Raft River Subbasin Assessment
and
Total Maximum Daily Loads

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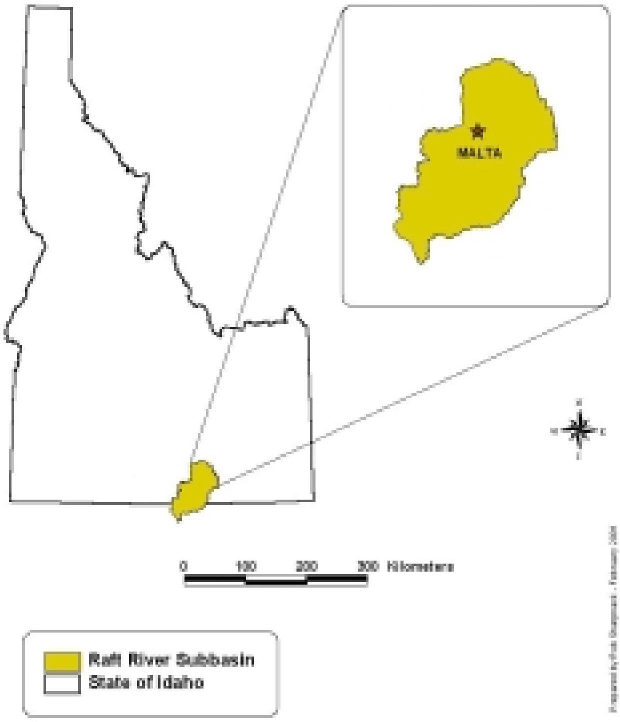
Executive Summary

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 (33 USC § 1251.101). 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 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 of impaired waters, currently 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 the water bodies in the Raft River Subbasin that have been placed on what is known as the "303(d) list."

This subbasin assessment (SBA) and TMDL analysis has been developed to comply with Idaho's TMDL schedule. This assessment describes the physical, biological, and cultural setting; water quality status; pollutant sources; and recent pollution control actions in the Raft River Subbasin located in south central Idaho. The first part of this document, the SBA, is an important first step in leading to the TMDL. The starting point for this assessment was Idaho's current §303(d) list of water quality limited water bodies. Only six segments of the Raft River Subbasin were listed on this list (DEQ 2001). The SBA portion of this document examines the current status of §303(d) listed waters and defines the extent of impairment and causes of water quality limitation throughout the subbasin. The loading analysis quantifies pollutant sources and allocates responsibility for load reductions needed to return listed waters to a condition of meeting water quality standards.

The general physical and biological characteristics of the Raft River Subbasin (Figure 1) have a strong influence on the water quality of the subbasin. Land use in the subbasin is predominantly rangeland (≅ 43 percent). Irrigated agriculture (cropland and pastures) also exists in the subbasin where water is either pumped from the ground or diverted from Raft River. The major population center of the basin is the town of Malta. The subbasin contains two different water sources. The first of these is runoff from the snowpack and other precipitation events in the mountainous regions that surround the subbasin to the south, east, and west. The second is the Raft River Aquifer below Malta and Almo, which is part of the Eastern Snake River Plain Aquifer. These sources affect water quality to varying degrees. The water from the local aquifer has caused significant changes in the water quality of many of the streams of the subbasin, because in part, it is often the only water source to many streams throughout most of the summer. As a result, some of the streams and rivers maintain high quality water with sufficient flows to provide for fully supported cold water aquatic life (i.e., Raft River near The Narrows), while other streams and rivers throughout south central Idaho are dry. In the Sublett Range the karst geology leads to low amounts of runoff water from precipitation events being delivered to the streams, while large amounts of water are delivered to the streams from the aquifer.

Subbasin at a Glance



Hydrologic Unit Code	17040210
Subbasin Drainage Size	3,196.1 km^2 in Idaho 3,919.1 km^2 Total
Total Streams *Perennial Streams*	3,861.0 km 901.9 km
Total ListedSstream Length	159.95 km
Applicable Water Quality Standards	• IDAPA 58.01.02.200-General Surface Water Quality Criteria • IDAPA 58.01.02.250-Surface Water Quality Criteria for Aquatic Life Use Designations
Beneficial Uses Affected	Cold Water Aquatic Life Salmonid Spawning Secondary Contact Recreation
Pollutants of Concern	Sediment Nutrients (Total phosphorus) Bacteria

Figure 1. Raft River in relationship to the state of Idaho.

The subbasin land forms, vegetation, topography, and precipitation can be defined by two ecoregions. The predominant ecoregion of the subbasin is the Northern Basin and Range. The Northern Basin and Range ecoregion is predominantly sagebrush-steppe, juniper-mountain lands. Most of the surface streams are intermittent or ephemeral in nature due to evaporation and low annual precipitation. Consequently, limited riparian habitat exists within the subbasin. Those streams that remain perennial usually form from spring sources in the more mountainous regions of the subbasin. Along these stream courses some riparian habitats persist.

Nutrients, bacteria, and sediment are the most common listed pollutants in the subbasin. These pollutants were listed on the six 1996 §303(d) listed water bodies within the subbasin. Other listed pollutants and stressors include dissolved oxygen, flow, temperature, ammonia, salinity, habitat alteration, and unknown. The SBA portion of the SBA-TMDL determines the current amount of each particular pollutant in each of the watersheds of the §303(d) listed water bodies. The SBA also determines what impacts to the beneficial uses each pollutant may have.

Key Findings

In general, the impacts to the beneficial uses were determined by assessing the biological communities and the limited water chemistry data available. When these two data sets were in agreement with one another, appropriate actions, such as completing a TMDL or delisting the stream, were undertaken.

The water quality of the Raft River Subbasin, in some areas, is of high quality. In other areas of the subbasin flow alteration is the most dominant cause for beneficial use impairment. Nutrients are a listed pollutant in Sublett Reservoir. It was determined that, to effectively reduce the amount of excess nutrients entering the reservoir, TMDLs should be developed on Lake Fork and Sublett Creeks, the two tributaries of the reservoir. However, in these reaches it was determined that total phosphorus (TP) was not in excess impairing the beneficial uses of the creeks. In the Raft River and other watersheds nitrogen compounds are not in excess of U.S. Environmental Protection Agency (EPA) "Blue Book" recommendations (*Water Quality Criteria 1972*. [EPA 1975]). Background TP concentrations at a Utah sampling site of Raft River averaged 0.101 milligrams per liter (mg/L) for the period of record. Total phosphorus concentrations near the end of the reach averaged 0.077 mg/L. In the reservoir, TP concentrations averaged 0.028 mg/L for the data set. Total phosphorus concentrations in the Sublett Creek Watershed averaged 0.061 mg/L over the period of record, while in the Lake Fork Creek tributary, TP concentrations averaged 0.098 mg/L for the data set. The target selected for the reservoir TMDL (0.050 mg/L TP) was used to assess the two streams feeding the reservoir. These guidelines were set by the EPA for TP concentrations in rivers flowing into lakes and reservoirs. A 49 percent reduction in TP will be required for nonpoint sources within the Lake Fork Creek Watershed and an 18 percent reduction will be required for Sublett Creek.

