# Lochsa River Subbasin Temperature Total Maximum Daily Loads:

## Addendum to the Lochsa River Subbasin Assessment

**Draft**

**State of Idaho**
**Department of Environmental Quality**

**November 2011**

# Lochsa River Subbasin Temperature Total Maximum Daily Loads

**November 2011**

**Prepared by:**
**State Technical Services Office**
**Department of Environmental Quality**
**1410 N. Hilton**
**Boise, ID 83706**

*This page intentionally left blank for correct double-sided printing.*

# Acknowledgments

Cover photo: Brushy Fork (2010), courtesy Jason Fales (Idaho Department of Environmental Quality).

*This page intentionally left blank for correct double-sided printing.*

# Table of Contents

# List of Tables

# List of Figures



# List of Appendices

# 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 |
| **CGP** | Construction General Permit |
| **CNF** | Clearwater National Forest |
| **CWA** | Clean Water Act |
| **DEQ** | Department of Environmental Quality |
| **EPA** | United States Environmental Protection Agency |
| **IDAPA** | Refers to citations of Idaho administrative rules |
| **kWh** | kilowatt-hour |
| **LA** | load allocation |
| **LC** | load capacity |
| **m** | meter |
| **mi** | mile |
| **MOS** | margin of safety |
| **NB** | natural background |
| **NPDES** | National Pollutant Discharge Elimination System |
| **NREL** | National Renewable Energy Laboratory |
| **PNV** | potential natural vegetation |
| **SWPPP** | Stormwater Pollution Prevention Plan |
| **TMDL** | total maximum daily load |
| **US** | United States |
| **U.S.C.** | United States Code |
| **WLA** | wasteload allocation |

*This page intentionally left blank for correct double-sided printing.*

# Executive Summary

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to Section 303 of the CWA, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the 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 and is included as the list of Category 5 waters in the Integrated Report. For waters identified on this list, states and tribes must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve water quality standards.

This document addresses water bodies in 37 assessment units (AUs) of the Lochsa River subbasin that have been placed on Idaho's current §303(d) list (i.e., the 2010 Integrated Report [DEQ 2011]) or are contributory waters to a major river requiring a temperature TMDL. This document only addresses the temperature TMDLs for these AU. For more information about these watersheds and the subbasin as a whole, see the *Lochsa River Subbasin Assessment* (DEQ 1999).

This TMDL analysis has been developed to comply with Idaho's TMDL requirements. The TMDL analysis quantifies pollutant sources and allocates responsibility for load reductions needed to return listed waters to a condition meeting water quality standards.

## Subbasin at a Glance

The Lochsa River subbasin (hydrologic unit code 17060303) is located in the northern portion of Idaho County east of Lewiston, Idaho, and west of Missoula, Montana. The Lochsa River, along with the Selway River, forms the headwaters of the Middle Fork Clearwater River. Listed on the Idaho 2010 §303(d) list for temperature pollution were the Lochsa River (6 AUs), lower tributaries to the Lochsa River (AU# ID17060303CL001_02), Boulder Creek (AU# ID17060303CL010_02 and 04), Storm Creek (AU# ID17060303CL032_03), Fish Creek (AU# ID17060303CL052_02, 03, and 04; ID17060303CL057_02 and 03), Deadman Creek (AU# ID17060303CL061_02), Canyon Creek (AU# ID17060303CL062_03), Pete King Creek (AU# ID17060303CL063_02 and 03), and Walde Creek (AU# ID17060303CL064_02)—20 AUs total (DEQ 2011).

The Idaho Department of Environmental Quality (DEQ) and US Environmental Protection Agency (EPA) performed a natural conditions evaluation of 6th-order watersheds in the Lochsa River subbasin. This evaluation looked at a number of disturbance variables including road density, stream crossings, and streamside harvest miles. Of these watersheds, 14 failed the natural conditions evaluation because of the extent of harvest and road activities within them. Of the 20 AUs listed for temperature as described above, it was determined that Boulder Creek (2 AUs), Storm Creek (1 AU), and Fish Creek (5 AUs) were not among the 14 disturbed watersheds. No temperature

TMDLs were completed for these 8 AUs. However, 6 listed AUs (lower Lochsa River tributaries, Deadman Creek, Canyon Creek, Pete King Creek, and Walde Creek) were among the 14 disturbed watersheds. DEQ has decided to include temperature TMDLs for an additional 31 AUs in the remaining portions of the 14 disturbed watersheds as potential sources of heat to the Lochsa River. The resulting 37 tributary AUs with temperature TMDLs included in this document are presented in Table A and Figure A. The temperature TMDLs for the 6 AUs representing the Lochsa River itself are by default the TMDLs for the 37 tributary AUs. The tributaries represent the source of the impact-related heat load to the river. Direct solar load to the river itself is considered at natural background levels in this context.

**Table A. Tributary watersheds for which temperature TMDLs were developed.**

| Watershed | Assessment Units |
|---|---|
| Pete King Creek | **063_02, 063_03, 064_02** |
| Canyon Creek | 062_02, **062_03** |
| Deadman Creek | 059_02, 059_03, 060_02, **061_02**, 060_03 |
| Lower Small Tributaries | **001_02** |
| Post Office Creek | 048_02, 048_03 |
| Squaw Creek | 045_02, 045_03, 046_02, 047_02 |
| Badger/Wendover Creeks | 044_02, 043_02 |
| Papoose Creek | 041_02, 041_03, 042_02 |
| Walton/Cliff Creeks | 023_02, 022_02, 020_02a |
| Crooked Fork | 034_05, 038_04, 034_02, 038_02 |
| Colt Killed Creek (White Sand) | 024_02, 024_04, 033_02 |
| Brushy Fork | 035_02, 035_03, 035_04 |
| Upper Brushy Fork | 037_02 |
| Spruce Creek | 036_02 |

*Note:* AUs in bold font are §303(d) listed as of 2010 (DEQ 2011).

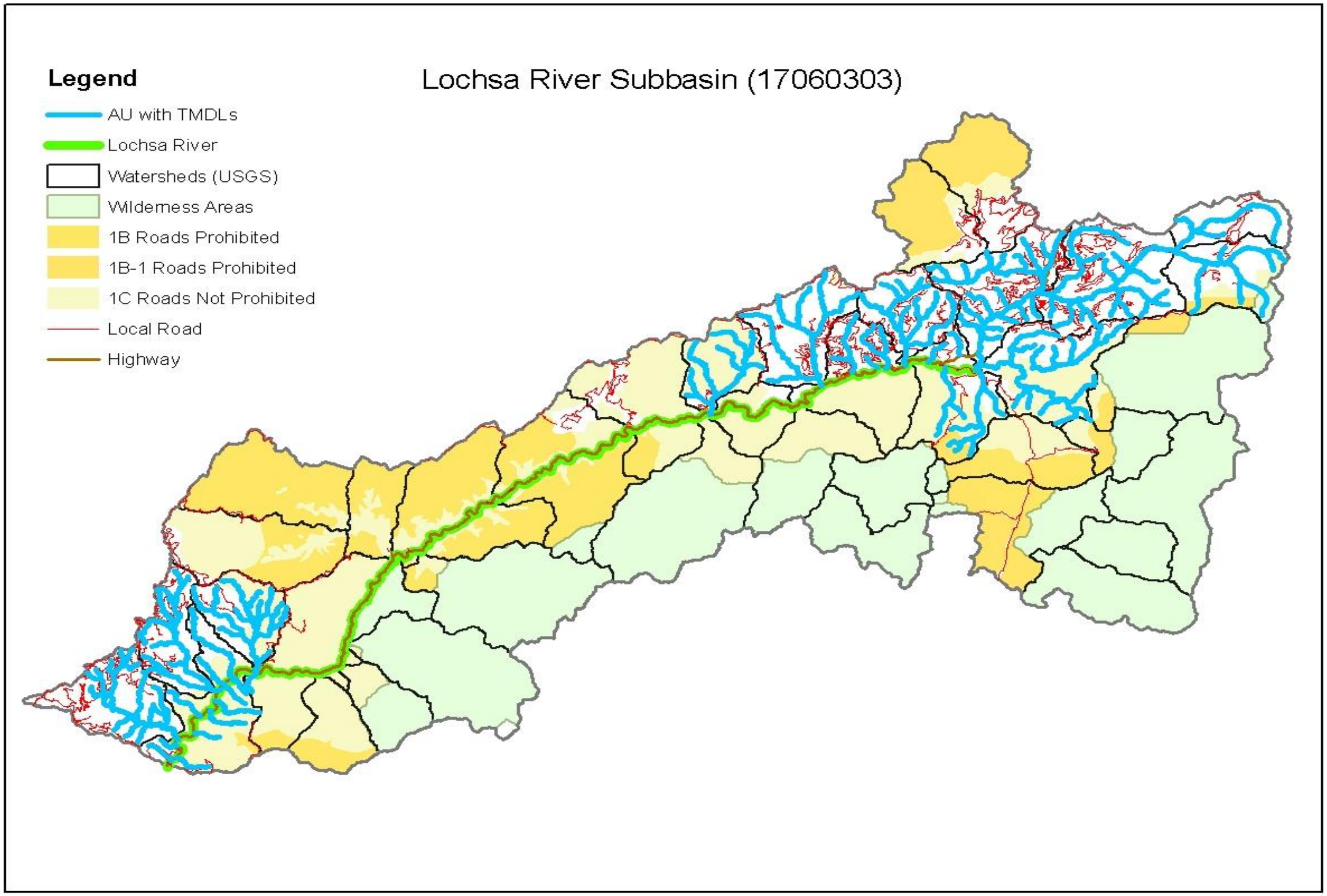



**Figure A. Subbasin at a glance.**

## Key Findings

The 2010 §303(d) list of impaired waters includes 20 AUs in the Lochsa River subbasin listed for reasons associated with temperature criteria violations (Table B); 8 of those AUs were determined to be un-impacted because of low road/harvest densities or roadless/wilderness area designations (DEQ 2011). An additional 6 AUs represent the Lochsa River itself, which is assumed to be at natural shading levels. Excess solar load to the Lochsa River from the lack of shade was determined to result from inputs from 37 tributary AUs (6 of which were §303(d) listed for temperature) in the subbasin (Table A).

Effective shade targets were established for streams in the 37 tributary AUs based on the concept of maximum shading under potential natural vegetation resulting in natural background temperature levels. Shade targets were derived from effective shade curves developed for similar vegetation types in Idaho. Existing shade was determined from aerial photo interpretation and partially field verified with Solar Pathfinder data.

Some watersheds, especially in the Brushy Fork portion of the subbasin, lack shade and have relatively large excess loads. There are many more streams in the analysis that either meet target shade levels or are within the same 10% shade class. This analysis shows that the majority of watersheds outside of roadless areas have only been slightly affected by land-clearing activities near riparian areas.

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

**Table B. Summary of assessment outcomes for §303(d)-listed streams.**

| Water Body Segment/ Assessment Unit | Pollutant | TMDL(s) Completed | Recommended Changes to §303(d) List | Justification |
|---|---|---|---|---|
| Lower Lochsa River tributaries ID17060303CL001_02 | Temperature | Yes | Move to Category 4a | Excess solar load from lack of shade |
| Lochsa River ID17060303CL001_05, ID17060303CL003_05, ID17060303CL008_05, ID17060303CL009_05, ID17060303CL013_05, ID17060303CL020_05 | Temperature | Yes | Move to Category 4a | Excess solar load from lack of shade in tributary watersheds |
| Boulder Creek ID17060303CL010_02, ID17060303CL010_04 | Temperature | No | Delist | Undisturbed watershed |
| Storm Creek ID17060303CL032_03 | Temperature | No | Delist | Undisturbed watershed |
| Fish Creek ID17060303CL052_02, ID17060303CL052_03, ID17060303CL052_04, ID17060303CL057_02, ID17060303CL057_03 | Temperature | No | Delist | Undisturbed watershed |
| Deadman Creek ID17060303CL061_02 | Temperature | Yes | Move to Category 4a | Excess solar load from lack of shade |
| Canyon Creek ID17060303CL062_03 | Temperature | Yes | Move to Category 4a | Excess solar load from lack of shade |
| Pete King Creek ID17060303CL063_02, ID17060303CL063_03 | Temperature | Yes | Move to Category 4a | Excess solar load from lack of shade |
| Walde Creek ID17060303CL064_02 | Temperature | Yes | Move to Category 4a | Excess solar load from lack of shade |

# Introduction

This total maximum daily load (TMDL) is an addendum to the *Lochsa River Subbasin Assessment* (DEQ 1999). That document included four sections, which make up the subbasin assessment, and did not include any TMDLs. This addendum incorporates TMDLs for temperature-impaired streams. These TMDLs are typically addressed in section 5, and as such, we have retained the section 5 numbering below. Please refer to the original subbasin assessment for more information about subbasin characteristics, water quality concerns and status, and water quality data summaries and conclusions (DEQ 1999).

This document addresses water bodies in 37 assessment units (AUs) of the Lochsa River subbasin that have been placed on Idaho's current §303(d) list (i.e., the 2010 Integrated Report [DEQ 2011]) or are contributory waters to a major river requiring a temperature TMDL. The 2010 Integrated Report listed 20 AUs for temperature impairments in the Lochsa River subbasin. However, DEQ determined that 8 of these AUs were in undisturbed watersheds and should be delisted. Effective shade targets were established for 37 tributary AUs based on the concept of maximum shading under potential natural vegetation (PNV) resulting in natural background temperatures.

# 5. Total Maximum Daily Loads

A TMDL prescribes an upper limit (i.e., load capacity) on discharge of a pollutant from all sources so as to ensure water quality standards are met. It further allocates this load capacity among the various sources of the pollutant. Pollutant sources fall into two broad classes: point sources, each of which receives a wasteload allocation, and nonpoint sources, each of which receives a load allocation. Natural background contributions, when present, are considered part of the load allocation but are often broken out on their own because they represent 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 be a part of the TMDL.

Practically, the margin of safety and natural background are both reductions in the load capacity available for allocation to pollutant sources. This load capacity can be summarized by the following equation:

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

Where:

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

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

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

Another step in a load analysis is the quantification of current pollutant loads by source. This step allows the specification of load reductions as percentages of current conditions, considers equities in load reduction responsibility, and is necessary for pollutant trading to occur. 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 loads 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, the US Environmental Protection Agency (EPA) allows for seasonal or annual loads.

## 5.1 Instream Water Quality Targets

For the Lochsa River subbasin temperature TMDLs, we utilized a PNV approach. The Idaho water quality standards include a provision (IDAPA 58.01.02.200.09) establishing that if natural conditions exceed numeric water quality criteria, exceedance of the criteria is not considered a violation of water quality standards. In these situations, natural conditions essentially become the water quality standard, and the natural level of shade and channel width become the target of the TMDL. The instream temperature that results from attaining these conditions is consistent with the water quality standards even if it exceeds numeric temperature criteria. See Appendix A for further discussion of water quality standards and 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 effects on stream water temperature, see *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 one most likely to be controlled. The parameters that affect the amount of solar radiation hitting a stream throughout its length are shade and stream morphology. Shade is provided by the surrounding vegetation and other physical features such as hillsides, canyon walls, terraces, and high banks. Stream morphology affects the density of riparian vegetation and water storage in the alluvial aquifer. Streamside vegetation and channel morphology are the factors influencing shade that are most likely to have been influenced by anthropogenic activities and can be most readily corrected and addressed by a TMDL.

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

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

PNV along a stream is that riparian plant community that could grow to an overall mature state, although some level of natural disturbance is usually included in the development and use of shade targets. Vegetation can be removed by disturbance either naturally (e.g., wildfire, disease/old age, wind damage, wildlife grazing) or anthropogenically (e.g., domestic livestock grazing, vegetation removal, erosion). The idea behind PNV as targets for temperature TMDLs is that PNV provides a natural level of solar loading to the stream without any anthropogenic removal of shade-producing vegetation. 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 potential vegetation (and therefore potential shade) from models of plant community structure (shade curves for specific riparian plant communities), and we can measure or estimate existing canopy cover or shade. Comparing the two (potential and existing shade) tells us how much excess solar load the stream is receiving and what potential there is to decrease solar gain. Streams disturbed by wildfire, flood, or some other natural disturbance will be at less than PNV and require time to recover. Streams that have been disturbed by human activity may require additional restoration above and beyond natural recovery.

Existing shade was estimated for 37 assessment units (AUs) in the Lochsa River subbasin from visual interpretation of aerial photos taken in 2009. Some of 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, shade decreases as vegetation has less ability to shade the center of wide streams. As the vegetation gets taller, the more shade the plant community is able to provide at any given channel width.

Existing and PNV shade was converted to solar loads from data collected on flat-plate collectors at the nearest National Renewable Energy Laboratory (NREL) weather stations collecting these data. In this case, the Missoula, Montana, 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 A).

PNV shade and the associated target solar 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 considered to be consistent with the Idaho water quality standards, even if they exceed numeric criteria by more than 0.3 °C.[1]

## Aerial Photo Interpretation

Estimates of shade based on plant type and density take into account natural breaks in vegetation density and are marked out as stream segments on a 1:100,000 or 1:250,000 hydrography. Each segment was assigned a single value representing the bottom of a 10% shade class (adapted from the cumulative watershed effects process [IDL 2000]). For example, if shade for a particular stretch of stream was estimated somewhere between 50% and 59%, we assigned a 50% shade class to that section of stream. The estimate is based on a general intuitive observation about the kind of vegetation present, its density, and stream width. Streams where the banks and water are clearly visible are usually in low shade classes (10%, 20%, or 30%). Streams with dense forest or heavy brush where no portion of the stream is visible are usually in high shade classes (70%, 80%, or 90%). More open canopies where portions of the stream may be visible usually fall into moderate shade classes (40%, 50%, or 60%).

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

## 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 location where the tracing is made. To adequately characterize the effective shade on a stream reach, ten traces were taken at systematic intervals along the length of the stream in question.

At each sampling location, the Solar Pathfinder was placed in the middle of the stream at about the bankfull water level. Ten traces were taken following the manufacturer's

[1] A unit conversion chart is provided in Appendix B.

instructions (orient to south and level) for taking traces. Systematic sampling was used because it is easiest to accomplish while still not biasing the sampling location. For each sampled reach, the sampler started at a unique location, such as 50 to 100 meters (m) from a bridge or fence line, and then proceeded upstream or downstream stopping to take additional traces at fixed intervals (e.g., every 50 m, every 50 paces, etc.). One can also randomly locate points of measurement by generating random numbers to be used as interval distances.

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

## 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. Shadows produced by vegetation cover a lower percentage of the water surface in wider streams, and widened streams can also have less vegetative cover if shoreline vegetation has eroded away.

This width factor (i.e., near-stream disturbance zone or bankfull width) may not be discernable from aerial photo interpretation. Accordingly, this parameter must be estimated from available information. DEQ used regional curves for the major basins in Idaho—developed from data compiled by Diane Hopster of the Idaho Department of Lands—to estimate natural bankfull width (Figure 1).

For each stream evaluated in the load analysis, natural bankfull width was estimated based on the drainage area of the Clearwater curve from Figure 1. The Clearwater curve was ultimately chosen because of its proximity to the Lochsa River watershed. Additionally, existing width data should be evaluated and compared to these curve estimates if such data are available. However, for the Lochsa River watershed, only a few Beneficial Use Reconnaissance Program (BURP) sites exist, and bankfull width data from those sites represent only spot data (three measured widths in a reach only several hundred meters long) that are not always representative of the stream as a whole. In general, we found BURP bankfull width data to agree with bankfull width estimates from the Clearwater basin curve and chose not to make natural widths any smaller than these Clearwater basin estimates. Tables containing natural bankfull width estimates for each stream in each subwatershed are presented in Appendix C (Table C-2). The load analysis tables discussed in section 5.3 and presented in Appendix D contain a natural stream width and an existing stream width for every stream segment in the analysis based on the bankfull width results presented in Table C-2.

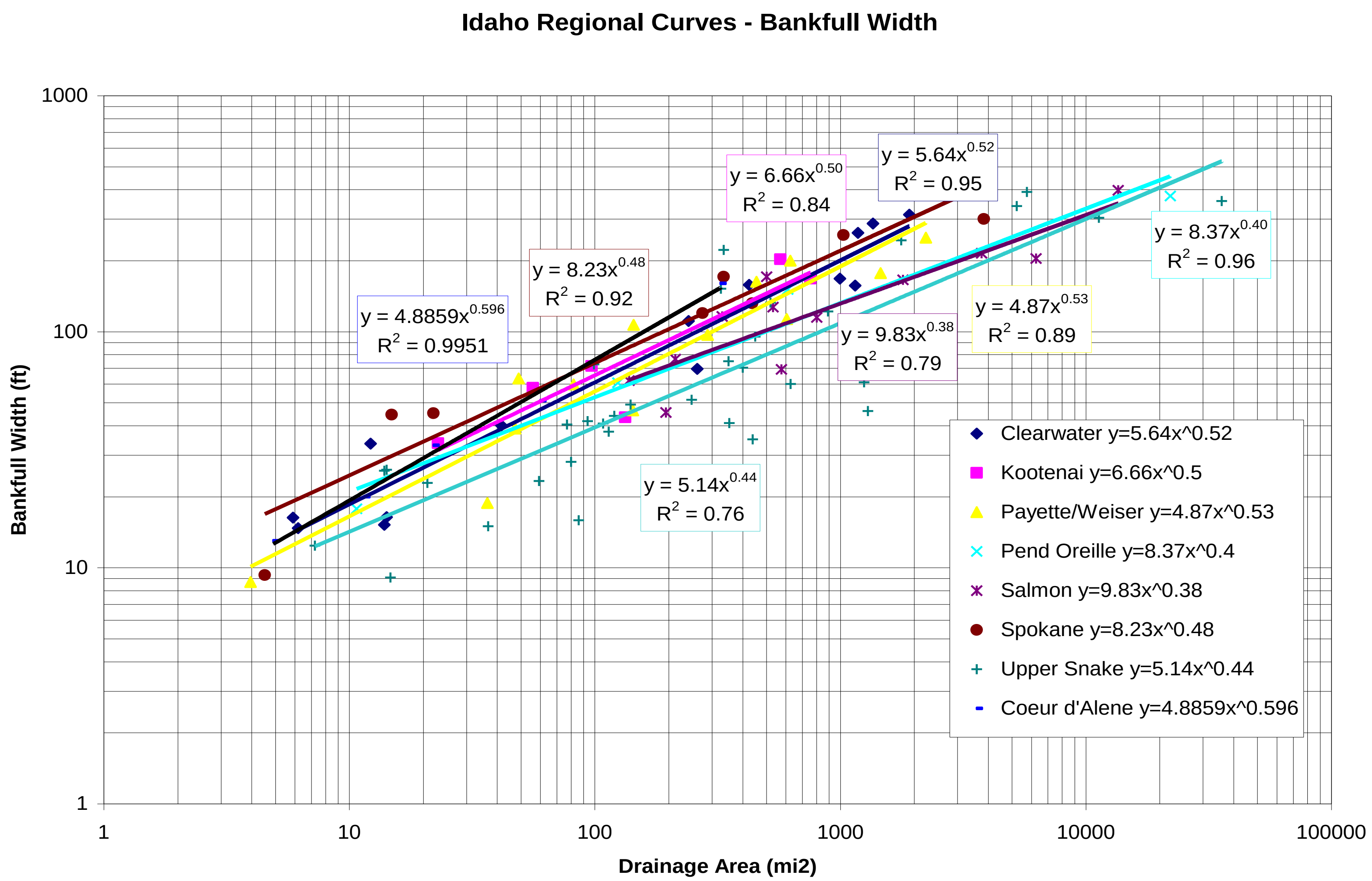



**Figure 1. Bankfull width as a function of drainage area.**

## Design Conditions

The Lochsa River subbasin sits on the divide between the Idaho Batholith Level III Ecoregion and the Northern Rockies Level III Ecoregion to the north (McGrath et al. 2001). The northern portion of the Lochsa River subbasin is within the "Clearwater Mountains and Breaks" Level IV Ecoregion of the Northern Rockies Level III Ecoregion (McGrath et al. 2001). This region is exposed to substantial maritime influence resulting in moist coniferous forests that are transitional in species composition between northern Idaho Panhandle forests and the drier forests of the southern Idaho Batholith. The southern portion of the subbasin and the area around Brushy Fork and Spruce Creek are in the "Lochsa Uplands" Level IV Ecoregion—a moderately dissected landscape of granitic soils mantled with volcanic ash that supports grand fir, Douglas-fir, and western larch. Engelmann spruce and subalpine fir are common at high elevations, and western redcedar can be found on north-facing slopes and in canyons. The Lochsa River valley itself is within the "Lochsa–Selway–Clearwater Canyons" Level IV Ecoregion of the Idaho Batholith. With steeper canyon topography than nearby mountains, this ecoregion can be warmer and drier with increasing depth. The ecoregion is dominated by Douglas-fir, grand fir, western redcedar, western larch, and western white pine with ponderosa pine increasing on lower, drier sites.

The Clearwater National Forest (CNF) identifies three broad groups of forest types based on their land type association classification system:

- Breaklands—forests on steep slopes at lower elevations, with warmer temperature regimes
- Uplands—forests generally above the breaklands in elevation and with more rolling topography; cooler and more mesic than breaklands
- Subalpine—the setting above the uplands with respect to elevation, with mixed topography and generally colder temperatures

Shade curves (described below) used to develop targets for PNV temperature TMDLs in Idaho were developed by the Idaho Department of Environmental Quality (DEQ) and EPA from information about these landtype groups (see Shumar and de Varona 2009).

## Target Selection

To determine PNV shade targets for the Lochsa River subbasin, effective shade curves from the CNF section of DEQ's PNV TMDL procedures manual (Shumar and de Varona 2009) were examined. These curves were produced using vegetation community modeling of Idaho plant communities. Effective shade curves include percent shade on the vertical axis and stream width on the horizontal axis. As a stream becomes wider, a given vegetation type loses its ability to shade wider and wider streams. For the Lochsa River subbasin, curves for the most similar vegetation type were selected for shade target determinations.

First, an overlay of CNF landtypes grouped as breaklands, uplands, and subalpine was placed over the stream being examined. Streams in the lower part of the subbasin (Pete King Creek to Deadman Creek) typically originated in upland or breakland landtypes. Streams in the northern subbasin (from Post Office Creek to Crooked Fork) tended to originate in subalpine forests then drain into breakland forests. Brushy Fork and Spruce Creek were almost completely dominated by subalpine forest landtypes.

As streams progress downstream, they would periodically leave the forest groups and enter a region where other nonforest landtypes occur. Visual observations of these regions revealed that stream valleys widened, alder communities tended to dominate the streamside vegetation, and the forest was further away from the stream. In some locations, especially in the upper subalpine zone—such as Packer Meadow on Pack Creek and Elk Meadows on Brushy Fork—large patches of grass meadow existed. Therefore, we developed new shade curves for this region that are based on the CNF upland landtype and the mountain alder (*Alnus incana*) nonforest community of southern Idaho or the CNF subalpine forest type and the graminoid nonforest community of southern Idaho (see Shumar and De Varona 2009 for descriptions of these plant communities).

We split the 41-m riparian buffer width in the model used to create shade curves (described in Shumar and De Varona 2009) such that the first five zones adjacent to the stream are based on the mountain alder community dimensions (55% canopy cover and 5.1 m weighted average height) or the graminoid community dimensions (100% canopy cover and 0.7 m height), and the four remaining zones furthest from the stream utilize the CNF uplands forest dimensions (81% canopy cover and 21 m weighted average height) or the CNF subalpine forest dimensions (78% canopy cover and 21 m height). The resulting shade curves were designated as the CNF Upland Forest – Alder Mixed and the CNF Subalpine Forest – Graminoid Meadow Mixed and can be seen in Appendix C (Figures C-1 and C-2). These shade curves are used for shade targets on those portions of streams in this TMDL where the valley widens and the forest no longer dominates the streamside vegetation.

## Monitoring Points

The accuracy of the aerial photo interpretations was field verified with a Solar Pathfinder at 10 sites. Results showed that the original aerial photo interpretation was within 20%, or two shade classes (Table 1). The original aerial photo interpretation overestimated shade by an average of 5% ± 10.2 (mean ± 95% confidence interval) when all 10 sites were examined together. However, sites on Brushy Fork were consistently underestimated in the original interpretation. When examined separately, 4 sites in the Brushy Fork region (includes Spruce Creek) had an average difference of -13% ± 9.4, and the remaining 6 sites had an average difference of 17% ± 4.1. These data were used to calibrate the eye and aerial photo interpretation was repeated. The resulting existing shade values presented in this document represent those adjusted values.

In the future, effective shade monitoring can take place on any reach throughout the 37 AUs and be compared to estimates of existing shade seen in Appendix C (Figures C-4, C-7, and C-10) and described in the load analysis tables in Appendix D. Those areas with the largest disparity between existing shade estimates and target shade levels 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 segment length for each estimate of existing shade varies 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 averaged together should suffice to determine new future shade levels within each segment.

