	4,000	7,000	(1,000)	0%
020_03	4th of July Creek	17	190	Hardwoods 1	60%	2.28	7	1,000	2,000	80%	1.14	7	1,000	1,000	(1,000)	0%
020_03	4th of July Creek	18	160	Hardwoods 1	60%	2.28	7	1,000	2,000	70%	1.71	7	1,000	2,000	0	0%
020_03	4th of July Creek	19	1110	Hardwoods 1	60%	2.28	7	8,000	20,000	80%	1.14	7	8,000	9,000	(10,000)	0%
020_03	4th of July Creek	20	430	Hardwoods 1	60%	2.28	7	3,000	7,000	50%	2.85	7	3,000	9,000	2,000	-10%
020_03	4th of July Creek	21	190	Hardwoods 1	52%	2.74	9	2,000	5,000	40%	3.42	9	2,000	7,000	2,000	-12%
020_03	4th of July Creek	22	430	Hardwoods 1	52%	2.74	9	4,000	10,000	0%	5.70	9	4,000	20,000	10,000	-52%
020_03	4th of July Creek	23	100	Hardwoods 1	52%	2.74	9	900	2,000	30%	3.99	9	900	4,000	2,000	-22%
020_03	4th of July Creek	24	80	Hardwoods 1	52%	2.74	9	700	2,000	0%	5.70	9	700	4,000	2,000	-52%
020_03	4th of July Creek	25	1100	Hardwoods 1	52%	2.74	9	10,000	30,000	30%	3.99	9	10,000	40,000	10,000	-22%
020_03	4th of July Creek	26	330	Hardwoods 1	48%	2.96	10	3,300	9,800	20%	4.56	10	3,300	15,000	5,200	-28%
020_03	4th of July Creek	27	1000	Hardwoods 1	48%	2.96	10	10,000	30,000	0%	5.70	10	10,000	57,000	27,000	-48%
020_03	4th of July Creek	28	280	Hardwoods 1	48%	2.96	10	2,800	8,300	30%	3.99	10	2,800	11,000	2,700	-18%
020_03	4th of July Creek	29	310	Hardwoods 1	48%	2.96	10	3,100	9,200	0%	5.70	10	3,100	18,000	8,800	-48%
							Totals		180,000					230,000	55,000	

Table 13. Existing and Potential Solar Loads for 4th of July Creek Tributaries.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
020_02	Rooney Draw	1	1200	Group B	98%	0.11	1	1,000	100	90%	0.57	1	1,000	600	500	-8%
020_02	Rooney Draw	2	130	Group B	98%	0.11	1	100	10	70%	1.71	1	100	200	200	-28%
020_02	Boyle Draw	1	2100	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
020_02	Boyle Draw	2	930	Group B	98%	0.11	2	2,000	200	80%	1.14	2	2,000	2,000	2,000	-18%
020_02	Boyle Draw	3	130	Group B	98%	0.11	2	300	30	90%	0.57	2	300	200	200	-8%
020_02	Mill Creek	1	1300	Group B	98%	0.11	1	1,000	100	90%	0.57	1	1,000	600	500	-8%
020_02	Mill Creek	2	1400	Group B	98%	0.11	2	3,000	300	80%	1.14	2	3,000	3,000	3,000	-18%
020_02	Mill Creek	3	520	Group B	98%	0.11	2	1,000	100	90%	0.57	2	1,000	600	500	-8%
020_02	Mason Creek	1	740	Group A	95%	0.29	1	700	200	90%	0.57	1	700	400	200	-5%
020_02	Mason Creek	2	1100	Group B	98%	0.11	1	1,000	100	90%	0.57	1	1,000	600	500	-8%
020_02	Mason Creek	3	1850	Group B	98%	0.11	2	4,000	500	90%	0.57	2	4,000	2,000	2,000	-8%
020_02	Mason Creek	4	550	Group B	97%	0.17	3	2,000	300	90%	0.57	3	2,000	1,000	700	-7%
020_02	Mason Creek	5	860	Group B	97%	0.17	3	3,000	500	80%	1.14	3	3,000	3,000	3,000	-17%
020_02	Mason Creek	6	240	Group B	97%	0.17	3	700	100	70%	1.71	3	700	1,000	900	-27%
020_02	Mason Creek	7	190	Group B	97%	0.17	3	600	100	80%	1.14	3	600	700	600	-17%
020_02	trib to Mason	1	1800	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
020_02	trib to Mason	2	640	Group B	98%	0.11	2	1,000	100	80%	1.14	2	1,000	1,000	900	-18%
020_02	trib to Mason	3	540	Group B	98%	0.11	2	1,000	100	90%	0.57	2	1,000	600	500	-8%
020_02	trib to Mason	4	250	Group B	98%	0.11	2	500	60	60%	2.28	2	500	1,000	900	-38%
020_02	Terrill Draw	1	1300	Group B	98%	0.11	1	1,000	100	90%	0.57	1	1,000	600	500	-8%
020_02	Terrill Draw	2	400	Group B	98%	0.11	1	400	50	80%	1.14	1	400	500	500	-18%
020_02	Curran Creek	1	2300	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
020_02	Curran Creek	2	1200	Group B	98%	0.11	2	2,000	200	90%	0.57	2	2,000	1,000	800	-8%
020_02	Curran Creek	3	500	Hardwoods 1	94%	0.34	2	1,000	300	90%	0.57	2	1,000	600	300	-4%
020_02	Curran Creek	4	380	Hardwoods 1	94%	0.34	2	800	300	80%	1.14	2	800	900	600	-14%
020_02	Curran Creek	5	1300	Hardwoods 1	86%	0.80	3	4,000	3,000	90%	0.57	3	4,000	2,000	(1,000)	0%
020_02	Curran Creek	6	420	Hardwoods 1	78%	1.25	4	2,000	3,000	80%	1.14	4	2,000	2,000	(1,000)	0%
020_02	Curran Creek	7	110	Hardwoods 1	78%	1.25	4	400	500	90%	0.57	4	400	200	(300)	0%
020_02	Curran Creek	8	160	Hardwoods 1	78%	1.25	4	600	800	80%	1.14	4	600	700	(100)	0%
020_02	Curran Creek	9	160	Hardwoods 1	78%	1.25	4	600	800	70%	1.71	4	600	1,000	200	-8%
020_02	Curran Creek	10	170	Hardwoods 1	78%	1.25	4	700	900	80%	1.14	4	700	800	(100)	0%
020_02	Curran Creek	11	240	Hardwoods 1	78%	1.25	4	1,000	1,000	58%	2.39	4	1,000	2,000	1,000	-20%
020_02	Curran Creek	12	130	Hardwoods 1	78%	1.25	4	500	600	90%	0.57	4	500	300	(300)	0%

Remove for final version

Table 13 (cont.). Existing and Potential Solar Loads for 4th of July Creek Tributaries.

Remove for final version

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
020_02	2nd to Curran	1	1700	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
020_02	Service Creek	1	690	Group B	98%	0.11	1	700	80	90%	0.57	1	700	400	300	-8%
020_02	Service Creek	2	90	Group B	98%	0.11	1	90	10	60%	2.28	1	90	200	200	-38%
020_02	Service Creek	3	120	Group B	98%	0.11	1	100	10	0%	5.70	1	100	600	600	-98%
020_02	Service Creek	4	290	Group B	98%	0.11	1	300	30	10%	5.13	1	300	2,000	2,000	-88%
020_02	Service Creek	5	90	Group B	98%	0.11	1	90	10	60%	2.28	1	90	200	200	-38%
020_02	Service Creek	6	1000	Hardwoods 1	97%	0.17	1	1,000	200	90%	0.57	1	1,000	600	400	-7%
020_02	Service Creek	7	210	Hardwoods 1	97%	0.17	1	200	30	70%	1.71	1	200	300	300	-27%
020_02	Service Creek	8	210	Hardwoods 1	97%	0.17	1	200	30	80%	1.14	1	200	200	200	-17%
020_02	Service Creek	9	210	Hardwoods 1	97%	0.17	1	200	30	50%	2.85	1	200	600	600	-47%
020_02	Service Creek	10	60	Hardwoods 1	97%	0.17	1	60	10	90%	0.57	1	60	30	20	-7%
020_02	Bentley Creek	1	2400	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
020_02	Bentley Creek	2	260	Group B	98%	0.11	2	500	60	60%	2.28	2	500	1,000	900	-38%
020_02	Bentley Creek	3	140	Group B	98%	0.11	2	300	30	70%	1.71	2	300	500	500	-28%
020_02	Bentley Creek	4	220	Group B	98%	0.11	2	400	50	30%	3.99	2	400	2,000	2,000	-68%
020_02	Bentley Creek	5	380	Group B	98%	0.11	2	800	90	10%	5.13	2	800	4,000	4,000	-88%
020_02	Bentley Creek	6	420	Group B	97%	0.17	3	1,000	200	60%	2.28	3	1,000	2,000	2,000	-37%
020_02	Bentley Creek	7	220	Group B	97%	0.17	3	700	100	50%	2.85	3	700	2,000	2,000	-47%
020_02	Bentley Creek	8	590	Group B	97%	0.17	3	2,000	300	80%	1.14	3	2,000	2,000	2,000	-17%
020_02	Bentley Creek	9	110	Group B	97%	0.17	3	300	50	90%	0.57	3	300	200	200	-7%
020_02	Bentley Creek	10	310	Group B	97%	0.17	3	900	200	70%	1.71	3	900	2,000	2,000	-27%
020_02	Bentley Creek	11	440	Hardwoods 1	72%	1.60	5	2,000	3,000	70%	1.71	5	2,000	3,000	0	-2%
020_02	Fern Creek	1	1500	Group A	95%	0.29	1	2,000	600	90%	0.57	1	2,000	1,000	400	-5%
020_02	Fern Creek	2	1100	Group A	94%	0.34	2	2,000	700	90%	0.57	2	2,000	1,000	300	-4%
020_02	Fern Creek	3	590	Hardwoods 1	94%	0.34	2	1,000	300	90%	0.57	2	1,000	600	300	-4%
020_02	Fern Creek	4	230	Hardwoods 1	86%	0.80	3	700	600	70%	1.71	3	700	1,000	400	-16%
020_02	Fern Creek	5	510	Hardwoods 1	86%	0.80	3	2,000	2,000	50%	2.85	3	2,000	6,000	4,000	-36%
020_02	Fern Creek	6	230	Hardwoods 1	86%	0.80	3	700	600	70%	1.71	3	700	1,000	400	-16%
020_02	Fern Creek	7	240	Hardwoods 1	86%	0.80	3	700	600	60%	2.28	3	700	2,000	1,000	-26%
020_02	Fern Creek	8	270	Hardwoods 1	78%	1.25	4	1,000	1,000	30%	3.99	4	1,000	4,000	3,000	-48%
020_02	Fern Creek	9	140	Hardwoods 1	78%	1.25	4	600	800	70%	1.71	4	600	1,000	200	-8%
020_02	Fern Creek	10	250	Hardwoods 1	78%	1.25	4	1,000	1,000	80%	1.14	4	1,000	1,000	0	0%
020_02	Fern Creek	11	710	Hardwoods 1	78%	1.25	4	3,000	4,000	50%	2.85	4	3,000	9,000	5,000	-28%
020_02	Fern Creek	12	210	Hardwoods 1	78%	1.25	4	800	1,000	83%	0.97	4	800	800	(200)	0%
020_02	Fern Creek	13	60	Hardwoods 1	78%	1.25	4	200	300	90%	0.57	4	200	100	(200)	0%
020_02	1st to Fern	1	3400	Group B	98%	0.11	2	7,000	800	90%	0.57	2	7,000	4,000	3,000	-8%
020_02	Ranienan Creek	1	3400	Group B	98%	0.11	2	7,000	800	90%	0.57	2	7,000	4,000	3,000	-8%
020_02	Ranienan Creek	2	380	Group B	98%	0.11	2	800	90	80%	1.14	2	800	900	800	-18%
							Totals	29	35,000					97,000	84,000	

Remove for final version

Table 14. Existing and Potential Solar Loads for Rose Creek and Tributaries.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
021_02	Rose Creek	1	3200	Group B	98%	0.11	2	6,000	700	90%	0.57	2	6,000	3,000	2,000	-8%
021_02	Rose Creek	2	120	Group B	97%	0.17	3	400	70	80%	1.14	3	400	500	400	-17%
021_02	Rose Creek	3	150	Group B	97%	0.17	3	500	90	90%	0.57	3	500	300	200	-7%
021_02	Rose Creek	4	380	Group B	97%	0.17	3	1,000	200	50%	2.85	3	1,000	3,000	3,000	-47%
021_02	Rose Creek	5	130	Group B	97%	0.17	3	400	70	10%	5.13	3	400	2,000	2,000	-87%
021_02	Rose Creek	6	570	Hardwoods 1	78%	1.25	4	2,000	3,000	0%	5.70	4	2,000	10,000	7,000	-78%
021_02	Rose Creek	7	160	Hardwoods 1	78%	1.25	4	600	800	50%	2.85	4	600	2,000	1,000	-28%
021_02	Rose Creek	8	90	Hardwoods 1	78%	1.25	4	400	500	0%	5.70	4	400	2,000	2,000	-78%
021_02	Rose Creek	9	240	Hardwoods 1	78%	1.25	4	1,000	1,000	40%	3.42	4	1,000	3,000	2,000	-38%
021_02	Rose Creek	10	930	Hardwoods 1	72%	1.60	5	5,000	8,000	60%	2.28	5	5,000	10,000	2,000	-12%
021_02	Rose Creek	11	650	Hardwoods 1	72%	1.60	5	3,000	5,000	30%	3.99	5	3,000	10,000	5,000	-42%
021_02	Rose Creek	12	160	Hardwoods 1	65%	2.00	6	1,000	2,000	20%	4.56	6	1,000	5,000	3,000	-45%
021_02	Rose Creek	13	1100	Hardwoods 1	65%	2.00	6	7,000	10,000	10%	5.13	6	7,000	40,000	30,000	-55%
021_02	1st to Rose	1	2000	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
021_02	1st to Rose	2	580	Group B	98%	0.11	2	1,000	100	80%	1.14	2	1,000	1,000	900	-18%
021_02	1st to Rose	3	100	Group B	98%	0.11	2	200	20	10%	5.13	2	200	1,000	1,000	-88%
021_02	1st to Rose	4	60	Group B	98%	0.11	2	100	10	0%	5.70	2	100	600	600	-98%
021_02	1st to Rose Lak	1	170	Group A	95%	0.29	1	200	60	90%	0.57	1	200	100	40	-5%
021_02	1st to Rose Lak	2	190	Group B	98%	0.11	1	200	20	90%	0.57	1	200	100	80	-8%
021_02	1st to Rose Lak	3	150	Group B	98%	0.11	1	200	20	70%	1.71	1	200	300	300	-28%
021_02	1st to Rose Lak	4	790	Group B	98%	0.11	1	800	90	80%	1.14	1	800	900	800	-18%
021_02	1st to Rose Lak	5	310	Group B	98%	0.11	2	600	70	90%	0.57	2	600	300	200	-8%
021_02	1st to Rose Lak	6	420	Group B	98%	0.11	2	800	90	80%	1.14	2	800	900	800	-18%
021_02	1st to Rose Lak	7	120	Hardwoods 1	94%	0.34	2	200	70	70%	1.71	2	200	300	200	-24%
021_02	1st to Rose Lak	8	50	Hardwoods 1	94%	0.34	2	100	30	80%	1.14	2	100	100	70	-14%
021_02	1st to Rose Lak	9	430	Hardwoods 1	94%	0.34	2	900	300	70%	1.71	2	900	2,000	2,000	-24%
							Totals		33,000					99,000	67,000	

Remove for final version

Table 15. Existing and Potential Solar Loads for Killarney Lake Tributaries.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
022_02	Lane Creek	1	2200	Group B	98%	0.11	2	4,000	500	90%	0.57	2	4,000	2,000	2,000	-8%
022_02	Lane Creek	2	820	Hardwoods 1	86%	0.80	3	2,000	2,000	90%	0.57	3	2,000	1,000	(1,000)	0%
022_02	Lane Creek	3	890	Hardwoods 1	86%	0.80	3	3,000	2,000	80%	1.14	3	3,000	3,000	1,000	-6%
022_02	McGinnis Creek	1	1600	Group B	98%	0.11	2	3,000	300	90%	0.57	2	3,000	2,000	2,000	-8%
022_02	Chatfield Creek	1	2100	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
022_02	Chatfield Creek	2	100	Hardwoods 1	94%	0.34	2	200	70	50%	2.85	2	200	600	500	-44%
022_02	Chatfield Creek	3	190	Hardwoods 1	94%	0.34	2	400	100	70%	1.71	2	400	700	600	-24%
022_02	Chatfield Creek	4	260	Hardwoods 1	94%	0.34	2	500	200	90%	0.57	2	500	300	100	-4%
022_02	Armstrong Cr	1	2900	Group B	98%	0.11	2	6,000	700	90%	0.57	2	6,000	3,000	2,000	-8%
022_02	Armstrong Cr	2	470	Group B	97%	0.17	3	1,000	200	90%	0.57	3	1,000	600	400	-7%
022_02	Armstrong Cr	3	210	Group B	97%	0.17	3	600	100	80%	1.14	3	600	700	600	-17%
022_02	1st to Armstrong	1	3000	Group B	98%	0.11	2	6,000	700	90%	0.57	2	6,000	3,000	2,000	-8%
022_02	WF Fortier Cr	1	2100	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
022_02	1st to Fortier	1	1200	Group B	98%	0.11	1	1,000	100	90%	0.57	1	1,000	600	500	-8%
022_02	2nd to Fortier	1	2900	Group B	98%	0.11	2	6,000	700	90%	0.57	2	6,000	3,000	2,000	-8%
022_02	Fortier Creek	1	1600	Group B	98%	0.11	2	3,000	300	90%	0.57	2	3,000	2,000	2,000	-8%
022_02	Fortier Creek	2	1100	Group B	97%	0.17	3	3,000	500	90%	0.57	3	3,000	2,000	2,000	-7%
022_02	Fortier Creek	3	600	Group B	96%	0.23	4	2,000	500	90%	0.57	4	2,000	1,000	500	-6%
022_02	Fortier Creek	4	160	Group B	96%	0.23	4	600	100	80%	1.14	4	600	700	600	-16%
022_02	Fortier Creek	5	400	Hardwoods 1	78%	1.25	4	2,000	3,000	70%	1.71	4	2,000	3,000	0	-8%
022_02	Killarney Creek	1	2500	Group B	98%	0.11	2	5,000	600	90%	0.57	2	5,000	3,000	2,000	-8%
022_02	Killarney Creek	2	410	Group B	97%	0.17	3	1,000	200	80%	1.14	3	1,000	1,000	800	-17%
022_02	Killarney Creek	3	420	Hardwoods 1	86%	0.80	3	1,000	800	20%	4.56	3	1,000	5,000	4,000	-66%
022_02	Killarney Creek	4	210	Hardwoods 1	86%	0.80	3	600	500	80%	1.14	3	600	700	200	-6%
							Totals		15,000					41,000	26,000	

Remove for final version

Table 16. Existing and Potential Solar Loads for Blue Lake Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
024_02	Blue Lake Creek	1	2500	Group A	94%	0.34	2	5,000	2,000	90%	0.57	2	5,000	3,000	1,000	-4%
024_02	Blue Lake Creek	2	640	Group A	97%	0.17	3	2,000	300	80%	1.14	3	2,000	2,000	2,000	-17%
024_02	Blue Lake Creek	3	580	Group B	97%	0.17	3	2,000	300	88%	0.68	3	2,000	1,000	700	-9%
024_02	Blue Lake Creek	4	890	Hardwoods 1	78%	1.25	4	4,000	5,000	80%	1.14	4	4,000	5,000	0	2%
024_02	Blue Lake Creek	5	280	Hardwoods 1	78%	1.25	4	1,000	1,000	50%	2.85	4	1,000	3,000	2,000	-28%
024_02	Blue Lake Creek	6	1500	Hardwoods 1	72%	1.60	5	8,000	10,000	10%	5.13	5	8,000	40,000	30,000	-62%
024_02	trib to Blue Lake	1	1600	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
024_02	Cottonwood Cr	1	1450	Group B	98%	0.11	1	1,000	100	90%	0.57	1	1,000	600	500	-8%
024_02	Cottonwood Cr	2	1450	Group B	98%	0.11	2	3,000	300	90%	0.57	2	3,000	2,000	2,000	-8%
024_02	Cottonwood Cr	3	1430	Group B	97%	0.17	3	4,000	700	93%	0.40	3	4,000	2,000	1,000	-4%
024_02	un-named creek	1	2300	Group A	95%	0.29	1	2,000	600	90%	0.57	1	2,000	1,000	400	-5%
024_02	un-named creek	2	220	Group A	94%	0.34	2	400	100	80%	1.14	2	400	500	400	-14%
024_02	un-named creek	3	330	Group A	94%	0.34	2	700	200	50%	2.85	2	700	2,000	2,000	-44%
024_02	un-named creek	4	320	Hardwoods 1	94%	0.34	2	600	200	90%	0.57	2	600	300	100	-4%
024_02	un-named creek	5	230	Hardwoods 1	94%	0.34	2	500	200	10%	5.13	2	500	3,000	3,000	-84%
							Totals		21,000					66,000	46,000	

Remove for final version

Table 17. Existing and Potential Solar Loads for Carlin Creek.

Segment Details					Target					Existing					Summary	
AU	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
026_02	Pleasant Creek	1	2000	Forest	98%	0.11	2	4,000	500	90%	0.57	2	4,000	2,000	2,000	-8%
026_02	Pleasant Creek	2	440	Group B	97%	0.17	3	1,000	200	90%	0.57	3	1,000	600	400	-7%
026_02	Pleasant Creek	3	630		97%	0.17	3	2,000	300	90%	0.57	3	2,000	1,000	700	-7%
026_02	Pleasant Creek	4	520		96%	0.23	4	2,000	500	80%	1.14	4	2,000	2,000	2,000	-16%
026_02	1st to Pleasant	1	240		98%	0.11	1	200	20	80%	1.14	1	200	200	200	-18%
026_02	1st to Pleasant	2	1900		98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
026_02	No Creek	1	2200		98%	0.11	2	4,000	500	90%	0.57	2	4,000	2,000	2,000	-8%
026_02	Carrill Creek	1	2700		98%	0.11	2	5,000	600	90%	0.57	2	5,000	3,000	2,000	-8%
026_02	trib to Carlin Cr	1	1500		98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
026_02	trib to Carlin Cr	2	510		98%	0.11	1	500	60	80%	1.14	1	500	600	500	-18%
026_02	trib to Carlin Cr	3	610		98%	0.11	2	1,000	100	70%	1.71	2	1,000	2,000	2,000	-28%
026_02	trib to Carlin Cr	4	1200		98%	0.11	2	2,000	200	95%	0.29	2	2,000	600	400	-3%
026_02	Carlin Creek	1	1700		98%	0.11	2	3,000	300	90%	0.57	2	3,000	2,000	2,000	-8%
026_02	Carlin Creek	2	850	Nonforest	86%	0.80	3	3,000	2,000	80%	1.14	3	3,000	3,000	1,000	-6%
026_02	Carlin Creek	3	440	Group 1	86%	0.80	3	1,000	800	70%	1.71	3	1,000	2,000	1,000	-16%
026_02	Carlin Creek	4	110		78%	1.25	4	400	500	90%	0.57	4	400	200	(300)	0%
026_02	Carlin Creek	5	600		78%	1.25	4	2,000	3,000	70%	1.71	4	2,000	3,000	0	-8%
026_02	Carlin Creek	6	950		72%	1.60	5	5,000	8,000	90%	0.57	5	5,000	3,000	(5,000)	0%
026_02	Carlin Creek	7	1500		72%	1.60	5	8,000	10,000	80%	1.14	5	8,000	9,000	(1,000)	0%
026_02	Carlin Creek	8	820		65%	2.00	6	5,000	10,000	70%	1.71	6	5,000	9,000	(1,000)	0%
026_02	Carlin Creek	9	440		65%	2.00	6	3,000	6,000	80%	1.14	6	3,000	3,000	(3,000)	0%
026_02	Carlin Creek	10	600		65%	2.00	6	4,000	8,000	70%	1.71	6	4,000	7,000	(1,000)	0%
026_02	Carlin Creek	11	210		65%	2.00	6	1,000	2,000	40%	3.42	6	1,000	3,000	1,000	-25%
026_02	Carlin Creek	12	120		65%	2.00	6	700	1,000	0%	5.70	6	700	4,000	3,000	-65%
026_02	un-named (S of	1	290	Group B	98%	0.11	1	300	30	90%	0.57	1	300	200	200	-8%
026_02	un-named (S of	2	340		98%	0.11	1	300	30	80%	1.14	1	300	300	300	-18%
026_02	un-named (S of	3	460	Group A	95%	0.29	1	500	100	80%	1.14	1	500	600	500	-15%
026_02	un-named (S of	4	1100		94%	0.34	2	2,000	700	90%	0.57	2	2,000	1,000	300	-4%
026_02	un-named (S of	5	260		94%	0.34	2	500	200	50%	2.85	2	500	1,000	800	-44%
026_02	Hungry Hollow	1	1700		94%	0.34	2	3,000	1,000	90%	0.57	2	3,000	2,000	1,000	-4%
026_02	Hungry Hollow	2	110		94%	0.34	2	200	70	70%	1.71	2	200	300	200	-24%
							Totals		57,000					70,000	14,000	

Remove for final version

Table 18. Existing and Potential Solar Loads for Beauty Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
028_02	Beauty Creek	1	1600	Group B	98%	0.11	2	3,000	300	93%	0.40	4	6,000	2,000	2,000	-5%
028_02	Beauty Creek	2	2070	Group B	96%	0.23	4	8,000	2,000	80%	1.14	5	10,000	10,000	8,000	-16%
028_03	Beauty Creek	1	1300	Group B	94%	0.34	5	7,000	2,000	81%	1.08	6	8,000	9,000	7,000	-13%
028_03	Beauty Creek	2	900	Group B	94%	0.34	5	5,000	2,000	78%	1.25	6	5,000	6,000	4,000	-16%
028_03	Beauty Creek	3	100	Group B	93%	0.40	6	600	200	90%	0.57	6	600	300	100	-3%
028_03	Beauty Creek	4	420	Hardwoods 1	65%	2.00	6	3,000	6,000	70%	1.71	6	3,000	5,000	(1,000)	0%
028_03	Beauty Creek	5	1100	Hardwoods 1	65%	2.00	6	7,000	10,000	40%	3.42	7	8,000	30,000	20,000	-25%
028_03	Beauty Creek	6	310	Hardwoods 1	65%	2.00	6	2,000	4,000	60%	2.28	7	2,000	5,000	1,000	-5%
							Totals		27,000					67,000	41,000	

Table 19. Existing and Potential Solar Loads for Beauty Creek Tributaries.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
028_02	SF Beauty Cr	1	1100	Group B	98%	0.11	1	1,000	100	90%	0.57	1	1,000	600	500	-8%
028_02	SF Beauty Cr	2	640	Group B	98%	0.11	2	1,000	100	90%	0.57	2	1,000	600	500	-8%
028_02	SF Beauty Cr	3	280	Group B	98%	0.11	2	600	70	89%	0.63	2	600	400	300	-9%
028_02	trib to SF	1	860	Group B	98%	0.11	1	900	100	90%	0.57	1	900	500	400	-8%
028_02	2nd to Beauty	1	2000	Group B	98%	0.11	2	4,000	500	90%	0.57	2	4,000	2,000	2,000	-8%
028_02	Varnum Creek	1	2110	Group B	98%	0.11	2	4,000	500	90%	0.57	2	4,000	2,000	2,000	-8%
028_02	Varnum Creek	2	950	Group B	97%	0.17	3	3,000	500	90%	0.57	3	3,000	2,000	2,000	-7%
028_02	Varnum Creek	3	200	Group B	97%	0.17	3	600	100	80%	1.14	3	600	700	600	-17%
028_02	Hagerman Cr	1	1700	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
028_02	5th to Beauty	1	1300	Group B	98%	0.11	1	1,000	100	80%	1.14	1	1,000	1,000	900	-18%
028_02	5th to Beauty	2	980	Group B	98%	0.11	1	1,000	100	93%	0.40	1	1,000	400	300	-5%
028_02	Caribou Creek	1	2300	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
028_02	Caribou Creek	2	280	Group B	98%	0.11	2	600	70	80%	1.14	2	600	700	600	-18%
028_02	un-named creek	1	1900	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
028_02	un-named creek	2	140	Group A	94%	0.34	2	300	100	90%	0.57	2	300	200	100	-4%
028_02	un-named creek	3	160	Group A	94%	0.34	2	300	100	70%	1.71	2	300	500	400	-24%
028_02	un-named creek	4	220	Group A	94%	0.34	2	400	100	90%	0.57	2	400	200	100	-4%
							Totals		3,100					15,000	13,000	

Remove for final version

Table 20. Existing and Potential Solar Loads for Wolf Lodge Creek.

