Willow Creek TMDLs: Addendum to the Lower Boise River TMDLs, Subbasin Assessment, Total Maximum Daily Loads

Draft

Department of Environmental Quality

Willow Creek Assessment and Total Maximum Daily Loads
Conceptual Approach Report

Introduction: Willow Creek is a third-order (Strahler 1957) north side tributary to the Boise River with approximately 28 miles of perennial stream (U.S. Geological Survey 2009), located in the north-central portion of the lower Boise River subbasin; also identified as Hydrologic Unit Code (HUC) 17050114 with two water body identification (WBID) labels: ID 17050114SW015_02 and ID 17050114SW015_03 (Figure A). Willow Creek drains approximately 85 square miles of agricultural and low-density urban land between the foothills of the Boise Ridge and the Boise River. The stream flows across terrain with slopes ranging from <1-36 %, with the steepest slopes forming the south and south-east boundary of the watershed. The watershed lithology is dominated by Plio-Pleistocene igneous and sedimentary strata with narrow lenses of Quaternary alluvium that frame the present-day perennial watercourse. The soils in the watershed are described as fine sandy-loam to silty clay-loam with erosion indices (K-factors) ranging from 0.24 to 0.38 (on a scale of 0 to 1); indicating moderate erosive potential. Streams in ID 17050114SW015_02 are documented as almost entirely intermittent or ephemeral and the mainstem of Willow Creek, in ID 17050114SW015_03, has reported measured flows that range from 121 cubic feet per second (cfs) to 0 cfs. Up to 93% of the land use in the watershed is agricultural, with only one tenth of 1% (0.1%) identified as urban.

The identified pollutants in this watershed are almost exclusively agricultural in nature. In developing the *Lower Boise River TMDL Subbasin Assessment, Total Maximum Daily Loads* (DEQ 1999) DEQ determined that Willow Creek is a significant contributor of sediment and bacteria pollution to the lower Boise River and assigned a suspended sediment load reduction, from 1995 loads, of 37% and a bacteria load reduction of 94% to Willow Creek at its confluence with the Boise River. Data analysis for a five-year review of the lower Boise River TMDL was completed in 2009. The review included a comparative analysis of data collected in 2005 with loads calculated in 1995 for the TMDL. That analysis estimated a 43% reduction in sediment (compared to 1995) delivered to the lower Boise River, and no significant reduction in bacteria. Data collected by ISDA in 2008, and published in 2009, enable a more accurate comparison to 1995 suspended sediment concentration (SSC) data. Based on revised long-term averages, which include ISDA 2008 discharge and SSC data, Willow Creek is contributing 5.08 tons per day (t/d) of sediment to the lower Boise River, which is 2.8 t/d more than the lower Boise River target of 2.28 t/d. The recent analysis estimates that Willow Creek contributes 40% more SSC to the lower Boise River than when the lower Boise River TMDL was developed.