Flow and habitat alteration issues were not discussed in the SBA-TMDL due to current DEQ policy. It is DEQ policy that flow and habitat alterations are pollution, but not pollutants requiring TMDLs. The EPA considers certain unnatural conditions, such as flow alteration, a lack of flow, or habitat alteration, that are not the result of the discharge of a specific pollutants as "pollution." TMDLs are not required for water bodies impaired by pollution, but not specific pollutants. These forms of pollution will remain on the §303(d) list; however, TMDLs will not be completed on segments listed with altered flow or habitat as a pollutant at this time.

Temperature, under the current standards, is a listed pollutant on Raft River. In other areas of the state bioassessment data conflict with current temperature information and water quality standards. This is likely the result of the state's current water quality standards being derived from an outdated understanding of the cold water aquatic life's temperature requirements. However, DEQ is proceeding with a temperature TMDL on Raft River. Currently, DEQ is participating in a regional review of temperature criteria, which is being organized by EPA Region 10. Following the conclusion of the temperature review, the temperature exceedance documented now in the Raft River will be reassessed and, if needed, temperature TMDLs will be completed on other segments or updated on the Raft River segment. To facilitate the development of temperature TMDLs based upon solar pathfinder information, streams with fully supported beneficial uses and the average shade component of those streams, as measured by the solar pathfinder, will be used to develop temperature TMDLs within the Raft River Subbasin. These reference streams will be used to set the shade and thermal load components for temperature TMDL developed and presented in this document.

The following Tables (1-3) summarize the TMDLs to be completed, streams and pollutants retained on the §303(d) list, and recommended delisting actions as a result of the Raft River SBA.

Table 1. Streams and pollutants for which TMDLs were developed.

Segment	TMDL-pollutant	TMDL-pollutant	TMDL-pollutant
Raft River	Temperature	Bacteria	Sediment –Bed load
Sublett Creek	Nutrients – TP[a,b]		
Cassia Creek	Nutrients – TP[a]	Sediment –Bed load	
Fall Creek	Nutrients – TP[a]	Bacteria	
Lake Fork Creek	Nutrients – TP[a,b*]		
Sublett Reservoir	Nutrients – TP[a,b]		

[a] TP = total phosphorus
[b] completed to satisfy reservoir TMDL

Table 2. Delistings in the Raft River Subbasin.

Segment	TMDL-pollutant	TMDL-pollutant	TMDL-pollutant	TMDL-pollutant	TMDL-pollutant
Raft River - Utah to Malta	Sediment – TSS[a]	Dissolved Oxygen	Salinity		
Raft River - Malta to Snake River	Nutrients – TP[b]	Bacteria	Sediment	Ammonia	Dissolved Oxygen
Sublett Creek	Nutrients	Bacteria	Sediment	Dissolved Oxygen	
Fall Creek	Unknown				
Sublett Reservoir	Sediment	Dissolved oxygen			

[a] TP = Total Phosphorus
[b] TSS = Total Suspended Solids

Table 3. Stream/pollution combinations retained on the §303(d) list.

SEGMENT	TMDL-POLLUTANT
Raft River	Flow Alteration
Sublett Creek	Flow Alteration
Sublett Reservoir	Flow Alteration
Cassia Creek	Flow Alteration
Cassia Creek	Habitat Alteration

5. Total Maximum Daily Loads

A TMDL prescribes an upper limit on discharge of a pollutant from all sources 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 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 relationship of specific loads to attainment of water quality standards, the rules regarding TMDLs (40 CFR part 130) require a margin of safety (MOS) be a part of the TMDL.

Practically, the MOS is a reduction in the LC that is available for allocation to pollutant sources. The natural background load is also effectively a reduction in the LC 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 LA 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

Instream water quality targets are the basis for load calculations. From these targets, loads for the various water bodies are calculated. Although TMDLs are expressed in a mass per unit time, as required by the CWA and EPA, the instream targets are typically what the local stakeholders look to when they assess data collected on their streams of concern. As a result, instream water quality targets should be something understandable such as water quality standards or other straightforward targets. Complex targets can be just as confusing and as unworkable as load calculations and should be avoided. Instream water quality targets for the Raft River Subbasin were chosen from a variety of sources. Principally, the Idaho Water Quality Standards were used to set instream targets. When the water quality standards related beneficial use impairment to a narrative standard; however, (e.g., IDAPA 58.01.02.200.03 "...surface waters shall be free from deleterious materials in concentrations that impair beneficial uses"), other sources were consulted to determine appropriate instream water quality targets. Other sources used to determine appropriate instream water quality targets were the CWA, the Code of Federal Regulations, EPA technical support documents and guidelines, other states' water quality standards, other TMDLs written by the state of Idaho and submitted to or approved by EPA, and scientific papers from refereed journals. Instream water quality targets developed from sources other than the state of Idaho's water quality standards will be reviewed at such time that numeric standards are adopted and codified by the state of Idaho following negotiated rule making.

Targets were developed for four pollutants found to be impairing the beneficial uses of the listed water bodies identified in previous sections of the SBA. These pollutants are nutrients, bacteria, sediment, and temperature. Other pollutants have been demonstrated to be not degrading the beneficial uses in the various listed water bodies. The EPA considers certain unnatural conditions, such as flow alteration, a lack of flow, or habitat alteration, that are not the result of the discharge of specific pollutants, as "pollution". TMDLs are not required for water bodies impaired by pollution but not specific pollutants.

Design Conditions

Typically, design conditions are based upon the critical periods for specific beneficial uses respective of the pollutants and water bodies or upon some reference system within the subbasin or creek. Design conditions often vary from stream to stream for various pollutants. One of the reasons for such variability is the different land use practices along each stream. Other factors also increase loadings at different times of the year from pollutant to pollutant. For example, TP and sediment may impair a beneficial use on a stream at different times of the year. Typically, sediment is more likely to impact a system in the spring runoff during higher flow, while TP will impact a stream at during summer growing season. Therefore, the critical periods for each stream and each pollutant will be discussed separately. In addition, much of the sediment design was based upon reference reaches within each creek. In some cases prototypical reference conditions for stream bank erosion were used. These conditions will be outlined in the following sections.

Raft River

In the upper portion of Raft River flow alteration plays a significant role in water quality. For the most part flow is removed from the system from the Utah section of the river. In most years little, if any, water enters Idaho for the greater part of the year. Often times the only flow entering Idaho is winter base flow and some early spring runoff. Because of this flow regime, beneficial uses are not impacted by pollutants for which TMDLs can easily be written. However, bed load sediment does impact the beneficial uses during the limited time water is present within the system. This is typically during spring runoff events due to the substantial amount of raw and exposed banks. These bank conditions are exacerbated by the flow alteration problems seen throughout Raft River, in that the bank stabilizing vegetation is reduced or growth is limited because of the lack of water. However, at several locations along the upper portion of Raft River substantial springs emerge and recharge the system. These springs are located mainly at the area known as The Narrows. The Raft River then flows for several miles year round before it is again diverted and dewatered. Along these sections the riparian community is often healthy and vigorous. Any TMDLs developed for other constituents, such as temperature and bacteria will be applicable for the section of Raft River near The Narrows. Other sections flow alteration problems proceed any other pollutant. At such time that perennial flow is returned to the system the nonsediment TMDLs will be reviewed to determine if the LAs can be extrapolated to the remainder of the system.