Remove for final version

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
029_02	Wolf Lodge Cr	1	370	Group B	98%	0.11	1	400	50	90%	0.57	1	400	200	200	-8%
029_02	Wolf Lodge Cr	2	610	Group B	98%	0.11	1	600	70	80%	1.14	1	600	700	600	-18%
029_02	Wolf Lodge Cr	3	870	Group B	98%	0.11	2	2,000	200	90%	0.57	2	2,000	1,000	800	-8%
029_02	Wolf Lodge Cr	4	1000	Group B	97%	0.17	3	3,000	500	90%	0.57	3	3,000	2,000	2,000	-7%
029_02	Wolf Lodge Cr	5	1460	Group B	96%	0.23	4	6,000	1,000	90%	0.57	4	6,000	3,000	2,000	-6%
029_02	Wolf Lodge Cr	6	150	Group B	96%	0.23	4	600	100	70%	1.71	5	800	1,000	900	-26%
029_02	Wolf Lodge Cr	7	410	Group B	96%	0.23	4	2,000	500	90%	0.57	5	2,000	1,000	500	-6%
029_02	Wolf Lodge Cr	8	650	Group B	96%	0.23	4	3,000	700	80%	1.14	5	3,000	3,000	2,000	-16%
029_02	Wolf Lodge Cr	9	990	Group B	94%	0.34	5	5,000	2,000	90%	0.57	6	6,000	3,000	1,000	-4%
029_02	Wolf Lodge Cr	10	980	Group B	94%	0.34	5	5,000	2,000	80%	1.14	6	6,000	7,000	5,000	-14%
029_02	Wolf Lodge Cr	11	470	Group B	94%	0.34	5	2,000	700	60%	2.28	7	3,000	7,000	6,000	-34%
029_03	Wolf Lodge Cr	12	140	Hardwoods 1	65%	2.00	6	800	2,000	30%	3.99	7	1,000	4,000	2,000	-35%
029_03	Wolf Lodge Cr	13	500	Hardwoods 1	65%	2.00	6	3,000	6,000	70%	1.71	8	4,000	7,000	1,000	5%
029_03	Wolf Lodge Cr	14	380	Hardwoods 1	60%	2.28	7	3,000	7,000	50%	2.85	9	3,000	9,000	2,000	-10%
029_03	Wolf Lodge Cr	15	600	Hardwoods 1	55%	2.57	8	5,000	10,000	50%	2.85	10	6,000	20,000	10,000	-5%
029_03	Wolf Lodge Cr	16	270	Hardwoods 1	52%	2.74	9	2,000	5,000	0%	5.70	10	3,000	20,000	20,000	-52%
029_03	Wolf Lodge Cr	17	340	Hardwoods 1	52%	2.74	9	3,000	8,000	30%	3.99	10	3,000	10,000	2,000	-22%
029_03	Wolf Lodge Cr	18	370	Hardwoods 1	52%	2.74	9	3,000	8,000	10%	5.13	10	4,000	20,000	10,000	-42%
029_03	Wolf Lodge Cr	19	220	Hardwoods 1	48%	2.96	10	2,200	6,500	10%	5.13	11	2,400	12,000	5,500	-38%
029_03	Wolf Lodge Cr	20	200	Hardwoods 1	48%	2.96	10	2,000	5,900	0%	5.70	11	2,200	13,000	7,100	-48%
029_03	Wolf Lodge Cr	21	320	Hardwoods 1	48%	2.96	10	3,200	9,500	20%	4.56	11	3,500	16,000	6,500	-28%
029_03	Wolf Lodge Cr	22	230	Hardwoods 1	48%	2.96	10	2,300	6,800	30%	3.99	12	2,800	11,000	4,200	-18%
029_03	Wolf Lodge Cr	23	300	Hardwoods 1	45%	3.14	11	3,300	10,000	20%	4.56	12	3,600	16,000	6,000	-25%
029_03	Wolf Lodge Cr	24	250	Hardwoods 1	45%	3.14	11	2,800	8,800	30%	3.99	12	3,000	12,000	3,200	-15%
029_03	Wolf Lodge Cr	25	290	Hardwoods 1	45%	3.14	11	3,200	10,000	40%	3.42	13	3,800	13,000	3,000	-5%
029_03	Wolf Lodge Cr	26	450	Hardwoods 1	45%	3.14	11	5,000	16,000	20%	4.56	13	5,900	27,000	11,000	-25%
029_03	Wolf Lodge Cr	27	210	Hardwoods 1	41%	3.36	12	2,500	8,400	30%	3.99	13	2,700	11,000	2,600	-11%
029_03	Wolf Lodge Cr	28	200	Hardwoods 1	41%	3.36	12	2,400	8,100	0%	5.70	14	2,800	16,000	7,900	-41%
029_03	Wolf Lodge Cr	29	280	Hardwoods 1	41%	3.36	12	3,400	11,000	40%	3.42	14	3,900	13,000	2,000	-1%
029_03	Wolf Lodge Cr	30	240	Hardwoods 1	41%	3.36	12	2,900	9,800	30%	3.99	14	3,400	14,000	4,200	-11%
029_03	Wolf Lodge Cr	31	260	Hardwoods 1	39%	3.48	13	3,400	12,000	40%	3.42	15	3,900	13,000	1,000	0%
029_03	Wolf Lodge Cr	32	130	Hardwoods 1	39%	3.48	13	1,700	5,900	40%	3.42	15	2,000	6,800	900	0%
029_03	Wolf Lodge Cr	33	520	Hardwoods 1	39%	3.48	13	6,800	24,000	20%	4.56	15	7,800	36,000	12,000	-19%
029_03	Wolf Lodge Cr	34	40	Hardwoods 1	39%	3.48	13	520	1,800	90%	0.57	15	600	340	(1,500)	0%
029_03	Wolf Lodge Cr	35	1530	Hardwoods 1	37%	3.59	14	21,000	75,000	10%	5.13	16	24,000	120,000	45,000	-27%
029_03	Wolf Lodge Cr	36	530	Hardwoods 1	35%	3.71	15	8,000	30,000	20%	4.56	17	9,000	41,000	11,000	-15%
029_03	Wolf Lodge Cr	37	480	Hardwoods 1	35%	3.71	15	7,200	27,000	0%	5.70	17	8,200	47,000	20,000	-35%
							Totals		340,000					560,000	220,000	

Remove for final version

Table 21. Existing and Potential Solar Loads for Wolf Lodge Creek Tributaries.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
029_02	Phantom Creek	1	1900	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
029_02	Phantom Creek	2	190	Group B	98%	0.11	2	400	50	70%	1.71	2	400	700	700	-28%
029_02	Phantom Creek	3	920	Group B	98%	0.11	2	2,000	200	90%	0.57	2	2,000	1,000	800	-8%
029_02	Blue Grouse Cr	1	2400	Group B	98%	0.11	2	5,000	600	90%	0.57	2	5,000	3,000	2,000	-8%
029_02	Onawa Creek	1	2300	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
029_02	Halliday Creek	1	1900	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
029_02	Stella Creek	1	2610	Group B	98%	0.11	2	5,000	600	90%	0.57	2	5,000	3,000	2,000	-8%
029_02	Stella Creek	2	680	Group B	97%	0.17	3	2,000	300	90%	0.57	3	2,000	1,000	700	-7%
029_02	Stella Creek	3	380	Group B	97%	0.17	3	1,000	200	70%	1.71	3	1,000	2,000	2,000	-27%
029_02	Stella Creek	4	780	Group B	97%	0.17	3	2,000	300	90%	0.57	3	2,000	1,000	700	-7%
029_02	Stella Creek	5	800	Group A	80%	1.14	4	3,000	3,000	90%	0.57	4	3,000	2,000	(1,000)	0%
029_02	Stella Creek	6	450	Group B	96%	0.23	4	2,000	500	80%	1.14	4	2,000	2,000	2,000	-16%
029_02	Stella Creek	7	970	Group A	72%	1.60	5	5,000	8,000	90%	0.57	5	5,000	3,000	(5,000)	0%
029_02	Stella Creek	8	460	Group B	94%	0.34	5	2,000	700	90%	0.57	5	2,000	1,000	300	-4%
029_02	1st to Stella	1	1600	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
029_02	2nd to Stella	1	1600	Group B	98%	0.11	2	3,000	300	90%	0.57	2	3,000	2,000	2,000	-8%
029_02	3rd to Stella	1	1100	Group B	98%	0.11	1	1,000	100	90%	0.57	1	1,000	600	500	-8%
029_02	3rd to Stella	2	1000	Group A	94%	0.34	2	2,000	700	90%	0.57	2	2,000	1,000	300	-4%
029_02	Lonsome Creek	1	2900	Group A	94%	0.34	2	6,000	2,000	90%	0.57	2	6,000	3,000	1,000	-4%
029_02	Lonsome Creek	2	180	Hardwoods 1	78%	1.25	4	700	900	90%	0.57	4	700	400	(500)	0%
029_02	Lonsome Creek	3	120	Hardwoods 1	78%	1.25	4	500	600	80%	1.14	4	500	600	0	0%
029_02	Lonsome Creek	4	120	Hardwoods 1	72%	1.60	5	600	1,000	70%	1.71	5	600	1,000	0	-2%
029_02	Lonsome Creek	5	60	Hardwoods 1	72%	1.60	5	300	500	0%	5.70	5	300	2,000	2,000	-72%
029_02	Lonsome Creek	6	430	Hardwoods 1	72%	1.60	5	2,000	3,000	70%	1.71	5	2,000	3,000	0	-2%
029_02	Lonsome Creek	7	100	Hardwoods 1	72%	1.60	5	500	800	90%	0.57	5	500	300	(500)	0%
029_02	Lonsome Creek	8	40	Hardwoods 1	72%	1.60	5	200	300	70%	1.71	5	200	300	0	-2%
029_02	Lonsome Creek	9	250	Hardwoods 1	65%	2.00	6	2,000	4,000	0%	5.70	6	2,000	10,000	6,000	-65%
029_02	Lonsome Creek	10	130	Hardwoods 1	65%	2.00	6	800	2,000	10%	5.13	6	800	4,000	2,000	-55%
029_02	Lonsome Creek	11	160	Hardwoods 1	65%	2.00	6	1,000	2,000	0%	5.70	6	1,000	6,000	4,000	-65%
029_02	Lonsome Creek	12	160	Hardwoods 1	65%	2.00	6	1,000	2,000	30%	3.99	6	1,000	4,000	2,000	-35%
029_02	Lonsome Creek	13	130	Hardwoods 1	65%	2.00	6	800	2,000	40%	3.42	6	800	3,000	1,000	-25%
029_02	1st to Lonsome	1	2900	Group B	98%	0.11	2	6,000	700	90%	0.57	2	6,000	3,000	2,000	-8%
029_02	1st to Lonsome	2	210	Group B	98%	0.11	2	400	50	80%	1.14	2	400	500	500	-18%
							Totals		38,000					68,000	31,000	

Remove for final version

Table 22. Existing and Potential Solar Loads for Cedar Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
030_02	Cedar Creek	1	2900	Group B	98%	0.11	1	3,000	300	93%	0.40	1	3,000	1,000	700	-5%
030_02	Cedar Creek	2	90	Group B	98%	0.11	2	200	20	20%	4.56	2	200	900	900	-78%
030_02	Cedar Creek	3	610	Group B	98%	0.11	2	1,000	100	80%	1.14	2	1,000	1,000	900	-18%
030_02	Cedar Creek	4	80	Group B	98%	0.11	2	200	20	20%	4.56	2	200	900	900	-78%
030_02	Cedar Creek	5	190	Group B	98%	0.11	2	400	50	60%	2.28	2	400	900	900	-38%
030_02	Cedar Creek	6	790	Group B	98%	0.11	2	2,000	200	70%	1.71	2	2,000	3,000	3,000	-28%
030_02	Cedar Creek	7	370	Group B	97%	0.17	3	1,000	200	80%	1.14	3	1,000	1,000	800	-17%
030_02	Cedar Creek	8	200	Group B	97%	0.17	3	600	100	70%	1.71	3	600	1,000	900	-27%
030_02	Cedar Creek	9	450	Group B	97%	0.17	3	1,000	200	90%	0.57	3	1,000	600	400	-7%
030_02	Cedar Creek	10	370	Group B	97%	0.17	3	1,000	200	50%	2.85	3	1,000	3,000	3,000	-47%
030_02	Cedar Creek	11	320	Group B	97%	0.17	3	1,000	200	90%	0.57	3	1,000	600	400	-7%
030_02	Cedar Creek	12	190	Group B	97%	0.17	3	600	100	63%	2.11	3	600	1,000	900	-34%
030_02	Cedar Creek	13	180	Group B	97%	0.17	3	500	90	40%	3.42	3	500	2,000	2,000	-57%
030_02	Cedar Creek	14	70	Hardwoods 1	78%	1.25	4	300	400	40%	3.42	4	300	1,000	600	-38%
030_02	Cedar Creek	15	60	Hardwoods 1	78%	1.25	4	200	300	90%	0.57	4	200	100	(200)	0%
030_02	Cedar Creek	16	40	Hardwoods 1	78%	1.25	4	200	300	80%	1.14	4	200	200	(100)	0%
030_02	Cedar Creek	17	750	Hardwoods 1	78%	1.25	4	3,000	4,000	90%	0.57	4	3,000	2,000	(2,000)	0%
030_02	Cedar Creek	18	130	Hardwoods 1	78%	1.25	4	500	600	50%	2.85	4	500	1,000	400	-28%
030_02	Cedar Creek	19	130	Hardwoods 1	78%	1.25	4	500	600	70%	1.71	4	500	900	300	-8%
030_03	Cedar Creek	20	420	Group B	94%	0.34	5	2,000	700	80%	1.14	5	2,000	2,000	1,000	-14%
030_03	Cedar Creek	21	210	Hardwoods 1	72%	1.60	5	1,000	2,000	60%	2.28	5	1,000	2,000	0	-12%
030_03	Cedar Creek	22	300	Hardwoods 1	72%	1.60	5	2,000	3,000	60%	2.28	5	2,000	5,000	2,000	-12%
030_03	Cedar Creek	23	550	Hardwoods 1	72%	1.60	5	3,000	5,000	70%	1.71	5	3,000	5,000	0	-2%
030_03	Cedar Creek	24	490	Hardwoods 1	72%	1.60	5	2,000	3,000	68%	1.82	5	2,000	4,000	1,000	-4%
030_03	Cedar Creek	25	370	Hardwoods 1	72%	1.60	5	2,000	3,000	50%	2.85	5	2,000	6,000	3,000	-22%
							Totals		25,000					46,000	22,000	

Remove for final version

Table 23. Existing and Potential Solar Loads for Cedar Creek Tributaries.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
030_02	SF Cedar Creek	1	1500	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
030_02	SF Cedar Creek	2	670	Hardwoods 1	94%	0.34	2	1,000	300	90%	0.57	2	1,000	600	300	-4%
030_02	SF Cedar Creek	3	710	Hardwoods 1	86%	0.80	3	2,000	2,000	80%	1.14	3	2,000	2,000	0	-6%
030_02	SF Cedar Creek	4	660	Group A	80%	1.14	4	3,000	3,000	90%	0.57	4	3,000	2,000	(1,000)	0%
030_02	SF Cedar Creek	5	670	Hardwoods 1	72%	1.60	5	3,000	5,000	80%	1.14	5	3,000	3,000	(2,000)	0%
030_02	SF Cedar Creek	6	40	Hardwoods 1	72%	1.60	5	200	300	90%	0.57	5	200	100	(200)	0%
030_02	1st to SF Cedar	1	2500	Group B	98%	0.11	2	5,000	600	90%	0.57	2	5,000	3,000	2,000	-8%
030_02	2nd to SF Ceda	1	1500	Group B	98%	0.11	1	2,000	200	80%	1.14	1	2,000	2,000	2,000	-18%
030_02	3rd to SF Cedar	1	3600	Group B	98%	0.11	2	7,000	800	90%	0.57	2	7,000	4,000	3,000	-8%
030_02	Alder Creek	1	2100	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
030_02	Alder Creek	2	1040	Group B	98%	0.11	2	2,000	200	80%	1.14	2	2,000	2,000	2,000	-18%
030_02	Alder Creek	3	1400	Group B	97%	0.17	3	4,000	700	80%	1.14	3	4,000	5,000	4,000	-17%
030_02	Alder Creek	4	590	Group B	97%	0.17	3	2,000	300	90%	0.57	3	2,000	1,000	700	-7%
030_02	Alder Creek	5	630	Group B	96%	0.23	4	3,000	700	90%	0.57	4	3,000	2,000	1,000	-6%
030_02	1st to Alder	1	2100	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
030_02	1st to Alder	2	1800	Group B	98%	0.11	2	4,000	500	90%	0.57	2	4,000	2,000	2,000	-8%
030_02	1st to Alder	3	210	Group B	98%	0.11	2	400	50	80%	1.14	2	400	500	500	-18%
030_02	1st to Alder	4	130	Group B	98%	0.11	2	300	30	70%	1.71	2	300	500	500	-28%
030_02	Chinese Gulch	1	980	Group B	98%	0.11	1	1,000	100	80%	1.14	1	1,000	1,000	900	-18%
030_02	Chinese Gulch	2	1800	Group B	98%	0.11	1	2,000	200	70%	1.71	1	2,000	3,000	3,000	-28%
030_02	Chinese Gulch	3	480	Group B	98%	0.11	1	500	60	90%	0.57	1	500	300	200	-8%
030_02	Chinese Gulch	4	100	Group B	98%	0.11	1	100	10	60%	2.28	1	100	200	200	-38%
030_02	Chinese Gulch	5	110	Group B	98%	0.11	1	100	10	80%	1.14	1	100	100	90	-18%
030_02	un-named	1	2400	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
030_02	Rutherford Gulch	1	600	Group B	98%	0.11	1	600	70	90%	0.57	1	600	300	200	-8%
030_02	Rutherford Gulch	2	2100	Group B	98%	0.11	2	4,000	500	80%	1.14	2	4,000	5,000	5,000	-18%
030_02	Rutherford Gulch	3	190	Group B	98%	0.11	2	400	50	70%	1.71	2	400	700	700	-28%
030_02	Rutherford Gulch	4	980	Group B	97%	0.17	3	3,000	500	90%	0.57	3	3,000	2,000	2,000	-7%
030_02	Rutherford Gulch	5	110	Group B	97%	0.17	3	300	50	80%	1.14	3	300	300	300	-17%
030_02	Rutherford Gulch	6	460	Group A	89%	0.63	3	1,000	600	70%	1.71	3	1,000	2,000	1,000	-19%
030_02	Rutherford Gulch	7	330	Group A	89%	0.63	3	1,000	600	10%	5.13	3	1,000	5,000	4,000	-79%
030_02	Rutherford Gulch	8	380	Group A	89%	0.63	3	1,000	600	50%	2.85	3	1,000	3,000	2,000	-39%
030_02	un-named	1	1600	Group B	98%	0.11	2	3,000	300	90%	0.57	2	3,000	2,000	2,000	-8%
							Totals		19,000					59,000	40,000	

Remove for final version

Table 24. Existing and Potential Solar Loads for Marie Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
031_02	Marie Creek	1	6000	Group B	98%	0.11	2	10,000	1,000	90%	0.57	2	10,000	6,000	5,000	-8%
031_02	Marie Creek	2	460	Group B	96%	0.23	4	2,000	500	80%	1.14	4	2,000	2,000	2,000	-16%
031_02	Marie Creek	3	410	Group B	96%	0.23	4	2,000	500	50%	2.85	4	2,000	6,000	6,000	-46%
031_02	Marie Creek	4	640	Group B	96%	0.23	4	3,000	700	70%	1.71	4	3,000	5,000	4,000	-26%
031_02	Marie Creek	5	320	Group B	94%	0.34	5	2,000	700	40%	3.42	5	2,000	7,000	6,000	-54%
031_02	Marie Creek	6	340	Group B	94%	0.34	5	2,000	700	50%	2.85	5	2,000	6,000	5,000	-44%
031_02	Marie Creek	7	900	Group B	94%	0.34	5	5,000	2,000	75%	1.43	8	7,000	10,000	8,000	-19%
031_02	Marie Creek	8	270	Group B	91%	0.51	7	2,000	1,000	80%	1.14	7	2,000	2,000	1,000	-11%
031_02	Marie Creek	9	1090	Hardwoods 1	60%	2.28	7	8,000	20,000	78%	1.25	8	9,000	10,000	(10,000)	0%
031_02	Marie Creek	10	820	Hardwoods 1	60%	2.28	7	6,000	10,000	75%	1.43	6	5,000	7,000	(3,000)	0%
031_02	Marie Creek	11	130	Hardwoods 1	60%	2.28	7	900	2,000	40%	3.42	7	900	3,000	1,000	-20%
031_02	Marie Creek	12	570	Hardwoods 1	55%	2.57	8	5,000	10,000	0%	5.70	8	5,000	30,000	20,000	-55%
031_02	Marie Creek	13	230	Hardwoods 1	55%	2.57	8	2,000	5,000	60%	2.28	8	2,000	5,000	0	0%
031_02	Marie Creek	14	90	Hardwoods 1	55%	2.57	8	700	2,000	0%	5.70	8	700	4,000	2,000	-55%
031_02	Marie Creek	15	360	Hardwoods 1	55%	2.57	8	3,000	8,000	50%	2.85	8	3,000	9,000	1,000	-5%
031_02	Marie Creek	16	440	Hardwoods 1	55%	2.57	8	4,000	10,000	40%	3.42	8	4,000	10,000	0	-15%
031_02	Marie Creek	17	280	Hardwoods 1	55%	2.57	8	2,000	5,000	20%	4.56	8	2,000	9,000	4,000	-35%
031_02	Marie Creek	18	250	Hardwoods 1	55%	2.57	8	2,000	5,000	30%	3.99	8	2,000	8,000	3,000	-25%
031_02	Marie Creek	19	310	Hardwoods 1	55%	2.57	8	2,000	5,000	60%	2.28	8	2,000	5,000	0	0%
031_02	1st to Marie	1	1600	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
031_02	2nd to Marie	1	2100	Group B	98%	0.11	2	4,000	500	90%	0.57	2	4,000	2,000	2,000	-8%
031_02	3rd to Marie	1	1600	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
031_02	Skitwish Creek	1	970	Group B	98%	0.11	1	1,000	100	80%	1.14	1	1,000	1,000	900	-18%
031_02	Skitwish Creek	2	5200	Group B	97%	0.17	3	20,000	3,000	90%	0.57	3	20,000	10,000	7,000	-7%
031_02	Burton Creek	1	2900	Group B	98%	0.11	2	6,000	700	90%	0.57	2	6,000	3,000	2,000	-8%
031_02	Searchlight Cr	1	3200	Group B	98%	0.11	2	6,000	700	91%	0.51	2	6,000	3,000	2,000	-7%
							Totals		95,000					170,000	71,000	

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Table 25. Existing and Potential Solar Loads for Fernan Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
034_02a	Fernan Creek	1	230	Group B	97%	0.17	3	700	100	80%	1.14	3	700	800	700	-17%
034_02a	Fernan Creek	2	150	Hardwoods 1	78%	1.25	4	600	800	60%	2.28	4	600	1,000	200	-18%
034_02a	Fernan Creek	3	90	Hardwoods 1	78%	1.25	4	400	500	0%	5.70	4	400	2,000	2,000	-78%
034_02a	Fernan Creek	4	280	Hardwoods 1	78%	1.25	4	1,000	1,000	70%	1.71	4	1,000	2,000	1,000	-8%
034_02a	Fernan Creek	5	200	Hardwoods 1	78%	1.25	4	800	1,000	77%	1.31	4	800	1,000	0	-1%
034_02a	Fernan Creek	6	90	Hardwoods 1	78%	1.25	4	400	500	0%	5.70	4	400	2,000	2,000	-78%
034_02a	Fernan Creek	7	120	Hardwoods 1	78%	1.25	4	500	600	10%	5.13	4	500	3,000	2,000	-68%
034_03	Fernan Creek	8	310	Hardwoods 1	72%	1.60	5	2,000	3,000	0%	5.70	5	2,000	10,000	7,000	-72%
034_03	Fernan Creek	9	50	Hardwoods 1	72%	1.60	5	300	500	50%	2.85	5	300	900	400	-22%
034_03	Fernan Creek	10	110	Hardwoods 1	72%	1.60	5	600	1,000	0%	5.70	5	600	3,000	2,000	-72%
034_03	Fernan Creek	11	240	Hardwoods 1	72%	1.60	5	1,000	2,000	70%	1.71	5	1,000	2,000	0	-2%
034_03	Fernan Creek	12	260	Hardwoods 1	72%	1.60	5	1,000	2,000	30%	3.99	5	1,000	4,000	2,000	-42%
034_03	Fernan Creek	13	200	Hardwoods 1	72%	1.60	5	1,000	2,000	50%	2.85	5	1,000	3,000	1,000	-22%
034_03	Fernan Creek	14	140	Hardwoods 1	72%	1.60	5	700	1,000	60%	2.28	5	700	2,000	1,000	-12%
034_03	Fernan Creek	15	80	Hardwoods 1	72%	1.60	5	400	600	0%	5.70	5	400	2,000	1,000	-72%
034_03	Fernan Creek	16	160	Hardwoods 1	72%	1.60	5	800	1,000	50%	2.85	5	800	2,000	1,000	-22%
034_03	Fernan Creek	17	770	Hardwoods 1	72%	1.60	5	4,000	6,000	30%	3.99	5	4,000	20,000	10,000	-42%
034_03	Fernan Creek	18	700	Hardwoods 1	65%	2.00	6	4,000	8,000	0%	5.70	6	4,000	20,000	10,000	-65%
034_03	Fernan Creek	19	140	Hardwoods 1	65%	2.00	6	800	2,000	20%	4.56	6	800	4,000	2,000	-45%
034_03	Fernan Creek	20	210	Hardwoods 1	65%	2.00	6	1,000	2,000	10%	5.13	6	1,000	5,000	3,000	-55%
034_03	Fernan Creek	21	1440	Hardwoods 1	65%	2.00	6	9,000	20,000	30%	3.99	6	9,000	40,000	20,000	-35%
032_03	Fernan Creek	22	60	Hardwoods 1	60%	2.28	7	400	900	90%	0.57	7	400	200	(700)	0%
032_03	Fernan Creek	23	40	Hardwoods 1	60%	2.28	7	300	700	0%	5.70	12	500	3,000	2,000	-60%
032_03	Fernan Creek	24	50	Hardwoods 1	60%	2.28	7	400	900	90%	0.57	7	400	200	(700)	0%
032_03	Fernan Creek	25	200	Hardwoods 1	60%	2.28	7	1,000	2,000	0%	5.70	40	8,000	50,000	50,000	-60%
032_03	Fernan Creek	26	90	Hardwoods 1	60%	2.28	7	600	1,000	60%	2.28	2	200	500	(500)	0%
032_03	Fernan Creek	27	100	Hardwoods 1	60%	2.28	7	700	2,000	20%	4.56	3	300	1,000	(1,000)	-40%
032_03	Fernan Creek	28	110	Hardwoods 1	60%	2.28	7	800	2,000	50%	2.85	4	400	1,000	(1,000)	-10%
032_03	Fernan Creek	29	170	Hardwoods 1	60%	2.28	7	1,000	2,000	20%	4.56	5	900	4,000	2,000	-40%
032_03	Fernan Creek	30	250	Hardwoods 1	60%	2.28	7	2,000	5,000	0%	5.70	7	2,000	10,000	5,000	-60%
							Totals		72,000					200,000	120,000	

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Table 26. Existing and Potential Solar Loads for Fernan Creek Tributaries.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/ day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
034_02	Fernan Creek	1	440	Group B	98%	0.11	1	400	50	90%	0.57	1	400	200	200	-8%
034_02	Fernan Creek	2	620	Group B	98%	0.11	1	600	70	87%	0.74	1	600	400	300	-11%
034_02	Fernan Creek	3	1000	Group B	98%	0.11	1	1,000	100	90%	0.57	1	1,000	600	500	-8%
034_02	Fernan Creek	4	2200	Group B	98%	0.11	2	4,000	500	90%	0.57	2	4,000	2,000	2,000	-8%
034_02	Fernan Creek	5	1490	Group B	97%	0.17	3	4,000	700	80%	1.14	3	4,000	5,000	4,000	-17%
034_02	State Creek	1	1100	Group B	98%	0.11	1	1,000	100	90%	0.57	1	1,000	600	500	-8%
034_02	State Creek	2	1300	Group B	98%	0.11	2	3,000	300	80%	1.14	2	3,000	3,000	3,000	-18%
034_02	Jungle Gulch	1	1700	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
034_02	Smith Gulch	1	1600	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
034_02	Dry Gulch	1	1500	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
034_02	Dry Gulch	2	190	Group B	98%	0.11	1	200	20	80%	1.14	1	200	200	200	-18%
034_02	Dry Gulch	3	1000	Group B	98%	0.11	2	2,000	200	90%	0.57	2	2,000	1,000	800	-8%
034_02	Dry Gulch	4	370	Group B	98%	0.11	2	700	80	86%	0.80	2	700	600	500	-12%
034_02	Dry Gulch trib.	1	1700	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
034_02	Rondo Gulch	1	2300	Group B	98%	0.11	1	2,000	200	90%	0.57	1	2,000	1,000	800	-8%
034_02	Rondo Gulch	2	320	Group B	98%	0.11	2	600	70	80%	1.14	2	600	700	600	-18%
034_02	Rondo Gulch	3	130	Group B	98%	0.11	2	300	30	0%	5.70	2	300	2,000	2,000	-98%
034_02	unamed trib.	1	690	Group B	98%	0.11	1	700	80	90%	0.57	1	700	400	300	-8%
034_02	unamed trib.	2	950	Group B	98%	0.11	2	2,000	200	80%	1.14	2	2,000	2,000	2,000	-18%
034_02	Stacel Draw	1	1200	Group B	98%	0.11	1	1,000	100	90%	0.57	1	1,000	600	500	-8%
034_02	Stacel Draw	2	300	Group B	98%	0.11	1	300	30	80%	1.14	1	300	300	300	-18%
034_02	Stacel Draw	3	120	Group B	98%	0.11	2	200	20	90%	0.57	2	200	100	80	-8%
034_02	Stacel Draw	4	160	Group B	98%	0.11	2	300	30	80%	1.14	2	300	300	300	-18%
034_02	Stacel Draw	5	600	Group B	98%	0.11	2	1,000	100	90%	0.57	2	1,000	600	500	-8%
034_02	Stacel Draw	6	1900	Group B	97%	0.17	3	6,000	1,000	80%	1.14	3	6,000	7,000	6,000	-17%
							Totals		4,800					33,000	29,000	

Figure 3. Target Shade for 21 Assessment Units in the Coeur d'Alene Lake Subbasin.