**Table 1. Solar Pathfinder results from ten sites in the Lochsa River subbasin.**

| aerial class (%) | pathfinder actual (%) | pathfinder class (%) | delta (%) | | Sites |
|---|---|---|---|---|---|
| 30 | 32.1 | 30 | 0 | | spruce |
| 20 | 42.5 | 40 | -20 | | brushy 1 |
| 0 | 22.7 | 20 | -20 | | brushy 2 |
| 30 | 48.4 | 40 | -10 | | brushy 3 |
| 50 | 38 | 30 | 20 | | waw 1 |
| 70 | 65.3 | 60 | 10 | | waw 2 |
| 80 | 69.2 | 60 | 20 | | post office |
| 90 | 87.7 | 80 | 10 | | apgar |
| 90 | 76.2 | 70 | 20 | | canyon |
| 80 | 61.1 | 60 | 20 | | pete king |
| | | | 5 | average | |
| | | | 16.50 | std dev | |
| | | | 10.23 | 95%CI | |

| | | | | | |
|---|---|---|---|---|---|
| 50 | 38 | 30 | 20 | | waw 1 |
| 70 | 65.3 | 60 | 10 | | waw 2 |
| 80 | 69.2 | 60 | 20 | | post office |
| 90 | 87.7 | 80 | 10 | | apgar |
| 90 | 76.2 | 70 | 20 | | canyon |
| 80 | 61.1 | 60 | 20 | | pete king |
| | | | 17 | average | |
| | | | 5.16 | std dev | |
| | | | 4.13 | 95%CI | |

| | | | | | |
|---|---|---|---|---|---|
| 30 | 32.1 | 30 | 0 | | spruce |
| 20 | 42.5 | 40 | -20 | | brushy 1 |
| 0 | 22.7 | 20 | -20 | | brushy 2 |
| 30 | 48.4 | 40 | -10 | | brushy 3 |
| | | | -13 | average | |
| | | | 9.57 | std dev | |
| | | | 9.38 | 95%CI | |

## 5.2 Load Capacity

The load capacity for a stream under PNV is essentially the solar load allowed under the shade targets specified for the reaches within that stream. These loads are determined by multiplying the solar load measured by a flat-plate collector (under full sun) for a given period of time by the fraction of solar radiation not blocked by shade (i.e., the percent open or 100% minus percent shade). In other words, if a shade target is 60% (or 0.6), 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 from flat-plate collectors at the NREL weather station in Missoula, Montana. The solar loads used in this TMDL are spring/summer averages (i.e., an average load for the 6-month period from April through September). These months coincide with the time of year when stream temperatures are increasing, deciduous vegetation is in leaf, and fall spawning is occurring. The load analysis tables in Appendix D show the PNV shade targets (identified as target or potential shade) and their corresponding potential summer load (in kilowatt-hours per square meter per day [kWh/m$^2$/day] and kilowatt-hours/day [kWh/day]) that serve as the load capacities for the streams. Figures C-3, C-6, and C-9 in Appendix C also show target shade. Existing and target loads in kWh/day can be summed for the entire stream or portion of stream examined in a single load analysis table. These total loads are shown at the bottom of their respective columns in each table.

The effective shade calculations are based on a 6-month period from April through September. This period coincides with the critical time period when temperatures affect beneficial uses, such as spring and fall salmonid spawning, and when cold water aquatic life criteria may be exceeded during summer months. Late July and early August typically represent the period of highest stream temperatures. However, solar gains can begin early in the spring and affect not only the highest temperatures reached later in the summer but also salmonid spawning temperatures in spring and fall. Thus, solar loading in these streams is evaluated from spring (April) to early fall (September).

The AU with the largest potential or target load was the 4th-order segment of Colt Killed Creek (AU# ID17060303CL024_04) with slightly greater than 2 million kWh/day (Table D-6 in Appendix D). The smallest target load was in the Cold Storage Creek AU (AU# ID17060303CL020_02a) with 3,111 kWh/day (Table D-2 in Appendix D).

## 5.3 Estimates of Existing Pollutant Loads

Regulations allow that loadings "...may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading" (Water quality planning and management, 40 CFR § 130.2(I)). An estimate must be made for each point source. Nonpoint sources are typically estimated based on the type of sources (land use) and area (such as a subwatershed) but may be aggregated by type of source or land area. When 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. Like target shade, existing shade was converted to a solar load by multiplying the fraction of open stream by the solar radiation measured on a flat-plate collector at the NREL weather station. Existing shade data are presented in load analysis tables in Appendix D and Figures C-4, C-7, and C-10 in Appendix C. Like load capacities (potential loads), existing loads in the load analysis tables are presented on an area basis (kWh/m$^2$/day) and as a total load (kWh/day).

Like target loads, existing loads in kWh/day are summed for the entire stream or portion of stream examined in a single load analysis 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 (i.e., lack of shade) to be discussed next in the load allocation section.

The AU with the largest existing load was the 4th-order segment of Colt Killed Creek (AU# ID17060303CL024_04) with slightly less than 2.2 million kWh/day (Table D-6 in Appendix D). The smallest existing load was in the Walde Creek AU (AU# ID17060303CL063_03) with 4,620 kWh/day (Table D-32 in Appendix D).

## 5.4 Load Allocation

Because this TMDL is based on PNV, which is equivalent to background loading, the load allocation is essentially the desire to achieve natural background conditions. However, in order to reach that objective, load allocations are assigned to nonpoint source activities that have affected or may affect riparian vegetation and shade as a whole. Therefore, load allocations are stream reach specific and are dependent upon the target load for a given reach. Load analysis tables in Appendix D show the target or potential shade, which is converted to a potential summer load by multiplying the inverse fraction (1 minus shade fraction) by the average loading measured by a flat-plate collector from April through September. The result is the load capacity of the stream, which is necessary to achieve background conditions. There is no opportunity to further remove shade from the stream by any activity without exceeding its load capacity. Additionally, because this TMDL is dependent upon background conditions for achieving water quality standards, all tributaries to the waters examined here need to be in natural conditions to prevent excess heat loads to the system.

Table 2 shows the total existing, total target, and total excess heat loads; the proportion of existing load that is in excess; and average lack of shade for each watershed examined. The size of a stream influences the size of the excess load. Large streams have higher existing and target loads by virtue of their larger channel widths. Table 2 lists the tributaries in order of their excess loads, from highest to lowest. Therefore, large tributaries tend to be listed first and small tributaries last. AUs or watersheds with relatively large excess loads, where the proportion of existing load in excess is 20% or greater, have been color coded as red in Table 2. Those AUs that have a lower proportion in excess are shaded green in Table 2.

Brushy Fork Creek and its tributaries and Crooked Fork and its tributaries are some of the larger water bodies in the analysis and are listed first in Table 2. These water bodies tend to have high excess loads in proportion to existing loads. Other watersheds with high excess loads include the lower Lochsa River tributaries, lower Pete King Creek tributaries, Walde Creek and its tributaries, Parachute Creek, and Cold Storage Creek. These small watersheds that have proportionately high excess loads are not necessarily in bad condition (see Figures C-5, C-8, and C-11 in Appendix C). Much of that excess load results from the slight difference between existing shade, reported as a 10% class interval (e.g., 90%), and target shade, assigned as a specific integer (e.g., 98%). Conversely, some other large water bodies (e.g., Colt Killed Creek, Walton Creek and tributaries, Canyon Creek and tributaries, and lower Pete King Creek) have low excess loads relative to their existing loads despite some areas with a lack of shade greater than 10%. In fact, lower Pete King Creek is one of 5 AUs (along with portions of Deadman Creek, Canyon Creek, Badger Creek, and Cliff Creek) that have no excess load due to heavily vegetated reaches. There are a number of small watersheds that have proportionately low excess loads (less than 10% of existing loads), including Waw’aalamnime Creek and its East Fork, Post Office Creek, East Fork Deadman Creek, Walton Creek, and Beaver Creek.

Although the preceding analysis focuses on total heat loads for streams in this TMDL, it is important to note that differences between existing and target shade, as depicted in the lack-of-shade figures (Figures C-5, C-8, and C-11 in Appendix C), are the key to successfully restoring these waters to achieving water quality standards. Target shade levels for individual reaches should be the goal managers strive for with future implementation plans. Managers should focus on the largest differences between existing and target shade as locations to prioritize implementation efforts. Each load analysis table contains a column that lists the lack of shade on the stream. This value 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 condition. The average lack of shade listed at the bottom of the column in each load analysis table is also listed in Table 2 and represents a general level of condition for comparison among streams.

The shade deficiencies that result in excess loads are visible in the lack-of-shade figures in Appendix C (Figures C-5, C-8, and C-11). Figure C-5 shows several locations in the Brushy Fork watersheds where shade is lacking by more than 30%. Compared to other watersheds, these watersheds have more stream segments that lack shade by anywhere from 10% to 29%. Figure C-8 shows that upper Papoose Creek has a few locations that also lack considerable shade. Watersheds in the lower portion of the subbasin (Figure C-11) are in relatively good condition with regard to lack of shade.

**Table 2. Total solar loads, excess load, and average lack of shade for all waters.**

| Water Body and Assessment Unit | Total Existing Load (kWh/day) | Total Target Load (kWh/day) | Excess Load (kWh/day and %) | Average Lack of Shade (%) |
|---|---|---|---|---|
| Brushy Fork Creek (ID17060303CL035_03) | 426,608 | 237,108 | 189,499 (44%) | -21 |
| Brushy Fork Creek (ID17060303CL035_04) | 456,115 | 313,293 | 142,822 (31%) | -27 |
| Crooked Fork Creek (ID17060303CL034_05) | 1,284,850 | 1,150,211 | 134,639 (10%) | -10 |
| Colt Killed Creek (ID17060303CL024_04) | 2,171,868 | 2,037,959 | 133,909 (6%) | -7 |
| Crooked Fork Creek (ID17060303CL038_04) | 646,217 | 551,912 | 94,305 (15%) | -14 |
| Brushy Fork tributaries (ID17060303CL035_02) | 235,934 | 144,747 | 91,186 (39%) | -9 |
| Brushy Fork and tributaries (ID17060303CL037_02) | 221,755 | 155,780 | 65,974 (30%) | -18 |
| Spruce Creek and tributaries (ID17060303CL036_02) | 439,670 | 374,493 | 65,177 (15%) | -11 |
| Crooked Fork tributaries (ID17060303CL038_02) | 51,761 | 21,634 | 30,126 (58%) | -12 |
| Papoose Creek and tributaries (ID17060303CL041_02 & _03) | 163,812 | 134,692 | 29,120 (18%) | -11 |
| Crooked Fork tributaries (ID17060303CL034_02) | 24,822 | 10,189 | 14,633 (59%) | -9 |
| Canyon Creek and tributaries (ID17060303CL062_02) | 167,233 | 153,915 | 13,318 (8%) | -9 |
| Lower Lochsa River tributaries (ID17060303CL001_02)[a] | 55,561 | 42,343 | 13,218 (24%) | -7 |
| Colt Killed tributaries (ID17060303CL024_02) | 88,776 | 75,760 | 13,015 (15%) | -7 |
| Waw'aalamnime and East Fork (ID17060303CL045_02 & _03) | 154,952 | 144,324 | 10,627 (7%) | -8 |
| Walton Creek and tributaries (ID17060303CL023_02) | 1,390,059 | 1,379,546 | 10,513 (0.8%) | -8 |
| Lower Pete King Creek tributaries (ID17060303CL063_02)[a] | 21,120 | 10,680 | 10,440 (49%) | -9 |
| Doe Creek and tributary (ID17060303CL047_02) | 58,867 | 48,740 | 10,127 (17%) | -7 |
| Walde Creek and tributaries (ID17060303CL064_02)[a] | 25,669 | 16,707 | 8,961 (35%) | -8 |
| Post Office Creek and tributaries (ID17060303CL048_02 & _03) | 118,008 | 110,355 | 7,653 (6%) | -7 |
| Parachute Creek (ID17060303CL042_02) | 21,571 | 14,484 | 7,087 (33%) | -8 |
| West Fork Waw'aalamnime Creek (ID17060303CL046_02) | 26,494 | 20,378 | 6,116 (23%) | -6 |
| Deadman Creek and tributaries (ID17060303CL061_02)[a] | 32,923 | 28,767 | 4,156 (13%) | -8 |
| East Fork Deadman Creek and tributaries (ID17060303CL060_02 & _03) | 52,844 | 48,698 | 4,146 (8%) | -6 |

| Water Body and Assessment Unit | Total Existing Load (kWh/day) | Total Target Load (kWh/day) | Excess Load (kWh/day and %) | Average Lack of Shade (%) |
|---|---|---|---|---|
| Beaver Creek and tributaries (ID17060303CL033_02) | 66,479 | 62,974 | 3,504 (5%) | -7 |
| Wendover Creek and tributary (ID17060303CL043_02) | 12,502 | 9,611 | 2,890 (23%) | -5 |
| Cold Storage Creek and others (ID17060303CL020_02a) | 5,748 | 3,111 | 2,636 (46%) | -6 |
| Deadman Creek and tributaries (ID17060303CL059_02 & _03) | 58,322 | 62,740 | 0 (0%) | -1 |
| Badger Creek and tributary (ID17060303CL044_02) | 19,410 | 21,072 | 0 (0%) | -7 |
| Cliff Creek and tributary (ID17060303CL022_02) | 14,152 | 15,880 | 0 (0%) | -5 |
| Lower Pete King Creek (ID17060303CL063_03)[a] | 209,605 | 253,345 | 0 (0%) | -2 |
| Canyon Creek (ID17060303CL062_03)[a] | 16,764 | 20,196 | 0 (0%) | 0 |

[a] §303(d)-listed assessment unit (DEQ 2011)

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

A certain amount of excess load is potentially created by the existing shade/target shade difference inherent in the loading analysis. Because existing shade is reported as a 10% class level and target shade is a unique integer between 0 and 100, there is usually a difference between the two. 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 the 80% shade class. This automatic difference of 6% could be attributed to the margin of safety.

## Wasteload Allocation

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

## 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% shade class, which likely underestimates actual shade in the loading analysis. Although the loading analysis used in this TMDL involves gross estimations that are likely to have large variances, load allocations are applied to the stream and its riparian vegetation rather than specific nonpoint source activities and can be adjusted as more information is gathered from the stream environment.

## Seasonal Variation

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

## Construction Stormwater and TMDL Wasteload Allocations

### *Construction Stormwater*

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

### *The Construction General Permit*

If a construction project disturbs more than 1 acre of land (or is part of a larger common development that will disturb more than 1 acre), the operator is required to apply for a Construction General Permit (CGP) from EPA after developing a site-specific Stormwater Pollution Prevention Plan (SWPPP).

### *Stormwater Pollution Prevention Plan*

To obtain the CGP, operators must develop a site-specific SWPPP. Operators must document the erosion, sediment, and pollution controls they intend to use; inspect the controls periodically; and maintain best management practices (BMPs) throughout the life of the project.

### *Construction Stormwater Requirements*

When a stream is on Idaho's §303(d) list and has a TMDL developed, DEQ may incorporate a gross wasteload allocation for anticipated construction stormwater activities. TMDLs developed in the past that did not have a wasteload allocation for construction stormwater activities or new TMDLs will also be considered in compliance with provisions of the TMDL if they obtain a CGP under the NPDES program and implement appropriate BMPs.

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

## 5.5 Implementation Strategies

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

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

### Time Frame

Implementation of this TMDL relies on riparian area management practices that will provide a mature canopy cover to shade the stream and prevent excess solar heat loading. Because implementation is dependent on mature riparian communities to substantially improve stream temperatures, DEQ believes 10–20 years may be a reasonable amount time for achieving water quality standards.

### Approach

Water bodies included in this TMDL are within the CNF forest reserves. Implementation of this TMDL will occur through actions required by the CNF's strategic forest plan (i.e., land and resource management plan) and the Inland Native Fish Strategy included in the plan. This plan, including the Inland Native Fish Strategy, provides protection for resident native fish populations and their habitat by using and applying BMPs for riparian management.

Riparian area management practices will provide a mature canopy cover to address excess solar heat loading to water bodies and are considered to be equivalent to, or compliant with, the TMDL's percent riparian canopy closure surrogate target.

### Designated Management Agencies and Responsible Parties

DEQ recognizes the authorities and responsibilities of the CNF and will enlist its involvement and authorities for protecting water quality through implementation of IDAPA 58.01.02 and Clean Water Act Section 401.

### Monitoring Strategy

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

## 5.6 Public Participation

DEQ anticipates the finalization of this TMDL with the assistance of the CNF and the Clearwater Basin Advisory Group. Since the water bodies included in this TMDL are within the CNF forest reserves, the CNF is considered instrumental in the success of this TMDL. Members of the Clearwater Basin Advisory Group represent agriculture, local government, Nez Perce Tribe, recreation, forestry, point source discharger, environmental, mining, livestock, and at-large interests. Both the Clearwater Basin Advisory Group and the CNF have been consulted in the development of this TMDL.

In the final version of this addendum, the distribution list for the draft document and a summary of public comments and participation will be included as Appendices E and F, respectively.

## 5.7 Conclusions

In the 2010 Integrated Report, 20 AUs were listed for temperature impairments in the Lochsa River subbasin. This TMDL analysis found 8 of these AUs (Boulder, Storm, and Fish Creeks) were unimpaired and should be delisted. TMDLs were developed for the remaining AUs, which should be moved to Category 4a in the next Integrated Report (Table 3).

DEQ also examined additional tributary AUs for their contribution to excess heat loads in the Lochsa River. In total, effective shade targets were established for 37 tributary AUs in the Lochsa River subbasin based on the concept of maximum shading under PNV will result in natural background temperature levels. Shade targets were derived from effective shade curves developed for similar vegetation types in Idaho. Existing shade was determined from aerial photo interpretation that was field verified in some locations with Solar Pathfinder data.

Some watersheds, especially in the Brushy Fork portion of the subbasin, lack shade and have relatively large excess loads. There are many more streams in the analysis that either meet target shade levels or are within the same 10% shade class. This analysis shows that the majority of watersheds outside of roadless areas have only been slightly affected by land-clearing activities near riparian areas.

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

**Table 3. Summary of assessment outcomes.**

| Water Body Segment/ Assessment Unit | Pollutant | TMDL(s) Completed | Recommended Changes to §303(d) List | Justification |
|---|---|---|---|---|
| Lower Lochsa River tributaries ID17060303CL001_02 | Temperature | Yes | Move to Category 4a | Excess solar load from lack of shade |
| Lochsa River ID17060303CL001_05, ID17060303CL003_05, ID17060303CL008_05, ID17060303CL009_05, ID17060303CL013_05, ID17060303CL020_05 | Temperature | Yes | Move to Category 4a | Excess solar load from lack of shade in tributary watersheds |
| Boulder Creek ID17060303CL010_02, ID17060303CL010_04 | Temperature | No | Delist | Undisturbed watershed |
| Storm Creek ID17060303CL032_03 | Temperature | No | Delist | Undisturbed watershed |
| Fish Creek ID17060303CL052_02, ID17060303CL052_03, ID17060303CL052_04, ID17060303CL057_02, ID17060303CL057_03 | Temperature | No | Delist | Undisturbed watershed |
| Deadman Creek ID17060303CL061_02 | Temperature | Yes | Move to Category 4a | Excess solar load from lack of shade |
| Canyon Creek ID17060303CL062_03 | Temperature | Yes | Move to Category 4a | Excess solar load from lack of shade |
| Pete King Creek ID17060303CL063_02, ID17060303CL063_03 | Temperature | Yes | Move to Category 4a | Excess solar load from lack of shade |
| Walde Creek ID17060303CL064_02 | Temperature | Yes | Move to Category 4a | Excess solar load from lack of shade |

# References Cited

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

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

DEQ (Idaho Division of Environmental Quality). 1999. Lochsa River subbasin assessment. Lewiston, ID: DEQ, Lewiston Regional Office.

DEQ (Idaho Department of Environmental Quality). 2005. Catalog of stormwater best management practices for Idaho cities and counties. Boise, ID: DEQ.

DEQ (Idaho Department of Environmental Quality). 2011. Idaho's 2010 Integrated Report. Boise, ID: DEQ.

EPA (US Environmental Protection Agency). 1996. Biological criteria: Technical guidance for streams and small rivers. Washington, DC: EPA, Office of Water. EPA 822-B-96-001. 162 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. Boise, ID: Department of Environmental Quality. 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. Boca Raton, FL: CRC Press. pp. 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.

IDL (Idaho Department of Lands). 2000. Forest practices cumulative watershed effects process for Idaho. Boise, ID: IDL.

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

Küchler, A.U. 1964. Potential natural vegetation of the conterminous United States. American Geographical Society Special Publication 36.

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. Reston, VA: US Geological Service.

OWEB (Oregon's Watershed Enhancement Board). 2001. Addendum to water quality monitoring technical guide book: Chapter 14, stream shade and canopy cover monitoring methods. Salem, OR: OWEB.

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.

Shumar, M.L., and J. De Varona. 2009. The potential natural vegetation (PNV) temperature total maximum daily load (TMDL) procedures manual. Boise, ID: Idaho Department of Environmental Quality.

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

USGS (US Geological Survey). 1987. Hydrologic unit maps. Denver, CO: USGS. Water supply paper 2294. 63 p.

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

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

Water quality planning and management, 40 CFR Part 130.

# Glossary

| Term | Definition |
|---|---|
| **§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. |
| **Algae** | Non-vascular (without water-conducting tissue) aquatic plants that occur as single cells, colonies, or filaments. |
| **Ambient** | General conditions in the environment (Armantrout 1998). In the context of water quality, ambient waters are those representative of general conditions, not associated with episodic perturbations or specific disturbances such as a wastewater outfall (EPA 1996). |
| **Anthropogenic** | Relating to, or resulting from, the influence of human beings on nature. |
| **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 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. |

**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.

**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

**Best Management Practices (BMPs)**

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

**Biological Integrity**

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

**Biota**

The animal and plant life of a given region.

**Clean Water Act (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.

**Community**

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

**Criteria**

In the context of water quality, numeric or descriptive factors taken into account in setting standards for various pollutants. These factors are used to determine limits on allowable concentration levels, and to limit the number of violations per year. The 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.

**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).

**Disturbance**

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

**Ecosystem**

The interacting system of a biological community and its non-living (abiotic) environmental surroundings.

**Environment**

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

**Erosion**

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

**Exceedance**

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

**Existing Beneficial Use or Existing Use**

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

**Flow**

See *Discharge*.

**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).

**Geographic Information Systems (GIS)**

A georeferenced database.

**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 streamflow.

**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 Unit**

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

**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.

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

**Margin of Safety (MOS)**
An implicit or explicit portion of a water body's loading capacity set aside to allow 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.

**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.

**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.

**Monitoring**

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

**Mouth**

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

**National Pollutant Discharge Elimination System (NPDES)**

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

**Natural Condition**

The condition that exists with little or no anthropogenic influence.

**Nitrogen**

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

**Nonpoint Source**

A dispersed source of pollutants, generated from a geographical area when pollutants are dissolved or suspended in runoff and then delivered into waters of the state. Nonpoint sources are without a discernable point or origin. 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 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).

**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.

**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.

**Phosphorus**

An element essential to plant growth, often in limited supply, and thus considered a nutrient.

**Point Source**

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

**Pollutant**

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

**Pollution**

A very broad concept that encompasses human-caused changes in the environment 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.

**Potential Natural Vegetation (PNV)**

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

**Protocol**

A series of formal steps for conducting a test or survey.

**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. |
| **Riparian** | Associated with aquatic (stream, river, lake) habitats. Living or located on the bank of a water body. |
| **River** | A large, natural, or human-modified stream that flows in a defined course or channel or in a series of diverging and converging channels. |
| **Runoff** | The portion of rainfall, melted snow, or irrigation water that flows across the 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. |
| **Species** | 1) A reproductively isolated aggregate of interbreeding organisms having common attributes and usually designated by a common name. 2) An organism belonging to such a category. |

**Spring**

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

**Stream**

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

**Stream Order**

Hierarchical ordering of streams based on the degree of branching. A 1st-order stream is an unforked or unbranched stream. Under Strahler's (1957) system, higher order streams result from the joining of two streams of the same order.

**Stormwater Runoff**

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

**Subbasin**

A large watershed of several hundred thousand acres. 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.

**Taxon**

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

**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.

**Tributary**

A stream feeding into a larger stream or lake.

**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 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 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. |
| **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. |

*This page intentionally left blank for correct double-sided printing.*

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

Water Quality Standards Applicable to Salmonid Spawning Temperature

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

- 13 $^{o}$C as a daily maximum water temperature
- 9 $^{o}$C as a daily average water temperature

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

Natural Background Provisions

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

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

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

*This page intentionally left blank for correct double-sided printing.*

# Appendix B. Unit Conversion Chart

*This page intentionally left blank for correct double-sided printing.*

**Table B-1. Metric–English unit conversions.**

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

[a] 1 cfs = 0.65 million gallons per day; 1 million gallons per day = 1.55 cfs.

[b] The ratio of 1 ppm = 1 mg/L is approximate and is only accurate for water.

*This page intentionally left blank for correct double-sided printing.*

# Appendix C. Data Sources, Bankfull Width Estimates, New Shade Curves, and Shade Figures

## List of Figures



## List of Tables

*This page intentionally left blank for correct double-sided printing.*

**Table C-1. Data sources for 37 assessment units with TMDLs.**

| Water Body | Data Source | Type of Data | Collection Date |
|---|---|---|---|
| 10 sites on 7 water bodies (Spruce Creek, Brushy Fork, Waw'aalamnime Creek, Post Office Creek, Apgar Creek, Canyon Creek, and Pete King Creek) | DEQ Lewiston Regional Office | Pathfinder effective shade and stream width | Fall 2010 |
| All 37 assessment units | DEQ State Technical Services Office | Aerial photo interpretation of existing shade and stream width estimation | Summer 2010 |

**Table C-2. Bankfull width estimates (in meters) for streams in the Lochsa River subbasin TMDL based on drainage area (in square miles) and existing measurements.**