Subbasin Assessment Summary

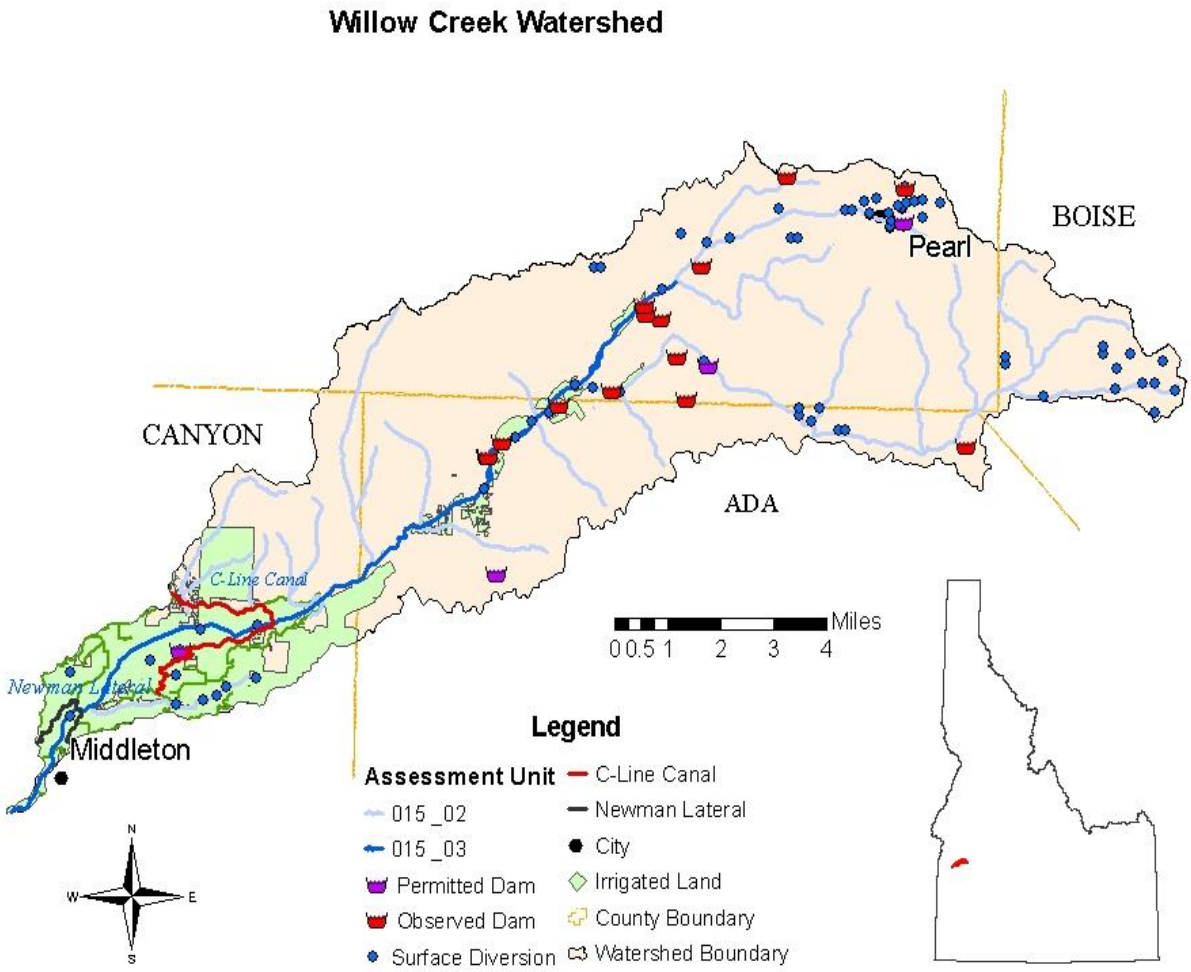

Figure A. Willow Creek Watershed Assessment Units, Flow Controls, and Irrigated Lands.

Segments Listed in the 303(d) List:
The water quality limited segments of the subbasin are listed in Table 1 and shown in Figure A. These listings are based on data collected since 1996 by multiple agencies.

Table 1: Water Quality limited segments in Willow Creek

Year	Assessment Unit	Watershed	Listed pollutants
1998	Headwaters to Boise River	Willow Creek	Unknown
2002	015_02	Willow Creek	Unknown, Temperature
	015_03	Willow Creek	Unknown, Temperature
2008	015_02	Willow Creek	Combined Biota/Habitat, Temperature
	015_03	Willow Creek	Combined Biota/Habitat, Temperature

AU 015_02 and AU 015_03 are listed in the 2008 Integrated Report as impaired by combined biota / habitat assessments and temperature (Figure A). This report is available at: http://www.deq.idaho.gov/water/data_reports/surface_water/monitoring/integrated_report_2008_final_entire.pdf. Data collected by agencies between 1996 and 2010 is used to identify pollutants and potential sources and quantify pollutant loads. DEQ attempted to collect Beneficial Use Reconnaissance Program (BURP) data from AU 015_02 three times between 1996 and 2005, with no success due to dry streams and access limitations. Three attempts to collect BURP data from AU 015_03 resulted in one successful survey in 1996 (1996SBOIA082) that yielded a determination that beneficial uses are not supported. The most recent attempt in March of 2008, which can be used as Tier II data in accordance with the *Water Body Assessment Guidance*, second edition (WBAG II) (Grafe et al. 2002), also documents dry stream conditions.