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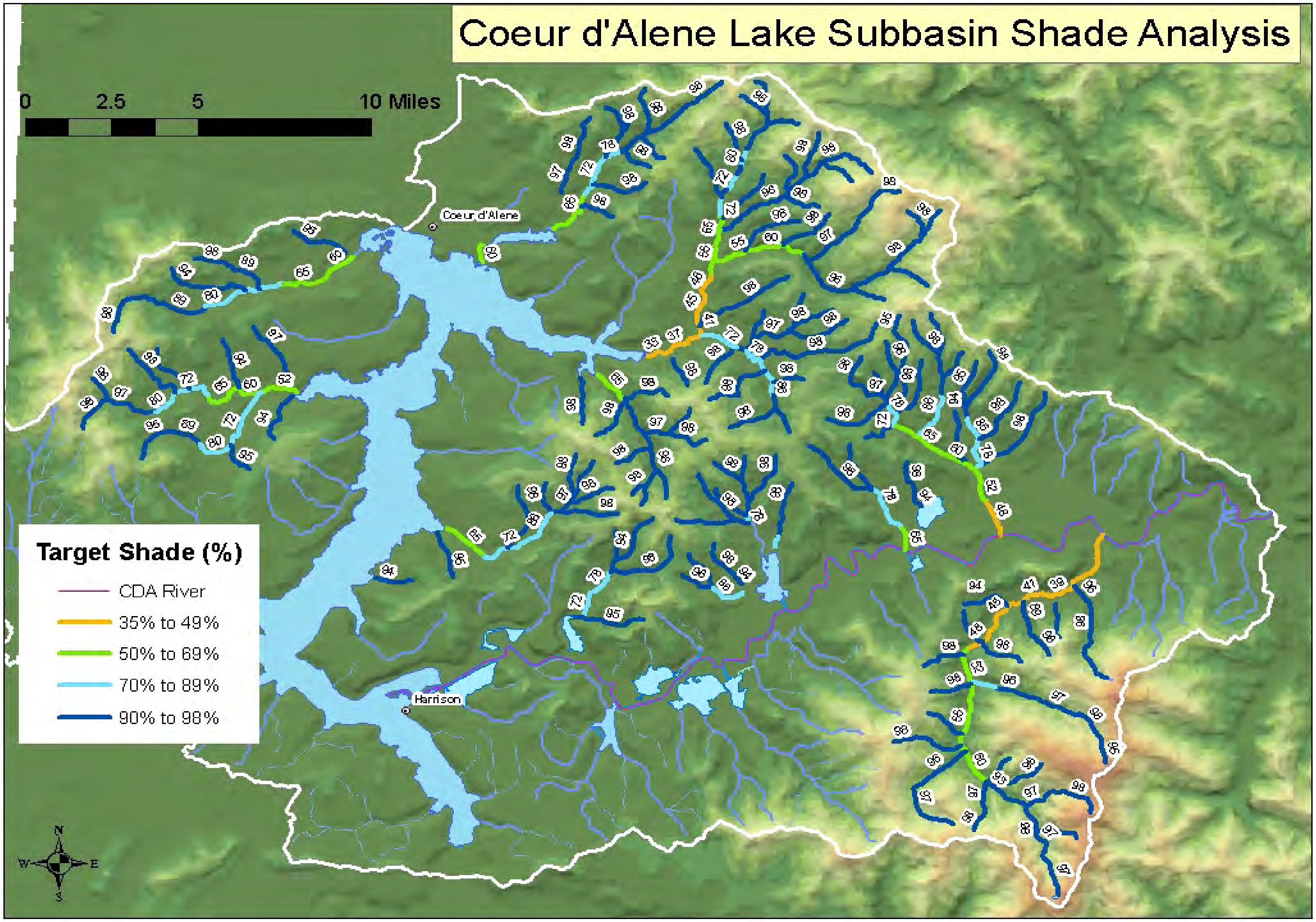

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Figure 4. Existing Shade Estimated for 21 Assessment Units in the Coeur d'Alene Lake Subbasin.

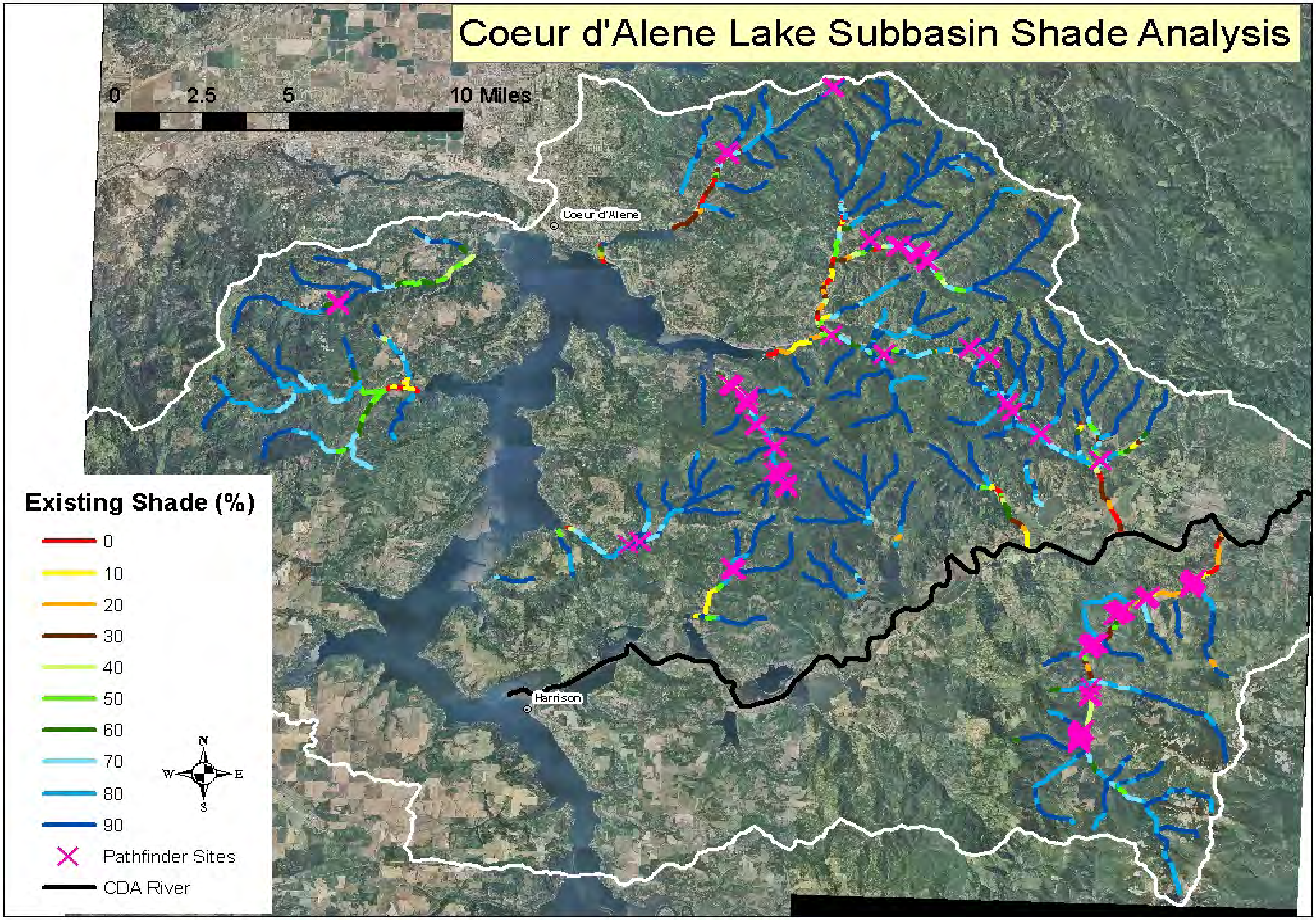

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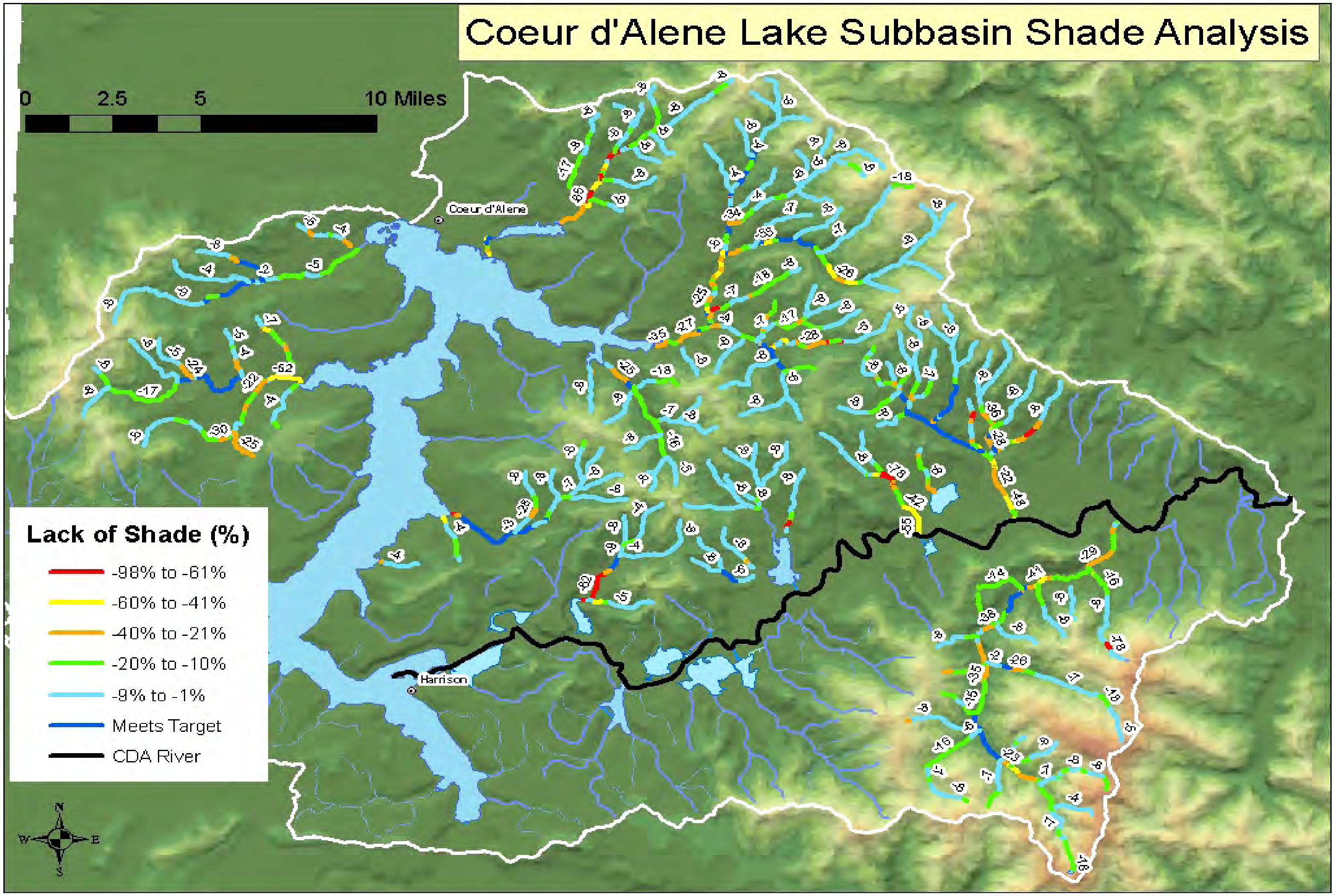
Figure 5. Lack of Shade (Difference Between Existing and Target) for 21 Assessment Units in the Coeur d’Alene Lake Subbasin.



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Load Allocation

Because this TMDL is based on potential natural vegetation, 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 non point source activities that have or may affect riparian vegetation and shade as a whole. Load allocations are therefore stream reach specific and are dependent upon the target load for a given reach. Tables 6 through 26 show the target or potential shade which is converted to a potential summer load by multiplying the inverse fraction (1-shade fraction) by the average loading to a flat plate collector for the months of April through September. That is the loading capacity of the stream and it is necessary to achieve background conditions. There is no opportunity to further remove shade from the stream by any activity without exceeding its loading capacity. Additionally, because this TMDL is dependent upon background conditions for achieving WQS, all tributaries to the waters examined here need to be in natural conditions in order to prevent excess heat loads to the system.

Table 27 shows the total existing, target and excess heat load (kWh/day) experienced by each assessment unit examined and the average lack of shade (difference between existing and target shade) for each assessment unit. 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 as compared to smaller streams. Table 27 lists the assessment units in order of their excess loads highest to lowest. Therefore, large tributaries tend to be listed first and small tributaries are listed last. In the Excess Load column of Table 27 the percent value represents the proportion of total existing load that is in excess (also known as the percent reduction needed to achieve target load). Additionally, each loading table contains a final column that lists the lack of shade on the stream. It is derived from subtracting the target shade from the existing shade for each segment. Thus, stream segments with the largest lack of shade are in the worst shape. The average lack of shade listed at the bottom of that last column in each loading table is also listed in the table below and represents a general level of condition for comparison among streams.

Although the following analysis dwells on total heat loads for streams in this TMDL, it is important to note that differences between existing shade and target shade, as depicted in Lack of Shade Figures (Figures 5 and in Appendix C) and the last column of each loading table (Tables 6 through 26), are the key to successfully restoring these waters to achieving WQS. Target shade levels for individual reaches should be the goal managers strive for with future implementation plans. Managers should key in on the largest differences between existing and target shade as locations to prioritize implementation efforts.

Table 27. Total Existing, Target and Excess Solar Loads for All Tributaries.

Assessment Unit (Major Waterbody)	Existing Load (kWh/day)	Target Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade Average (%)
17010303PN029_02, 029_03 (Wolf Lodge Creek)	560,000	340,000	220,000 (39%)	-18
17010303PN015_02 (Latour Creek)	790,000	580,000	210,000 (27%)	-19
17010303PN034_02a, 034_03, 032_03 (Fernan Creek)	200,000	72,000	120,000 (60%)	-37
17010303PN031_02 (Marie Creek)	170,000	95,000	71,000 (42%)	-19
17010303PN015_02 (Latour Tributaries)	98,000	30,000	70,000 (71%)	-15
17010303PN021_02 (Rose Creek)	99,000	33,000	67,000(68%)	-35
17010303PN020_02 (4th of July Tributaries)	97,000	35,000	64,000 (66%)	-19
17010303PN020_02, 020_03 (4th of July Creek)	230,000	180,000	55,000 (24%)	-17
17010303PN004_02, 004_03 (Mica Creek)	91,000	42,000	47,000 (52%)	-35
17010303PN024_02 (Blue Lake Creek)	66,000	21,000	46,000 (70%)	-20
17010303PN002_02 (Cougar Creek)	130,000	88,000	43,000 (33%)	-12
17010303PN028_02, 028_03 (Beauty Creek)	67,000	27,000	41,000 (61%)	-10

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17010303PN030_02 (Cedar Tributaries)	59,000	19,000	40,000 (68%)	-15
17010303PN029_02 (Wolf Lodge Tributaries)	68,000	38,000	31,000 (46%)	-16
17010303PN034_02 (Fernan Tributaries)	33,000	4,800	29,000 (88%)	-15
17010303PN004_02 (NF Mica Creek)	100,000	74,000	27,000 (27%)	-9
17010303PN022_02 (Killarney Lake Tribs)	41,000	15,000	26,000 (63%)	-13
17010303PN004_03 (SF Mica Creek)	62,000	39,000	23,000 (37%)	-14
17010303PN030_02, 030_03 (Cedar Creek)	46,000	25,000	22,000 (48%)	-23
17010303PN026_02 (Carlin Creek)	70,000	57,000	14,000 (20%)	-12
17010303PN028_02 (Beauty Tributaries)	15,000	3,100	13,000 (87%)	-10

All assessment units (AU) lack shade to some degree. Although Wolf Lodge Creek has the largest excess load, it is derived from two AU (17010303PN029_02 & 029_03). Assessment Unit 17010303PN015_02 (Latour Creek, Larch Creek, Baldy Creek and other Latour tributaries) has the largest excess load for a single AU of those examined which is not surprising considering Latour Creek is one of the largest watersheds examined with large existing and target loads. However, Latour Creek's excess load was only 27% of its total existing load, a relatively small proportion compared to many other AU in the analysis. Figure C-9 shows that Latour Creek riparian shade has been affected throughout its watershed. Wolf Lodge Creek has a high excess load as well, but its proportion in excess (39%) is slightly higher than in Latour Creek suggesting that Wolf Lodge Creek is in slightly poorer condition regarding shade. Portions of Wolf Lodge Creek below Marie Creek have a substantial lack of shade (Figures C-21 and C-24). The 4th of July Creek (ID17010303PN020_02 & 020_03) and Carlin Creek (ID17010303PN026_02) AUs have the lowest proportion of existing load in excess (24% and 20%, respectively) and some of the lowest average lack of shade values. Both of these watersheds have substantial numbers of reaches that either meet shade targets or have existing shade that is within the same 10%-class interval as their target (see Figures C-3 and C-15). The NF Mica Creek AU

(17010303PN004_02) is also in reasonably good condition with an excess load of only 27%. Beauty Creek (Figure C-18) could fall into this category as well, however, because of the dominance of reaches that lack shade by <9% the resulting excess load becomes substantial. In reality tributaries to Beauty Creek at least are likely in good condition. Many of the remaining AU fall into the middle ground where excess loads represent >30% of their total existing loads and they lack shade on an average of about 10% to 37%. Many of these AU, for example Cougar Creek (ID17010303PN002_02) (Figure C-3), have substantial reaches that meet shade targets and many headwater tributaries where the existing 10%-class interval (usually 90%) is within 9% of the target shade (often 98%). Only in the lower reaches where there have been impacts to shade from land clearing activities (residential and agricultural development) do we see substantial lack of shade.

A certain amount of excess load and hence percent reduction is potentially created by the existing shade/target shade difference inherent in the loading analysis. Because existing shade is reported as a 10% class level and target shade is a unique integer, there is always a difference between them. For example, say a particular stretch of stream has a target shade of 86% based on its vegetation type and natural bankfull width. If existing shade on that stretch of stream were at target level, it would be recorded as 80% existing shade in the loading analysis because it falls into that existing shade class. There is an automatic difference of 6% which could be real or potentially attributable to the margin of safety.

Wasteload Allocation

Although several discharges exist in the Subbasin adjacent to Coeur d'Alene Lake, there are no known NPDES permitted point sources in the affected watersheds. Thus, there are no wasteload allocations either. Should a point source be proposed that would have thermal consequence on these waters, then background provisions addressing such discharges in Idaho water quality standards (IDAPA 58.01.02.200.09 & IDAPA 58.01.02.401.03) should be involved (see Appendix B).

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 reduced to the next lower 10% class interval, which likely underestimates actual shade in the loading analysis. Although the loading analysis used in this TMDL involves gross estimations that are likely to have large variances, there are no load allocations that may benefit or suffer from that variance.

Seasonal Variation

This TMDL is based on average summer loads. All loads have been calculated to be inclusive of the six month period from April through September. This time period was chosen because it represents the time period when the combination of increasing air and water temperatures coincides with increasing solar inputs and increasing vegetative shade. The critical time period is June when spring salmonids spawning is occurring, July and August when maximum temperatures exceed cold water aquatic life criteria, and September during fall salmonids spawning. Water temperature is not likely to be a problem for beneficial uses outside of this time period because of cooler weather and lower sun angle.

Construction Storm Water and TMDL Waste Load Allocations

Construction Storm Water

The Clean Water Act requires operators of construction sites to obtain permit coverage to discharge storm water to a water body or to a municipal storm sewer. In Idaho, EPA has issued a general permit for storm water discharges from construction sites. In the past storm water was treated as a non-point source of pollutants. However, because storm water can be managed on site through management practices or when discharged through a discrete conveyance such as a storm sewer, it now requires a National Pollution Discharge Elimination System (NPDES) Permit.

The Construction General Permit (CGP)

If a construction project disturbs more than one acre of land (or is part of larger common development) that will disturb more than one acre), the operator is required to apply for permit coverage from EPA after developing a site-specific Storm Water Pollution Prevention Plan.

Storm Water Pollution Prevention Plan (SWPPP)

In order to obtain the Construction General Permit operators must develop a site-specific Storm Water Pollution Prevention Plan. The operator must document the erosion, sediment, and pollution controls they intend to use, inspect the controls periodically and maintain the best management practices (BMPs) through the life of the project

Construction Storm Water Requirements

When a stream is on Idaho's § 303(d) list and has a TMDL developed DEQ now incorporates a gross waste load allocation (WLA) for anticipated construction storm water activities. TMDLs developed in the past that did not have a WLA for construction storm water activities will also be considered in compliance with provisions of the TMDL if they obtain a CGP under the NPDES program and implement the appropriate Best Management Practices.

Typically there are specific requirements you must follow to be consistent with any local pollutant allocations. Many communities throughout Idaho are currently developing rules for post-construction storm water management. Sediment is usually the main pollutant of concern in storm water from construction sites. The application of specific best management practices from *Idaho's Catalog of Storm Water Best Management Practices for Idaho Cities and Counties* is generally sufficient to meet the standards and requirements of the General Construction Permit, unless local ordinances have more stringent and site specific standards that are applicable.

Implementation Strategies

Implementation strategies for TMDLs produced using potential natural vegetation-based shade and solar loading should incorporate the loading tables presented in this TMDL. These tables need to be updated, first to field verify the existing shade levels that have not yet been field verified, and secondly to monitor progress towards achieving reductions and the goals of the TMDL. Using the solar pathfinder to measure existing shade levels in the field is important to achieving both objectives. It is likely that further field verification will find discrepancies with reported existing shade levels in the loading tables. Due to the inexact nature of the aerial photo interpretation technique, these tables should not be viewed as complete until verified. Implementation strategies should include solar pathfinder monitoring to simultaneously field verify the TMDL and mark progress towards achieving desired reductions in solar loads.

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

Time Frame

Approach

Responsible Parties

Monitoring Strategy

Conclusions

Thirteen major watersheds representing 21 assessment units (AU) were identified as having stream temperature problems in the Coeur d'Alene Lake subbasin. This TMDL examined the relationship between existing shade levels on streams and shade targets developed from vegetation typing in the region. Existing and target shade levels were converted to solar loads for an analysis of excess loading to streams.

Most streams examined in this TMDL lacked shade and had excess solar loads. Latour Creek and Wolf Lodge Creek AU had the largest excess loads, but not necessarily the highest proportion in excess. The 4^{th} of July Creek and Carlin Creek AUs had the lowest levels of excess load and lack of shade. Most remaining AU examined had similar levels of disturbance mostly occurring in lower elevation sections that are affected by land clearing activities.

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

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Table 28. Summary of assessment outcomes.

Water Body Segment/ AU	Pollutant	TMDL(s) Completed	Recommended Changes to §303(d) List	Justification
Cougar Creek/ ID17010303PN002_02	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
Mica Creek/ ID17010303PN004_03	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
NF & SF Mica Creek/ ID17010303PN004_02	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
Latour, Baldy, Larch Creeks/ ID17010303PN015_02	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
4th of July Creek/ ID17010303PN020_02 ID17010303PN020_03	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
Rose Creek/ ID17010303PN021_02	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
Killarney Lake Tributaries/ ID17010303PN022_02	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
Blue Lake Creek/ ID17010303PN024_02	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
Carlin Creek/ ID17010303PN026_02	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
Beauty Creek/ ID17010303PN028_03 ID17010303PN028_02	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
Wolf Lodge Creek/ ID17010303PN029_03 ID17010303PN029_02	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
Cedar Creek/ ID17010303PN030_02 ID17010303PN030_03	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
Marie Creek/ ID17010303PN031_02	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade
Fernan Creek/ ID17010303PN032_03 ID17010303PN034_03 ID17010303PN034_02a ID17010303PN034_02	Temperature	Yes	Move to 4A	Excess Load from Lack of Shade

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References Cited

American Geological Institute. 1962. Dictionary of geological terms. Doubleday and Company. Garden City, NY. 545 p.

Armantrout, N.B., compiler. 1998. Glossary of aquatic habitat inventory terminology. American Fisheries Society. Bethesda, MD. 136 p.

Batt, P.E. 1996. Governor Philip E. Batt's Idaho bull trout conservation plan. State of Idaho, Office of the Governor. Boise, ID. 20 p + appendices.

Clean Water Act (Federal water pollution control act), 33 U.S.C. § 1251-1387. 1972.

Denny, P. 1980. Solute movement in submerged angiosperms. Biology Review. 55:65-92.

EPA. 1996. Biological criteria: technical guidance for streams and small rivers. EPA 822-B-96-001. U.S. Environmental Protection Agency, Office of Water. Washington, DC. 162 p.

US Fish and Wildlife Service. Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for Bull Trout in the Coterminous United States; Final Rule. Federal Register Vol. 75, No. 200 (October 18, 2010) (to be codified at 50 CFR Part 17).

Franson, M.A.H., L.S. Clesceri, A.E. Greenberg, and A.D. Eaton, editors. 1998. Standard methods for the examination of water and wastewater, twentieth edition. American Public Health Association. Washington, DC. 1,191 p.

Grafe, C.S., C.A. Mebane, M.J. McIntyre, D.A. Essig, D.H. Brandt, and D.T. Mosier. 2002. The Idaho Department of Environmental Quality water body assessment guidance, second edition-final. Department of Environmental Quality. Boise, ID. 114 p.

