

Weiser River Subbasin Temperature Total Maximum Daily Loads:

Addendum to the Weiser River Subbasin Assessment and TMDL



FINAL



Department of Environmental Quality

June 2006

Weiser Subbasin Temperature TMDLs

June 2006

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

Acknowledgments

Cover photo of the Weiser River by Barry Burnell (September 2005).

Table of Contents

Acknowledgments	i
Table of Contents	ii
List of Tables	iv
List of Figures	vi
List of Appendices	vii
Abbreviations, Acronyms, and Symbols	viii
Executive Summary	x
Subbasin at a Glance	x
Key Findings	xii
5. Total Maximum Daily Loads	1
5.1 In-stream Water Quality Targets	1
Design Conditions	7
Target Selection	8
Monitoring Points	10
5.2 Load Capacity	10
5.3 Estimates of Existing Pollutant Loads	11
5.4 Load Allocation	37
Wasteload Allocation	38
Margin of Safety	40
Seasonal Variation	40
Construction Storm Water and TMDL Waste Load Allocations	41
<i>Construction Storm Water</i>	41
<i>The Construction General Permit (CGP)</i>	41
<i>Storm Water Pollution Prevention Plan (SWPPP)</i>	41
<i>Construction Storm Water Requirements</i>	41
5.5 Implementation Strategies	41
Time Frame	42
Approach	42
Responsible Parties	42
Monitoring Strategy	42
5.6 Conclusions	42
References Cited	44
<i>GIS Coverages</i>	46
<i>Other Related Documents</i>	46
Glossary	47

Appendix A. Unit Conversion Chart	72
Appendix B. State and Site-Specific Standards and Criteria	74
Appendix C. Data Sources and Temperature Data.....	78
Appendix D. Distribution List.....	81
Appendix E. Public Comments.....	83

List of Tables

Table A. Streams and pollutants for which TMDLs were developed.	xii
Table B. Summary of assessment outcomes.	xiii
Table 1. Existing and Potential Solar Loads for the Weiser River, Headwaters to Fruitvale.	12
Table 2. Existing and Potential Solar Loads for West Branch Weiser River.	13
Table 3. Existing and Potential Solar Loads for the Weiser River, Fruitvale to Mouth.	14
Table 4. Existing and Potential Solar Loads for East Fork Weiser River.	16
Table 5. Existing and Potential Solar Loads for West Fork Weiser River.	17
Table 6. Existing and Potential Solar Loads for Hornet Creek.	19
Table 7. Existing and Potential Solar Loads for North Hornet Creek.	20
Table 8. Existing and Potential Solar Loads for Middle Fork Weiser River.	21
Table 9. Existing and Potential Solar Loads for Pine Creek.	23
Table 10. Existing and Potential Solar Loads for Little Pine Creek.	24
Table 11. Existing and Potential Solar Loads for East Pine Creek.	24
Table 12. Existing and Potential Solar Loads for West Pine Creek.	25
Table 13. Existing and Potential Solar Loads for Little Weiser River.	26
Table 14. Existing and Potential Solar Loads for Mann Creek.	27
Table 15. Existing and Potential Solar Loads for Monroe Creek.	30
Table 16. Existing and Potential Solar Loads for Lower Crane Creek.	32
Table 17. Existing and Potential Solar Loads for North Crane Creek.	33
Table 18. Existing and Potential Solar Loads for South Crane Creek.	35

Table 19. Excess Solar Load and Percent Reduction to Achieve Loading Capacity for the Weiser River and Associated Tributaries.	38
Table 20. Effluent Temperatures (°C) Necessary to Maintain Cold Water Aquatic Life Criteria at Council.....	39
Table 21. Effluent Temperatures (°C) Necessary to Maintain Cold Water Aquatic Life Criteria at Cambridge.....	40
Table 22. Summary of assessment outcomes.	43
Table A-1. Metric - English unit conversions.....	73
Table C-1. Data sources for Weiser River and major tributaries TMDLs.....	79

List of Figures

Figure A. Subbasin at a glance.....	xi
Figure 1. Drainage Area and Bankfull Width Estimates (Red Numbers) for the Weiser Subbasin. Weiser River Flow Direction is from Right (headwaters) to Left (mouth).	6
Figure 2. Existing Shade Estimated for the Weiser Subbasin by Aerial Photo Interpretation.	36
Figure B-1. Bankfull Width as a Function of Drainage Area	76

List of Appendices

Appendix A. Unit Conversion Chart	72
Appendix B. State and Site-Specific Standards and Criteria	74
Appendix C. Data Sources and Temperature Data.....	78
Appendix D. Distribution List.....	81
Appendix E. Public Comments.....	83

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	IDL	Idaho Department of Lands
AU	assessment unit	IDWR	Idaho Department of Water Resources
BMP	best management practice	LA	load allocation
BURP	Beneficial Use Reconnaissance Program	LC	load capacity
C	Celsius	m	meter
CWA	Clean Water Act	mi	mile
CWE	cumulative watershed effects	mi²	square miles
DEQ	Department of Environmental Quality	MOS	margin of safety
EPA	United States Environmental Protection Agency	MWMT	maximum weekly maximum temperature
FPA	Idaho Forest Practices Act	n.a.	not applicable
FWS	U.S. Fish and Wildlife Service	NA	not assessed
GIS	Geographical Information Systems	NB	natural background
HUC	Hydrologic Unit Code	nd	no data (data not available)
I.C.	Idaho Code	NPDES	National Pollutant Discharge Elimination System
IDAPA	Refers to citations of Idaho administrative rules	PNV	potential natural vegetation
IDFG	Idaho Department of Fish and Game	SBA	subbasin assessment
		STATSGO	State Soil Geographic Database
		TMDL	total maximum daily load
		U.S.	United States
		U.S.C.	United States Code

USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USFS	United States Forest Service
USGS Survey	United States Geological
WAG	Watershed Advisory Group
WLA	wasteload allocation
WQLS	water quality limited segment
WQMP plan	water quality management
WQRP	water quality restoration plan
WQS	water quality standard

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. 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 four water bodies in the Weiser River Subbasin that have been placed on Idaho's current §303(d) list. Additionally, a watershed approach was taken to examine shade characteristics on the entire Weiser River and ten associated tributaries. This document only addresses the temperature TMDLs. For more information about these watersheds and the subbasin as a whole see the *Weiser River Watershed Subbasin Assessment and Total Maximum Daily Loads* (IDEQ, 2004a).

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

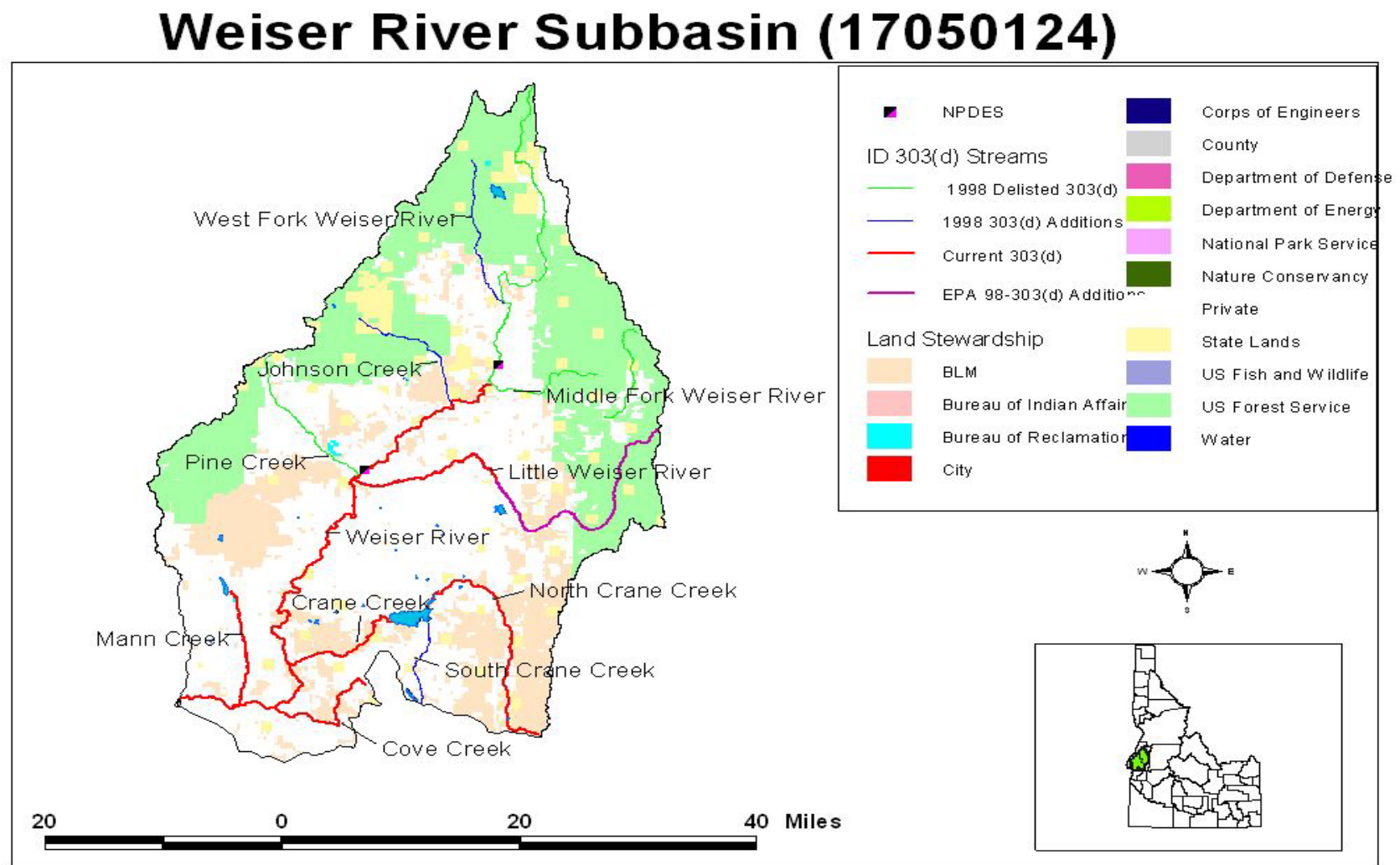
Subbasin at a Glance

The Weiser River Subbasin (17050124) is located in southwestern Idaho (see inset, Figure A). Approximately twelve stream segments were originally listed on the court ordered Idaho 1998 303d list of polluted waters. Only two stream segments were listed for temperature pollution, and they are the Weiser River from Galloway Dam to mouth and North Crane Creek, headwaters to Crane Creek Reservoir.

The Environmental Protection Agency (EPA) added streams to Idaho's 1998 303d list of impaired waters that exceeded Idaho's temperature criteria. In the Weiser River Subbasin the Weiser River from Little Weiser confluence to Galloway Dam, the Little Weiser River, headwaters to mouth, and all of the Crane Creek drainage were among those EPA additions (Figure A).

In this temperature TMDL, we will present loading analyses for the five temperature listed segments, as well as for the Weiser River as a whole and ten of its major tributaries. Because water temperature in a segment of flowing water can be strongly influenced by the waters flowing into and mixing with it, it is important to gain perspective on heat loading throughout the entire watershed as well.

Figure A. Subbasin at a glance.



Key Findings

Five stream segments were placed on the 1998 303d list of impaired waters by EPA for reasons associated with temperature criteria violations (Table A). Two stream segments were on the original 1998 list and three were added by EPA in 2001.

This TMDL addresses solar loading to streams as a result of shade from riparian vegetation and topography. Hydrologic aspects (such as irrigation structures and reservoirs, but not channel width) of stream temperature may have an impact (positive or negative), but were not assessed in this TMDL. The affects of reservoirs on downstream temperatures will be investigated at some time in the future after completion of this TMDL. Effective shade targets were established for the Weiser River and ten associated tributaries based on the concept of maximum shading under potential natural vegetation equals natural background temperature levels. Shade targets were derived from effective shade curves developed for similar vegetation types in the Northwest. Existing shade was determined from aerial photo interpretation field verified with solar pathfinder data. Shade was converted to a solar load based on National Renewable Energy Laboratory station data.

Potential solar loads were compared to existing solar loads. Excess loads result from existing solar loads being higher than potential. The Weiser River from Fruitvale to the Snake River had the highest excess load at a little more than 3 million kWh/day; however that represented only 9% of the river's total solar load. The Little Weiser River and the Hornet Creek drainage had the second (1.5 million kWh/day) and third (624,406 kWh/day) highest excess loads, and the percent reduction necessary to achieve potential loads was 28% and 35%, respectively. The East Fork Weiser River had the highest percent reduction needed at 63% although excess loads were moderate at 176,552 kWh/day. Rain-on-snow flooding events and recent wildfires in the East Fork Weiser River drainage are likely responsible for the high percent reduction. The Crane Creek drainage, Mann Creek, and Pine Creek had the lowest percent reductions needed and relatively low excess loads suggesting that these streams are closest to achieving potential solar loads. In general, streams with excess solar loads less than 20% of their total solar loads (<20% reduction) are in relatively good shape with regard to shade and are of lower priority for improvement.

An examination of wasteload allocations for two NPDES discharges to the Weiser River show that effluent temperature will have little effect on cold water aquatic life criteria.

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

Stream	Pollutant(s)
Weiser River, Galloway Dam to mouth	Temperature
North Crane Creek, headwaters to mouth	Temperature
Weiser River, Little Weiser River to Galloway Dam	Temperature
Little Weiser River, headwaters to mouth	Temperature
Crane Creek, headwaters to mouth	Temperature

Table B. Summary of assessment outcomes.

Water Body Segment/ AU	Pollutant	TMDL(s) Completed	Recommended Changes to §303(d) List	Justification
Weiser River, Galloway Dam to mouth/ ID17050124SW001_06	Temperature	Yes	n.a.	Existing Shade
North Crane Creek, headwaters to mouth/ ID17050124SW006_02 ID17050124SW006_03 ID17050124SW006_04	Temperature	Yes	n.a.	Existing Shade
Weiser River, Little Weiser River to Galloway Dam/ ID17050124SW001_06 ID17050124SW001_05 ID17050124SW007_05 & 05a	Temperature	Yes	n.a.	Existing Shade
Little Weiser River, headwaters to mouth/ ID17050124SW008_02 ID17050124SW008_03 ID17050124SW008_04	Temperature	Yes	n.a.	Existing Shade
Crane Creek, headwaters to mouth/ ID17050124SW003_05 ID17050124SW005_02 ID17050124SW005_03 ID17050124SW005_04	Temperature	Yes	n.a.	Existing Shade

5. Total Maximum Daily Loads

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

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

Another step in a loading analysis is the quantification of current pollutant loads by source. This allows the specification of load reductions as percentages from current conditions, considers equities in load reduction responsibility, and is necessary in order for pollutant trading to occur. The load capacity must be based on critical conditions – the conditions when water quality standards are most likely to be violated. If protective under critical conditions, a TMDL will be more than protective under other conditions. Because both load capacity and pollutant source loads vary, and not necessarily in concert, determination of critical conditions can be more complicated than it may appear on the surface.

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

5.1 In-stream Water Quality Targets

For the Weiser subbasin temperature TMDLs we utilize a potential natural vegetation (PNV) approach. The Idaho water quality standards include a provision (IDAPA 58.01.02.200.09)

which establishes that if natural conditions exceed numeric water quality criteria, exceedance of the criteria is not considered to be a violation of water quality standards. In these situations, natural conditions essentially become the water quality standard, and the natural level of shade and channel width become the target of the TMDL. The instream temperature which results from attainment of these conditions is consistent with the water quality standards, even though it may exceed numeric temperature criteria. See Appendix B for further discussion of water quality standards and background provisions. The PNV approach is described below. Additionally, the procedures and methodologies to develop PNV target shade levels and to estimate existing shade levels are described in this section. For a more complete discussion of shade and its affects on stream water temperature, the reader is referred to the South Fork Clearwater Subbasin Assessment and TMDL (IDEQ, 2004b). Hydrologic (such as irrigation structures and reservoirs, but not channel width) aspects of stream temperature were not assessed, and their affects (positive or negative) are unknown at this time, but will be determined upon assessment sometime in the future.

Potential Natural Vegetation for Temperature TMDLs

There are a several important contributors of heat to a stream including ground water temperature, air temperature and direct solar radiation (Poole and Berman 2001). Of these, direct solar radiation is the source of heat that is most likely to be controlled or manipulated. The parameters that affect or control the amount of solar radiation hitting a stream throughout its length are shade and stream morphology. Shade is provided by the surrounding vegetation and other physical features such as hillsides, canyon walls, terraces, and high banks. Stream morphology affects how closely riparian vegetation grows together and water storage in the alluvial aquifer. Streamside vegetation and channel morphology are factors influencing shade, which are most likely to have been influenced by anthropogenic activities, and which can be most readily corrected and addressed by a TMDL.

Depending on how much vertical elevation also surrounds the stream, vegetation further away from the riparian corridor can provide shade. However, riparian vegetation provides a substantial amount of shade on a stream by virtue of its proximity. We can measure the amount of shade that a stream enjoys in a number of ways. Effective shade, that shade provided by all objects that intercept the sun as it makes its way across the sky, can be measured in a given spot with a solar pathfinder or with optical equipment similar to a fish-eye lens on a camera. Effective shade can also be modeled using detailed information about riparian plants and their communities, topography, and the stream's aspect. In addition to shade, canopy cover is a similar parameter that affects solar radiation. Canopy cover is the vegetation that hangs directly over the stream, and can be measured using a densiometer, or estimated visually either on site or on aerial photography. All of these methods tell us information about how much the stream is covered and how much of it is exposed to direct solar radiation.

Potential natural vegetation (PNV) along a stream is that intact riparian plant community that has grown to **an overall mature state, although some level of natural disturbance is usually included in our development and use of shade targets**. The PNV can be removed by disturbance either naturally (wildfire, disease/old age, wind-blown, wildlife grazing) or anthropogenically (domestic livestock grazing, vegetation removal, erosion). The idea behind PNV as targets for temperature TMDLs is that PNV provides a natural level of solar loading to the stream **without any anthropogenic removal of shade producing vegetation**.

Anything less than PNV results in the stream heating up from anthropogenically created additional solar inputs. We can estimate PNV from models of plant community structure (shade curves for specific riparian plant communities), and we can measure existing vegetative cover or shade. Comparing the two will tell us how much excess solar load the stream is receiving, and what potential there is to decrease solar gain. Streams disturbed by wildfire require their own time to recover. Streams that have been disturbed by human activity may require additional restoration above and beyond natural recovery.