Bacteria samples collected in 2000, 2001, and 2008 by the Idaho State Department of Agriculture (ISDA) from two different locations in AU 015_03 document single-sample bacteria concentrations ranging from 10 to 3,300 colony forming units per 100 milliliters (cfu/100mL), SSC ranging from 1 to 196 milligrams per liter (mg/L), and measured instantaneous surface water temperature, dissolved oxygen (DO), and pH are within water quality standards (WQS) criteria for beneficial use support.

The United States Geological Survey (USGS) has collected data from the location that was selected as a load allocation (LA) control location for the lower Boise River TMDL (DEQ 1999) nine times since the TMDL was developed (Figure B). Data reported from these samples document bacteria concentrations that range from 12 to 1,200 cfu/100mL and SSCs that range from 5 to 1,630 mg/L. Instantaneous surface water temperature measurements exceeded COLD beneficial use WQS once (2001), and reported DO and pH meets WQS criteria.

The City of Boise collected continuous water temperature data from a location near the USGS and lower Boise River TMDL LA location from February to October 2004. When these data are compared to the historical maximum weekly maximum temperature (MWMT) reported for the nearest agrimet station, in Nampa, ID, the surface water temperature exceeds COLD WQS criterion 9.0% of the time.

There are two permitted point source discharges in the watershed; the city of Middleton municipal separate storm sewer system (MS4); which discharges to Willow Creek in AU 015_03, and the Canyon Highway District No. 4 MS4, which may discharge to Willow Creek in AU 015_02 and/or AU 015_03. These National Pollutant Discharge Elimination System (NPDES) permits are issued (and are administered) by EPA in 2009 and can be accessed at http://yosemite.epa.gov/r10/water.nsf/NPDES+Permits/MS4+requirements+-+Region+10/$FILE/ids028100_middleton_ms4_fp_modified_123009.pdf and http://yosemite.epa.gov/r10/water.nsf/NPDES+Permits/MS4+requirements+-+Region+10/$FILE/IDS028134%20Canyon%20HD%20FP.pdf