Hughes, R.M. 1995. Defining acceptable biological status by comparing with reference condition. In: Davis, W.S. and T.P. Simon, editors. Biological assessment and criteria: tools for water resource planning and decision making. CRC Press. Boca Raton, FL. p 31-48.

Idaho Code § 39.3611. Development and implementation of total maximum daily load or equivalent processes.

Idaho Code § 39.3615. Creation of watershed advisory groups.

IDAPA 58.01.02. Idaho water quality standards and wastewater treatment requirements.

IDEQ. 1999. Coeur d'Alene Lake and River (17010303) Sub-basin Assessment and Proposed Total Maximum Daily Loads. Idaho Department of Environmental Quality. December 23, 1999.

IDEQ. 2004. South Fork Clearwater River Subbasin Assessment and TMDLs. Idaho Department of Environmental Quality, U.S. Environmental Protection Agency, and Nez Perce Tribe. March, 2004.

IDL. 2000. Forest Practices Cumulative Watershed Effects Process for Idaho. Idaho Department of Lands. March 2000.

Karr, J.R. 1991. Biological integrity: a long-neglected aspect of water resource management. Ecological Applications 1:66-84.

May, Bruce. Westslope Cutthroat Trout Status Update Summary 2009. http://www.westernnativetrout.org/sites/default/files/Westslope%20Status%20review.pdf

McGrath, C.L., A.J. Woods, J.M. Omernik, S.A. Bryce, M. Edmondson, J.A. Nesser, J. Shelden, R.C. Crawford, J.A. Comstock, and M.D. Plocher. 2001. Ecoregions of Idaho. US Geological Service, Reston, VA.

Newcombe, C.P. and J.O.T. Jensen. 1996. Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management. Volume 16(4): 693-727.

OWEB. (2001). Addendum to Water Quality Monitoring Technical Guide Book: Chapter 14 Stream Shade and Canopy Cover Monitoring Methods. Oregon's Watershed Enhancement Board. 775 Summer St. NE., Suite 360, Salem, OR 97301-1290.

Poole, G.C. and C.H. Berman. 2001. An ecological perspective on in-stream temperature: natural heat dynamics and mechanisms of human-caused thermal degradation. Environmental Management 27(6):787-802.

Rand, G.W., editor. 1995. Fundamentals of aquatic toxicology: effects, environmental fate, and risk assessment, second edition. Taylor and Francis. Washington, DC. 1,125 p.

Rosgen, D.L. 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, CO.

Shumar, M. and J. de Varona. 2009. The Potential Natural Vegetation (PNV) Temperature Total Maximum Daily Load (TMDL) Procedures Manual. Idaho Department of Environmental Quality. Boise, ID. 308p. http://www.deq.idaho.gov/water/data_reports/surface_water/monitoring/pnv_temp_tmdl_manual_revised_1009.pdf

Strahler, A.N. 1957. Quantitative analysis of watershed geomorphology. Transactions American Geophysical Union 38:913-920.

USDA. 1999. A procedure to estimate the response of aquatic systems to changes in phosphorus and nitrogen inputs. National Water and Climate Center, Natural Resources Conservation Service. Portland, OR.

USGS. 1987. Hydrologic unit maps. Water supply paper 2294. United States Geological Survey. Denver, CO. 63 p.

Water Environment Federation. 1987. The Clean Water Act of 1987. Water Environment Federation. Alexandria, VA. 318 p.

Water Quality Act of 1987, Public Law 100-4. 1987.

Water quality planning and management, 40 CFR Part 130.

Wetzel, R.G. 1983. Limnology. Saunders College Publishing. New York, NY.

GIS Coverages

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Other Related Documents

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 U.S. Environmental Protection Agency, Congress, and the public evaluate whether U.S. waters meet water quality standards, the progress made in maintaining and restoring water quality, and the extent of the remaining problems.

§303(d)
Refers to section 303 subsection "d" of the Clean Water Act. 303(d) requires states to develop a list of 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 U.S. Environmental Protection Agency approval.

Acre-foot
A volume of water that would cover an acre to a depth of one foot. Often used to quantify reservoir storage and the annual discharge of large rivers.

Adsorption
The adhesion of one substance to the surface of another. Clays, for example, can adsorb phosphorus and organic molecules

Aeration
A process by which water becomes charged with air directly from the atmosphere. Dissolved gases, such as oxygen, are then available for reactions in water.

Aerobic
Describes life, processes, or conditions that require the presence of oxygen.

Adfluvial
Describes fish whose life history involves seasonal migration from lakes to streams for spawning.

Adjunct
In the context of water quality, adjunct refers to areas directly adjacent to focal or refuge habitats that have been degraded by human or natural disturbances and do not presently support high diversity or abundance of native species.

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Alevin	A newly hatched, incompletely developed fish (usually a salmonid) still in nest or inactive on the bottom of a water body, living off stored yolk.
Algae	Non-vascular (without water-conducting tissue) aquatic plants that occur as single cells, colonies, or filaments.
Alluvium	Unconsolidated recent stream deposition.
Ambient	General conditions in the environment (Armantrout 1998). In the context of water quality, ambient waters are those representative of general conditions, not associated with episodic perturbations or specific disturbances such as a wastewater outfall (EPA 1996).
Anadromous	Fish, such as salmon and sea-run trout, that live part or the majority of their lives in the saltwater but return to fresh water to spawn.
Anaerobic	Describes the processes that occur in the absence of molecular oxygen and describes the condition of water that is devoid of molecular oxygen.
Anoxia	The condition of oxygen absence or deficiency.
Anthropogenic	Relating to, or resulting from, the influence of human beings on nature.
Anti-Degradation	Refers to the U.S. Environmental Protection Agency's interpretation of the Clean Water Act goal that states and tribes maintain, as well as restore, water quality. This applies to waters that meet or are of higher water quality than required by state standards. State rules provide that the quality of those high quality waters may be lowered only to allow important social or economic development and only after adequate public participation (IDAPA 58.01.02.051). In all cases, the existing beneficial uses must be maintained. State rules further define lowered water quality to be 1) a measurable change, 2) a change adverse to a use, and 3) a change in a pollutant relevant to the water's uses (IDAPA 58.01.02.003.61).

Aquatic

Occurring, growing, or living in water.

Aquifer

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

Assemblage (aquatic)

An association of interacting populations of organisms in a given water body; for example, a fish assemblage or a benthic macroinvertebrate assemblage (also see Community) (EPA 1996).

Assessment Database (ADB)

The ADB is a relational database application designed for the U.S. Environmental Protection Agency for tracking water quality assessment data, such as use attainment and causes and sources of impairment. States need to track this information and many other types of assessment data for thousands of water bodies and integrate it into meaningful reports. The ADB is designed to make this process accurate, straightforward, and user-friendly for participating states, territories, tribes, and basin commissions.

Assessment Unit (AU)

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

Assimilative Capacity

The ability to process or dissipate pollutants without ill effect to beneficial uses.

Autotrophic

An organism is considered autotrophic if it uses carbon dioxide as its main source of carbon. This most commonly happens through photosynthesis.

Batholith

A large body of intrusive igneous rock that has more than 40 square miles of surface exposure and no known floor. A batholith usually consists of coarse-grained rocks such as granite.

Bedload

Material (generally sand-sized or larger sediment) that is carried along the streambed by rolling or bouncing.

Beneficial Use

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

Beneficial Use Reconnaissance Program (BURP)

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

Benthic

Pertaining to or living on or in the bottom sediments of a water body

Benthic Organic Matter.

The organic matter on the bottom of a water body.

Benthos

Organisms living in and on the bottom sediments of lakes and streams. Originally, the term meant the lake bottom, but it is now applied almost uniformly to the animals associated with the lake and stream bottoms.

Best Management Practices (BMPs)

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

Best Professional Judgment

A conclusion and/or interpretation derived by a trained and/or technically competent individual by applying interpretation and synthesizing information.

Biochemical Oxygen Demand (BOD)

The amount of dissolved oxygen used by organisms during the decomposition (respiration) of organic matter, expressed as mass of oxygen per volume of water, over some specified period of time.

Biological Integrity

1) The condition of an aquatic community inhabiting unimpaired 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).

Biomass	The weight of biological matter. Standing crop is the amount of biomass (e.g., fish or algae) in a body of water at a given time. Often expressed as grams per square meter.
Biota	The animal and plant life of a given region.
Biotic	A term applied to the living components of an area.
Clean Water Act (CWA)	The Federal Water Pollution Control Act (commonly known as the Clean Water Act), as last reauthorized by the Water Quality Act of 1987, establishes a process for states to use to develop information on, and control the quality of, the nation's water resources.
Coliform Bacteria	A group of bacteria predominantly inhabiting the intestines of humans and animals but also found in soil. Coliform bacteria are commonly used as indicators of the possible presence of pathogenic organisms (also see Fecal Coliform Bacteria, *E. Coli*, and Pathogens).
Colluvium	Material transported to a site by gravity.
Community	A group of interacting organisms living together in a given place.
Conductivity	The ability of an aqueous solution to carry electric current, expressed in micro (μ) mhos/centimeter at 25 °C. Conductivity is affected by dissolved solids and is used as an indirect measure of total dissolved solids in a water sample.
Cretaceous	The final period of the Mesozoic era (after the Jurassic and before the Tertiary period of the Cenozoic era), thought to have covered the span of time between 135 and 65 million years ago.
Criteria	In the context of water quality, numeric or descriptive factors taken into account in setting standards for various pollutants. These factors are used to determine limits on allowable concentration levels, and to limit the number of violations per

	year. The U.S. Environmental Protection Agency develops criteria guidance; states establish criteria.
Cubic Feet per Second	A unit of measure for the rate of flow or discharge of water. One cubic foot per second is the rate of flow of a stream with a cross-section of one square foot flowing at a mean velocity of one foot per second. At a steady rate, once cubic foot per second is equal to 448.8 gallons per minute and 10,984 acre-feet per day.
Cultural Eutrophication	The process of eutrophication that has been accelerated by human-caused influences. Usually seen as an increase in nutrient loading (also see Eutrophication).
Culturally Induced Erosion	Erosion caused by increased runoff or wind action due to the work of humans in deforestation, cultivation of the land, overgrazing, and disturbance of natural drainages; the excess of erosion over the normal for an area (also see Erosion).
Debris Torrent	The sudden down slope movement of soil, rock, and vegetation on steep slopes, often caused by saturation from heavy rains.
Decomposition	The breakdown of organic molecules (e.g., sugar) to inorganic molecules (e.g., carbon dioxide and water) through biological and nonbiological processes.
Depth Fines	Percent by weight of particles of small size within a vertical core of volume of a streambed or lake bottom sediment. The upper size threshold for fine sediment for fisheries purposes varies from 0.8 to 6.5 millimeters depending on the observer and methodology used. The depth sampled varies but is typically about one foot (30 centimeters).
Designated Uses	Those water uses identified in state water quality standards that must be achieved and maintained as required under the Clean Water Act.
Discharge	The amount of water flowing in the stream channel at the time of measurement. Usually expressed as cubic feet per second (cfs).

Dissolved Oxygen (DO)	The oxygen dissolved in water. Adequate DO is vital to fish and other aquatic life.
Disturbance	Any event or series of events that disrupts ecosystem, community, or population structure and alters the physical environment.
E. coli	Short for *Escherichia coli, E. coli* are a group of bacteria that are a subspecies of coliform bacteria. Most *E. coli* are essential to the healthy life of all warm-blooded animals, including humans, 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.
Ecology	The scientific study of relationships between organisms and their environment; also defined as the study of the structure and function of nature.
Ecological Indicator	A characteristic of an ecosystem that is related to, or derived from, a measure of a biotic or abiotic variable that can provide quantitative information on ecological structure and function. An indicator can contribute to a measure of integrity and sustainability. Ecological indicators are often used within the multimetric index framework.
Ecological Integrity	The condition of an unimpaired ecosystem as measured by combined chemical, physical (including habitat), and biological attributes (EPA 1996).
Ecosystem	The interacting system of a biological community and its non-living (abiotic) environmental surroundings.
Effluent	A discharge of untreated, partially treated, or treated wastewater into a receiving water body.
Endangered Species	Animals, birds, fish, plants, or other living organisms threatened with imminent extinction. Requirements for declaring a species as endangered are contained in the Endangered Species Act.

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

Eocene
An epoch of the early Tertiary period, after the Paleocene and before the Oligocene.

Eolian
Windblown, referring to the process of erosion, transport, and deposition of material by the wind.

Ephemeral Stream
A stream or portion of a stream that flows only in direct response to precipitation. It receives little or no water from springs and no long continued supply from melting snow or other sources. Its channel is at all times above the water table (American Geological Institute 1962).

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

Eutrophic
From Greek for “well nourished,” this describes a highly productive body of water in which nutrients do not limit algal growth. It is typified by high algal densities and low clarity.

Eutrophication
1) Natural process of maturing (aging) in a body of water. 2) The natural and human-influenced process of enrichment with nutrients, especially nitrogen and phosphorus, leading to an increased production of organic matter.

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

Existing Beneficial Use or Existing Use
A beneficial use actually attained in waters on or after November 28, 1975, whether or not the use is designated for the waters in Idaho’s *Water Quality Standards and Wastewater Treatment Requirements* (IDAPA 58.01.02).

Exotic Species
A species that is not native (indigenous) to a region.

Extrapolation
Estimation of unknown values by extending or projecting from known values.

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Fauna

Animal life, especially the animals characteristic of a region, period, or special environment.

Fecal Coliform Bacteria

Bacteria found in the intestinal tracts of all warm-blooded animals or mammals. Their presence in water is an indicator of pollution and possible contamination by pathogens (also see Coliform Bacteria, *E. coli*, and Pathogens).

Fecal Streptococci

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

Feedback Loop

In the context of watershed management planning, a feedback loop is a process that provides for tracking progress toward goals and revising actions according to that progress.

Fixed-Location Monitoring

Sampling or measuring environmental conditions continuously or repeatedly at the same location.

Flow

See *Discharge*.

Fluvial

In fisheries, this describes fish whose life history takes place entirely in streams but migrate to smaller streams for spawning.

Focal

Critical areas supporting a mosaic of high quality habitats that sustain a diverse or unusually productive complement of native species.

Fully Supporting

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

Fully Supporting but Threatened

An intermediate assessment category describing water bodies that fully support beneficial uses, but have a declining trend in

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water quality conditions, which if not addressed, will lead to a "not fully supporting" status.

Geographical Information Systems (GIS)
A georeferenced database.

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

Grab Sample
A single sample collected at a particular time and place. It may represent the composition of the water in that water column.

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

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

Growth Rate
A measure of how quickly something living will develop and grow, such as the amount of new plant or animal tissue produced per a given unit of time, or number of individuals added to a population.

Habitat
The living place of an organism or community.

Headwater
The origin or beginning of a stream.

Hydrologic Basin
The area of land drained by a river system, a reach of a river and its tributaries in that reach, a closed basin, or a group of streams forming a drainage area (also see Watershed).

Hydrologic Cycle
The cycling of water from the atmosphere to the earth (precipitation) and back to the atmosphere (evaporation and plant transpiration). Atmospheric moisture, clouds, rainfall, runoff, surface water, ground water, and water infiltrated in soils are all part of the hydrologic cycle.

Hydrologic Unit
One of a nested series of numbered and named watersheds arising from a national standardization of watershed

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

Hydrologic Unit Code (HUC)

The number assigned to a hydrologic unit. Often used to refer to fourth field hydrologic units.

Hydrology

The science dealing with the properties, distribution, and circulation of water.

Impervious

Describes a surface, such as pavement, that water cannot penetrate.

Influent

A tributary stream.

Inorganic

Materials not derived from biological sources.

Instantaneous

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

Intergravel Dissolved Oxygen

The concentration of dissolved oxygen within spawning gravel. Consideration for determining spawning gravel includes species, water depth, velocity, and substrate.

Intermittent Stream

1) A stream that flows only part of the year, such as when the ground water table is high or when the stream receives water from springs or from surface sources such as melting snow in mountainous areas. The stream ceases to flow above the streambed when losses from evaporation or seepage exceed the available stream flow. 2) A stream that has a period of zero flow for at least one week during most years.

Interstate Waters

Waters that flow across or form part of state or international boundaries, including boundaries with Native American nations.

Irrigation Return Flow

Surface (and subsurface) water that leaves a field following the application of irrigation water and eventually flows into streams.

Key Watershed

A watershed that has been designated in Idaho Governor Batt's *State of Idaho Bull Trout Conservation Plan* (1996) as critical to the long-term persistence of regionally important trout populations.

Knickpoint

Any interruption or break of slope.

Land Application

A process or activity involving application of wastewater, surface water, or semi-liquid material to the land surface for the purpose of treatment, pollutant removal, or ground water recharge.

Limiting Factor

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

Limnology

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

Load Allocation (LA)

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

Load(ing)

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

Load(ing) Capacity (LC)

A determination of 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, and a margin of safety, it becomes a total maximum daily load.

Loam

Refers to a soil with a texture resulting from a relative balance of sand, silt, and clay. This balance imparts many desirable characteristics for agricultural use.

Loess	A uniform wind-blown deposit of silty material. Silty soils are among the most highly erodible.
Lotic	An aquatic system with flowing water such as a brook, stream, or river where the net flow of water is from the headwaters to the mouth.
Luxury Consumption	A phenomenon in which sufficient nutrients are available in either the sediments or the water column of a water body, such that aquatic plants take up and store an abundance in excess of the plants' current needs.
Macroinvertebrate	An invertebrate animal (without a backbone) large enough to be seen without magnification and retained by a 500µm mesh (U.S. #30) screen.
Macrophytes	Rooted and floating vascular aquatic plants, commonly referred to as water weeds. These plants usually flower and bear seeds. Some forms, such as duckweed and coontail (*Ceratophyllum sp.*), are free-floating forms not rooted in sediment.
Margin of Safety (MOS)	An implicit or explicit portion of a water body's loading capacity set aside to allow the uncertainly about the relationship between the pollutant loads and the quality of the receiving water body. This is a required component of a total maximum daily load (TMDL) and is often incorporated into conservative assumptions used to develop the TMDL (generally within the calculations and/or models). The MOS is not allocated to any sources of pollution.
Mass Wasting	A general term for the down slope movement of soil and rock material under the direct influence of gravity.
Mean	Describes the central tendency of a set of numbers. The arithmetic mean (calculated by adding all items in a list, then dividing by the number of items) is the statistic most familiar to most people.
Median	The middle number in a sequence of numbers. If there is an even number of numbers, the median is the average of the two

middle numbers. For example, 4 is the median of 1, 2, 4, 14, 16; 6 is the median of 1, 2, 5, 7, 9, 11.

Metric

1) A discrete measure of something, such as an ecological indicator (e.g., number of distinct taxon). 2) The metric system of measurement.

Milligrams per Liter (mg/L)

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

Million Gallons per Day (MGD)

A unit of measure for the rate of discharge of water, often used to measure flow at wastewater treatment plants. One MGD is equal to 1.547 cubic feet per second.

Miocene

Of, relating to, or being an epoch of, the Tertiary between the Pliocene and the Oligocene periods, or the corresponding system of rocks.

Monitoring

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

Mouth

The location where flowing water enters into a larger water body.

National Pollution Discharge Elimination System (NPDES)

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

Natural Condition

The condition that exists with little or no anthropogenic influence.

Nitrogen

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

Nodal

Areas that are separated from focal and adjunct habitats, but serve critical life history functions for individual native fish.

Nonpoint Source

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

Not Assessed (NA)

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

Not Fully Supporting

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

Nuisance

Anything that is injurious to the public health or an obstruction to the free use, in the customary manner, of any waters of the state.

Nutrient

Any substance required by living things to grow. An element or its chemical forms essential to life, such as carbon, oxygen, nitrogen, and phosphorus. Commonly refers to those elements in short supply, such as nitrogen and phosphorus, which usually limit growth.

Nutrient Cycling

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

Oligotrophic

The Greek term for "poorly nourished." This describes a body of water in which productivity is low and nutrients are limiting to algal growth, as typified by low algal density and high clarity.

Organic Matter

Compounds manufactured by plants and animals that contain principally carbon.

Orthophosphate

A form of soluble inorganic phosphorus most readily used for algal growth.

Oxygen-Demanding Materials

Those materials, mainly organic matter, in a water body that consume oxygen during decomposition.

Parameter

A variable, measurable property whose value is a determinant of the characteristics of a system, such as temperature, dissolved oxygen, and fish populations are parameters of a stream or lake.

Partitioning

The sharing of limited resources by different races or species; use of different parts of the habitat, or the same habitat at different times. Also the separation of a chemical into two or more phases, such as partitioning of phosphorus between the water column and sediment.

Pathogens

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.

Perennial Stream

A stream that flows year-around in most years.

Periphyton

Attached microflora (algae and diatoms) growing on the bottom of a water body or on submerged substrates, including larger plants.

Pesticide

Substances or mixtures of substances intended for preventing, destroying, repelling, or mitigating any pest. Also, any substance or mixture intended for use as a plant regulator, defoliant, or desiccant.

pH	The negative $\log_{10}$ of the concentration of hydrogen ions, a measure which in water ranges from very acid (pH=1) to very alkaline (pH=14). A pH of 7 is neutral. Surface waters usually measure between pH 6 and 9.
Phased TMDL	A total maximum daily load (TMDL) that identifies interim load allocations and details further monitoring to gauge the success of management actions in achieving load reduction goals and the effect of actual load reductions on the water quality of a water body. Under a phased TMDL, a refinement of load allocations, wasteload allocations, and the margin of safety is planned at the outset.
Phosphorus	An element essential to plant growth, often in limited supply, and thus considered a nutrient.
Physiochemical	In the context of bioassessment, the term is commonly used to mean the physical and chemical factors of the water column that relate to aquatic biota. Examples in bioassessment usage include saturation of dissolved gases, temperature, pH, conductivity, dissolved or suspended solids, forms of nitrogen, and phosphorus. This term is used interchangeable with the term "physical/chemical."
Plankton	Microscopic algae (phytoplankton) and animals (zooplankton) that float freely in open water of lakes and oceans.
Point Source	A source of pollutants characterized by having a discrete conveyance, such as a pipe, ditch, or other identifiable "point" of discharge into a receiving water. Common point sources of pollution are industrial and municipal wastewater.
Pollutant	Generally, any substance introduced into the environment that adversely affects the usefulness of a resource or the health of humans, animals, or ecosystems.
Pollution	A very broad concept that encompasses human-caused changes in the environment which alter the functioning of natural processes and produce undesirable environmental and health effects. This includes human-induced alteration of the physical,

	biological, chemical, and radiological integrity of water and other media.
Population	A group of interbreeding organisms occupying a particular space; the number of humans or other living creatures in a designated area.
Pretreatment	The reduction in the amount of pollutants, elimination of certain pollutants, or alteration of the nature of pollutant properties in wastewater prior to, or in lieu of, discharging or otherwise introducing such wastewater into a publicly owned wastewater treatment plant.
Primary Productivity	The rate at which algae and macrophytes fix carbon dioxide using light energy. Commonly measured as milligrams of carbon per square meter per hour.
Protocol	A series of formal steps for conducting a test or survey.
Qualitative	Descriptive of kind, type, or direction.
Quality Assurance (QA)	A program organized and designed to provide accurate and precise results. Included are the selection of proper technical methods, tests, or laboratory procedures; sample collection and preservation; the selection of limits; data evaluation; quality control; and personnel qualifications and training (Rand 1995). The goal of QA is to assure the data provided are of the quality needed and claimed (EPA 1996).
Quality Control (QC)	Routine application of specific actions required to provide information for the quality assurance program. Included are standardization, calibration, and replicate samples (Rand 1995). QC is implemented at the field or bench level (EPA 1996).
Quantitative	Descriptive of size, magnitude, or degree.
Reach	A stream section with fairly homogenous physical characteristics.

Reconnaissance

An exploratory or preliminary survey of an area.

Reference

A physical or chemical quantity whose value is known and thus is used to calibrate or standardize instruments.

Reference Condition

1) A condition that fully supports applicable beneficial uses with little affect from human activity and represents the highest level of support attainable. 2) A benchmark for populations of aquatic ecosystems used to describe desired conditions in a biological assessment and acceptable or unacceptable departures from them. The reference condition can be determined through examining regional reference sites, historical conditions, quantitative models, and expert judgment (Hughes 1995).

Reference Site

A specific locality on a water body that is minimally impaired and is representative of reference conditions for similar water bodies.

Representative Sample

A portion of material or water that is as similar in content and consistency as possible to that in the larger body of material or water being sampled.

Resident

A term that describes fish that do not migrate.

Respiration

A process by which organic matter is oxidized by organisms, including plants, animals, and bacteria. The process converts organic matter to energy, carbon dioxide, water, and lesser constituents.

Riffle

A relatively shallow, gravelly area of a streambed with a locally fast current, recognized by surface choppiness. Also an area of higher streambed gradient and roughness.

Riparian

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

Riparian Habitat Conservation Area (RHCA)

A U.S. Forest Service description of land within the following number of feet up-slope of each of the banks of streams:

- 300 feet from perennial fish-bearing streams

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- 150 feet from perennial non-fish-bearing streams
- 100 feet from intermittent streams, wetlands, and ponds in priority watersheds.

River

A large, natural, or human-modified stream that flows in a defined course or channel or in a series of diverging and converging channels.

Runoff

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

Sediments

Deposits of fragmented materials from weathered rocks and organic material that were suspended in, transported by, and eventually deposited by water or air.

Settleable Solids

The volume of material that settles out of one liter of water in one hour.

Species

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

Spring

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

Stagnation

The absence of mixing in a water body.

Stenothermal

Unable to tolerate a wide temperature range.

Stratification

A Department of Environmental Quality classification method used to characterize comparable units (also called classes or strata).

Stream

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

Stream Order

Hierarchical ordering of streams based on the degree of branching. A first-order stream is an unforked or unbranched stream. Under Strahler's (1957) system, higher order streams result from the joining of two streams of the same order.

Storm Water Runoff

Rainfall that quickly runs off the land after a storm. In developed watersheds the water flows off roofs and pavement into storm drains that may feed quickly and directly into the stream. The water often carries pollutants picked up from these surfaces.

Stressors

Physical, chemical, or biological entities that can induce adverse effects on ecosystems or human health.

Subbasin

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

Subbasin Assessment (SBA)

A watershed-based problem assessment that is the first step in developing a total maximum daily load in Idaho.

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 Fines

Sediments of small size deposited on the surface of a streambed or lake bottom. The upper size threshold for fine sediment for fisheries purposes varies from 0.8 to 605 millimeters depending on the observer and methodology used. Results are typically expressed as a percentage of observation points with fine sediment.

Surface Runoff

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

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Surface Water

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

Suspended Sediments

Fine material (usually sand size or smaller) that remains suspended by turbulence in the water column until deposited in areas of weaker current. These sediments cause turbidity and, when deposited, reduce living space within streambed gravels and can cover fish eggs or alevins.

Taxon

Any formal taxonomic unit or category of organisms (e.g., species, genus, family, order). The plural of taxon is taxa (Armantrout 1998).

Tertiary

An interval of geologic time lasting from 66.4 to 1.6 million years ago. It constitutes the first of two periods of the Cenozoic Era, the second being the Quaternary. The Tertiary has five subdivisions, which from oldest to youngest are the Paleocene, Eocene, Oligocene, Miocene, and Pliocene epochs.

Thalweg

The center of a stream's current, where most of the water flows.

Threatened Species

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

Total Maximum Daily Load (TMDL)

A TMDL is a water body's load capacity after it has been allocated among pollutant sources. It can be expressed on a time basis other than daily if appropriate. Sediment loads, for example, are often calculated on an annual bases. 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.

Total Dissolved Solids

Dry weight of all material in solution in a water sample as determined by evaporating and drying filtrate.

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Total Suspended Solids (TSS)

The dry weight of material retained on a filter after filtration. Filter pore size and drying temperature can vary. American Public Health Association Standard Methods (Franson et al. 1998) call for using a filter of 2.0 microns or smaller; a 0.45 micron filter is also often used. This method calls for drying at a temperature of 103-105 °C.

Toxic Pollutants

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

Tributary

A stream feeding into a larger stream or lake.

Trophic State

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

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Turbidity

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

Vadose Zone

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

Wasteload Allocation (WLA)

The portion of receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. Wasteload allocations specify how much pollutant each point source may release to a 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 interface with the sediment layer at the bottom. The idea derives from a vertical series of measurements (oxygen, temperature, phosphorus) used to characterize water.