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

Pathfinder Methodology

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

At each sampling location the solar pathfinder should be placed in the middle of the stream about one foot above the water. Follow the manufacturer's instructions (orient to true south and level) for taking traces. Systematic sampling is easiest to accomplish and still not bias the location of sampling. Start at a unique location such as 100 m from a bridge or fence line and then proceed upstream or downstream stopping to take additional traces at fixed intervals (e.g. every 100m, every half-mile, every degree change on a GPS, every 0.5 mile change on an odometer, etc.). One can also randomly locate points of measurement by generating random numbers to be used as interval distances.

It is a good idea to take notes while taking solar pathfinder traces, and to photograph the stream at several unique locations. Pay special attention to changes in riparian plant communities and what kinds of plant species (the large, dominant, shade producing ones) are present. Additionally or as a substitution, one can take densiometer readings at the same

location as solar pathfinder traces. This provides the potential to develop relationships between canopy cover and effective shade for a given stream.

Aerial Photo Interpretation

Canopy coverage estimates or expectations of shade based on plant type and density are provided for natural breaks in vegetation density, marked out on 1:100K hydrography. Each interval is assigned a single value representing the bottom of a 10%-canopy coverage or shade class as described below (*adapted from the CWE process, IDL, 2000*). For example, if we estimate that canopy cover for a particular stretch of stream is somewhere between 50% and 59%, we assign the value of 50% to that section of stream. The estimate is based on a general intuitive observation about the kind of vegetation present, its density, and the width of the stream. The typical vegetation type (below) shows the kind of landscape a particular cover class usually falls into for a stream 5m wide or less. For example, if a section of a 5m wide stream is identified as 20% cover class, it is usually because it is in agricultural land, meadows, open areas, or clearcuts. However, that does not mean that the 20% cover class cannot occur in shrublands and forests, because it does on wider streams.

<u>Cover class</u>	<u>Typical vegetation type on 5m wide stream</u>
0 = 0 – 9% cover	agricultural land, denuded areas
10 = 10 – 19%	ag land, meadows, open areas, clearcuts
20 = 20 – 29%	ag land, meadows, open areas, clearcuts
30 = 30 – 39%	ag land, meadows, open areas, clearcuts
40 = 40 – 49%	shrublands/meadows
50 = 50 – 59%	shrublands/meadows, open forests
60 = 60 – 69%	shrublands/meadows, open forests
70 = 70 – 79%	forested
80 = 80 – 89%	forested
90 = 90 – 100%	forested

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

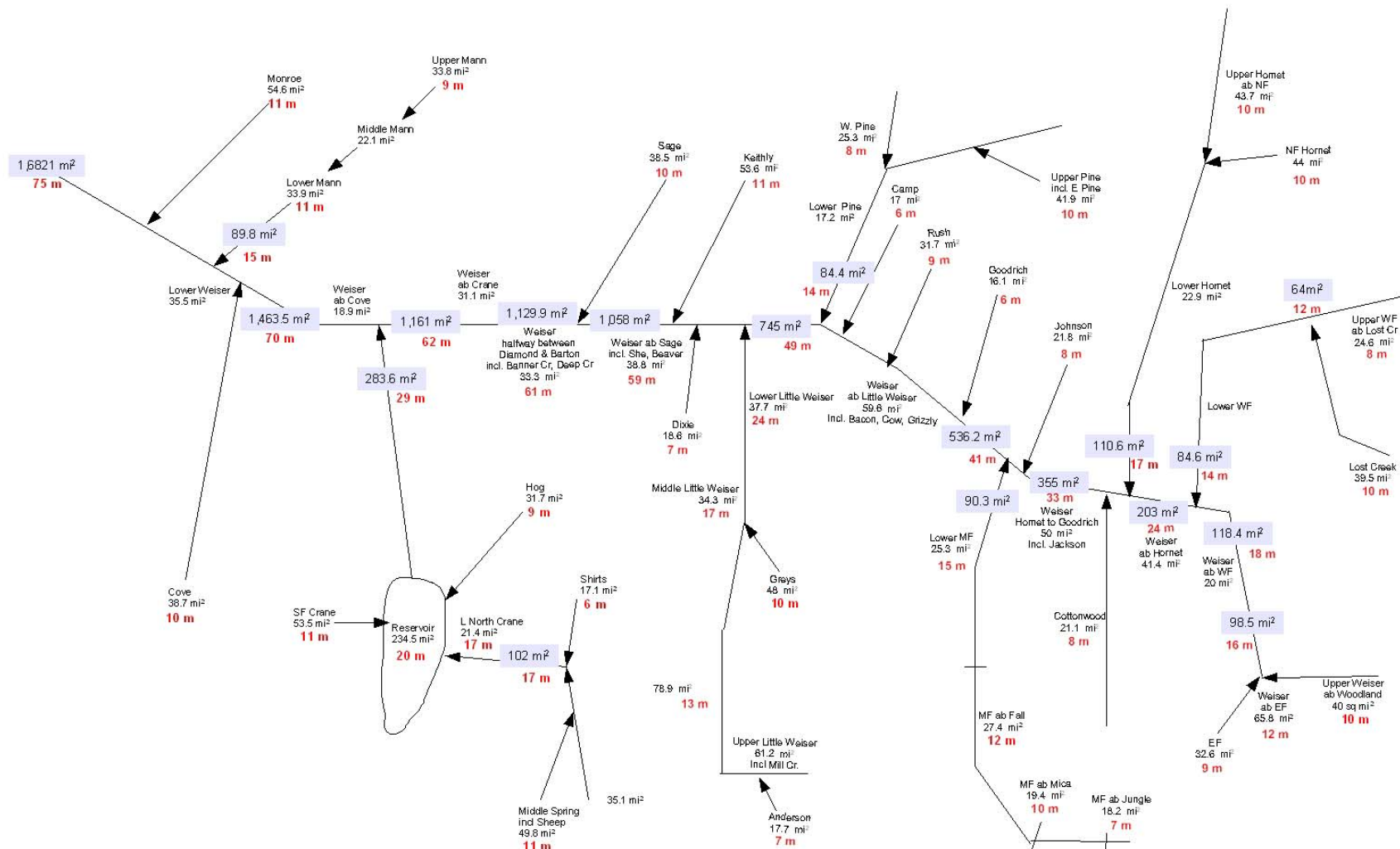
Stream Morphology

Measures of current bankfull width or near stream disturbance zone width may not reflect widths that were present under PNV. As impacts to streams and riparian areas occur, width-to-depth ratios tend to increase such that streams become wider and shallow. Shadow length produced by vegetation covers a lower percentage of the water surface in wider streams, and widened streams can also have less vegetative cover if shoreline vegetation has been eroded away.

Shade target selection, which involves evaluating the amount of shade provided at PNV conditions, necessitates recognition of potential natural stream widths as well. In this TMDL appropriate stream widths for shade target selection were determined from analysis of the relationship between drainage area and bankfull width (Rosgen, 1996) (see Appendix B for more discussion on determining appropriate stream widths).

Figure 1 shows the bankfull widths (in red) determined from drainage area relationships (Appendix B) for the Weiser River and its major tributaries. Bankfull widths determined from drainage area are generally less than or equal to existing bankfull widths measured in the field during solar pathfinder field verification and from BURP sites. The West Fork Weiser River was the only stream where existing bankfull measurements were substantially less than estimates determined from drainage area relationships. The loading analysis for the West Fork uses existing bankfull widths (10m at mouth) instead of estimates shown in Figure 1 (14m at mouth). Loading analyses for all other streams use drainage area-based bankfull widths as displayed in Figure 1.

Figure 1. Drainage Area and Bankfull Width Estimates (Red Numbers) for the Weiser Subbasin. Weiser River Flow Direction is from Right (headwaters) to Left (mouth).



Design Conditions

Weiser River

The Weiser River from its headwaters to its mouth was divided into five general riparian vegetation types. The upper 'conifer' zone north of Fruitvale has four vegetation types and below Fruitvale the riparian vegetation is characterized as a single vegetation type dominated by cottonwood trees. The five types include:

- 1) a *mixed conifer* vegetation type at the very headwaters where denser stands of subalpine fir, Douglas fir, grand fir, and Ponderosa pine occur, followed by
- 2) a *conifer/meadow* vegetation type where tree density is more open and shrub and grass meadows may occupy thin areas along stream banks with conifers in the nearby overstory,
- 3) a *grass meadow* community on wide open meadows where conifers and shrubs tend to be absent or much reduced,
- 4) a *cottonwood/conifer mix* community that occurs in the area above and below Starkey where a transition occurs between the conifer zone and the cottonwood/shrub community, and
- 5) a *cottonwood/shrub* community where cottonwood trees dominate an understory of mixed deciduous shrubs.

Tributaries

Tributaries to the Weiser River have most of these same riparian vegetation types as the main Weiser River to varying degrees. Additionally, some tributaries have a *deciduous shrub mix* vegetation type that occupies the middle elevations between the conifer zone and the cottonwood zone.

Crane Creek

The Crane Creek watershed is considerably different from other tributaries to the Weiser River. North Crane Creek and South Crane Creek originate in less vegetated terrain where the riparian area is not influenced by conifers. North and South Crane Creeks are dominated by a *mixed deciduous shrub* riparian vegetation from their headwaters to Crane Creek Reservoir. This lower elevation shrub vegetation type is different from the deciduous shrub mix found on other tributaries, with more coyote willow dominating the mixture and less alder found at higher elevation shrub communities. Below the reservoir, Crane Creek runs through basalt canyon country with a thin veil of *willow* riparian vegetation in most areas. Lower Crane Creek emerges from the canyon onto a broader, flat floodplain area. This area was included in the *cottonwood/shrub* community typical of the Weiser River and the lower end of other tributaries.

Canyons

The lower portions of the Weiser River and Crane Creek run through several large areas of basalt canyon country. In these areas canyon walls provide most if not all the effective shade. The geomorphology in these canyons prevents extensive floodplains and riparian community development (see cover photo). The shade target for the canyons along the lower

Weiser River is based on actual measurements of shade produced by a solar pathfinder (10% class interval). The willow vegetation type selected for lower Crane Creek produces a similar level of shade target.

Target Selection

To determine potential natural vegetation shade targets for the Weiser Subbasin, effective shade curves from several existing temperature TMDLs were examined. These TMDLs had previously used vegetation community modeling to produce these shade curves. For the Weiser Subbasin curves for the most similar vegetation type were selected for shade target determinations. Because no two landscapes are exactly the same, shade targets were derived by taking an average of the various shade curves available. 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.

The effective shade calculations are based on a six month period from April through September. This six-month period is the critical time period when temperatures affect beneficial uses, including April through early July when spring salmonid spawning temperatures are typically exceeded, September when fall salmonid spawning temperatures are typically exceeded, and late July and August when cold water aquatic life criteria are typically exceeded [see *Weiser River Watershed Subbasin Assessment and TMDLs* (IDEQ, 2004a) for information on temperature exceedances]. Late July and early August represent a period of highest stream temperatures. Solar gains can begin early in the spring and affect not only the highest temperatures reached later on in the summer, but solar loadings affect salmonids spawning temperatures in spring and fall. Thus, solar loading in these streams is evaluated from spring (April) to early fall (September).

Shade Targets

For the Weiser Subbasin an attempt was made to match the various vegetation types using effective shade curves from a variety of Northwest TMDLs. Although these TMDLs reflect a wide variety of geomorphologies and topographies, effective shades at the same stream width were remarkably similar. The following tables show derivations of shade targets at natural stream widths (e.g. 1m = 1 meter wide) encountered in the loading analysis for each vegetation type. Numbers in these tables are percent shade.

Mixed Conifer	1m	2m	4m	6m	8m	10m	12m
subalpine fir (IDEQ, 2002)	95	95	92	88	85	81	78
mixed conifer (CRWQCB, 2002)	94	94	93	91	89	87	85
VRU3 (IDEQ, 2004)	95	95	92	89	85	80	78
Conifer zone (ODEQ, 2004b)	94	94	86	80	76	72	70
Average	94.5	94.5	90.75	87	83.75	80	77.75
Target (%)	95	95	91	87	84	80	78

Conifer/meadow	2m	4m	6m	8m	10m	12m	16m
Qff2 (ODEQ, 2004a)	85	80	75	69	66	60	49
Qbf (ODEQ, 2004a)	85	80	75	70	66	60	50
ponderosa pine (IDEQ, 2002)	80	75	72	65	59	55	48
VRU10 (IDEQ, 2004)	88	82	75	72	67	64	48
Average	84.5	79.25	74.25	69	64.5	59.75	48.75
Target (%)	85	79	74	69	65	60	49

Meadow/grass	4m	5m	6m
tufted hairgrass (IDEQ, 2002)	15	12	10
Ow (ODEQ, 2004a)	25	22	20
graminoid/willow (ODEQ, 2003)	14	10	9
Average	18	14.67	13
Target (%)	18	15	13

Conifer/cottonwood mix	10m	12m	14m	16m	18m
willow/cottonwood/aspen (ODEQ, 2003)	35	30	25	22	20
deciduous/conifer mix (ODEQ, 2004b)	74	66	64	62	60
Qalf (Odeq, 2004a)	58	50	46	42	38
Average	55.67	48.667	45	42.00	39.33
Target (%)	56	49	45	42	39

Cottonwood/shrub	6m	8m	10m	12m	14m	15m	16m	17m thru 24m	26m thru 40m	42m thru 75m			
Deciduous zone (ODEQ, 2004b)	84	76	72	65	60	60	56	56	44	40	37	24	10
willow/cottonwood/aspen (ODEQ, 2003)	50	42	32	30	25	22	22	21	17	17	13	12	5
Qalf (Odeq, 2004a)	69	63	55	51	46	45	41	40	33	31	23	22	15
Average	67.67	60.33	53.00	48.67	43.67	42.33	39.67	39.00	31.33	29.33	24.33	19.33	10.00
Target (%)	68	60	53	49	44	42	40	39	31	29	24	19	10

Deciduous Shrub Mix	2m	4m	6m	8m	10m	12m
mountain alder (ODEQ, 2003)	88	80	68	60	50	40
willow/alder (ODEQ, 2003)	82	68	58	45	40	30
Average	85	74	63	52.5	45	35
Target (%)	85	74	63	53	45	35

Crane Creek Shrub Mix	1m	2m	4m	6m	8m	10m	12m	14m	16m
willow mix (ODEQ, 2003)	80	70	45	35	25	20	15	12	10
coyote willow (IDEQ, 2002)	90	72	41	27	23	18	15	13	11
VRU12/16 (IDEQ, 2004)	85	70	38	26	22	17	14	12	10
Ow (ODEQ, 2004a)	70	65	30	20	15	13	10	9	7
Average	81.25	69.25	38.5	27	21.25	17	13.5	11.5	9.5
Target (%)	81	69	39	27	21	17	14	12	10

L. Crane Creek Willow	20m	22m	24m	26m	28m
willow (ODEQ, 2003)	15	14	13	12	10
Target (%)	15	14	13	12	10

Monitoring Points

Effective shade monitoring can take place on any reach throughout the Weiser River and associated tributaries and compared to estimates of existing shade seen on Figure 2 and described in Tables 1 through 18. Those areas with the largest disparity between existing shade estimates and shade targets should be monitored with solar pathfinders to verify the existing shade levels and to determine progress towards meeting shade targets. It is important to note that many existing shade estimates have not been field verified, and may require adjustment during the implementation process. Stream segments for each change in existing shade vary in length depending on land use or landscape that has affected that shade level. It is appropriate to monitor within a given existing shade segment to see if that segment has increased its existing shade towards target levels. Five to ten equally spaced solar pathfinder measurements within that segment averaged together should suffice to determine new shade levels in the future.

5.2 Load Capacity

The loading capacity for a stream under PNV is essentially the solar loading allowed under the shade targets specified for the reaches within that stream. These loads are determined by multiplying the solar load to a flat plate collector (under full sun) for a given period of time by the fraction of the solar radiation that is not blocked by shade (i.e. the percent open or 1-percent shade). In other words, if a shade target is 60% (or 0.6), then the solar load hitting the stream under that target is 40% of the load hitting the flat plate collector under full sun.

We obtained solar load data for flat plate collectors from National Renewable Energy Laboratory (NREL) weather stations near by. In this case, the station at Boise, Idaho was used. The solar loads used in this TMDL are spring/summer averages, thus, we use an average load for the six month period from April through September. These months coincide with time of year that stream temperatures are increasing and when deciduous vegetation is in leaf. Tables 1 through 18 show the PNV shade targets (identified as Target or Potential Shade) and their corresponding potential summer load (in kWh/m²/day and kWh/day) that serve as the loading capacities for the streams.

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. To the extent possible, background loads should be distinguished from human-caused increases in nonpoint loads.

Existing loads in this temperature TMDL come from estimates of existing shade as determined from aerial photo interpretations. Like target shade, existing shade was converted to a solar load by multiplying the fraction of open stream by the solar radiation measured on a flat plate collector at the NREL weather stations. Existing shade data are presented in Tables 1 through 18 and Figure 2.

Like loading capacities (potential loads), existing loads in Tables 1 through 18 are presented on an area basis ($\text{kWh}/\text{m}^2/\text{day}$) and as a total load (kWh/day). Total loads are highly variable in amount depending on the size of the stream. Large rivers that are wide have less shade than smaller, narrow streams. Thus, total potential loads on rivers are expected to be quite large. The percent reduction calculation at the bottom of each table shows the relationship between excess load (when existing load is greater than potential load) and total load. A large river may have a very large excess load, but it represents only a small percent reduction because its total load is expected to be much greater. Conversely, a small stream may have a small excess load in relation to other larger streams, but its percent reduction could be high because it has a small total load to begin with.