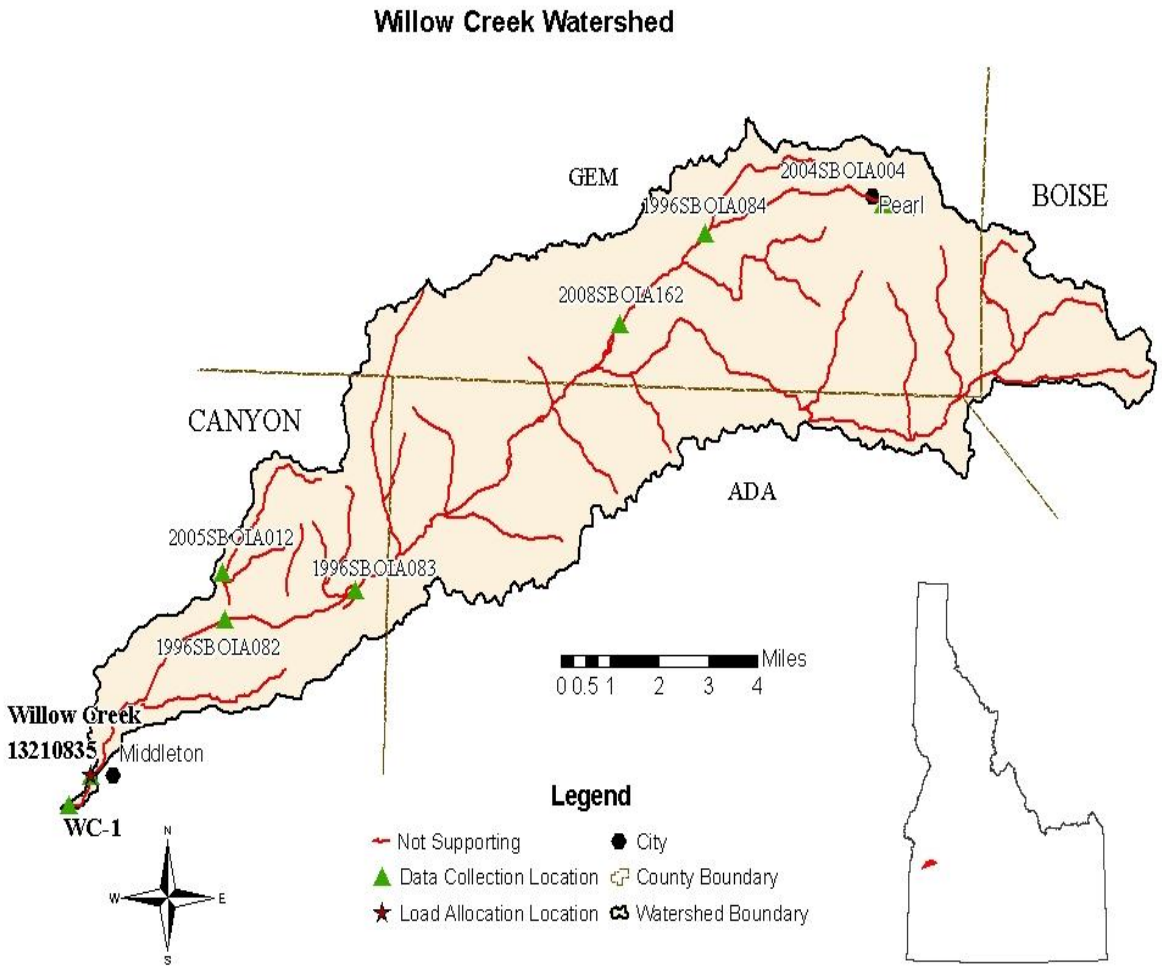

Figure B. Location of data collection locations in the Willow Creek watershed, 1996 to 2010.

Based on data collected from 2000 through 2010 from multiple locations in both AUs, and a comprehensive evaluation of watershed characteristics as specified in the WBAG II (Grafe et al. 2002), the most likely causes of beneficial use support impairment in AU 015_02 are flow and habitat alteration and sediment (Table 2). While AU 015_02 is not listed as impaired for sediment, it is a source of sediment and DEQ believes that when water is present the AU is impaired by sediment. In AU 015_03 the most likely cause of beneficial use support impairment are flow and habitat alteration, sediment, and bacteria. Because TMDLs are not developed for flow and habitat alteration, and sediment and bacteria from anthropogenic sources are quantifiable and controllable, TMDLs are developed for sediment and bacteria.

Table 2. Summary of water quality data sources, determination of beneficial use attainment, and pollutant type for assessment units in the willow Creek watershed.

Assessment Unit (2008 Integrated Report)	Stream Segment Description	Collection Agency	Data Collected	Year
015_02	1st and 2nd order Willow, North Fork Willow, South Fork Willow Creeks and tributaries	[1]DEQ	BURP data, satellite photo image review.	[1]1996, 2004-5, 2008
015_03	3rd order Willow Creek, North Fork Willow Creek, and tributaries.	[1]DEQ, [2]USGS [3]ISDA, [4]CB	[1]BURP data, satellite photo image review. [3]Nutrients, bacteria, sediment, field parameters. [4]Temperature.	[1]1996, 2008; [2]2000, 2005; [3]2000-2001, 2008; [4]2004

[1] Department of Environmental Quality (DEQ), [2] United States Geological Survey (USGS), [3] Idaho State Department of Agriculture (ISDA), [4] City of Boise (CB).