Water Pollution

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

Water Quality

A term used to describe the biological, chemical, and physical characteristics of water with respect to its suitability for a beneficial use.

Water Quality Criteria

Levels of water quality expected to render a body of water suitable for its designated uses. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, or industrial processes.

Water Quality Limited

A label that describes water bodies for which one or more water quality criterion is not met or beneficial uses are not fully supported. Water quality limited segments may or may not be on a §303(d) list.

Water Quality Limited Segment (WQLS)

Any segment placed on a state's §303(d) list for failure to meet applicable water quality standards, and/or is not expected to meet applicable water quality standards in the period prior to the next list. These segments are also referred to as "§303(d) listed."

Water Quality Management Plan

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

Water Quality Modeling

The prediction of the response of some characteristics of lake or stream water based on mathematical relations of input variables such as climate, stream flow, and inflow water quality.

Water Quality Standards

State-adopted and U.S. 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 which contributes runoff to a common point in a drainage network, or to a lake outlet. Watersheds are infinitely nested, and any large watershed is composed of smaller "subwatersheds." 2) The whole geographic region which 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.

Wetland

An area that is at least some of the time saturated by surface or ground water so as to support with vegetation adapted to saturated soil conditions. Examples include swamps, bogs, fens, and marshes.

Young of the Year

Young fish born the year captured, evidence of spawning activity.

Appendix A. Unit Conversion Chart

Table A-1. Metric - English unit conversions.

	English Units	Metric Units	To Convert	Example
Distance	Miles (mi)	Kilometers (km)	1 mi = 1.61 km 1 km = 0.62 mi	3 mi = 4.83 km 3 km = 1.86 mi
Length	Inches (in) Feet (ft)	Centimeters (cm) Meters (m)	1 in = 2.54 cm 1 cm = 0.39 in 1 ft = 0.30 m 1 m = 3.28 ft	3 in = 7.62 cm 3 cm = 1.18 in 3 ft = 0.91 m 3 m = 9.84 ft
Area	Acres (ac) Square Feet (ft^2) Square Miles (mi^2)	Hectares (ha) Square Meters (m^2) Square Kilometers (km^2)	1 ac = 0.40 ha 1 ha = 2.47 ac 1 ft^2 = 0.09 m^2 1 m^2 = 10.76 ft^2 1 mi^2 = 2.59 km^2 1 km^2 = 0.39 mi^2	3 ac = 1.20 ha 3 ha = 7.41 ac 3 ft^2 = 0.28 m^2 3 m^2 = 32.29 ft^2 3 mi^2 = 7.77 km^2 3 km^2 = 1.16 mi^2
Volume	Gallons (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 = 35.31cfs	3 ft^3/sec = 0.09 m^3/sec 3 m^3/sec = 105.94 ft^3/sec
Concentration	Parts per Million (ppm)	Milligrams per Liter (mg/L)	1 ppm = 1 mg/L[b]	3 ppm = 3 mg/L
Weight	Pounds (lbs)	Kilograms (kg)	1 lb = 0.45 kg 1 kg = 2.20 lbs	3 lb = 1.36 kg 3 kg = 6.61 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 is equal to 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 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 DEQ is generally from March 15th to July 1st each year (Grafe et al., 2002). Fall spawning can occur as early as August 15th and continue with incubation on into the following spring up to June 1st. As per IDAPA 58.01.02.250.02.e.ii., the water quality criteria that need to be met during that time period are:

> 13^oC as a daily maximum water temperature,
>
> 9^oC as a daily average water temperature.

For the purposes of a temperature TMDL, the highest recorded water temperature in a recorded data set (excluding any high water temperatures that may occur on days when air temperatures exceed the 90th percentile of highest annual MWMT air temperatures) is compared to the daily maximum criterion of 13^oC. 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 these 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. As per IDAPA 58.01.02.200.09:

> *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, pollutant levels shall not exceed the natural background conditions, except that temperature levels may be increased above natural background conditions when allowed under Section 401.*

Section 401 relates to point source wastewater treatment requirements. In this case if temperature criteria for any aquatic life use is exceeded due to natural conditions, then a point source discharge cannot raise the water temperature by more than 0.3^oC (IDAPA 58.01.02.401.03.a.v.).

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Appendix C. Data Sources, Pathfinder Results and Watershed Figures

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Table C-1. Data sources for the Coeur d'Alene Lake TMDLs.

Water Body	Data Source	Type of Data	When Collected
Beauty Creek, Latour Creek, Marie Creek	DEQ Regional Office	Pathfinder effective shade and stream width	Summer 2007
Nine Waters and Associated Tributaries	DEQ State Technical Services Office	Aerial Photo Interpretation of existing shade and stream width estimation	March-April 2007, 2008
	DEQ IDASA Database	Temperature	

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Table C-2. Solar Pathfinder Results in 2007.

aerial class	pathfinder actual	pathfinder class	delta		
90	93.8	90	0		beauty-1
40	39.9	30	10		beauty-2
80	77.8	70	10		beauty-3
90	90.8	90	0		beauty-4
80	81.1	80	0		beauty-5
60	75.4	70	-10		marie-1
70	75.9	70	0		marie-2
70	78.3	70	0		marie-3
60	75.7	70	-10		latour-1
60	69.5	60	0		latour-2
50	48.2	40	10		latour-3
20	24.2	20	0		latour-4
20	29.6	20	0		latour-5a
30	55.3	50	-20		latour-5b
20	17.6	10	10		latour-6
20	56.2	50	-30		latour-7a
40	68.6	60	-20		latour-7b
20	51.4	50	-30		latour-8
0	5.5	0	0		latour-9
10	16	10	0		latour-10
10	21.1	20	-10		latour-11
45	55	49	-4	average	
28.57	27.03	27.55	12.07	std dev	
12.22	11.56	11.78	5.16	95%CI	

aerial class	pathfinder actual	pathfinder class	delta		
90	93.8	90	0		beauty-1
40	39.9	30	10		beauty-2
80	77.8	70	10		beauty-3
90	90.8	90	0		beauty-4
80	81.1	80	0		beauty-5
76	77	72	4	average	
20.74	21.60	24.90	5.48	std dev	
18.18	18.93	21.83	4.80	95%CI	

aerial class	pathfinder actual	pathfinder class	delta		
60	75.4	70	-10		marie-1
70	75.9	70	0		marie-2
70	78.3	70	0		marie-3
67	77	70	-3	average	
5.77	1.55	0.00	5.77	std dev	
6.53	1.75	#NUM!	6.53	95%CI	

aerial class	pathfinder actual	pathfinder class	delta		
60	75.7	70	-10		latour-1
60	69.5	60	0		latour-2
50	48.2	40	10		latour-3
20	24.2	20	0		latour-4
20	29.6	20	0		latour-5a
30	55.3	50	-20		latour-5b
20	17.6	10	10		latour-6
20	56.2	50	-30		latour-7a
40	68.6	60	-20		latour-7b
20	51.4	50	-30		latour-8
0	5.5	0	0		latour-9
10	16	10	0		latour-10
10	21.1	20	-10		latour-11
28	41	35	-8	average	
19.22	23.47	22.95	13.63	std dev	
10.45	12.76	12.48	7.41	95%CI	

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Table C-3. Solar Pathfinder Results in 2010.

aerial class	pathfinder actual	pathfinder class	delta		
80	87.3	80	0		fernan #1
90	87.3	80	10		fernan #1
50	76.6	70	-20		fernan #2
60	86.5	80	-20		fernan #3
90	86.5	80	10		fernan #3
90	91	90	0		searchlight
90	93	90	0		cedar #1
80	67.8	60	20		cedar #2
80	63.5	60	20		cedar #3
10	80.5	80	-70		4th july #2
80	80.1	80	0		4th july #3
30	82.9	80	-50		fern
70	58.4	50	20		curran
90	89.2	80	10		beauty #1
90	92.9	90	0		beauty #3
80	89.6	90	-10		carlin
90	95.3	90	0		carlin trib
80	88.1	80	0		blue lake
90	92.5	90	0		cottonwood
90	92.8	90	0		cougar
			-4	average	
			22.34	std dev	
			9.79	95%CI	

4th of July #1 and Beauty trib #2 were not on the hydrography in question.

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Figure C-1. Target Shade for Cougar Creek (17010303PN002_02).

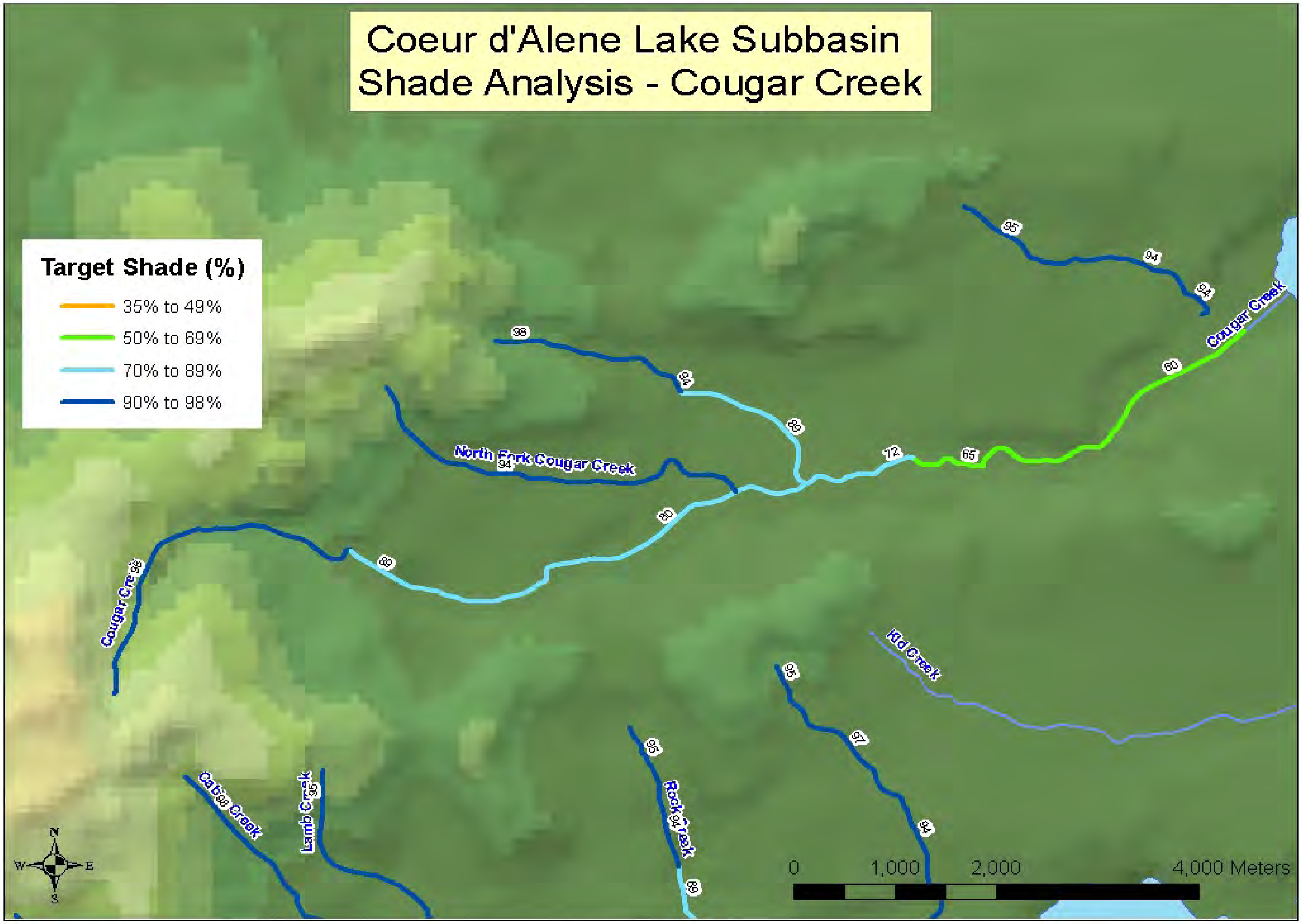

Figure C-2. Existing Shade Estimated for Cougar Creek (17010303PN002_02).

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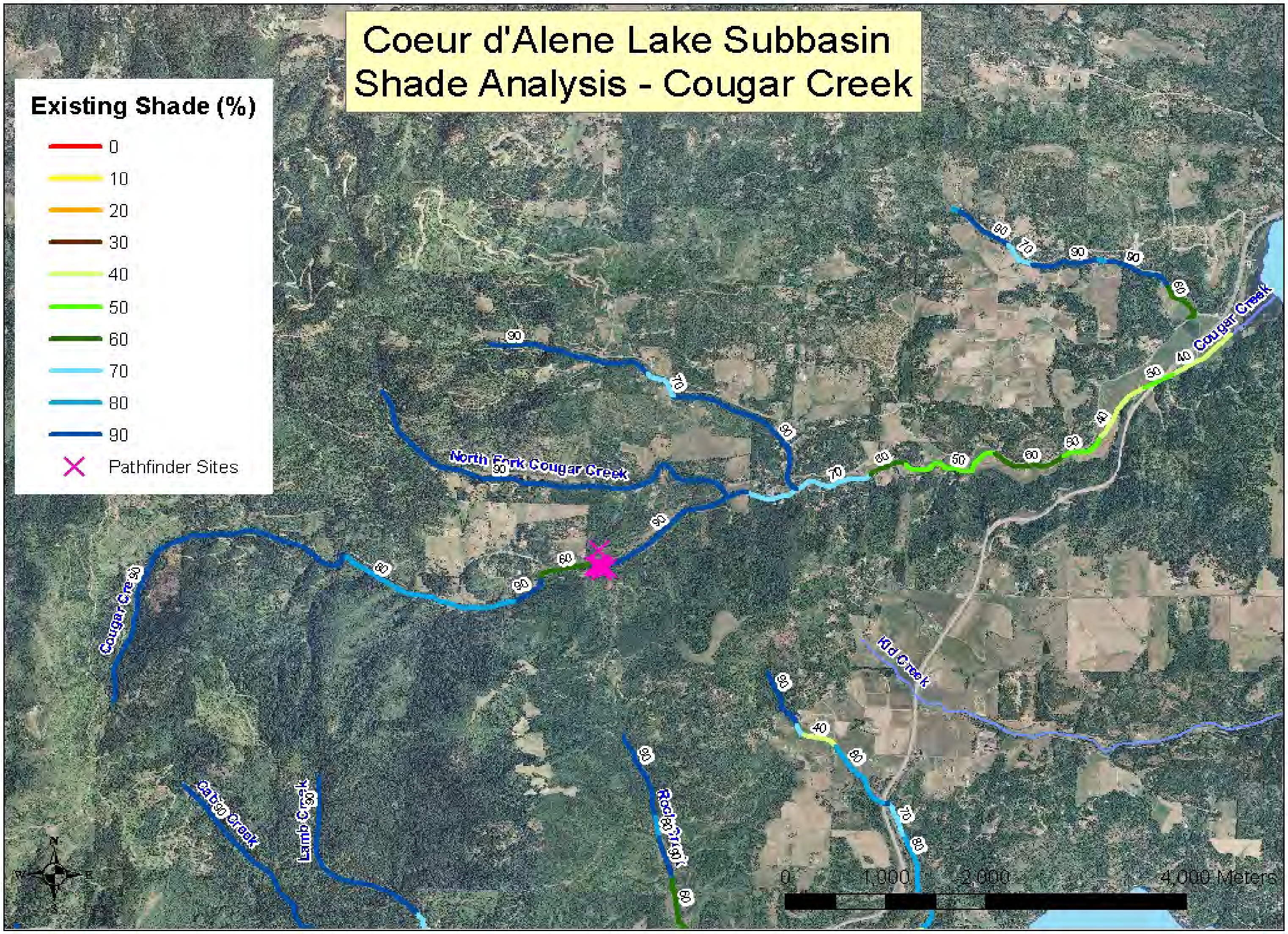

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Figure C-3. Lack of Shade (Difference Between Existing and Target) for Cougar Creek (17010303PN002_02).

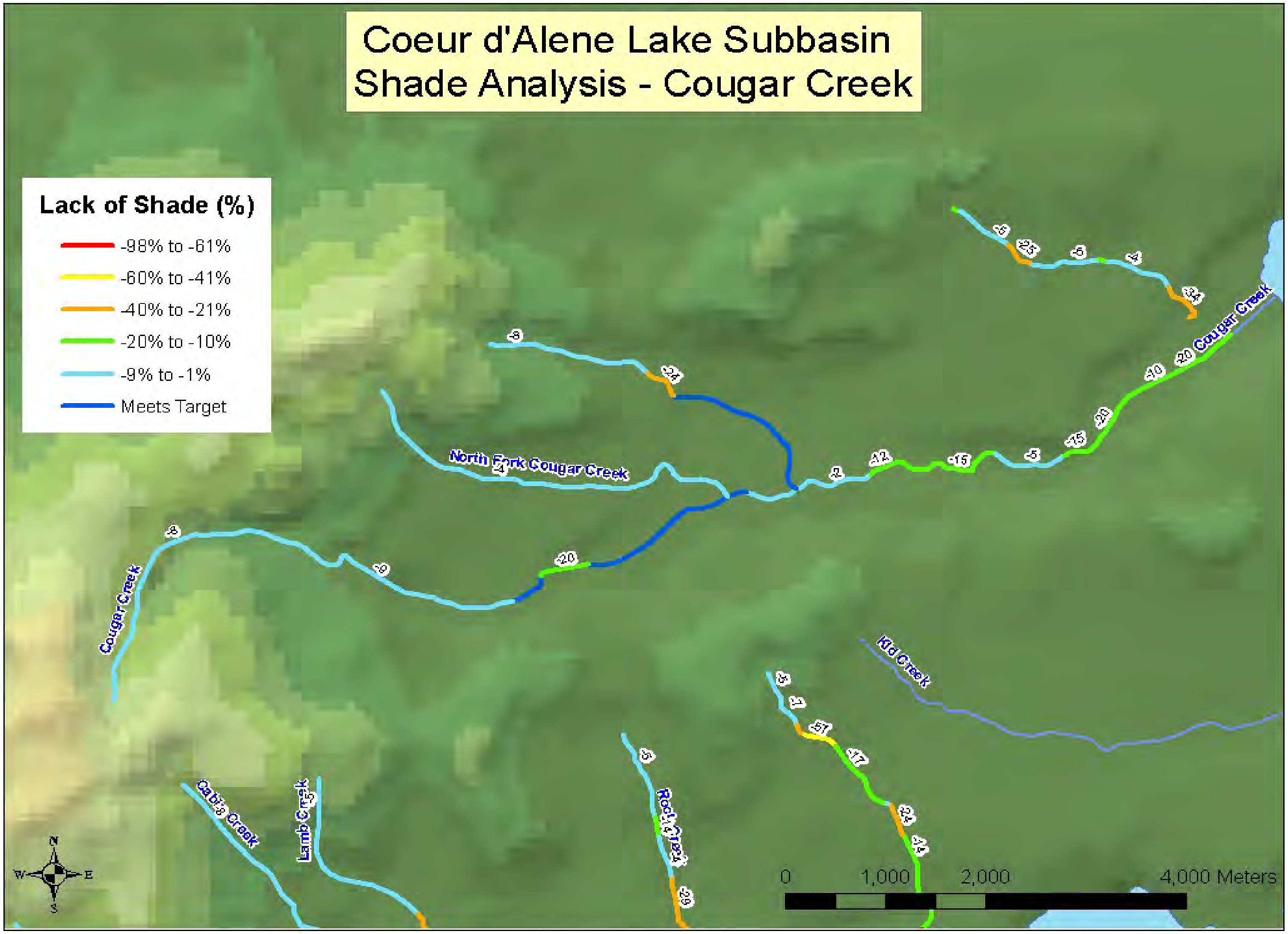

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Figure C-4. Target Shade for Mica Creek (ID17010303PN004_02 & _03).

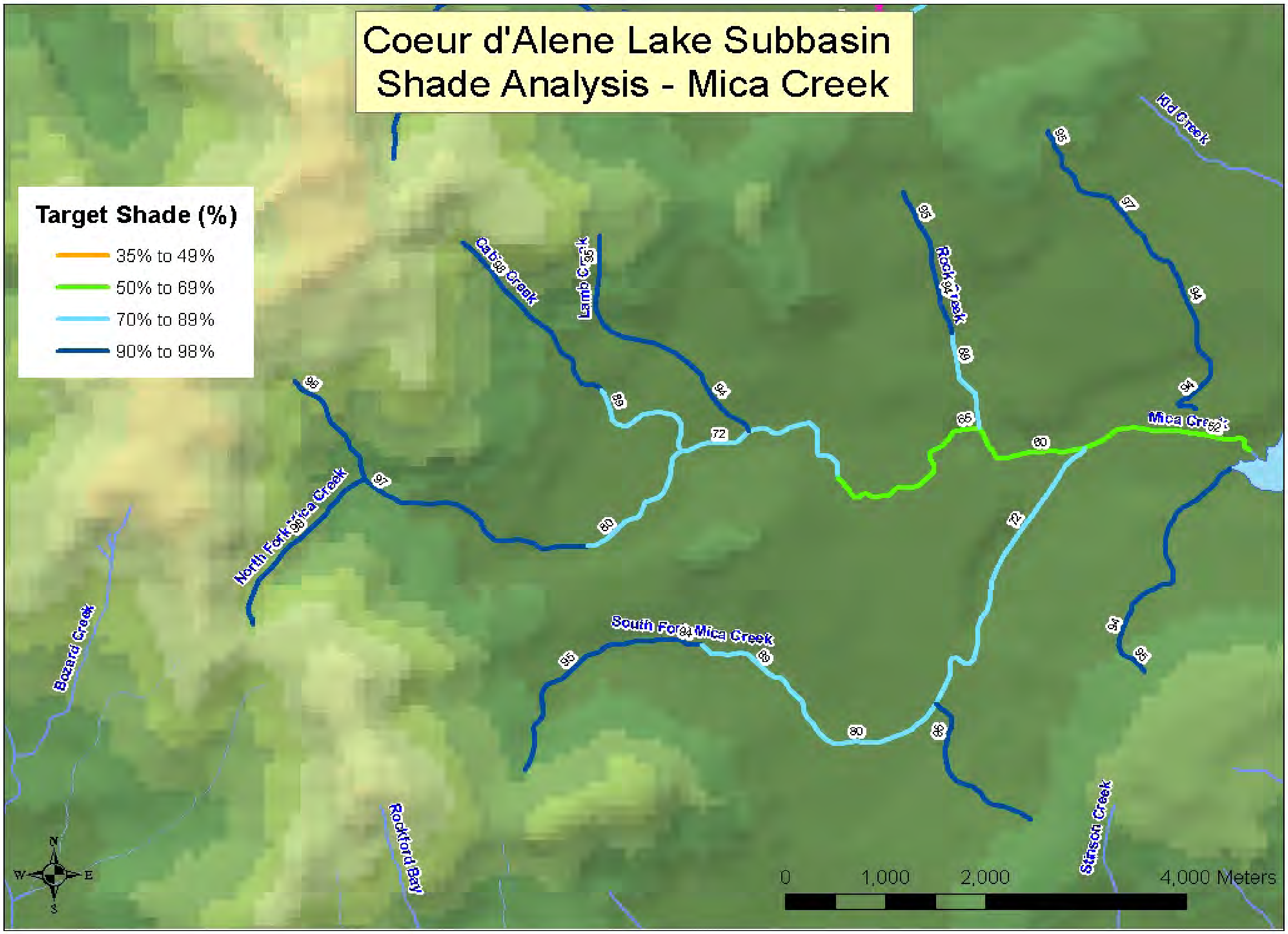

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Figure C-5. Existing Shade Estimated for Mica Creek (ID17010303PN004_02 & _03).

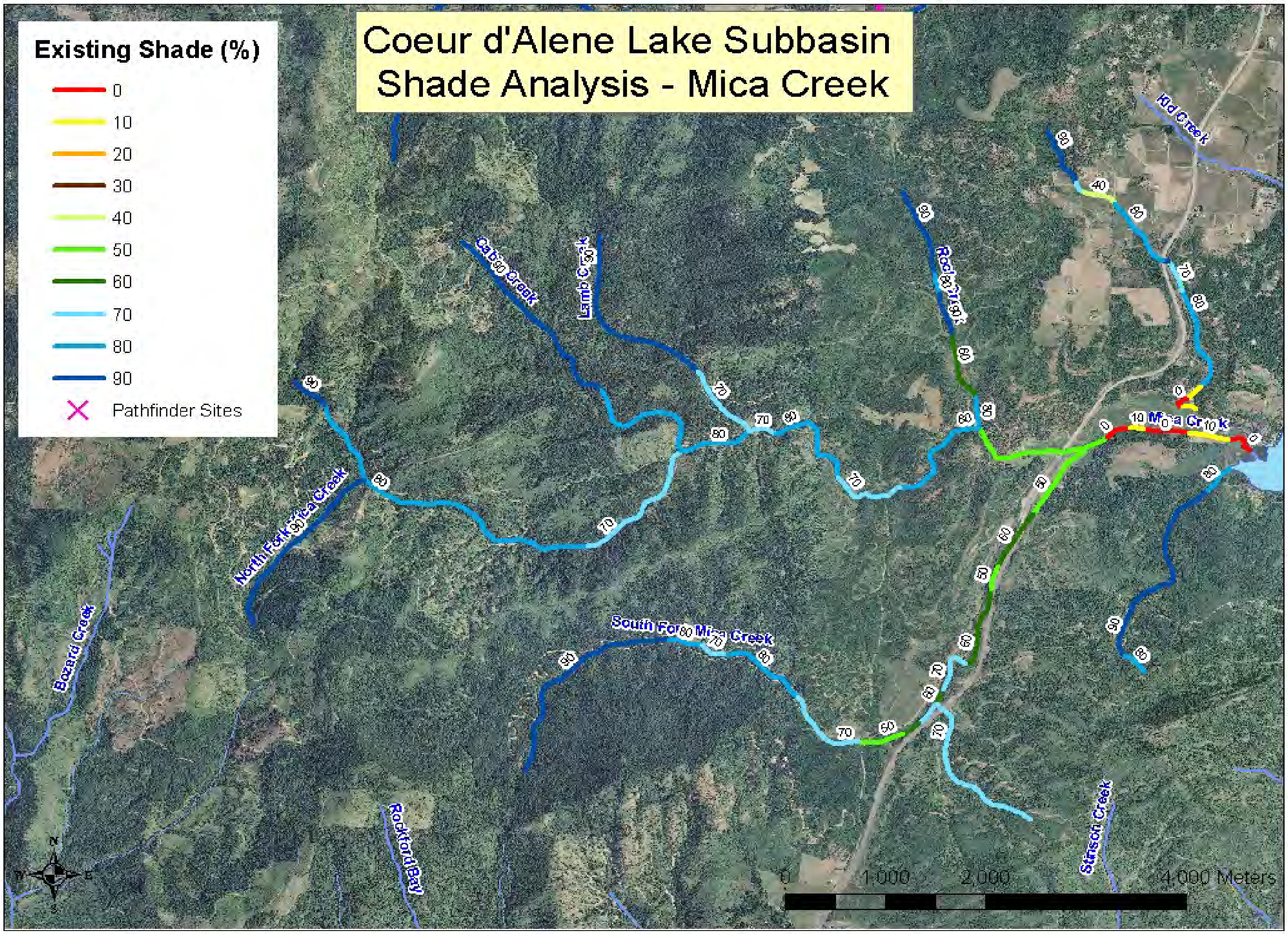

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Figure C-6. Lack of Shade (Difference Between Existing and Target) for Mica Creek (ID17010303PN004_02 & _03).