Table 1. Existing and Potential Solar Loads for the Weiser River, Headwaters to Fruitvale.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	Weiser headwaters to Fruitvale
7825	0.8	1.276	0.95	0.319	-0.96	mixed conifer
670	0.7	1.914	0.95	0.319	-1.595	
440	0.6	2.552	0.85	0.957	-1.595	conifer/meadow
750	0.4	3.828	0.85	0.957	-2.871	
830	0.3	4.466	0.85	0.957	-3.509	
410	0.6	2.552	0.85	0.957	-1.595	
830	0.2	5.104	0.79	1.3398	-3.7642	
210	0.4	3.828	0.79	1.3398	-2.4882	
970	0.3	4.466	0.79	1.3398	-3.1262	
2340	0.2	5.104	0.18	5.2316	0.1276	meadow/grass
2600	0.5	3.19	0.77	1.4674	-1.7226	conifer/meadow
1470	0.2	5.104	0.15	5.423	0.319	meadow/grass
830	0.3	4.466	0.15	5.423	0.957	
2220	0.2	5.104	0.13	5.5506	0.4466	
870	0	6.38	0.13	5.5506	-0.8294	
870	0.2	5.104	0.69	1.9778	-3.1262	conifer/meadow
330	0.4	3.828	0.69	1.9778	-1.8502	
520	0.3	4.466	0.69	1.9778	-2.4882	
320	0.2	5.104	0.65	2.233	-2.871	
3290	0.3 ^a	4.466	0.65	2.233	-2.233	
660	0.2	5.104	0.65	2.233	-2.871	
3160	0.5 ^b	3.19	0.6	2.552	-0.638	
810	0.3 ^c	4.466	0.6	2.552	-1.914	
2780	0.4	3.828	0.6	2.552	-1.276	
1410	0.3	4.466	0.49	3.2538	-1.2122	
1370	0.2	5.104	0.39	3.8918	-1.2122	cottonwood/conifer mix
10450	0.4 ^d	3.828	0.39	3.8918	0.0638	
Segment Length (meters)	Segment Area (m2)	Existing Summer Load (kWh/day)	Natural Stream Width (m)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
7825	7825	9985	1	2496	-7489	
670	1340	2565	2	427	-2137	
440	880	2246	2	842	-1404	
750	1500	5742	2	1436	-4307	
830	1660	7414	2	1589	-5825	
410	820	2093	2	785	-1308	
830	3320	16945	4	4448	-12497	
210	840	3216	4	1125	-2090	
970	3880	17328	4	5198	-12130	
2340	9360	47773	4	48968	1194	
2600	13000	41470	5	19076	-22394	

1470	7350	37514	5	39859	2345
830	4150	18534	5	22505	3972
2220	13320	67985	6	73934	5949
870	5220	33304	6	28974	-4329
870	6960	35524	8	13765	-21758
330	2640	10106	8	5221	-4885
520	4160	18579	8	8228	-10351
320	3200	16333	10	7146	-9187
3290	32900	146931	10	73466	-73466
660	6600	33686	10	14738	-18949
3160	37920	120965	12	96772	-24193
810	9720	43410	12	24805	-18604
2780	33360	127702	12	85135	-42567
1410	22560	100753	16	73406	-27347
1370	24660	125865	18	95972	-29893
10450	188100	720047	18	732048	12001
Total	447,245	1,814,013		1,482,364	-331,649

% Reduction

-18

a = pathfinder measurement 35.9%; b = pathfinder measurement 51.1%; c = pathfinder measurement 35.8%; d = pathfinder measurement 39.9%

Table 2. Existing and Potential Solar Loads for West Branch Weiser River.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	West Branch
5030	0.8	1.276	0.95	0.319	-0.96	conifer mix
130	0.4	3.828	0.79	1.3398	-2.4882	conifer/meadow
1060	0.7	1.914	0.79	1.3398	-0.5742	
340	0.4	3.828	0.18	5.2316	1.4036	meadow/grass
Segment Length (meters)	Segment Area (m2)	Existing Summer Load (kWh/day)	Natural Stream Width (m)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
5030	10060	12837	2	3209	-9627	
130	520	1991	4	697	-1294	
1060	4240	8115	4	5681	-2435	
340	1360	5206	4	7115	1909	
Total	16,180	28,149		16,702	-11,447	

% Reduction

-41

Table 3. Existing and Potential Solar Loads for the Weiser River, Fruitvale to Mouth.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	Weiser, Fruitvale to mouth
1400	0.2	5.104	0.37	4.0194	-1.08	cottonwood shrub mix
5620	0.3	4.466	0.37	4.0194	-0.4466	
2010	0.1	5.742	0.35	4.147	-1.595	
910	0.2	5.104	0.35	4.147	-0.957	
2300	0.1	5.742	0.33	4.2746	-1.4674	
2530	0.2	5.104	0.31	4.4022	-0.7018	
7460	0.1	5.742	0.28	4.5936	-1.1484	
2300	0	6.38	0.26	4.7212	-1.6588	
1780	0.1	5.742	0.24	4.8488	-0.8932	
1890	0	6.38	0.24	4.8488	-1.5312	
5460	0.1	5.742	0.24	4.8488	-0.8932	
2400	0	6.38	0.19	5.1678	-1.2122	
4300	0.1	5.742	0.19	5.1678	-0.5742	
1610	0	6.38	0.19	5.1678	-1.2122	
1100	0.1	5.742	0.19	5.1678	-0.5742	
610	0	6.38	0.19	5.1678	-1.2122	
500	0.1	5.742	0.19	5.1678	-0.5742	
540	0	6.38	0.19	5.1678	-1.2122	
520	0.1	5.742	0.19	5.1678	-0.5742	
1180	0	6.38	0.19	5.1678	-1.2122	
430	0.1	5.742	0.19	5.1678	-0.5742	
420	0	6.38	0.19	5.1678	-1.2122	
2790	0.1	5.742	0.18	5.2316	-0.5104	
1000	0	6.38	0.18	5.2316	-1.1484	
1430	0.1	5.742	0.18	5.2316	-0.5104	
4480	0.1 ^a	5.742	0.1	5.742	0	canyon
2230	0	6.38	0.17	5.2954	-1.0846	canyon
880	0.1	5.742	0.17	5.2954	-0.4466	
810	0	6.38	0.16	5.3592	-1.0208	
2030	0.1	5.742	0.15	5.423	-0.319	
930	0	6.38	0.15	5.423	-0.957	
2610	0.1 ^b	5.742	0.15	5.423	-0.319	
4870	0	6.38	0.15	5.423	-0.957	
26190	0.1	5.742	0.1	5.742	0	canyon
5880	0.1	5.742	0.14	5.4868	-0.2552	canyon
5430	0	6.38	0.13	5.5506	-0.8294	
2590	0.1	5.742	0.12	5.6144	-0.1276	
2340	0	6.38	0.11	5.6782	-0.7018	
7560	0	6.38	0.11	5.6782	-0.7018	
1940	0.1	5.742	0.11	5.6782	-0.0638	
1020	0.1	5.742	0.1	5.742	0	

Segment Length (meters)	Segment Area (m2)	Existing Summer Load (kWh/day)	Natural Stream Width (m)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)
1400	25200	128621	18	101289	-27332
5620	101160	451781	18	406603	-45178
2010	40200	230828	20	166709	-64119
910	18200	92893	20	75475	-17417
2300	50600	290545	22	216295	-74250
2530	60720	309915	24	267302	-42613
7460	223800	1285060	30	1028048	-257012
2300	82800	528264	36	390915	-137349
1780	71200	408830	40	345235	-63596
1890	75600	482328	40	366569	-115759
5460	218400	1254053	40	1058978	-195075
2400	100800	643104	42	520914	-122190
4300	180600	1037005	42	933305	-103701
1610	67620	431416	42	349447	-81969
1100	48400	277913	44	250122	-27791
610	26840	171239	44	138704	-32535
500	22000	126324	44	113692	-12632
540	23760	151589	44	122787	-28802
520	22880	131377	44	118239	-13138
1180	53100	338778	45	274410	-64368
430	19350	111108	45	99997	-11111
420	18900	120582	45	97671	-22911
2790	128340	736928	46	671424	-65505
1000	46000	293480	46	240654	-52826
1430	68640	394131	48	359097	-35034
4480	224000	1286208	50	1286208	0
2230	111500	711370	50	590437	-120933
880	45760	262754	52	242318	-20436
810	43740	279061	54	234411	-44650
2030	113680	652751	56	616487	-36264
930	52080	332270	56	282430	-49841
2610	151380	869224	58	820934	-48290
4870	282460	1802095	58	1531781	-270314
26190	1571400	9022979	60	9022979	0
5880	370440	2127066	63	2032530	-94536
5430	358380	2286464	66	1989224	-297240
2590	181300	1041025	70	1017891	-23134
2340	168480	1074902	72	956663	-118239
7560	551880	3520994	73	3133685	-387309
1940	143560	824322	74	815162	-9159
1020	76500	439263	75	439263	0
Total	6,241,650	36,960,839		33,726,281	-3,234,559

% Reduction

-9

a = pathfinder measurement 9.9%; b = pathfinder measurement 9.1%

Table 4. Existing and Potential Solar Loads for East Fork Weiser River.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	East Fork Weiser
2550	0.7	1.914	0.95	0.319	-1.60	conifer
10530	0.8	1.276	0.91	0.5742	-0.7018	
1710	0.7	1.914	0.91	0.5742	-1.3398	
890	0.8	1.276	0.87	0.8294	-0.4466	
760	0.7	1.914	0.87	0.8294	-1.0846	
4780	0.6	2.552	0.87	0.8294	-1.7226	
320	0.7	1.914	0.84	1.0208	-0.8932	
1490	0.6	2.552	0.84	1.0208	-1.5312	
1110	0.4 ^a	3.828	0.84	1.0208	-2.8072	
840	0.1	5.742	0.67	2.1054	-3.6366	conifer/meadow
Segment Length (meters)	Segment Area (m2)	Existing Summer Load (kWh/day)	Natural Stream Width (m)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
2550	5100	9761	2	1627	-8135	
10530	42120	53745	4	24185	-29560	
1710	6840	13092	4	3928	-9164	
890	5340	6814	6	4429	-2385	
760	4560	8728	6	3782	-4946	
4780	28680	73191	6	23787	-49404	
320	2560	4900	8	2613	-2287	
1490	11920	30420	8	12168	-18252	
1110	8880	33993	8	9065	-24928	
840	7560	43410	9	15917	-27493	% Reduction
Total	123,560	278,053		101,501	-176,552	-63

a = pathfinder measurement 41.9%

Table 5. Existing and Potential Solar Loads for West Fork Weiser River.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	West Fork Weiser
3070	0.8 ^a	1.276	0.95	0.319	-0.96	conifer
930	0.6	2.552	0.91	0.5742	-1.9778	
4990	0.8	1.276	0.91	0.5742	-0.7018	
860	0.7	1.914	0.87	0.8294	-1.0846	
970	0.6 ^b	2.552	0.87	0.8294	-1.7226	
450	0.7 ^c	1.914	0.87	0.8294	-1.0846	
570	0.6	2.552	0.87	0.8294	-1.7226	
830	0.8	1.276	0.87	0.8294	-0.4466	
560	0.5	3.19	0.69	1.9778	-1.2122	conifer/meadow
730	0.6	2.552	0.69	1.9778	-0.5742	
330	0.8	1.276	0.69	1.9778	0.7018	
660	0.6	2.552	0.69	1.9778	-0.5742	
1410	0.7	1.914	0.69	1.9778	0.0638	
520	0.5	3.19	0.69	1.9778	-1.2122	
940	0.7	1.914	0.69	1.9778	0.0638	conifer/cottonwood
550	0.3	4.466	0.56	2.8072	-1.6588	
960	0.4	3.828	0.56	2.8072	-1.0208	
1430	0.3	4.466	0.56	2.8072	-1.6588	cottonwood/shrub
430	0.6	2.552	0.53	2.9986	0.4466	
680	0.5	3.19	0.53	2.9986	-0.1914	
530	0.6	2.552	0.53	2.9986	0.4466	
1510	0.5	3.19	0.53	2.9986	-0.1914	
1280	0.4	3.828	0.53	2.9986	-0.8294	
330	0.2	5.104	0.53	2.9986	-2.1054	
230	0.3	4.466	0.53	2.9986	-1.4674	
Segment Length (meters)	Segment Area (m2)	Existing Summer Load (kWh/day)	Natural Stream Width (m)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
3070	6140	7835	2	1959	-5876	
930	3720	9493	4	2136	-7357	
4990	19960	25469	4	11461	-14008	
860	5160	9876	6	4280	-5597	
970	5820	14853	6	4827	-10026	
450	2700	5168	6	2239	-2928	
570	3420	8728	6	2837	-5891	
830	4980	6354	6	4130	-2224	
560	4480	14291	8	8861	-5431	
730	5840	14904	8	11550	-3353	
330	2640	3369	8	5221	1853	
660	5280	13475	8	10443	-3032	
1410	11280	21590	8	22310	720	
520	4160	13270	8	8228	-5043	

940	7520	14393	8	14873	480
550	5500	24563	10	15440	-9123
960	9600	36749	10	26949	-9800
1430	14300	63864	10	40143	-23721
430	4300	10974	10	12894	1920
680	6800	21692	10	20390	-1302
530	5300	13526	10	15893	2367
1510	15100	48169	10	45279	-2890
1280	12800	48998	10	38382	-10616
330	3300	16843	10	9895	-6948
230	2300	10272	10	6897	-3375
Total	172,400	478,717		347,516	-131,201

% Reduction

-27

a = pathfinder measurement 82.3%; b = pathfinder measurement 59.7%; c = pathfinder measurement 70.5%

Table 6. Existing and Potential Solar Loads for Hornet Creek.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	Hornet Creek
200	0.8	1.276	0.95	0.319	-0.96	conifer
1470	0.7	1.914	0.95	0.319	-1.60	
4100	0.8	1.276	0.95	0.319	-0.96	
1780	0.7	1.914	0.91	0.5742	-1.34	
1470	0.6	2.552	0.79	1.3398	-1.21	conifer/meadow
2340	0.5	3.19	0.79	1.3398	-1.85	
1290	0.4	3.828	0.68	2.0416	-1.79	cottonwood/shrub
250	0.2	5.104	0.68	2.0416	-3.06	
420	0.4	3.828	0.68	2.0416	-1.79	
300	0.2	5.104	0.68	2.0416	-3.06	
1030	0.4	3.828	0.68	2.0416	-1.79	
1290	0.3	4.466	0.6	2.552	-1.91	
1200	0.2	5.104	0.6	2.552	-2.55	
900	0.1	5.742	0.53	2.9986	-2.74	
1390	0.3	4.466	0.53	2.9986	-1.47	
400	0.2	5.104	0.44	3.5728	-1.53	
660	0.1	5.742	0.44	3.5728	-2.17	
1480	0	6.38	0.44	3.5728	-2.81	
1270	0.2	5.104	0.44	3.5728	-1.53	
310	0.1	5.742	0.44	3.5728	-2.17	
1650	0.2	5.104	0.4	3.828	-1.28	
1740	0.1	5.742	0.4	3.828	-1.91	
1490	0.2	5.104	0.4	3.828	-1.28	
940	0.1	5.742	0.4	3.828	-1.91	
1440	0.3	4.466	0.4	3.828	-0.638	
580	0.2	5.104	0.39	3.8918	-1.2122	
750	0.3	4.466	0.39	3.8918	-0.5742	
Segment Length (meters)	Segment Area (m2)	Existing Summer Load (kWh/day)	Natural Stream Width (m)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
200	200	255	1	64	-191	
1470	2940	5627	2	938	-4689	
4100	8200	10463	2	2616	-7847	
1780	7120	13628	4	4088	-9539	
1470	5880	15006	4	7878	-7128	
2340	9360	29858	4	12541	-17318	
1290	7740	29629	6	15802	-13827	
250	1500	7656	6	3062	-4594	
420	2520	9647	6	5145	-4502	
300	1800	9187	6	3675	-5512	
1030	6180	23657	6	12617	-11040	
1290	10320	46089	8	26337	-19752	
1200	9600	48998	8	24499	-24499	
900	9000	51678	10	26987	-24691	
1390	13900	62077	10	41681	-20397	
400	5600	28582	14	20008	-8575	
660	9240	53056	14	33013	-20043	
1480	20720	132194	14	74028	-58165	
1270	17780	90749	14	63524	-27225	
310	4340	24920	14	15506	-9414	
1650	26400	134746	16	101059	-33686	
1740	27840	159857	16	106572	-53286	
1490	23840	121679	16	91260	-30420	
940	15040	86360	16	57573	-28787	
1440	23040	102897	16	88197	-14700	
580	9860	50325	17	38373	-11952	
750	12750	56942	17	49620	-7321	
Total	292,710	1,405,763		926,662	-479,100	% Reduction -34

Table 7. Existing and Potential Solar Loads for North Hornet Creek.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	N. Hornet Creek
6400	0.8	1.276	0.95	0.319	-0.96	conifer
4530	0.7	1.914	0.79	1.3398	-0.5742	conifer/meadow
1640	0.6	2.552	0.74	1.6588	-0.8932	shrub mix
440	0.5	3.19	0.63	2.3606	-0.8294	
1390	0.4	3.828	0.63	2.3606	-1.4674	
1240	0.3	4.466	0.63	2.3606	-2.1054	
800	0.1	5.742	0.53	2.9986	-2.7434	
540	0.5	3.19	0.6	2.552	-0.638	cottonwood/shrub
130	0	6.38	0.53	2.9986	-3.3814	shrub mix
300	0.3	4.466	0.53	2.9986	-1.4674	
950	0.2	5.104	0.53	2.9986	-2.1054	
880	0	6.38	0.53	2.9986	-3.3814	
430	0.1	5.742	0.45	3.509	-2.233	
210	0.3	4.466	0.53	2.9986	-1.4674	cottonwood/shrub
420	0.4	3.828	0.53	2.9986	-0.8294	
230	0.3	4.466	0.53	2.9986	-1.4674	
Segment Length (meters)	Segment Area (m2)	Existing Summer Load (kWh/day)	Natural Stream Width (m)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
6400	12800	16333	2	4083	-12250	
4530	18120	34682	4	24277	-10405	
1640	6560	16741	4	10882	-5859	
440	2640	8422	6	6232	-2190	
1390	8340	31926	6	19687	-12238	
1240	7440	33227	6	17563	-15664	
800	6400	36749	8	19191	-17558	
540	4320	13781	8	11025	-2756	
130	1040	6635	8	3119	-3517	
300	2400	10718	8	7197	-3522	
950	7600	38790	8	22789	-16001	
880	7040	44915	8	21110	-23805	
430	4300	24691	10	15089	-9602	
210	2100	9379	10	6297	-3082	
420	4200	16078	10	12594	-3483	
230	2300	10272	10	6897	-3375	
Total	97,600	353,337		208,031	-145,306	% Reduction -41