Qualitative Data

Figure C. Willow Creek upstream of Middleton, summer 2006.

Figure D. Willow Creek in Middleton, summer 2006.

Land Use

The current primary land use is agriculture, which accounts for 93% of the land use in the watershed (Table 3). Rangeland accounts for the largest portion (80%) of agriculture land use and irrigated agriculture accounts for 17% of the agricultural land use. Developed urban and residential land use account for less than 1% of the land use in the watershed and includes part of the city of Middleton, which has its center in the lower Boise River subbasin, just east of the watershed boundary.

Table 3. Proportion of land uses in the Willow Creek watershed, using 1992 data.

Land Use Type	Proportion of Total Estimated Land use	Proportion of Categorized Land Use
Unclassified/ Uncategorized	0	34
Rural Residential	2	0.4
Irrigated Crops	16	11
AFOs	0.09	0.07
Other Crops	1	0.7
Rangeland (grazing)	74	52
Agricultural Subtotal	**93**	**64**
Water/Wetland	0.7	0.5
Barren	0.02	0.01
Urban Residential	0.08	0.06
Commercial/ Industrial	0.4	0.4

Land Stewardship

Land stewardship in the Willow Creek watershed is primarily controlled by private interests with federal (Bureau of Land Management [BLM] and Bureau of Reclamation [BOR]) and state agencies managing the remainder of the watershed (Table 3 and Figure E). Almost all streamside land is privately owned and human development over the past 140 years has altered natural flow patterns and volume in perennial and intermittent streams; modified aquatic and riparian habitat; and disconnected the stream from the floodplain.

Table 4. Land stewardship in the Willow Creek watershed by total acres and proportion.

Stewardship Entity	Total Acres	Proportion by Acres
Private	44,962	82.8
Bureau of Land Management	7,903	14.5
State of Idaho	1,372	2.5
Bureau of Reclamation	20	0.04