Because of the impacts from flow alteration the design condition for Raft River for the other pollutants is the nonirrigation season through early spring when water is present within the system. The creek is impaired by bed load sediments during this time. Typically, sediments are more likely to impair the beneficial uses at higher flows. These uses are impaired by the elevated suspended load that occurs during the high spring flows. These flows also redistribute the bed load stored within the system throughout the year. Most of this load is coming from bank erosion of Raft River. Due to flow alteration, limited TSS data are available on the upper segment. Load allocations will be developed using bank erosion rates developed by the NRCS and refined for TMDL use by the DEQ Idaho Falls Regional Office staff. The loads to the creek are derived from high flow events eroding unstable banks throughout the system. These loads can be estimated from bank heights and the percent unstable bank length within a system. The loads would then be reflective of average peak flow from the predicted hydrograph and USGS data.

In the case of Raft River temperature issues, cold water aquatic life and salmonid spawning are the designated beneficial uses affected by increased temperature. The salmonid population consists or consisted of stocked and naturalized populations of rainbow and brown trout, as well as native populations of cutthroat trout. Currently it is unknown if brown and cutthroat trout inhabit Raft River. It is unlikely that naturalized rainbows exist within the water body. The spawning and incubation periods of these three salmonids range from early spring, to the middle of the summer, to the fall. These times should be considered the critical periods for the beneficial uses of the stream. Temperature exceedances, of both the cold water aquatic life use and salmonid spawning, typically occur throughout the summer months. This period also corresponds with the end of spawning and incubation period of the rainbow and cutthroat trout.

The land use practices along the reach may have long term effects on the ability of Raft River to meet state water quality standards. Agricultural practices (both grazing and farming practices) have removed significant portions of the riparian vegetation, changing the potential shade of the stream. These land use practices do not necessarily occur only during the critical period but have occurred throughout the year and over the past several decades. As a result, the potential vegetation along much of the river may be row crops, short pasture grasses, and rangeland communities, rather than a taller willow dominated riparian community. The temperature target selection will need to reflect this historic change in potential riparian community and how it is applied through the solar pathfinder model.

Raft River is designated for primary contact recreation. Bacteria contamination occurrences in Raft River correspond with the time of year that temperature increases. Although the causal mechanisms are not the same, the BMPs that would be used to alleviate the temperature issues would likely alleviate the bacteria issues as well. As riparian cover increases, the ability for fecal material to be deposited or migrate into the creek will decrease. Although the two constituents will respond in a similar manner a statistical link between the two cannot be made. Therefore, LAs will have to be made on both, rather than using one as a surrogate for the other as can be done with other constituents (e.g., sediment and TP). However, it is likely that one implementation plan could cover both constituents.

The design conditions for the bacteria TMDL will be based on the period when (if) swimming might occur. Primary contact recreation is generally applicable only during May 30 to September 1, as people are only likely to swim in the warmest months. In Raft River, this period corresponds with the descending limb of the hydrograph and summer low flow. Therefore, the TMDL's LC will be based upon the average summer flow conditions (June through August). In Raft River by The Narrows, this is approximately 0.46 m^3/second.

Sublett Creek

The data collected and presented by DEQ in this report suggest that Sublett Creek below the reservoir is impaired only by flow alteration. As previously described, DEQ and EPA do not have mechanisms in place to deal with flow alteration TMDLs. However, nutrient contamination does occur in the reservoir. Because of this, the upper reaches of Sublett Creek will have a nutrient TMDL completed to meet the beneficial uses of the reservoir. The design conditions for the upper section will be discussed in following sections.

Cassia Creek

It has been determined that the listed portion of Cassia Creek is impaired by flow alteration, nutrients, sediment, and bacteria. Flow alteration, in the lower listed segment, is the dominant factor impairing beneficial uses. The other constituents are present when water is present within Cassia Creek. However, the lack of flow for a significant portion of the year masks the affect the other constituents may have on the beneficial uses of Cassia Creek. This is especially true in the lower 6 miles of the listed portion of the creek. In this area, water is removed from the channel, depending on the water year, from April until October. Given this flow regime, little, if any, affects will be seen by other constituents. However, in the upper 5 miles of the system, water appears to be within the channel throughout the year

(Etcheverry 2001). In this section, TMDLs for the other constituents will be meaningful. In addition, as the TMDLs are implemented in the upper section of the system, perennial flow in the lower section may be restored.

Because of the impacts from flow alteration the design condition for Cassia Creek for the other pollutants is the nonirrigation season through early spring when water is present within the system. The creek is impaired by both nutrients and sediments during this time. Typically, sediments are more likely to impair the beneficial uses at higher flows, while nutrients are more likely to impair a system during lower flows. In the case of Cassia Creek, the time when nutrients typically impair the system corresponds with the time flow is most likely zero due to irrigation demands. Therefore, the LC of nutrients will be based upon average springtime flows when water and nutrients are present in the system.

Sediment also appears to impair the beneficial uses of lower Cassia Creek. These uses are impaired by the elevated suspended load that occurs during the high spring flows. These flows also redistribute the bed load stored within the system throughout the year. Much of this load is coming from bank erosion of Cassia Creek. Due to flow alteration, limited TSS data are available on the lower segment. Load allocations will be developed using bank erosion rates developed by the NRCS and refined for TMDL use by the DEQ Idaho Falls Regional Office staff. The loads to the creek are derived from high flow events eroding unstable banks throughout the system. These loads can be estimated from bank heights and the percent unstable bank length within a system. The loads would then be reflective of average peak flow from the predicted hydrograph and USGS data.

The upper unlisted portion is also impaired by bacteria. Bacteria seem to impact the upper segment in the spring and again in the fall. These times correspond with the presence of cattle. Other times of the year, the cattle are on the ranges in different portions of the watershed. The critical period for the recreational beneficial uses falls typically within May to October. Recreation activities during this period include hiking, biking, fishing, and hunting. It is equally likely that water would be ingested at any time during this period, but the highest concentrations of bacteria typically occur earlier in the year. This may be because runoff from pastures and uplands occurs following spring rainstorms. At other times of the year runoff from pastures is less likely because of a lack of precipitation during the summer and fall. Therefore, to be protective of the beneficial use, the design conditions should fall within the critical period when the bacteria contamination is most likely to occur. In both the upper and lower segments this appears to be during the month of May. Consequently, the design flows for the TMDL will be those average discharges from the late spring.

Fall Creek

The data collected and presented by DEQ in this report indicate that bacteria and nutrients impair the beneficial uses of Fall Creek. The critical period for the recreational beneficial uses falls typically within May to October. Nutrients also impair systems during this period as plant growth is optimized by the increasing water temperature found during the period. The hydrology of Fall Creek is unique in that there does not appear to be a strong link to watershed precipitation. As a spring creek, Fall Creek discharges approximately 0.03

m^3/second year round. Load capacities for bacteria and nutrients will be developed with that value and can be extrapolated to any season due to the limited variability in the hydrograph.

Lake Fork Creek

The data collected and presented by DEQ in this report suggests that Lake Fork Creek is not impaired by nutrients. However, the nutrients in Lake Fork Creek are elevated enough to cause beneficial use impairment in Sublett Reservoir. Because of this, the upper reaches of Lake Fork Creek with have a nutrient TMDL completed to meet the beneficial uses of the reservoir. The design conditions for the upper section will be discussed in following sections.