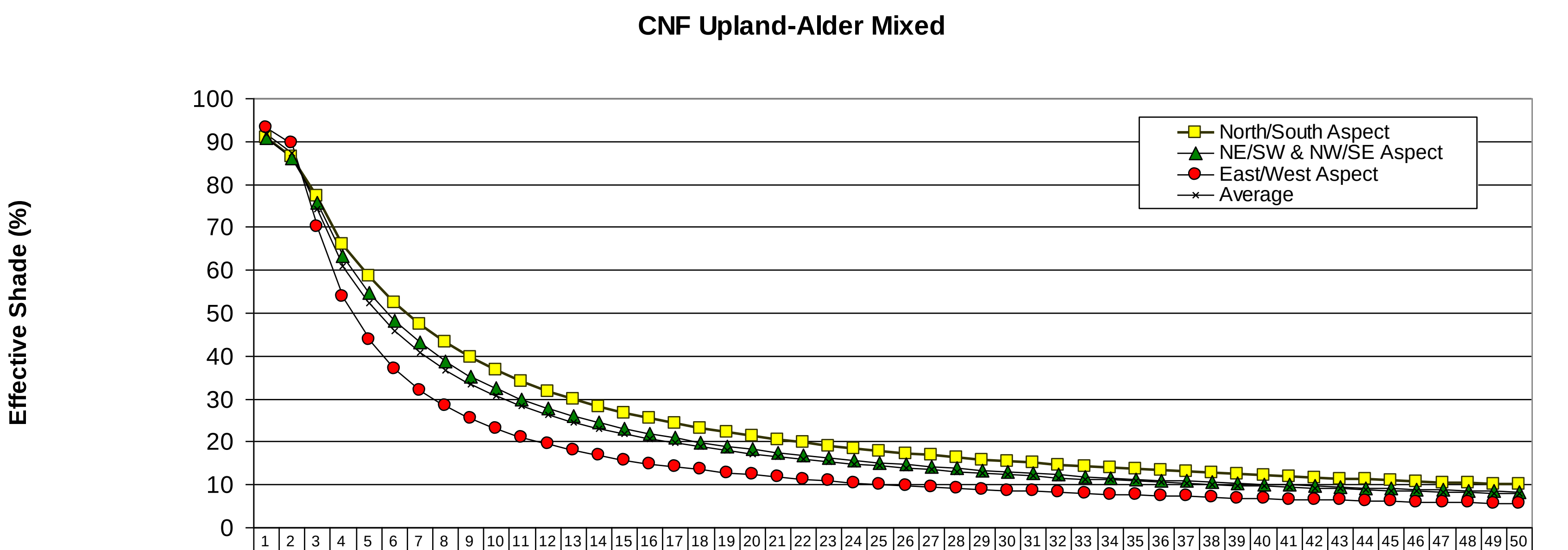
| Location | area (sq mi) | Clearwater (m) | Existing in meters (yr) |
|---|---|---|---|
| Pete King Creek ab Walde Creek | 7.48 | 5 | |
| Pete King Creek bl Walde Creek | 15.76 | 7 | |
| Pete King Creek ab Placer Creek | 18 | 8 | |
| Pete King Creek ab Nut Creek | 23.73 | 9 | |
| Pete King Creek @ mouth | 27.55 | 10 | 10.6(10) |
| Walde Creek bl 2nd tributary | 2.03 | 2 | |
| Walde Creek @ mouth | 8.28 | 5 | |
| 1st tributary to Walde Creek | 0.63 | 1 | |
| 2nd tributary to walde Creek | 0.6 | 1 | |
| 3rd tributary to Walde Creek | 1.02 | 2 | |
| Polar Creek bl fork | 0.9 | 2 | |
| Polar Creek @ mouth | 2.49 | 3 | |
| 1st tributary to Polar Creek | 0.53 | 1 | |
| 1st tributary to Pete King Creek | 0.56 | 1 | |
| 2nd tributary to Pete King Creek | 0.5 | 1 | |
| 3rd tributary to Pete King Creek | 0.56 | 1 | |
| 4th tributary to Pete King Creek | 0.38 | 1 | |
| Nut Creek @ mouth | 2.37 | 3 | |
| 1st tributary to Nut Creek | 0.56 | 1 | |
| Canyon Creek ab 1st tributary | 0.54 | 1 | 2.3 bl 1st(02) |
| Canyon Creek ab Mystery Creek | 6.25 | 4 | |
| Canyon Creek ab SF Canyon Cr | 15.04 | 7 | 7.8(10) |
| Canyon Creek @ mouth | 19.7 | 8 | |
| 1st tributary to Canyon Creek | 0.82 | 2 | |
| 2nd tributary to Canyon Creek | 0.68 | 1 | |
| 3rd tributary to Canyon Creek | 1.14 | 2 | |
| Mystery Creek @ mouth | 2.58 | 3 | |
| 4th tributary to Canyon Creek | 0.8 | 2 | |
| 5th tributary to Canyon Creek | 0.35 | 1 | |
| SF Canyon Creek ab Cabin Creek | 1.43 | 2 | |
| SF Canyon Creek bl Cabin Creek | 2.37 | 3 | |
| SF Canyon Creek @ mouth | 4.46 | 4 | |
| Cabin Creek @ mouth | 0.94 | 2 | |

| | | | |
|---|---|---|---|
| Deadman Creek ab 1st tributary | 1.28 | 2 | |
| Deadman Creek ab EF Deadman Cr | 6.58 | 5 | |
| Deadman Creek @ mouth | 19.82 | 8 | 7.6(05) |
| 1st tributary to Deadman Creek | 1.35 | 2 | |
| 2nd tributary to Deadman Creek | 1.01 | 2 | |
| 3rd tributary to Deadman Creek | 0.5 | 1 | |
| EF Deadman Creek ab 1st tributary | 3.11 | 3 | |
| EF Deadman Creek ab 5th tributary | 8.4 | 5 | |
| EF Deadman Creek @ mouth | 11.14 | 6 | |
| 1st tributary to EF Deadman Cr | 1.04 | 2 | |
| 2nd tributary to EF Deadman Cr | 0.3 | 1 | |
| 3rd tributary to EF Deadman Cr | 0.57 | 1 | |
| 4th tributary to EF Deadman Cr | 2.2 | 3 | |
| 5th tributary to EF Deadman Cr | 2.35 | 3 | |
| 5th tributary left fork | 0.59 | 1 | |
| 5th tributary right fork | 0.81 | 2 | |
| un-named S of Lowell Creek | 1.28 | 2 | |
| Lottie Creek @ mouth | 1.34 | 2 | |
| Lowell Creek @ mouth | 0.64 | 1 | |
| Cat Creek @ mouth | 0.95 | 2 | |
| Rye Patch Creek @ mouth | 2.3 | 3 | |
| Handy Creek @ mouth | 2.35 | 3 | |
| Hellgate Creek @ mouth | 1.84 | 2 | |
| Chance Creek @ mouth | 1.54 | 2 | |
| Apgar Creek @ mouth | 1.66 | 2 | 3.7(10) |
| Glade Creek @ mouth | 4.97 | 4 | |
| un-named opposite Glade Creek | 0.42 | 1 | |
| un-named opposite Deadman Creek | 0.63 | 1 | |
| Post Office Creek ab 1st tributary | 3.6 | 3 | |
| Post Office Creek bl 1st tributary | 4.99 | 4 | |
| Post Office Creek ab WF Post Office | 11 | 6 | |
| Post Office Creek ab 4th tributary | 16.51 | 7 | |
| Post Office Creek @ mouth | 18.99 | 8 | 7.5(10) 9.2(04) 8.8(07) |
| 1st tributary to Post Office Creek | 1.39 | 2 | |
| 2nd tributary to Post Office Creek | 0.81 | 2 | |
| 3rd tributary to Post Office Creek | 1.41 | 2 | |
| 4th tributary to Post Office Creek | 1.76 | 2 | |
| 1st tributary to 4th tributary | 0.34 | 1 | |
| WF Post Office Creek @ mouth | 4.89 | 4 | |

| | | | |
|---|---|---|---|
| Waw aalamnime Cr ab EF | 2.93 | 3 | |
| Waw aalamnime Cr ab WF | 7.84 | 5 | |
| Waw aalamnime Cr ab Doe Creek | 16.95 | 7 | 9.8, 8.3(10) |
| Waw aalamnime Cr @ mouth | 26.88 | 10 | |
| EF Waw aalamnime Cr @ mouth | 2.85 | 3 | |
| WF Waw aalamnime Cr ab Spring Cr | 3.02 | 3 | |
| WF Waw aalamnime Cr @ mouth | 5.38 | 4 | |
| Spring Creek @ mouth | 1.44 | 2 | |
| Doe Creek ab 1st tributary | 7.06 | 5 | |
| Doe Creek @ mouth | 9.7 | 6 | |
| 1st tributary to Doe Creek | 1.92 | 2 | |
| Badger Creek ab 1st tributary | 4 | 4 | 4.2(02) |
| Badger Creek @ mouth | 5.55 | 4 | |
| 1st tributary to Badger Creek | 0.95 | 2 | |
| Cold Storage Creek @ mouth | 0.68 | 1 | |
| Wendover Creek ab WF Wendover | 1.09 | 2 | |
| Wendover Creek @ mouth | 3.94 | 4 | 6.3(02) |
| WF Wendover Creek @ mouth | 1.95 | 2 | |
| Un-named E of Papoose Creek | 0.82 | 2 | |
| Un-named ab Powell Pasture | 0.99 | 2 | |
| Cliff Creek @ mouth | 6.15 | 4 | |
| 1st tributary to Cliff Creek | 0.76 | 1 | |
| Walton Creek ab 1st tributary | 1.17 | 2 | |
| Walton Creek bl 1st tributary | 2.04 | 2 | |
| Walton Creek bl Kube Creek | 5.32 | 4 | |
| Walton Creek @ mouth | 11.13 | 6 | |
| 1st tributary to Walton Creek | 0.87 | 2 | |
| 2nd tributary to Walton Creek | 0.5 | 1 | |
| 3rd tributary to Walton Creek | 1.55 | 2 | |
| Kube Creek @ mouth | 1.02 | 2 | |
| Papoose Creek bl EF/WF confluence | 15.17 | 7 | |
| Papoose Creek @ mouth | 20.8 | 8 | 7.4(02) |
| Parachute Creek @ mouth | 4.35 | 4 | 3.8(02) |
| WF Papoose Creek right fork | 0.48 | 1 | |
| WF Papoose Creek left fork | 0.93 | 2 | |
| WF Papoose Creek bl 2nd tributary | 4.65 | 4 | |
| WF Papoose Creek @ confluence | 10.66 | 6 | 7.4(07) |
| 1st tributary to WF Papoose Cr | 1.37 | 2 | |
| 2nd tributary to WF Papoose Cr | 0.87 | 2 | |
| 3rd tributary to WF Papoose Cr | 2.6 | 3 | |
| 4th tributary to WF Papoose Cr | 0.7 | 1 | |
| EF Papoose Creek ab 1st tributary | 2.23 | 3 | |
| EF Papoose Creek @ confluence | 4.51 | 4 | 5.2(07) |
| 1st tributary to EF Papoose Cr | 0.95 | 2 | |

| | | | |
|---|---|---|---|
| Colt Killed Creek bl Storm Creek | 213.94 | 28 | |
| Colt Killed Creek ab Beaver Creek | 228.24 | 29 | |
| Colt Killed Creek @ mouth | 247.19 | 30 | |
| 1st tributary to Colt Killed Creek | 0.68 | 1 | |
| Crab Creek @ mouth | 2.48 | 3 | |
| 2nd tributary to Colt Killed Creek | 0.56 | 1 | |
| 3rd tributary to Colt Killed Creek | 0.51 | 1 | |
| 4th tributary to Colt Killed Creek | 1.17 | 2 | |
| Cabin Creek ab 1st tributary | 3.56 | 3 | |
| Cabin Creek @ mouth | 4.69 | 4 | |
| 1st tributary to Cabin Creek | 0.46 | 1 | |
| Beaver Creek ab 1st tributary | 2.31 | 3 | |
| Beaver Creek bl 2nd tributary | 6.65 | 5 | |
| Beaver Creek @ mouth | 11.28 | 6 | |
| 1st tributary to Beaver Creek | 0.99 | 2 | |
| 2nd tributary to Beaver Creek | 1.22 | 2 | |
| 3rd tributary to Beaver Creek | 0.85 | 2 | |
| 4th tributary to Beaver Creek | 0.82 | 2 | |
| Crooked Fork bl Boulder Creek | 55.43 | 14 | |
| Crooked Fork bl Haskell Creek | 72.41 | 16 | |
| Crooked Fork ab Brushy Fork | 73.69 | 16 | |
| Crooked Fork bl Brushy Fork | 155.03 | 24 | |
| Crooked Fork @ mouth | 169.44 | 25 | |
| Shotgun Creek ab 1st tributary | 1.01 | 2 | |
| Shotgun Creek @ mouth | 5.74 | 4 | |
| 1st tributary to Shotgun Creek | 0.73 | 1 | |
| 2nd tributary to Shotgun Creek | 0.48 | 1 | |
| 1st tributary to Crooked Fork | 0.56 | 1 | |
| 2nd tributary to Crooked Fork | 0.92 | 2 | |
| Rock Creek @ mouth | 2.78 | 3 | |
| Haskell Creek ab 1st tributary | 1.58 | 2 | 3.1(98) |
| Haskell Creek @ mouth | 3.22 | 3 | |
| 1st tributary to Haskell Creek | 0.59 | 1 | |
| 3rd tributary to Crooked Fork | 0.85 | 2 | |
| 4th tributary to Crooked Fork | 0.6 | 1 | |
| 5th tributary to Crooked Fork | 0.65 | 1 | |
| 6th tributary to Crooked Fork | 0.71 | 1 | |
| 7th tributary to Crooked Fork | 2.11 | 3 | |
| 8th tributary to Crooked Fork | 0.94 | 2 | |
| 9th tributary to Crooked Fork | 0.56 | 1 | |
| 10th tributary to Crooked Fork | 1.39 | 2 | |
| 11th tributary to Crooked Fork | 0.61 | 1 | |

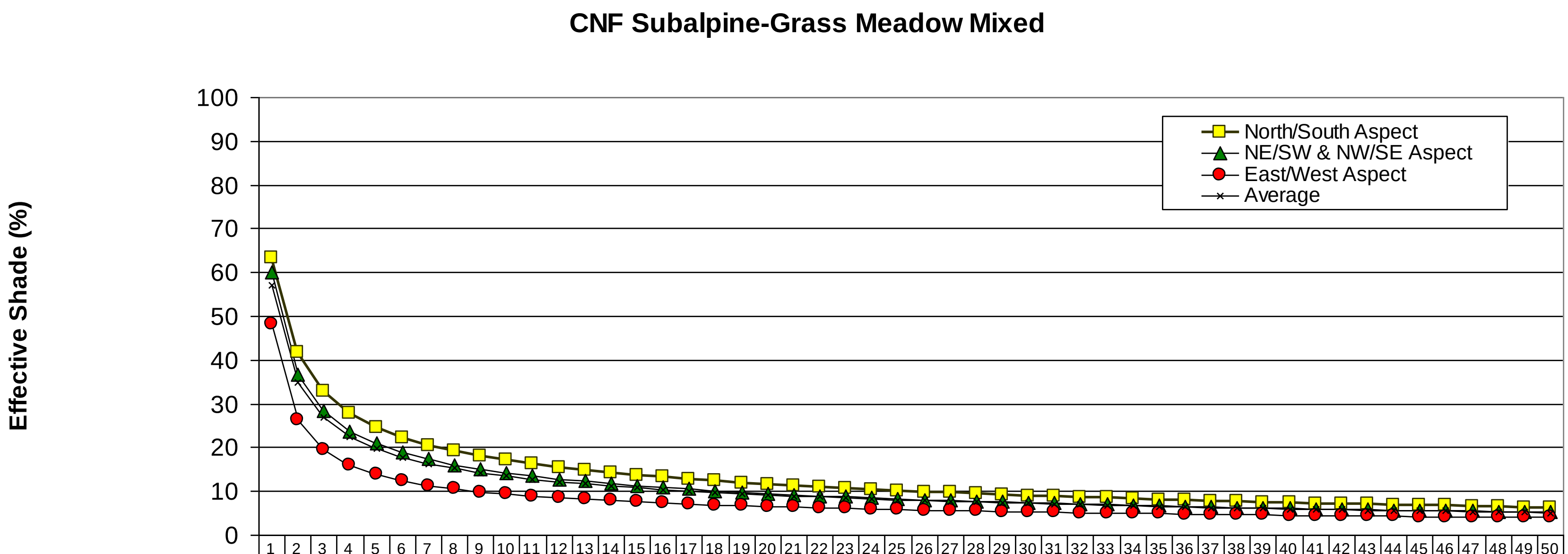
| | | | |
|---|---|---|---|
| Brushy Fork ab Elk Meadows | 3.9 | 3 | |
| Brushy Fork ab 1st tributary | 11.89 | 6 | |
| Brushy Fork ab Spruce Creek | 16.03 | 7 | |
| Brushy Fork bl Spruce Creek | 40.63 | 12 | 15.8, 18.1, 15.1(10) |
| Brushy Fork ab Twin Creek | 51.32 | 13 | |
| Brushy Fork bl Twin Creek | 59.39 | 14 | |
| Brushy Fork @ mouth | 81.34 | 17 | |
| 1st tributary to Brushy Fork | 1.46 | 2 | |
| 2nd tributary to Brushy Fork | 0.88 | 2 | |
| 3rd tributary to Brushy Fork | 1.08 | 2 | |
| 4th tributary to Brushy Fork | 1.75 | 2 | |
| 5th tributary to Brushy Fork | 0.73 | 1 | |
| Twin Creek ab Cherokee Creek | 5.63 | 4 | |
| Twin Creek @ mouth | 8.07 | 5 | |
| 1st tributary to Twin Creek | 0.92 | 2 | |
| 2nd tributary to Twin Creek | 0.56 | 1 | |
| Cherokee Creek ab 1st tributary | 1.21 | 2 | |
| Cherokee Creek @ mouth | 2.3 | 3 | |
| 1st tributary to Cherokee Creek | 0.59 | 1 | |
| 6th tributary to Brushy Fork | 1.71 | 2 | |
| 1st tributary to 6th tributary | 0.33 | 1 | |
| 7th tributary to Brushy Fork | 2.91 | 3 | |
| Pack Creek ab Packer Meadows | 2.69 | 3 | |
| Pack Creek ab 1st tributary | 7.4 | 5 | 5.8(98) 4.4(07) |
| Pack Creek @ mouth | 11.16 | 6 | |
| 1st tributary to Pack Creek | 0.8 | 2 | |
| 8th tributary to Brushy Fork | 0.34 | 1 | |
| Spruce Creek bl NF/SF confluence | 13.69 | 7 | |
| Spruce Creek @ mouth | 24.6 | 9 | 10.8(10) |
| 1st tributary to Spruce Creek | 0.65 | 1 | |
| Shoot Creek @ mouth | 5.13 | 4 | |
| SF Spruce Creek @ wilderness bdy | 2.43 | 3 | |
| SF Spruce Creek @ confluence | 8.35 | 5 | |
| un-connected tributary to SF Spruce | 1.22 | 2 | |
| NF Spruce Creek ab 1st tributary | 1.3 | 2 | |
| NF Spruce Creek @ confluence | 5.34 | 4 | |
| 1st tributary to NF Spruce Creek | 0.69 | 1 | |




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

| "Vegetation" Channel Width (meters) | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North/South Aspect | 17 | 17 | 16 | 16 | 15 | 15 | 15 | 14 | 14 | 13 | 13 | 13 | 13 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | 10 | 10 | 10 | 10 |
| NE/SW & NW/SE Aspect | 15 | 14 | 14 | 13 | 13 | 13 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | 10 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 9 | 9 | 8 | 8 |
| East/West Aspect | 10 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| Average | 14 | 13 | 13 | 13 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 8 |

**Figure C-1. Shade curve for the Clearwater National Forest (CNF) Upland Forest – Alder Mixed community type.**




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North/South Aspect | 63 | 42 | 33 | 28 | 25 | 22 | 21 | 19 | 18 | 17 | 16 | 15 | 15 | 14 | 14 | 13 | 13 | 12 | 12 | 12 | 11 | 11 | 11 | 10 | 10 |
| NE/SW & NW/SE Aspect | 60 | 37 | 28 | 24 | 21 | 19 | 17 | 16 | 15 | 14 | 13 | 13 | 12 | 12 | 11 | 11 | 11 | 10 | 10 | 10 | 9 | 9 | 9 | 9 | 8 |
| East/West Aspect | 48 | 26 | 19 | 16 | 14 | 12 | 11 | 11 | 10 | 9 | 9 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 6 |
| Average | 57 | 35 | 27 | 23 | 20 | 18 | 16 | 15 | 14 | 14 | 13 | 12 | 12 | 11 | 11 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 9 | 8 | 8 |

| | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North/South Aspect | 10 | 10 | 9 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 6 |
| NE/SW & NW/SE Aspect | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 |
| East/West Aspect | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Average | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 5 |

"Vegetation" Channel Width (meters)

**Figure C-2. Shade curve for the Clearwater National Forest (CNF) Subalpine Forest – Graminoid Meadow Mixed community type.**