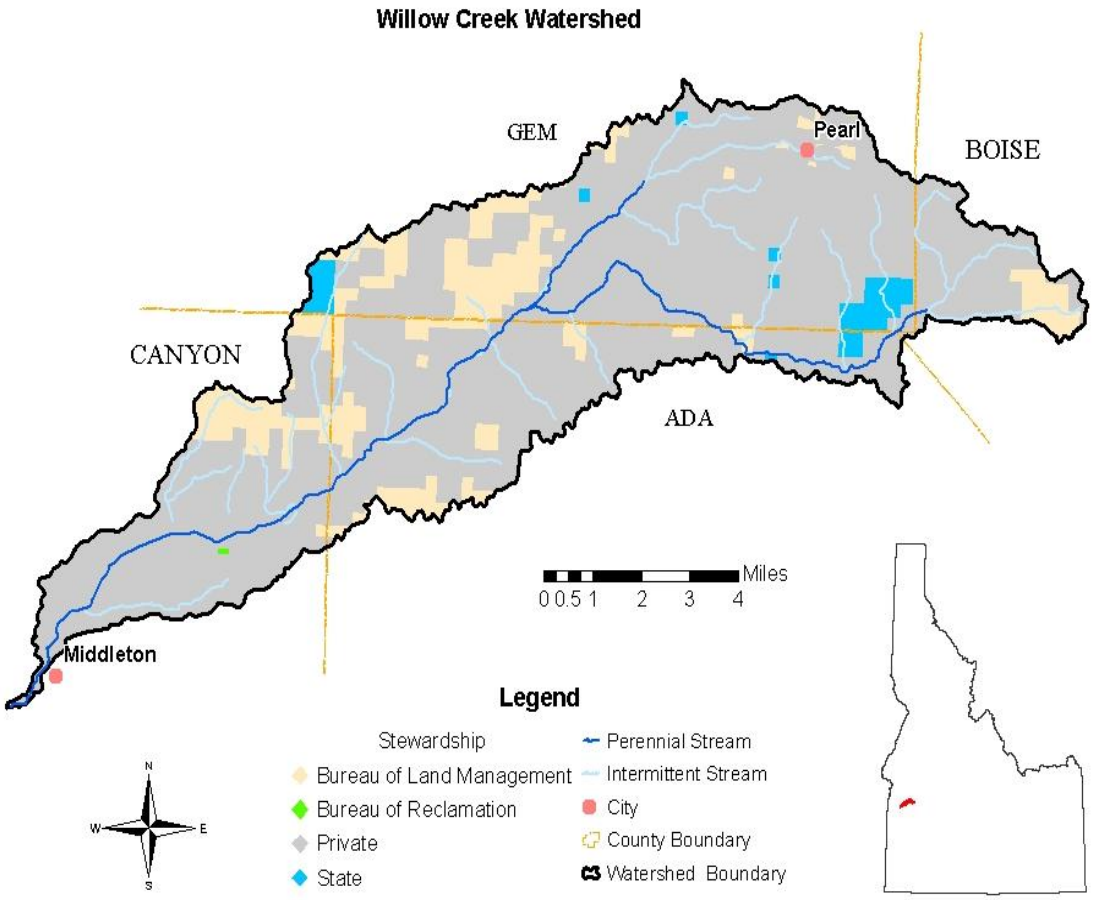

Figure E. Land stewardship categories in the Willow Creek watershed.

Constructed flow controls developed to facilitate irrigated agriculture and urban development are generally accompanied by increases in sediment and agricultural waste loads as irrigation districts construct drains and canals to terminate in or intersect natural streams. There are three irrigation companies that control surface water flows and operate irrigation systems in the Willow Creek watershed. Table 5 and Figure F summarize the acres and identify areas of operation for each irrigation company in the watershed.

Table 5. Acres of Willow Creek watershed served by irrigation companies.

Irrigation Company	Acres
Black Canyon Irrigation District	5,166.7
Middleton Irrigation Association	416.9
Canyon County Water Company, Ltd.	90.4

