Willow Creek Subbasin Assessment and TMDLs

Department of Environmental Quality

May 18, 2004

5. Total Maximum Daily Load(s)

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 waste load allocation (WLA); and nonpoint sources, which receive a load allocation (LA). Natural background (NB), when present, is considered part of the load allocation, 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 130) require a margin of safety (MOS) be a part of the TMDL.

Practically, the MOS 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 LC is determined. Then the LC is broken down into its components: the necessary MOS is determined and subtracted; then NB, if relevant, is quantified and subtracted; and then the remainder is allocated among pollutant sources. When the breakdown and allocation is completed, we have a TMDL, which must equal the LC.

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. Also a required part of the loading analysis is that the LC 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 LC 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 Instream Water Quality Targets

The goal of the TMDL is to restore "full support of designated beneficial uses" on all 303(d) listed streams within the Willow Creek Subbasin. Water quality pollutants of concern for which a TMDL will be written are sediment, temperature, and nutrients. A TMDL will not be written for streams listed with flow alteration as a pollutant since the EPA does not believe that flow (or lack of flow) is a pollutant as defined by CWA Section 502(6). The objective of this TMDL is to establish a declining trend in pollutant loading and to regularly monitor the pollutant load and beneficial use support. Pollutant reductions may be attained, in part, by improving canopy cover, vegetative buffers, and decreasing stream width/depth ratios along streambanks.

Design Conditions

To quantify the seasonal and annual variability and critical timing of sediment loading, climate and hydrology must be considered. This sediment analysis characterizes sediment loads using average annual rates determined from empirical characteristics that developed over time within the influence of peak and base flow conditions. Annual erosion and sediment delivery are functions of a climate where wet water years typically produce the highest sediment loads. Additionally, the annual average sediment load is not distributed equally throughout the year. Erosion typically occurs during a few critical months.

The temperature critical time periods for salmonid spawning in the Willow Creek Subbasin are identified as May 1st through June 30th (Schrader 2003) for rainbow trout and Yellowstone cutthroat trout; and September 15th through November 15th for brook trout and brown trout.

Nutrient loading rates are calculated from a flow-based perspective to account for the seasonal variability associated with streamflow on Willow Creek.

Target Selection

TMDL target selection addresses temperature, sediment, and nutrient values, which are discussed in the following:

Temperature

Temperature TMDL criteria is based on Idaho's existing numeric criteria for salmonid spawning. Instream targets shall be less than the instantaneous temperature (13°C) and the maximum daily average temperature shall be below 9°C during salmonid spawning periods.

Sediment

Target selection of sediment is dependent on existing narrative criteria of [IDAPA 58.01.02.200.08].

Sediment targets for this subbasin are based on streambank erosion quantitative allocations in tons/mile/year. The reduction in streambank erosion prescribed in this TMDL is directly linked to the improvement of riparian vegetation density to armor streambanks thereby reducing lateral recession, trapping sediment and reducing stream energy, which in turn reduces stream erosivity and instream sediment loading. It is assumed that by reducing chronic sediment, there will be a decrease in subsurface fine sediment that will ultimately improve the status of beneficial uses.

It is assumed that natural background sediment loading rates from bank erosion equate to 80% bank stability as described in Overton and others (1995), where banks are expressed as a percentage of the total estimated bank length. Natural condition streambank stability potential is generally 80% or greater for Rosgen A, B, and C channel types in plutonic, volcanic, metamorphic, and sedimentary geology types. Therefore, an 80% bank stability target based on streambank erosion inventories shall be the target for sediment.

Surface erosion from unimproved/unsurfaced roads does on not occur naturally, therefore it is known that natural background sediment loading rates from road impacts are 0%. A target of 50% of the current loading has been established based on a reasonable expectation from best management practice (BMP) implementation.

Unnatural streambed sediment size composition can directly impair spawning success, egg survival to emergence, rearing habitat, and fish escapement from stream. It is necessary to reduce the component of subsurface fine sediment less than 6.35 mm to below 28% of total subsurface sediment. This sediment particle size parameter should be considered as part of target monitoring to evaluate any significant shift in subsurface fine particle frequency distribution.

Nutrients

The target selection for nutrients is dependent on the existing narrative criteria of [IDAPA 58.01.02.200.06].

Both nitrogen and phosphorous reach surface waters at an elevated rate as a result of human activities and it is known that elevated levels of nutrients lead to biological nuisances and eutrophication, both of which impair insect and fish survival. The nitrogen and phosphorus targets established for this TMDL are numeric indicators that have been chosen for the attainment of beneficial uses.

Nutrient targets for this TMDL are based on EPA literature values of 0.05 mg/L total phosphorus (TP) and 0.3 mg/L nitrate + nitrite nitrogen (NO_2+NO_3).

Monitoring Points

Monitoring points for this TDML address subsurface sediment, streambank stability, nutrient, and temperature monitoring, all of which are discussed in the following.

Subsurface Sediment

Subsurface sediment substrate monitoring points shall occur in habitat determined suitable for salmonid spawning within listed stream segments using the McNeil core sediment sampling method. The amount of habitat suitable for salmonid spawning will increase after the implementation of management practices identified to reduce fine sediment.