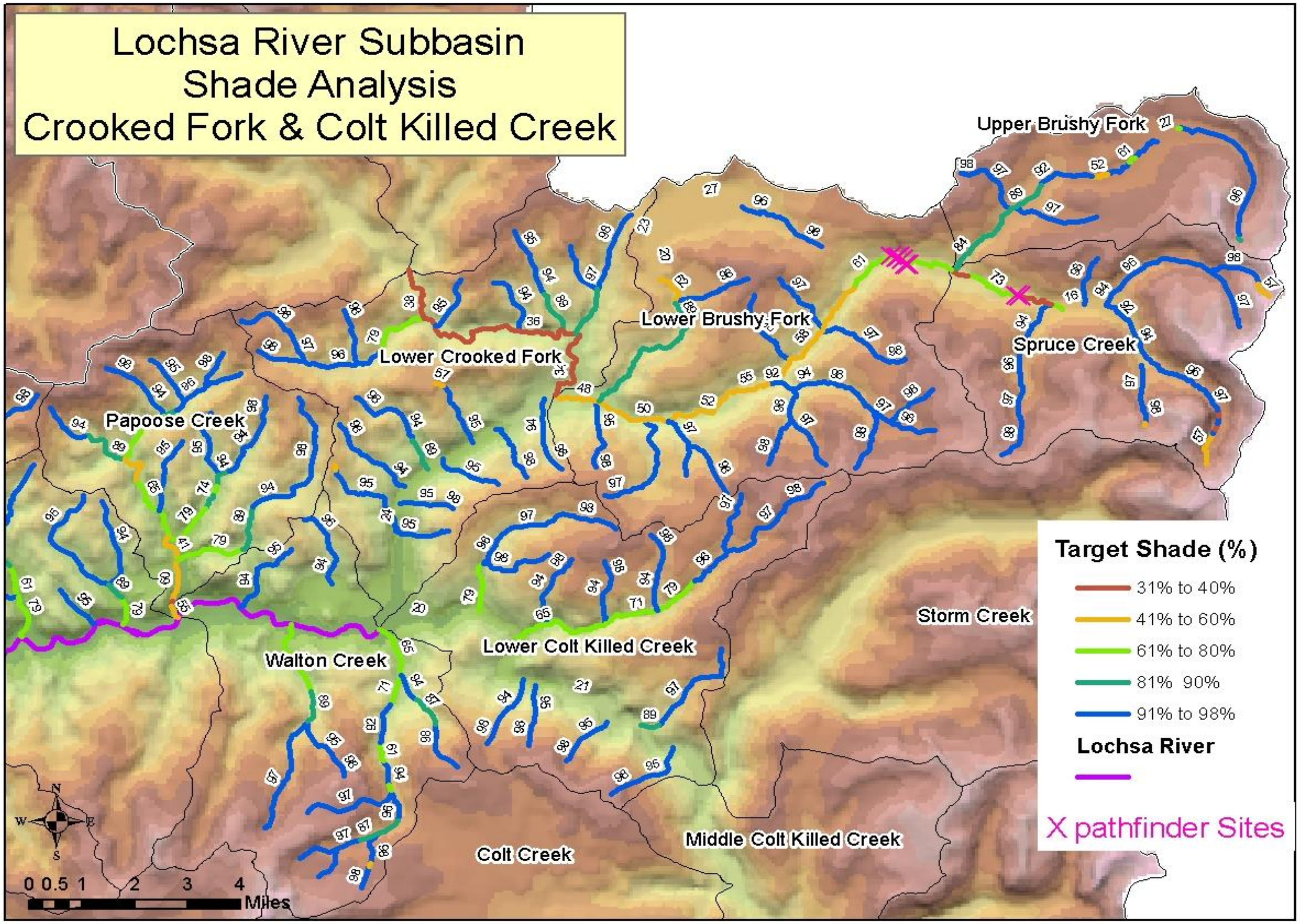



**Figure C-3. Target shade for assessment units in the upper Lochsa River subbasin.**

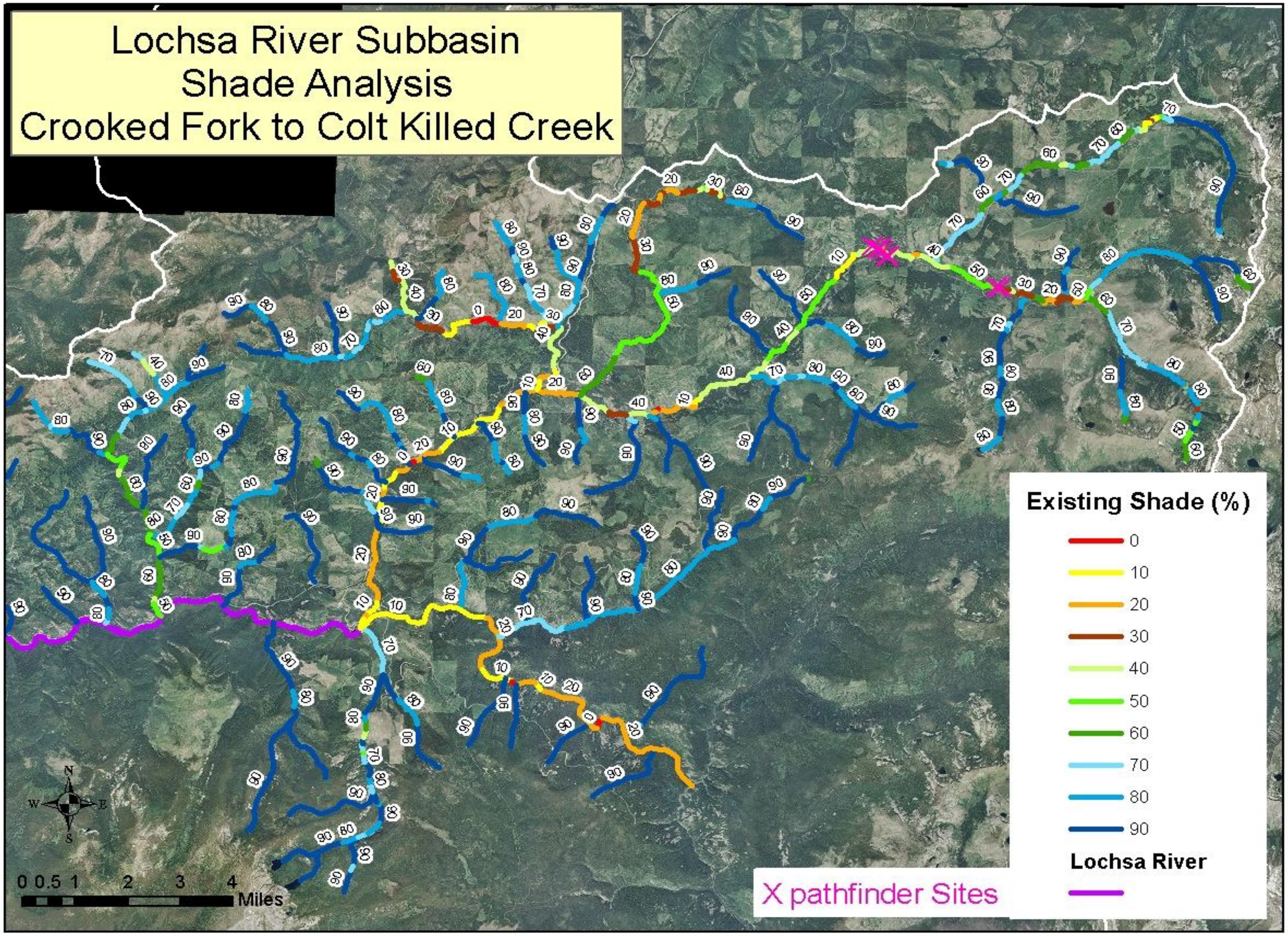



**Figure C-4. Existing shade from aerial photo interpretation for assessment units in the upper Lochsa River subbasin.**

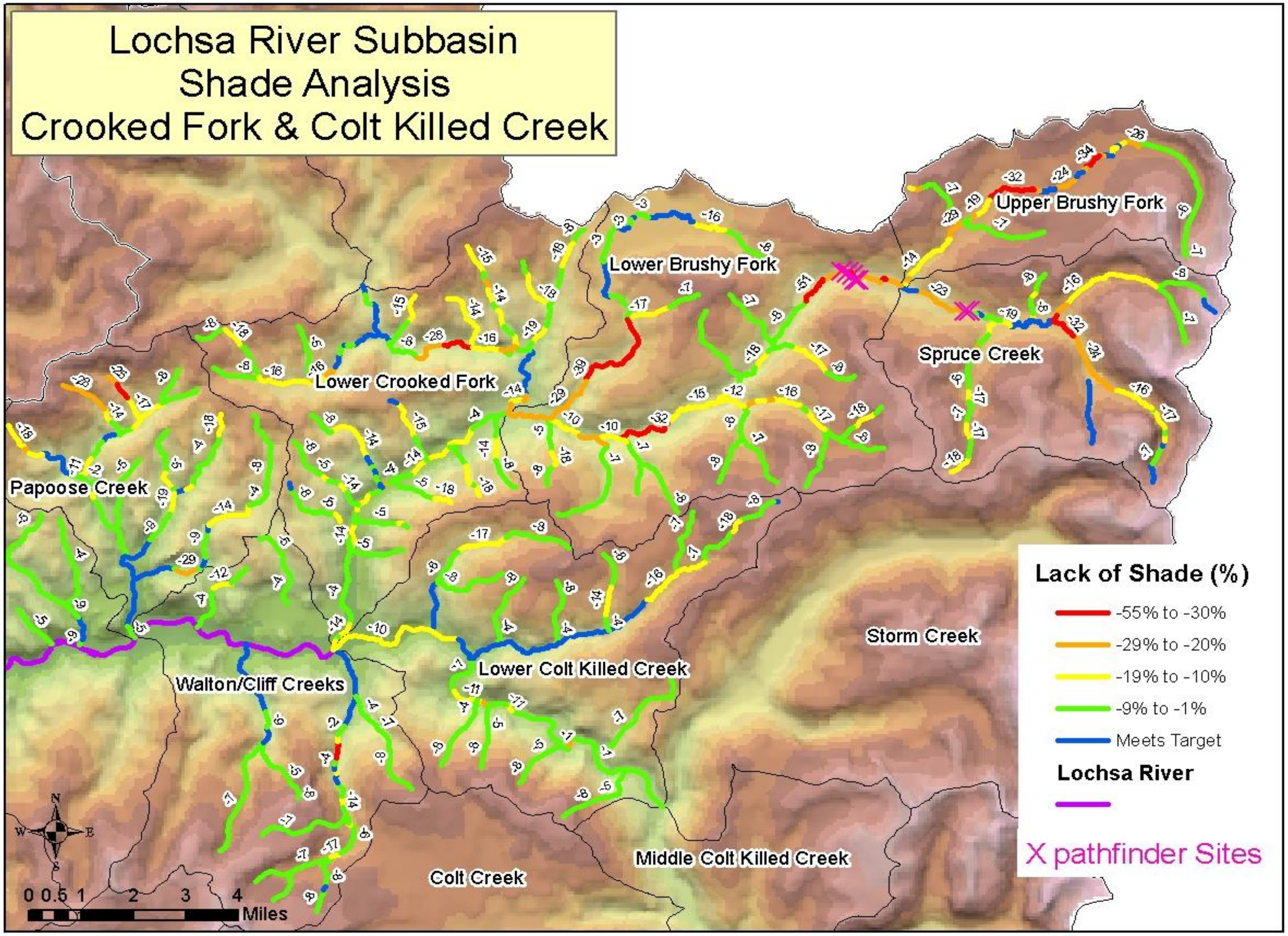



**Figure C-5. Lack of shade for assessment units in the upper Lochsa River subbasin.**

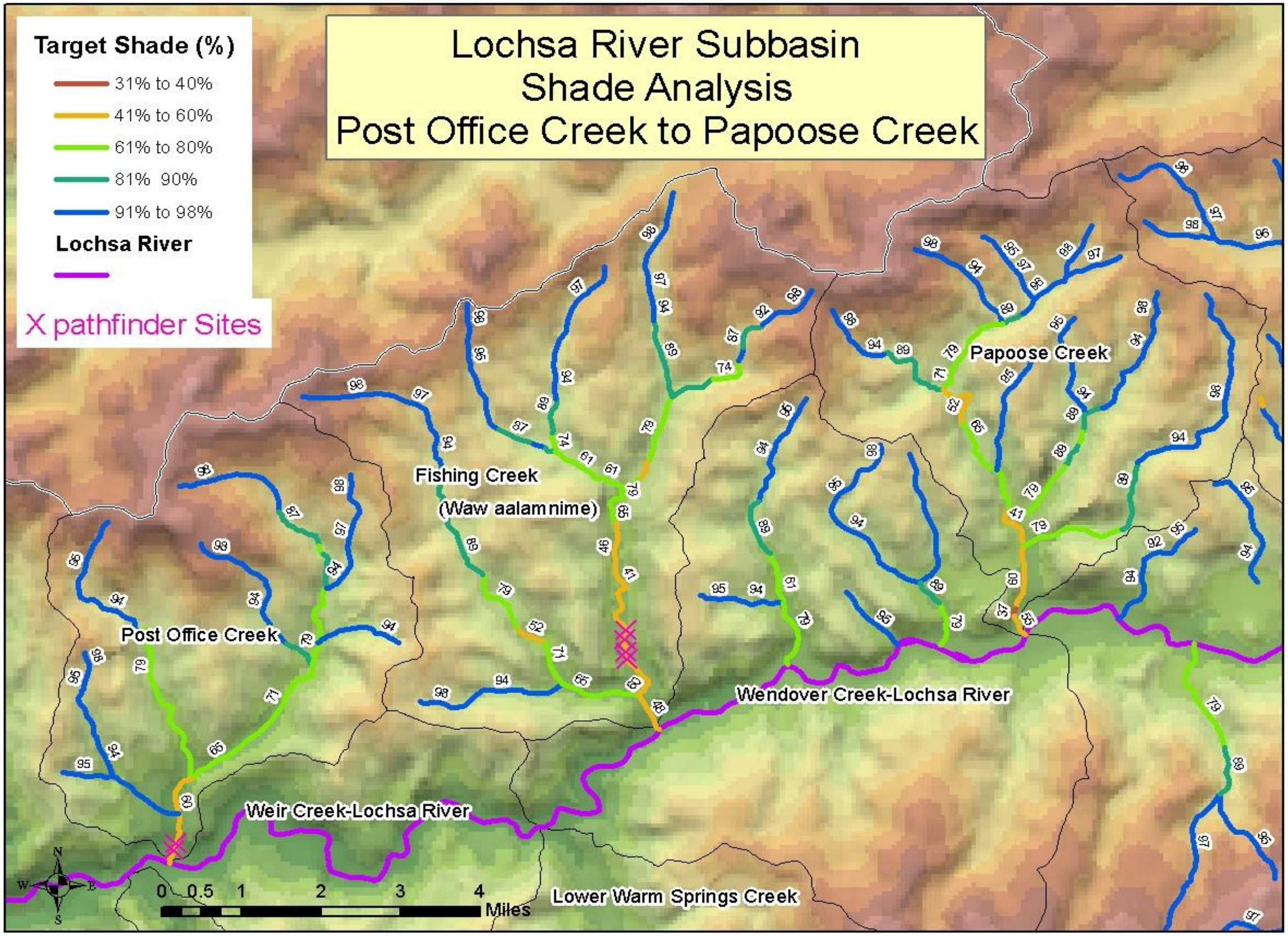



**Figure C-6. Target shade for assessment units in the middle Lochsa River subbasin.**

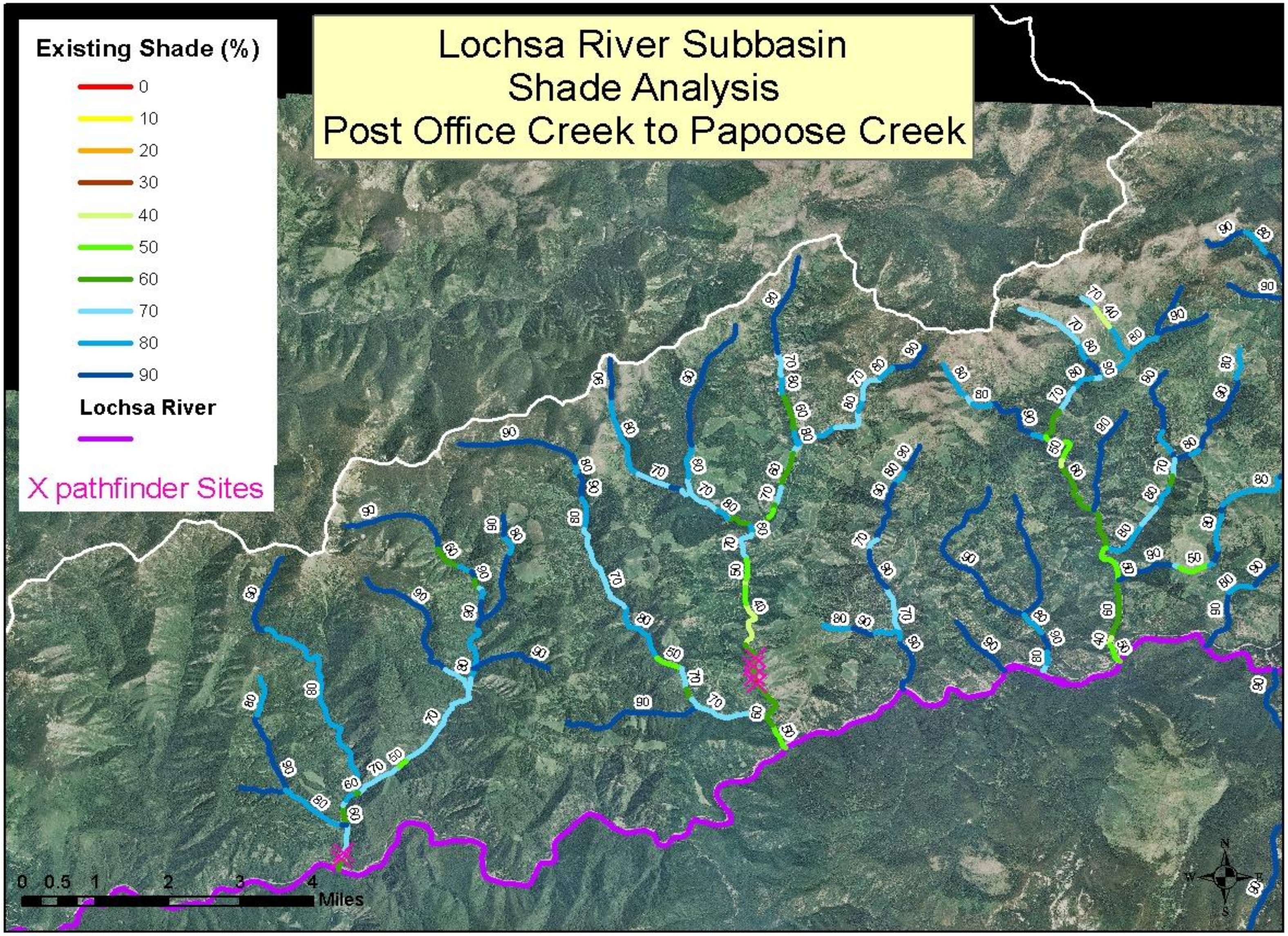



**Figure C-7. Existing shade from aerial photo interpretation for assessment units in the middle Lochsa River subbasin.**

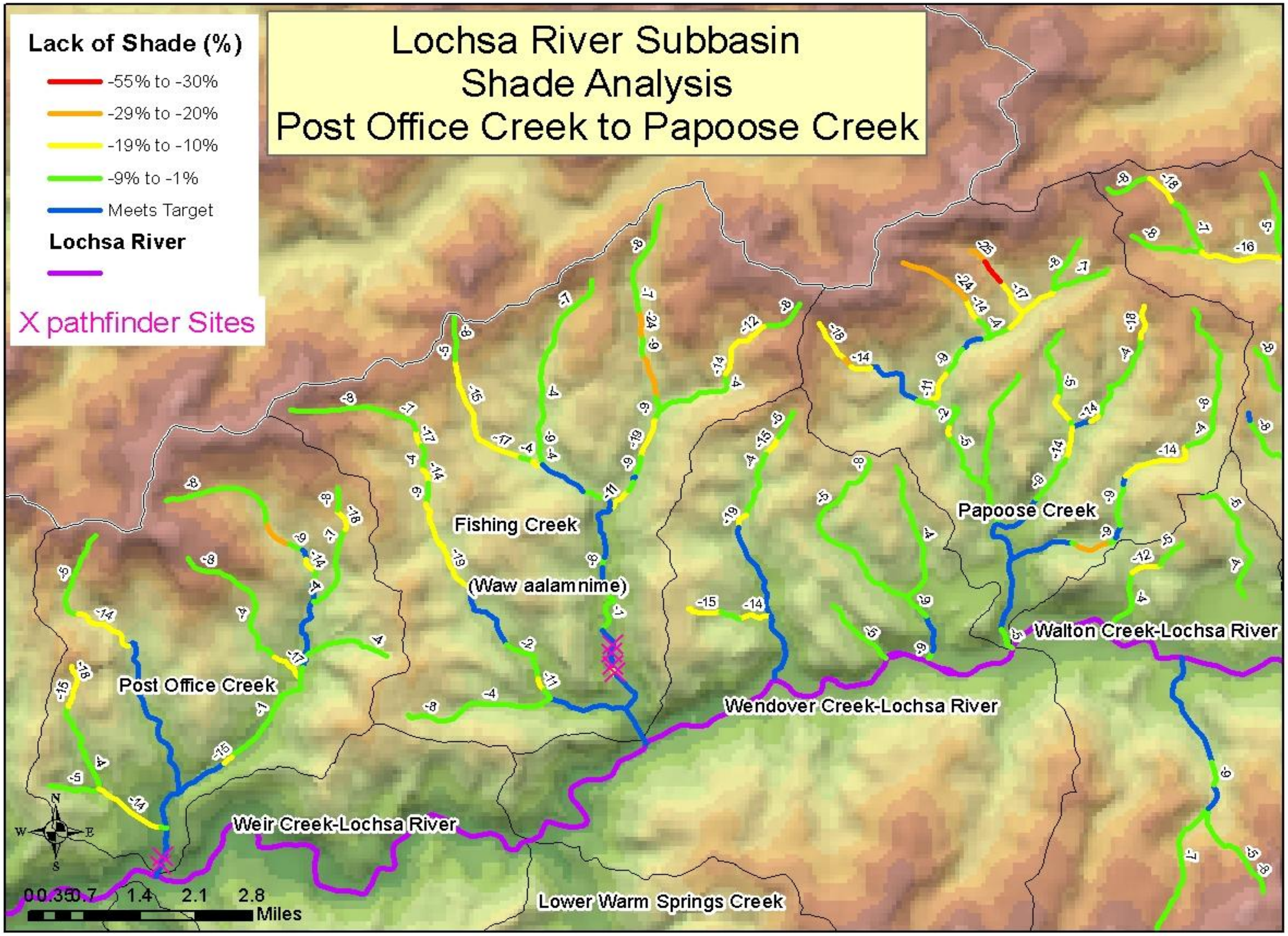



**Figure C-8. Lack of shade for assessment units in the middle Lochsa River subbasin.**

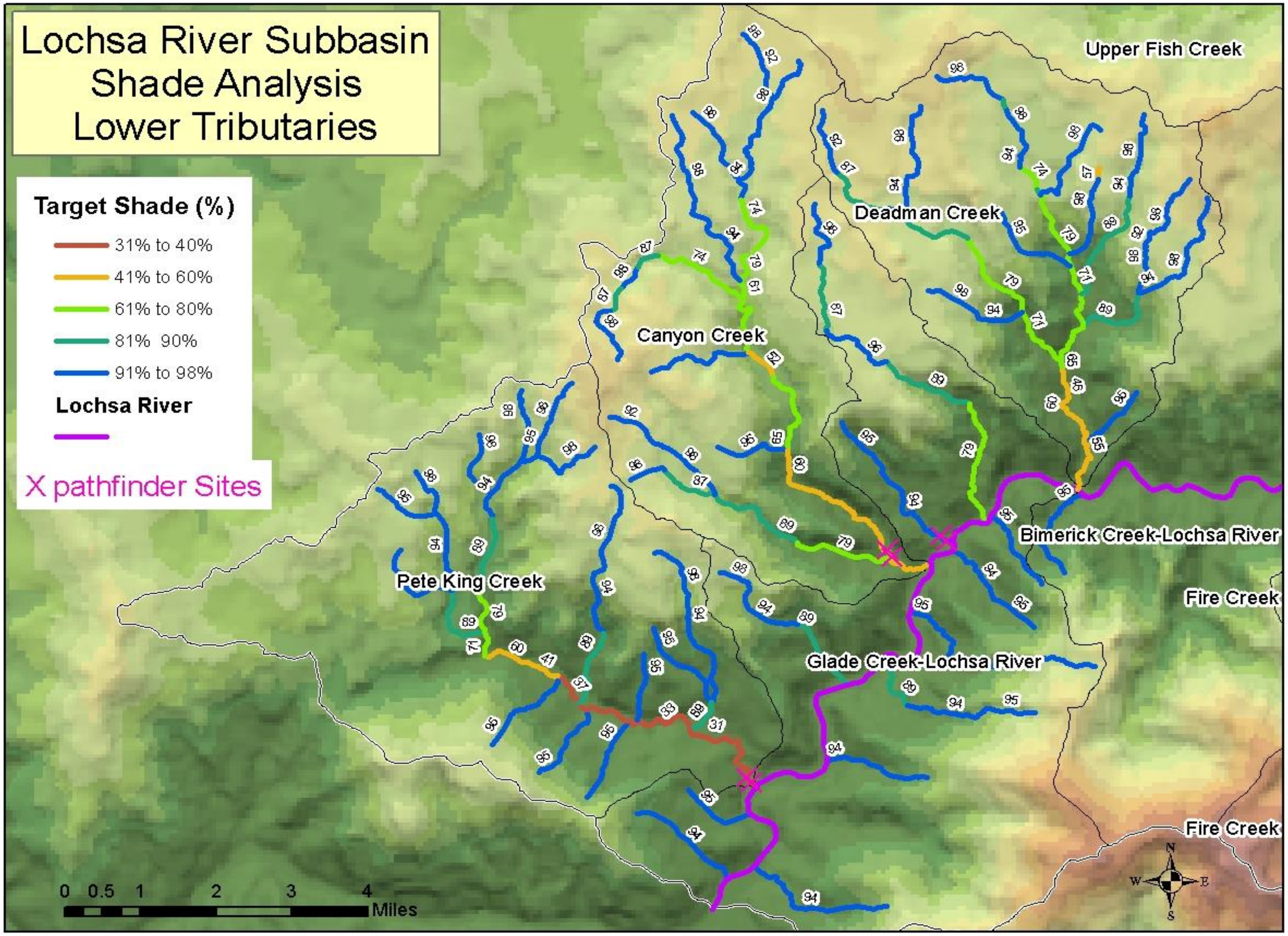



**Figure C-9. Target shade for assessment units in the lower Lochsa River subbasin.**

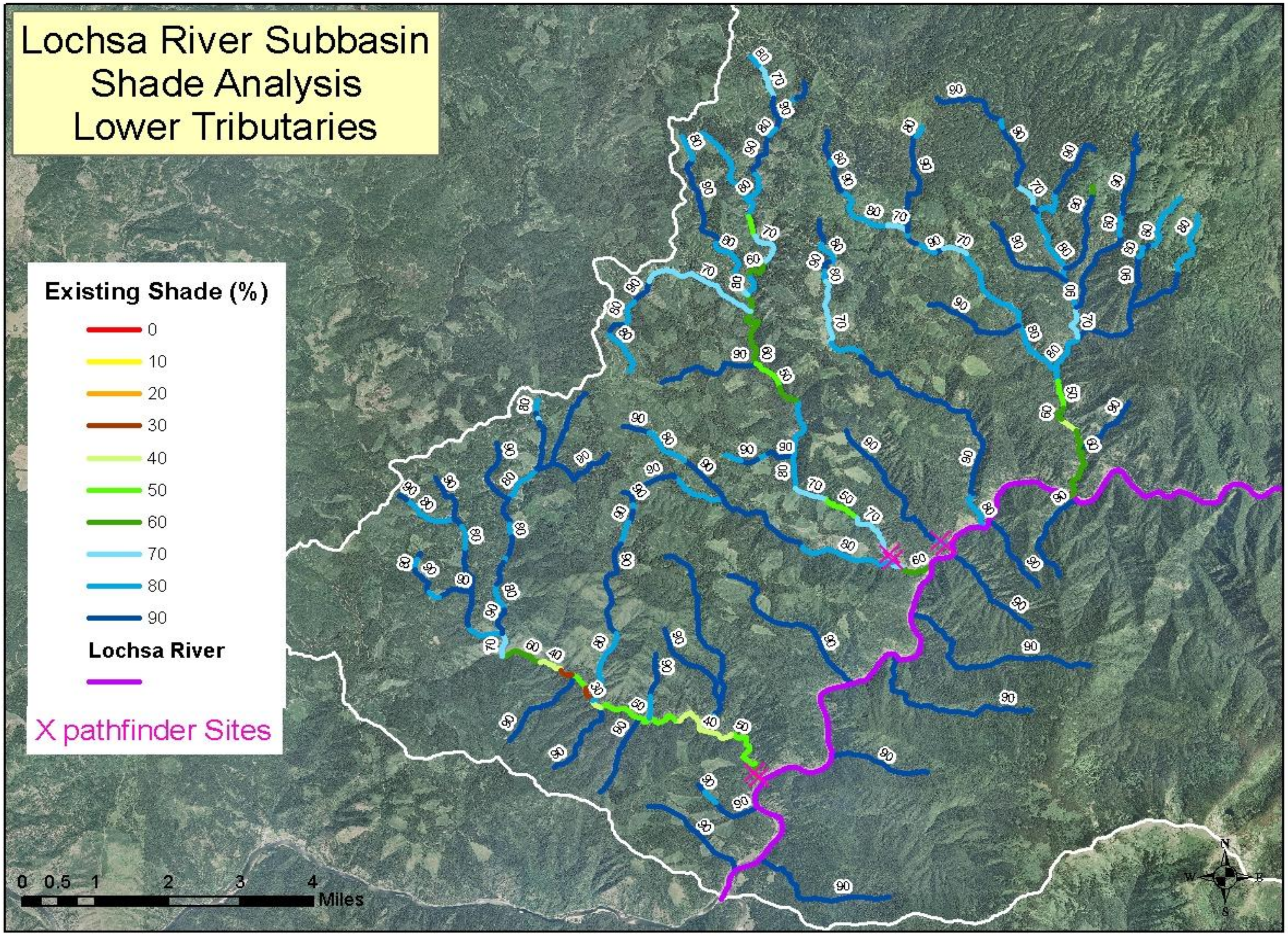



**Figure C-10. Existing shade from aerial photo interpretation for assessment units in the lower Lochsa River subbasin.**

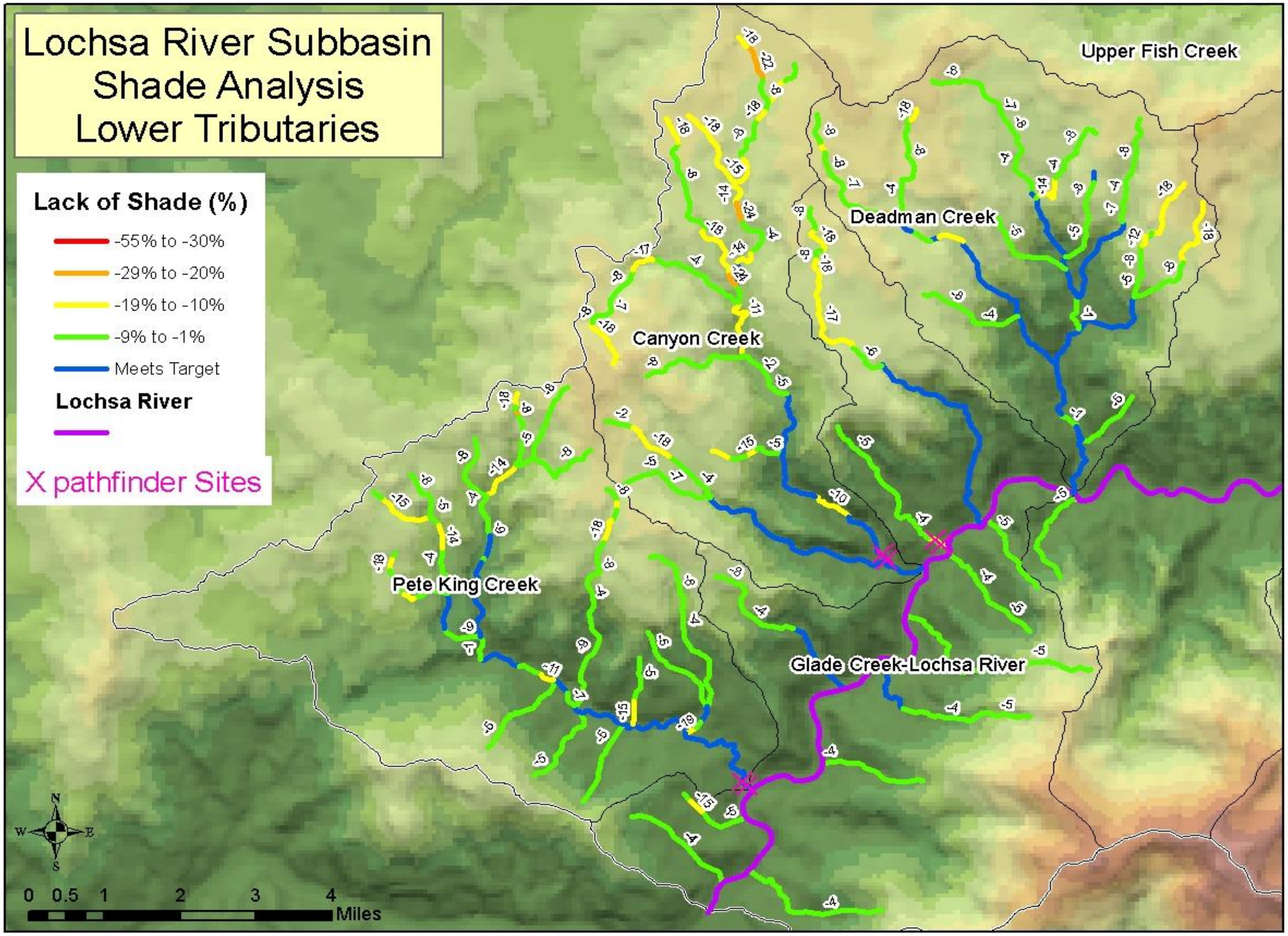



**Figure C-11. Lack of shade for assessment units in the lower Lochsa River subbasin.**

*This page intentionally left blank for correct double-sided printing.*

# Appendix D. Load Analysis Tables

**Table D-1. Existing and potential solar loads for lower Lochsa River tributaries (AU# ID17060303CL001_02).**

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m²/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m²/day) | Potential Load minus Existing load (kWh/m²/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m²) | Existing Summer Load (kWh/day) | Natural Segment Area (m²) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Lower Lochsa Tributaries** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL001_02 | | | | | | | | | | | | | | | |
| 2600 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 5200 | 2860 | 5200 | 1716 | -1144 | -4 | breakland | un-named/Lowell |
| 3400 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 6800 | 3740 | 6800 | 2244 | -1496 | -4 | | Lottie Creek |
| 220 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 220 | 121 | 220 | 60.5 | -60.5 | -5 | | Lowell Creek |
| 340 | 0.8 | 1.1 | 0.95 | 0.275 | -0.825 | 1 | 1 | 340 | 374 | 340 | 93.5 | -280.5 | -15 | | |
| 1100 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 1100 | 605 | 1100 | 302.5 | -302.5 | -5 | | |
| 2300 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 4600 | 2530 | 4600 | 1518 | -1012 | -4 | | Cat Creek |
| 770 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 770 | 423.5 | 770 | 84.7 | -338.8 | -8 | upland | Rye Patch Creek |
| 1700 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 3400 | 1870 | 3400 | 1122 | -748 | -4 | breakland | |
| 1800 | 0.9 | 0.55 | 0.89 | 0.605 | 0.055 | 3 | 3 | 5400 | 2970 | 5400 | 3267 | 297 | 0 | | |
| 1400 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 1400 | 770 | 1400 | 385 | -385 | -5 | | Handy Creek |
| 1400 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 2800 | 1540 | 2800 | 924 | -616 | -4 | | |
| 1500 | 0.9 | 0.55 | 0.89 | 0.605 | 0.055 | 3 | 3 | 4500 | 2475 | 4500 | 2722.5 | 247.5 | 0 | | |
| 2600 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 2600 | 1430 | 2600 | 715 | -715 | -5 | | Hellgate Creek |
| 2500 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 5000 | 2750 | 5000 | 1650 | -1100 | -4 | | |
| 1300 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 1300 | 715 | 1300 | 357.5 | -357.5 | -5 | | Chance Creek |
| 1300 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 2600 | 1430 | 2600 | 858 | -572 | -4 | | |
| 2000 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 2000 | 1100 | 2000 | 550 | -550 | -5 | | Apgar Creek |
| 1500 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 3000 | 1650 | 3000 | 990 | -660 | -4 | | |
| 490 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 3 | 2 | 1470 | 1617 | 980 | 323.4 | -1293.6 | -14 | | |
| 590 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 590 | 324.5 | 590 | 64.9 | -259.6 | -8 | upland | Glade Creek |
| 620 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 620 | 682 | 620 | 68.2 | -613.8 | -18 | | |
| 270 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 270 | 148.5 | 270 | 29.7 | -118.8 | -8 | | |
| 260 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 260 | 286 | 260 | 28.6 | -257.4 | -18 | | |
| 1500 | 0.7 | 1.65 | 0.87 | 0.715 | -0.935 | 2 | 2 | 3000 | 4950 | 3000 | 2145 | -2805 | -17 | alder mix | |
| 860 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 2 | 2 | 1720 | 1892 | 1720 | 189.2 | -1702.8 | -18 | upland | |
| 830 | 0.9 | 0.55 | 0.96 | 0.22 | -0.33 | 3 | 3 | 2490 | 1369.5 | 2490 | 547.8 | -821.7 | -6 | | |
| 2200 | 0.9 | 0.55 | 0.89 | 0.605 | 0.055 | 3 | 3 | 6600 | 3630 | 6600 | 3993 | 363 | 0 | breakland | |
| 2100 | 0.9 | 0.55 | 0.79 | 1.155 | 0.605 | 4 | 4 | 8400 | 4620 | 8400 | 9702 | 5082 | 0 | | |
| 970 | 0.8 | 1.1 | 0.79 | 1.155 | 0.055 | 4 | 4 | 3880 | 4268 | 3880 | 4481.4 | 213.4 | 0 | | |
| 2000 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 2000 | 1100 | 2000 | 550 | -550 | -5 | | un-named/Glade |
| 2400 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 2400 | 1320 | 2400 | 660 | -660 | -5 | | un-named/Deadman |
| | | | | | | | **Total** | **86,730** | **55,561** | **86,240** | **42,343** | **-13,218** | **-7** | | |

**Table D-2. Existing and potential solar loads for Cold Storage Creek and others (AU# 17060303CL020_02a).**

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m$^2$/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m$^2$/day) | Potential Load minus Existing load (kWh/m$^2$/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m$^2$) | Existing Summer Load (kWh/day) | Natural Segment Area (m$^2$) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Cold Storage Creek & Others** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL020_02a | | | | | | | | | | | | | | | |
| 1500 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 1500 | 825 | 1500 | 412.5 | -412.5 | -5 | breakland | Cold Storage Cr |
| 670 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 670 | 368.5 | 670 | 184.25 | -184.25 | -5 | | un-named E of Papoose Cr |
| 640 | 0.8 | 1.1 | 0.92 | 0.44 | -0.66 | 1 | 1 | 640 | 704 | 640 | 281.6 | -422.4 | -12 | alder mix | |
| 1500 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 3000 | 1650 | 3000 | 990 | -660 | -4 | breakland | |
| 1400 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 1400 | 770 | 1400 | 385 | -385 | -5 | | un-named ab Powell Pasture |
| 1300 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 2600 | 1430 | 2600 | 858 | -572 | -4 | | |
| | | | | | | | **Total** | **9,810** | **5,748** | **9,810** | **3,111** | **-2,636** | **-6** | | |

**Table D-3. Existing and potential solar loads for Cliff Creek and tributary (AU# 17060303CL022_02).**

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m$^2$/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m$^2$/day) | Potential Load minus Existing load (kWh/m$^2$/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m$^2$) | Existing Summer Load (kWh/day) | Natural Segment Area (m$^2$) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Cliff Creek & Tributary** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL022_02 | | | | | | | | | | | | | | | |
| 630 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 630 | 346.5 | 630 | 69.3 | -277.2 | -8 | subalpine | Tributary to Cliff Creek |
| 1700 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 1700 | 935 | 1700 | 467.5 | -467.5 | -5 | breakland | |
| 4100 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 8200 | 4510 | 8200 | 1353 | -3157 | -7 | subalpine | Cliff Creek |
| 580 | 0.9 | 0.55 | 0.89 | 0.605 | 0.055 | 3 | 3 | 1740 | 957 | 1740 | 1052.7 | 95.7 | 1 | breakland | |
| 510 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 1530 | 1683 | 1530 | 925.65 | -757.35 | -9 | | |
| 2600 | 0.9 | 0.55 | 0.79 | 1.155 | 0.605 | 4 | 4 | 10400 | 5720 | 10400 | 12012 | 6292 | 0 | | |
| | | | | | | | **Total** | **24,200** | **14,152** | **24,200** | **15,880** | **1,729** | **-5** | | |