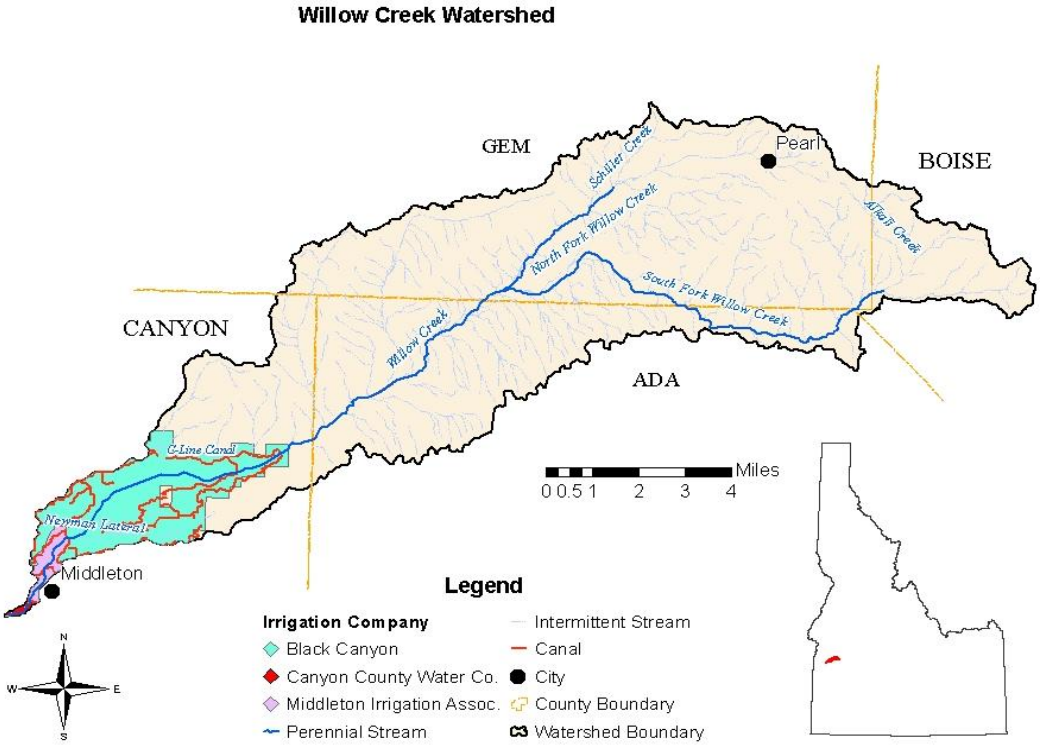

Figure F. Areas controlled by irrigation companies in the Willow Creek watershed.

Water Quality Standards and Impairments

TMDL

The goal of a TMDL is to restore beneficial use support to streams, lakes, and rivers. Idaho describes beneficial uses as existing, designated, or presumed. The beneficial uses that apply to Willow Creek are listed in Table 6.

Beneficial Uses

Idaho WQS require that surface waters of the state be protected for beneficial uses, wherever attainable (IDAPA 58.01.02.050.02). These beneficial uses are interpreted as existing uses, designated uses, and presumed uses as briefly described in the following paragraphs. The *Water Body Assessment Guidance*, second edition (Grafe et al. 2002) gives a more detailed description of beneficial use identification for use assessment purposes.

Existing Uses

Existing uses under the CWA are "those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards." The existing in-stream water uses and the level of water quality necessary to protect the uses shall be maintained and protected (IDAPA 58.01.02.050.02, .02.051.01, and .02.053). Existing uses include uses actually occurring, whether or not the level of quality to fully support the uses exists. A practical application of this concept would be to apply the existing use of salmonid spawning (SS) to a water that could support salmonid spawning, but salmonid spawning is not occurring due to other factors, such as dams blocking migration.

Designated Uses

Designated uses under the CWA are "those uses specified in water quality standards for each water body or segment, whether or not they are being attained." Designated uses are simply uses officially recognized by the state. In Idaho these include uses such as aquatic life support, recreation in and on the water, domestic water supply, and agricultural uses. Water quality must be sufficiently maintained to meet the most sensitive use. Designated uses may be added or removed using specific procedures provided for in state law, but the effect must not be to preclude protection of an existing higher quality use such as cold water aquatic life (COLD) or salmonid spawning. Designated uses are specifically listed for water bodies in Idaho in tables in the Idaho WQS (see IDAPA 58.01.02.003.27 and .02.109-.02.160 in addition to citations for existing uses).

Presumed Uses

In Idaho, most water bodies listed in the tables of designated uses in the WQS do not yet have specific use designations. These undesignated uses are to be designated. In the interim, and absent information on existing uses, DEQ presumes that most waters in the state will support cold water aquatic life and either primary or secondary contact recreation (IDAPA 58.01.02.101.01). To protect these so-called "presumed uses," DEQ will apply the numeric cold water criteria and primary or secondary contact recreation criteria to undesignated waters. If in addition to these presumed uses, an additional existing use, (e.g., salmonid spawning) exists, because of the requirement to protect levels of water quality for existing uses, then the additional numeric criteria for salmonid spawning would additionally apply (e.g., intergravel dissolved oxygen, temperature).

Table 6. Beneficial uses of §303(d) listed (2008) streams in the Willow Creek watershed.

Assessment Unit	Beneficial Uses	Listed Impairments (2008)
015_02	Presumed: COLD, PCR/SCR	Temperature, Combined Biota/Habitat Bioassessments
015_03	Presumed: COLD, PCR/SCR	Temperature, Combined Biota/Habitat Bioassessments

COLD – cold water aquatic life, PCR— primary contact recreation, SCR – secondary contact recreation

In determining beneficial use support, Idaho WQS allow for less weight to be given to departures from criteria that are brief or infrequent (< 10%) if habitat and biological data indicate that aquatic life beneficial uses (i.e. COLD) are otherwise supported. Based on the available data, elevated stream temperatures do not exceed Idaho WQS criteria for the presumed beneficial uses of Willow Creek and are not the cause for non-support of beneficial uses in Willow Creek.