Streambank Stability

Streambank erosion inventories/assessments shall occur on sediment-impaired streams to evaluate overall bank stability.

Temperature Monitoring

Stream temperatures will be monitored with an instream temperature logger in previously established monitoring sites to maintain consistency.

Nutrient Monitoring

Water column nutrients will be monitored in previously established monitoring sites as well as a new downstream site (near the reservoir) to reflect the downstream end of the listed segment, as well as critical reaches upstream. Continued grab sampling in established monitoring sites also helps maintain consistency. Nutrient grab samples will be collected in accordance with methodologies that yield the most accurate representation of water column nutrient levels.

5.2 Load Capacity

A load capacity is “the greatest loading a waterbody can receive without violating water quality standards” [40 CFR §130.2]. This must be at a level to meet “...water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge...” (Clean Water Act § 303(d)(C)). Likely sources of uncertainty include lack of knowledge of assimilative capacity, uncertain relation of selected target(s) to beneficial use(s), and variability in target measurement.

Load capacities are defined for sediment, temperature, and nutrients as discussed in the following.

Sediment

The load capacity for sediment from streambank erosion shall be based on assumed natural streambank stabilities of greater than or equal to 80% (Overton et al 1995). Because it is presumed that beneficial uses were or would be supported at natural background sediment loading rates, the loading capacity lies somewhere between the current loading level and sediment loading from natural streambank erosion.

- Natural background loading rates are not necessarily the loading capacities. An adaptive management approach will be used to provide reductions in sediment loading based on best management practice (BMP) usage coupled with data collection and monitoring to determine the loading point at which beneficial uses are supported.

- The estimated capacity is directly related to the improvement of riparian vegetation density and structure as well as maintenance of roads and stream crossings. Increased vegetative cover provides a protective covering of streambanks, reduces lateral recession, traps sediment, and reduces erosive energy of the stream.

There is a large degree of uncertainty as to the percentage of sediment loading available before beneficial uses are no longer supported. It is difficult to determine a road erosion target where beneficial uses are supported. Because it is presumed that beneficial uses were or would be supported at natural background sediment loading rates, the loading capacity lies somewhere between the current loading level and sediment loading from natural erosion. The loading capacity for sediment from road erosion shall be an average annual load based on the assumption that BMP improvements will reduce sedimentation to an acceptable level. It is reasonable to suggest that beneficial use support may be obtained at a loading capacity of one half (50%) the current erosion rate.

Temperature

The loading capacities for streams listed for temperature, are based on Idaho's temperature criteria for salmonid spawning. Water temperatures shall be less than the instantaneous temperature [13°C (55.4°F)] and the maximum daily average temperature shall be below 9°C (48.2°F) during salmonid spawning periods. Factors considered in this load capacity value include the following:

- All streams are considered salmonid spawning streams because either salmonids have been observed in the stream or it is a tributary of a major salmonid spawning stream and is potentially spawning ground. Additionally, all streams are considered coldwater aquatic life streams and additional criteria apply during the summer months.

- The loading capacity is season specific and should only apply to salmonid spawning areas.

- The use of the highest recorded temperature rather than the average maximum temperature to compare to the criterion provides an implicit margin of safety over all of the cooler years when temperatures would not be so high.

Nutrients

An average annual load may paint an unrealistic picture in a stream with a wide range in flow regimes. Therefore, loading capacity, current loads and associated load allocations will be visualized from a flow-based perspective. Loading capacity was calculated for TP (Figure 28) and nitrogen as NO2+NO3 (Figure 29) using the target concentrations and flows ranging

from one to 2,500 cfs. Flow ranges are based on maximum and minimum streamflows recorded on Willow Creek at station #13057940, below Tex Creek, as discussed in section 2.3 of the Subbasin Assessment.

The loading capacity is calculated in pounds per day based on flow. Figures 28 and 29 show the linear rate of nutrient loading, at target level, based on streamflow. The regression lines illustrate the loading capacity for nitrate + nitrite nitrogen and total phosphorus.

- The loading capacity is calculated from the target concentration based on flow.
- The loading capacity assumes no change in the target concentration as a result of season or location.