Sublett Reservoir

It has been determined that Sublett Reservoir is impaired by flow alteration and nutrients. Flow alteration is the dominant factor impairing beneficial uses. The reservoir often undergoes several drawdowns throughout the summer. In dry years, the reservoir can be drained almost 100 percent. The lack of pool volume during late summer may mask the nutrient effects on the beneficial uses of the reservoir.

The reservoir is fed by two streams: Sublett Creek and Lake Fork Creek. These two streams lack the hyrological variability of most normal streams. They are spring fed systems with limited influence from precipitation events within their watersheds. Therefore, the design conditions used to determine load capacities for the reservoir and the creeks can be based upon the annual average flow in each creek. The lack of variability makes this value applicable throughout the year regardless of season.

Target Selection

Nutrients

Three water bodies within the Raft River Subbasin do not meet the narrative standard for nutrients. Therefore, these segments will be considered for application of a TMDL for restoration and protection of designated beneficial uses. Water quality will be restored through the TMDL process and the subsequent implementation plans developed by the land management agencies. The TMDLs will establish a limit on the quantity of nutrients that may enter the segments from sources in the local watersheds. The nutrient limits will be set at a level such that the segments will not exceed the estimated load capacities supportive of a good to excellent fisheries and will allow the water quality to improve to restore degraded beneficial uses. These targets shall be a monthly average of not more than 0.05 mg/L TP with a daily maximum of 0.08 mg/L to allow for natural variability in Lake Fork Creek and Sublett Creek. The average monthly target is within the range identified by the EPA as supporting beneficial uses of water flowing into lakes and reservoirs. This will restore the beneficial uses of Sublett Reservoir. Total phosphorus targets for Fall Creek and Cassia Creek shall be set at not more than 0.100 mg/L of TP with a daily maximum of 0.160 mg/L TP to allow for natural variability in those streams. The average monthly target is within the range identified by EPA as supporting beneficial uses of free flowing streams and rivers.

The TP target values of 0.05 mg/L and 0.100 mg/L do not imply that degradation by TP may occur up to the target value. Rather, TP values should be less than the respective targets on an average monthly basis and daily maximum, which will allow for some exceedances of the instream standards to account for seasonal and daily variation. However, it is DEQ's administrative policy under IDAPA 58.01.02.050.01 that the adoption of water quality standards and the enforcement of such standards is not intended to conflict with the apportionment of water to the state through any of the interstate compacts or court decrees. or to interfere with the rights of Idaho appropriators, either now of in the future, in the utilization of the water appropriations which have been granted to them under the statutory procedure. Yet, IDAPA 58.01.02.50.02.a states: "Wherever attainable, surface waters of the state shall be protected for beneficial uses which for surface waters includes all recreational use in and on the water surface and the preservation and propagation of desirable species of aquatic biota." The existing and designated beneficial uses of these segments will be protected through the TMDL process as legally described. Acts of God and or uncontrollable flood/drought events will be exempt during the period of impact until such time that the impact is stabilized and the imminent and substantial danger to the public health or environment (IDAPA 58.01.02.350.02.a) is minimized so that the activity may be conducted in compliance with approved BMPs…to fully protect the beneficial uses (IDAPA 58.01.02.350.02.b.ii. (2)).

Other activities that may cause degradation, but which are outside the scope of IDAPA 58.01.02.050.01 and which there is foreknowledge of the event's occurrence will require a formal written letter from the individual, organization, or agency to the Twin Falls Regional Office (TFRO) about the nature of the potential event. If the activity violates IDAPA 58.01.02.350.02.b.i, such that it will occur in a manner not in accordance with approved BMPs, or in a manner which does not demonstrate a knowledgeable and reasonable effort to minimize the resulting adverse water quality impacts, then DEQ's TFRO will seek intervention by the director of DEQ for preparation of a compliance schedule (as provided in Idaho Code 39-116). DEQ may also institute administrative or civil proceedings including injunctive relief as provided in Idaho Code 39-108.

Bacteria

The state of Idaho has a water quality standard for *E. coli* that covers both primary and secondary contact recreation. All of the systems in the subbasin are undesignated water bodies except the Raft River. These undesignated water bodies are afforded protection for primary and secondary contact recreation according to IDAPA 58.01.02.101.01.a. After a review of the physical properties of the listed systems, DEQ-TFRO has determined that likely recreational activities include fishing, wading, and infrequent swimming. These recreational activities are descriptive of the existing uses consistent with secondary contact recreation. As a result, the water quality bacteria targets will be those water quality criteria for secondary contact recreation. Thus, the number of colonies of *E. coli* shall not exceed a single instantaneous sample of 576 col/100 ml and the geometric mean of five samples collected in a 30 day period of 126 col/100 ml.

Additionally, the target bacteria load (576 col/100 ml) will be segregated into percentages based on land uses. Thus, if 40 percent of the land use is attributable to agriculture, then 230 col/100 ml of the target will be distributed to agriculture. The remainder (576 - 230 = 346 col/100 ml) will be distributed to the other land uses where appropriate. An essential assumption in this method of distribution is that the water quality standard is the LC of a system. By using a percentage of the target or "load capacity," the calculations become unitless percentages, which overcomes the inherent problems of calculating loads from a parameter which does not lend itself to loading calculations. Allocations can then be made from this percentage of the load according to land use in the watershed. The MOS (10 percent in all cases) would be used to hold back a percent of the load from the LC.

Compliance with the water quality target and the TMDL will be based on the geometric mean (126 col/100 ml) for secondary contact recreation as described in the IDAPA regulations. Because the major exceedances occur primarily during the grazing season (April through September), monitoring of the water bodies will occur primarily during the grazing season, although year-round monitoring may be developed so that comparisons between the grazed and nongrazed seasons can be assessed. It is recognized that bacteria are a singular parameter that has a statistically significant linkage to TSS. (See *Upper Snake Rock Watershed Management Plan* [Buhidar 1999] for a review of surrogate use of TSS for bacteria reductions.) During the implementation phase of this TMDL, land management agencies will provide guidance as to site-specific BMPs that will effectively reduce *E. coli*, such that conjunction with TSS reductions will yield *E. coli* reductions, and eventually reach beneficial uses and/or state water quality standards.

Sediment

The antidegradation policy for the state of Idaho (IDAPA 58.01.02.051(01)) indicates that the existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected. Most of the listed segments in the Raft River Subbasin appear to be meeting the narrative standard for suspended sediment although they are listed for sediment on the 1998 §303(d) list. Because of this, higher water quality for suspended sediment degradation of the water quality beyond these conditions shall not occur but shall be maintained at or below these levels throughout the implementation of the TMDL. The sediment limit, in the listed segments of the subbasin, will be set at a level such that the rivers and streams will not exceed the estimated LC supportive of a good fishery and will not allow the water quality to degrade worse than current levels. This target shall be a monthly average of less than 50 mg/L of TSS with a daily maximum of 83 mg/L to allow for natural variability. The average monthly target is within the range identified by the European Inland Fisheries Advisory Commission (EIFAC 1965) and the Committee on Water Quality Criteria from the Environmental Studies Board of the National Academy of Science and National Academy of Engineers (NAS/NAE 1973) as supporting a moderate fishery. Total suspend solids values less than 50 mg/L do not imply that degradation by TSS may occur up to 50 mg/L. Rather, TSS values should be less than 50 mg/L on an average monthly basis, which will allow for some exceedances of the in-stream standard to account for seasonal and daily variation.