## Table D-4. Existing and potential solar loads for Walton Creek and tributaries (AU# 17060303CL023_02).

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m²/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m²/day) | Potential Load minus Existing load (kWh/m²/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m²) | Existing Summer Load (kWh/day) | Natural Segment Area (m²) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Walton Creek & Tributaries** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL023_02 | | | | | | | | | | | | | | | |
| 540 | 0 | 5.5 | 0 | 5.5 | 0 | 240 | 240 | 129600 | 712800 | 129600 | 712800 | 0 | 0 | lake | 1st tributary to |
| 1200 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 2400 | 1320 | 2400 | 396 | -924 | -7 | subalpine | Walton Creek |
| 740 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 740 | 407 | 740 | 81.4 | -325.6 | -8 | | 2nd tributary to |
| 120 | 0.7 | 1.65 | 0.57 | 2.365 | 0.715 | 1 | 1 | 120 | 198 | 120 | 283.8 | 85.8 | 0 | meadow | Walton Creek |
| 1100 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 1100 | 605 | 1100 | 121 | -484 | -8 | subalpine | |
| 3000 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 6000 | 3300 | 6000 | 990 | -2310 | -7 | | Kube Creek |
| 1700 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 1700 | 935 | 1700 | 187 | -748 | -8 | | 3rd tributary to |
| 1000 | 0.8 | 1.1 | 0.87 | 0.715 | -0.385 | 2 | 2 | 2000 | 2200 | 2000 | 1430 | -770 | -7 | alder mix | Walton Creek |
| 940 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 1880 | 1034 | 1880 | 620.4 | -413.6 | -4 | breakland | |
| 470 | 0 | 5.5 | 0 | 5.5 | 0 | 240 | 240 | 112800 | 620400 | 112800 | 620400 | 0 | 0 | lake | Walton Creek |
| 2100 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 4200 | 2310 | 4200 | 693 | -1617 | -7 | subalpine | |
| 520 | 0.8 | 1.1 | 0.87 | 0.715 | -0.385 | 2 | 2 | 1040 | 1144 | 1040 | 743.6 | -400.4 | -7 | alder mix | |
| 310 | 0.7 | 1.65 | 0.87 | 0.715 | -0.935 | 2 | 2 | 620 | 1023 | 620 | 443.3 | -579.7 | -17 | | |
| 500 | 0.8 | 1.1 | 0.87 | 0.715 | -0.385 | 2 | 2 | 1000 | 1100 | 1000 | 715 | -385 | -7 | | |
| 630 | 0.9 | 0.55 | 0.96 | 0.22 | -0.33 | 3 | 3 | 1890 | 1039.5 | 1890 | 415.8 | -623.7 | -6 | subalpine | |
| 100 | 0.8 | 1.1 | 0.96 | 0.22 | -0.88 | 3 | 3 | 300 | 330 | 300 | 66 | -264 | -16 | | |
| 340 | 0.9 | 0.55 | 0.96 | 0.22 | -0.33 | 3 | 3 | 1020 | 561 | 1020 | 224.4 | -336.6 | -6 | | |
| 200 | 0.7 | 1.65 | 0.74 | 1.43 | -0.22 | 3 | 3 | 600 | 990 | 600 | 858 | -132 | -4 | alder mix | |
| 360 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 4 | 4 | 1440 | 1584 | 1440 | 475.2 | -1108.8 | -14 | subalpine | |
| 490 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 4 | 4 | 1960 | 1078 | 1960 | 646.8 | -431.2 | -4 | | |
| 330 | 0.7 | 1.65 | 0.61 | 2.145 | 0.495 | 4 | 4 | 1320 | 2178 | 1320 | 2831.4 | 653.4 | 0 | alder mix | |
| 120 | 0.5 | 2.75 | 0.61 | 2.145 | -0.605 | 4 | 4 | 480 | 1320 | 480 | 1029.6 | -290.4 | -11 | | |
| 180 | 0.7 | 1.65 | 0.61 | 2.145 | 0.495 | 4 | 4 | 720 | 1188 | 720 | 1544.4 | 356.4 | 0 | | |
| 210 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 4 | 4 | 840 | 462 | 840 | 277.2 | -184.8 | -4 | subalpine | |
| 280 | 0.4 | 3.3 | 0.92 | 0.44 | -2.86 | 5 | 5 | 1400 | 4620 | 1400 | 616 | -4004 | -52 | | |
| 280 | 0.6 | 2.2 | 0.92 | 0.44 | -1.76 | 5 | 5 | 1400 | 3080 | 1400 | 616 | -2464 | -32 | | |
| 250 | 0.8 | 1.1 | 0.92 | 0.44 | -0.66 | 5 | 5 | 1250 | 1375 | 1250 | 550 | -825 | -12 | | |
| 330 | 0.9 | 0.55 | 0.92 | 0.44 | -0.11 | 5 | 5 | 1650 | 907.5 | 1650 | 726 | -181.5 | -2 | | |
| 1000 | 0.9 | 0.55 | 0.71 | 1.595 | 1.045 | 5 | 5 | 5000 | 2750 | 5000 | 7975 | 5225 | 0 | breakland | |
| 1800 | 0.7 | 1.65 | 0.65 | 1.925 | 0.275 | 6 | 6 | 10800 | 17820 | 10800 | 20790 | 2970 | 0 | | |
| | | | | | | | **Total** | **297,270** | **1,390,059** | **297,270** | **1,379,546** | **-10,513** | **-8** | | |

## Table D-5. Existing and potential solar loads for Colt Killed Creek tributaries (AU# 17060303CL024_02).

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m²/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m²/day) | Potential Load minus Existing load (kWh/m²/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m²) | Existing Summer Load (kWh/day) | Natural Segment Area (m²) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Colt Killed Creek Tributaries** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL024_02 | | | | | | | | | | | | | | | |
| 1200 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 1200 | 660 | 1200 | 132 | -528 | -8 | subalpine | 1st tributary |
| 1600 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 1600 | 880 | 1600 | 440 | -440 | -5 | breakland | |
| 3600 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 7200 | 3960 | 7200 | 1188 | -2772 | -7 | subalpine | Crab Creek |
| 560 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 1680 | 1848 | 1680 | 1016.4 | -831.6 | -9 | breakland | |
| 140 | 0 | 5.5 | 0 | 5.5 | 0 | 80 | 80 | 11200 | 61600 | 11200 | 61600 | 0 | 0 | lake | 2nd tributary |
| 790 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 790 | 434.5 | 790 | 86.9 | -347.6 | -8 | subalpine | |
| 1100 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 1100 | 605 | 1100 | 302.5 | -302.5 | -5 | breakland | |
| 1200 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 1200 | 660 | 1200 | 132 | -528 | -8 | subalpine | 3rd tributary |
| 860 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 860 | 473 | 860 | 236.5 | -236.5 | -5 | breakland | |
| 1300 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 1300 | 715 | 1300 | 143 | -572 | -8 | subalpine | 4th tributary |
| 1200 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 2400 | 1320 | 2400 | 792 | -528 | -4 | breakland | |
| 2100 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 2100 | 1155 | 2100 | 231 | -924 | -8 | subalpine | Cabin Creek |
| 1700 | 0.8 | 1.1 | 0.97 | 0.165 | -0.935 | 2 | 2 | 3400 | 3740 | 3400 | 561 | -3179 | -17 | | |
| 1200 | 0.9 | 0.55 | 0.96 | 0.22 | -0.33 | 3 | 3 | 3600 | 1980 | 3600 | 792 | -1188 | -6 | | |
| 1700 | 0.8 | 1.1 | 0.79 | 1.155 | 0.055 | 4 | 4 | 6800 | 7480 | 6800 | 7854 | 374 | 0 | breakland | |
| 2300 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 2300 | 1265 | 2300 | 253 | -1012 | -8 | subalpine | 1st to Cabin Cr |
| | | | | | | | **Total** | **48,730** | **88,776** | **48,730** | **75,760** | **-13,015** | **-7** | | |

## Table D-6. Existing and potential solar loads for Colt Killed Creek (AU# 17060303CL024_04).

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m²/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m²/day) | Potential Load minus Existing load (kWh/m²/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m²) | Existing Summer Load (kWh/day) | Natural Segment Area (m²) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Colt Killed Creek** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL024_04 | | | | | | | | | | | | | | | |
| 4220 | 0.2 | 4.4 | 0.21 | 4.345 | -0.055 | 28 | 28 | 118160 | 519904 | 118160 | 513405.2 | -6498.8 | -1 | breakland | bl Storm Creek |
| 420 | 0 | 5.5 | 0.21 | 4.345 | -1.155 | 28 | 28 | 11760 | 64680 | 11760 | 51097.2 | -13582.8 | -21 | | |
| 330 | 0.2 | 4.4 | 0.21 | 4.345 | -0.055 | 28 | 28 | 9240 | 40656 | 9240 | 40147.8 | -508.2 | -1 | | |
| 2200 | 0.2 | 4.4 | 0.21 | 4.345 | -0.055 | 29 | 29 | 63800 | 280720 | 63800 | 277211 | -3509 | -1 | | |
| 290 | 0.1 | 4.95 | 0.21 | 4.345 | -0.605 | 29 | 29 | 8410 | 41629.5 | 8410 | 36541.45 | -5088.05 | -11 | | |
| 580 | 0.2 | 4.4 | 0.21 | 4.345 | -0.055 | 29 | 29 | 16820 | 74008 | 16820 | 73082.9 | -925.1 | -1 | | |
| 190 | 0 | 5.5 | 0.21 | 4.345 | -1.155 | 29 | 29 | 5510 | 30305 | 5510 | 23940.95 | -6364.05 | -21 | | |
| 1100 | 0.1 | 4.95 | 0.21 | 4.345 | -0.605 | 29 | 29 | 31900 | 157905 | 31900 | 138605.5 | -19299.5 | -11 | | |
| 1400 | 0.2 | 4.4 | 0.21 | 4.345 | -0.055 | 29 | 29 | 40600 | 178640 | 40600 | 176407 | -2233 | -1 | | |
| 760 | 0.2 | 4.4 | 0.2 | 4.4 | 0 | 30 | 30 | 22800 | 100320 | 22800 | 100320 | 0 | 0 | | Crooked Fork |
| 4600 | 0.1 | 4.95 | 0.2 | 4.4 | -0.55 | 30 | 30 | 138000 | 683100 | 138000 | 607200 | -75900 | -10 | | confluence |
| | | | | | | | **Total** | **467,000** | **2,171,868** | **467,000** | **2,037,959** | **-133,909** | **-7** | | |

## Table D-7. Existing and potential solar loads for Beaver Creek and tributaries (AU# 17060303CL033_02).

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m²/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m²/day) | Potential Load minus Existing load (kWh/m²/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m²) | Existing Summer Load (kWh/day) | Natural Segment Area (m²) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Beaver Creek & Tributaries** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL033_02 | | | | | | | | | | | | | | | |
| 2200 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 4400 | 2420 | 4400 | 726 | -1694 | -7 | subalpine | 1st tributary |
| 1200 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 1200 | 660 | 1200 | 132 | -528 | -8 | | 2nd tributary to |
| 920 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 2 | 2 | 1840 | 2024 | 1840 | 607.2 | -1416.8 | -14 | breakland | Beaver Creek |
| 520 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 1040 | 572 | 1040 | 343.2 | -228.8 | -4 | | |
| 600 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 600 | 330 | 600 | 66 | -264 | -8 | subalpine | 3rd tributary to |
| 1600 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 3200 | 1760 | 3200 | 1056 | -704 | -4 | breakland | Beaver Creek |
| 690 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 690 | 379.5 | 690 | 75.9 | -303.6 | -8 | subalpine | 4th tributary to |
| 1900 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 3800 | 2090 | 3800 | 1254 | -836 | -4 | breakland | Beaver Creek |
| 130 | 0.6 | 2.2 | 0.57 | 2.365 | 0.165 | 1 | 1 | 130 | 286 | 130 | 307.45 | 21.45 | 0 | meadow | Beaver Creek |
| 1300 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 1300 | 715 | 1300 | 143 | -572 | -8 | subalpine | |
| 420 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 420 | 462 | 420 | 46.2 | -415.8 | -18 | | |
| 1500 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 3000 | 1650 | 3000 | 495 | -1155 | -7 | | |
| 2300 | 0.8 | 1.1 | 0.96 | 0.22 | -0.88 | 3 | 3 | 6900 | 7590 | 6900 | 1518 | -6072 | -16 | | |
| 1600 | 0.8 | 1.1 | 0.79 | 1.155 | 0.055 | 4 | 4 | 6400 | 7040 | 6400 | 7392 | 352 | 0 | breakland | |
| 2500 | 0.8 | 1.1 | 0.71 | 1.595 | 0.495 | 5 | 5 | 12500 | 13750 | 12500 | 19937.5 | 6187.5 | 0 | | |
| 2500 | 0.7 | 1.65 | 0.65 | 1.925 | 0.275 | 6 | 6 | 15000 | 24750 | 15000 | 28875 | 4125 | 0 | | |
| | | | | | | | **Total** | **62,420** | **66,479** | **62,420** | **62,974** | **-3,504** | **-7** | | |

**Table D-8. Existing and potential solar loads for Crooked Fork Creek tributaries (AU# 17060303CL034_02).**

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m$^2$/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m$^2$/day) | Potential Load minus Existing load (kWh/m$^2$/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m$^2$) | Existing Summer Load (kWh/day) | Natural Segment Area (m$^2$) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Crooked Fork Tributaries** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL034_02 | | | | | | | | | | | | | | | |
| 1100 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 1100 | 605 | 1100 | 121 | -484 | -8 | subalpine | 3rd tributary to |
| 820 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 2 | 2 | 1640 | 1804 | 1640 | 541.2 | -1262.8 | -14 | breakland | Crooked Fork |
| 650 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 1300 | 715 | 1300 | 429 | -286 | -4 | | |
| 420 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 420 | 462 | 420 | 46.2 | -415.8 | -18 | subalpine | 4th tributary to |
| 130 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 130 | 71.5 | 130 | 14.3 | -57.2 | -8 | | Crooked Fork |
| 570 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 570 | 627 | 570 | 62.7 | -564.3 | -18 | | |
| 910 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 910 | 500.5 | 910 | 250.25 | -250.25 | -5 | breakland | |
| 230 | 0.6 | 2.2 | 0.57 | 2.365 | 0.165 | 1 | 1 | 230 | 506 | 230 | 543.95 | 37.95 | 0 | meadow | 5th tributary |
| 1300 | 0.8 | 1.1 | 0.95 | 0.275 | -0.825 | 1 | 1 | 1300 | 1430 | 1300 | 357.5 | -1072.5 | -15 | breakland | |
| 810 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 810 | 445.5 | 810 | 222.75 | -222.75 | -5 | | |
| 560 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 560 | 616 | 560 | 61.6 | -554.4 | -18 | subalpine | 6th tributary to |
| 1500 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 1500 | 825 | 1500 | 412.5 | -412.5 | -5 | breakland | Crooked Fork |
| 870 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 870 | 478.5 | 870 | 95.7 | -382.8 | -8 | subalpine | 7th tributary to |
| 1400 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 2 | 2 | 2800 | 3080 | 2800 | 924 | -2156 | -14 | breakland | Crooked Fork |
| 390 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 2 | 2 | 780 | 858 | 780 | 257.4 | -600.6 | -14 | | |
| 350 | 0.9 | 0.55 | 0.89 | 0.605 | 0.055 | 3 | 3 | 1050 | 577.5 | 1050 | 635.25 | 57.75 | 0 | | |
| 140 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 420 | 462 | 420 | 254.1 | -207.9 | -9 | | |
| 220 | 0.9 | 0.55 | 0.89 | 0.605 | 0.055 | 3 | 3 | 660 | 363 | 660 | 399.3 | 36.3 | 0 | | |
| 280 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 840 | 924 | 840 | 508.2 | -415.8 | -9 | | |
| 130 | 0.9 | 0.55 | 0.89 | 0.605 | 0.055 | 3 | 3 | 390 | 214.5 | 390 | 235.95 | 21.45 | 0 | | |
| 680 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 680 | 374 | 680 | 74.8 | -299.2 | -8 | subalpine | 8th tributary to |
| 860 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 860 | 473 | 860 | 236.5 | -236.5 | -5 | breakland | Crooked Fork |
| 220 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 2 | 2 | 440 | 484 | 440 | 145.2 | -338.8 | -14 | | |
| 380 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 760 | 418 | 760 | 250.8 | -167.2 | -4 | | |
| 320 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 2 | 2 | 640 | 704 | 640 | 211.2 | -492.8 | -14 | | |
| 580 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 1160 | 638 | 1160 | 382.8 | -255.2 | -4 | | |
| 100 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 100 | 55 | 100 | 11 | -44 | -8 | subalpine | 9th tributary to |
| 190 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 190 | 209 | 190 | 20.9 | -188.1 | -18 | | Crooked Fork |
| 1400 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 1400 | 770 | 1400 | 385 | -385 | -5 | breakland | |
| 160 | 0.6 | 2.2 | 0.57 | 2.365 | 0.165 | 1 | 1 | 160 | 352 | 160 | 378.4 | 26.4 | 0 | meadow | 10th tributary to |
| 630 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 630 | 346.5 | 630 | 69.3 | -277.2 | -8 | subalpine | |
| 1300 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 1300 | 715 | 1300 | 357.5 | -357.5 | -5 | breakland | Crooked Fork |
| 300 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 2 | 2 | 600 | 660 | 600 | 198 | -462 | -14 | | |
| 490 | 0.7 | 1.65 | 0.94 | 0.33 | -1.32 | 2 | 2 | 980 | 1617 | 980 | 323.4 | -1293.6 | -24 | | |
| 460 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 920 | 506 | 920 | 303.6 | -202.4 | -4 | | |
| 1700 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 1700 | 935 | 1700 | 467.5 | -467.5 | -5 | | 11th tributary |
| | | | | | | | **Total** | **30,800** | **24,822** | **30,800** | **10,189** | **-14,633** | **-9** | | |

**Table D-9. Existing and potential solar loads for Crooked Fork Creek (AU# 17060303CL034_05).**

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m²/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m²/day) | Potential Load minus Existing load (kWh/m²/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m²) | Existing Summer Load (kWh/day) | Natural Segment Area (m²) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Crooked Fork** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL034_05 | | | | | | | | | | | | | | | |
| 1300 | 0.2 | 4.4 | 0.24 | 4.18 | -0.22 | 24 | 24 | 31200 | 137280 | 31200 | 130416 | -6864 | -4 | breakland | bl Brushy Fork |
| 2700 | 0.1 | 4.95 | 0.24 | 4.18 | -0.77 | 24 | 24 | 64800 | 320760 | 64800 | 270864 | -49896 | -14 | | |
| 870 | 0.2 | 4.4 | 0.24 | 4.18 | -0.22 | 24 | 24 | 20880 | 91872 | 20880 | 87278.4 | -4593.6 | -4 | | |
| 160 | 0 | 5.5 | 0.24 | 4.18 | -1.32 | 24 | 24 | 3840 | 21120 | 3840 | 16051.2 | -5068.8 | -24 | | |
| 550 | 0.2 | 4.4 | 0.24 | 4.18 | -0.22 | 24 | 24 | 13200 | 58080 | 13200 | 55176 | -2904 | -4 | | |
| 630 | 0.1 | 4.95 | 0.24 | 4.18 | -0.77 | 25 | 25 | 15750 | 77962.5 | 15750 | 65835 | -12127.5 | -14 | | |
| 420 | 0.2 | 4.4 | 0.24 | 4.18 | -0.22 | 25 | 25 | 10500 | 46200 | 10500 | 43890 | -2310 | -4 | | |
| 970 | 0.1 | 4.95 | 0.24 | 4.18 | -0.77 | 25 | 25 | 24250 | 120037.5 | 24250 | 101365 | -18672.5 | -14 | | |
| 2600 | 0.2 | 4.4 | 0.24 | 4.18 | -0.22 | 25 | 25 | 65000 | 286000 | 65000 | 271700 | -14300 | -4 | | |
| 570 | 0.1 | 4.95 | 0.24 | 4.18 | -0.77 | 25 | 25 | 14250 | 70537.5 | 14250 | 59565 | -10972.5 | -14 | | |
| 140 | 0.2 | 4.4 | 0.24 | 4.18 | -0.22 | 25 | 25 | 3500 | 15400 | 3500 | 14630 | -770 | -4 | | Colt Killed Cr |
| 320 | 0.1 | 4.95 | 0.24 | 4.18 | -0.77 | 25 | 25 | 8000 | 39600 | 8000 | 33440 | -6160 | -14 | | confluence |
| | | | | | | | **Total** | **275,170** | **1,284,850** | **275,170** | **1,150,211** | **-134,639** | **-10** | | |

## Table D-10. Existing and potential solar loads for Brushy Fork Creek tributaries (AU# 17060303CL035_02).

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m²/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m²/day) | Potential Load minus Existing load (kWh/m²/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m²) | Existing Summer Load (kWh/day) | Natural Segment Area (m²) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | shade curves | Brushy Fork Tributaries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL035_02 | | | | | | | | | | | | | | | |
| 2300 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 4600 | 2530 | 4600 | 759 | -1771 | -7 | subalpine | 3rd to Brushy Fk |
| 920 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 920 | 506 | 920 | 101.2 | -404.8 | -8 | | 4th tributary to |
| 1400 | 0.8 | 1.1 | 0.97 | 0.165 | -0.935 | 2 | 2 | 2800 | 3080 | 2800 | 462 | -2618 | -17 | | Brushy Fork |
| 630 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 1260 | 693 | 1260 | 207.9 | -485.1 | -7 | | |
| 2700 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 2700 | 1485 | 2700 | 297 | -1188 | -8 | | 5th to Brushy Fk |
| 1500 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 1500 | 825 | 1500 | 165 | -660 | -8 | | Twin Creek |
| 580 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 1160 | 638 | 1160 | 191.4 | -446.6 | -7 | | |
| 850 | 0.8 | 1.1 | 0.97 | 0.165 | -0.935 | 2 | 2 | 1700 | 1870 | 1700 | 280.5 | -1589.5 | -17 | | |
| 300 | 0.9 | 0.55 | 0.96 | 0.22 | -0.33 | 3 | 3 | 900 | 495 | 900 | 198 | -297 | -6 | | |
| 880 | 0.8 | 1.1 | 0.96 | 0.22 | -0.88 | 3 | 3 | 2640 | 2904 | 2640 | 580.8 | -2323.2 | -16 | | |
| 210 | 0.7 | 1.65 | 0.94 | 0.33 | -1.32 | 4 | 4 | 840 | 1386 | 840 | 277.2 | -1108.8 | -24 | | |
| 270 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 4 | 4 | 1080 | 1188 | 1080 | 356.4 | -831.6 | -14 | | |
| 430 | 0.7 | 1.65 | 0.94 | 0.33 | -1.32 | 4 | 4 | 1720 | 2838 | 1720 | 567.6 | -2270.4 | -24 | | |
| 870 | 0.8 | 1.1 | 0.92 | 0.44 | -0.66 | 5 | 5 | 4350 | 4785 | 4350 | 1914 | -2871 | -12 | | |
| 270 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 270 | 148.5 | 270 | 29.7 | -118.8 | -8 | | 1st tributary to |
| 860 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 860 | 946 | 860 | 94.6 | -851.4 | -18 | | Twin Creek |
| 590 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 1180 | 649 | 1180 | 194.7 | -454.3 | -7 | | |
| 2100 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 2100 | 1155 | 2100 | 231 | -924 | -8 | | 2nd to Twin Cr |
| 1900 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 3800 | 2090 | 3800 | 627 | -1463 | -7 | | Cherokee Creek |
| 1100 | 0.9 | 0.55 | 0.96 | 0.22 | -0.33 | 3 | 3 | 3300 | 1815 | 3300 | 726 | -1089 | -6 | | |
| 1700 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 1700 | 935 | 1700 | 187 | -748 | -8 | | 1st to Cherokee |
| 2100 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 2100 | 1155 | 2100 | 231 | -924 | -8 | | 6th tributary to |
| 860 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 1720 | 946 | 1720 | 283.8 | -662.2 | -7 | | Brushy Fork |
| 240 | 0.8 | 1.1 | 0.97 | 0.165 | -0.935 | 2 | 2 | 480 | 528 | 480 | 79.2 | -448.8 | -17 | | |
| 950 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 950 | 522.5 | 950 | 104.5 | -418 | -8 | | 1st to 6th |
| 3500 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 7000 | 3850 | 7000 | 1155 | -2695 | -7 | | 7th tributary to |
| 260 | 0.7 | 1.65 | 0.96 | 0.22 | -1.43 | 3 | 3 | 780 | 1287 | 780 | 171.6 | -1115.4 | -26 | | Brushy Fork |
| 120 | 0.9 | 0.55 | 0.96 | 0.22 | -0.33 | 3 | 3 | 360 | 198 | 360 | 79.2 | -118.8 | -6 | | |
| 760 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 760 | 418 | 760 | 83.6 | -334.4 | -8 | | 8th tributary to |
| 480 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 480 | 528 | 480 | 52.8 | -475.2 | -18 | | Brushy Fork |
| 1100 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 1100 | 605 | 1100 | 302.5 | -302.5 | -5 | breakland | |
| 1000 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 1000 | 550 | 1000 | 110 | -440 | -8 | subalpine | 1st tributary to |
| 1400 | 0.8 | 1.1 | 0.97 | 0.165 | -0.935 | 2 | 2 | 2800 | 3080 | 2800 | 462 | -2618 | -17 | | Pack Creek |
| 1900 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 1900 | 1045 | 1900 | 209 | -836 | -8 | | Pack Creek |
| 1100 | 0.8 | 1.1 | 0.96 | 0.22 | -0.88 | 3 | 3 | 3300 | 3630 | 3300 | 726 | -2904 | -16 | | |
| 100 | 0.3 | 3.85 | 0.27 | 4.015 | 0.165 | 3 | 3 | 300 | 1155 | 300 | 1204.5 | 49.5 | 0 | subalpine | |
| 300 | 0.4 | 3.3 | 0.27 | 4.015 | 0.715 | 3 | 3 | 900 | 2970 | 900 | 3613.5 | 643.5 | 0 | meadow | |
| 300 | 0.3 | 3.85 | 0.27 | 4.015 | 0.165 | 3 | 3 | 900 | 3465 | 900 | 3613.5 | 148.5 | 0 | grass mix | |
| 150 | 0.4 | 3.3 | 0.27 | 4.015 | 0.715 | 3 | 3 | 450 | 1485 | 450 | 1806.75 | 321.75 | 0 | | |
| 50 | 0.5 | 2.75 | 0.27 | 4.015 | 1.265 | 3 | 3 | 150 | 412.5 | 150 | 602.25 | 189.75 | 0 | | |
| 230 | 0.4 | 3.3 | 0.27 | 4.015 | 0.715 | 3 | 3 | 690 | 2277 | 690 | 2770.35 | 493.35 | 0 | | |
| 380 | 0.3 | 3.85 | 0.27 | 4.015 | 0.165 | 3 | 3 | 1140 | 4389 | 1140 | 4577.1 | 188.1 | 0 | | |
| 200 | 0.3 | 3.85 | 0.23 | 4.235 | 0.385 | 4 | 4 | 800 | 3080 | 800 | 3388 | 308 | 0 | | |
| 520 | 0.2 | 4.4 | 0.23 | 4.235 | -0.165 | 4 | 4 | 2080 | 9152 | 2080 | 8808.8 | -343.2 | -3 | | |
| 110 | 0.3 | 3.85 | 0.23 | 4.235 | 0.385 | 4 | 4 | 440 | 1694 | 440 | 1863.4 | 169.4 | 0 | | |
| 300 | 0.2 | 4.4 | 0.23 | 4.235 | -0.165 | 4 | 4 | 1200 | 5280 | 1200 | 5082 | -198 | -3 | | |
| 500 | 0.3 | 3.85 | 0.23 | 4.235 | 0.385 | 4 | 4 | 2000 | 7700 | 2000 | 8470 | 770 | 0 | | |
| 1300 | 0.2 | 4.4 | 0.23 | 4.235 | -0.165 | 4 | 4 | 5200 | 22880 | 5200 | 22022 | -858 | -3 | | |
| 1400 | 0.3 | 3.85 | 0.2 | 4.4 | 0.55 | 5 | 5 | 7000 | 26950 | 7000 | 30800 | 3850 | 0 | | |
| 1200 | 0.5 | 2.75 | 0.52 | 2.64 | -0.11 | 5 | 5 | 6000 | 16500 | 6000 | 15840 | -660 | -2 | alder mix | |
| 3200 | 0.5 | 2.75 | 0.89 | 0.605 | -2.145 | 6 | 6 | 19200 | 52800 | 19200 | 11616 | -41184 | -39 | subalpine | |
| 1700 | 0.6 | 2.2 | 0.89 | 0.605 | -1.595 | 6 | 6 | 10200 | 22440 | 10200 | 6171 | -16269 | -29 | | |
| | | | | | | | Total | **124,760** | **235,934** | **124,760** | **144,747** | **-91,186** | **-9** | | |