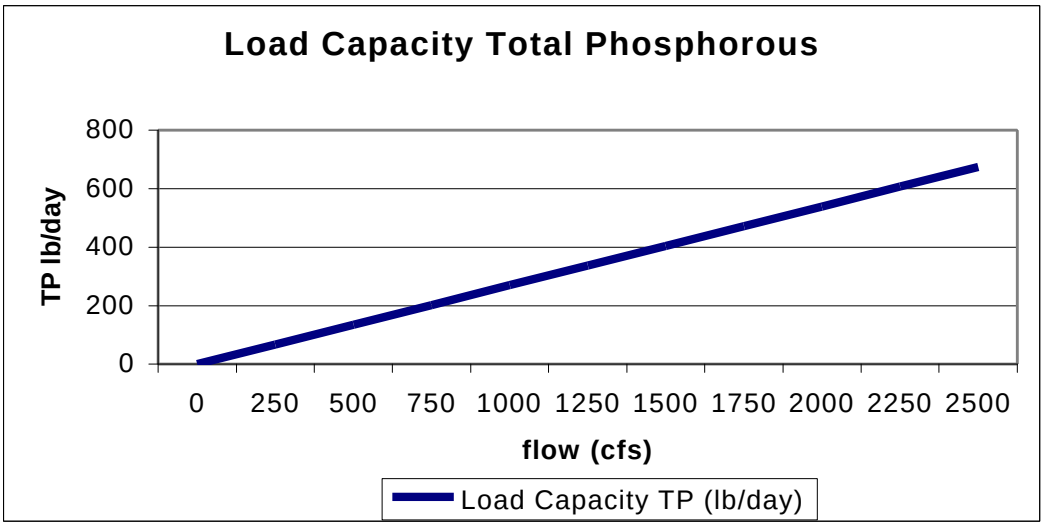

Figure 28. Total Phosphorus Load Capacity for Willow Creek

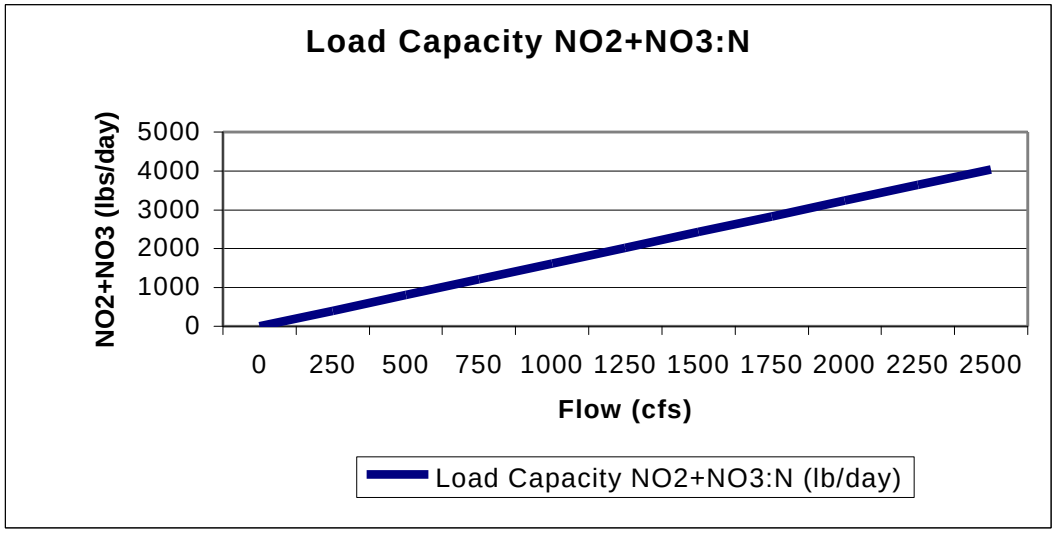

Figure 29. Nitrogen Load Capacity for Willow Creek

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 sub-watershed), 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.

Estimated existing pollutant loads for streambank sediment are based on streambank erosion inventories conducted by MSE and DEQ in 2001 and 2003 respectively. Current sediment loading-rates for streams in the Willow Creek Subbasin are quantitatively estimated in tons/mile/year, as shown in Table 43.

Sediment loading from unimproved/unsurfaced roads adjacent to (within 50 m) 303(d) listed waters was estimated using numerical values from the Forest Service Interface for the Water Erosion Prediction Project Model (WEPP). The model provided a quick evaluation of erosion and sediment delivery from unsurfaced roads. Model input parameters are climate, soil, road surface condition, road and buffer topographic features (slope and length), road design, road width, and the presence of gravel. The model estimates (output) quantity of sediment delivered from the buffer to the stream and amount of sediment leaving the eroding portion of the road. These two output parameters combined give the total quantity of sediment delivered to the stream annually. (USDA 2003) Table 43 shows the calculated current sediment loading from road erosion on Meadow and Tex Creeks.

Temperature loads are determined by using the maximum daily and maximum daily average temperatures recorded in the spring and fall spawning periods. Table 44 shows current loads determined for temperature.

Phosphorus and nitrogen loads entering the system are determined based on all of the monitoring data (sites lumped) collected during 2003 (Appendix F). Loads are calculated in lb/day based on analytical results (mg/L) and streamflow data (cfs) at the time of collection.

5.4 Load Allocation

Wasteload Allocation

Because there are no point source discharges in the Willow Creek Subbasin, there are no wasteload allocations (WLA) in the TMDL.

Load Allocation

For the Willow Creek Subbasin, sediment, temperature, and nutrient load allocations have been developed, as shown on tables 43 through 44. The load allocation is the amount of loading capacity allocated to a given source without exceeding water quality criteria.

The sediment load allocations for the Willow Creek Subbasin are developed from streambank erosion inventories and WEPP road erosion modeling. On Tex and Meadow Creeks, road sediment loads have been added to the streambank sediment loads to develop the total load allocation(s).

Table 43. Sediment load allocations for Willow Creek Subbasin.