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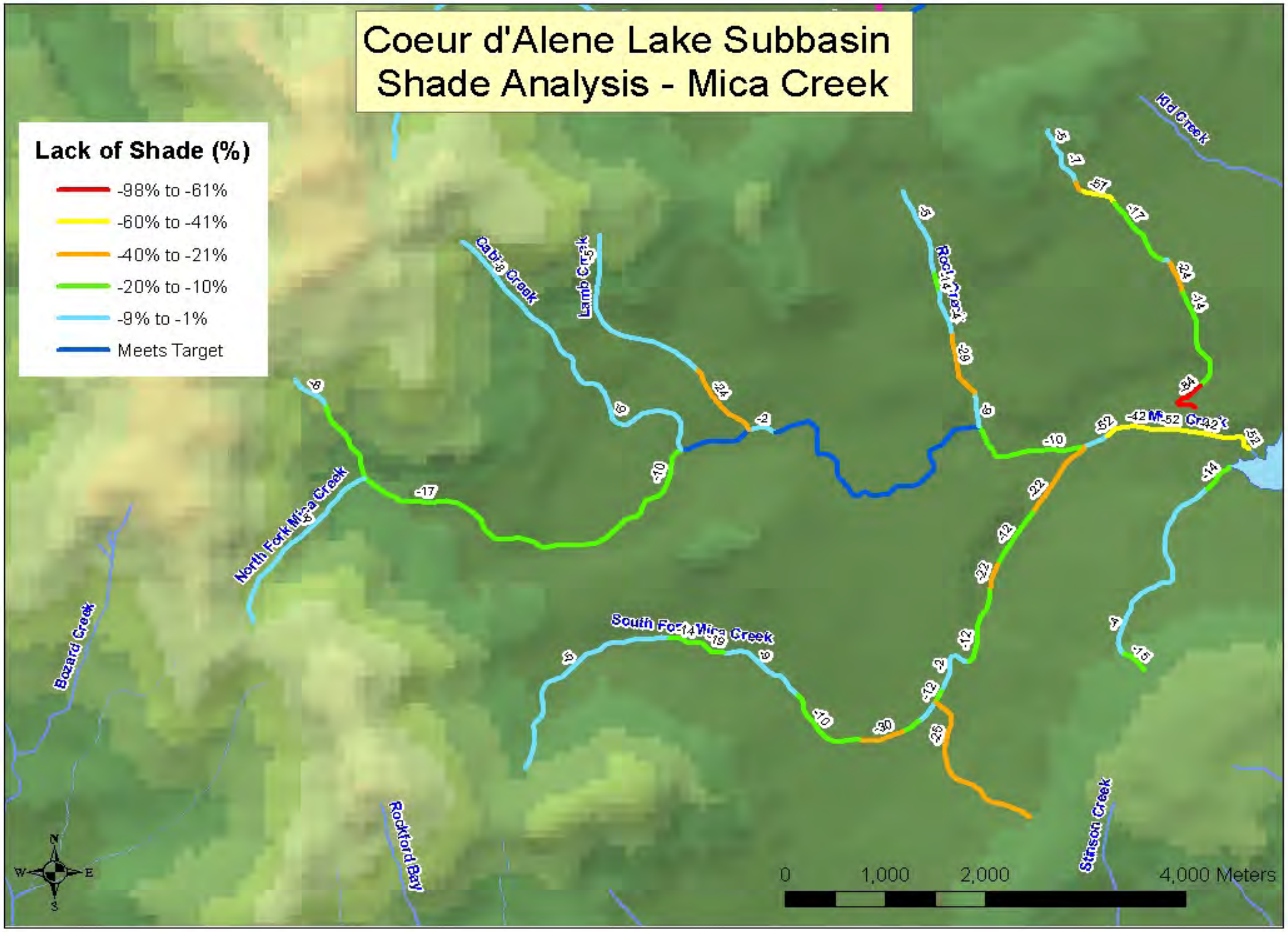

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Figure C-7. Target Shade for Latour Creek (ID17010303PN015_02).

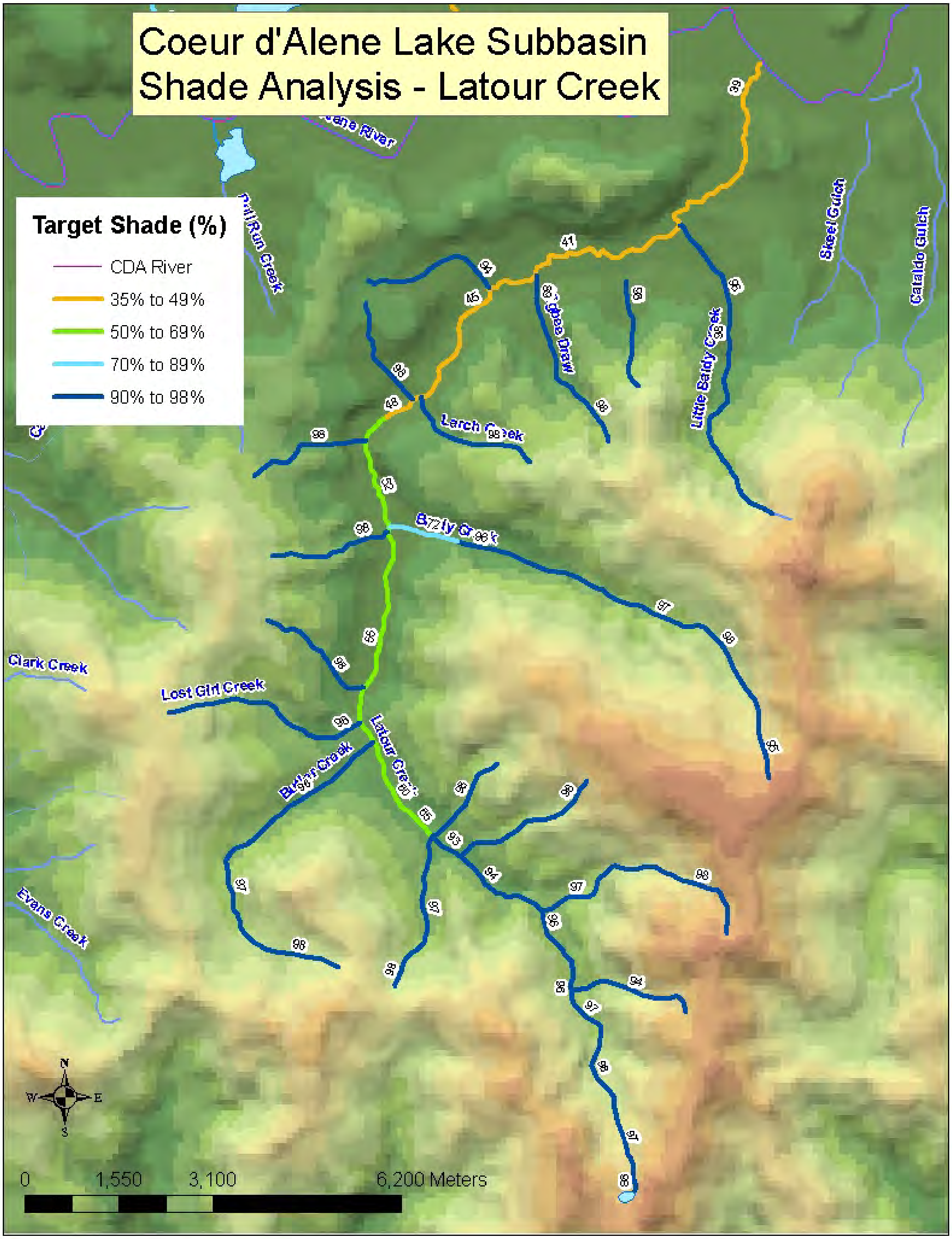

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Figure C-8. Existing Shade Estimated for Latour Creek (ID17010303PN015_02).

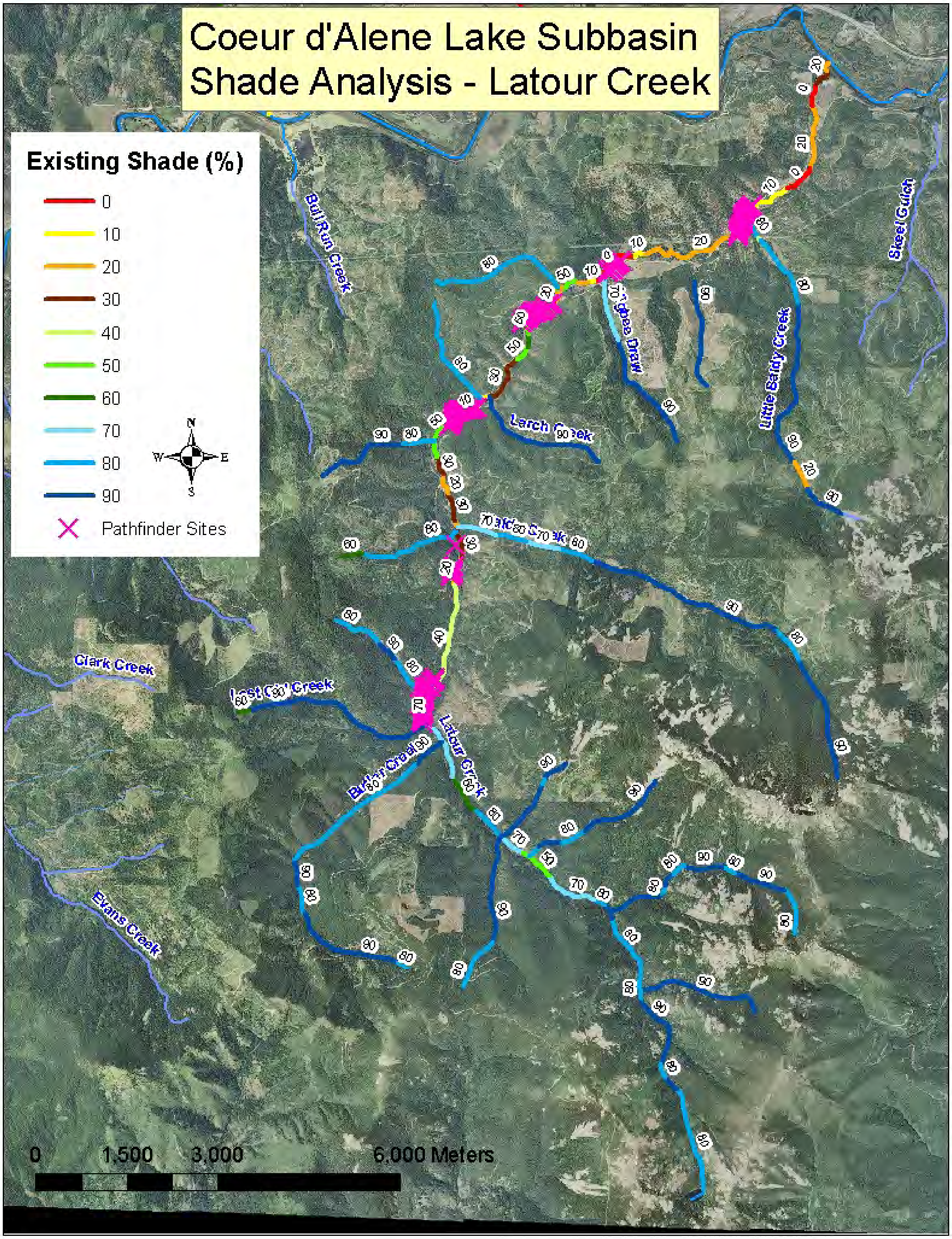

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Figure C-9. Lack of Shade (Difference Between Existing and Target) for Latour Creek (ID17010303PN015_02).

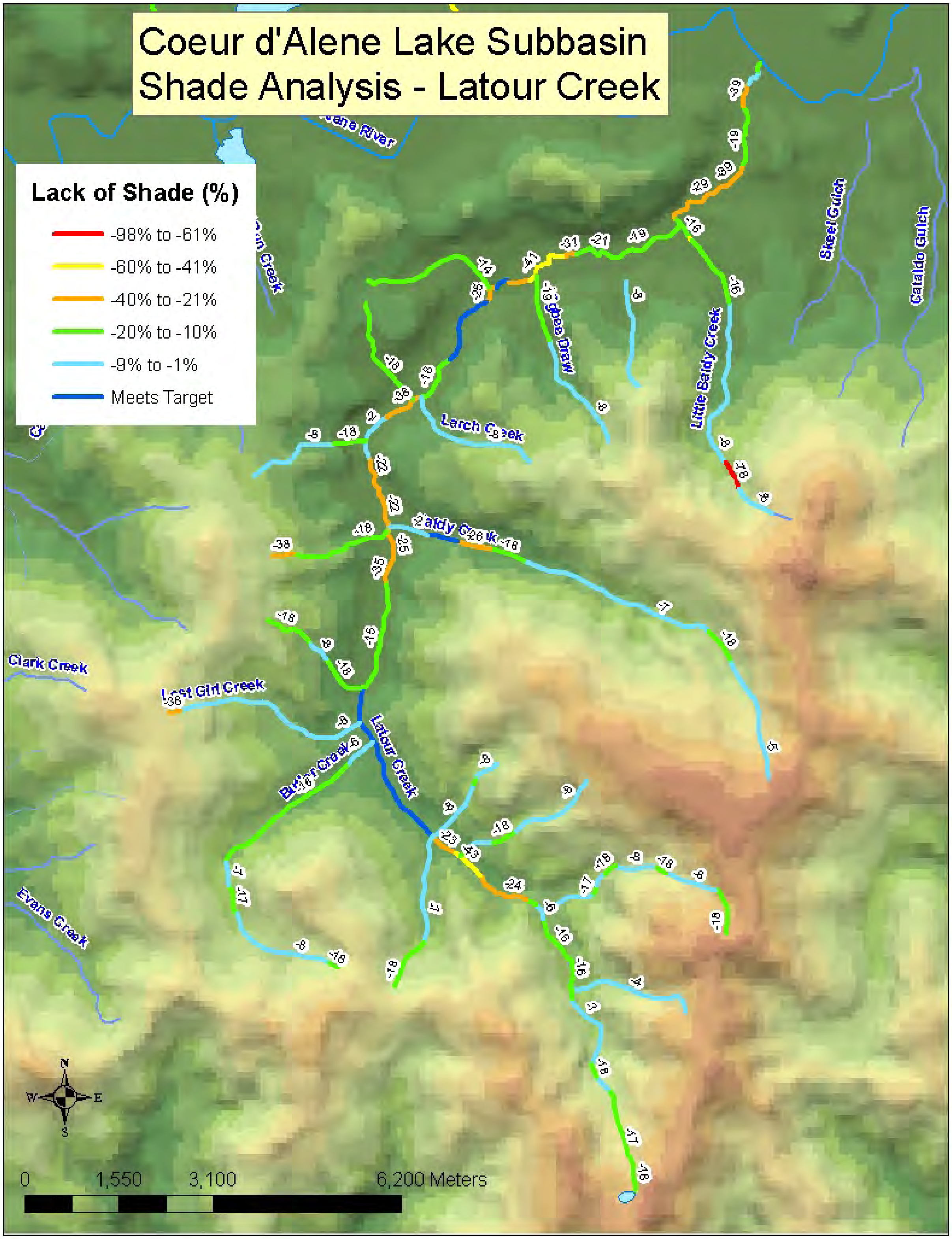

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Figure C-10. Target Shade for 4th of July Creek (ID17010303PN020_02 & _03) and Rose Creek (ID17010303PN021_02).

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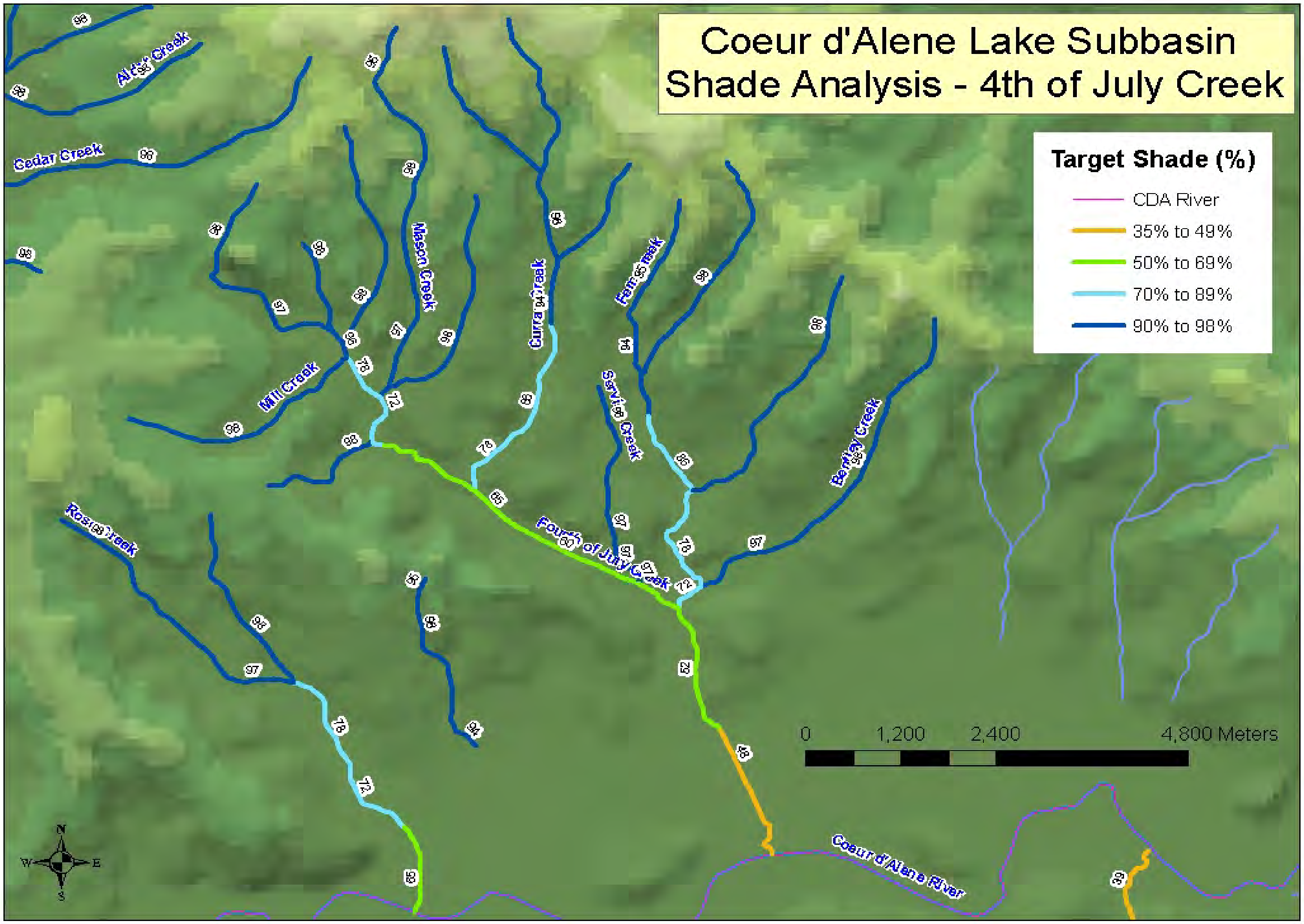

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Figure C-11. Existing Shade Estimated for 4th of July Creek (ID17010303PN020_02 & _03) and Rose Creek (ID17010303PN021_02).

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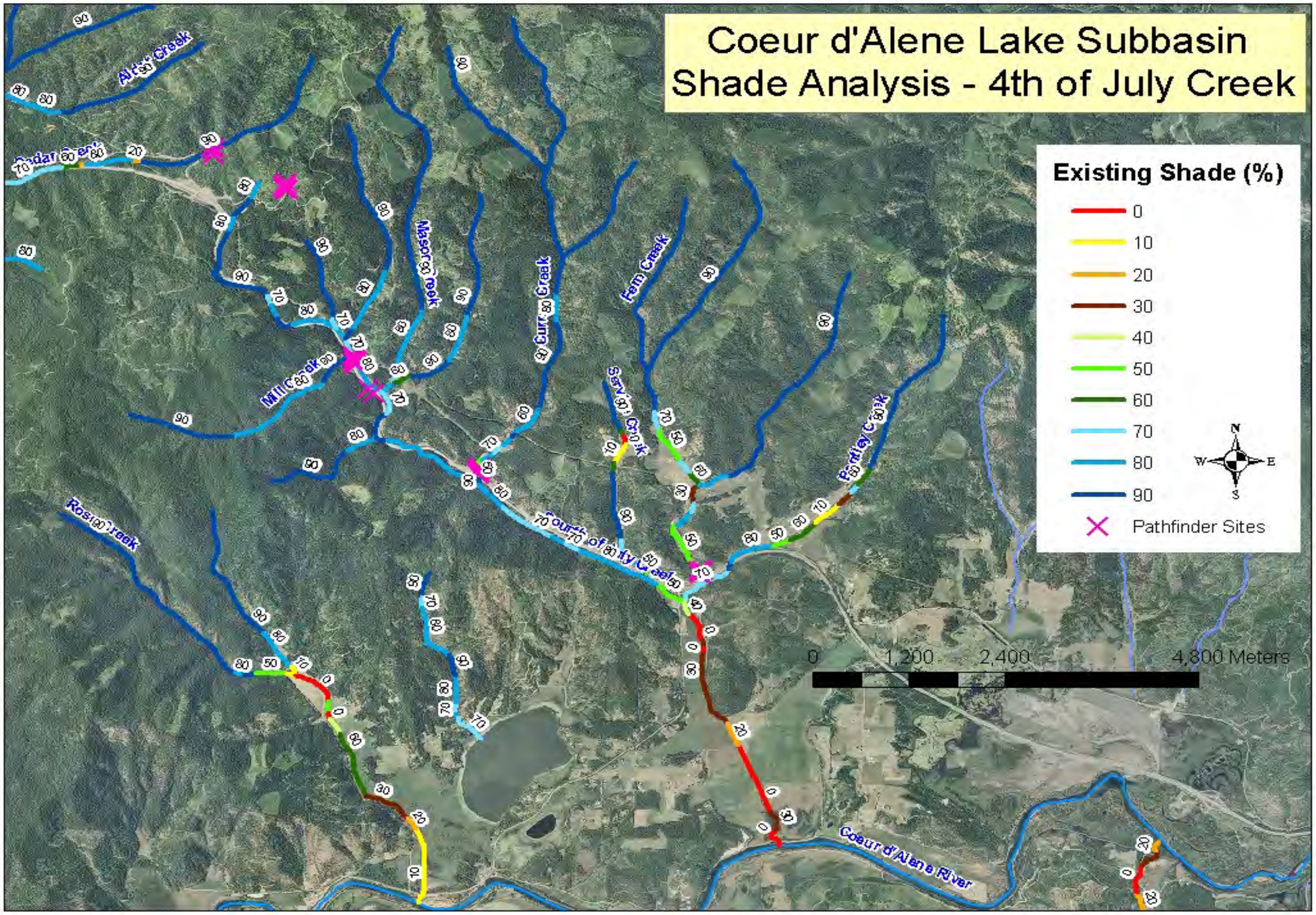
Coeur d'Alene Lake Subbasin
Shade Analysis - 4th of July Creek
Existing Shade (%)
0
10
20
30
40
50
60
70
80
90
Pathfinder Sites
0 1,200 2,400 4,800 Meters
N
S
E
W
Coeur d'Alene River
Mill Creek
Mason Creek
Curry Creek
Fern Creek
Bentley Creek
Rose Creek

Figure C-12. Lack of Shade (Difference Between Existing and Target) for 4th of July Creek (ID17010303PN020_02 & _03) and Rose Creek (ID17010303PN021_02).

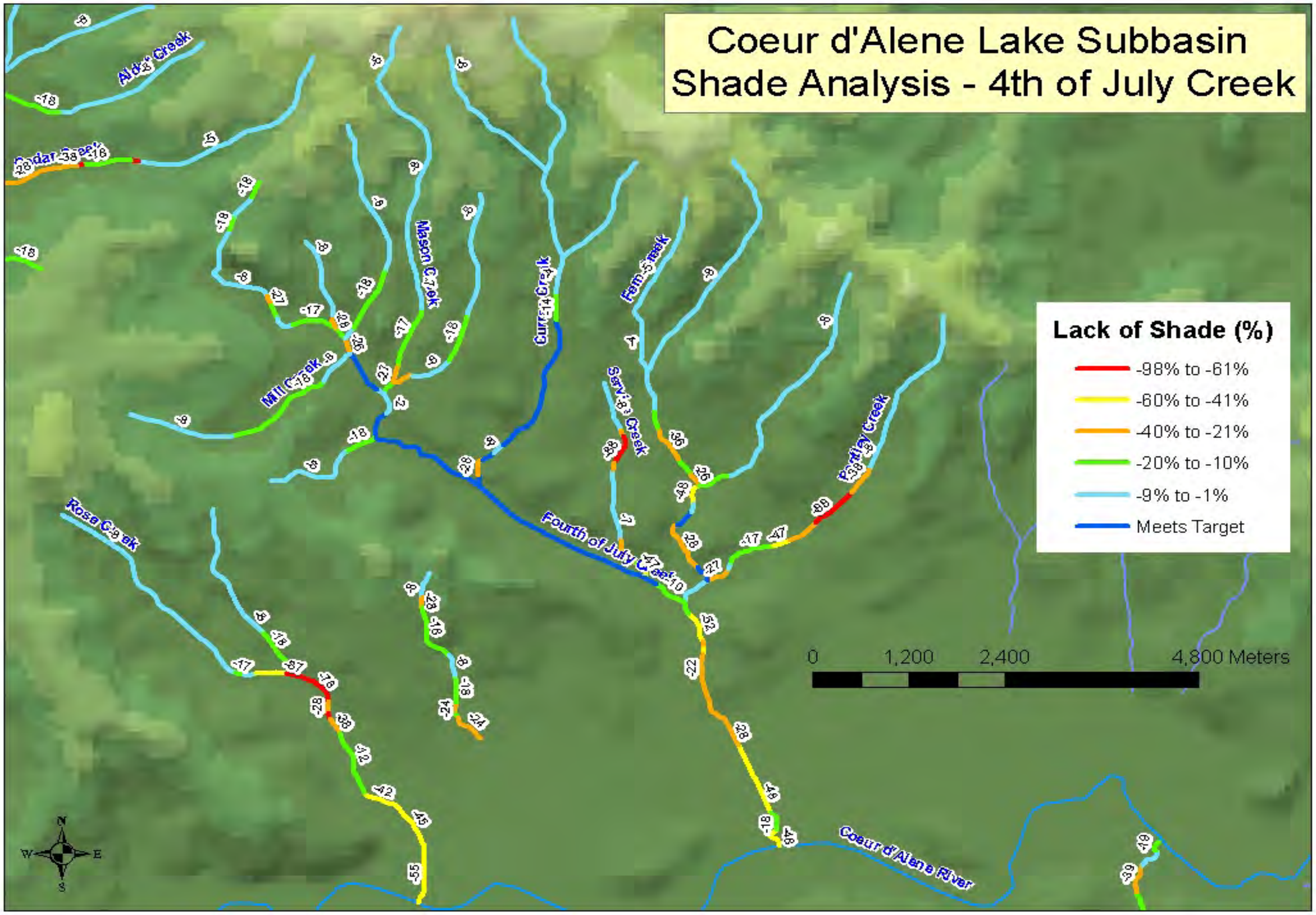

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Figure C-13. Target Shade for Killarney Tributaries (ID17010303PN022_02, Blue Lake Creek (ID17010303PN024_02) and Carlin Creek (ID17010303PN026_02).