Table 8. Existing and Potential Solar Loads for Middle Fork Weiser River.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	Middle Fork Weiser
2560	0.8	1.276	0.95	0.319	-0.96	conifer
2090	0.7	1.914	0.95	0.319	-1.595	
940	0.6	2.552	0.91	0.5742	-1.9778	
1870	0.5	3.19	0.79	1.3398	-1.8502	conifer/meadow
840	0.6	2.552	0.91	0.5742	-1.9778	conifer
2240	0.5	3.19	0.74	1.6588	-1.5312	conifer/meadow
570	0.3	4.466	0.74	1.6588	-2.8072	
940	0.5	3.19	0.74	1.6588	-1.5312	
1610	0.4	3.828	0.69	1.9778	-1.8502	
1530	0.2	5.104	0.69	1.9778	-3.1262	
730	0.3	4.466	0.69	1.9778	-2.4882	
260	0.4	3.828	0.69	1.9778	-1.8502	
3110	0.5	3.19	0.65	2.233	-0.957	
1050	0.4	3.828	0.65	2.233	-1.595	
1180	0.5	3.19	0.56	2.8072	-0.3828	cottonwood/conifer
890	0.6 ^a	2.552	0.56	2.8072	0.2552	
3820	0.5 ^b	3.19	0.49	3.2538	0.0638	
3150	0.4	3.828	0.49	3.2538	-0.5742	cottonwood/shrub
2280	0.2	5.104	0.49	3.2538	-1.8502	
2080	0.3	4.466	0.44	3.5728	-0.8932	
870	0.4	3.828	0.44	3.5728	-0.2552	
1870	0.2	5.104	0.44	3.5728	-1.5312	
1140	0.3	4.466	0.42	3.7004	-0.7656	
3020	0.2	5.104	0.42	3.7004	-1.4036	
500	0.1	5.742	0.42	3.7004	-2.0416	
Segment Length (meters)	Segment Area (m2)	Existing Summer Load (kWh/day)	Natural Stream Width (m)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
2560	5120	6533	2	1633	-4900	
2090	4180	8001	2	1333	-6667	
940	3760	9596	4	2159	-7437	
1870	7480	23861	4	10022	-13839	
840	3360	8575	4	1929	-6645	
2240	13440	42874	6	22294	-20579	
570	3420	15274	6	5673	-9601	
940	5640	17992	6	9356	-8636	
1610	12880	49305	8	25474	-23831	
1530	12240	62473	8	24208	-38265	
730	5840	26081	8	11550	-14531	
260	2080	7962	8	4114	-3848	
3110	31100	99209	10	69446	-29763	

1050	10500	40194	10	23447	-16748
1180	11800	37642	10	33125	-4517
890	8900	22713	10	24984	2271
3820	45840	146230	12	149154	2925
3150	37800	144698	12	122994	-21705
2280	27360	139645	12	89024	-50621
2080	29120	130050	14	104040	-26010
870	12180	46625	14	43517	-3108
1870	26180	133623	14	93536	-40087
1140	17100	76369	15	63277	-13092
3020	45300	231211	15	167628	-63583
500	7500	43065	15	27753	-15312
Total	390,120	1,569,799		1,131,670	-438,129

% Reduction

-28

a = pathfinder measurement 62.6%; b = pathfinder measurements 49.5% and 56.5%

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

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	Pine Creek
4750	0.7	1.914	0.85	0.957	-0.96	shrub mix
620	0.5	3.19	0.74	1.6588	-1.5312	
370	0.4	3.828	0.74	1.6588	-2.1692	
490	0.5	3.19	0.74	1.6588	-1.5312	
2160	0.4	3.828	0.63	2.3606	-1.4674	
970	0.5	3.19	0.53	2.9986	-0.1914	
500	0.4	3.828	0.53	2.9986	-0.8294	
3580	0.5	3.19	0.53	2.9986	-0.1914	cottonwood/shrub
4840	0.4	3.828	0.53	2.9986	-0.8294	
1830	0.6	2.552	0.49	3.2538	0.7018	
1920	0.4	3.828	0.49	3.2538	-0.5742	
470	0.5	3.19	0.49	3.2538	0.0638	
240	0.1	5.742	0.49	3.2538	-2.4882	
2240	0.4	3.828	0.44	3.5728	-0.2552	
780	0.7	1.914	0.44	3.5728	1.6588	
460	0.2	5.104	0.44	3.5728	-1.5312	
Segment Length (meters)	Segment Area (m2)	Existing Summer Load (kWh/day)	Natural Stream Width (m)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
4750	9500	18183	2	9092	-9092	
620	2480	7911	4	4114	-3797	
370	1480	5665	4	2455	-3210	
490	1960	6252	4	3251	-3001	
2160	12960	49611	6	30593	-19018	
970	7760	24754	8	23269	-1485	
500	4000	15312	8	11994	-3318	
3580	35800	114202	10	107350	-6852	
4840	48400	185275	10	145132	-40143	
1830	21960	56042	12	71453	15412	
1920	23040	88197	12	74968	-13230	
470	5640	17992	12	18351	360	
240	2880	16537	12	9371	-7166	
2240	31360	120046	14	112043	-8003	
780	10920	20901	14	39015	18114	
460	6440	32870	14	23009	-9861	
Total	226,580	779,751		685,461	-94,290	% Reduction -12

Table 10. Existing and Potential Solar Loads for Little Pine Creek.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	Little Pine Creek
2050	0.6	2.552	0.85	0.957	-1.60	conifer/meadow
2130	0.8	1.276	0.95	0.319	-0.957	conifer
1470	0.7	1.914	0.91	0.5742	-1.3398	
960	0.6	2.552	0.74	1.6588	-0.8932	shrub mix
2470	0.5	3.19	0.74	1.6588	-1.5312	
Segment Length (meters)	Segment Area (m2)	Existing Summer Load (kWh/day)	Natural Stream Width (m)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
2050	4100	10463	2	3924	-6540	
2130	4260	5436	2	1359	-4077	
1470	5880	11254	4	3376	-7878	
960	3840	9800	4	6370	-3430	
2470	9880	31517	4	16389	-15128	
Total	27,960	68,470		31,418	-37,052	% Reduction -54

Table 11. Existing and Potential Solar Loads for East Pine Creek.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	East Pine Creek
1180	0.7	1.914	0.85	0.957	-0.96	conifer/meadow
2820	0.5	3.19	0.85	0.957	-2.233	
1230	0.7	1.914	0.95	0.319	-1.595	conifer
930	0.6	2.552	0.91	0.5742	-1.9778	
700	0.4	3.828	0.79	1.3398	-2.4882	conifer/meadow
2720	0.6	2.552	0.79	1.3398	-1.2122	
720	0.7	1.914	0.79	1.3398	-0.5742	
6930	0.6	2.552	0.63	2.3606	-0.1914	shrub mix
Segment Length (meters)	Segment Area (m2)	Existing Summer Load (kWh/day)	Natural Stream Width (m)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
1180	2360	4517	2	2259	-2259	
2820	5640	17992	2	5397	-12594	
1230	2460	4708	2	785	-3924	
930	3720	9493	4	2136	-7357	
700	2800	10718	4	3751	-6967	
2720	10880	27766	4	14577	-13189	
720	2880	5512	4	3859	-1654	
6930	41580	106112	6	98154	-7958	
Total	72,320	186,819		130,918	-55,902	% Reduction -30

Table 12. Existing and Potential Solar Loads for West Pine Creek.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	West Pine Creek
10750	0.8	1.276	0.95	0.319	-0.96	conifer
1570	0.7	1.914	0.79	1.3398	-0.5742	conifer/meadow
2160	0.6	2.552	0.79	1.3398	-1.2122	
2200	0.5	3.19	0.74	1.6588	-1.5312	shrub mix
610	0.4	3.828	0.63	2.3606	-1.4674	
2230	0.6	2.552	0.63	2.3606	-0.1914	
2160	0.5	3.19	0.63	2.3606	-0.8294	
600	0.6	2.552	0.6	2.552	0	cottonwood/shrub
Segment Length (meters)	Segment Area (m2)	Existing Summer Load (kWh/day)	Natural Stream Width (m)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
10750	21500	27434	2	6859	-20576	
1570	6280	12020	4	8414	-3606	
2160	8640	22049	4	11576	-10473	
2200	8800	28072	4	14597	-13475	
610	3660	14010	6	8640	-5371	
2230	13380	34146	6	31585	-2561	
2160	12960	41342	6	30593	-10749	
600	4800	12250	8	12250	0	
Total	80,020	191,323		124,513	-66,810	% Reduction -35

Table 13. Existing and Potential Solar Loads for Little Weiser River.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	Little Weiser River
5640	0.8	1.276	0.95	0.319	-0.96	conifer
5720	0.7	1.914	0.79	1.3398	-0.5742	conifer/meadow
2350	0.5	3.19	0.74	1.6588	-1.5312	
1980	0.6	2.552	0.74	1.6588	-0.8932	
4260	0.5	3.19	0.69	1.9778	-1.2122	
1690	0.4	3.828	0.69	1.9778	-1.8502	
1330	0.5	3.19	0.65	2.233	-0.957	
2020	0.4	3.828	0.65	2.233	-1.595	
1870	0.3	4.466	0.45	3.509	-0.957	shrub mix
1990	0.2	5.104	0.35	4.147	-0.957	
970	0.1	5.742	0.35	4.147	-1.595	
4490	0.2	5.104	0.49	3.2538	-1.8502	cottonwood/shrub
960	0.3	4.466	0.44	3.5728	-0.8932	
3770	0.2	5.104	0.44	3.5728	-1.5312	
1260	0.1	5.742	0.4	3.828	-1.914	
3430	0.2	5.104	0.37	4.0194	-1.0846	
2660	0.1 ^a	5.742	0.35	4.147	-1.595	
2520	0.2	5.104	0.35	4.147	-0.957	
16530	0.1 ^b	5.742	0.33	4.2746	-1.4674	
6470	0 ^c	6.38	0.31	4.4022	-1.9778	
Segment Length (meters)	Segment Area (m2)	Existing Summer Load (kWh/day)	Natural Stream Width (m)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
5640	11280	14393	2	3598	-10795	
5720	22880	43792	4	30655	-13138	
2350	14100	44979	6	23389	-21590	
1980	11880	30318	6	19707	-10611	
4260	34080	108715	8	67403	-41312	
1690	13520	51755	8	26740	-25015	
1330	13300	42427	10	29699	-12728	
2020	20200	77326	10	45107	-32219	
1870	18700	83514	10	65618	-17896	
1990	23880	121884	12	99030	-22853	
970	11640	66837	12	48271	-18566	
4490	53880	275004	12	175315	-99689	
960	13440	60023	14	48018	-12005	
3770	52780	269389	14	188572	-80817	
1260	20160	115759	16	77172	-38586	
3430	61740	315121	18	248158	-66963	
2660	53200	305474	20	220620	-84854	
2520	50400	257242	20	209009	-48233	
16530	363660	2088136	22	1554501	-533635	
6470	155280	990686	24	683574	-307113	
Total	1,020,000	5,362,773		3,864,157	-1,498,616	% Reduction
						-28

a = pathfinder measurement 19.1%; b = pathfinder measurement 18.4%; c = pathfinder measurement 1.0%

Table 14. Existing and Potential Solar Loads for Mann Creek.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	Mann Creek
2510	0.8	1.276	0.95	0.319	-0.96	conifer
1680	0.7	1.914	0.95	0.319	-1.595	
6650	0.8	1.276	0.91	0.5742	-0.7018	
3650	0.7	1.914	0.79	1.3398	-0.5742	conifer/meadow
450	0.6	2.552	0.74	1.6588	-0.8932	
160	0.7	1.914	0.74	1.6588	-0.2552	
690	0.6	2.552	0.74	1.6588	-0.8932	
960	0.4	3.828	0.63	2.3606	-1.4674	shrub mix
350	0.6	2.552	0.63	2.3606	-0.1914	
740	0.4	3.828	0.63	2.3606	-1.4674	
550	0.6	2.552	0.63	2.3606	-0.1914	
740	0.5	3.19	0.53	2.9986	-0.1914	
1430	0.6	2.552	0.53	2.9986	0.4466	
490	0.4	3.828	0.53	2.9986	-0.8294	
1480	0.6	2.552	0.53	2.9986	0.4466	
300	0.3	4.466	0.53	2.9986	-1.4674	
1560	0.6	2.552	0.45	3.509	0.957	
1660	0.5	3.19	0.45	3.509	0.319	
170	0.3	4.466	0.45	3.509	-0.957	
150	0.2	5.104	0.45	3.509	-1.595	cottonwood/shrub
430	0.4	3.828	0.49	3.2538	-0.5742	
360	0.6	2.552	0.49	3.2538	0.7018	
780	0.4	3.828	0.49	3.2538	-0.5742	
730	0.5	3.19	0.49	3.2538	0.0638	
690	0.6	2.552	0.49	3.2538	0.7018	
1000	0.4	3.828	0.49	3.2538	-0.5742	
250	0.1	5.742	0.49	3.2538	-2.4882	
1930	0.4	3.828	0.49	3.2538	-0.5742	
1240	0.3	4.466	0.49	3.2538	-1.2122	
1660	0.5	3.19	0.49	3.2538	0.0638	
870	0.4	3.828	0.44	3.5728	-0.2552	
620	0.2	5.104	0.44	3.5728	-1.5312	
520	0.3	4.466	0.44	3.5728	-0.8932	
420	0.4	3.828	0.44	3.5728	-0.2552	
250	0.3	4.466	0.44	3.5728	-0.8932	
350	0.4	3.828	0.44	3.5728	-0.2552	
210	0.3	4.466	0.44	3.5728	-0.8932	
1620	0.2	5.104	0.44	3.5728	-1.5312	
590	0.1	5.742	0.44	3.5728	-2.1692	
490	0.2	5.104	0.44	3.5728	-1.5312	
200	0.1	5.742	0.44	3.5728	-2.1692	
1060	0	6.38	0.44	3.5728	-2.8072	
470	0.4	3.828	0.44	3.5728	-0.2552	

310	0.3	4.466	0.44	3.5728	-0.8932
1500	0.5	3.19	0.4	3.828	0.638
510	0.3	4.466	0.4	3.828	-0.638
560	0.5	3.19	0.4	3.828	0.638
200	0	6.38	0.4	3.828	-2.552
490	0.2	5.104	0.4	3.828	-1.276
800	0.4	3.828	0.4	3.828	0
Segment Length (meters)	Segment Area (m2)	Existing Summer Load (kWh/day)	Natural Stream Width (m)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)
2510	5020	6406	2	1601	-4804
1680	3360	6431	2	1072	-5359
6650	26600	33942	4	15274	-18668
3650	14600	27944	4	19561	-8383
450	2700	6890	6	4479	-2412
160	960	1837	6	1592	-245
690	4140	10565	6	6867	-3698
960	5760	22049	6	13597	-8452
350	2100	5359	6	4957	-402
740	4440	16996	6	10481	-6515
550	3300	8422	6	7790	-632
740	5920	18885	8	17752	-1133
1430	11440	29195	8	34304	5109
490	3920	15006	8	11755	-3251
1480	11840	30216	8	35503	5288
300	2400	10718	8	7197	-3522
1560	15600	39811	10	54740	14929
1660	16600	52954	10	58249	5295
170	1700	7592	10	5965	-1627
150	1500	7656	10	5264	-2393
430	5160	19752	12	16790	-2963
360	4320	11025	12	14056	3032
780	9360	35830	12	30456	-5375
730	8760	27944	12	28503	559
690	8280	21131	12	26941	5811
1000	12000	45936	12	39046	-6890
250	3000	17226	12	9761	-7465
1930	23160	88656	12	75358	-13298
1240	14880	66454	12	48417	-18038
1660	19920	63545	12	64816	1271
870	12180	46625	14	43517	-3108
620	8680	44303	14	31012	-13291
520	7280	32512	14	26010	-6502
420	5880	22509	14	21008	-1501
250	3500	15631	14	12505	-3126
350	4900	18757	14	17507	-1250
210	2940	13130	14	10504	-2626
1620	22680	115759	14	81031	-34728

Weiser Subbasin Temperature TMDL

June 2006

590	8260	47429	14	29511	-17918
490	6860	35013	14	24509	-10504
200	2800	16078	14	10004	-6074
1060	14840	94679	14	53020	-41659
470	6580	25188	14	23509	-1679
310	4340	19382	14	15506	-3876
1500	24000	76560	16	91872	15312
510	8160	36443	16	31236	-5206
560	8960	28582	16	34299	5716
200	3200	20416	16	12250	-8166
490	7840	40015	16	30012	-10004
800	12800	48998	16	48998	0
Total	429,420	1,554,385		1,319,965	-234,420

% Reduction

-15

Table 15. Existing and Potential Solar Loads for Monroe Creek.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	Monroe Creek
4300	0.8	1.276	0.85	0.957	-0.32	conifer/meadow
3780	0.7	1.914	0.85	0.957	-0.957	shrub mix
690	0.5	3.19	0.74	1.6588	-1.5312	
220	0.3	4.466	0.74	1.6588	-2.8072	
1410	0.6	2.552	0.74	1.6588	-0.8932	
1730	0.7	1.914	0.74	1.6588	-0.2552	
570	0.5	3.19	0.74	1.6588	-1.5312	
520	0.1	5.742	0.74	1.6588	-4.0832	
7290	0.6	2.552	0.74	1.6588	-0.8932	
650	0.5	3.19	0.63	2.3606	-0.8294	
330	0.2	5.104	0.63	2.3606	-2.7434	
640	0.5	3.19	0.63	2.3606	-0.8294	
1420	0.6	2.552	0.63	2.3606	-0.1914	
1100	0.5	3.19	0.63	2.3606	-0.8294	
1930	0.4	3.828	0.63	2.3606	-1.4674	
590	0.5	3.19	0.6	2.552	-0.638	cottonwood/shrub
200	0.2	5.104	0.6	2.552	-2.552	
770	0.4	3.828	0.6	2.552	-1.276	
980	0.5	3.19	0.6	2.552	-0.638	
200	0.1	5.742	0.6	2.552	-3.19	
730	0.6	2.552	0.6	2.552	0	
150	0	6.38	0.6	2.552	-3.828	
610	0.6	2.552	0.6	2.552	0	
1120	0.4	3.828	0.6	2.552	-1.276	
380	0.7	1.914	0.6	2.552	0.638	
300	0.5	3.19	0.6	2.552	-0.638	
330	0.7	1.914	0.6	2.552	0.638	
270	0.1	5.742	0.6	2.552	-3.19	
3080	0.6	2.552	0.53	2.9986	0.4466	
1020	0.7	1.914	0.53	2.9986	1.0846	
200	0	6.38	0.53	2.9986	-3.3814	
1100	0.7	1.914	0.53	2.9986	1.0846	
Segment Length (meters)	Segment Area (m2)	Existing Summer Load (kWh/day)	Natural Stream Width (m)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
4300	8600	10974	2	8230	-2743	
3780	7560	14470	2	7235	-7235	
690	2760	8804	4	4578	-4226	
220	880	3930	4	1460	-2470	
1410	5640	14393	4	9356	-5038	
1730	6920	13245	4	11479	-1766	
570	2280	7273	4	3782	-3491	