Stream		CURRENT LOAD Existing Erosion Rate (t/mi/yr)	LOAD CAPACITY Erosion Rate (t/mi/yr)	LOAD ALLOCATION Total Erosion Rate Reduction (t/mi/yr)	Total Erosion % Reduction to Meet Load Capacity
Mill Creek		26	8	-18	68
Sellars Creek		304	11	-293	96
Brockman Creek		384	25	-359	93
Tex Creek		8	4	-4	50
Corral Creek		226	18	-208	92
Sawmill Creek		340	19	-321	94
Crane Creek		172	25	-147	86
Hell Creek		402	39	-363	90
Homer Creek		411	20	-391	95
Lava Creek		537	16	-521	97
Willow Creek		213	14	-199	93
Seventy Creek		288	11	-277	96
Meadow Creek	Bank	49	20	-29	59
	Road	11	6	-5	45
	Total	60	26	-34	57

Since cutthroat trout is perhaps the species of most concern and its spawning phase the most critical period, spring spawning will be the focus of the needed reductions in temperature.

Table 44. Temperature load allocations for Willow Creek Subbasin.

Stream	Temperature Statistic	CURRENT LOAD Highest Recorded Temperature	LOAD CAPACITY Criteria	LOAD ALLOCATION Temperature reduction	% Reduction to meet load capacity
Corral Creek	Max Daily	22.39°C	13°C	-9.39°C	42%
	Daily Ave	21.95°C	9°C	-12.95°C	59%
Homer Creek	Max Daily	26.42°C	13°C	-13.42°C	51%
	Daily Ave	18.79°C	9°C	-9.79°C	52%
Hell Creek	Max Daily	19.51°C	13°C	-6.51°C	33%
	Daily Ave	17.41°C	9°C	-8.41°C	48%
Tex Creek	Max Daily	24.19°C	13°C	-11.19°C	46%
	Daily Ave	17.96C	9°C	-8.96°C	50%
Sawmill Creek	Max Daily	20.9°C	13°C	-7.9°C	38%
	Daily Ave	18.11°C	9°C	-9.11°C	50%
Grays Lake Outlet (Homer Creek to mouth)	Max Daily	28.34°C	13°C	-15.34°C	54%
	Daily Ave	21.58°C	9°C	-12.58°C	58%
Grays Lake Outlet (Outlet to Homer Creek)	Max Daily	28.34°C	13°C	-15.34°C	54%
	Daily Ave	21.58°C	9°C	-12.58°C	58%
Brockman Creek	Max Daily	19.70°C	13°C	-6.70°C	34%
	Daily Ave	17.84°C	9°C	-8.84°C	50%
Rock Creek	Max Daily	24.54°C	13°C	-11.54°C	47%
	Daily Ave	21.97°C	9°C	-12.97°C	60%
Willow Creek (Headwaters to Ririe Reservoir)	Max Daily	24.54°C	13°C	-11.54°C	47%
	Daily Ave	21.97°C	9°C	-12.97°C	60%
Sellars Creek	Max Daily	26.7°C	13°C	-13.7°C	51%
	Daily Ave	18.51°C	9°C	-9.51°C	51%
Mill Creek	Max Daily	24°C	13°C	-11°C	46%
	Daily Ave	18.2°C	9°C	-9.2°C	51%
Lava Creek	Max Daily	22.8°C	13°C	-9.8°C	43%
	Daily Ave	18.44°C	9°C	-9.44°C	51%

All load allocations are dedicated to nonpoint sources as whole. No attempt was made to divide the allocation amongst different nonpoint source activities. Nutrient load allocations were developed based on the highest current loading and the loading capacity at the loadings measured discharge (Table 45). The highest TP current load was 13 lb/day at 41 cfs. The loading capacity at 41 cfs would be 11 lb/day. To account for uncertainties, an additional 10% reduction for a margin of safety (MOS) is calculated into the target (load allocation) so, the target load becomes 10 lb/day (10% reduction in 11 lb/day load capacity). The difference between the current load and the target load (10% MOS) becomes the load allocation: -3

lb/day TP or a 23% reduction. The same procedure computed the nitrogen load allocation for Willow Creek.

Table 45. Nutrient load allocations for Willow Creek.

Parameter	Highest Current Load (lb/day)	Flow (cfs)	Load Capacity (lb/day)	Load Capacity (lb/day) with 10% MOS	Load Allocation (lb/day)	% Reduction to Meet Load Capacity
TP	13	41	11	10	-3	23%
N	48	11	18	16	-32	67%

Brockman Creek

Over utilization of the land on Brockman Creek has contributed to active downcutting, creating a stream that is highly entrenched. In 2001 and 2003, streambank erosion inventories were conducted showing bank stabilities ranging from 79% in the upper reaches to 44% in the lower section. Additionally, rigorous grazing occurs along Shirley Creek, contained in the Brockman Creek Assessment Unit (AU); the load allocation for Brockman Creek also applies to Shirley Creek.

Brockman Creek is not listed for temperature, however USFS thermograph data show that stream temperatures exceed Idaho's salmonid spawning criteria. The temperature data collection point is at the forest boundary, upstream of Corral Creek. Although late season, dry stream conditions existed during 2001-2003, nevertheless, historically Brockman Creek has historically maintained flows throughout the summer and into the fall. In order to protect beneficial use support, temperature load allocations are necessary for Brockman Creek (four AUs). The maximum daily temperature recorded from both thermographs is 19.7°C, and the maximum daily average temperature is 17.84°C. A 34% and 50% temperature reduction is necessary to meet the criteria.