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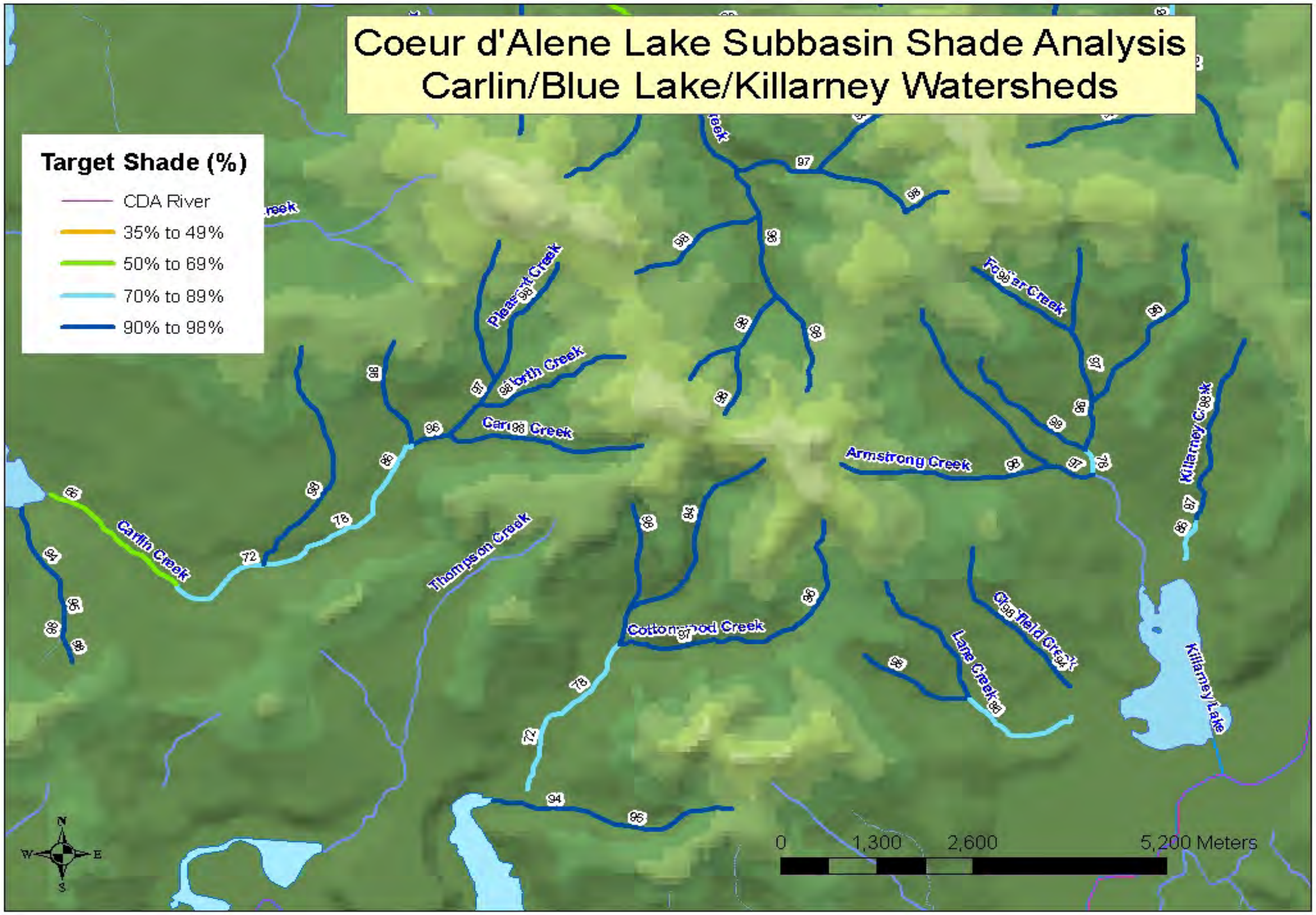

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Figure C-14. Existing Shade Estimated for Killarney Tributaries (ID17010303PN022_02, Blue Lake Creek (ID17010303PN024_02) and Carlin Creek (ID17010303PN026_02).

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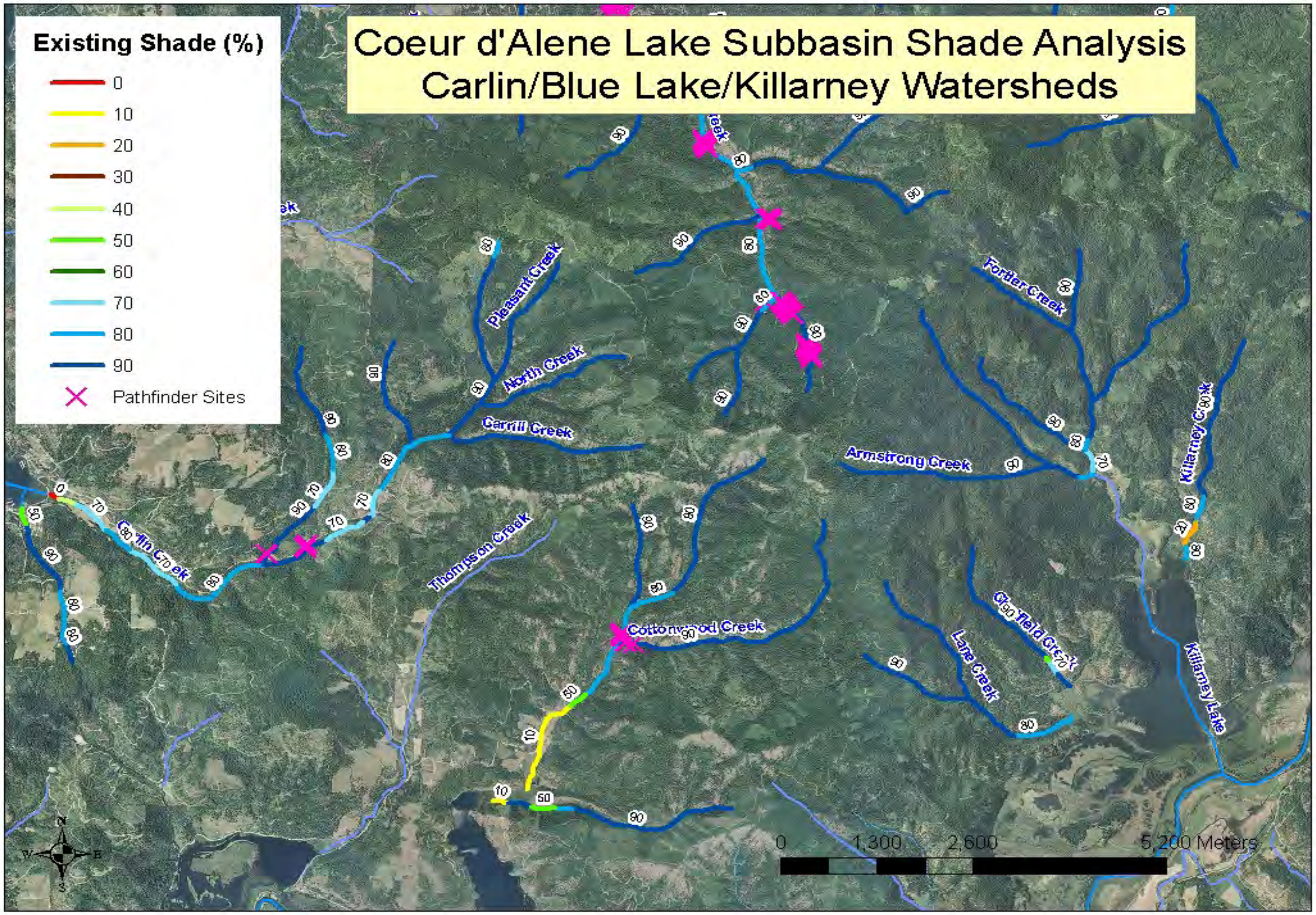

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Figure C-15. Lack of Shade (Difference Between Existing and Target) for Killarney Tributaries (ID17010303PN022_02, Blue Lake Creek (ID17010303PN024_02) and Carlin Creek (ID17010303PN026_02).

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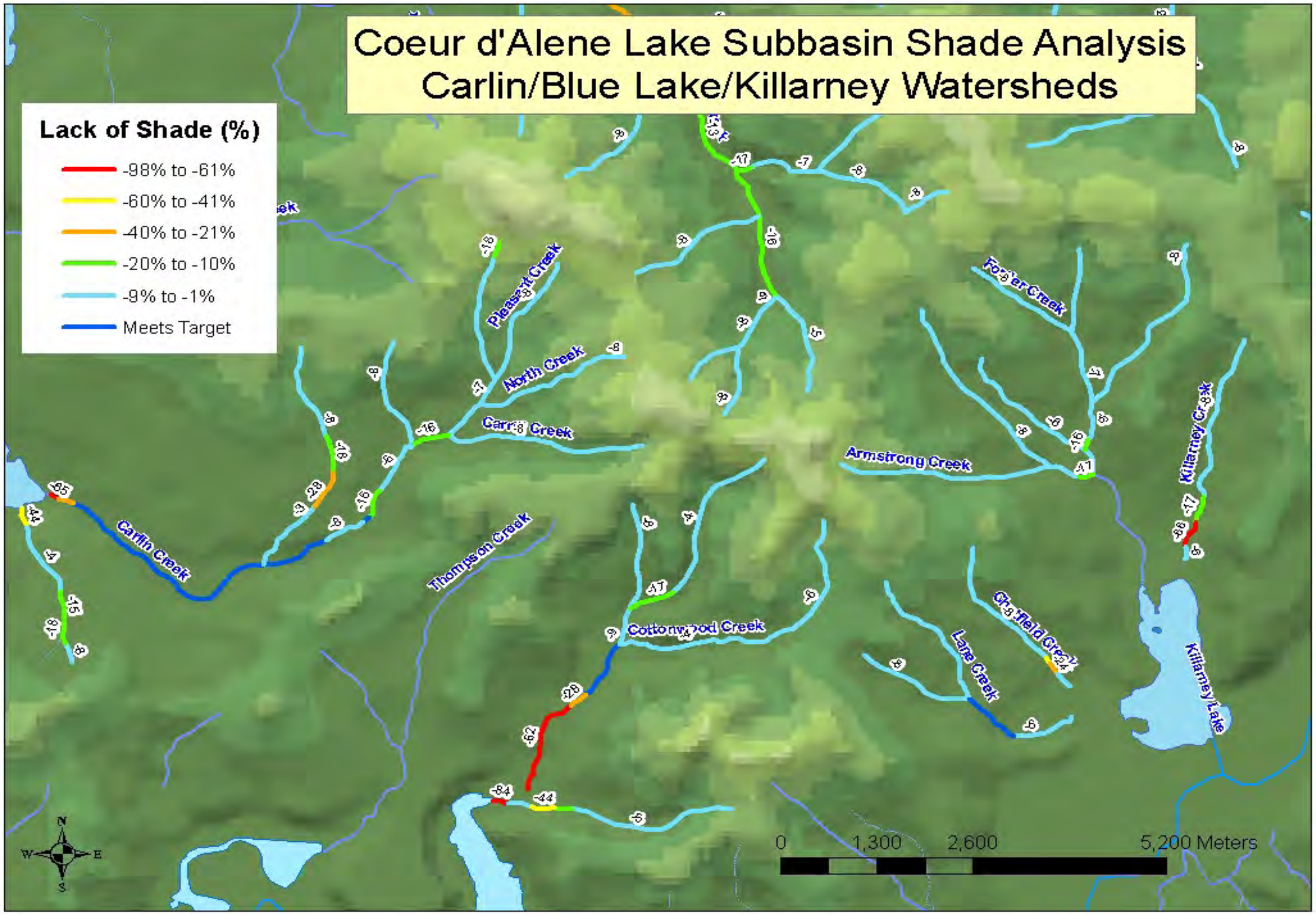

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Figure C-16. Target Shade for Beauty Creek (ID17010303PN028_02 & _03).

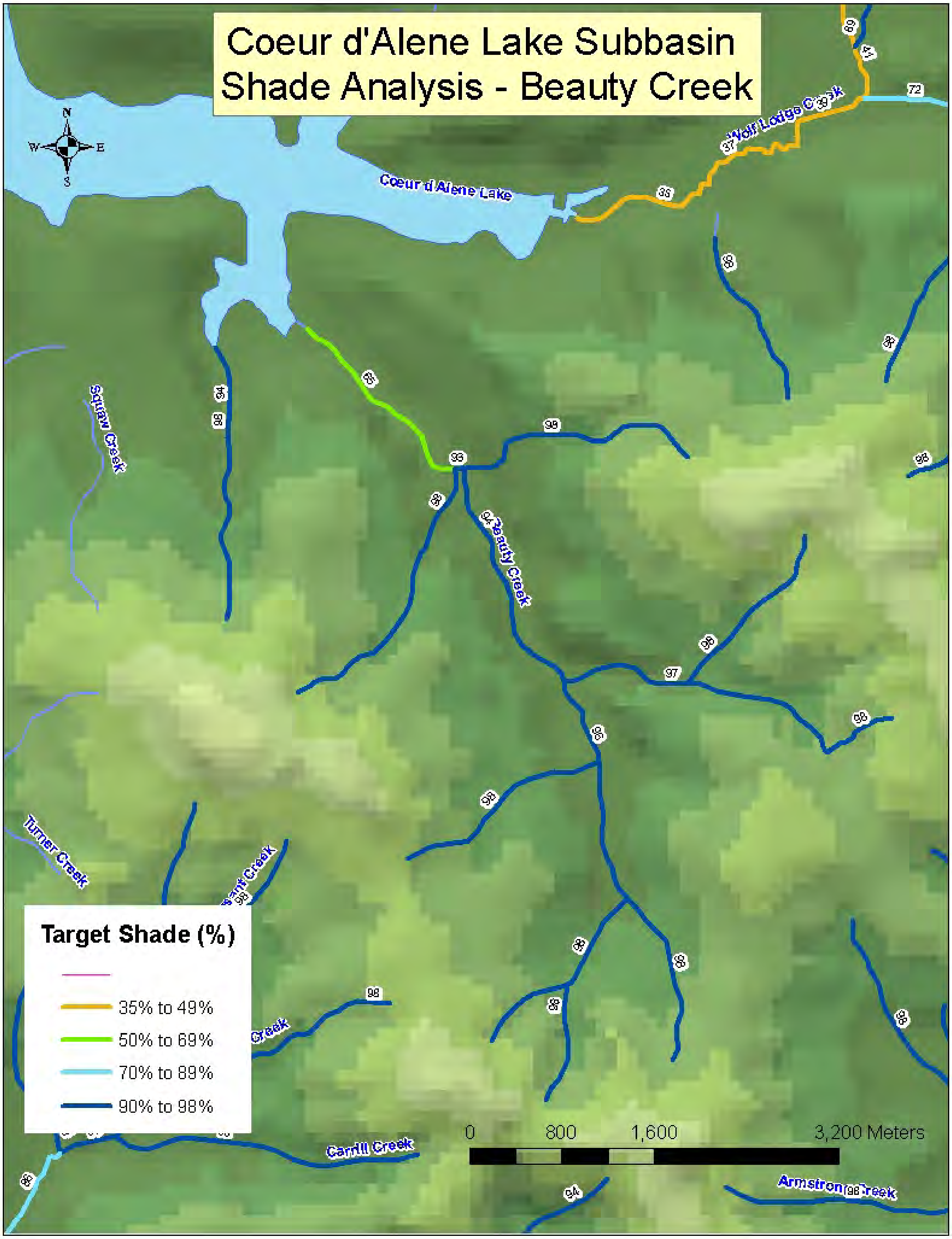

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Figure C-17. Existing Shade Estimated for Beauty Creek (ID17010303PN028_02 & _03).

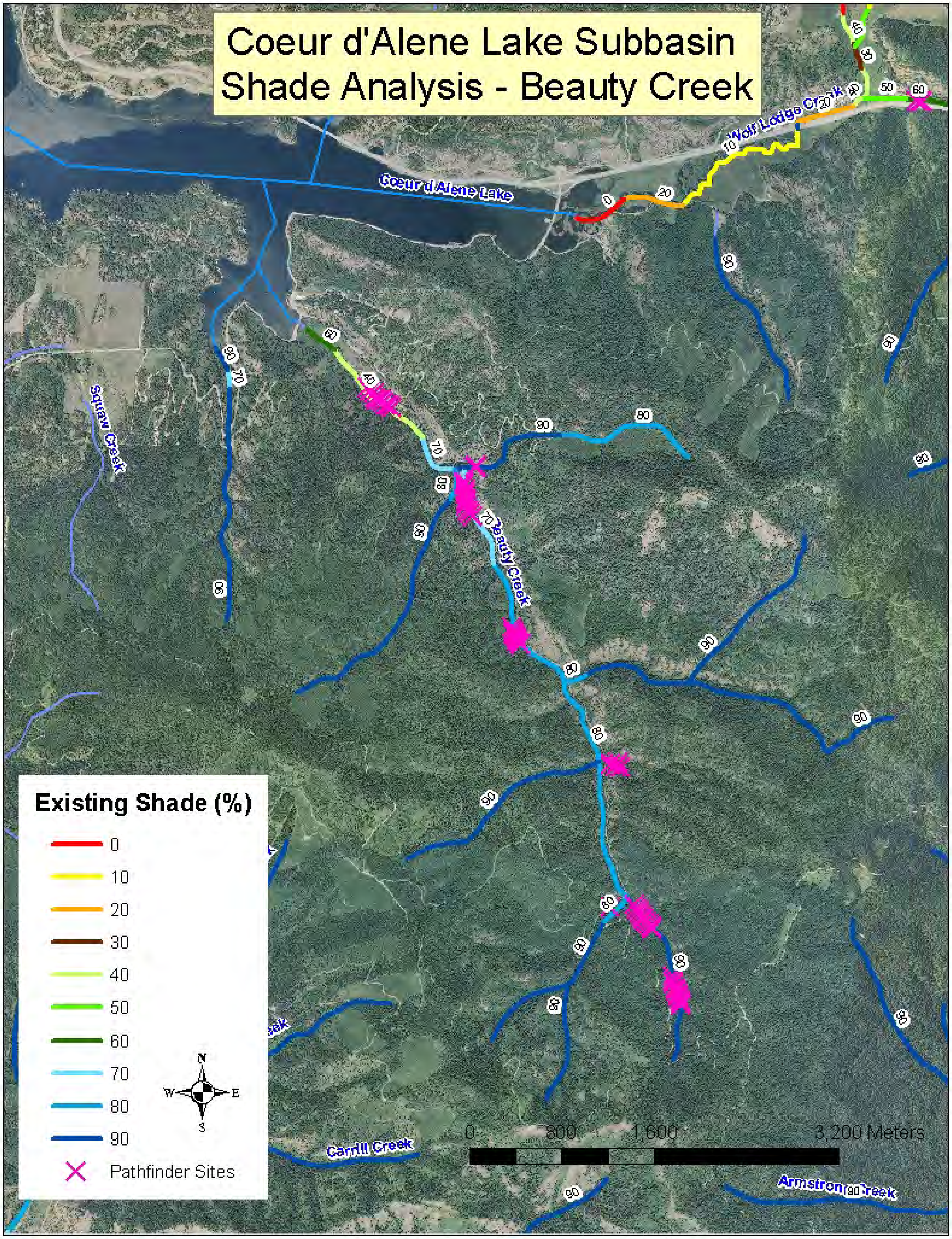

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Figure C-18. Lack of Shade (Difference Between Existing and Target) for Beauty Creek (ID17010303PN028_02 & _03).

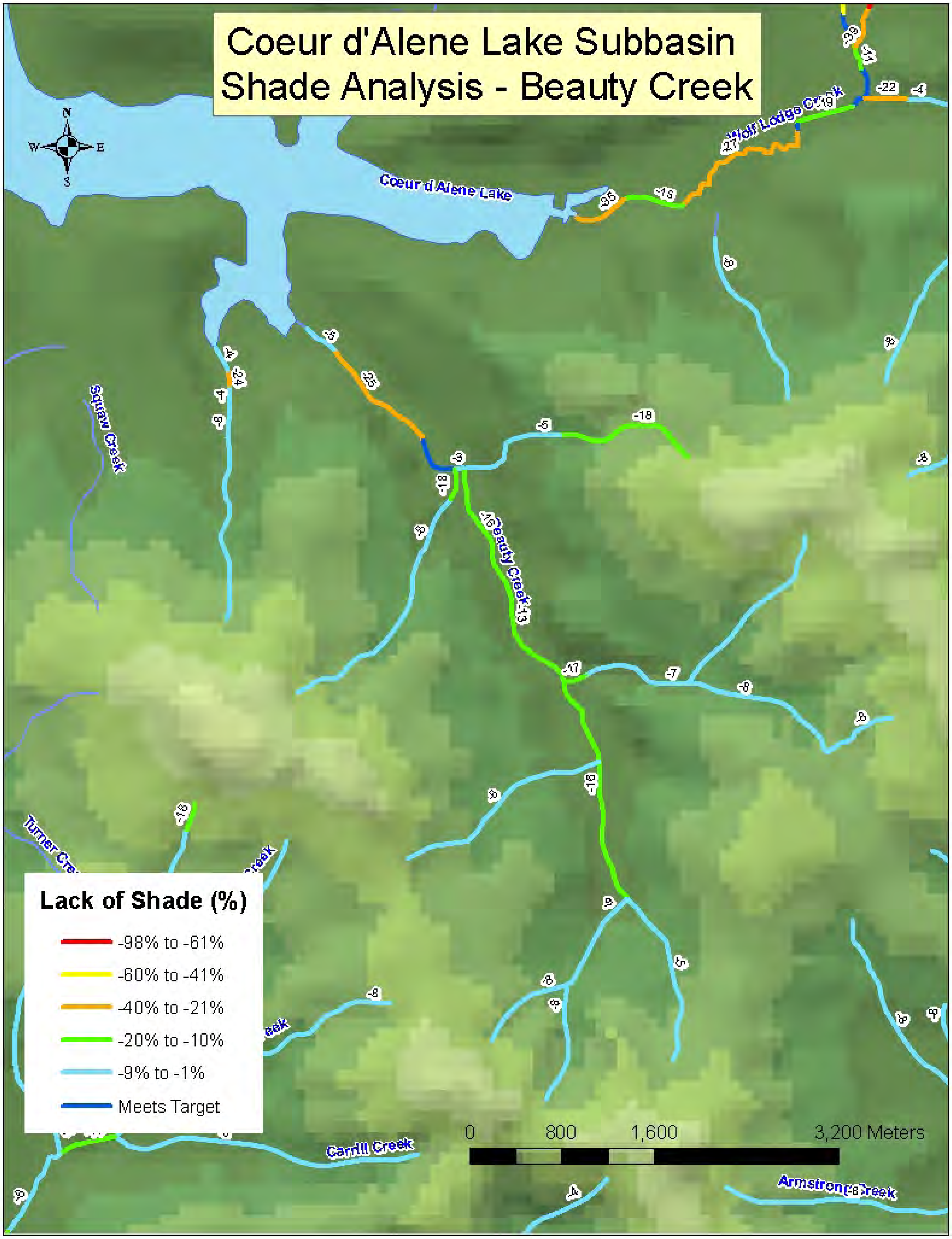

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Figure C-19. Target Shade for Upper Wolf Lodge Creek (ID17010303PN029_02 & _03) and Marie Creek (ID17010303PN031_02).

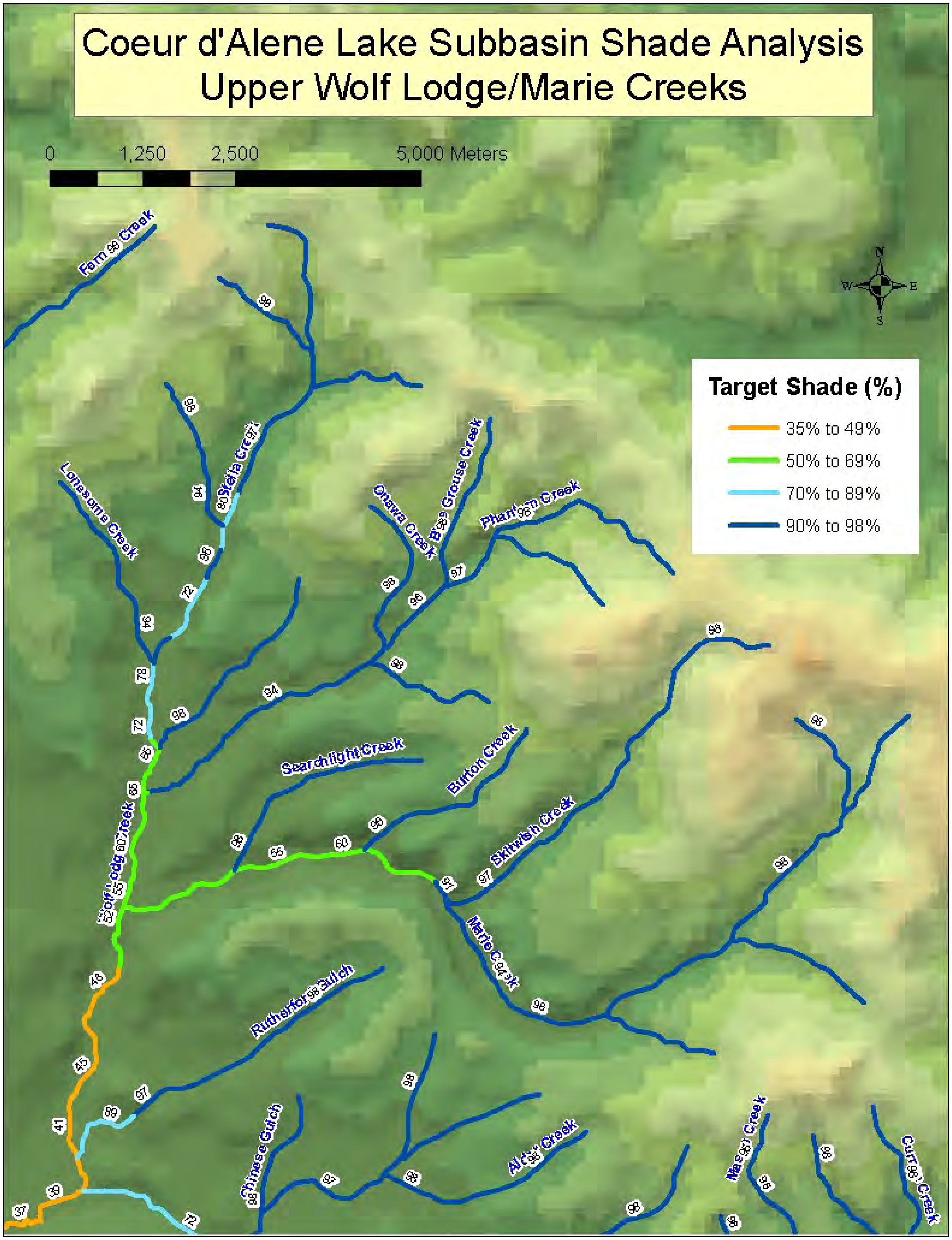

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Figure C-20. Existing Shade Estimated for Upper Wolf Lodge Creek (ID17010303PN029_02 & _03) and Marie Creek (ID17010303PN031_02).

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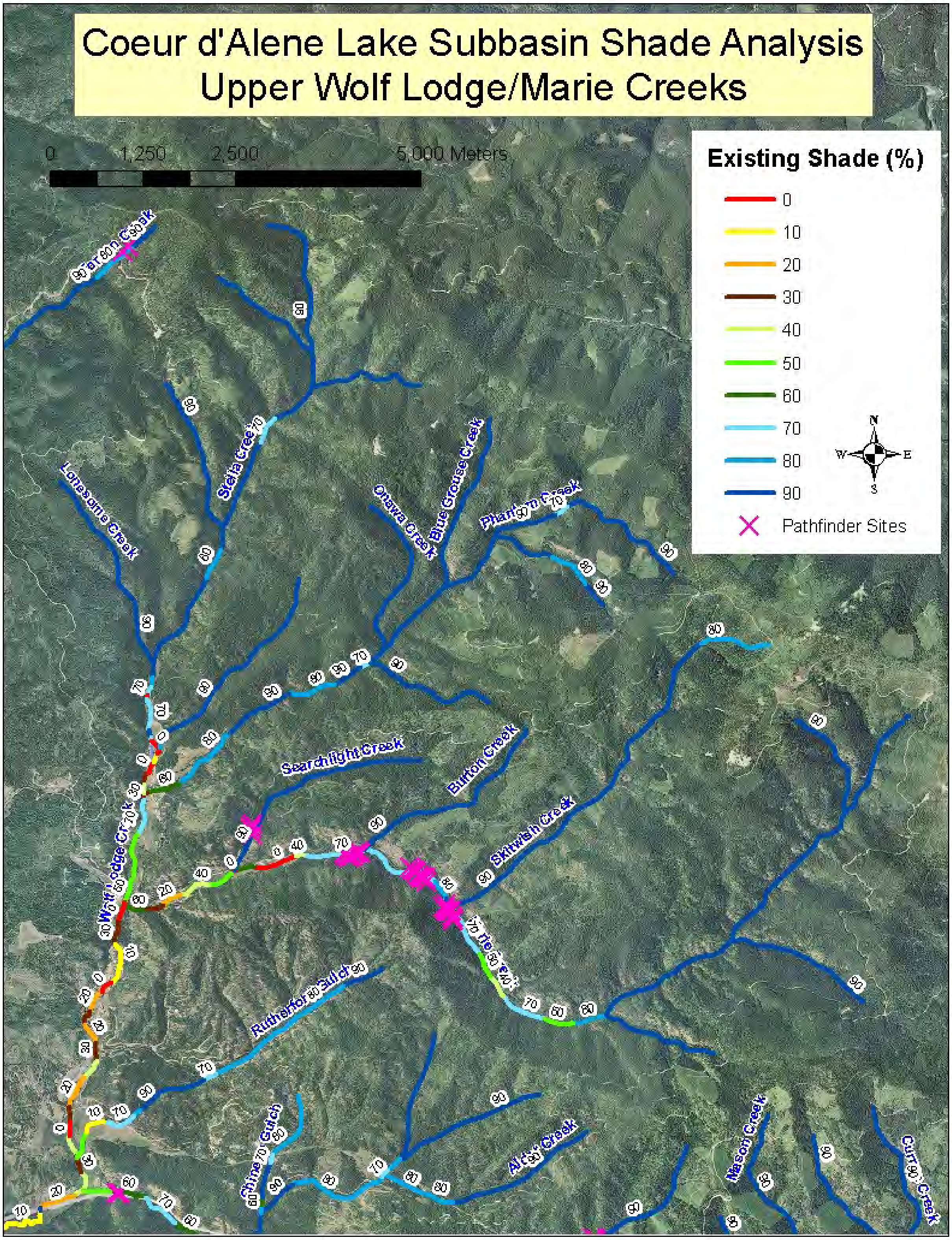

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Figure C-21. Lack of Shade (Difference Between Existing and Target) for Upper Wolf Lodge Creek (ID17010303PN029_02 & _03) and Marie Creek (ID17010303PN031_02).