520	2080	11943	4	3450	-8493
7290	29160	74416	4	48371	-26046
650	3900	12441	6	9206	-3235
330	1980	10106	6	4674	-5432
640	3840	12250	6	9065	-3185
1420	8520	21743	6	20112	-1631
1100	6600	21054	6	15580	-5474
1930	11580	44328	6	27336	-16992
590	4720	15057	8	12045	-3011
200	1600	8166	8	4083	-4083
770	6160	23580	8	15720	-7860
980	7840	25010	8	20008	-5002
200	1600	9187	8	4083	-5104
730	5840	14904	8	14904	0
150	1200	7656	8	3062	-4594
610	4880	12454	8	12454	0
1120	8960	34299	8	22866	-11433
380	3040	5819	8	7758	1940
300	2400	7656	8	6125	-1531
330	2640	5053	8	6737	1684
270	2160	12403	8	5512	-6890
3080	30800	78602	10	92357	13755
1020	10200	19523	10	30586	11063
200	2000	12760	10	5997	-6763
1100	11000	21054	10	32985	11931
Total	209,340	594,552		481,196	-113,356

% Reduction

-19

Table 16. Existing and Potential Solar Loads for Lower Crane Creek.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	Lower Crane Creek
5550	0 ^a	6.38	0.15	5.423	-0.96	willow
900	0.1	5.742	0.15	5.423	-0.319	
2580	0	6.38	0.14	5.4868	-0.8932	
270	0.1	5.742	0.14	5.4868	-0.2552	
690	0	6.38	0.13	5.5506	-0.8294	
1750	0.1	5.742	0.13	5.5506	-0.1914	
2400	0.2	5.104	0.12	5.6144	0.5104	
680	0.1	5.742	0.12	5.6144	-0.1276	
370	0.2	5.104	0.1	5.742	0.638	
1140	0.1	5.742	0.1	5.742	0	
4530	0	6.38	0.29	4.5298	-1.8502	cottonwood/shrub
Segment Length (meters)	Segment Area (m2)	Existing Summer Load (kWh/day)	Natural Stream Width (m)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
5550	111000	708180	20	601953	-106227	
900	18000	103356	20	97614	-5742	
2580	56760	362129	22	311431	-50698	
270	5940	34107	22	32592	-1516	
690	16560	105653	24	91918	-13735	
1750	42000	241164	24	233125	-8039	
2400	62400	318490	26	350339	31849	
680	17680	101519	26	99263	-2256	
370	10360	52877	28	59487	6610	
1140	31920	183285	28	183285	0	
4530	126840	809239	28	574560	-234679	
Total	499,460	3,019,999		2,635,565	-384,433	% Reduction
						-13

a = pathfinder measurements 4.4, 1.2, and 7.2 %

Table 17. Existing and Potential Solar Loads for North Crane Creek.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	North Crane Creek
1090	0	6.38	0	6.38	0.00	dry
330	0.2	5.104	0.81	1.2122	-3.8918	shrub spring
4500	0	6.38	0	6.38	0	dry
870	0.1	5.742	0.69	1.9778	-3.7642	shrub
290	0	6.38	0.69	1.9778	-4.4022	
390	0.2	5.104	0.39	3.8918	-1.2122	
600	0.1	5.742	0.39	3.8918	-1.8502	
140	0	6.38	0.39	3.8918	-2.4882	
300	0.2	5.104	0.39	3.8918	-1.2122	
1500	0.3	4.466	0.39	3.8918	-0.5742	
300	0.1	5.742	0.27	4.6574	-1.0846	
190	0	6.38	0.27	4.6574	-1.7226	
470	0.1	5.742	0.27	4.6574	-1.0846	
2510	0	6.38	0.27	4.6574	-1.7226	
3470	0.1	5.742	0.21	5.0402	-0.7018	
220	0	6.38	0.21	5.0402	-1.3398	
1430	0.1	5.742	0.21	5.0402	-0.7018	
1200	0	6.38	0.21	5.0402	-1.3398	
1030	0.1	5.742	0.17	5.2954	-0.4466	
870	0	6.38	0.17	5.2954	-1.0846	
570	0.3	4.466	0.17	5.2954	0.8294	
6360	0.1	5.742	0.14	5.4868	-0.2552	
730	0	6.38	0.14	5.4868	-0.8932	
1630	0.1	5.742	0.12	5.6144	-0.1276	
560	0	6.38	0.12	5.6144	-0.7656	
1220	0.1	5.742	0.12	5.6144	-0.1276	
730	0	6.38	0.12	5.6144	-0.7656	
630	0.1	5.742	0.12	5.6144	-0.1276	
910	0	6.38	0.1	5.742	-0.638	
770	0.1	5.742	0.1	5.742	0	
370	0.2	5.104	0.1	5.742	0.638	
480	0.1	5.742	0.1	5.742	0	
4000	0	6.38	0.1	5.742	-0.638	
Segment Length (meters)	Segment Area (m2)	Existing Summer Load (kWh/day)	Natural Stream Width (m)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
1090	1090	6954	1	6954	0	
330	330	1684	1	400	-1284	
4500	9000	57420	2	57420	0	
870	1740	9991	2	3441	-6550	
290	580	3700	2	1147	-2553	
390	1560	7962	4	6071	-1891	

600	2400	13781	4	9340	-4440
140	560	3573	4	2179	-1393
300	1200	6125	4	4670	-1455
1500	6000	26796	4	23351	-3445
300	1800	10336	6	8383	-1952
190	1140	7273	6	5309	-1964
470	2820	16192	6	13134	-3059
2510	15060	96083	6	70140	-25942
3470	27760	159398	8	139916	-19482
220	1760	11229	8	8871	-2358
1430	11440	65688	8	57660	-8029
1200	9600	61248	8	48386	-12862
1030	10300	59143	10	54543	-4600
870	8700	55506	10	46070	-9436
570	5700	25456	10	30184	4728
6360	76320	438229	12	418753	-19477
730	8760	55889	12	48064	-7824
1630	22820	131032	14	128121	-2912
560	7840	50019	14	44017	-6002
1220	17080	98073	14	95894	-2179
730	10220	65204	14	57379	-7824
630	8820	50644	14	49519	-1125
910	14560	92893	16	83604	-9289
770	12320	70741	16	70741	0
370	5920	30216	16	33993	3777
480	7680	44099	16	44099	0
4000	64000	408320	16	367488	-40832
Total	376,880	2,240,898		2,039,241	-201,657

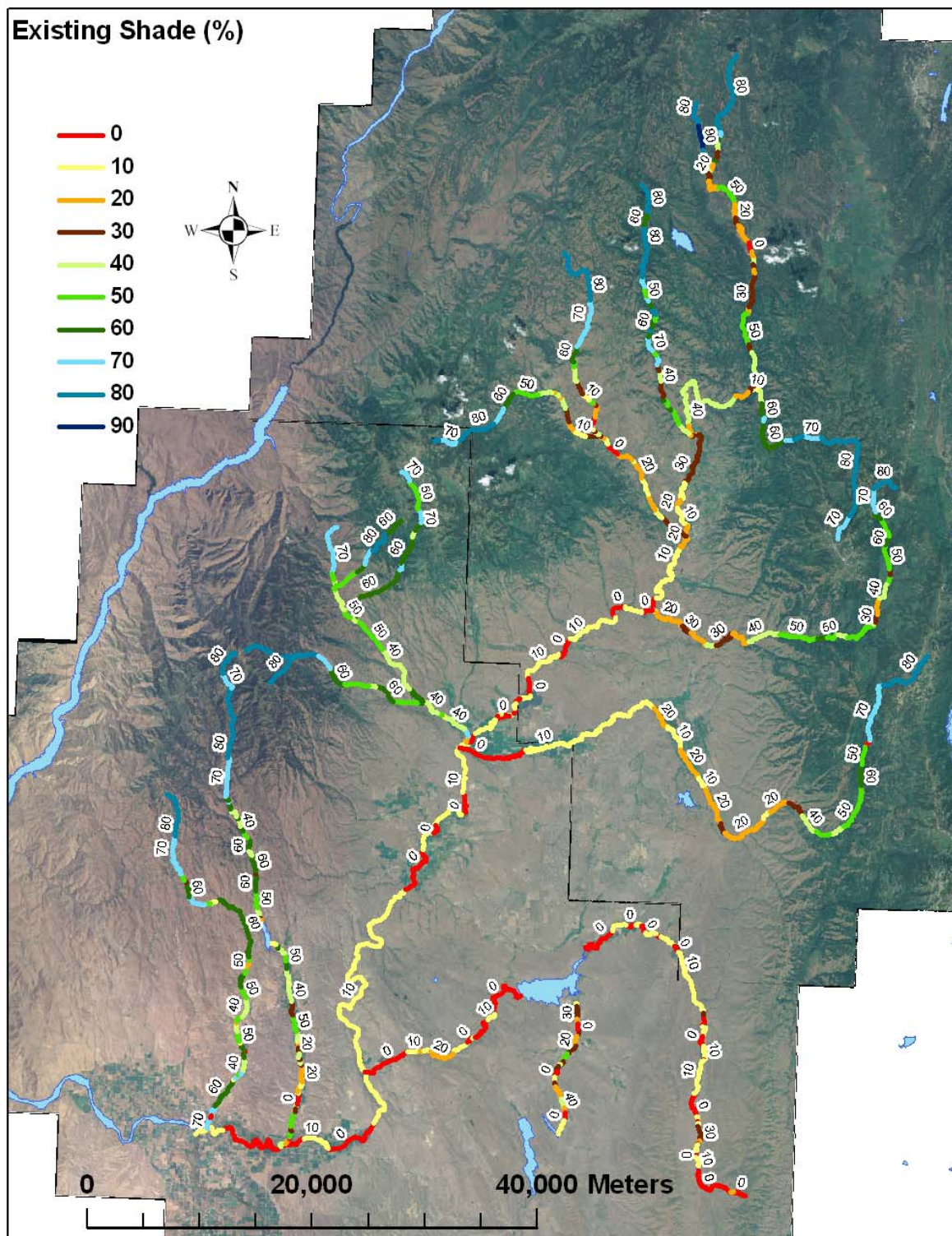
% Reduction

-9

Table 18. Existing and Potential Solar Loads for South Crane Creek.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	South Crane Creek
1390	0.1	5.742	0.81	1.2122	-4.53	shrub
800	0	6.38	0.81	1.2122	-5.1678	
460	0.2	5.104	0.69	1.9778	-3.1262	
880	0.4	3.828	0.69	1.9778	-1.8502	
1320	0.2	5.104	0.69	1.9778	-3.1262	
330	0.3	4.466	0.39	3.8918	-0.5742	
500	0.1	5.742	0.39	3.8918	-1.8502	
680	0	6.38	0.39	3.8918	-2.4882	
640	0.3	4.466	0.39	3.8918	-0.5742	
310	0.4	3.828	0.27	4.6574	0.8294	
390	0.3	4.466	0.27	4.6574	0.1914	
930	0.5	3.19	0.27	4.6574	1.4674	
1050	0.3	4.466	0.27	4.6574	0.1914	
980	0.2	5.104	0.21	5.0402	-0.0638	
680	0.3	4.466	0.21	5.0402	0.5742	
620	0	6.38	0.21	5.0402	-1.3398	
490	0.2	5.104	0.21	5.0402	-0.0638	
1190	0.3	4.466	0.17	5.2954	0.8294	
400	0.1	5.742	0.17	5.2954	-0.4466	
Segment Length (meters)	Segment Area (m2)	Existing Summer Load (kWh/day)	Natural Stream Width (m)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
1390	1390	7981	1	1685	-6296	
800	800	5104	1	970	-4134	
460	920	4696	2	1820	-2876	
880	1760	6737	2	3481	-3256	
1320	2640	13475	2	5221	-8253	
330	1320	5895	4	5137	-758	
500	2000	11484	4	7784	-3700	
680	2720	17354	4	10586	-6768	
640	2560	11433	4	9963	-1470	
310	1860	7120	6	8663	1543	
390	2340	10450	6	10898	448	
930	5580	17800	6	25988	8188	
1050	6300	28136	6	29342	1206	
980	7840	40015	8	39515	-500	
680	5440	24295	8	27419	3124	
620	4960	31645	8	24999	-6645	
490	3920	20008	8	19758	-250	
1190	11900	53145	10	63015	9870	
400	4000	22968	10	21182	-1786	
Total	70,250	339,741		317,425	-22,317	% Reduction
						-7

Figure 2. Existing Shade Estimated for the Weiser Subbasin by Aerial Photo Interpretation.



5.4 Load Allocation

Because this TMDL is based on potential natural vegetation, which is equivalent to background loading, the load allocation is essentially the desire to achieve background conditions. However, in order to reach that objective, load allocations are assigned to non point source activities that have or may affect riparian vegetation and shade. Load allocations are therefore stream reach specific and are dependent upon the target load for a given reach. Tables 1 through 18 show the target or potential shade which is converted to a potential summer load by multiplying the inverse fraction (1-shade fraction) by the average loading to a flat plate collector for the months of April through September. That is the loading capacity of the stream, and reaching it is necessary to achieve background conditions. There is no opportunity to allocate shade removal to an activity.

Excess solar loads for the various streams and the percent reduction relative to each stream's total load are presented in Table 19. Because existing load is subtracted from potential load in the loading tables, any excess load where the existing load is higher than potential load results in a negative number. The Weiser River from Fruitvale to its mouth had the largest excess solar load at a little more than 3 million kWh/day. However, this excess load represents only 9% of the river's total solar load. The Little Weiser River and the Hornet Creek drainage represent the second and third largest excess loads and percent reductions were 28% and 35%, respectively. These two streams should be targeted for further analysis and possibly for riparian restoration activities. The East Fork Weiser River had the highest percent reduction at 63% although its excess load was at a moderate level (-176,552 kWh/day) relative to the other streams. The high reduction is likely the result of rain-on-snow flood events in the late 1990s as well as recent wildfires in that drainage. Streams with the least needed reductions are Crane Creek, Pine Creek, and Mann Creek. In general, streams with excess solar loads less than 20% of their total solar loads (>20% reduction) are in relatively good shape with regard to shade and are of lower priority for improvement.

Table 19. Excess Solar Load and Percent Reduction to Achieve Loading Capacity for the Weiser River and Associated Tributaries.

Water Body	Excess Load (kWh/day)	Percent Reduction
Weiser River, Fruitvale to mouth	-3,234,559	9%
Little Weiser River	-1,498,616	28%
Hornet Creek drainage (summation)	-624,406	35%
Crane Creek drainage (summation)	-608,417	11%
Hornet Creek	-479,100	34%
Middle Fork Weiser River	-438,129	28%
Lower Crane Creek	-384,433	13%
Weiser River, headwaters to Fruitvale	-331,649	18%
Pine Creek drainage (summation)	-254,054	21%
Mann Creek	-234,420	15%
North Crane Creek	-201,667	9%
East Fork Weiser River	-176,552	63%
North Hornet Creek	-145,306	41%
West Fork Weiser River	-131,201	27%
Monroe Creek	-113,356	19%
Pine Creek	-94,290	12%
West Pine Creek	-66,810	35%
East Pine Creek	-55,902	30%
Little Pine Creek	-37,052	54%
South Crane Creek	-22,317	7%
West Branch Weiser River	-11,447	41%

Wasteload Allocation

In addition to having load allocations for nonpoint source activities, there are also point sources in the affected watersheds. There are two NPDES-permitted discharges to the Weiser River, however neither is to a 303d listed segment of the river. Both discharges are POTWs, at the cities of Council and Cambridge. Design flows at these facilities are relatively low compared to the flow regime of the Weiser River. Thus, significant heat loads to the river are not anticipated.

To evaluate the heat contribution of these two discharges, a mass balance approach was used to identify the temperature of the discharge at various effluent flows necessary to achieve no more than a 0.3°C rise above desired temperature criteria. Cold water aquatic life (19°C)

temperature criteria were evaluated, but not salmonid spawning temperature criteria as the Weiser River is not designated for salmonid spawning. Tables 20 and 21 show discharge temperatures that would be needed to maintain criteria levels plus 0.3°C at mean monthly flows and various effluent flow rates. These tables are based on the formula:

$$\text{Effluent temperature (°C)} = (((\text{effluent flow} + (0.25 \times \text{river flow})) \times (19 + 0.3)) - ((0.25 \times \text{river flow}) \times 19)) / \text{effluent flow}$$

At the lowest mean monthly flow and the design effluent flow, Council would need to maintain a 27.4°C effluent temperature to not exceed cold water aquatic life criteria levels by more than 0.3°C (Table 20). Under the same scenario, Cambridge would need 34.9°C effluent temperatures to maintain cold water aquatic life criteria. Cambridge is allowed higher effluent temperatures because it has a smaller design flow than Council in this analysis and more river flow for dilution.