## Table D-11. Existing and potential solar loads for Brushy Fork Creek (AU# 17060303CL035_03).

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m²/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m²/day) | Potential Load minus Existing load (kWh/m²/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m²) | Existing Summer Load (kWh/day) | Natural Segment Area (m²) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Brushy Fork** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL035_03 | | | | | | | | | | | | | | | |
| 510 | 0.4 | 3.3 | 0.61 | 2.145 | -1.155 | 15 | 12 | 7650 | 25245 | 6120 | 13127.4 | -12117.6 | -21 | subalpine | bl Spruce Cr |
| 230 | 0.2 | 4.4 | 0.61 | 2.145 | -2.255 | 15 | 12 | 3450 | 15180 | 2760 | 5920.2 | -9259.8 | -41 | | |
| 1100 | 0.4 | 3.3 | 0.61 | 2.145 | -1.155 | 15 | 12 | 16500 | 54450 | 13200 | 28314 | -26136 | -21 | | |
| 310 | 0.2 | 4.4 | 0.61 | 2.145 | -2.255 | 15 | 12 | 4650 | 20460 | 3720 | 7979.4 | -12480.6 | -41 | | |
| 880 | 0.4 | 3.3 | 0.61 | 2.145 | -1.155 | 15 | 12 | 13200 | 43560 | 10560 | 22651.2 | -20908.8 | -21 | | |
| 920 | 0.1 | 4.95 | 0.61 | 2.145 | -2.805 | 15 | 12 | 13800 | 68310 | 11040 | 23680.8 | -44629.2 | -51 | | |
| 1800 | 0.5 | 2.75 | 0.58 | 2.31 | -0.44 | 15 | 13 | 27000 | 74250 | 23400 | 54054 | -20196 | -8 | | |
| 80 | 0.5 | 2.75 | 0.58 | 2.31 | -0.44 | 15 | 13 | 1200 | 3300 | 1040 | 2402.4 | -897.6 | -8 | | |
| 190 | 0.5 | 2.75 | 0.58 | 2.31 | -0.44 | 15 | 13 | 2850 | 7837.5 | 2470 | 5705.7 | -2131.8 | -8 | | |
| 690 | 0.4 | 3.3 | 0.58 | 2.31 | -0.99 | 15 | 13 | 10350 | 34155 | 8970 | 20720.7 | -13434.3 | -18 | | |
| 600 | 0.5 | 2.75 | 0.58 | 2.31 | -0.44 | 15 | 13 | 9000 | 24750 | 7800 | 18018 | -6732 | -8 | | |
| 220 | 0.5 | 2.75 | 0.58 | 2.31 | -0.44 | 15 | 13 | 3300 | 9075 | 2860 | 6606.6 | -2468.4 | -8 | | |
| 930 | 0.4 | 3.3 | 0.58 | 2.31 | -0.99 | 15 | 13 | 13950 | 46035 | 12090 | 27927.9 | -18107.1 | -18 | | ab Twin Creek |
| | | | | | | | **Total** | **126,900** | **426,608** | **106,030** | **237,108** | **-189,499** | **-21** | | |

## Table D-12. Existing and potential solar loads for Brushy Fork Creek (AU# 17060303CL035_04).

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m²/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m²/day) | Potential Load minus Existing load (kWh/m²/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m²) | Existing Summer Load (kWh/day) | Natural Segment Area (m²) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Brushy Fork** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL035_04 | | | | | | | | | | | | | | | |
| 1900 | 0.4 | 3.3 | 0.55 | 2.475 | -0.825 | 15 | 14 | 28500 | 94050 | 26600 | 65835 | -28215 | -15 | subalpine | bl Twin Creek |
| 250 | 0.1 | 4.95 | 0.52 | 2.64 | -2.31 | 15 | 15 | 3750 | 18562.5 | 3750 | 9900 | -8662.5 | -42 | | |
| 450 | 0.2 | 4.4 | 0.52 | 2.64 | -1.76 | 15 | 15 | 6750 | 29700 | 6750 | 17820 | -11880 | -32 | | |
| 110 | 0.1 | 4.95 | 0.52 | 2.64 | -2.31 | 15 | 15 | 1650 | 8167.5 | 1650 | 4356 | -3811.5 | -42 | | |
| 670 | 0.2 | 4.4 | 0.52 | 2.64 | -1.76 | 15 | 15 | 10050 | 44220 | 10050 | 26532 | -17688 | -32 | | |
| 120 | 0 | 5.5 | 0.52 | 2.64 | -2.86 | 15 | 15 | 1800 | 9900 | 1800 | 4752 | -5148 | -52 | | |
| 240 | 0.2 | 4.4 | 0.52 | 2.64 | -1.76 | 15 | 15 | 3600 | 15840 | 3600 | 9504 | -6336 | -32 | | |
| 740 | 0.4 | 3.3 | 0.5 | 2.75 | -0.55 | 16 | 16 | 11840 | 39072 | 11840 | 32560 | -6512 | -10 | | |
| 570 | 0.3 | 3.85 | 0.5 | 2.75 | -1.1 | 16 | 16 | 9120 | 35112 | 9120 | 25080 | -10032 | -20 | | |
| 1100 | 0.4 | 3.3 | 0.5 | 2.75 | -0.55 | 16 | 16 | 17600 | 58080 | 17600 | 48400 | -9680 | -10 | | |
| 110 | 0.4 | 3.3 | 0.48 | 2.86 | -0.44 | 17 | 17 | 1870 | 6171 | 1870 | 5348.2 | -822.8 | -8 | | |
| 1300 | 0.2 | 4.4 | 0.48 | 2.86 | -1.54 | 17 | 17 | 22100 | 97240 | 22100 | 63206 | -34034 | -28 | | at mouth |
| | | | | | | | **Total** | **118,630** | **456,115** | **116,730** | **313,293** | **-142,822** | **-27** | | |

## Table D-13. Existing and potential solar loads for Spruce Creek and tributaries (AU# 17060303CL036_02).

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load ($kWh/m^2/day$) | Potential Shade (fraction) | Potential Summer Load ($kWh/m^2/day$) | Potential Load minus Existing load ($kWh/m^2/day$) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area ($m^2$) | Existing Summer Load (kWh/day) | Natural Segment Area ($m^2$) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Spruce Creek & Tributaries** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL036_02 | | | | | | | | | | | | | | | |
| 650 | 0.6 | 2.2 | 0.57 | 2.365 | 0.165 | 1 | 1 | 650 | 1430 | 650 | 1537.25 | 107.25 | 0 | meadow | SF Spruce Creek |
| 440 | 0.5 | 2.75 | 0.57 | 2.365 | -0.385 | 1 | 1 | 440 | 1210 | 440 | 1040.6 | -169.4 | -7 | | |
| 180 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 180 | 99 | 180 | 19.8 | -79.2 | -8 | subalpine | |
| 200 | 0.5 | 2.75 | 0.35 | 3.575 | 0.825 | 2 | 2 | 400 | 1100 | 400 | 1430 | 330 | 0 | meadow | |
| 240 | 0.8 | 1.1 | 0.97 | 0.165 | -0.935 | 2 | 2 | 480 | 528 | 480 | 79.2 | -448.8 | -17 | subalpine | |
| 210 | 0.3 | 3.85 | 0.35 | 3.575 | -0.275 | 2 | 2 | 420 | 1617 | 420 | 1501.5 | -115.5 | -5 | meadow | |
| 680 | 0.8 | 1.1 | 0.97 | 0.165 | -0.935 | 2 | 2 | 1360 | 1496 | 1360 | 224.4 | -1271.6 | -17 | subalpine | |
| 90 | 0.2 | 4.4 | 0.27 | 4.015 | -0.385 | 3 | 3 | 270 | 1188 | 270 | 1084.05 | -103.95 | -7 | meadow | |
| 1300 | 0.8 | 1.1 | 0.96 | 0.22 | -0.88 | 3 | 3 | 3900 | 4290 | 3900 | 858 | -3432 | -16 | subalpine | |
| 2400 | 0.7 | 1.65 | 0.94 | 0.33 | -1.32 | 4 | 4 | 9600 | 15840 | 9600 | 3168 | -12672 | -24 | | |
| 820 | 0.6 | 2.2 | 0.92 | 0.44 | -1.76 | 5 | 5 | 4100 | 9020 | 4100 | 1804 | -7216 | -32 | | |
| 2100 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 4200 | 2310 | 4200 | 693 | -1617 | -7 | | NF Spruce Creek |
| 3200 | 0.8 | 1.1 | 0.96 | 0.22 | -0.88 | 3 | 3 | 9600 | 10560 | 9600 | 2112 | -8448 | -16 | | |
| 460 | 0.7 | 1.65 | 0.94 | 0.33 | -1.32 | 4 | 4 | 1840 | 3036 | 1840 | 607.2 | -2428.8 | -24 | | |
| 230 | 0.5 | 2.75 | 0.94 | 0.33 | -2.42 | 4 | 4 | 920 | 2530 | 920 | 303.6 | -2226.4 | -44 | | |
| 550 | 0.6 | 2.2 | 0.57 | 2.365 | 0.165 | 1 | 1 | 550 | 1210 | 550 | 1300.75 | 90.75 | 0 | meadow | 1st tributary to NF Spruce Cr |
| 1800 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 1800 | 990 | 1800 | 198 | -792 | -8 | | |
| 140 | 0 | 5.5 | 0 | 5.5 | 0 | 100 | 100 | 14000 | 77000 | 14000 | 77000 | 0 | 0 | lake | un-connected bl SF Spruce |
| 60 | 0.6 | 2.2 | 0.57 | 2.365 | 0.165 | 1 | 1 | 60 | 132 | 60 | 141.9 | 9.9 | 0 | meadow | |
| 60 | 0 | 5.5 | 0 | 5.5 | 0 | 50 | 50 | 3000 | 16500 | 3000 | 16500 | 0 | 0 | lake | |
| 850 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 850 | 935 | 850 | 93.5 | -841.5 | -18 | | |
| 1100 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 2200 | 1210 | 2200 | 363 | -847 | -7 | | |
| 740 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 740 | 407 | 740 | 81.4 | -325.6 | -8 | | 1st tributary to Spruce Creek |
| 120 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 120 | 132 | 120 | 13.2 | -118.8 | -18 | | |
| 570 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 570 | 313.5 | 570 | 62.7 | -250.8 | -8 | | |
| 250 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 250 | 275 | 250 | 27.5 | -247.5 | -18 | | |
| 200 | 0 | 5.5 | 0 | 5.5 | 0 | 110 | 110 | 22000 | 121000 | 22000 | 121000 | 0 | 0 | lake | Shoot Creek |
| 800 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 800 | 880 | 800 | 88 | -792 | -18 | | |
| 510 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 510 | 280.5 | 510 | 56.1 | -224.4 | -8 | | |
| 570 | 0.8 | 1.1 | 0.97 | 0.165 | -0.935 | 2 | 2 | 1140 | 1254 | 1140 | 188.1 | -1065.9 | -17 | | |
| 770 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 1540 | 847 | 1540 | 254.1 | -592.9 | -7 | | |
| 360 | 0.8 | 1.1 | 0.97 | 0.165 | -0.935 | 2 | 2 | 720 | 792 | 720 | 118.8 | -673.2 | -17 | | |
| 1100 | 0.9 | 0.55 | 0.96 | 0.22 | -0.33 | 3 | 3 | 3300 | 1815 | 3300 | 726 | -1089 | -6 | | |
| 150 | 0.8 | 1.1 | 0.96 | 0.22 | -0.88 | 3 | 3 | 450 | 495 | 450 | 99 | -396 | -16 | | |
| 240 | 0.7 | 1.65 | 0.94 | 0.33 | -1.32 | 4 | 4 | 960 | 1584 | 960 | 316.8 | -1267.2 | -24 | | |
| 540 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 4 | 4 | 2160 | 1188 | 2160 | 712.8 | -475.2 | -4 | | |
| 680 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 4 | 4 | 2720 | 2992 | 2720 | 897.6 | -2094.4 | -14 | | |
| 630 | 0.2 | 4.4 | 0.16 | 4.62 | 0.22 | 7 | 7 | 4410 | 19404 | 4410 | 20374.2 | 970.2 | 0 | meadow | Spruce Creek |
| 210 | 0.3 | 3.85 | 0.16 | 4.62 | 0.77 | 7 | 7 | 1470 | 5659.5 | 1470 | 6791.4 | 1131.9 | 0 | | |
| 410 | 0.3 | 3.85 | 0.16 | 4.62 | 0.77 | 7 | 7 | 2870 | 11049.5 | 2870 | 13259.4 | 2209.9 | 0 | | |
| 550 | 0.4 | 3.3 | 0.16 | 4.62 | 1.32 | 7 | 7 | 3850 | 12705 | 3850 | 17787 | 5082 | 0 | | |
| 370 | 0.6 | 2.2 | 0.79 | 1.155 | -1.045 | 8 | 8 | 2960 | 6512 | 2960 | 3418.8 | -3093.2 | -19 | subalpine | |
| 640 | 0.3 | 3.85 | 0.37 | 3.465 | -0.385 | 8 | 8 | 5120 | 19712 | 5120 | 17740.8 | -1971.2 | -7 | alder mix | |
| 170 | 0.4 | 3.3 | 0.37 | 3.465 | 0.165 | 8 | 8 | 1360 | 4488 | 1360 | 4712.4 | 224.4 | 0 | | |
| 520 | 0.3 | 3.85 | 0.37 | 3.465 | -0.385 | 8 | 8 | 4160 | 16016 | 4160 | 14414.4 | -1601.6 | -7 | | |
| 1600 | 0.5 | 2.75 | 0.73 | 1.485 | -1.265 | 9 | 9 | 14400 | 39600 | 14400 | 21384 | -18216 | -23 | subalpine | |
| 540 | 0.4 | 3.3 | 0.33 | 3.685 | 0.385 | 9 | 9 | 4860 | 16038 | 4860 | 17909.1 | 1871.1 | 0 | alder mix | |
| | | | | | | | **Total** | **144,260** | **439,670** | **144,260** | **374,493** | **-65,177** | **-11** | | |

## Table D-14. Existing and potential solar loads for Brushy Fork Creek and tributaries (AU# 17060303CL037_02).

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m$^2$/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m$^2$/day) | Potential Load minus Existing load (kWh/m$^2$/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m$^2$) | Existing Summer Load (kWh/day) | Natural Segment Area (m$^2$) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Brushy Fork & Tributaries** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL037_02 | | | | | | | | | | | | | | | |
| 2700 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 5400 | 2970 | 5400 | 891 | -2079 | -7 | subalpine | 1st tributary |
| 100 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 100 | 110 | 100 | 11 | -99 | -18 | | 2nd tributary to Brushy Fork |
| 220 | 0.7 | 1.65 | 0.98 | 0.11 | -1.54 | 1 | 1 | 220 | 363 | 220 | 24.2 | -338.8 | -28 | | |
| 1800 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 3600 | 1980 | 3600 | 594 | -1386 | -7 | | |
| 290 | 0.8 | 1.1 | 0.97 | 0.165 | -0.935 | 2 | 2 | 580 | 638 | 580 | 95.7 | -542.3 | -17 | | |
| 200 | 0 | 5.5 | 0 | 5.5 | 0 | 90 | 90 | 18000 | 99000 | 18000 | 99000 | 0 | 0 | lake | Brushy Fork |
| 220 | 0.8 | 1.1 | 0.87 | 0.715 | -0.385 | 2 | 2 | 440 | 484 | 440 | 314.6 | -169.4 | -7 | alder mix | |
| 4700 | 0.9 | 0.55 | 0.96 | 0.22 | -0.33 | 3 | 3 | 14100 | 7755 | 14100 | 3102 | -4653 | -6 | subalpine | |
| 410 | 0.7 | 1.65 | 0.96 | 0.22 | -1.43 | 3 | 3 | 1230 | 2029.5 | 1230 | 270.6 | -1758.9 | -26 | | |
| 80 | 0.5 | 2.75 | 0.74 | 1.43 | -1.32 | 3 | 3 | 240 | 660 | 240 | 343.2 | -316.8 | -24 | alder mix | |
| 230 | 0.1 | 4.95 | 0.27 | 4.015 | -0.935 | 3 | 3 | 690 | 3415.5 | 690 | 2770.35 | -645.15 | -17 | meadow | |
| 150 | 0.3 | 3.85 | 0.27 | 4.015 | 0.165 | 3 | 3 | 450 | 1732.5 | 450 | 1806.75 | 74.25 | 0 | | |
| 370 | 0.1 | 4.95 | 0.27 | 4.015 | -0.935 | 3 | 3 | 1110 | 5494.5 | 1110 | 4456.65 | -1037.85 | -17 | | |
| 300 | 0.4 | 3.3 | 0.23 | 4.235 | 0.935 | 4 | 4 | 1200 | 3960 | 1200 | 5082 | 1122 | 0 | | |
| 130 | 0.7 | 1.65 | 0.94 | 0.33 | -1.32 | 4 | 4 | 520 | 858 | 520 | 171.6 | -686.4 | -24 | subalpine | |
| 630 | 0.6 | 2.2 | 0.94 | 0.33 | -1.87 | 4 | 4 | 2520 | 5544 | 2520 | 831.6 | -4712.4 | -34 | | |
| 170 | 0.7 | 1.65 | 0.94 | 0.33 | -1.32 | 4 | 4 | 680 | 1122 | 680 | 224.4 | -897.6 | -24 | | |
| 260 | 0.6 | 2.2 | 0.61 | 2.145 | -0.055 | 4 | 4 | 1040 | 2288 | 1040 | 2230.8 | -57.2 | -1 | alder mix | |
| 890 | 0.7 | 1.65 | 0.94 | 0.33 | -1.32 | 4 | 4 | 3560 | 5874 | 3560 | 1174.8 | -4699.2 | -24 | subalpine | |
| 560 | 0.6 | 2.2 | 0.52 | 2.64 | 0.44 | 5 | 5 | 2800 | 6160 | 2800 | 7392 | 1232 | 0 | alder mix | |
| 180 | 0.7 | 1.65 | 0.92 | 0.44 | -1.21 | 5 | 5 | 900 | 1485 | 900 | 396 | -1089 | -22 | subalpine | |
| 150 | 0.4 | 3.3 | 0.92 | 0.44 | -2.86 | 5 | 5 | 750 | 2475 | 750 | 330 | -2145 | -52 | | |
| 1500 | 0.6 | 2.2 | 0.92 | 0.44 | -1.76 | 5 | 5 | 7500 | 16500 | 7500 | 3300 | -13200 | -32 | | |
| 730 | 0.7 | 1.65 | 0.89 | 0.605 | -1.045 | 6 | 6 | 4380 | 7227 | 4380 | 2649.9 | -4577.1 | -19 | | |
| 200 | 0.6 | 2.2 | 0.89 | 0.605 | -1.595 | 6 | 6 | 1200 | 2640 | 1200 | 726 | -1914 | -29 | | |
| 160 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 6 | 6 | 960 | 1056 | 960 | 580.8 | -475.2 | -9 | | |
| 180 | 0.6 | 2.2 | 0.89 | 0.605 | -1.595 | 6 | 6 | 1080 | 2376 | 1080 | 653.4 | -1722.6 | -29 | | |
| 620 | 0.6 | 2.2 | 0.89 | 0.605 | -1.595 | 6 | 6 | 3720 | 8184 | 3720 | 2250.6 | -5933.4 | -29 | | |
| 1900 | 0.7 | 1.65 | 0.84 | 0.88 | -0.77 | 7 | 7 | 13300 | 21945 | 13300 | 11704 | -10241 | -14 | | |
| 240 | 0.6 | 2.2 | 0.84 | 0.88 | -1.32 | 7 | 7 | 1680 | 3696 | 1680 | 1478.4 | -2217.6 | -24 | | |
| 150 | 0.7 | 1.65 | 0.84 | 0.88 | -0.77 | 7 | 7 | 1050 | 1732.5 | 1050 | 924 | -808.5 | -14 | | |
| | | | | | | | **Total** | **95,000** | **221,755** | **95,000** | **155,780** | **-65,974** | **-18** | | |

**Table D-15. Existing and potential solar loads for Crooked Fork Creek tributaries (AU# 17060303CL038_02).**

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m$^2$/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m$^2$/day) | Potential Load minus Existing load (kWh/m$^2$/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m$^2$) | Existing Summer Load (kWh/day) | Natural Segment Area (m$^2$) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Crooked Fork Tributaries** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL038_02 | | | | | | | | | | | | | | | |
| 1500 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 1500 | 825 | 1500 | 165 | -660 | -8 | subalpine | 1st tributary |
| 250 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 250 | 137.5 | 250 | 27.5 | -110 | -8 | | 2nd tributary to |
| 1600 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 1600 | 880 | 1600 | 440 | -440 | -5 | breakland | Shotgun Creek |
| 960 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 960 | 528 | 960 | 105.6 | -422.4 | -8 | subalpine | Shotgun Creek |
| 660 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 660 | 726 | 660 | 72.6 | -653.4 | -18 | | |
| 1300 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 2600 | 1430 | 2600 | 429 | -1001 | -7 | | |
| 1700 | 0.8 | 1.1 | 0.96 | 0.22 | -0.88 | 3 | 3 | 5100 | 5610 | 5100 | 1122 | -4488 | -16 | | |
| 210 | 0.7 | 1.65 | 0.96 | 0.22 | -1.43 | 3 | 3 | 630 | 1039.5 | 630 | 138.6 | -900.9 | -26 | | |
| 310 | 0.8 | 1.1 | 0.96 | 0.22 | -0.88 | 3 | 3 | 930 | 1023 | 930 | 204.6 | -818.4 | -16 | | |
| 400 | 0.7 | 1.65 | 0.96 | 0.22 | -1.43 | 3 | 3 | 1200 | 1980 | 1200 | 264 | -1716 | -26 | | |
| 480 | 0.8 | 1.1 | 0.79 | 1.155 | 0.055 | 4 | 4 | 1920 | 2112 | 1920 | 2217.6 | 105.6 | 0 | breakland | |
| 310 | 0.7 | 1.65 | 0.79 | 1.155 | -0.495 | 4 | 4 | 1240 | 2046 | 1240 | 1432.2 | -613.8 | -9 | | |
| 110 | 0.8 | 1.1 | 0.79 | 1.155 | 0.055 | 4 | 4 | 440 | 484 | 440 | 508.2 | 24.2 | 0 | | |
| 170 | 0.7 | 1.65 | 0.79 | 1.155 | -0.495 | 4 | 4 | 680 | 1122 | 680 | 785.4 | -336.6 | -9 | | |
| 930 | 0.8 | 1.1 | 0.79 | 1.155 | 0.055 | 4 | 4 | 3720 | 4092 | 3720 | 4296.6 | 204.6 | 0 | | |
| 1000 | 0.8 | 1.1 | 0.95 | 0.275 | -0.825 | 1 | 1 | 1000 | 1100 | 1000 | 275 | -825 | -15 | | 1st tributary to |
| 860 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 860 | 473 | 860 | 236.5 | -236.5 | -5 | | Crooked Fork |
| 2200 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 2 | 2 | 4400 | 4840 | 4400 | 1452 | -3388 | -14 | | 2nd tributary |
| 1000 | 0.8 | 1.1 | 0.95 | 0.275 | -0.825 | 1 | 1 | 1000 | 1100 | 1000 | 275 | -825 | -15 | | Rock Creek |
| 290 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 290 | 159.5 | 290 | 79.75 | -79.75 | -5 | | |
| 270 | 0.7 | 1.65 | 0.94 | 0.33 | -1.32 | 2 | 2 | 540 | 891 | 540 | 178.2 | -712.8 | -24 | | |
| 530 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 2 | 2 | 1060 | 1166 | 1060 | 349.8 | -816.2 | -14 | | |
| 220 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 440 | 242 | 440 | 145.2 | -96.8 | -4 | | |
| 630 | 0.7 | 1.65 | 0.89 | 0.605 | -1.045 | 3 | 3 | 1890 | 3118.5 | 1890 | 1143.45 | -1975.05 | -19 | | |
| 330 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 990 | 1089 | 990 | 598.95 | -490.05 | -9 | | |
| 450 | 0.7 | 1.65 | 0.89 | 0.605 | -1.045 | 3 | 3 | 1350 | 2227.5 | 1350 | 816.75 | -1410.75 | -19 | | |
| 340 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 340 | 187 | 340 | 37.4 | -149.6 | -8 | subalpine | 1st tributary to |
| 1400 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 1400 | 1540 | 1400 | 154 | -1386 | -18 | | Haskell Creek |
| 580 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 580 | 319 | 580 | 63.8 | -255.2 | -8 | | Haskell Creek |
| 820 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 820 | 902 | 820 | 90.2 | -811.8 | -18 | | |
| 1400 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 2800 | 1540 | 2800 | 462 | -1078 | -7 | | |
| 670 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 2010 | 2211 | 2010 | 1216.05 | -994.95 | -9 | breakland | |
| 760 | 0.7 | 1.65 | 0.89 | 0.605 | -1.045 | 3 | 3 | 2280 | 3762 | 2280 | 1379.4 | -2382.6 | -19 | | |
| 260 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 780 | 858 | 780 | 471.9 | -386.1 | -9 | | |
| | | | | | | | **Total** | **48,260** | **51,761** | **48,260** | **21,634** | **-30,126** | **-12** | | |

## Table D-16. Existing and potential solar loads for Crooked Fork Creek (AU# 17060303CL038_04).

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m$^2$/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m$^2$/day) | Potential Load minus Existing load (kWh/m$^2$/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m$^2$) | Existing Summer Load (kWh/day) | Natural Segment Area (m$^2$) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Crooked Fork** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL038_04 | | | | | | | | | | | | | | | |
| 310 | 0.4 | 3.3 | 0.38 | 3.41 | 0.11 | 14 | 14 | 4340 | 14322 | 4340 | 14799.4 | 477.4 | 0 | breakland | bl Boulder Cr |
| 400 | 0.3 | 3.85 | 0.38 | 3.41 | -0.44 | 14 | 14 | 5600 | 21560 | 5600 | 19096 | -2464 | -8 | | |
| 1200 | 0.4 | 3.3 | 0.38 | 3.41 | 0.11 | 14 | 14 | 16800 | 55440 | 16800 | 57288 | 1848 | 0 | | |
| 460 | 0.4 | 3.3 | 0.38 | 3.41 | 0.11 | 14 | 14 | 6440 | 21252 | 6440 | 21960.4 | 708.4 | 0 | | |
| 1100 | 0.3 | 3.85 | 0.38 | 3.41 | -0.44 | 14 | 14 | 15400 | 59290 | 15400 | 52514 | -6776 | -8 | | |
| 1300 | 0.1 | 4.95 | 0.38 | 3.41 | -1.54 | 14 | 14 | 18200 | 90090 | 18200 | 62062 | -28028 | -28 | | |
| 940 | 0 | 5.5 | 0.36 | 3.52 | -1.98 | 15 | 15 | 14100 | 77550 | 14100 | 49632 | -27918 | -36 | | |
| 810 | 0.2 | 4.4 | 0.36 | 3.52 | -0.88 | 15 | 15 | 12150 | 53460 | 12150 | 42768 | -10692 | -16 | | |
| 290 | 0.1 | 4.95 | 0.36 | 3.52 | -1.43 | 15 | 15 | 4350 | 21532.5 | 4350 | 15312 | -6220.5 | -26 | | |
| 200 | 0.3 | 3.85 | 0.36 | 3.52 | -0.33 | 15 | 15 | 3000 | 11550 | 3000 | 10560 | -990 | -6 | | |
| 240 | 0.1 | 4.95 | 0.36 | 3.52 | -1.43 | 15 | 15 | 3600 | 17820 | 3600 | 12672 | -5148 | -26 | | |
| 470 | 0.3 | 3.85 | 0.36 | 3.52 | -0.33 | 15 | 15 | 7050 | 27142.5 | 7050 | 24816 | -2326.5 | -6 | | |
| 1900 | 0.4 | 3.3 | 0.34 | 3.63 | 0.33 | 16 | 16 | 30400 | 100320 | 30400 | 110352 | 10032 | 0 | | |
| 220 | 0.1 | 4.95 | 0.34 | 3.63 | -1.32 | 16 | 16 | 3520 | 17424 | 3520 | 12777.6 | -4646.4 | -24 | | |
| 490 | 0.2 | 4.4 | 0.34 | 3.63 | -0.77 | 16 | 16 | 7840 | 34496 | 7840 | 28459.2 | -6036.8 | -14 | | |
| 290 | 0.1 | 4.95 | 0.34 | 3.63 | -1.32 | 16 | 16 | 4640 | 22968 | 4640 | 16843.2 | -6124.8 | -24 | | ab Brushy Fork |
| | | | | | | | **Total** | **157,430** | **646,217** | **157,430** | **551,912** | **-94,305** | **-14** | | |