However, it is DEQ's administrative policy under IDAPA 58.01.02.050.01 that the adoption of water quality standards and the enforcement of such standards is not intended to conflict with the apportionment of water to the state through any of the interstate compacts or court decrees, or to interfere with the rights of Idaho appropriators, either now of in the future, in the utilization of the water appropriations which have been granted to them under the statutory procedure. Yet, IDAPA 58.01.02.50.02.a states “Wherever attainable, surface waters of the state shall be protected for beneficial uses which for surface waters includes all recreational use in and on the water surface and the preservation and propagation of desirable species of aquatic biota.” The existing and designated beneficial uses of the subbasin will be protected through the antidegradation as previously described. Acts of God and or uncontrollable flood/drought events will be exempt during the period of impact until such time that the impact is stabilized and the imminent and substantial danger to the public health or environment (IDAPA 58.01.02.350.02.a) is minimized so that the activity may be conducted in compliance with approved BMPs…to fully protect the beneficial uses (IDAPA 58.01.02.350.02.b.ii. (2)).

Other activities that may cause degradation but which are outside the scope of IDAPA 58.01.02.050.01 and which there is foreknowledge of the event’s occurrence will require a formal written letter from the individual, organization, or agency to DEQ-TFRO about the nature of the potential event. If the activity violates IDAPA 58.01.02.350.02.b.i, such that it will occur in a manner not in accordance with approved BMPs, or in a manner which does not demonstrate a knowledgeable and reasonable effort to minimize the resulting adverse water quality impacts then DEQ-TFRO will seek intervention by the Director of DEQ for preparation of a compliance schedule (as provided in Idaho Code 39-116). DEQ may also institute administrative or civil proceedings including injunctive relief as provided in Idaho Code 39-108.

Cassia Creek is the lone exception in the subbasin in that it is seasonally affected by excess suspended sediment. As a result, sediment targets will be developed and load capacities determined. However, these targets will be based on the nutrient reduction TMDL proposed for Cassia Creek and therefore the nutrient targets will serve as surrogates for any proposed suspended sediment reduction targets, load capacities, and allocations. These targets shall be a monthly average TP concentration of no more that 0.100 mg/L with a daily maximum of no more that 0.160 mg/L TP. As seen in Figure 37 a strong relationship exists between TSS and TP in Cassia Creek. This relationship is based in part to the physical nature of TP molecules to adhere to suspended sediment particles and the land use practices in the watershed that contribute both TP and suspended sediment. Therefore, any reduction in TP is most likely to come from the same BMPs that would reduce sediment. Furthermore, as seen in the TP: TSS relationship (Figure 37.), TP reductions to approximately 0.151 mg/L should result in TSS levels meeting the above targets (< 50 mg/L monthly average) for support of salmonid populations (cold water aquatic life and salmonid spawning). However, further TP reductions are proposed for Cassia Creek. The current target for the stream is set at a 0.100 mg/L monthly average. This level of phosphorus reduction should, theoretically, reduce TSS levels to background levels (near 20 mg/L). Because the nutrient TMDL goals far exceed the goals that will be established for a suspended sediment reductions TMDL compliance with the sediment reduction goals shall be determined when Cassia Creek attains < 50 mg/L TSS monthly average and an 80 mg/L daily maximum.

Bed load sediment impairs both Cassia Creek and Raft River. Bed load sediment loads will be developed to meet bank stability targets using a stream bank erosion estimate developed by the NRCS and refined for TMDLs by DEQ’s Idaho Falls Regional Office. The current state of science does not allow specification of a sediment load or LC to meet the narrative criteria for sediment and to fully support beneficial uses for cold water aquatic life and salmonid spawning. All that can be said is that the LC lies somewhere between current loading and levels that relate to natural stream bank erosion levels. It is assumed that beneficial uses were or would be fully supported at natural background sediment loading rates. These rates were assumed to equate to the 70 percent bank stability regimes required to meet state water quality standards.

Beneficial uses may be fully supported at higher rates of sediment loading. The strategy is to establish a declining trend in sediment load indicator targets (i.e., percent fines or TSS), and to regularly monitor water quality and beneficial uses' support status. If it is established that fully supported uses are achieved at intermediate sediment loads above natural background levels, and that the narrative sediment standards are being met, the TMDL will be revised accordingly.

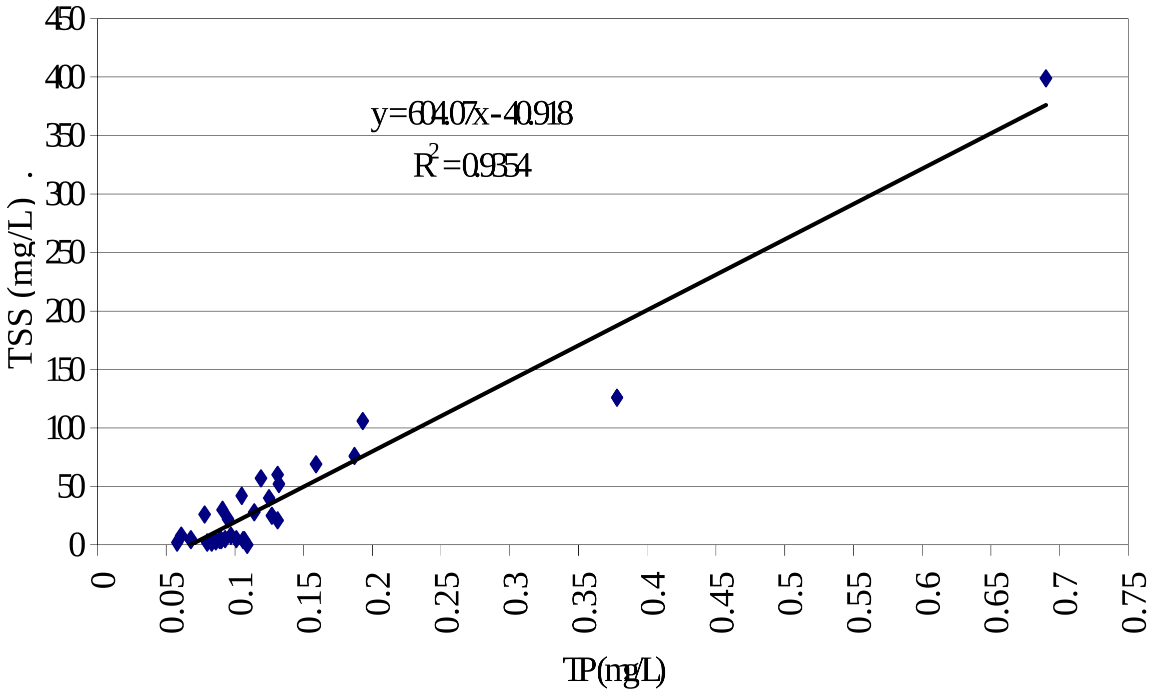


Figure 37. Total phosphorus: total suspended solids relationship of Cassia Creek.