Table 20. Effluent Temperatures (°C) Necessary to Maintain Cold Water Aquatic Life Criteria at Council

Criteria at Council

Weiser Flow (cfs)	Council Effluent Discharge (cfs)					
mean monthly	0.1	0.2	0.4	0.6	0.8	
64.5	67.7	43.5	31.4	27.4	25.3	Sept
68.9	71.0	45.1	32.2	27.9	25.8	Aug
79	78.6	48.9	34.1	29.2	26.7	Oct
94.1	89.9	54.6	36.9	31.1	28.1	July
139	123.6	71.4	45.4	36.7	32.3	Nov
228	190.3	104.8	62.0	47.8	40.7	Jan
249	206.1	112.7	66.0	50.4	42.6	Dec
342	275.8	147.6	83.4	62.1	51.4	Feb
417	332.0	175.7	97.5	71.4	58.4	June
782	605.8	312.5	165.9	117.1	92.6	Mar
1048	805.3	412.3	215.8	150.3	117.6	May
1525	1163.1	591.2	305.2	209.9	162.3	Apr

Council - Coldwater Aquatic Life Criteria

effluent T limits which would not cause >0.3C increase
when cold water criteria are applicable
assuming ambient T = 19 C

Design Flow

0.4 MGD
0.6 cfs

Table 21. Effluent Temperatures (°C) Necessary to Maintain Cold Water Aquatic Life Criteria at Cambridge

Weiser Flow (cfs)	Cambridge Effluent Discharge (cfs)					
mean monthly	0.1	0.2	0.3	0.4	0.6	
83.1	81.6	50.5	40.1	34.9	29.7	Aug
83.8	82.2	50.7	40.3	35.0	29.8	Sept
111	102.6	60.9	47.1	40.1	33.2	Oct
190	161.8	90.6	66.8	54.9	43.1	July
198	167.8	93.6	68.8	56.4	44.1	Nov
377	302.0	160.7	113.6	90.0	66.4	Dec
444	352.3	185.8	130.3	102.6	74.8	Jan
678	527.8	273.6	188.8	146.4	104.1	Feb
886	683.8	351.5	240.8	185.4	130.1	June
1185	908.1	463.7	315.6	241.5	167.4	Mar
1693	1289.1	654.2	442.6	336.7	230.9	May
1702	1295.8	657.6	444.8	338.4	232.1	Apr

Cambridge - Coldwater Aquatic Life Criteria

effluent T limits which would not cause >0.3C increase
when cold water criteria are applicable
assuming ambient T = 19 C

Design Flow

0.25 MGD
0.4 cfs

Tables 20 and 21 generally suggest that effluent temperature has little effect on the temperature regime of the Weiser River. All effluent temperatures are well above 25°C under the various mean monthly river flow and effluent flow scenarios.

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.** Although the loading analysis used in this TMDL involves gross estimations that are likely to have large variances, there are no load allocations that may benefit or suffer from that variance.

Seasonal Variation

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

Construction Storm Water and TMDL Waste Load Allocations

Construction Storm Water

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

The Construction General Permit (CGP)

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

Storm Water Pollution Prevention Plan (SWPPP)

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

Construction Storm Water Requirements

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

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

5.5 Implementation Strategies

Implementation strategies for TMDLs produced using potential natural vegetation-based shade and solar loading should incorporate the loading tables presented in this TMDL. Using the solar pathfinder to measure existing shade levels in the field is important to achieving both objectives. It is likely that further field verification will find discrepancies with reported existing shade levels in the loading tables. Due to the inexact nature of the aerial photo interpretation technique, these tables should not be viewed as complete until verified.

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

Time Frame

The timeframe for implementation will be similar to that in the Weiser River TMDL. See page 233 or contact the DEQ Boise Regional Office for more information.

Approach

The approach for implementation will be similar to that in the Weiser River TMDL. See page 234 or contact the DEQ Boise Regional Office for more information.

Responsible Parties

The responsible parties for implementation will be similar to those in the Weiser River TMDL. See page 236 or contact the DEQ Boise Regional Office for more information.

Monitoring Strategy

The monitoring strategy for implementation will be similar to those in the Weiser River TMDL. See page 238 or contact the DEQ Boise Regional Office for more information. Tables 1 through 18 need to be updated, first to field verify the existing shade levels that have not yet been field verified, and secondly to monitor progress towards achieving reductions and the goals of the TMDL. The monitoring strategies should include solar pathfinder monitoring to simultaneously field verify the TMDL and mark progress towards achieving desired reductions in solar loads.

5.6 Conclusions

All stream examined show excess solar loading. The entire Crane Creek drainage had relatively low excess solar loading relative to its total load. Thus the percent reduction necessary to achieve potential loads in the Crane Creek drainage was 11%. Three-quarters of the excess loading in the Crane Creek drainage occurs in the lower Crane Creek below the reservoir. Efforts to restore lower Crane Creek to its potential solar loads should focus in on the last 4000 meters of that stream to achieve the greatest reductions.

The Little Weiser River had the second highest excess solar load at a little more than 1.4 million kWh/day. This excess loading represents 28% of the total solar loading to this river. Over 50% of the excess solar loading occurs in the last 14 miles (23,000 m) of this river. Any tall vegetation development along the lower portion of the Little Weiser River, if possible given the constraints of levees and other land use activities, would be of benefit to reducing solar loading.

The lower section of the Weiser River from Fruitvale to the Snake River had the highest excess loading; however that loading only represented 9% of the total solar loading to this portion of the river. The 303d listed section of the Weiser River from Galloway Dam to the Snake River receives 688,235 kWh/day or 21% of the excess solar load. In fact, the excess solar loading to the Weiser River, Fruitvale to mouth, results from small incremental increases in loading throughout its entire length, not from just one section of the river.

Several other non-listed tributaries stand out as possible contributors of excess heat. Most notably the Hornet Creek drainage had the third largest excess solar load and needed a 35% reduction to achieve potential. Because that stream has not been thoroughly investigated or field verified, more work needs to be done to determine the extent of the problem in Hornet Creek. The Middle Fork Weiser River also ranks moderately high in excess solar load and percent reduction required to achieve potential. For the purposes of prioritizing restoration activities, in general, streams with excess solar loads less than 20% of their total solar loads (>20% reduction) are in relatively good shape with regard to shade compared to those with higher excess loads. Streams with high excess solar loads should be targeted first for implementation to get the most improvements per effort.

An examination of wasteload allocations for two NPDES discharges to the Weiser River show that effluent temperature will have little effect on cold water aquatic life criteria.

Table 22. Summary of assessment outcomes.

Water Body Segment/ AU	Pollutant	TMDL(s) Completed	Recommended Changes to §303(d) List	Justification
Weiser River, Galloway Dam to mouth/ ID17050124SW001_06	Temperature	Yes	n.a.	Existing Shade
North Crane Creek, headwaters to mouth/ ID17050124SW006_02 ID17050124SW006_03 ID17050124SW006_04	Temperature	Yes	n.a.	Existing Shade
Weiser River, Little Weiser River to Galloway Dam/ ID17050124SW001_06 ID17050124SW001_05 ID17050124SW007_05 & 05_a	Temperature	Yes	n.a.	Existing Shade
Little Weiser River, headwaters to mouth/ ID17050124SW008_02 ID17050124SW008_03 ID17050124SW008_04	Temperature	Yes	n.a.	Existing Shade
Crane Creek, headwaters to mouth/ ID17050124SW003_05 ID17050124SW005_02 ID17050124SW005_03 ID17050124SW005_04	Temperature	Yes	n.a.	Existing Shade

References Cited

The following references are references cited in the boilerplate language and in the glossary. Do not delete any of these references. Add all references you cite using the references listed below as examples or following the Council of Biology Editors (CBE) or another common format, as discussed in the guidance document.

- American Geological Institute. 1962. Dictionary of geological terms. Doubleday and Company. Garden City, NY. 545 p.
- Armantrout, N.B., compiler. 1998. Glossary of aquatic habitat inventory terminology. American Fisheries Society. Bethesda, MD. 136 p.
- Batt, P.E. 1996. Governor Philip E. Batt's Idaho bull trout conservation plan. State of Idaho, Office of the Governor. Boise, ID. 20 p + appendices.
- Clean Water Act (Federal water pollution control act), 33 U.S.C. § 1251-1387. 1972.
- Chugg, J.C. and M.A. Fosberg. 1980. Soil Survey of Boundary County Area, Idaho. USDA Soil Conservation Service and USDI Bureau of Indian Affairs. 72p. + maps.
- CRWQCB. 2002. Mattole River Watershed, Technical Support Document for the Total Maximum Daily Loads for Sediment and Temperature. California Regional Water Quality Control Board, North Coast Region. October, 2002.
- Denny, P. 1980. Solute movement in submerged angiosperms. *Biology Review*. 55:65-92.
- EPA. 1996. Biological criteria: technical guidance for streams and small rivers. EPA 822-B-96-001. U.S. Environmental Protection Agency, Office of Water. Washington, DC. 162 p.
- Franson, M.A.H., L.S. Clesceri, A.E. Greenberg, and A.D. Eaton, editors. 1998. Standard methods for the examination of water and wastewater, twentieth edition. American Public Health Association. Washington, DC. 1,191 p.
- Grafe, C.S., C.A. Mebane, M.J. McIntyre, D.A. Essig, D.H. Brandt, and D.T. Mosier. 2002. The Idaho Department of Environmental Quality water body assessment guidance, second edition-final. Department of Environmental Quality. Boise, ID. 114 p.
- Hughes, R.M. 1995. Defining acceptable biological status by comparing with reference condition. In: Davis, W.S. and T.P. Simon, editors. *Biological assessment and criteria: tools for water resource planning and decision making*. CRC Press. Boca Raton, FL. p 31-48.
- Idaho Code § 39.3611. Development and implementation of total maximum daily load or equivalent processes.
- Idaho Code § 39.3615. Creation of watershed advisory groups.
- IDAPA 58.01.02. Idaho water quality standards and wastewater treatment requirements.
- IDEQ, 2002. Middle Salmon River-Chamberlain Creek Subbasin Assessment and Crooked Creek Total Maximum Daily Load. Idaho Department of Environmental Quality. Final December 2002.

- IDEQ, 2004a. Weiser River Watershed Subbasin Assessment and Total Maximum Daily Loads. Boise Regional Office, Idaho Department of Environmental Quality. Draft June 2004.
- IDEQ. 2004b. South Fork Clearwater River Subbasin Assessment and TMDLs. Idaho Department of Environmental Quality, U.S. Environmental Protection Agency, and Nez Perce Tribe. March, 2004.
- IDL. 2000. Forest Practices Cumulative Watershed Effects Process for Idaho. Idaho Department of Lands. March 2000.
- Jankovsky-Jones, M. 1996. Wetland and riparian plant species of the Kootenai River valley. IDFG, Conservation Data Center.
- Karr, J.R. 1991. Biological integrity: a long-neglected aspect of water resource management. *Ecological Applications* 1:66-84.
- Newcombe, C.P. and J.O.T. Jensen. 1996. Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk and impact. *North American Journal of Fisheries Management*. Volume 16(4): 693-727.
- ODEQ. 2003. Alvord Lake Subbasin Total Maximum Daily Load (TMDL) & Water Quality Management Plan (WQMP). Oregon Department of Environmental Quality. December 2003.
- ODEQ. 2004a. Willamette Basin TMDL, Appendix C: Potential near-stream land cover in the Willamette Basin for temperature total maximum daily loads (TMDLs). Water Quality Division, Oregon Department of Environmental Quality. January, 2004.
- ODEQ. 2004b. Walla Walla River Subbasin Stream Temperature Total Maximum Daily Load and Water Quality Management Plan, Review Draft. Oregon Department of Environmental Quality. November 19, 2004.
- OWEB. (2001). Addendum to Water Quality Monitoring Technical Guide Book: Chapter 14 Stream Shade and Canopy Cover Monitoring Methods. Oregon's Watershed Enhancement Board. 775 Summer St. NE., Suite 360, Salem, OR 97301-1290.
- Poole, G.C. and C.H. Berman. 2001. An ecological perspective on in-stream temperature: natural heat dynamics and mechanisms of human-caused thermal degradation. *Environmental Management* 27(6):787-802.
- Rand, G.W., editor. 1995. Fundamentals of aquatic toxicology: effects, environmental fate, and risk assessment, second edition. Taylor and Francis. Washington, DC. 1,125 p.
- Rosgen, D.L. 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, CO.
- Strahler, A.N. 1957. Quantitative analysis of watershed geomorphology. *Transactions American Geophysical Union* 38:913-920.
- USDA. 1999. A procedure to estimate the response of aquatic systems to changes in phosphorus and nitrogen inputs. National Water and Climate Center, Natural Resources Conservation Service. Portland, OR.
- USGS. 1987. Hydrologic unit maps. Water supply paper 2294. United States Geological Survey. Denver, CO. 63 p.

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

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

Water quality planning and management, 40 CFR Part 130.

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

GIS Coverages

Restriction of liability: Neither the state of Idaho nor the Department of Environmental Quality, nor any of their employees make any warranty, express or implied, or assume any legal liability or responsibility for the accuracy, completeness or usefulness of any information or data provided. Metadata is provided for all data sets, and no data should be used without first reading and understanding its limitations. The data could include technical inaccuracies or typographical errors. The Department of Environmental Quality may update, modify, or revise the data used at any time, without notice.

Other Related Documents

Glossary

305(b)

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

§303(d)

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

Acre-foot

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

Adsorption

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

Aeration

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

Aerobic

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

Adfluvial

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

Adjunct

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

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

Aquatic	Occurring, growing, or living in water.
Aquifer	An underground, water-bearing layer or stratum of permeable rock, sand, or gravel capable of yielding of water to wells or springs.
Assemblage (aquatic)	An association of interacting populations of organisms in a given water body; for example, a fish assemblage or a benthic macroinvertebrate assemblage (also see Community) (EPA 1996).
Assessment Database (ADB)	The ADB is a relational database application designed for the U.S. Environmental Protection Agency for tracking water quality assessment data, such as use attainment and causes and sources of impairment. States need to track this information and many other types of assessment data for thousands of water bodies and integrate it into meaningful reports. The ADB is designed to make this process accurate, straightforward, and user-friendly for participating states, territories, tribes, and basin commissions.
Assessment Unit (AU)	A segment of a water body that is treated as a homogenous unit, meaning that any designated uses, the rating of these uses, and any associated causes and sources must be applied to the entirety of the unit.
Assimilative Capacity	The ability to process or dissipate pollutants without ill effect to beneficial uses.
Autotrophic	An organism is considered autotrophic if it uses carbon dioxide as its main source of carbon. This most commonly happens through photosynthesis.
Batholith	A large body of intrusive igneous rock that has more than 40 square miles of surface exposure and no known floor. A batholith usually consists of coarse-grained rocks such as granite.
Bedload	Material (generally sand-sized or larger sediment) that is carried along the streambed by rolling or bouncing.

Beneficial Use

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

Beneficial Use Reconnaissance Program (BURP)

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

Benthic

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

Benthic Organic Matter.

The organic matter on the bottom of a water body.

Benthos

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

Best Management Practices (BMPs)

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

Best Professional Judgment

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

Biochemical Oxygen Demand (BOD)

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

Biological Integrity

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

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

Cubic Feet per Second

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

Cultural Eutrophication

The process of eutrophication that has been accelerated by human-caused influences. Usually seen as an increase in nutrient loading (also see Eutrophication).

Culturally Induced Erosion

Erosion caused by increased runoff or wind action due to the work of humans in deforestation, cultivation of the land, overgrazing, and disturbance of natural drainages; the excess of erosion over the normal for an area (also see Erosion).

Debris Torrent

The sudden down slope movement of soil, rock, and vegetation on steep slopes, often caused by saturation from heavy rains.

Decomposition

The breakdown of organic molecules (e.g., sugar) to inorganic molecules (e.g., carbon dioxide and water) through biological and nonbiological processes.

Depth Fines

Percent by weight of particles of small size within a vertical core of volume of a streambed or lake bottom sediment. The upper size threshold for fine sediment for fisheries purposes varies from 0.8 to 6.5 millimeters depending on the observer and methodology used. The depth sampled varies but is typically about one foot (30 centimeters).

Designated Uses

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

Discharge

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

Dissolved Oxygen (DO)

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

Disturbance

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

E. coli

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

Ecology

The scientific study of relationships between organisms and their environment; also defined as the study of the structure and function of nature.

Ecological Indicator

A characteristic of an ecosystem that is related to, or derived from, a measure of a biotic or abiotic variable that can provide quantitative information on ecological structure and function. An indicator can contribute to a measure of integrity and sustainability. Ecological indicators are often used within the multimetric index framework.

Ecological Integrity

The condition of an unimpaired ecosystem as measured by combined chemical, physical (including habitat), and biological attributes (EPA 1996).

Ecosystem

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

Effluent

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

Endangered Species

Animals, birds, fish, plants, or other living organisms threatened with imminent extinction. Requirements for declaring a species as endangered are contained in the Endangered Species Act.

Environment

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

Eocene	An epoch of the early Tertiary period, after the Paleocene and before the Oligocene.
Eolian	Windblown, referring to the process of erosion, transport, and deposition of material by the wind.
Ephemeral Stream	A stream or portion of a stream that flows only in direct response to precipitation. It receives little or no water from springs and no long continued supply from melting snow or other sources. Its channel is at all times above the water table (American Geological Institute 1962).
Erosion	The wearing away of areas of the earth's surface by water, wind, ice, and other forces.
Eutrophic	From Greek for "well nourished," this describes a highly productive body of water in which nutrients do not limit algal growth. It is typified by high algal densities and low clarity.
Eutrophication	1) Natural process of maturing (aging) in a body of water. 2) The natural and human-influenced process of enrichment with nutrients, especially nitrogen and phosphorus, leading to an increased production of organic matter.
Exceedance	A violation (according to DEQ policy) of the pollutant levels permitted by water quality criteria.
Existing Beneficial Use or Existing Use	A beneficial use actually attained in waters on or after November 28, 1975, whether or not the use is designated for the waters in Idaho's <i>Water Quality Standards and Wastewater Treatment Requirements</i> (IDAPA 58.01.02).
Exotic Species	A species that is not native (indigenous) to a region.
Extrapolation	Estimation of unknown values by extending or projecting from known values.
Fauna	Animal life, especially the animals characteristic of a region, period, or special environment.

Fecal Coliform Bacteria

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

Fecal Streptococci

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

Feedback Loop

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

Fixed-Location Monitoring

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

Flow

See *Discharge*.

Fluvial

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

Focal

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

Fully Supporting

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

Fully Supporting Cold Water

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

Fully Supporting but Threatened

An intermediate assessment category describing water bodies that fully support beneficial uses, but have a declining trend in water quality conditions, which if not addressed, will lead to a “not fully supporting” status.

Geographical Information Systems (GIS)

A georeferenced database.

Geometric Mean	A back-transformed mean of the logarithmically transformed numbers often used to describe highly variable, right-skewed data (a few large values), such as bacterial data.
Grab Sample	A single sample collected at a particular time and place. It may represent the composition of the water in that water column.
Gradient	The slope of the land, water, or streambed surface.
Ground Water	Water found beneath the soil surface saturating the layer in which it is located. Most ground water originates as rainfall, is free to move under the influence of gravity, and usually emerges again as stream flow.
Growth Rate	A measure of how quickly something living will develop and grow, such as the amount of new plant or animal tissue produced per a given unit of time, or number of individuals added to a population.
Habitat	The living place of an organism or community.
Headwater	The origin or beginning of a stream.
Hydrologic Basin	The area of land drained by a river system, a reach of a river and its tributaries in that reach, a closed basin, or a group of streams forming a drainage area (also see Watershed).
Hydrologic Cycle	The cycling of water from the atmosphere to the earth (precipitation) and back to the atmosphere (evaporation and plant transpiration). Atmospheric moisture, clouds, rainfall, runoff, surface water, ground water, and water infiltrated in soils are all part of the hydrologic cycle.
Hydrologic Unit	One of a nested series of numbered and named watersheds arising from a national standardization of watershed delineation. The initial 1974 effort (USGS 1987) described four levels (region, subregion, accounting unit, and cataloging unit) of watersheds throughout the United States. The fourth level is uniquely identified by an eight-digit code built of two-digit fields for each level in the classification. Originally termed a cataloging unit, fourth field hydrologic units have

been more commonly called subbasins. Fifth and sixth field hydrologic units have since been delineated for much of the country and are known as watershed and subwatersheds, respectively.