The presence of geothermal springs on Brockman Creek has not been documented through analytical data however, some say that there are geothermal springs on Brockman Creek near the Brockman Creek/Dan Creek intersection and on Idaho Endowment Land just upstream from this intersection. With the possible presence of geothermal springs on Brockman Creek, it becomes even more important to protect riparian vegetation since Brockman Creek has two documented salmonid spawning tributaries, Sawmill and Corral Creek.

Corral Creek

Stream temperature data was recorded on Corral Creek (SK026_02) at the mouth in 2000 and 2002. Year 2000 stream temperature data is available from 07/07/00 through 09/27/00, allowing for evaluation of a portion of the fall spawning period (September 15th through November 15th) in 2000. Temperature logger data from 2002 (06/20/02 through 09/10/03) allows for the evaluation of spring spawning temperatures (May 1st through June 30th). The spring and fall spawning times that were recorded occurred during the critical timeframe where temperatures are expected to be the highest: the last 22 days of spring spawning and the first 22 days of fall spawning (DEQ 2002). If the partial data record includes the critical

period, it can be inferred that the frequency of temperature exceedances still remains greater than 10%. A 42% reduction in maximum daily temperatures is prescribed in the TMDL.

Road erosion and grazing are the primary sources of beneficial use impairment on Corral Creek. In the fall of 2001, a streambank erosion inventory was conducted on Corral Creek, showing bank erosion at approximately 63%. A 92% reduction in total erosion is prescribed in the TMDL.

Crane Creek

Streambank erosion inventories conducted in the fall of 2001 showed bank stabilities of 67% and 56% in upper and lower reaches, respectively. Topographically some portions of Crane Creek (lower) are in steep walled canyons. The confining nature of the canyon limits the land use and bank stabilities are somewhat higher. The current estimated erosion rate is 172 tons/mile/year. A sediment-loading rate of 25 tons/mile/year is recommended to guarantee beneficial use support.

Grays Lake Outlet

Grays Lake Outlet is temperature listed from headwaters to mouth. Three temperature loggers were placed in the stream by IDFG in 2001. Two loggers were placed near the Homer Creek confluence, with the other logger at the mouth. In all cases, there were exceedances in spawning temperature criteria. Spring spawning temperatures were not recorded at the mouth in 2001, however, spring temperature readings were evaluated at the Homer Creek confluence and the load allocation has been developed for the mouth based on the readings further upstream. Where two data sets exist (above Homer Creek confluence), the highest value for daily maximum and average daily temperatures from both data sets was used for the development of the load allocation. Reductions of 54% and 58% in maximum and average daily temperatures in Grays Lake Outlet are required to meet the temperature loading capacity.

Sediment and nutrients are listed pollutants above the falls on Grays Lake Outlet. Water from Grays Lake is allocated for irrigation, and discharge from Grays Lake to the outlet is seriously limited. Streamflows gradually increase further downstream from groundwater recharge and tributary influences. However, a nutrient TMDL will not be written for this section of Grays Lake Outlet because streamflows are anthropogenically limited and it is nearly impossible to control or regulate the nutrient concentrations of the Grays Lake wetland waters.

A sediment TMDL is also not necessary because the flow altered state of this reach prohibits sediment transport and the falls serve as a fish barrier, hence a fishery cannot be supported in this reach of Grays Lake Outlet.

Grays Lake Outlet, below the falls is not listed for sediment, however, streambed sampling in Fall 2003 show 44% sediment fines in salmonid spawning gravels and bank erosivities

around 45% (Homer Creek confluence). Improved land management is necessary to reduce the known sediment impacts in selected areas of the stream.

Hell Creek

Continuous riparian habitat destruction is the primary cause of beneficial use impairment in the drainage. Hell and Dan Creeks are unable to support coldwater aquatic life and salmonid spawning. Hell Creek is 303(d) listed for nutrients and sediment. Nutrient data collected on Grays Lake Outlet, at the Hell Creek confluence is below established criteria, and field observations show that sediment is the limiting factor where beneficial use support attainment is concerned

With regards to sediment, streambank erosion inventories conducted on Hell Creek in 2001 show bank stabilities less than the 80% target with a current estimated erosion rate of 402 tons/mile/year. The load allocation prescribes a sediment-loading rate of 39 tons/mile/year.

Hell Creek is not 303(d) listed for temperature, however, stream temperature data collected by IDFG in 2001 show that temperatures exceeded spring salmonid spawning criteria. Daily maximum stream temperatures were within temperature criterion at the IDFG site in 2001, however, 27% of the time, daily average temperatures were above 13°C.

Homer Creek

Homer Creek is not 303(d) listed for temperature, however, stream temperature data collected at the mouth in 2001 show major exceedances in salmonid spawning temperature criteria (spring and fall). There is an incomplete data set for both the spring and fall spawning period, however, the critical periods are present and according to DEQ policy, it can be inferred that the exceedances in temperature would still be greater than 10%. Stream temperature data on upper Homer Creek showed that spring stream temperatures were above salmonid spawning criteria prior to dry stream conditions in late July.