As there is no water chemistry data available for AU 015_02 and cumulative habitat, observational, and biological data document that intermittent or ephemeral streams are the dominant stream type in this AU; it is reasonable to conclude that cold water aquatic life and recreation beneficial uses are not likely to be present in this AU and impairment status (by temperature or bacteria) is not supported by the available data. It is possible that sediment is transported to AU 015_03 from AU 015_02 in concentrations that impair beneficial uses, although there is no water quality data to confirm that concept. While AU 015_02 is not listed as impaired for sediment, DEQ determined that the AU is impaired by sediment and as such, AU 015_02 is included in the sediment TMDL and sediment load allocations (LAs) are developed for AU 015_02 in an effort to restore beneficial use support in AU 015_03.

Bacteria concentrations in AU 015_03 that exceed single-sample WQS criterion are documented multiple times from 2000 through 2009 and a bacteria TMDL is developed for AU 015_03.

Flow and habitat alteration are observable throughout both AUs, and pervasive in AU 015_03 (Figure B). This type of impairment is not conducive to quantification and will not be addressed in the TMDLs.

Table 7. Load allocations, lower Boise River 1999 TMDL (DEQ 1999) and 2008 addendum (DEQ 2008b).

Water Body Name	Boundaries	AU	Pollutants 1996 303(d) List	1996 Designated Uses	LAs in TMDL (1999)	LAs in TMDL Addendum (2008)
Willow Creek	Headwaters to Boise River	015	Unknown	CWB, SCR	Sediment-2.28 Tons/day-Bacteria- Fecal Coliform – PCR, 50 cfu/100mL; SCR, 200 cfu/100mL geomean	Bacteria- PCR, 406 cfu/100mL, geomean 126 cfu/100mL; SCR, 576 cfu/100mL, geomean 126 cfu/100mL

AU – assessment unit, CWB- Cold Water Biota, PCR-Primary Contact Recreation, SCR-Secondary Contact Recreation, cfu – colony forming units, mL – milliliters, geomean-geometric mean calculated according to Idaho water quality standards.

Table 8. Selected numeric criteria supportive of designated beneficial uses in Idaho water quality standards.

Designated, Presumed, and Existing Beneficial Uses			
Water Quality Parameter	**Primary Contact Recreation**	**Secondary Contact Recreation**	**Cold Water Aquatic Life**
Water Quality Standards: IDAPA 58.01.02.250			
Bacteria, ph, and Dissolved Oxygen (DO)	Less than 126 *E. coli*/100 ml[a] as a geometric mean of a minimum of five samples collected every three to seven days over 30 days; no sample greater than 406 *E. coli* organisms/100 ml.	Less than 126 *E. coli*/100 ml[a] as a geometric mean of a minimum of five samples collected every three to seven days over 30 days; no sample greater than 576 *E. coli*/100 ml.	pH between 6.5 and 9.0 DO[b] exceeds 6.0 mg/L[c] at all times.
Temperature[d]			22 °C or less daily maximum; 19 □°C or less daily average
Turbidity			Turbidity shall not exceed background by more than 50 NTU[e] instantaneously or more than 25 NTU for more than 10 consecutive days.
Ammonia			Ammonia not to exceed calculated concentration based on pH and temperature.

[a] *Escherichia coli* per 100 milliliters
[b] dissolved oxygen
[c] milligrams per liter
[d] Temperature Exemption - Exceeding the temperature criteria will not be considered a water quality standard violation when the air temperature exceeds the ninetieth percentile of the seven-day average daily maximum air temperature calculated in yearly series over the historic record measured at the nearest weather reporting station.
[e] Nephelometric turbidity units