Hydrologic Unit Code (HUC)

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

Hydrology

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

Impervious

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

Influent

A tributary stream.

Inorganic

Materials not derived from biological sources.

Instantaneous

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

Intergravel Dissolved Oxygen

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

Intermittent Stream

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

Interstate Waters

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

Irrigation Return Flow

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

Key Watershed	A watershed that has been designated in Idaho Governor Batt's <i>State of Idaho Bull Trout Conservation Plan</i> (1996) as critical to the long-term persistence of regionally important trout populations.
Knickpoint	Any interruption or break of slope.
Land Application	A process or activity involving application of wastewater, surface water, or semi-liquid material to the land surface for the purpose of treatment, pollutant removal, or ground water recharge.
Limiting Factor	A chemical or physical condition that determines the growth potential of an organism. This can result in a complete inhibition of growth, but typically results in less than maximum growth rates.
Limnology	The scientific study of fresh water, especially the history, geology, biology, physics, and chemistry of lakes.
Load Allocation (LA)	A portion of a water body's load capacity for a given pollutant that is given to a particular nonpoint source (by class, type, or geographic area).
Load(ing)	The quantity of a substance entering a receiving stream, usually expressed in pounds or kilograms per day or tons per year. Loading is the product of flow (discharge) and concentration.
Load(ing) Capacity (LC)	A determination of how much pollutant a water body can receive over a given period without causing violations of state water quality standards. Upon allocation to various sources, and a margin of safety, it becomes a total maximum daily load.
Loam	Refers to a soil with a texture resulting from a relative balance of sand, silt, and clay. This balance imparts many desirable characteristics for agricultural use.
Loess	A uniform wind-blown deposit of silty material. Silty soils are among the most highly erodible.

Lotic

An aquatic system with flowing water such as a brook, stream, or river where the net flow of water is from the headwaters to the mouth.

Luxury Consumption

A phenomenon in which sufficient nutrients are available in either the sediments or the water column of a water body, such that aquatic plants take up and store an abundance in excess of the plants' current needs.

Macroinvertebrate

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

Macrophytes

Rooted and floating vascular aquatic plants commonly referred to as water weeds. These plants usually flower and bear seeds. Some forms, such as duckweed and coontail (*Ceratophyllum sp.*), are free-floating forms not rooted in sediment.

Margin of Safety (MOS)

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

Mass Wasting

A general term for the down slope movement of soil and rock material under the direct influence of gravity.

Mean

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

Median

The middle number in a sequence of numbers. If there is an even number of numbers, the median is the average of the two middle numbers. For example, 4 is the median of 1, 2, 4, 14, 16; 6 is the median of 1, 2, 5, 7, 9, 11.

Metric	1) A discrete measure of something, such as an ecological indicator (e.g., number of distinct taxon). 2) The metric system of measurement.
Milligrams per Liter (mg/L)	A unit of measure for concentration. In water, it is essentially equivalent to parts per million (ppm).
Million Gallons per Day (MGD)	A unit of measure for the rate of discharge of water, often used to measure flow at wastewater treatment plants. One MGD is equal to 1.547 cubic feet per second.
Miocene	Of, relating to, or being an epoch of, the Tertiary between the Pliocene and the Oligocene periods, or the corresponding system of rocks.
Monitoring	A periodic or continuous measurement of the properties or conditions of some medium of interest, such as monitoring a water body.
Mouth	The location where flowing water enters into a larger water body.
National Pollution Discharge Elimination System (NPDES)	A national program established by the Clean Water Act for permitting point sources of pollution. Discharge of pollution from point sources is not allowed without a permit.
Natural Condition	The condition that exists with little or no anthropogenic influence.
Nitrogen	An element essential to plant growth, and thus is considered a nutrient.
Nodal	Areas that are separated from focal and adjunct habitats, but serve critical life history functions for individual native fish.
Nonpoint Source	A dispersed source of pollutants, generated from a geographical area when pollutants are dissolved or suspended in runoff and then delivered into waters of the state. Nonpoint sources are without a discernable point or origin. They include, but are not limited to, irrigated and non-irrigated lands used for

grazing, crop production, and silviculture; rural roads; construction and mining sites; log storage or rafting; and recreation sites.

Not Assessed (NA)

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

Not Attainable

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

Not Fully Supporting

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

Not Fully Supporting Cold Water

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

Nuisance

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

Nutrient

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

Nutrient Cycling

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

Oligotrophic

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

Organic Matter	Compounds manufactured by plants and animals that contain principally carbon.
Orthophosphate	A form of soluble inorganic phosphorus most readily used for algal growth.
Oxygen-Demanding Materials	Those materials, mainly organic matter, in a water body that consume oxygen during decomposition.
Parameter	A variable, measurable property whose value is a determinant of the characteristics of a system, such as temperature, dissolved oxygen, and fish populations are parameters of a stream or lake.
Partitioning	The sharing of limited resources by different races or species; use of different parts of the habitat, or the same habitat at different times. Also the separation of a chemical into two or more phases, such as partitioning of phosphorus between the water column and sediment.
Pathogens	A small subset of microorganisms (e.g., certain bacteria, viruses, and protozoa) that can cause sickness or death. Direct measurement of pathogen levels in surface water is difficult. Consequently, indicator bacteria that are often associated with pathogens are assessed. <i>E. coli</i> , a type of fecal coliform bacteria, is used by the state of Idaho as the indicator for the presence of pathogenic microorganisms.
Perennial Stream	A stream that flows year-around in most years.
Periphyton	Attached microflora (algae and diatoms) growing on the bottom of a water body or on submerged substrates, including larger plants.
Pesticide	Substances or mixtures of substances intended for preventing, destroying, repelling, or mitigating any pest. Also, any substance or mixture intended for use as a plant regulator, defoliant, or desiccant.
pH	The negative log ₁₀ of the concentration of hydrogen ions, a measure which in water ranges from very acid (pH=1) to very

alkaline (pH=14). A pH of 7 is neutral. Surface waters usually measure between pH 6 and 9.

Phased TMDL

A total maximum daily load (TMDL) that identifies interim load allocations and details further monitoring to gauge the success of management actions in achieving load reduction goals and the effect of actual load reductions on the water quality of a water body. Under a phased TMDL, a refinement of load allocations, wasteload allocations, and the margin of safety is planned at the outset.

Phosphorus

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

Physiochemical

In the context of bioassessment, the term is commonly used to mean the physical and chemical factors of the water column that relate to aquatic biota. Examples in bioassessment usage include saturation of dissolved gases, temperature, pH, conductivity, dissolved or suspended solids, forms of nitrogen, and phosphorus. This term is used interchangeable with the term “physical/chemical.”

Plankton

Microscopic algae (phytoplankton) and animals (zooplankton) that float freely in open water of lakes and oceans.

Point Source

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

Pollutant

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

Pollution

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

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

Reference

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

Reference Condition

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

Reference Site

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

Representative Sample

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

Resident

A term that describes fish that do not migrate.

Respiration

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

Riffle

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

Riparian

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

Riparian Habitat Conservation Area (RHCA)

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

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

River	A large, natural, or human-modified stream that flows in a defined course or channel or in a series of diverging and converging channels.
Runoff	The portion of rainfall, melted snow, or irrigation water that flows across the surface, through shallow underground zones (interflow), and through ground water to creates streams.
Sediments	Deposits of fragmented materials from weathered rocks and organic material that were suspended in, transported by, and eventually deposited by water or air.
Settleable Solids	The volume of material that settles out of one liter of water in one hour.
Species	1) A reproductively isolated aggregate of interbreeding organisms having common attributes and usually designated by a common name. 2) An organism belonging to such a category.
Spring	Ground water seeping out of the earth where the water table intersects the ground surface.
Stagnation	The absence of mixing in a water body.
Stenothermal	Unable to tolerate a wide temperature range.
Stratification	A Department of Environmental Quality classification method used to characterize comparable units (also called classes or strata).
Stream	A natural water course containing flowing water, at least part of the year. Together with dissolved and suspended materials, a stream normally supports communities of plants and animals within the channel and the riparian vegetation zone.
Stream Order	Hierarchical ordering of streams based on the degree of branching. A first-order stream is an unforked or unbranched stream. Under Strahler's (1957) system, higher order streams result from the joining of two streams of the same order.

Storm Water Runoff

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

Stressors

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

Subbasin

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

Subbasin Assessment (SBA)

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

Subwatershed

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

Surface Fines

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

Surface Runoff

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

Surface Water

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

Suspended Sediments

Fine material (usually sand size or smaller) that remains suspended by turbulence in the water column until deposited in

areas of weaker current. These sediments cause turbidity and, when deposited, reduce living space within streambed gravels and can cover fish eggs or alevins.

Taxon

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

Tertiary

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

Thalweg

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

Threatened Species

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

Total Maximum Daily Load (TMDL)

A TMDL is a water body's load capacity after it has been allocated among pollutant sources. It can be expressed on a time basis other than daily if appropriate. Sediment loads, for example, are often calculated on an annual basis. A TMDL is equal to the load capacity, such that load capacity = margin of safety + natural background + load allocation + wasteload allocation = TMDL. In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several water bodies and/or pollutants within a given watershed.

Total Dissolved Solids

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

Total Suspended Solids (TSS)

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

Toxic Pollutants

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

Tributary

A stream feeding into a larger stream or lake.

Trophic State

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

Total Dissolved Solids

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

Total Suspended Solids (TSS)

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

Toxic Pollutants

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

Tributary

A stream feeding into a larger stream or lake.

Trophic State

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

Turbidity

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

Vadose Zone

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

Wasteload Allocation (WLA)

The portion of receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. Wasteload allocations specify how much pollutant each point source may release to a water body.

Water Body

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

Water Column

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

Water Pollution

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

Water Quality

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

Water Quality Criteria

Levels of water quality expected to render a body of water suitable for its designated uses.

Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, or industrial processes.

Water Quality Limited

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

Water Quality Limited Segment (WQLS)

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

Water Quality Management Plan

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

Water Quality Modeling

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

Water Quality Standards

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

Water Table

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

Watershed

1) All the land which contributes runoff to a common point in a drainage network, or to a lake outlet. Watersheds are infinitely nested, and any large watershed is composed of smaller “subwatersheds.” 2) The whole geographic region which contributes water to a point of interest in a water body.

Water Body Identification Number (WBID)

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

Wetland

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

Young of the Year

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

Appendix A. Unit Conversion Chart

Table A-1. Metric - English unit conversions.

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

^a 1 cfs = 0.65 million gallons per day; 1 million gallons per day is equal to 1.55 cfs.

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

Appendix B. State and Site-Specific Standards and Criteria

Water Quality Standards Applicable to Salmonid Spawning Temperature

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

13°C as a daily maximum water temperature,

9°C as a daily average water temperature.

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

Natural Background Provisions

For potential natural vegetation temperature TMDLs, it is assumed that natural temperatures may exceed these criteria during these time periods. If potential natural vegetation targets are achieved yet stream temperatures are warmer than these criteria, it is assumed that the stream's temperature is natural (provided there are no point sources or human induced ground water sources of heat) and natural background provisions of Idaho water quality standards apply. As per IDAPA 58.01.02.200.09:

When natural background conditions exceed any applicable water quality criteria set forth in Sections 210, 250, 251, 252, or 253, the applicable water quality criteria shall not apply; instead, pollutant levels shall not exceed the natural background conditions, except that temperature levels may be increased above natural background conditions when allowed under Section 401.

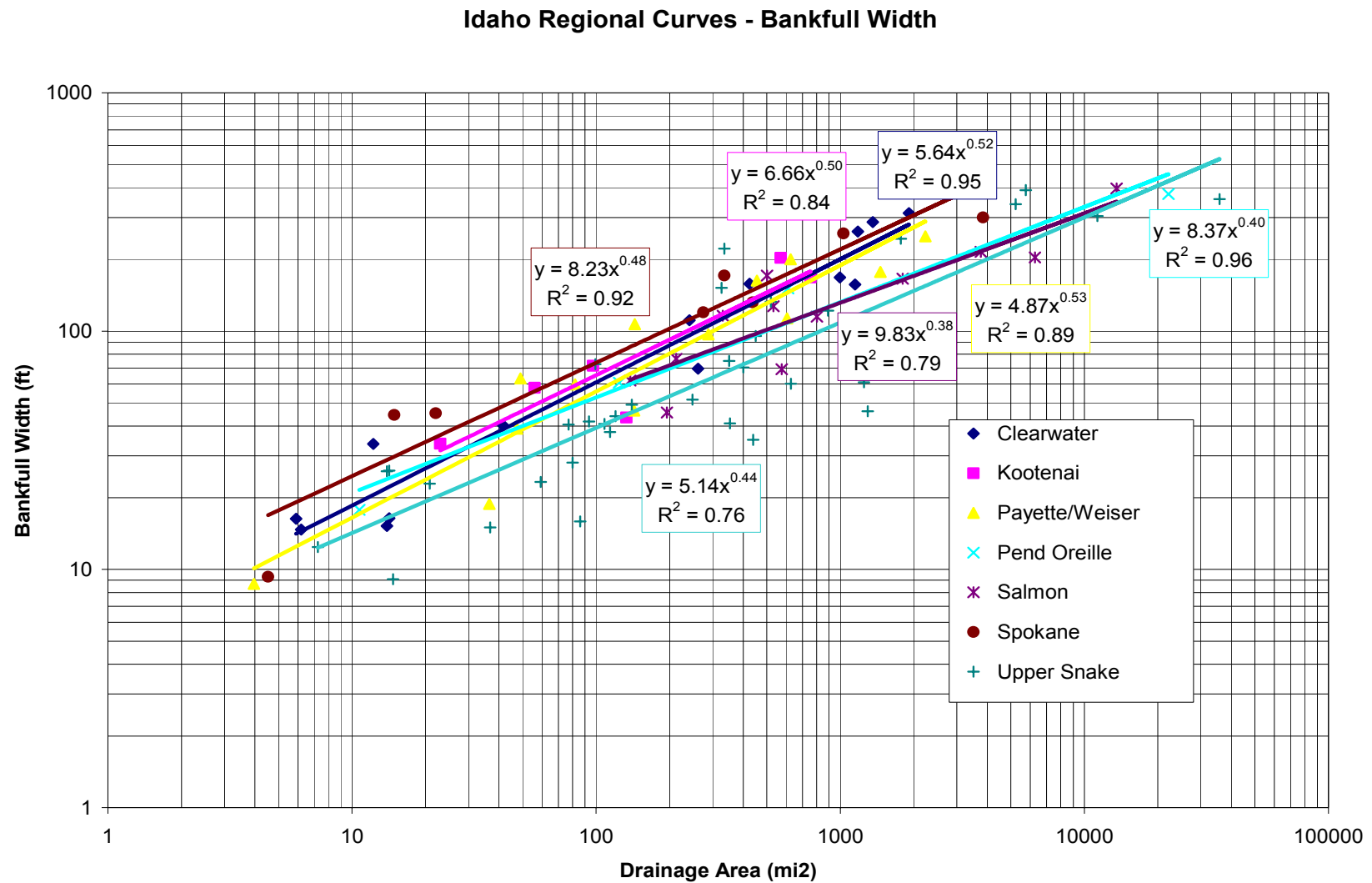
Section 401 relates to point source wastewater treatment requirements. In this case if temperature criteria for any aquatic life use is exceeded due to natural conditions, then a point source discharge cannot raise the water temperature by more than 0.3°C (IDAPA 58.01.02.401.03.a.v.).

Estimate of Bankfull Channel Width

The only factor not developed from the aerial photo work presented above is channel width (i.e., NSDZ or Bankfull Width). Accordingly, this parameter must be estimated from available information. We use regional curves developed by the Idaho Department of Lands to try to estimate bankfull width from drainage area size (Figure B-1). In this case, the regional curve for the Payette/Weiser basin was used.

For each stream evaluated in the loading analysis, bankfull width is estimated based on drainage area using these figures and equations. Additionally, existing width is evaluated from available data. If the stream's existing width is wider than that predicted by these two figures, then the Figure estimate of bankfull width is used in the loading analysis. If existing width is smaller, then existing width is used in the loading analysis.

Figure B-1. Bankfull Width as a Function of Drainage Area



Blank Page

Appendix C. Data Sources and Temperature Data

Table C-1. Data sources for Weiser River and major tributaries TMDLs.

Water Body	Data Source	Type of Data	When Collected
Weiser River, WF, MF, EF, Little Weiser River, Crane Creek	DEQ State Technical Services Office	Pathfinder effective shade and stream width	Fall 2005
Weiser River and ten major tributaries	DEQ State Technical Services Office	Aerial Photo Interpretation of existing shade and stream width estimation	Fall 2005

Blank Page

Appendix D. Distribution List

JEROME GRANDI
2294 WEISER RIVER ROAD
WEISER ID 83672

JOE QUALLS
55 W IDAHO STREET
WEISER ID 83672

JOHN FIELD
1025 LOWER CRANE CREEK
WEISER ID 83672

KIRK CAMPBELL
DEPT OF AGRICULTURE
2270 PENITENTIARY ROAD
BOISE ID 83701

VERN LOLLEY
732 HALE ROAD
WEISER ID 83672

BILL GAMBLE
COUNCIL RANGER DISTRICT
PO BOX 567
500 EAST WHITLEY
COUNCIL IDAHO 83612

RONALD POUND
889 MANN CREEK ROAD
WEISER ID 83672

VICKI LUKEHART
WEISER RIVER SCD
847 EAST 9TH STREET
WEISER ID 83672

ART CORREIA
1826 COVE ROAD
WEISER ID 83672

LAVELLE BRAUN
1129 OLDS FERRY ROAD
WEISER ID83672

SCOTT KOBERG
IASCD
6003 OVERLAND ROAD
SUITE 204
BOISE ID 83709

LEIGH WOODRUFF
EPA-IOO
1435 NORTH ORCHARD
BOISE IDAHO 83706

Appendix E. Public Comments

Blank Page



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, WA 98101

Reply to
Attn of: OWW-134

April 14, 2006

Craig Shepard
Idaho Department of Environmental Quality
1445 North Orchard
Boise, Idaho 83706

Subject: Weiser Subbasin Temperature Total Maximum Daily Loads (TMDL):
Addendum to the Weiser River Subbasin Assessment and TMDL, February
2006

Dear Craig:

Thank you for giving us the opportunity to review the draft *Weiser Subbasin Temperature Total Maximum Daily Loads (TMDL); Addendum to the Weiser River Subbasin Assessment and TMDL* dated February 21, 2006. This letter presents the Environmental Protection Agency (EPA) Region 10 comments on the TMDLs. The TMDL addendum addresses temperature for the Weiser River Watershed, Hydrologic Unit Code Number 17050124.