Temperature

The state of Idaho has water quality standards that are applicable to the water bodies of the Raft River Subbasin. Specifically, Raft River exceeds the water quality standards for its designated beneficial uses of cold water aquatic life and salmonid spawning (see Raft River existing water quality data). State water quality standards for cold water aquatic life are 22 °C or less with a daily average of no greater than 19 °C. Those standards established for salmonid spawning are water temperatures no greater than 13 °C and a maximum daily average no greater than 9 °C during the spawning and incubation period of the particular salmonid community within the water body.

In addition to the state water quality standards, a solar pathfinder based data will be used to determine instream temperatures based on reference location average shade. The numeric standards do not apply in all cases because they realistically cannot be met throughout the reach, even under ideal shading. In these cases, the “best achievable thermal load” is used as the target. The best achievable thermal load is based on the practical amount of shading possible as defined in the TMDL by shade and solar pathfinder data collected on reference streams within the region.

Site potential shading characteristics are derived from similar riparian communities within the Goose Creek, Raft River, and Upper Snake-Rock Subbasins. Site potential shading is not an estimate of presettlement conditions. These subbasins have seen changes because of anthropogenic impacts (e.g. channel armoring, straightening, entrenchment, and prescribed fire) and the historic condition is no longer attainable or attainable in the very long term. Thus, site potential shading is based upon maximum vegetation heights, maximum density, and optimal vegetative offset of the riparian community based upon a group of streams with fully supported beneficial uses, located within south central Idaho. These factors also influence the bank stability of a system. Potential changes in width/depth ratios are also taken into account for the particular channel type, but changes in the existing channel type are not modeled. The Raft River temperature TMDL will be based upon the site potential shading or thermal load from five streams with fully supported beneficial uses. These streams are examples of high quality waters that are available to develop the maximum thermal load target for south central Idaho. Extrapolation outside of this area should be undertaken with some reservations until reference shade can be determined for a greater area. The first of these five reference streams was the upper fully supporting segment of Trapper Creek, which is in the Goose Creek Subbasin. The percent shade, as determined from solar pathfinder data, indicates that Trapper Creek averages 28 percent shade June through August. The second was the fully supporting segments of Stinson Creek, which is in the Raft River Subbasin. Stinson Creek is 34 percent shaded. Cross Creek was the third streams used as it was another fully supporting stream within the Raft River Subbasin. It was determined that Cross Creek is also 28 percent shaded. Two Streams were selected in the Upper Snake-Rock subbasin, The upper portions of rock Creek and North Cottonwood Creek. Both have been assessed using WBAG II and within the Upper Snake Rock TMDL and have been determined to meet beneficial uses and have no temperature related impacts to the beneficial uses. It was determined that Rock Creek is 64 percent shaded while North Cottonwood Creek is 55 percent shaded. As other streams are located within the general area, the maximum thermal load will become more robust as the values from those streams are incorporated into the average of the reference streams. The current reference stream average is 42 percent shade during the months of June, July, and August.

The Raft River Subbasin has always had high summer temperatures, high solar radiation, and low summer flows. Temperatures are exacerbated by certain land use practices including flow diversion, but water temperatures have most likely never been cold during the hottest part of the year. Native fishes have either physiologically adapted to the high temperatures or have take thermal refuge in and near the spring sources located throughout the length of Raft River. Factoring in these natural conditions, the temperature targets are based upon the temperature decrease expected under optimal habitat conditions, which, while above the state numeric criteria, are protective of the native fish community and its reproduction.

Monitoring Points

The following are the compliance points to be used to determine if the various LAs and WLAs are being met following implementation of the TMDLs.

Raft River

The Raft River will be monitored at The Narrows area for compliance with the TMDL. Following complete implementation it is expected that perennial flow will be established above and below this point. When that should occur, the LAs will be extrapolated to the flow altered segments and the compliance point will be moved downstream. At The Narrows location temperature loggers will be placed annually to determine compliance with the temperature TMDL. In addition, at this location, *E. coli* samples will be taken to determine if state water quality standards and the TMDL are being met.

Cassia Creek

Cassia Creek will be monitored at two locations for compliance with the TMDLs. The first of these will be at the bridge crossing near the Conner Creek Junction. This location will serve as the compliance point for the upstream bacteria TMDL. At this location *E. coli* samples will be taken to determine if state water quality standards are being met. The second location that will serve as a compliance point for the lower perennial segment of Cassia Creek is the bridge crossing on the Hudspeth cutoff road. It is in this area that Cassia Creek is dewatered for the majority of the year. Upstream from this location water often flows into the summer months. Following implementation it is expected that perennial flow will be established below this point. When that should occur the LAs will be extrapolated to the lower, flow altered segment and the compliance point will be moved downstream. At the Hudspeth cutoff point, the stream will be monitored for sediment (TSS) and nutrient (TP) concentrations during the critical period.

Fall Creek

Fall Creek will be monitored for *E. coli* bacteria and TP near the mouth of the creek above the confluence with Lake Fork Creek.

Sublett Reservoir

Three compliance points will be established for Sublett Reservoir. The first of these will be at the mouth of Lake Fork Creek above the influence of the reservoir. This location will be monitored for TP concentrations to determine if the reductions in the Lake Fork Creek Watershed are being met. The second location will be at the mouth of Sublett Creek above the influence of the reservoir. This location will be monitored for TP concentrations to determine if the reductions in the Sublett Creek Watershed are being met. The third location will be used as the adaptive management or feedback loop for the TMDL and the load reduction requirements for the two watersheds. This location will be at Zmax (the deepest location in the main body of the reservoir). At this location, the parameters required to calculate the Carlson's TSI will be collected. These parameters are secchi depth, TP, TN, and chlorophyll *a*. The frequency of monitoring at this location will be much lower than at the other two locations.

5.2 Load Capacity

The CWA requires that a TMDL be developed from a LC. A LC is the greatest amount of load that a water body can carry without violating water quality standards. In those instances where there are numeric water quality standards, the LC of a water body for different pollutants can be very straightforward. Most of the pollutants in the Raft River TMDL; however, do not have numeric water quality standards; rather, they have the narrative standards (e.g., IDAPA 58.01.02.200.03 "...surface waters shall be free from deleterious materials in concentrations that impair beneficial uses"), as referenced in this document. As a result, the LC of the various segments and tributaries in the Raft River Subbasin, presented in Table 39, were estimated from extrapolations from the flow records available from USGS or DEQ and a variety of sources relating concentrations of pollutant to effects on beneficial uses or aquatic communities. Other sources used for concentrations were the CWA, the Code of Federal Regulations, EPA recommendations and guidelines, other states water quality standards, other TMDLs written by the state of Idaho and submitted to or approved by EPA, and scientific papers from refereed journals. Load capacities developed from sources other than the state of Idaho's water quality standards will be reviewed at such time that numeric standards are adopted and codified by the state of Idaho following negotiated rule making. Additionally, load capacities were developed from flow regimes identified as critical periods. In some cases, these critical periods were low flow conditions during a particular season. In other cases, the flow regime during the critical period was determined to be at or near zero. In these cases, the lowest flow to which the water quality standards apply in intermittent streams, 0.14 m^3/second for recreational uses and 0.03 m^3/second for aquatic life uses (IDAPA 58.01.02.070.07), was used to determine LC.