Streambank erosion is evident on banks along all of Homer Creek. Upper portions of Homer Creek are sparsely vegetated, with grazing the principal land use. On lower Homer Creek, vegetative cover averages around 50%. Riparian impacts are evident with bank stabilities unable to meet the 80% stability target. A 95% reduction in the sediment-loading rate is recommended for beneficial use support.

Lava Creek

Stream temperature data collected at the Dan Creek Road crossing reveal temperature exceedances of 85% (instantaneous) and 91% (average) during the spring spawning. The load allocation for maximum and average daily temperatures is –9.8°C and –9.44°C, respectively. It is expected that stream temperatures will improve with riparian zone enhancement. A culvert on upper Lava Creek continuously exists in a state that inhibits downstream flow. It is speculated that beaver activity combined with anthropogenic actions

continue to create this condition. Eliminating the anthropogenic cause of this condition and clearing the obstruction will assist in improving stream temperatures.

Streambank erosion inventories, conducted in 2001 and 2003, show bank stabilities of 24% at the upper inventory site and 55% at the lower inventory site. Current estimated sediment loading is 537 tons/mile/year. The load allocation calls for a sediment-loading rate of 16 tons/mile/year.

Meadow Creek

Grazing in the upper reaches and road erosion in the lower sections principally influence sedimentation in Meadow Creek. The load allocations for this TMDL were developed via erosion inventories and road erosion modeling. From headwaters to South Fork Meadow Creek, streambank stabilities exceed the 80% target; this target was achieved due to cessation and/or rotation of grazing practices in the vicinity.

Mill Creek

The land surrounding Mill Creek is privately and state owned with grazing as the principal land use. Monitoring and observations show that the largest impacts on the creek are in the middle and lower reaches where land utilization is maximized. Riparian fencing in the upper reaches have improved the riparian zone and thereby reduced streambank erosion. Substrate samples collected on Mill Creek, above the Willow Creek confluence, showed the presence of 43% fine sediment in spawning gravels. Streambank erosion inventories show the highest concentration of sedimentation occurring in the middle section of Mill Creek, above the Blackfoot Reservoir Road crossing. A 68% reduction in the erosion rate is recommended for Mill Creek. The 68% reduction in sediment loading applies to Buck Creek, also 303(d) listed, since it is located in the Mill Creek assessment unit.

To evaluate stream temperatures, a temperature logger was placed at the Blackfoot Reservoir Road crossing. Major temperature exceedances occurred during the fall and spring spawning periods. A 51% reduction in the average daily temperature is recommended in this TMDL.

Sawmill Creek

Sawmill Creek is 303(d) listed for temperature and sediment. Stream temperature data collected in 2003 documented major exceedances in the salmonid spawning criteria. A 38% reduction in maximum daily temperatures is warranted for salmonid spawning success. Streambanks evaluated with erosion inventories had bank stabilities around 29%, so a 94% load reduction is necessary for beneficial use attainment.

Sellars Creek

Riparian road impacts, riparian grazing, and flow alteration are the three principal causes of perturbation on Sellars Creek. Based on field observations, riparian grazing is the greatest source of sedimentation in the subbasin. According to IDFG, Sellars Creek is one of the

most important spawning tributaries in the subbasin. Recent sampling shows greater than 28% subsurface fines in spawning habitat on Sellars Creek. Streambank erosion inventories were conducted on upper Sellars Creek, just below the South Fork confluence, and middle Sellars Creek, below the Ririe Reservoir Road crossing. Streambank erosion on lower Sellars Creek, below Long Valley Road crossing, is nominal due to limited grazing. The current estimated erosion rate on Sellars Creek is 304 tons/mile/year. The load capacity is 11 tons/mile/year, so an erosion rate reduction of 293 tons/mile/year is prescribed in the TMDL.

Temperature loggers were placed in upper Sellars Creek (above South Fork Confluence) and in South Fork Sellars Creek (mouth) from 05/28/01 through 10/04/01. Spring temperatures through the salmonid spawning (May 1st though June 30th) period exceeded spawning criteria 65% and 85% of the time. Exceedances in fall spawning criteria occurred on South Fork Sellars Creek. In 2003, DEQ placed a temperature sensor at the Blackfoot Reservoir Road crossing from 05/07/03 through 10/26/03. Major exceedances of spring and fall spawning were documented at this location. The temperature TMDL is based on the readings at the Blackfoot Reservoir road because this is the lowermost temperature logger site, and temperatures at this location are higher than those at the upper sites.

Sellars Creek is impaired due to a lack of flow; however, EPA does not believe that flow (or lack of flow) is a pollutant as defined by CWA Section 502(6). Since TMDLs are not required to be established for waterbodies impaired by pollution but not pollutants, a TMDL has not been established for Sellars Creek for flow.

Seventy Creek

Seventy Creek (SK011_02) is 303(d) listed for temperature, sediment, and flow alteration. Currently there is no temperature data available to prove that the stream is temperature impaired. It is assumed that any temperature impairment from sedimentation will improve with riparian zone rehabilitation.

Streambank erosion inventories show banks on Seventy Creek, above the Blackfoot Reservoir Road, are relatively stable whereas, in the lower reaches, bank stabilities are as low as 39%. Sediment loading to Seventy Creek should not exceed 11 tons/mile/year.