EPA Region 10 wishes to acknowledge the substantial amount of technical work and effort that the Idaho Department of Environmental Quality (DEQ) staff has put forth in re-drafting this temperature TMDL, particularly Mark Shumar's effort to develop a potential natural vegetation approach. In general we are very supportive of this type of temperature TMDLs, and this represents an improvement over the original TMDL dated August 2004. We believe a natural shade-based approach results in more realistic targets which better fit the varied landscape found in the Weiser basin.

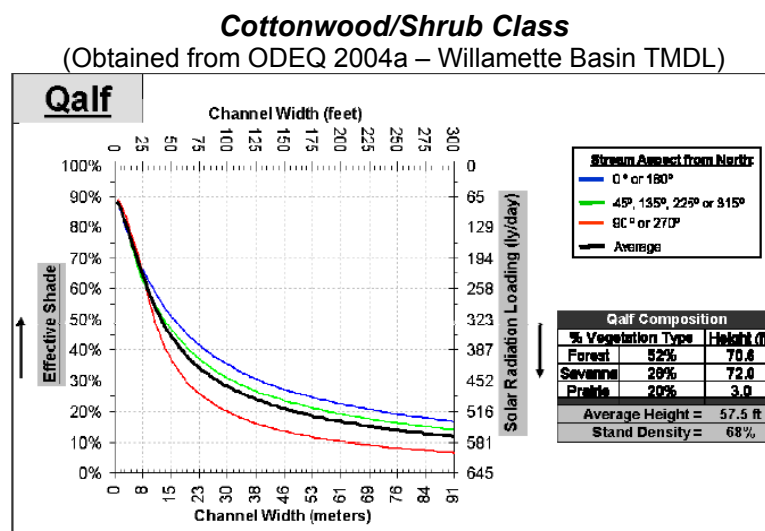
While we support the direction of this TMDL, we found that certain aspects of the document would benefit from further clarification or a slightly revised approach, and we offer the following detailed comments on the next page:

Specific Comments

Page	Comment
p. xii, 2	Reservoirs as background. The document indicates that “Hydrologic aspects (such as irrigation structures and reservoirs, but not channel width) of stream temperature were considered part of background conditions and were not addressed in this TMDL.” We are concerned that this may not be a valid interpretation or application of the Natural Conditions portion of the Idaho Water Quality Standards, since such anthropogenic features may impact water temperature and are not specifically excluded from the interpretation of natural background. The statement that they are part of background is not consistent with the standards unless analysis of their effects demonstrates their lack of impact on temperature. We recognize that IDEQ may not have data available to determine the impacts of these structures, and understandably this TMDL focused on potential natural vegetation which is known to affect stream temperature. However, dam and reservoir impacts should be evaluated and we recommend that it be identified in the TMDL when this assessment would be done. This issue, and options for operating these facilities in a manner which would improve water temperatures, might be considered during implementation plan development.
2	“Potential natural vegetation (PNV) along a stream is that intact riparian plant community that has grown to its fullest extent and has not been disturbed or reduced in any way.” We agree that PNV are reasonable shade targets as components of temperature TMDLs, but PNV commonly includes natural disturbance in the definition, and in the derivation of shade values representative of PNV. We also agree that it is appropriate to use PNV shade values from other TMDLs when it can be documented that the expected vegetation communities and other conditions are similar. However, the manner in which the shade targets were defined and derived in the original TMDLs should be brought forward. In particular, if natural disturbance (fire, mass wasting, etc.) was incorporated into targets in the source TMDLs, shade targets for the Weiser TMDL should be stated to include natural disturbance. This may be to the benefit of IDEQ in conveying these concepts to land owners, as the targets are intended to represent achievable shade levels which account for natural disturbance. For example, in EPA’s derivation of PNV shade targets in the SF Clearwater TMDL (2004), the targets have incorporated natural disturbance by including a portion of non-mature vegetation.
4 - 10	Canopy cover and shade target derivation methods. ▪ We agree that shade curves from other TMDLs may be used to derive targets for this TMDL. However, we are concerned that values from other TMDLs are

averaged, then assigned to the next lowest 10th percentile category. This procedure results in targets which are consistently below the average calculated from other TMDLs, and is not conservative. This has a pronounced effect in settings with low natural shade. For example, in the Meadow/Grass community, average PNV for 4 meter wide streams is calculated to be 18%, but the target used in the Weiser TMDL 10%. We think a more appropriate approach would be to use the average PNV calculated from other TMDLs, without any further adjustment, or to select the single most comparable shade curve and use it directly.

- Aspect is not included in the analysis. Shade values reported in the TMDL are reported as the average for various aspects. In the example below, the Weiser TMDL reported a 38% effective shade for 18 meters, but the range is about 30 to 50 depending on aspect.

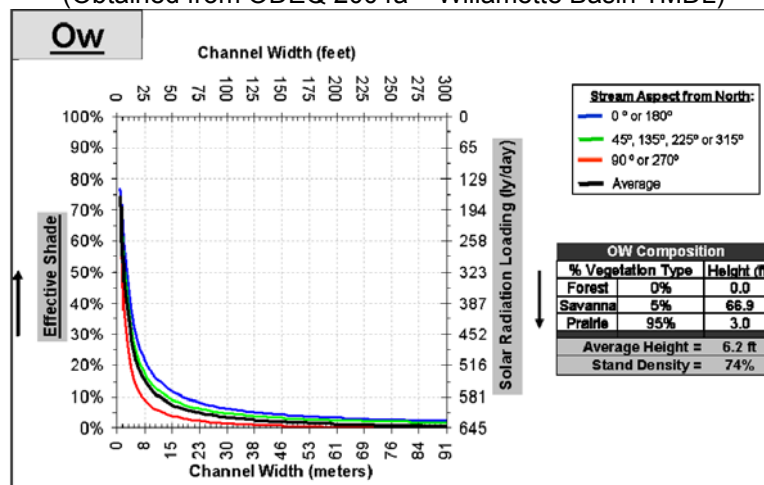


Given the significant range in appropriate shade targets given different aspects, we recommend including aspect as a variable in establishing shade targets.

- Potential problem in reading values from charts rather than calculating them. On the next page is an example of the shade curve in the Willamette TMDL used for the meadow class. First, it is very important to point out the difficulty to accurately read the target condition for this grassland class off of this image (i.e., the values change dramatically at different channel widths at the range of the analysis (4 to 6 meters)).

Meadow Grasslands Class

(Obtained from ODEQ 2004a – Willamette Basin TMDL)



This image also shows that shade decreases dramatically at wider channel conditions with “short” vegetation. The Weiser lists only a 4, 5, and 6 meter channel in the targets – this is well within the “down the slide” portion of lower potential shade values. In other words, a channel width of 2 meters would produce a lot more shade for the same “short” vegetation condition than expected at a 4 meter channel. It is unclear what the shade target is for 2 meter wide channels in the Weiser TMDL, but as it is presented, shade values for 4 meter channels might be applied, which would result in shade levels less than would be expected under natural conditions for narrower channels.

Table 1 (on the next page) presents effective shade we calculated for this class at various channel widths and aspect conditions¹. This table shows that shade levels are actually higher than reported in the TMDL (i.e., 32, 26, and 22% effective shade, not 25, 22, 20 as reported in the Weiser TMDL.). This is a source of error in deriving the Weiser targets.

In addition, results showed once again that aspect is important in shade production. For example, the calculated shade values for this condition are actually 32 (ranging from 38 to 23), 26 (ranging from 32 to 19), and 22 (ranging from 28 to 15), for 4, 5, and 6 meter channel widths, respectively.

It may be worth identifying the expected vegetation type, height, and density in various Weiser subbasin settings, and then selecting the single most appropriate shade curve from the other TMDLs, and including aspect as in Table 1.

¹ The model used in this analysis was obtained from the Washington Ecology webpage, and conditions described in the image above (6.2 feet height, and 74% canopy cover) were the input values.

Table 1

Meadow Grasslands Calculated Effective Shade - ODEQ Willamette TMDL – Region OW				
Width (meters)	Zero Aspect	45 Aspect	90 Aspect	Average Effective Shade
1	77%	74%	83%	78%
2	59%	55%	44%	53%
3	47%	42%	30%	40%
4	38%	33%	23%	32%
5	32%	28%	19%	26%
6	28%	24%	15%	22%
7	25%	21%	13%	19%
8	22%	18%	12%	17%
9	20%	16%	10%	15%
10	18%	15%	9%	14%
12	15%	12%	8%	12%
13	14%	11%	7%	11%
15	12%	10%	6%	9%
16	11%	9%	6%	9%
17	11%	9%	5%	8%
18	10%	8%	5%	8%
19	10%	8%	5%	7%
20	9%	7%	5%	7%
21	9%	7%	4%	7%
22	8%	7%	4%	6%
23	8%	6%	4%	6%
24	8%	6%	4%	6%
25	7%	6%	4%	6%
26	7%	6%	4%	5%
27	7%	5%	3%	5%
28	7%	5%	3%	5%
29	6%	5%	3%	5%
30	6%	5%	3%	5%
40	5%	4%	2%	4%
50	4%	3%	2%	3%
60	3%	2%	2%	2%
70	3%	2%	1%	2%
80	2%	2%	1%	2%
90	2%	2%	1%	2%

- 7 Meadow/Grass cover type. In establishing this cover type, we are unclear whether it represents current conditions or historic conditions prior to anthropogenic impact. In other areas, we have found existing meadow/grass settings which have resulted from the historic removal of shrubs and other vegetation along the stream. For example, the Red River meadow area historically was a shrub/meadow complex, but now is predominantly a grass meadow due to historic vegetation removal, followed by grazing. In that case, shade from the historic shrub meadow complex was a more appropriate target and desired vegetation mix than the current grass meadow. We are not clear whether that situation may have occurred in the Weiser Basin, but it may be worth looking into, e.g. through reference site information in county soil surveys, the Idaho Fish and Game Conservation Data Center, etc.
- 38 In the last sentence of the first paragraph it is stated that “There is no opportunity to allocate shade removal to an activity”. It is not clear what is intended by this statement. Is the intent that the allocation of natural shade levels means that no further removal of shade would be consistent with the allocations, because increases in shade are needed to meet the shade allocations? If so, some rewording of the original statement may be needed to add clarity.
- 38 “Streams with excess solar loads <20% of their total solar loads are in relatively good shape with regard to shade”. This statement may cause some confusion as to how it should be interpreted, and the message it sends. If the intent is to prioritize restoration activities, it may work just as well to simply suggest that restoration be prioritized based on the degree to which current shade levels depart from target conditions. In that way reaches with shade near the target levels, such as those within 20% of their target levels, would receive lower priority.
- In addition, the 20% figure is qualified by suggesting that a certain amount of holes in the “mature state” riparian potential natural shade are to be expected. We would recommend removing this statement, as most of the shade curves used as a basis for targets in the Weiser TMDL already incorporate natural disturbance (i.e. “holes”) in the target shade values.
- 41 Margin of safety. This section states that “... no loads allocated to sources or activities...” It may be more accurate to say that loads (shade levels) are allocated to lands adjacent to these streams at natural background levels, and loads to point sources are allocated at existing 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.

You may also want to consider noting that the method of estimating current canopy cover is conservative, and adds to the margin of safety, by assigning current shade levels from air photo interpretation to the next lowest 10th percentile category. As a result, the relative percent increase needed to meet shade targets is a conservative estimate.

EPA Region 10 appreciates the opportunity to comment on this document and appreciates the work that DEQ staff has put forth in its development. We hope these comments are helpful and we look forward to the submittal of the final TMDL in the near future. If you have any questions regarding these comments, please contact me at (206) 553-6327 or Leigh Woodruff at (208) 378-5774.

Sincerely,

Mark G. Filippini
Watershed Unit
Office of Water and Watersheds

cc: Marti Bridges, IDEQ
Mark Shumar, IDEQ

May 3, 2006

Mr. Mark G. Filippini
EPA, Region 10
Watershed Unit
1200 Sixth Avenue
Seattle, WA 98101

RE: Weiser Temperature TMDL Comments

Dear Mr. Filippini:

Comment #1 (p. xii, 2): We would consider the temperature of Crane Creek Reservoir to be a background condition for Crane Creek (reservoir to Weiser River). Considering the vegetation communities and the shade targets in the upper watershed, Crane Creek Reservoir can not be expected to meet standards and thus, would be considered background. This argument also held true for the lower Payette River TMDL, because the temperatures coming out of Black Canyon Reservoir were not expected to meet the cold water aquatic life temperature criteria.

Comment #2 (p. 2): We will adjust the document to reflect that a natural level of disturbance is already incorporated into the design and in the target shade curves.

Comment #3 (p. 4-10): We treated the target shade in a manner similar to how we treated existing shade to be consistent. When we do an aerial photo interpretation for existing shade, levels are placed into these 10% interval classes. When we do field verification with a solar pathfinder, that data is likewise put into one of these 10% classes. In other words, if we measure 18% in the field with a solar pathfinder, that section of the stream is designated as being in the 10% class because that class represents shade levels from 10% to 19.9%. By averaging the target shade curves and then putting the result into a 10% class, we were merely maintaining a consistency of approach. The 10% target class is not just 10% shade; it's the class from 10% to 19.9%. It is possible that existing shade could be measured as 10% in the field and its corresponding average target value was 19%, and they would be considered equal because they are both in the 10% class. However, the reverse could be true as well (19% field, 10% target average). The inexact nature of the whole process though does not lend itself to be that picky.

Others in WAG meetings have wondered about this too, in fact the Clark Fork WAG would like to use the mid-range value to represent the class. So they want to see classes labeled as 5%, 15%, 25%, etc. with 15% representing the class from 10% to 19.9%. If EPA would prefer this midrange value for a class label, we can switch all TMDLs to that.

Comment #3 (aspect): True aspect is not considered. It was our feeling that at a small scale the stream twists and turns and has many different aspects that would be difficult for us to

account for and still be timely. Therefore, we chose to go with the average line. It would be possible to determine a general trend for the whole stream, say north-south or east-west, and then use that aspect line for the whole stream. We did not think it necessary to be that exacting considering the gross nature of the whole process.

Comment #3 (chart reading): You are indeed correct that reading those charts is difficult and subject to error. The table you present would be easier to read. We will try to locate tables that correspond with the charts that we use, however, time is not available in large quantities and we will continue to use the charts for those shade curves that we cannot locate a corresponding table. We are somewhat perplexed as to how you found the ODEQ Willamette TMDL on Washington's Ecology webpage.

You raised the question about why we did not use smaller stream widths for the meadow grassland vegetation type where we used stream widths 4, 5 and 6 meters. We develop targets for a given community type based on the natural stream widths needed in the loading table. In other words, the grass meadow type occurred on the stream at a position where the stream was 4 to 6 meters wide. Above this point where the natural stream width is small, say 2 meters wide, it is in a different vegetation type, in this case mixed conifer or conifer/meadow types. Had the grass meadow occurred higher up the stream, then perhaps we would need a target for a 2-meter wide stream.

We use several shade curves and average them because we cannot say for sure that the vegetation in our TMDL is exactly like the vegetation in another TMDL. To choose just one curve is to say to the local people, your vegetation is the same as the vegetation found in Oregon or wherever. That does not go over well with WAG presentations. Instead we say that the curves we use represent a range of potential vegetation conditions that we are fairly sure your creek falls into. We then produce an average target value from that range. Choosing one only leads to arguments about which one we chose, did we choose one that is too lenient or too strict, etc. Because of the inexact nature of the process, we need to provide a process that does not appear like we are trying to cram something unrealistic down someone's throat.

Comment #4 (p. 7): The question about whether or not the grass meadow actually existed as natural vegetation, or did it contain shrubs, is an interesting question. Usually when we do aerial photo interpretation or on the ground field verification, we can usually find remnants of what was probably there historically. In the case of the meadows in the Little Salmon River meadows area and in this particular meadow on the upper Weiser River, we could not find remnant shrub vegetation. We turned to the historical botany literature and in fact requested help from an expert in the field of historical botany (Dr. Bertie Weddell, Draba Consulting, Pullman, WA) to see if we could answer that question and other questions that had arisen about potential natural vegetation in the New Meadows area. Unfortunately, we could not determine if any of the early botanists ever ventured into the valley or described it in any way. We found one brief description in Elsensohn (1965) [Elsensohn, Sister M. Alfreda. **Pioneer Days in Idaho County**. Two Volumes Complete. Caldwell, ID: Caxton Printers, 1965] that was insufficient to determine whether grass, trees, or shrubs were dominant. The soil surveys for these areas describe them as wet meadows. So it was a

judgment call on our part to decide that these specific meadows in the Weiser subbasin and in the Little Salmon River subbasin were in fact grass dominated. If you would like us to change that call, we can.

Comment #5 (p. 38): The statement was intended to convey that no vegetation removal is implied in any way. We don't want folks thinking that they can remove vegetation on shady streams. We will attempt to revise this language accordingly.

Comment #6 (p. 38): This statement evolved out of a discussion with the WAG on how to prioritize the issues. They specifically requested that we include that statement in the TMDL. As we adjust our language on mature state and holes in the landscape, we will attempt to make it clear we are talking about prioritizing implementation.

Comment #7 (p. 41): We will adjust the language accordingly.

We understand that an attempt is being made to have a meeting to discuss your comments. If we can answer any questions, please contact Mark Shumar at (208) 373-0132.

Sincerely,

Craig Shepard
Regional Manager
Water Quality

cc: Michael McIntyre, DEQ - Surface Water Program
Leigh Woodruff, EPA – IOO
Mark Shumar, DEQ – Technical Services