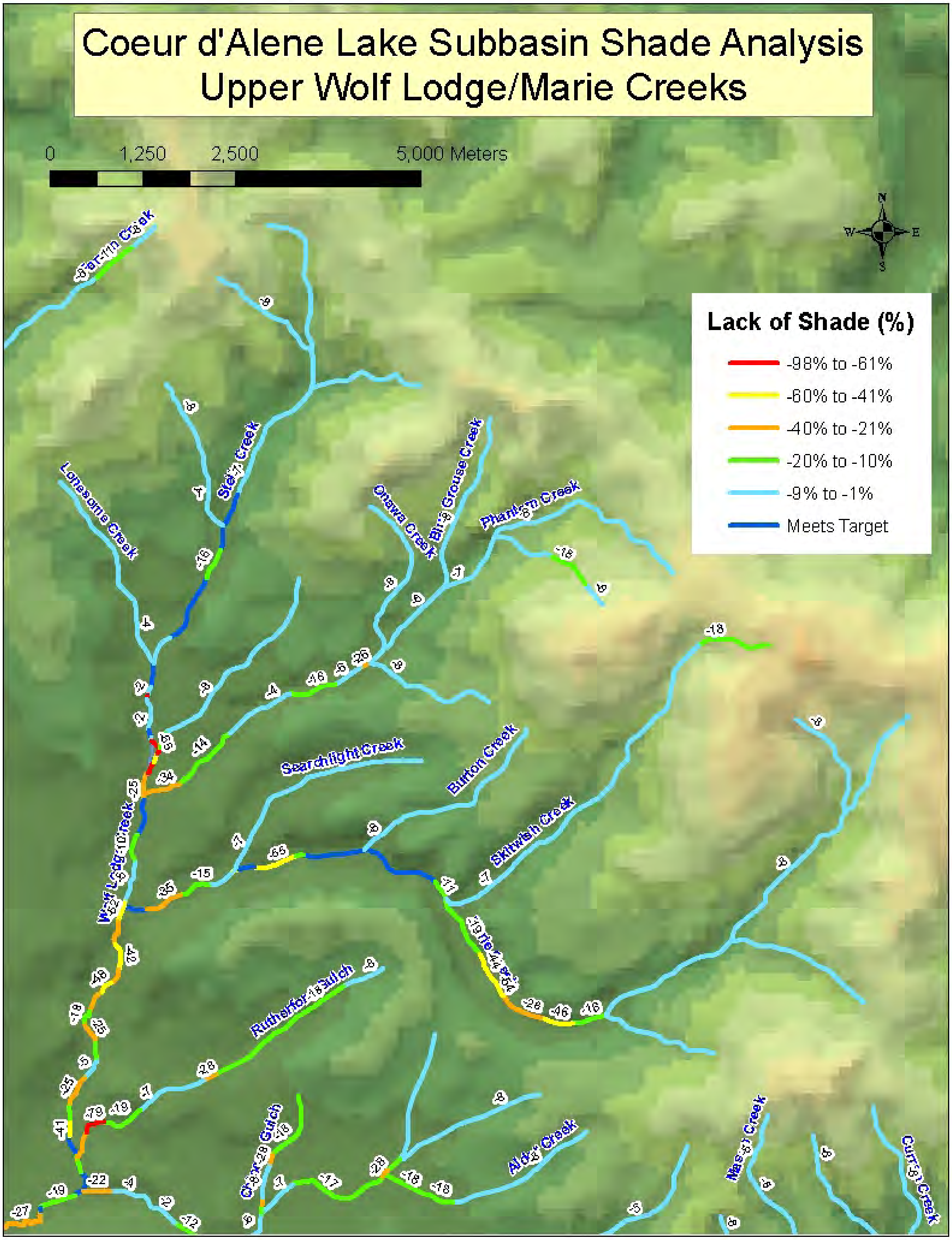

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Figure C-22. Target Shade for Lower Wolf Lodge Creek (ID17010303PN029_03) and Cedar Creek (ID17010303PN030_02 & _03).

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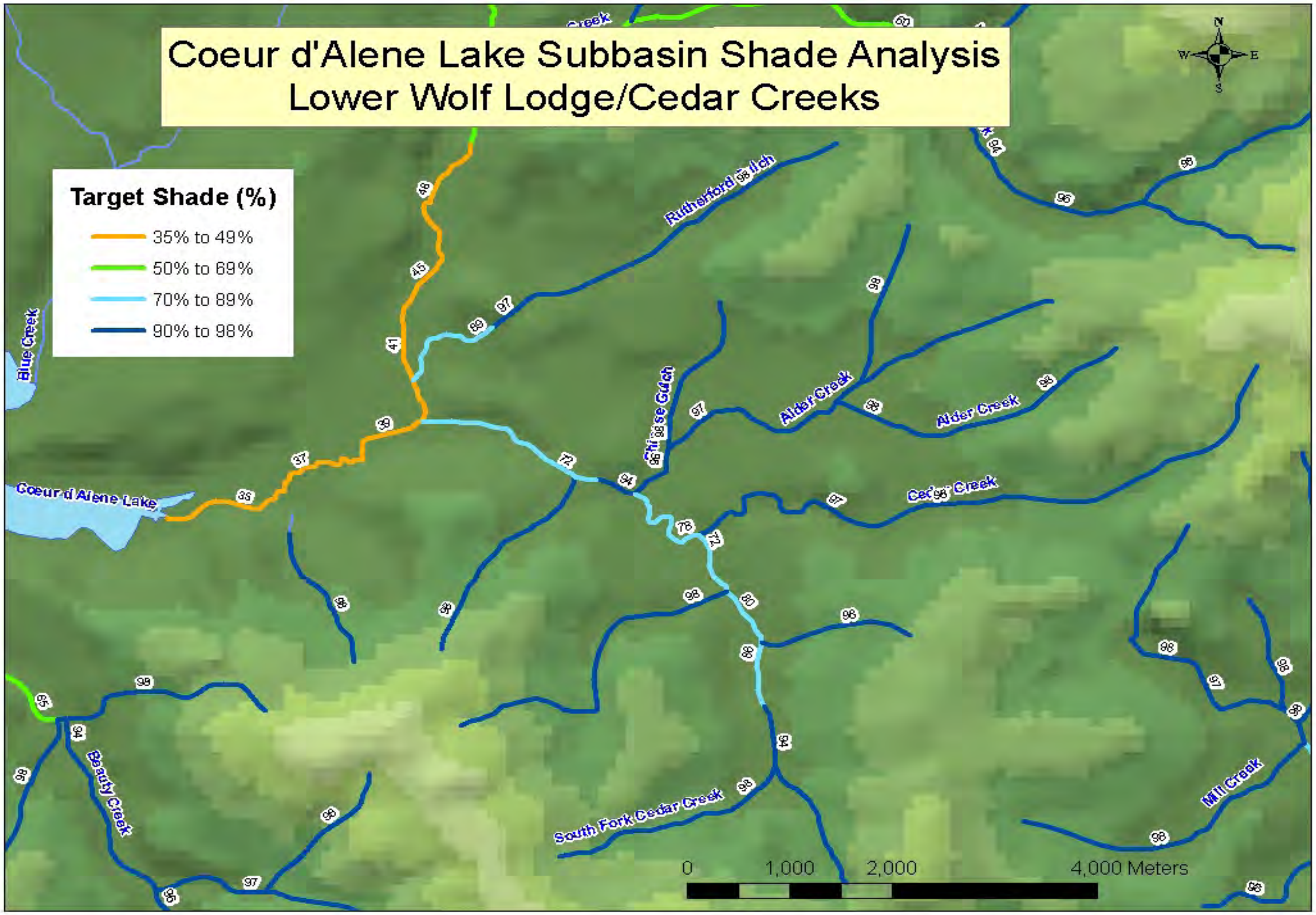

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Figure C-23. Existing Shade Estimated for Lower Wolf Lodge Creek (ID17010303PN029_03) and Cedar Creek (ID17010303PN030_02 & _03).

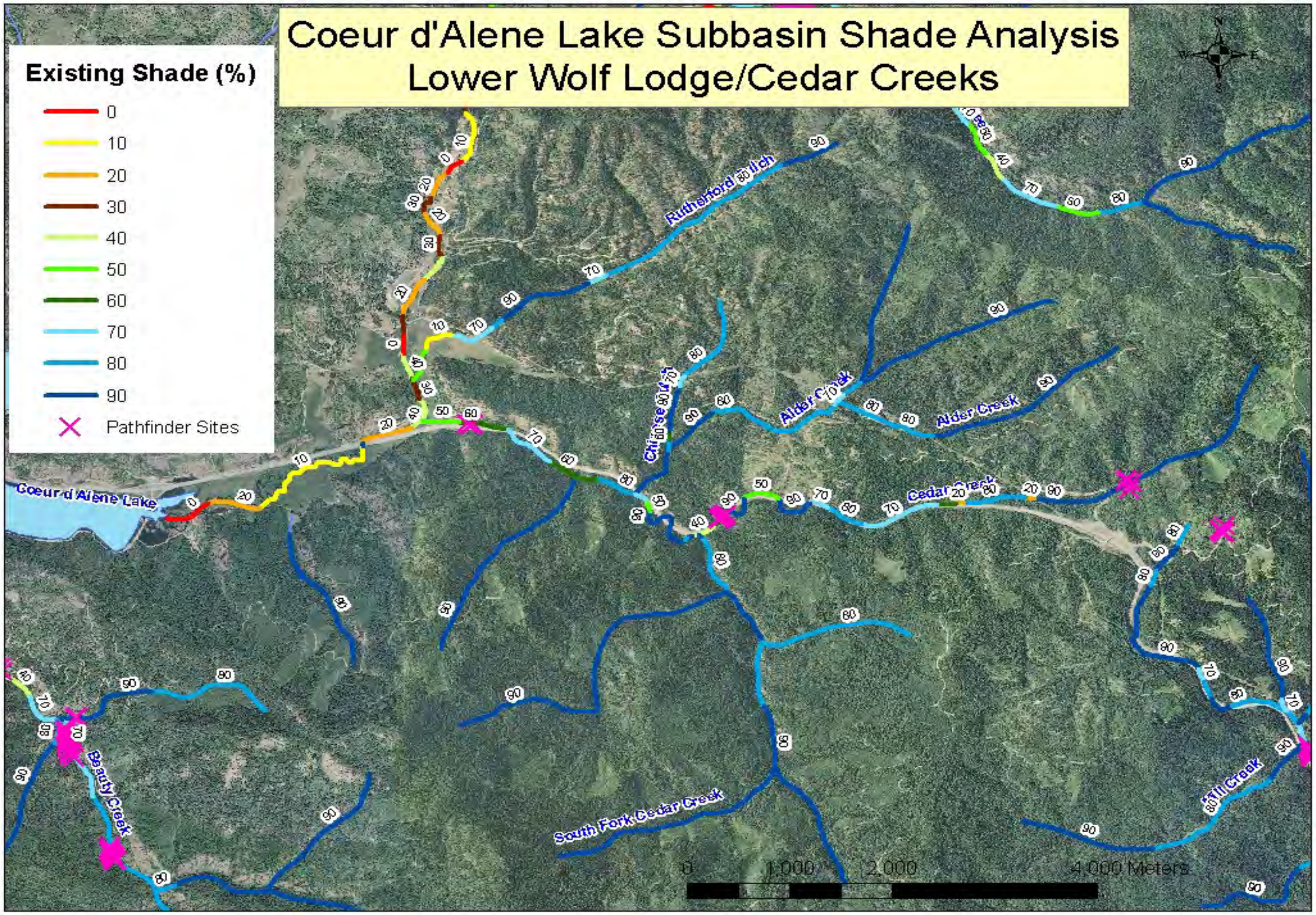

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Figure C-24. Lack of Shade (Difference Between Existing and Target) for Lower Wolf Lodge Creek (ID17010303PN029_03) and Cedar Creek (ID17010303PN030_02 & _03).

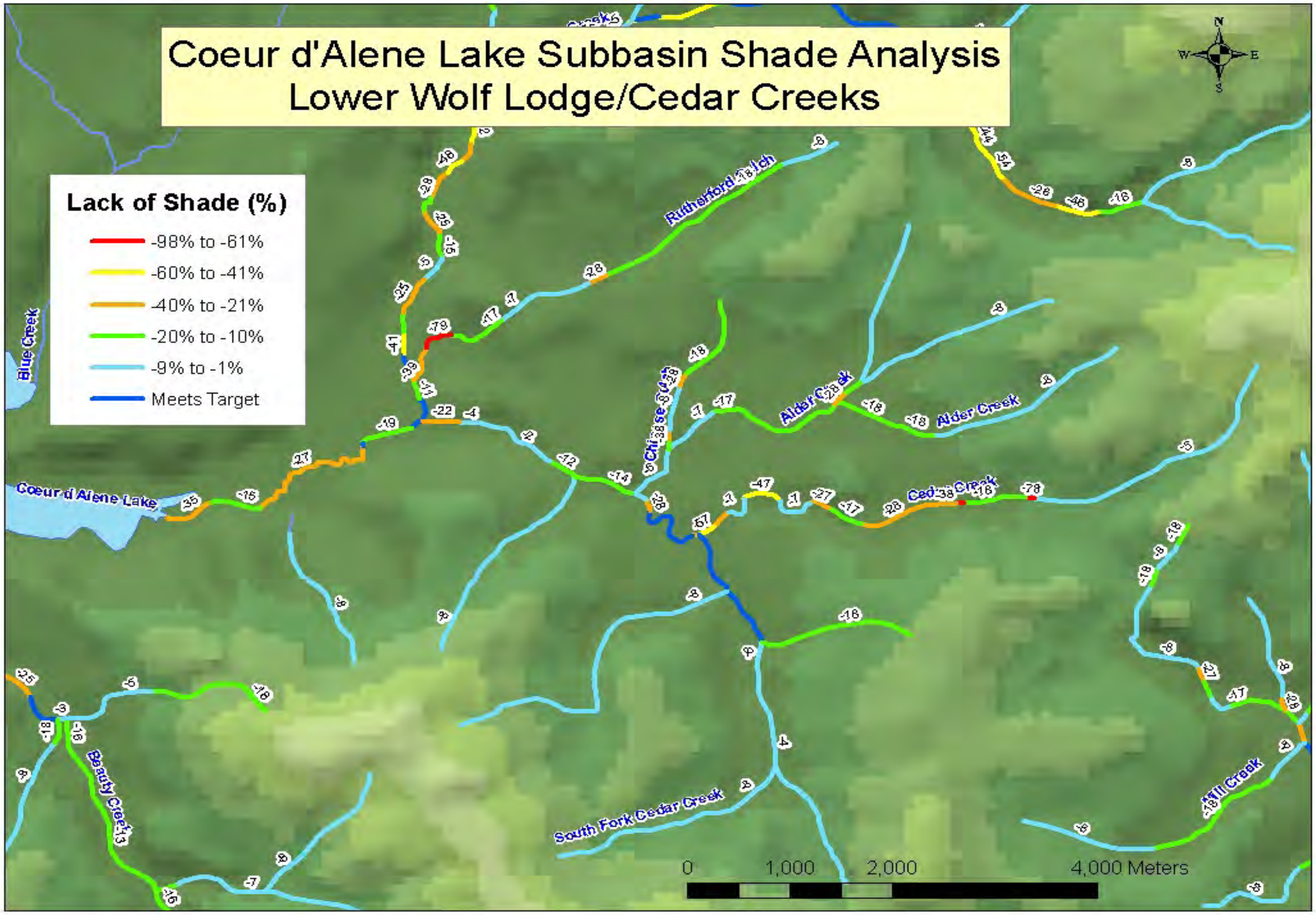

Figure C-25. Target Shade for Fernan Creek (ID17010303PN034_02 & _02a & _03 & ID17010303PN032_03).

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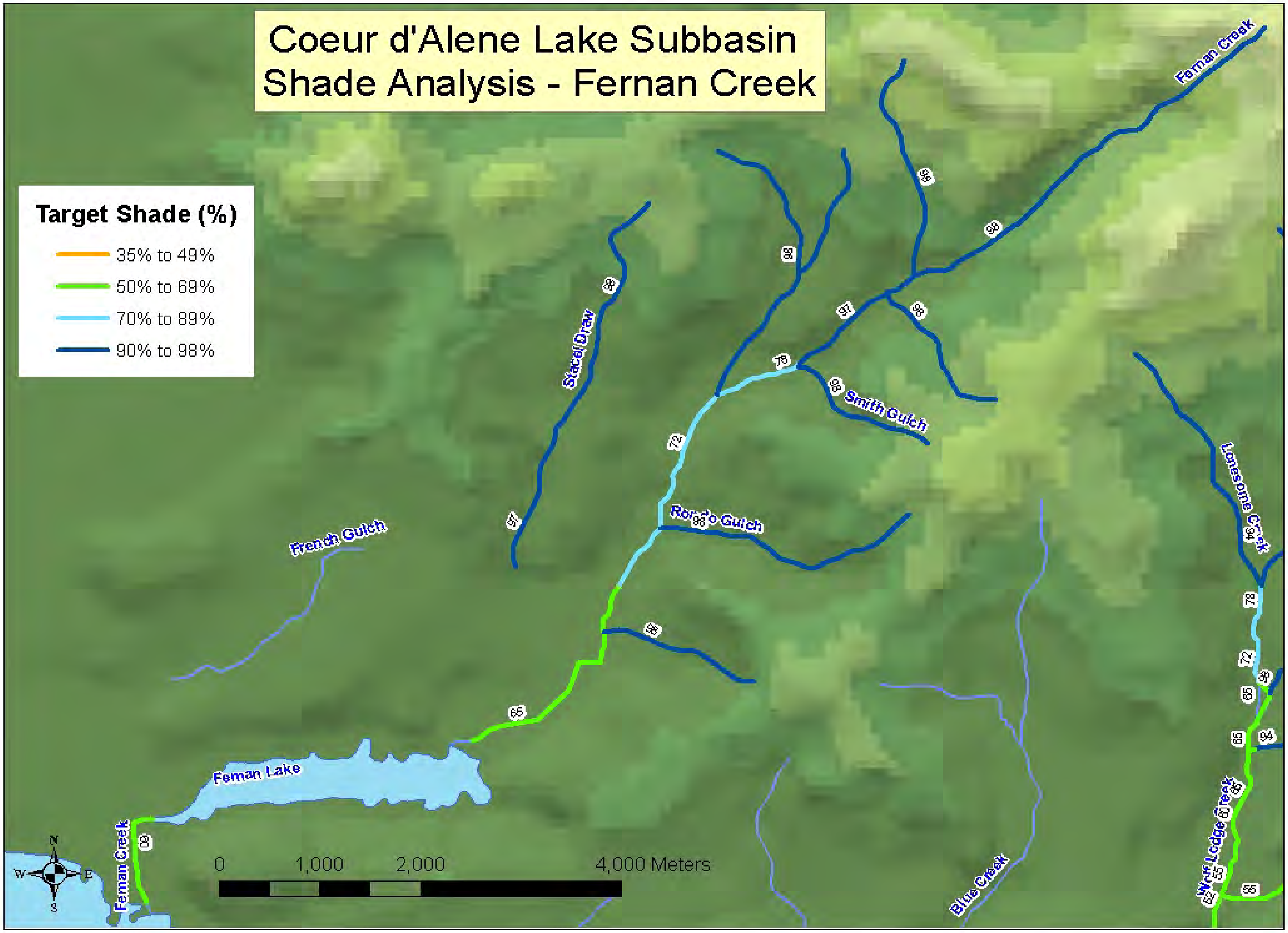

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Figure C-26. Existing Shade Estimated for Fernan Creek (ID17010303PN034_02 & _02a & _03 & ID17010303PN032_03).

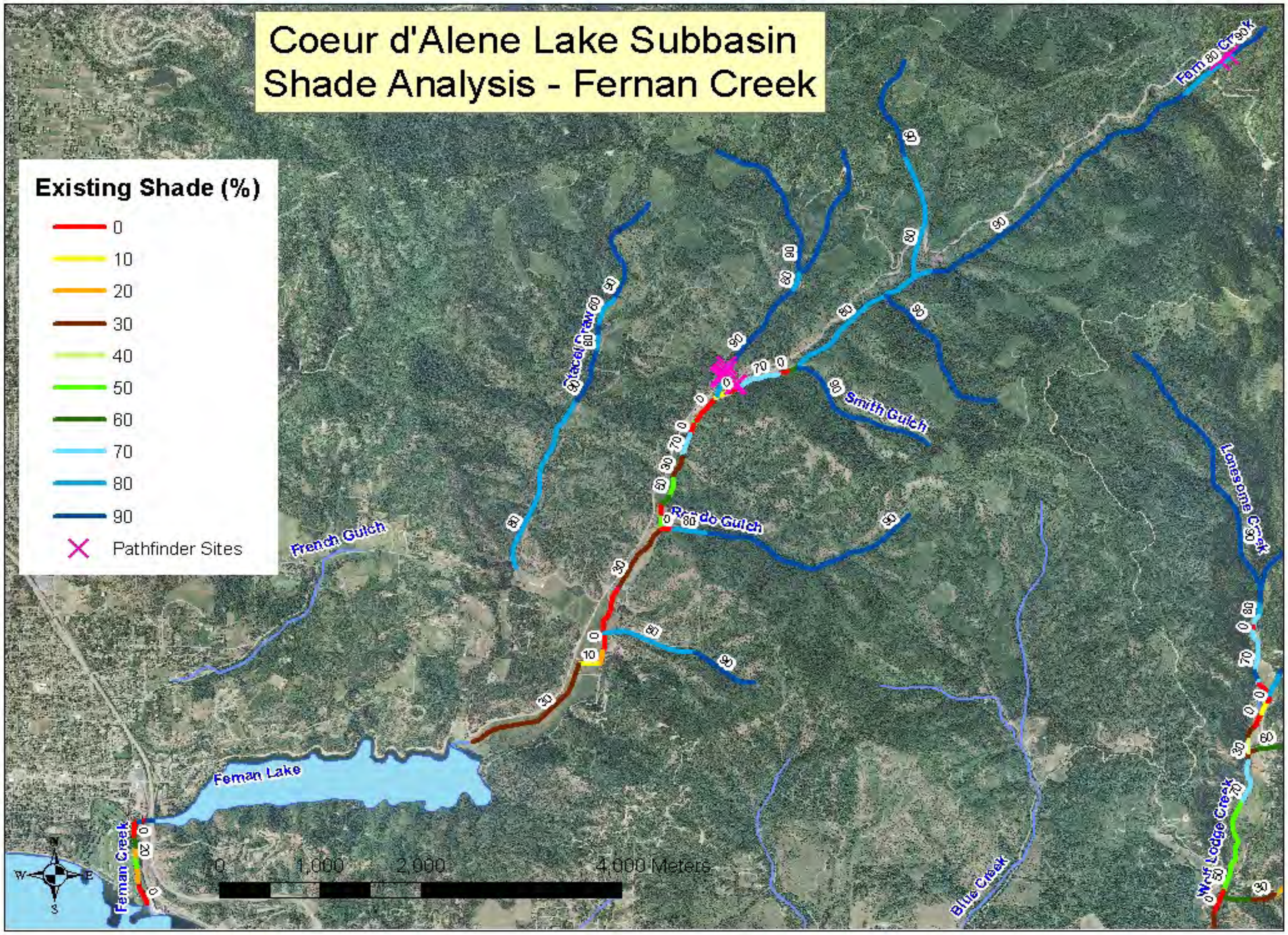

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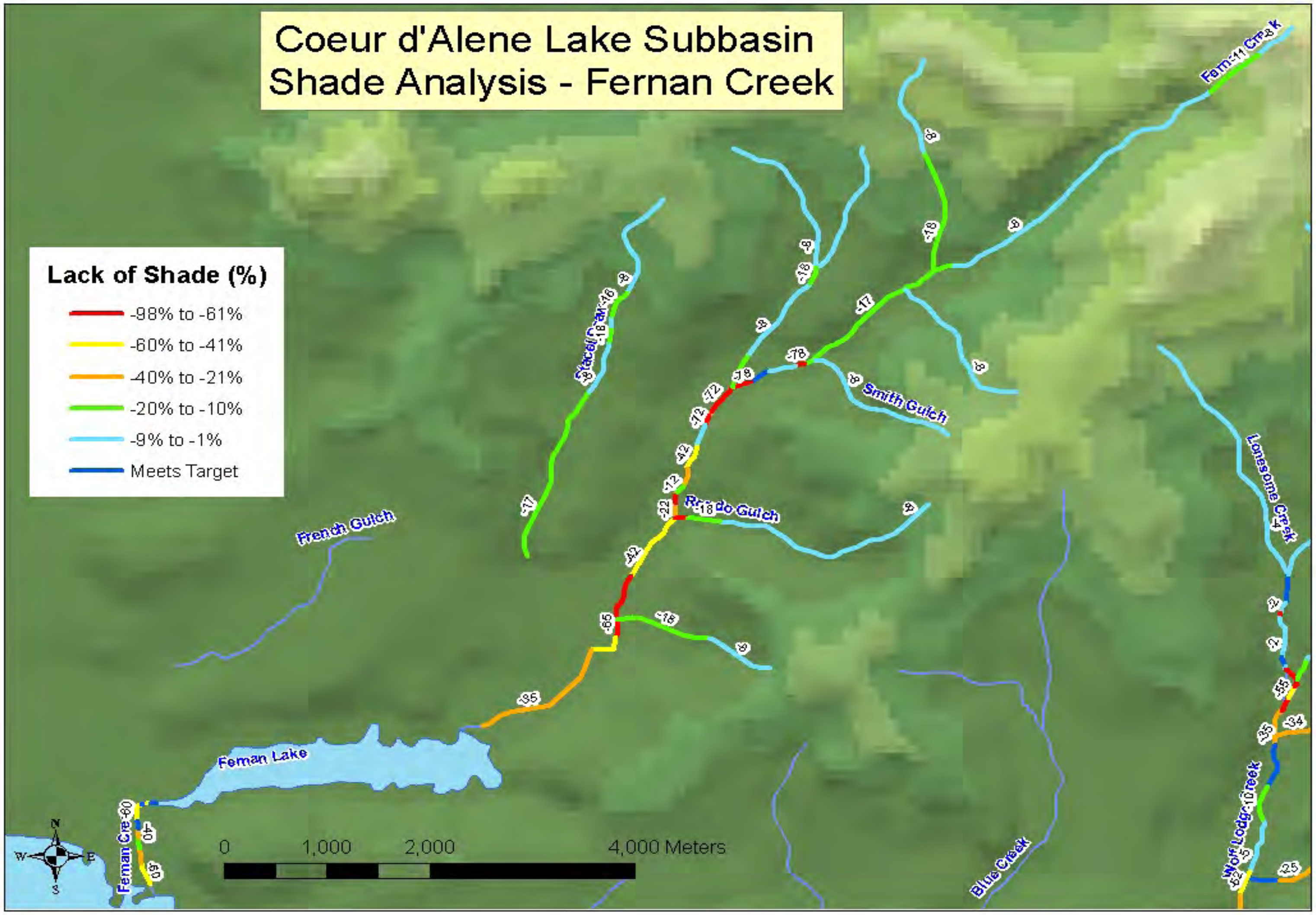
Figure C-27. Lack of Shade (Difference Between Existing and Target) for Fernan Creek (ID17010303PN034_02 & _02a & _03 & ID17010303PN032_03).



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Appendix D. Distribution List

Appendix E. Public Comments

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