**Table D-17. Existing and potential solar loads for Papoose Creek and tributaries (AU# 17060303CL041_02 & _03).**

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load ($kWh/m^2/day$) | Potential Shade (fraction) | Potential Summer Load ($kWh/m^2/day$) | Potential Load minus Existing load ($kWh/m^2/day$) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area ($m^2$) | Existing Summer Load (kWh/day) | Natural Segment Area ($m^2$) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Papoose Creek & Tributaries** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL041_02 | | | | | | | | | | | | | | | |
| 390 | 0.7 | 1.65 | 0.95 | 0.275 | -1.375 | 1 | 1 | 390 | 643.5 | 390 | 107.25 | -536.25 | -25 | breakland | 1st tributary to WF Papoose Cr |
| 530 | 0.4 | 3.3 | 0.95 | 0.275 | -3.025 | 1 | 1 | 530 | 1749 | 530 | 145.75 | -1603.25 | -55 | | |
| 790 | 0.8 | 1.1 | 0.97 | 0.165 | -0.935 | 2 | 2 | 1580 | 1738 | 1580 | 260.7 | -1477.3 | -17 | subalpine | |
| 980 | 0.7 | 1.65 | 0.98 | 0.11 | -1.54 | 1 | 1 | 980 | 1617 | 980 | 107.8 | -1509.2 | -28 | | 2nd tributary to WF Papoose Cr |
| 540 | 0.7 | 1.65 | 0.94 | 0.33 | -1.32 | 2 | 2 | 1080 | 1782 | 1080 | 356.4 | -1425.6 | -24 | breakland | |
| 530 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 2 | 2 | 1060 | 1166 | 1060 | 349.8 | -816.2 | -14 | | |
| 450 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 900 | 495 | 900 | 297 | -198 | -4 | | |
| 950 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 950 | 1045 | 950 | 104.5 | -940.5 | -18 | subalpine | 3rd tributary to WF Papoose Cr |
| 190 | 0.7 | 1.65 | 0.94 | 0.33 | -1.32 | 2 | 2 | 380 | 627 | 380 | 125.4 | -501.6 | -24 | breakland | |
| 410 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 2 | 2 | 820 | 902 | 820 | 270.6 | -631.4 | -14 | | |
| 1500 | 0.9 | 0.55 | 0.89 | 0.605 | 0.055 | 3 | 3 | 4500 | 2475 | 4500 | 2722.5 | 247.5 | 0 | | |
| 290 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 870 | 957 | 870 | 526.35 | -430.65 | -9 | | |
| 2500 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 2500 | 1375 | 2500 | 687.5 | -687.5 | -5 | | 4th tributary |
| 1200 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 1200 | 660 | 1200 | 132 | -528 | -8 | subalpine | WF Papoose Cr |
| 1200 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 2400 | 1320 | 2400 | 396 | -924 | -7 | | |
| 860 | 0.8 | 1.1 | 0.96 | 0.22 | -0.88 | 3 | 3 | 2580 | 2838 | 2580 | 567.6 | -2270.4 | -16 | | |
| 400 | 0.8 | 1.1 | 0.96 | 0.22 | -0.88 | 3 | 3 | 1200 | 1320 | 1200 | 264 | -1056 | -16 | | |
| 460 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 1380 | 1518 | 1380 | 834.9 | -683.1 | -9 | breakland | |
| 200 | 0.7 | 1.65 | 0.79 | 1.155 | -0.495 | 4 | 4 | 800 | 1320 | 800 | 924 | -396 | -9 | | |
| 480 | 0.8 | 1.1 | 0.79 | 1.155 | 0.055 | 4 | 4 | 1920 | 2112 | 1920 | 2217.6 | 105.6 | 0 | | |
| 620 | 0.7 | 1.65 | 0.79 | 1.155 | -0.495 | 4 | 4 | 2480 | 4092 | 2480 | 2864.4 | -1227.6 | -9 | | |
| 200 | 0.6 | 2.2 | 0.79 | 1.155 | -1.045 | 4 | 4 | 800 | 1760 | 800 | 924 | -836 | -19 | | |
| 540 | 0.6 | 2.2 | 0.71 | 1.595 | -0.605 | 5 | 5 | 2700 | 5940 | 2700 | 4306.5 | -1633.5 | -11 | | |
| 1100 | 0.5 | 2.75 | 0.52 | 2.64 | -0.11 | 5 | 5 | 5500 | 15125 | 5500 | 14520 | -605 | -2 | alder mix | |
| 140 | 0.4 | 3.3 | 0.52 | 2.64 | -0.66 | 5 | 5 | 700 | 2310 | 700 | 1848 | -462 | -12 | | |
| 1400 | 0.6 | 2.2 | 0.65 | 1.925 | -0.275 | 6 | 6 | 8400 | 18480 | 8400 | 16170 | -2310 | -5 | breakland | |
| 950 | 0.6 | 2.2 | 0.65 | 1.925 | -0.275 | 6 | 6 | 5700 | 12540 | 5700 | 10972.5 | -1567.5 | -5 | | |
| 1600 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 1600 | 880 | 1600 | 440 | -440 | -5 | | 1st tributary to EF Papoose Cr |
| 670 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 2 | 2 | 1340 | 1474 | 1340 | 442.2 | -1031.8 | -14 | | |
| 130 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 260 | 143 | 260 | 85.8 | -57.2 | -4 | | |
| 710 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 710 | 781 | 710 | 78.1 | -702.9 | -18 | subalpine | EF Papoose Cr |
| 2000 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 4000 | 2200 | 4000 | 1320 | -880 | -4 | breakland | |
| 200 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 2 | 2 | 400 | 440 | 400 | 132 | -308 | -14 | | |
| 380 | 0.9 | 0.55 | 0.89 | 0.605 | 0.055 | 3 | 3 | 1140 | 627 | 1140 | 689.7 | 62.7 | 0 | | |
| 380 | 0.7 | 1.65 | 0.89 | 0.605 | -1.045 | 3 | 3 | 1140 | 1881 | 1140 | 689.7 | -1191.3 | -19 | | |
| 320 | 0.6 | 2.2 | 0.74 | 1.43 | -0.77 | 3 | 3 | 960 | 2112 | 960 | 1372.8 | -739.2 | -14 | alder mix | |
| 540 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 1620 | 1782 | 1620 | 980.1 | -801.9 | -9 | breakland | |
| 500 | 0.7 | 1.65 | 0.79 | 1.155 | -0.495 | 4 | 4 | 2000 | 3300 | 2000 | 2310 | -990 | -9 | | |
| 1100 | 0.8 | 1.1 | 0.79 | 1.155 | 0.055 | 4 | 4 | 4400 | 4840 | 4400 | 5082 | 242 | 0 | | |
| AU# ID17060303PN041_03 | | | | | | | | | | | | | | | |
| 990 | 0.5 | 2.75 | 0.41 | 3.245 | 0.495 | 7 | 7 | 6930 | 19057.5 | 6930 | 22487.85 | 3430.35 | 0 | alder mix | Papoose Creek |
| 1400 | 0.6 | 2.2 | 0.6 | 2.2 | 0 | 7 | 7 | 9800 | 21560 | 9800 | 21560 | 0 | 0 | breakland | |
| 170 | 0.4 | 3.3 | 0.37 | 3.465 | 0.165 | 8 | 8 | 1360 | 4488 | 1360 | 4712.4 | 224.4 | 0 | alder mix | |
| 470 | 0.5 | 2.75 | 0.55 | 2.475 | -0.275 | 8 | 8 | 3760 | 10340 | 3760 | 9306 | -1034 | -5 | breakland | |
| | | | | | | | **Total** | **95,720** | **163,812** | **95,720** | **134,692** | **-29,120** | **-11** | | |

## Table D-18. Existing and potential solar loads for Parachute Creek (AU# 17060303CL042_02).

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m²/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m²/day) | Potential Load minus Existing load (kWh/m²/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m²) | Existing Summer Load (kWh/day) | Natural Segment Area (m²) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Parachute Creek** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL042_02 | | | | | | | | | | | | | | | |
| 2700 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 2700 | 1485 | 2700 | 297 | -1188 | -8 | subalpine breakland | Parachute Creek |
| 750 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 1500 | 825 | 1500 | 495 | -330 | -4 | | |
| 1600 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 2 | 2 | 3200 | 3520 | 3200 | 1056 | -2464 | -14 | | |
| 170 | 0.9 | 0.55 | 0.89 | 0.605 | 0.055 | 3 | 3 | 510 | 280.5 | 510 | 308.55 | 28.05 | 0 | | |
| 910 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 2730 | 3003 | 2730 | 1651.65 | -1351.35 | -9 | | |
| 290 | 0.9 | 0.55 | 0.89 | 0.605 | 0.055 | 3 | 3 | 870 | 478.5 | 870 | 526.35 | 47.85 | 0 | | |
| 170 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 510 | 561 | 510 | 308.55 | -252.45 | -9 | | |
| 700 | 0.5 | 2.75 | 0.79 | 1.155 | -1.595 | 4 | 4 | 2800 | 7700 | 2800 | 3234 | -4466 | -29 | | |
| 130 | 0.7 | 1.65 | 0.79 | 1.155 | -0.495 | 4 | 4 | 520 | 858 | 520 | 600.6 | -257.4 | -9 | | |
| 1300 | 0.9 | 0.55 | 0.79 | 1.155 | 0.605 | 4 | 4 | 5200 | 2860 | 5200 | 6006 | 3146 | 0 | | |
| | | | | | | | **Total** | **20,540** | **21,571** | **20,540** | **14,484** | **-7,087** | **-8** | | |

## Table D-19. Existing and potential solar loads for Wendover Creek and tributary (AU# 17060303CL043_02).

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m²/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m²/day) | Potential Load minus Existing load (kWh/m²/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m²) | Existing Summer Load (kWh/day) | Natural Segment Area (m²) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Wendover Creek & Tributary** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL043_02 | | | | | | | | | | | | | | | |
| 190 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 190 | 104.5 | 190 | 20.9 | -83.6 | -8 | subalpine breakland | WF Wendover Creek |
| 2000 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 2000 | 1100 | 2000 | 550 | -550 | -5 | | |
| 2200 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 4400 | 2420 | 4400 | 1452 | -968 | -4 | | |
| 3000 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 6000 | 3300 | 6000 | 1980 | -1320 | -4 | | Wendover Creek |
| 570 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 1710 | 1881 | 1710 | 1034.55 | -846.45 | -9 | | |
| 500 | 0.9 | 0.55 | 0.79 | 1.155 | 0.605 | 4 | 4 | 2000 | 1100 | 2000 | 2310 | 1210 | 0 | | |
| 290 | 0.8 | 1.1 | 0.79 | 1.155 | 0.055 | 4 | 4 | 1160 | 1276 | 1160 | 1339.8 | 63.8 | 0 | | |
| 200 | 0.7 | 1.65 | 0.79 | 1.155 | -0.495 | 4 | 4 | 800 | 1320 | 800 | 924 | -396 | -9 | | |
| | | | | | | | **Total** | **18,260** | **12,502** | **18,260** | **9,611** | **-2,890** | **-5** | | |

## Table D-20. Existing and potential solar loads for Badger Creek and tributary (AU# 17060303CL044_02).

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load ($kWh/m^2/day$) | Potential Shade (fraction) | Potential Summer Load ($kWh/m^2/day$) | Potential Load minus Existing load ($kWh/m^2/day$) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area ($m^2$) | Existing Summer Load (kWh/day) | Natural Segment Area ($m^2$) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Badger Creek & Tributary** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL044_02 | | | | | | | | | | | | | | | |
| 700 | 0.8 | 1.1 | 0.95 | 0.275 | -0.825 | 1 | 1 | 700 | 770 | 700 | 192.5 | -577.5 | -15 | breakland | tributary to Badger Creek |
| 400 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 800 | 440 | 800 | 264 | -176 | -4 | | |
| 690 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 2 | 2 | 1380 | 1518 | 1380 | 455.4 | -1062.6 | -14 | | |
| 610 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 610 | 335.5 | 610 | 167.75 | -167.75 | -5 | | Badger Creek |
| 460 | 0.8 | 1.1 | 0.95 | 0.275 | -0.825 | 1 | 1 | 460 | 506 | 460 | 126.5 | -379.5 | -15 | | |
| 1500 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 3000 | 1650 | 3000 | 990 | -660 | -4 | | |
| 340 | 0.7 | 1.65 | 0.89 | 0.605 | -1.045 | 3 | 3 | 1020 | 1683 | 1020 | 617.1 | -1065.9 | -19 | | |
| 940 | 0.9 | 0.55 | 0.89 | 0.605 | 0.055 | 3 | 3 | 2820 | 1551 | 2820 | 1706.1 | 155.1 | 0 | | |
| 1100 | 0.7 | 1.65 | 0.61 | 2.145 | 0.495 | 4 | 4 | 4400 | 7260 | 4400 | 9438 | 2178 | 0 | alder mix | |
| 140 | 0.8 | 1.1 | 0.79 | 1.155 | 0.055 | 4 | 4 | 560 | 616 | 560 | 646.8 | 30.8 | 0 | breakland | |
| 1400 | 0.9 | 0.55 | 0.79 | 1.155 | 0.605 | 4 | 4 | 5600 | 3080 | 5600 | 6468 | 3388 | 0 | | |
| | | | | | | | **Total** | **21,350** | **19,410** | **21,350** | **21,072** | **1,663** | **-7** | | |

**Table D-21. Existing and potential solar loads for Waw'aalamnime Creek and East Fork Waw'aalamnime Creek (AU# 17060303CL045_02 & _03).**

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m²/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m²/day) | Potential Load minus Existing load (kWh/m²/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m²) | Existing Summer Load (kWh/day) | Natural Segment Area (m²) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | shade curves | Waw aalamnime & EF Waw aalamnime |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL045_02 | | | | | | | | | | | | | | | |
| 960 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 960 | 528 | 960 | 105.6 | -422.4 | -8 | subalpine | East Fork Waw aalamnime Creek |
| 380 | 0.8 | 1.1 | 0.92 | 0.44 | -0.66 | 1 | 1 | 380 | 418 | 380 | 167.2 | -250.8 | -12 | alder mix | |
| 720 | 0.7 | 1.65 | 0.87 | 0.715 | -0.935 | 2 | 2 | 1440 | 2376 | 1440 | 1029.6 | -1346.4 | -17 | | |
| 320 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 2 | 2 | 640 | 704 | 640 | 211.2 | -492.8 | -14 | breakland | |
| 830 | 0.7 | 1.65 | 0.74 | 1.43 | -0.22 | 3 | 3 | 2490 | 4108.5 | 2490 | 3560.7 | -547.8 | -4 | alder mix | |
| 960 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 2880 | 3168 | 2880 | 1742.4 | -1425.6 | -9 | | |
| 1300 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 1300 | 715 | 1300 | 143 | -572 | -8 | subalpine | Waw aalamnime Creek |
| 1000 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 2000 | 1100 | 2000 | 330 | -770 | -7 | | |
| 540 | 0.7 | 1.65 | 0.94 | 0.33 | -1.32 | 2 | 2 | 1080 | 1782 | 1080 | 356.4 | -1425.6 | -24 | breakland | |
| 420 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 1260 | 1386 | 1260 | 762.3 | -623.7 | -9 | | |
| 1000 | 0.6 | 2.2 | 0.89 | 0.605 | -1.595 | 3 | 3 | 3000 | 6600 | 3000 | 1815 | -4785 | -29 | | |
| 280 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 840 | 924 | 840 | 508.2 | -415.8 | -9 | | |
| 250 | 0.7 | 1.65 | 0.79 | 1.155 | -0.495 | 4 | 4 | 1000 | 1650 | 1000 | 1155 | -495 | -9 | | |
| 850 | 0.6 | 2.2 | 0.79 | 1.155 | -1.045 | 4 | 4 | 3400 | 7480 | 3400 | 3927 | -3553 | -19 | | |
| 420 | 0.7 | 1.65 | 0.79 | 1.155 | -0.495 | 4 | 4 | 1680 | 2772 | 1680 | 1940.4 | -831.6 | -9 | | |
| 130 | 0.6 | 2.2 | 0.52 | 2.64 | 0.44 | 5 | 5 | 650 | 1430 | 650 | 1716 | 286 | 0 | alder mix | |
| 190 | 0.5 | 2.75 | 0.52 | 2.64 | -0.11 | 5 | 5 | 950 | 2612.5 | 950 | 2508 | -104.5 | -2 | | |
| 590 | 0.6 | 2.2 | 0.71 | 1.595 | -0.605 | 5 | 5 | 2950 | 6490 | 2950 | 4705.25 | -1784.75 | -11 | breakland | |
| | | | | | | | Subtotal | 28,900 | 46,244 | 28,900 | 26,683 | -19,561 | -11 | | |
| AU# ID17060303CL045_03 | | | | | | | | | | | | | | | |
| 780 | 0.7 | 1.65 | 0.65 | 1.925 | 0.275 | 6 | 6 | 4680 | 7722 | 4680 | 9009 | 1287 | 0 | breakland | |
| 450 | 0.5 | 2.75 | 0.46 | 2.97 | 0.22 | 6 | 6 | 2700 | 7425 | 2700 | 8019 | 594 | 0 | alder mix | |
| 210 | 0.4 | 3.3 | 0.46 | 2.97 | -0.33 | 6 | 6 | 1260 | 4158 | 1260 | 3742.2 | -415.8 | -6 | | |
| 380 | 0.5 | 2.75 | 0.46 | 2.97 | 0.22 | 6 | 6 | 2280 | 6270 | 2280 | 6771.6 | 501.6 | 0 | | |
| 1200 | 0.4 | 3.3 | 0.41 | 3.245 | -0.055 | 7 | 7 | 8400 | 27720 | 8400 | 27258 | -462 | -1 | | |
| 860 | 0.6 | 2.2 | 0.41 | 3.245 | 1.045 | 7 | 7 | 6020 | 13244 | 6020 | 19534.9 | 6290.9 | 0 | | |
| 230 | 0.3 | 3.85 | 0.41 | 3.245 | -0.605 | 7 | 7 | 1610 | 6198.5 | 1610 | 5224.45 | -974.05 | -11 | | |
| 950 | 0.6 | 2.2 | 0.6 | 2.2 | 0 | 7 | 7 | 6650 | 14630 | 6650 | 14630 | 0 | 0 | breakland | |
| 220 | 0.6 | 2.2 | 0.48 | 2.86 | 0.66 | 10 | 10 | 2200 | 4840 | 2200 | 6292 | 1452 | 0 | | |
| 600 | 0.5 | 2.75 | 0.48 | 2.86 | 0.11 | 10 | 10 | 6000 | 16500 | 6000 | 17160 | 660 | 0 | | |
| | | | | | | | Subtotal | 41,800 | 108,708 | 41,800 | 117,641 | 8,934 | -2 | | |
| | | | | | | | **Total** | **70,700** | **154,952** | **70,700** | **144,324** | **-10,627** | **-8** | | |

## Table D-22. Existing and potential solar loads for West Fork Waw'aalamnime Creek and tributary (AU# 17060303CL046_02).

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m²/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m²/day) | Potential Load minus Existing load (kWh/m²/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m²) | Existing Summer Load (kWh/day) | Natural Segment Area (m²) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **West Fork Waw aalamnime** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL046_02 | | | | | | | | | | | | | | | |
| 2300 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 4600 | 2530 | 4600 | 759 | -1771 | -7 | subalpine | West Fork |
| 880 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 1760 | 968 | 1760 | 580.8 | -387.2 | -4 | breakland | Waw aalamnime |
| 780 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 2340 | 2574 | 2340 | 1415.7 | -1158.3 | -9 | | Creek |
| 400 | 0.7 | 1.65 | 0.74 | 1.43 | -0.22 | 3 | 3 | 1200 | 1980 | 1200 | 1716 | -264 | -4 | alder mix | |
| 750 | 0.7 | 1.65 | 0.61 | 2.145 | 0.495 | 4 | 4 | 3000 | 4950 | 3000 | 6435 | 1485 | 9 | | |
| 270 | 0.8 | 1.1 | 0.79 | 1.155 | 0.055 | 4 | 4 | 1080 | 1188 | 1080 | 1247.4 | 59.4 | 0 | breakland | |
| 570 | 0.6 | 2.2 | 0.61 | 2.145 | -0.055 | 4 | 4 | 2280 | 5016 | 2280 | 4890.6 | -125.4 | -1 | alder mix | |
| 220 | 0.8 | 1.1 | 0.79 | 1.155 | 0.055 | 4 | 4 | 880 | 968 | 880 | 1016.4 | 48.4 | 0 | breakland | |
| 610 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 610 | 335.5 | 610 | 67.1 | -268.4 | -8 | subalpine | Spring Creek |
| 280 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 280 | 154 | 280 | 77 | -77 | -5 | breakland | |
| 2000 | 0.8 | 1.1 | 0.95 | 0.275 | -0.825 | 1 | 1 | 2000 | 2200 | 2000 | 550 | -1650 | -15 | | |
| 780 | 0.7 | 1.65 | 0.87 | 0.715 | -0.935 | 2 | 2 | 1560 | 2574 | 1560 | 1115.4 | -1458.6 | -17 | alder mix | |
| 270 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 540 | 297 | 540 | 178.2 | -118.8 | -4 | breakland | |
| 230 | 0.7 | 1.65 | 0.87 | 0.715 | -0.935 | 2 | 2 | 460 | 759 | 460 | 328.9 | -430.1 | -17 | alder mix | |
| | | | | | | | **Total** | **22,590** | **26,494** | **22,590** | **20,378** | **-6,116** | **-6** | | |

## Table D-23. Existing and potential solar loads for Doe Creek and tributary (AU# 17060303CL047_02).

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m²/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m²/day) | Potential Load minus Existing load (kWh/m²/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m²) | Existing Summer Load (kWh/day) | Natural Segment Area (m²) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Doe Creek & Tributary** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL047_02 | | | | | | | | | | | | | | | |
| 890 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 890 | 489.5 | 890 | 97.9 | -391.6 | -8 | subalpine | tributary to |
| 2200 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 4400 | 2420 | 4400 | 1452 | -968 | -4 | breakland | Doe Creek |
| 2100 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 2100 | 1155 | 2100 | 231 | -924 | -8 | subalpine | Doe Creek |
| 600 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 1200 | 660 | 1200 | 198 | -462 | -7 | | |
| 370 | 0.8 | 1.1 | 0.97 | 0.165 | -0.935 | 2 | 2 | 740 | 814 | 740 | 122.1 | -691.9 | -17 | | |
| 550 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 1100 | 605 | 1100 | 363 | -242 | -4 | breakland | |
| 310 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 2 | 2 | 620 | 682 | 620 | 204.6 | -477.4 | -14 | | |
| 470 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 1410 | 1551 | 1410 | 853.05 | -697.95 | -9 | | |
| 2200 | 0.7 | 1.65 | 0.89 | 0.605 | -1.045 | 3 | 3 | 6600 | 10890 | 6600 | 3993 | -6897 | -19 | | |
| 1500 | 0.8 | 1.1 | 0.79 | 1.155 | 0.055 | 4 | 4 | 6000 | 6600 | 6000 | 6930 | 330 | 0 | | |
| 600 | 0.5 | 2.75 | 0.52 | 2.64 | -0.11 | 5 | 5 | 3000 | 8250 | 3000 | 7920 | -330 | -2 | alder mix | |
| 510 | 0.7 | 1.65 | 0.71 | 1.595 | -0.055 | 5 | 5 | 2550 | 4207.5 | 2550 | 4067.25 | -140.25 | -1 | breakland | |
| 270 | 0.6 | 2.2 | 0.71 | 1.595 | -0.605 | 5 | 5 | 1350 | 2970 | 1350 | 2153.25 | -816.75 | -11 | | |
| 210 | 0.7 | 1.65 | 0.71 | 1.595 | -0.055 | 5 | 5 | 1050 | 1732.5 | 1050 | 1674.75 | -57.75 | -1 | | |
| 1600 | 0.7 | 1.65 | 0.65 | 1.925 | 0.275 | 6 | 6 | 9600 | 15840 | 9600 | 18480 | 2640 | 0 | | |
| | | | | | | | **Total** | **42,610** | **58,867** | **42,610** | **48,740** | **-10,127** | **-7** | | |

**Table D-24. Existing and potential solar loads for Post Office Creek and tributaries (AU# 17060303CL048_02 & _03).**

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m$^2$/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m$^2$/day) | Potential Load minus Existing load (kWh/m$^2$/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m$^2$) | Existing Summer Load (kWh/day) | Natural Segment Area (m$^2$) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Post Office Creek & Tributaries** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL048_02 | | | | | | | | | | | | | | | |
| 450 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 450 | 247.5 | 450 | 49.5 | -198 | -8 | subalpine | 1st tributary to |
| 500 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 500 | 550 | 500 | 55 | -495 | -18 | | Post Office |
| 1100 | 0.9 | 0.55 | 0.97 | 0.165 | -0.385 | 2 | 2 | 2200 | 1210 | 2200 | 363 | -847 | -7 | | |
| 720 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 1440 | 792 | 1440 | 475.2 | -316.8 | -4 | breakland | |
| 1800 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 3600 | 1980 | 3600 | 1188 | -792 | -4 | | 2nd tributary |
| 1400 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 1400 | 770 | 1400 | 154 | -616 | -8 | subalpine | 3rd tributary to |
| 1800 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 3600 | 1980 | 3600 | 1188 | -792 | -4 | breakland | Post Office |
| 720 | 0.7 | 1.65 | 0.87 | 0.715 | -0.935 | 2 | 2 | 1440 | 2376 | 1440 | 1029.6 | -1346.4 | -17 | alder mix | |
| 2000 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 2000 | 1100 | 2000 | 550 | -550 | -5 | | WF Post Office |
| 1300 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 2 | 2 | 2600 | 2860 | 2600 | 858 | -2002 | -14 | | |
| 3700 | 0.8 | 1.1 | 0.79 | 1.155 | 0.055 | 4 | 4 | 14800 | 16280 | 14800 | 17094 | 814 | 0 | | |
| 310 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 310 | 341 | 310 | 34.1 | -306.9 | -18 | subalpine | 4th tributary to |
| 600 | 0.8 | 1.1 | 0.95 | 0.275 | -0.825 | 1 | 1 | 600 | 660 | 600 | 165 | -495 | -15 | breakland | Post Office |
| 2000 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 4000 | 2200 | 4000 | 1320 | -880 | -4 | | |
| 1500 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 2 | 2 | 3000 | 3300 | 3000 | 990 | -2310 | -14 | | |
| 110 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 220 | 121 | 220 | 72.6 | -48.4 | -4 | | |
| 1000 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 1000 | 550 | 1000 | 275 | -275 | -5 | | 1st trib to 4th |
| 2600 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 2600 | 1430 | 2600 | 286 | -1144 | -8 | subalpine | Post Office |
| 640 | 0.6 | 2.2 | 0.87 | 0.715 | -1.485 | 2 | 2 | 1280 | 2816 | 1280 | 915.2 | -1900.8 | -27 | alder mix | Creek |
| 310 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 930 | 1023 | 930 | 562.65 | -460.35 | -9 | breakland | |
| 210 | 0.9 | 0.55 | 0.89 | 0.605 | 0.055 | 3 | 3 | 630 | 346.5 | 630 | 381.15 | 34.65 | 0 | | |
| 210 | 0.6 | 2.2 | 0.74 | 1.43 | -0.77 | 3 | 3 | 630 | 1386 | 630 | 900.9 | -485.1 | -14 | alder mix | |
| 130 | 0.7 | 1.65 | 0.89 | 0.605 | -1.045 | 3 | 3 | 390 | 643.5 | 390 | 235.95 | -407.55 | -19 | breakland | |
| 230 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 690 | 759 | 690 | 417.45 | -341.55 | -9 | | |
| 410 | 0.9 | 0.55 | 0.89 | 0.605 | 0.055 | 3 | 3 | 1230 | 676.5 | 1230 | 744.15 | 67.65 | 0 | | |
| 190 | 0.9 | 0.55 | 0.79 | 1.155 | 0.605 | 4 | 4 | 760 | 418 | 760 | 877.8 | 459.8 | 0 | | |
| 1450 | 0.8 | 1.1 | 0.79 | 1.155 | 0.055 | 4 | 4 | 5800 | 6380 | 5800 | 6699 | 319 | 0 | | |
| 2600 | 0.7 | 1.65 | 0.71 | 1.595 | -0.055 | 5 | 5 | 13000 | 21450 | 13000 | 20735 | -715 | -1 | | |
| 210 | 0.5 | 2.75 | 0.65 | 1.925 | -0.825 | 6 | 6 | 1260 | 3465 | 1260 | 2425.5 | -1039.5 | -15 | | |
| 1100 | 0.7 | 1.65 | 0.65 | 1.925 | 0.275 | 6 | 6 | 6600 | 10890 | 6600 | 12705 | 1815 | 0 | | |
| 170 | 0.6 | 2.2 | 0.6 | 2.2 | 0 | 7 | 7 | 1190 | 2618 | 1190 | 2618 | 0 | 0 | | |
| 160 | 0.8 | 1.1 | 0.6 | 2.2 | 1.1 | 7 | 7 | 1120 | 1232 | 1120 | 2464 | 1232 | 0 | | |
| 140 | 0.7 | 1.65 | 0.6 | 2.2 | 0.55 | 7 | 7 | 980 | 1617 | 980 | 2156 | 539 | 0 | | |
| 480 | 0.6 | 2.2 | 0.6 | 2.2 | 0 | 7 | 7 | 3360 | 7392 | 3360 | 7392 | 0 | 0 | | |
| AU# ID17060303CL048_03 | | | | | | | | | | | | | | | |
| 770 | 0.7 | 1.65 | 0.55 | 2.475 | 0.825 | 8 | 8 | 6160 | 10164 | 6160 | 15246 | 5082 | 0 | | |
| 340 | 0.6 | 2.2 | 0.55 | 2.475 | 0.275 | 8 | 8 | 2720 | 5984 | 2720 | 6732 | 748 | 0 | | |
| | | | | | | | **Total** | **94,490** | **118,008** | **94,490** | **110,355** | **-7,653** | **-7** | | |

## Table D-25. Existing and potential solar loads for Deadman Creek and tributaries (AU# 17060303CL059_02 & _03).

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m²/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m²/day) | Potential Load minus Existing load (kWh/m²/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m²) | Existing Summer Load (kWh/day) | Natural Segment Area (m²) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | shade curves | Deadman Creek & Tributaries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL059_02 | | | | | | | | | | | | | | | |
| 1600 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 1600 | 880 | 1600 | 440 | -440 | -5 | breakland | 3rd to Deadman |
| AU# ID17060303CL059_03 | | | | | | | | | | | | | | | |
| 260 | 0.8 | 1.1 | 0.65 | 1.925 | 0.825 | 6 | 6 | 1560 | 1716 | 1560 | 3003 | 1287 | 0 | | Deadman Creek |
| 670 | 0.5 | 2.75 | 0.46 | 2.97 | 0.22 | 6 | 6 | 4020 | 11055 | 4020 | 11939.4 | 884.4 | 0 | alder mix | |
| 350 | 0.6 | 2.2 | 0.6 | 2.2 | 0 | 7 | 7 | 2450 | 5390 | 2450 | 5390 | 0 | 0 | breakland | |
| 450 | 0.4 | 3.3 | 0.41 | 3.245 | -0.055 | 7 | 7 | 3150 | 10395 | 3150 | 10221.75 | -173.25 | -1 | alder mix | |
| 390 | 0.6 | 2.2 | 0.6 | 2.2 | 0 | 7 | 7 | 2730 | 6006 | 2730 | 6006 | 0 | 0 | breakland | |
| 1300 | 0.6 | 2.2 | 0.55 | 2.475 | 0.275 | 8 | 8 | 10400 | 22880 | 10400 | 25740 | 2860 | 0 | | |
| | | | | | | | **Total** | **25,910** | **58,322** | **25,910** | **62,740** | **4,418** | **-1** | | |