Upper Seventy Creek is flow altered, however, EPA does not believe that flow (or lack of flow) is a pollutant as defined by CWA Section 502(6). Since TMDLs are not required to be established for waterbodies impaired by pollution but not pollutants, a TMDL has not been established for Seventy Creek for flow.

Tex Creek

Tex Creek contains the AUs SK031_02 and _03, with _02 encompassing several unnamed tributaries, Indian Fork Creek, and Pipe Creek and _03 being Tex Creek, mainstem to Bulls Fork. Tex Creek is not listed for temperature however, stream temperature data show that there were elevated spawning temperatures in Tex Creek just below the Pipe Creek

confluence (approximately 1.7 stream miles above Bulls Fork). Temperature load allocations are necessary to protect beneficial use support.

Sediment impacts on Tex Creek have not been quantified through McNeil subsurface sediment sampling. Extremely dry conditions over recent years have prohibited the proper identification of salmonid spawning habitat. It is known that the Tex Creek fishery has trended downwards for, at a minimum, the past decade. It is presumed that the decline is due to high sedimentation in the stream. A sediment TMDL is necessary for Tex Creek. The load allocation was developed based on road erosion modeling because road impacts are the primary source of sedimentation loading in Tex Creek.

Willow Creek

Willow Creek is 303(d) listed for temperature above and below the reservoir. A temperature logger placed at Kepp's Crossing captured an entire season of data. Thermograph data show that stream temperatures at Kepp's Crossing are above salmonid spawning criteria. Recorded maximum daily temperatures are 24.54°C during spring spawning and 18.72°C during fall spawning.

Willow Creek, below the reservoir dam to Eagle Rock Canal, is listed for temperature and sediment. Temperature regimes below the reservoir are controlled by the Reservoir outlet structures, located well below the surface, stratified as the hypolimnion layer of lake. It is known that waters discharged from the hypolimnion meet Idaho's temperature criterion for cold water aquatic life. However, a temperature TMDL will not be written for this section of Willow Creek because flow from the Ririe Reservoir dam is reduced to zero discharge for four to five months of the year. According to IDFG, a viable fishery does not exist below the reservoir (Fredericks 2003). Salmonid spawning cannot occur here and the only fish present are entrained, meaning they "slipped" through the outlet structures. Streambank stabilities meet the 80% stability target, however, flow is the limiting factor for beneficial use support below the Ririe Reservoir, and therefore a sediment TMDL is not necessary.

Stream characteristics are different on Willow Creek, above the reservoir. Streambed sampling indicates that sediment impacts are present in the spawning gravels at Grays Lake Outlet and Kepp's Crossing. In both instances, 31% subsurface fines were observed. Streambank stabilities are less than 80% in most areas above Grays Lake Outlet with stabilities meeting the target in the steep walled canyons below the confluence with Grays Lake Outlet. The estimated erosion rate from streambank erosion is 213 tons/mile/year. The TMDL prescribes a sediment-loading rate of 14 tons/mile/year.

Ririe Reservoir is 303(d) listed for sediment. A TMDL will not be developed for Ririe Reservoir because the upstream sediment TMDLs will help to reduce sediment input into the reservoir.

Willow Creek is not listed for nutrients however, stream water quality monitoring data show that nutrient levels are above the EPA recommended criteria for nitrate + nitrite nitrogen and total phosphorus. The EPA criteria is based on use attainment standards that are applicable

when identifying levels of nitrogen and phosphorus where deleterious levels of aquatic plant growths occur. Along with the elevated nutrient levels, dissolved oxygen (DO) levels on Willow Creek are nearing the acute toxicity level for salmonids, and nuisance levels of plant growth in the stream were observed. Based on water quality data and field observations, nutrient TMDLs for nitrogen and phosphorus are warranted to protect and restore aquatic life in Willow Creek.

The Willow Creek TMDL is also important because it is protective of water quality in the Ririe Reservoir. Monitoring data show that TP levels in the reservoir, on several occasions are above the EPA recommended criteria of 0.025 mg/L for reservoirs. DO levels are at or near the state criteria of 6 mg/L [IDAPA 58.01.02.250.02.a] in waters above the hypolimnic layer of in the reservoir. A reduction in nutrient and sediment loading to the Ririe Reservoir will slow the process of eutrophication and thereby help preserve the reservoir's aesthetic, biological, and recreational values.

Rock Creek

Rock Creek (SK005_02), a tributary of Willow Creek is 303(d) listed for temperature. Temperature data for Rock Creek itself does not exist. However, temperature data is available just downstream of Rock Creek, on Willow Creek at Kepp's Crossing. For the purpose of this TMDL, and the assessment unit reporting system, Rock Creek will receive the same load allocation as Willow Creek proper.

Margin of Safety

The margin of safety (MOS) factored into sediment load allocations is implicit. The MOS includes the conservative assumptions used to develop existing sediment loads. Conservative assumptions made as part of the sediment loading analysis include the following:
Desired bank erosion rates are representative of assumed natural background conditions.
Water quality targets for percent depth fines are consistent with values measured and are set by local land management agencies based on established literature values, incorporating an adequate level of fry survival to provide for stable salmonid production.