The LC and loading analysis models for the various streams and pollutants were derived from a mass balance approach of monitoring data, upstream monitoring, downstream monitoring, source monitoring, and estimations of loads from that data. Links to the water quality targets and beneficial uses were drawn from other TMDLs completed by the state of Idaho, EPA guidelines and recommendations, and scientific literature.

Temperature

The primary source of temperature increases under anthropogenic control are those that increase the amount of solar radiation reaching the stream surface. Thus, the load of this resultant excess "heat" is calculated in kilowatts per hour per square meter per day (kwh/m^2/day). The LC is the amount of heat in the stream when the criteria or the best achievable temperature is met.

Based upon the solar table and the reference streams' average shade conditions, the annual average thermal LC for streams in the Raft River Subbasin is estimated to be 2.4 kwh/m^2/day. During the critical period of June, July, and August, the average LC is 4.1 kwh/m^2/day

Nutrients

The LC for nutrients was determined by calculation using the target of 0.1 mg/L TP for free flowing streams and critical period flow values (calculated from predicted annual hydrographs). For streams flowing into Sublett Reservoir the LC was determined using the 0.05 mg/L TP target and critical period flow values (calculated from predicted annual hydrographs).

The phosphorus LC's were identified for an average summer flow scenario. While these values are helpful in giving a relative understanding of the reductions required, and will apply reasonably over most water years, it should be noted that the absolute level of reduction required will depend on flow and concentration values specific to a given water year. The target shown to result in attainment of water quality standards and support of designated uses in the reach is an instream concentration of less than or equal to 0.1 mg/L TP. Transport and deposition of phosphorus, and the resulting algal growth within the reach, is seasonal in nature. Therefore, application of the 0.1 mg/L or 0.05 mg/L TP target is also seasonal in nature, extending from the beginning of May through the end of September. The length of this period was also determined by when BMPs would be most effective.

Due to water column nutrients, particularly TP, being more abundant than plant uptake rates, responses by plant communities to management efforts will take time. As TP inputs are reduced, plants that obtain nutrients from the water column (such as algae, epiphytes, and *Cerratophyllum* sp.) will likely be the first to decline. Because nutrients persist longer in sediments, plants that obtain nutrients from the sediments will persist longer. Nevertheless, as reductions in TP (and sediment) continue, sediment-bound nutrients will gradually be depleted as plant uptake outpaces recharge rates.

Sediment

The LC for sediment was determined based on the origin of the sediment. In those instances where the sediment is generated from stream bank erosion, the LC is based on the load generated from banks that are greater than 70 percent stable. This load defines the LC for the remaining segments of the stream. In instances where a numeric water column target is defined, the LC is based on the instream load that would be present when the target is met.

For example, the instream sediment target for Cassia Creek is 70 percent stable banks. The LC for Cassia Creek is based on maintaining 70 percent stable banks throughout the stream.

Bacteria

The LC for bacteria is based on the state water quality standard for *E. coli*. The bacteria LC is expressed in terms of percent of colony forming units. However, this is simply an accounting mechanism to convert a unit of measurement (colony forming units per 100 ml) to a unitless measurement because of the impracticality of converting to a mass per unit time measurement.

Table 39. Load capacities and critical periods.

Stream Name	Parameter	Critical Period	Load Capacity[a]
Raft River	Bacteria	June-August	576 col/100 ml
Raft River	Temperature	June-August	4.1 kwh/m^2/day
Cassia Creek	Sediment	March-May	2,160 kg/day
Cassia Creek	Bacteria	June-August	576 col/100 ml
Cassia Creek	Nutrients	March-May	4.32 kg/day
Fall Creek	Bacteria	June-August	576 col/100 ml
Fall Creek	Nutrients	June-September	0.26 kg/day
Lake Fork Creek	Nutrients	June-September	0.17 kg/day
Sublett creek Upper	Nutrients	June-September	0.48 kg/day

[a] col/100ml = colonies of bacteria per 100 milliliters of water, kwh/m^2/day = kilowatt hours per square meter per day, kg/day = kilograms per day.

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," (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 to larger units. To the extent possible, background loads should be distinguished from human-caused increases in nonpoint loads. In the Raft River Subbasin, data available to distinguish between nonpoint sources and background is very limited. In most cases, the anthropogenic stresses are applicable from the headwaters of a stream to its mouth. In these cases, it is assumed that the background levels of the various parameters are similar to other streams in south central Idaho. As such, background will be estimated for some streams until a better estimation or scientific evaluation can be made for each stream's background load (Table 40).

There are no point sources located within the Raft River Subbasin which discharge to any receiving water body regulated under the National pollution discharge elimination system (NPDES) permit process. However, there are several CAFOs that have NPDES permits.

These facilities are allowed zero discharges and therefore would have a 0 kg per day WLA. It is uncertain at this time if there are any land application sites in the subbasin. These permitted facilities would also be allowed 0 kg per day discharge to the surface waters under their governing permits. Consequently, CAFOs and land application sites will not be addressed in the wasteload allocations (WLA).

Fall Creek provides the clearest methods for estimating bacteria loads. Natural background was estimated from average bacteria counts collected during the noncritical period (April through June and October and November, December through March were not sampled). The nonpoint source load was estimated from the difference in the previous number and average bacteria counts collected during the critical period (July through August). Raft River and Cassia Creek are more complex in that several sampling locations exist, and some out of Idaho. Natural background was estimated from the noncritical period average at the upstream sampling location. The nonpoint source estimate was made from the difference between the "background" average and the data used to calculate the geometric mean standard violation. It should be noted that in other streams in south central Idaho, natural background counts of bacteria are near zero. Therefore, the additional background counts used in these TMDLs should be considered part of the implicit MOS.

In the upper segment of Raft River and Cassia Creek the primary source of sediment is from bank erosion; existing sediment loads were determined using the bank erosion inventory process. This method provides an estimation of erosion rates within the sampling reaches. These erosion rates were then used to calculate the current instream delivery of sediment within the system. In other TMDLs, the background load was assumed to be similar to that from streams or reaches with slight to moderate bank erosion rates and 70 percent stable banks.

In those streams determined to need nutrient TMDLs, natural background was assumed to be similar to that of the major drainages nearby. These drainages contain significant natural phosphorus deposits as well as some anthropogenic stresses. The background concentration has been determined to be very low (0.02 mg/L). Nutrient background determinations will be discussed in greater depth in following sections. The nonpoint source load was assumed to be the difference between the existing load and natural background. The existing load was calculated from the critical flow and the average annual concentration of TP in the different streams.

Existing temperature loads were estimated from the solar pathfinder model run with current vegetation cover, or solar view, to determine current kilowatt hours per square meter per day (Table 41). Natural background was considered the system potential load (Table 42) derived from the solar pathfinder model run with system potential cover.

Table 40. Background and nonpoint source loads in the Raft River Subbasin.