## Table D-26. Existing and potential solar loads for Deadman Creek and tributaries (AU# 17060303CL061_02).

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m²/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m²/day) | Potential Load minus Existing load (kWh/m²/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m²) | Existing Summer Load (kWh/day) | Natural Segment Area (m²) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | shade curves | Deadman Creek & Tributaries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL061_02 | | | | | | | | | | | | | | | |
| 780 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 780 | 429 | 780 | 85.8 | -343.2 | -8 | upland | 1st to Deadman |
| 170 | 0.8 | 1.1 | 0.92 | 0.44 | -0.66 | 1 | 1 | 170 | 187 | 170 | 74.8 | -112.2 | -12 | alder mix | |
| 560 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 560 | 308 | 560 | 61.6 | -246.4 | -8 | upland | |
| 1600 | 0.8 | 1.1 | 0.87 | 0.715 | -0.385 | 2 | 2 | 3200 | 3520 | 3200 | 2288 | -1232 | -7 | alder mix | |
| 480 | 0.7 | 1.65 | 0.94 | 0.33 | -1.32 | 2 | 2 | 960 | 1584 | 960 | 316.8 | -1267.2 | -24 | breakland | |
| 1300 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 1300 | 715 | 1300 | 143 | -572 | -8 | upland | 2nd to Deadman |
| 1000 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 2000 | 1100 | 2000 | 660 | -440 | -4 | breakland | |
| 270 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 270 | 297 | 270 | 29.7 | -267.3 | -18 | upland | Deadman Creek |
| 1600 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 1600 | 880 | 1600 | 176 | -704 | -8 | | |
| 920 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 1840 | 1012 | 1840 | 607.2 | -404.8 | -4 | breakland | |
| 140 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 420 | 462 | 420 | 254.1 | -207.9 | -9 | | |
| 280 | 0.9 | 0.55 | 0.89 | 0.605 | 0.055 | 3 | 3 | 840 | 462 | 840 | 508.2 | 46.2 | 0 | | |
| 470 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 1410 | 1551 | 1410 | 853.05 | -697.95 | -9 | | |
| 220 | 0.9 | 0.55 | 0.89 | 0.605 | 0.055 | 3 | 3 | 660 | 363 | 660 | 399.3 | 36.3 | 0 | | |
| 540 | 0.7 | 1.65 | 0.89 | 0.605 | -1.045 | 3 | 3 | 1620 | 2673 | 1620 | 980.1 | -1692.9 | -19 | | |
| 2200 | 0.8 | 1.1 | 0.79 | 1.155 | 0.055 | 4 | 4 | 8800 | 9680 | 8800 | 10164 | 484 | 0 | | |
| 1400 | 0.8 | 1.1 | 0.71 | 1.595 | 0.495 | 5 | 5 | 7000 | 7700 | 7000 | 11165 | 3465 | 0 | | |
| | | | | | | | **Total** | **33,430** | **32,923** | **33,430** | **28,767** | **-4,156** | **-8** | | |

**Table D-27. Existing and potential solar loads for East Fork Deadman Creek and tributaries (AU# 17060303CL060_02 & _03).**

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m²/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m²/day) | Potential Load minus Existing load (kWh/m²/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m²) | Existing Summer Load (kWh/day) | Natural Segment Area (m²) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **EF Deadman Creek & Tributaries** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL060_02 | | | | | | | | | | | | | | | |
| 1100 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 1100 | 605 | 1100 | 121 | -484 | -8 | upland | 1st tributary to |
| 430 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 860 | 473 | 860 | 283.8 | -189.2 | -4 | breakland | EF Deadman |
| 800 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 2 | 2 | 1600 | 1760 | 1600 | 528 | -1232 | -14 | | |
| 100 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 200 | 110 | 200 | 66 | -44 | -4 | | |
| 240 | 0.6 | 2.2 | 0.57 | 2.365 | 0.165 | 1 | 1 | 240 | 528 | 240 | 567.6 | 39.6 | 0 | meadow | 2nd tributary to |
| 920 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 920 | 506 | 920 | 101.2 | -404.8 | -8 | upland | EF Deadman |
| 1100 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 1100 | 605 | 1100 | 302.5 | -302.5 | -5 | breakland | |
| 2300 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 2300 | 1265 | 2300 | 632.5 | -632.5 | -5 | | 3rd tributary to EF |
| 1300 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 1300 | 715 | 1300 | 143 | -572 | -8 | upland | 4th tributary to |
| 720 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 1440 | 792 | 1440 | 475.2 | -316.8 | -4 | breakland | EF Deadman |
| 530 | 0.8 | 1.1 | 0.87 | 0.715 | -0.385 | 2 | 2 | 1060 | 1166 | 1060 | 757.9 | -408.1 | -7 | alder mix | |
| 2200 | 0.9 | 0.55 | 0.89 | 0.605 | 0.055 | 3 | 3 | 6600 | 3630 | 6600 | 3993 | 363 | 0 | | |
| 470 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 470 | 517 | 470 | 51.7 | -465.3 | -18 | subalpine | 5th tributary to |
| 1000 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 1000 | 1100 | 1000 | 110 | -990 | -18 | upland | EF Deadman |
| 170 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 170 | 93.5 | 170 | 18.7 | -74.8 | -8 | | (left fork) |
| 260 | 0.8 | 1.1 | 0.92 | 0.44 | -0.66 | 1 | 1 | 260 | 286 | 260 | 114.4 | -171.6 | -12 | alder mix | |
| 630 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 630 | 346.5 | 630 | 69.3 | -277.2 | -8 | | |
| 610 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 610 | 335.5 | 610 | 167.75 | -167.75 | -5 | breakland | |
| 1600 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 1600 | 1760 | 1600 | 176 | -1584 | -18 | upland | (right fork) |
| 750 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 2 | 2 | 1500 | 825 | 1500 | 165 | -660 | -8 | | |
| 670 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 1340 | 737 | 1340 | 442.2 | -294.8 | -4 | breakland | |
| 1900 | 0.9 | 0.55 | 0.89 | 0.605 | 0.055 | 3 | 3 | 5700 | 3135 | 5700 | 3448.5 | 313.5 | 0 | | (below forks) |
| 1700 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 1700 | 935 | 1700 | 187 | -748 | -8 | upland | EF Deadman |
| 140 | 0.8 | 1.1 | 0.87 | 0.715 | -0.385 | 2 | 2 | 280 | 308 | 280 | 200.2 | -107.8 | -7 | alder mix | Creek |
| 1100 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 2 | 2 | 2200 | 1210 | 2200 | 242 | -968 | -8 | upland | |
| 440 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 880 | 484 | 880 | 290.4 | -193.6 | -4 | breakland | |
| 690 | 0.7 | 1.65 | 0.74 | 1.43 | -0.22 | 3 | 3 | 2070 | 3415.5 | 2070 | 2960.1 | -455.4 | -4 | alder mix | |
| 140 | 0.9 | 0.55 | 0.89 | 0.605 | 0.055 | 3 | 3 | 420 | 231 | 420 | 254.1 | 23.1 | 0 | breakland | |
| 1800 | 0.8 | 1.1 | 0.79 | 1.155 | 0.055 | 4 | 4 | 7200 | 7920 | 7200 | 8316 | 396 | 0 | | |
| 700 | 0.8 | 1.1 | 0.71 | 1.595 | 0.495 | 5 | 5 | 3500 | 3850 | 3500 | 5582.5 | 1732.5 | 0 | | |
| 800 | 0.7 | 1.65 | 0.71 | 1.595 | -0.055 | 5 | 5 | 4000 | 6600 | 4000 | 6380 | -220 | -1 | | |
| AU# ID17060303CL060_03 | | | | | | | | | | | | | | | |
| 1000 | 0.8 | 1.1 | 0.65 | 1.925 | 0.825 | 6 | 6 | 6000 | 6600 | 6000 | 11550 | 4950 | 0 | | |
| | | | | | | | **Total** | **60,250** | **52,844** | **60,250** | **48,698** | **-4,146** | **-6** | | |

## Table D-28. Existing and potential solar loads for Canyon Creek and tributaries (AU# 17060303CL062_02).

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m²/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m²/day) | Potential Load minus Existing load (kWh/m²/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m²) | Existing Summer Load (kWh/day) | Natural Segment Area (m²) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | shade curves | Canyon Creek & Tributaries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | AU# ID17060303CL062_02 | | | | | | | | | |
| 250 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 250 | 275 | 250 | 27.5 | -247.5 | -18 | upland | 1st to Canyon Creek |
| 890 | 0.7 | 1.65 | 0.92 | 0.44 | -1.21 | 1 | 1 | 890 | 1468.5 | 890 | 391.6 | -1076.9 | -22 | alder mix | |
| 530 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 2 | 2 | 1060 | 583 | 1060 | 116.6 | -466.4 | -8 | upland | |
| 1300 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 1300 | 1430 | 1300 | 143 | -1287 | -18 | | 2nd to Canyon Creek |
| 610 | 0.8 | 1.1 | 0.95 | 0.275 | -0.825 | 1 | 1 | 610 | 671 | 610 | 167.75 | -503.25 | -15 | breakland | |
| 580 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 580 | 638 | 580 | 63.8 | -574.2 | -18 | upland | 3rd to Canyon Creek |
| 2400 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 2400 | 1320 | 2400 | 264 | -1056 | -8 | | |
| 380 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 2 | 2 | 760 | 836 | 760 | 83.6 | -752.4 | -18 | | |
| 970 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 2 | 2 | 1940 | 2134 | 1940 | 640.2 | -1493.8 | -14 | breakland | |
| 240 | 0.7 | 1.65 | 0.94 | 0.33 | -1.32 | 2 | 2 | 480 | 792 | 480 | 158.4 | -633.6 | -24 | | |
| 1200 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 1200 | 1320 | 1200 | 132 | -1188 | -18 | upland | Mystery Creek |
| 360 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 360 | 198 | 360 | 39.6 | -158.4 | -8 | | |
| 640 | 0.8 | 1.1 | 0.87 | 0.715 | -0.385 | 2 | 2 | 1280 | 1408 | 1280 | 915.2 | -492.8 | -7 | alder mix | |
| 620 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 2 | 2 | 1240 | 682 | 1240 | 136.4 | -545.6 | -8 | | |
| 540 | 0.7 | 1.65 | 0.87 | 0.715 | -0.935 | 2 | 2 | 1080 | 1782 | 1080 | 772.2 | -1009.8 | -17 | alder mix | |
| 2200 | 0.7 | 1.65 | 0.74 | 1.43 | -0.22 | 3 | 3 | 6600 | 10890 | 6600 | 9438 | -1452 | -4 | | |
| 880 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 880 | 484 | 880 | 96.8 | -387.2 | -8 | upland | 4th to Canyon Creek |
| 1500 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 3000 | 1650 | 3000 | 990 | -660 | -4 | breakland | |
| 350 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 350 | 385 | 350 | 38.5 | -346.5 | -18 | upland | 5th to Canyon Creek |
| 210 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 210 | 115.5 | 210 | 23.1 | -92.4 | -8 | | |
| 160 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 160 | 88 | 160 | 44 | -44 | -5 | breakland | |
| 290 | 0.8 | 1.1 | 0.95 | 0.275 | -0.825 | 1 | 1 | 290 | 319 | 290 | 79.75 | -239.25 | -15 | | |
| 620 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 620 | 341 | 620 | 170.5 | -170.5 | -5 | | |
| 550 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 550 | 302.5 | 550 | 60.5 | -242 | -8 | upland | SF Canyon Creek |
| 270 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 270 | 148.5 | 270 | 74.25 | -74.25 | -5 | breakland | |
| 1300 | 0.8 | 1.1 | 0.87 | 0.715 | -0.385 | 2 | 2 | 2600 | 2860 | 2600 | 1859 | -1001 | -7 | alder mix | |
| 2300 | 0.9 | 0.55 | 0.89 | 0.605 | 0.055 | 3 | 3 | 6900 | 3795 | 6900 | 4174.5 | 379.5 | 0 | | |
| 2200 | 0.8 | 1.1 | 0.79 | 1.155 | 0.055 | 4 | 4 | 8800 | 9680 | 8800 | 10164 | 484 | 0 | | |
| 600 | 0.9 | 0.55 | 0.92 | 0.44 | -0.11 | 1 | 1 | 600 | 330 | 600 | 264 | -66 | -2 | alder mix | Cabin Creek |
| 240 | 0.8 | 1.1 | 0.92 | 0.44 | -0.66 | 1 | 1 | 240 | 264 | 240 | 105.6 | -158.4 | -12 | | |
| 820 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 820 | 902 | 820 | 90.2 | -811.8 | -18 | upland | |
| 700 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 2 | 2 | 1400 | 770 | 1400 | 154 | -616 | -8 | | |
| 600 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 1200 | 660 | 1200 | 396 | -264 | -4 | breakland | |
| 480 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 480 | 264 | 480 | 52.8 | -211.2 | -8 | upland | Canyon Creek |
| 660 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 660 | 726 | 660 | 72.6 | -653.4 | -18 | | |
| 240 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 240 | 132 | 240 | 26.4 | -105.6 | -8 | | |
| 210 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 210 | 231 | 210 | 23.1 | -207.9 | -18 | | |
| 1100 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 2 | 2 | 2200 | 1210 | 2200 | 242 | -968 | -8 | | |
| 710 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 2 | 2 | 1420 | 1562 | 1420 | 468.6 | -1093.4 | -14 | breakland | |
| 570 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 2 | 2 | 1140 | 1254 | 1140 | 376.2 | -877.8 | -14 | | |
| 470 | 0.5 | 2.75 | 0.74 | 1.43 | -1.32 | 3 | 3 | 1410 | 3877.5 | 1410 | 2016.3 | -1861.2 | -24 | alder mix | |
| 1000 | 0.7 | 1.65 | 0.74 | 1.43 | -0.22 | 3 | 3 | 3000 | 4950 | 3000 | 4290 | -660 | -4 | | |
| 480 | 0.6 | 2.2 | 0.74 | 1.43 | -0.77 | 3 | 3 | 1440 | 3168 | 1440 | 2059.2 | -1108.8 | -14 | | |
| 600 | 0.8 | 1.1 | 0.79 | 1.155 | 0.055 | 4 | 4 | 2400 | 2640 | 2400 | 2772 | 132 | 0 | breakland | |
| 450 | 0.6 | 2.2 | 0.61 | 2.145 | -0.055 | 4 | 4 | 1800 | 3960 | 1800 | 3861 | -99 | -1 | alder mix | |
| 1600 | 0.6 | 2.2 | 0.71 | 1.595 | -0.605 | 5 | 5 | 8000 | 17600 | 8000 | 12760 | -4840 | -11 | breakland | |
| 810 | 0.5 | 2.75 | 0.52 | 2.64 | -0.11 | 5 | 5 | 4050 | 11137.5 | 4050 | 10692 | -445.5 | -2 | alder mix | |
| 540 | 0.6 | 2.2 | 0.65 | 1.925 | -0.275 | 6 | 6 | 3240 | 7128 | 3240 | 6237 | -891 | -5 | breakland | |
| 1500 | 0.8 | 1.1 | 0.65 | 1.925 | 0.825 | 6 | 6 | 9000 | 9900 | 9000 | 17325 | 7425 | 0 | | |
| 730 | 0.8 | 1.1 | 0.6 | 2.2 | 1.1 | 7 | 7 | 5110 | 5621 | 5110 | 11242 | 5621 | 0 | | |
| 690 | 0.7 | 1.65 | 0.6 | 2.2 | 0.55 | 7 | 7 | 4830 | 7969.5 | 4830 | 10626 | 2656.5 | 0 | | |
| 910 | 0.5 | 2.75 | 0.6 | 2.2 | -0.55 | 7 | 7 | 6370 | 17517.5 | 6370 | 14014 | -3503.5 | -10 | | |
| 1100 | 0.7 | 1.65 | 0.6 | 2.2 | 0.55 | 7 | 7 | 7700 | 12705 | 7700 | 16940 | 4235 | 0 | | |
| 360 | 0.7 | 1.65 | 0.6 | 2.2 | 0.55 | 7 | 7 | 2520 | 4158 | 2520 | 5544 | 1386 | 0 | | |
| | | | | | | | **Total** | **118,140** | **167,233** | **118,140** | **153,915** | **-13,318** | **-9** | | |

**Table D-29. Existing and potential solar loads for Canyon Creek and tributaries (AU# 17060303CL062_03).**

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m²/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m²/day) | Potential Load minus Existing load (kWh/m²/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m²) | Existing Summer Load (kWh/day) | Natural Segment Area (m²) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Canyon Creek & Tributaries** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL062_03 | | | | | | | | | | | | | | | |
| 270 | 0.7 | 1.65 | 0.55 | 2.475 | 0.825 | 8 | 8 | 2160 | 3564 | 2160 | 5346 | 1782 | 0 | breakland | Canyon Creek |
| 750 | 0.6 | 2.2 | 0.55 | 2.475 | 0.275 | 8 | 8 | 6000 | 13200 | 6000 | 14850 | 1650 | 0 | | |
| | | | | | | | **Total** | **8,160** | **16,764** | **8,160** | **20,196** | **3,432** | **0** | | |

**Table D-30. Existing and potential solar loads for lower Pete King Creek tributaries (AU# 17060303CL063_02).**

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m²/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m²/day) | Potential Load minus Existing load (kWh/m²/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m²) | Existing Summer Load (kWh/day) | Natural Segment Area (m²) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Lower Pete King Creek Tributaries** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL063_02 | | | | | | | | | | | | | | | |
| 2200 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 2200 | 1210 | 2200 | 605 | -605 | -5 | breakland | 1st to Pete King |
| 410 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 410 | 225.5 | 410 | 45.1 | -180.4 | -8 | upland | Placer Creek |
| 150 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 150 | 165 | 150 | 16.5 | -148.5 | -18 | | |
| 280 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 280 | 154 | 280 | 30.8 | -123.2 | -8 | | |
| 550 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 550 | 605 | 550 | 60.5 | -544.5 | -18 | | |
| 900 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 900 | 495 | 900 | 99 | -396 | -8 | | |
| 1500 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 3000 | 1650 | 3000 | 990 | -660 | -4 | breakland | |
| 1500 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 4500 | 4950 | 4500 | 2722.5 | -2227.5 | -9 | | |
| 240 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 720 | 792 | 720 | 435.6 | -356.4 | -9 | | |
| 2000 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 2000 | 1100 | 2000 | 550 | -550 | -5 | | 2nd to Pete King |
| 2000 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 2000 | 1100 | 2000 | 550 | -550 | -5 | | 3rd to Pete King |
| 1000 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 1000 | 550 | 1000 | 275 | -275 | -5 | | 4th to Pete King |
| 520 | 0.8 | 1.1 | 0.95 | 0.275 | -0.825 | 1 | 1 | 520 | 572 | 520 | 143 | -429 | -15 | | |
| 1200 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 1200 | 660 | 1200 | 132 | -528 | -8 | upland | Nut Creek |
| 2900 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 5800 | 3190 | 5800 | 1914 | -1276 | -4 | breakland | |
| 420 | 0.9 | 0.55 | 0.89 | 0.605 | 0.055 | 3 | 3 | 1260 | 693 | 1260 | 762.3 | 69.3 | 0 | | |
| 140 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 420 | 462 | 420 | 254.1 | -207.9 | -9 | | |
| 270 | 0.7 | 1.65 | 0.89 | 0.605 | -1.045 | 3 | 3 | 810 | 1336.5 | 810 | 490.05 | -846.45 | -19 | | |
| 2200 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 2200 | 1210 | 2200 | 605 | -605 | -5 | | 1st to Nut Creek |
| | | | | | | | **Total** | **29,920** | **21,120** | **29,920** | **10,680** | **-10,440** | **-9** | | |

**Table D-31. Existing and potential solar loads for lower Pete King Creek (AU# 17060303CL063_03).**

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m²/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m²/day) | Potential Load minus Existing load (kWh/m²/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m²) | Existing Summer Load (kWh/day) | Natural Segment Area (m²) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Lower Pete King Creek** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL063_03 | | | | | | | | | | | | | | | |
| 960 | 0.6 | 2.2 | 0.6 | 2.2 | 0 | 7 | 7 | 6720 | 14784 | 6720 | 14784 | 0 | 0 | breakland | bl Walde Creek |
| 520 | 0.4 | 3.3 | 0.41 | 3.245 | -0.055 | 7 | 7 | 3640 | 12012 | 3640 | 11811.8 | -200.2 | -1 | alder mix | |
| 300 | 0.3 | 3.85 | 0.41 | 3.245 | -0.605 | 7 | 7 | 2100 | 8085 | 2100 | 6814.5 | -1270.5 | -11 | | |
| 450 | 0.5 | 2.75 | 0.37 | 3.465 | 0.715 | 8 | 8 | 3600 | 9900 | 3600 | 12474 | 2574 | 0 | | |
| 340 | 0.3 | 3.85 | 0.37 | 3.465 | -0.385 | 8 | 8 | 2720 | 10472 | 2720 | 9424.8 | -1047.2 | -7 | | |
| 260 | 0.4 | 3.3 | 0.37 | 3.465 | 0.165 | 8 | 8 | 2080 | 6864 | 2080 | 7207.2 | 343.2 | 0 | | bl Placer Creek |
| 1000 | 0.5 | 2.75 | 0.37 | 3.465 | 0.715 | 8 | 8 | 8000 | 22000 | 8000 | 27720 | 5720 | 0 | | |
| 1000 | 0.5 | 2.75 | 0.33 | 3.685 | 0.935 | 9 | 9 | 9000 | 24750 | 9000 | 33165 | 8415 | 0 | | |
| 840 | 0.4 | 3.3 | 0.33 | 3.685 | 0.385 | 9 | 9 | 7560 | 24948 | 7560 | 27858.6 | 2910.6 | 0 | | |
| 860 | 0.4 | 3.3 | 0.31 | 3.795 | 0.495 | 10 | 10 | 8600 | 28380 | 8600 | 32637 | 4257 | 0 | | bl Nut Creek |
| 1300 | 0.5 | 2.75 | 0.31 | 3.795 | 1.045 | 10 | 10 | 13000 | 35750 | 13000 | 49335 | 13585 | 0 | | |
| 530 | 0.6 | 2.2 | 0.31 | 3.795 | 1.595 | 10 | 10 | 5300 | 11660 | 5300 | 20113.5 | 8453.5 | 0 | | |
| | | | | | | | **Total** | **72,320** | **209,605** | **72,320** | **253,345** | **43,740** | **-2** | | |

**Table D-32. Existing and potential solar loads for Walde Creek (AU# 17060303CL063_03).**

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m²/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m²/day) | Potential Load minus Existing load (kWh/m²/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m²) | Existing Summer Load (kWh/day) | Natural Segment Area (m²) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Walde Creek & Tributaries** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL063_03 | | | | | | | | | | | | | | | |
| 560 | 0.7 | 1.65 | 0.71 | 1.595 | -0.055 | 5 | 5 | 2800 | 4620 | 2800 | 4466 | -154 | -1 | breakland | Walde Creek |
| | | | | | | | **Total** | **2,800** | **4,620** | **2,800** | **4,466** | **-154** | **-1** | | |

**Table D-33. Existing and potential solar loads for Walde Creek and tributaries (AU# 17060303CL064_02).**

| Segment Length (meters) | Existing Shade (fraction) | Existing Summer Load (kWh/m$^2$/day) | Potential Shade (fraction) | Potential Summer Load (kWh/m$^2$/day) | Potential Load minus Existing load (kWh/m$^2$/day) | Existing Stream Width (m) | Natural Stream Width (m) | Existing Segment Area (m$^2$) | Existing Summer Load (kWh/day) | Natural Segment Area (m$^2$) | Potential Summer Load (kWh/day) | Potential Load minus Existing Load (kWh/day) | Lack of Shade (%) | **shade curves** | **Walde Creek & Tributaries** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU# ID17060303CL064_02 | | | | | | | | | | | | | | | |
| 990 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 990 | 544.5 | 990 | 108.9 | -435.6 | -8 | upland | 1st to Walde Creek |
| 720 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 720 | 396 | 720 | 198 | -198 | -5 | breakland | |
| 340 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 340 | 374 | 340 | 37.4 | -336.6 | -18 | upland | 2nd to Walde Creek |
| 140 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 140 | 77 | 140 | 15.4 | -61.6 | -8 | | |
| 80 | 0.7 | 1.65 | 0.98 | 0.11 | -1.54 | 1 | 1 | 80 | 132 | 80 | 8.8 | -123.2 | -28 | | |
| 210 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 210 | 115.5 | 210 | 23.1 | -92.4 | -8 | | |
| 940 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 940 | 517 | 940 | 258.5 | -258.5 | -5 | breakland | |
| 1000 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 1000 | 550 | 1000 | 110 | -440 | -8 | upland | 3rd to Walde Creek |
| 570 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 1140 | 627 | 1140 | 376.2 | -250.8 | -4 | breakland | |
| 590 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 590 | 324.5 | 590 | 64.9 | -259.6 | -8 | upland | Polar Creek |
| 570 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 570 | 313.5 | 570 | 156.75 | -156.75 | -5 | breakland | |
| 190 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 190 | 104.5 | 190 | 20.9 | -83.6 | -8 | upland | |
| 1300 | 0.8 | 1.1 | 0.95 | 0.275 | -0.825 | 1 | 1 | 1300 | 1430 | 1300 | 357.5 | -1072.5 | -15 | breakland | |
| 250 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 500 | 275 | 500 | 165 | -110 | -4 | | |
| 520 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 2 | 2 | 1040 | 1144 | 1040 | 343.2 | -800.8 | -14 | | |
| 1100 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 2200 | 1210 | 2200 | 726 | -484 | -4 | | |
| 790 | 0.9 | 0.55 | 0.89 | 0.605 | 0.055 | 3 | 3 | 2370 | 1303.5 | 2370 | 1433.85 | 130.35 | 0 | | |
| 880 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 2640 | 2904 | 2640 | 1597.2 | -1306.8 | -9 | | |
| 150 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 150 | 82.5 | 150 | 16.5 | -66 | -8 | upland | 1st to Polar Creek |
| 260 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 260 | 286 | 260 | 28.6 | -257.4 | -18 | | |
| 680 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 680 | 374 | 680 | 74.8 | -299.2 | -8 | | |
| 260 | 0.8 | 1.1 | 0.98 | 0.11 | -0.99 | 1 | 1 | 260 | 286 | 260 | 28.6 | -257.4 | -18 | | |
| 670 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 670 | 368.5 | 670 | 73.7 | -294.8 | -8 | | |
| 120 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 120 | 66 | 120 | 33 | -33 | -5 | breakland | |
| 1100 | 0.9 | 0.55 | 0.98 | 0.11 | -0.44 | 1 | 1 | 1100 | 605 | 1100 | 121 | -484 | -8 | upland | Walde Creek |
| 770 | 0.9 | 0.55 | 0.95 | 0.275 | -0.275 | 1 | 1 | 770 | 423.5 | 770 | 211.75 | -211.75 | -5 | breakland | |
| 380 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 760 | 418 | 760 | 250.8 | -167.2 | -4 | | |
| 980 | 0.8 | 1.1 | 0.94 | 0.33 | -0.77 | 2 | 2 | 1960 | 2156 | 1960 | 646.8 | -1509.2 | -14 | | |
| 690 | 0.9 | 0.55 | 0.94 | 0.33 | -0.22 | 2 | 2 | 1380 | 759 | 1380 | 455.4 | -303.6 | -4 | | |
| 290 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 870 | 957 | 870 | 526.35 | -430.65 | -9 | | |
| 550 | 0.9 | 0.55 | 0.89 | 0.605 | 0.055 | 3 | 3 | 1650 | 907.5 | 1650 | 998.25 | 90.75 | 0 | | |
| 110 | 0.8 | 1.1 | 0.89 | 0.605 | -0.495 | 3 | 3 | 330 | 363 | 330 | 199.65 | -163.35 | -9 | | |
| 570 | 0.9 | 0.55 | 0.89 | 0.605 | 0.055 | 3 | 3 | 1710 | 940.5 | 1710 | 1034.55 | 94.05 | 0 | | |
| 670 | 0.8 | 1.1 | 0.79 | 1.155 | 0.055 | 4 | 4 | 2680 | 2948 | 2680 | 3095.4 | 147.4 | 0 | | |
| 630 | 0.9 | 0.55 | 0.79 | 1.155 | 0.605 | 4 | 4 | 2520 | 1386 | 2520 | 2910.6 | 1524.6 | 0 | | |
| | | | | | | | **Total** | **34,830** | **25,669** | **34,830** | **16,707** | **-8,961** | **-8** | | |

*This page intentionally left blank for correct double-sided printing.*

# Appendix E. Distribution List

[To be added following the public comment period.]

*This page intentionally left blank for correct double-sided printing.*

# Appendix F. Public Comments

[To be added following the public comment period.]

*This page intentionally left blank for correct double-sided printing.*