With temperature TMDLs, the MOS is implicit by virtue of the following:
Use of the highest recorded temperature as existing load rather than an average high temperature for all sampling years.
The temperatures used were measured during warmer-than-average years. The loading capacity is season specific and should only apply to salmonid spawning areas, however, in flowing streams, temperatures above salmonid spawning areas can influence temperatures downstream.

With nutrient TMDLs, the MOS is explicit. A 10% MOS was used to reduce the available loading capacity in the Willow Creek nutrient TMDL.

Seasonal Variation

Seasonal variability was built-in to this TMDL by developing sediment loads using annual average rates determined from empirical characteristics that developed over time within the influence of runoff events and peak and base flow conditions. Streambank erosion inventories take into account that most bank recession occurs during peak flow events, when the banks are saturated. The estimated annual average sediment delivery is a function of bankfull discharge. It is assumed that the accumulation of sediment within dry channels is continuous until flow resumes and the accumulated sediment is transported and deposited.

Seasonal variability was incorporated into road sediment loads using annual average rates thereby incorporating all yearly climatic and hydrologic events. The WEPP evaluates annual sediment potential from a 30-year climatic record.

Seasonal variability was integrated into temperature TMDLs by taking into account the critical timeframes associated with salmonid reproduction.

There is substantial seasonal variation in flow and this variation was taken into account by visualizing the loading on a flow rate basis. All available sampling data represent low flow conditions, and no information is available on the behavior of nutrient loading at peak flows. If loading trends remain the same at higher flows, then the percent reduction remains the same, but actual loads will be higher at peak flows. The critical time period to control the most loading will be during the peak runoff.

Background

Natural background loading rates are assumed to be the natural sediment loading capacity of 80% or greater streambank stability and 28% or less subsurface fine sediment. Therefore natural background is accounted for in the load capacity. Where road erosion is concerned, natural background loading rates are 0%.

Natural background conditions for temperature can exceed the criteria, however natural temperature regimes in the Willow Creek Subbasin have not been isolated.

For nutrients, the load allocation includes that which would be produced naturally. However, with nutrients, some of the N and P load capacity belongs to background sources, but their quantity is unknown.

Reserve

If uses are supported at load levels different than those specified in the TMDL, then there may be some reserve capacity to adjust the TMDL loads.

5.5 Implementation Strategies

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

Several designated land management agencies are involved where watershed implementation is concerned. The largest portion of the watershed is a mosaic of private and state land. IDL and IASCD will provide implementation strategies for riparian management for the areas that fall under their realm of jurisdiction. A much smaller portion of the watershed is made up of BLM and USFS land, both of which are responsible for developing an implementation plan.

Approach

It is anticipated that by improving riparian management practices, overall riparian zone recovery will precipitate streambank stabilization, reduce sedimentation, increase canopy cover, and lower stream temperatures, all of which will precipitate overall stream habitat improvements. Such improvements will contribute to an overall improvement in stream morphology and habitat, shifting stream health towards beneficial use attainment.

Time Frame

The expected time frame for attaining water quality standard and restoring beneficial use is a function of management intensity, climate, ecological potential, and natural variability of environmental conditions. If implementation of best management practices is embraces enthusiastically some improvements may be seen in as little as several years. Even with aggressive implementation, however, some natural processes required for satisfying the requirements of this TMDL may not be seen for many years. The deleterious effects of historic land management practices have accrued over many years and recovery of natural systems may take longer than administrative needs allow for.

Responsible Parties

IASCD, IDL, BLM, and USFS are the identified as the federal and state entities that will be involved in or responsible for implementing the TMDL. Bonneville, Bingham, and Caribou Counties will be responsible for maintaining roads by utilizing BMPs to reduce road erosion to streams.

Monitoring Strategy

It is presumed that instream temperatures will continue to be monitored with temperature loggers to evaluate improvements or declines in temperature regimes. Streambank erosion inventories are intended for rapid assessment, but will allow for the evaluation of streambank condition in the absence of more rigorous evaluation. Stream subsurface fine sediment should continue to be assessed through McNeil sediment core sampling at established

intervals to identify trends toward meeting sediment targets. Nutrient and flow levels should be monitored on Willow Creek at the three designated monitoring sites (Section 5.1). Beneficial Use Reconnaissance Program monitoring will continue to be conducted by DEQ and should also provide insight regarding steam conditions.

5.6 Conclusions

The Willow Creek drainage is a fairly homogeneous drainage with unvarying land uses. The presence of fine sediment in spawning habitat and thermal loading during spawning season are the two largest water quality concerns. The direct relationship between stream sedimentation and stream temperatures is apparent with the coupling of sediment and temperature 303(d) listings. Lateral recession is a natural process however, it can be accelerated by reducing/eliminating riparian vegetation and the detachment of bank material (clumping and sloughing), all of which disrupt the natural stream system contributing to elevated stream temperatures. Where natural stream conditions and beneficial use support are concerned, minimized flow or lack of flow are also issues in the watershed. Increasing width/depth ratios and flow control or water catchment structures contribute to conditions where beneficial use support is strained or impossible.

Implementation plans for the Willow Creek Subbasin will prescribe for the improvement of riparian vegetation and the reduction of streambank and road erosion improving salmonid spawning habitat by reducing stream temperatures and fine sediment.