Stream Name	Pollutant	Natural Background[a]	Existing Nonpoint Source Load[a]	Existing Wasteload[a]
Raft River	Bacteria	69 col/100 ml	967 col/100 ml	0 col/100 ml
Raft River	Temperature	4.1 kwh/m^2/day	6.9 kwh/m^2/day	0 kwh/m^2/day
Raft River	Sediment	951 Mg/year	5,626 Mg/year	0 Mg/year
Cassia Creek	Sediment	437 Mg/year	2,763 Mg/year	0 Mg/year
Cassia Creek	Nutrients	0.86 kg/day	8.42 kg/day	0 kg/day
Cassia Creek	Bacteria	41 col/100 ml	937 col/100 ml	0 col/100 ml
Fall Creek	Nutrients	0.05 kg/day	0.29 kg/day	0 kg/day
Fall Creek	Bacteria	84 col/100 ml	1,114 col/100 ml	0 col/100 ml
Lake Fork Creek	Nutrients	0.07 kg/day	0.27 kg/day	0 kg/day
Sublett Creek Upper	Nutrients	0.19 kg/day	0.39 kg/day	0 kg/day

[a] col/100ml = colonies of bacteria per 100 milliliters of water, kwh/m^2/day = kilowatt hours per square meter per day, kg/day = kilograms per day., Mg/year = metric tons per year.

Table 41. Stream potential and existing solar view.

Month	Potential Solar View[a]	Raft River Existing Solar View[a]
January	15	93
February	29	93
March	46	97
April	61	99
May	58	99
June	61	99
July	59	99
August	54	98
September	45	98
October	33	94
November	18	94
December	15	93

[a] Units = percent sun as measured by a solar pathfinder.

Table 42. Potential and existing monthly solar load.

Month	Solar Load Capacity	Raft River Existing Solar Load
January	0.3	1.5
February	0.7	2.4
March	1.7	3.5
April	3.2	5.1
May	3.7	6.3
June	4.3	7.0
July	4.4	7.4
August	3.5	6.3
September	2.3	4.9
October	1.1	3.2
November	0.3	1.8
December	0.2	1.3

[a] Units = kilowatt hours per square meter per day

5.4 Load Allocation

The total allocations must include a MOS to take into account seasonal variability and uncertainty. Uncertainty arises in selection of water quality targets, LC, and estimates of existing loads, and may be attributed to incomplete knowledge or understanding of the system, such as uncertainties regarding assimilation, sketchy data, or variability in data. The MOS is effectively a reduction in LC that "comes off the top" (i.e., before any allocation to sources). Second in line is the background load, a further reduction in LC available for allocation. It is also prudent to allow for growth by reserving a portion of the remaining available load for future sources.

Apportion LC among existing and future pollutant sources. Allocations may take into account equitable cost, cost effectiveness, and credit for prior efforts, but all within the ceiling of remaining available load. These allocations may take the form of percent reductions rather than actual loads. Each point source must receive an allocation. Nonpoint sources may be allocated by subwatershed, land use, responsibility for actions, or a combination. It is not necessary to allocate a reduction in load for all nonpoint sources so long as water quality targets can be met with the reductions that are specified.

Margin of Safety

In addition to estimating a LC a given water body can carry, the CWA includes statutory requirements for a MOS in a TMDL. The MOS is intended to account for uncertainties in available data or in the actual effect controls will have on load reductions and the receiving water body's water quality. The MOS may be implicit, such as conservative assumptions used in various calculations, specifically those of natural background, LC, WLAs, and LAs. Otherwise, a MOS must be clearly defined. For the Raft River Subbasin TMDLs, an explicit MOS will be set at 10 percent for all pollutant/water body combinations. In addition, any conservative approaches used in the various calculations required by a TMDL will be included as an implicit component of the MOS. The implicit MOS; however, will not be clarified further. Rather, it will be assumed that conservative approaches taken throughout the document will have been sufficiently identified in appropriate sections.

Seasonal Variation

Total maximum daily loads must be established with consideration of seasonal variation. In the Raft River Subbasin there are seasonal influences on nearly every pollutant addressed. The summer growing season is when concentrations of bacteria, sediment, and nutrients are the highest. This is also when water temperatures are elevated. The increase in temperature is due to a combination of agricultural return flow and warmer air temperatures. Seasonal variation as it relates to development of these TMDLs is addressed simply by ensuring that loads are reduced during the critical period (when beneficial uses are impaired and loads are controllable). Thus, the effects of seasonal variation are built into the LAs.

Critical Period

The critical period for each water body is based on the time when beneficial uses must be protected and when pollutant loads are the highest. Each respective TMDL was developed such that the water quality standards will be achieved year around, yet the critical period defines when loading reductions must occur. Table 43 shows the critical period for each water body.

Background

Several recent Idaho TMDLs have discussed background levels for the various constituents. Much of that information is applicable to the Raft River Subbasin as well. Therefore the information was used in whole or in part *from The Big Wood River Watershed Management Plan* (Buhidar 2001)TMDL, the *Mid Snake Succor Creek TMDL* (Horsburgh 2003*), Snake River Hells Canyon TMDL* (Idaho DEQ and Oregon DEQ 2003) or *The Pahsimeroir River Subbasin Assessment and Total Maximum Daily Load* (Shumar and Reaney 2001) for the Raft River TMDLs.

Sediment

Background sediment production from stream banks equates to the load at 70 percent stream bank stability as described in Overton et al. (1995), where stable banks are expressed as a percentage of the total estimated bank length. Natural condition stream bank stability potential is generally at 80 percent or greater for A, B, and C channel types in plutonic, volcanic, metamorphic, and sedimentary geology types. Table 44 shows the sediment delivery loads for Cassia Creek based upon current and proposed bank stability ratings.

Nutrients

The following discussion comes from the *Snake River Hells Canyon TMDL* (Idaho DEQ and Oregon DEQ 2003) (SR-HC TMDL). The SR-HC TMDL assessed natural phosphorus conditions in the mainstem Snake River by looking at concentrations in the Blackfoot and Portneuf watersheds where there are high naturally occurring concentrations of phosphorus. Natural sources of nutrients include erosion of phosphorus-containing rock and soils through wind, precipitation, temperature extremes and other weathering events.

Natural deposits of phosphorus (Hovland and Moore, 1987) have been identified in the Snake River drainage near Pocatello, Idaho (river mile [RM] 731.2). Geological deposits in the Blackfoot River watershed (inflow at RM 750.6) contain phosphorus in sufficient concentrations that they have been mined. The Snake River flows through this area some distance upstream of the SR-HC TMDL reach.

In an effort to assess the potential magnitude of natural phosphorus concentrations in the mainstem Snake River due to these geological deposits, TP concentrations occurring in the mainstem near the Blackfoot and Portneuf River inflows (RMs 750.6 and 731.2, respectively) were evaluated. Data were available for the Snake River near Blackfoot, Idaho (USGS gage No. 13069500, RM 750.1) and for the Blackfoot and Portneuf Rivers (USGS 2001). The mainstem Snake River and these tributary river systems, where they flow through the natural mineral deposits represent a worst-case scenario for evaluation of natural phosphorus loading and were identified as potential sources of naturally-occurring phosphorus to the SR-HC reach. The USGS gauged flow data and water quality data from the 1970s to the late 1990s is available for the Blackfoot and Portneuf Rivers (USGS gage No. 13068500, and No.13075500, respectively). Because both the mainstem and tributary watersheds have been settled for some time, and land and water management has occurred extensively, the data compiled represent both natural and anthropogenic loading.

Total phosphorus concentrations in the Snake River mainstem, measured near Blackfoot, Idaho (RM 750.1), from 1990 to 1998 averaged 0.035 mg/L (range ≤ 0.01 to 0.11 mg/L, median = 0.03 mg/L, mode = 0.02 mg/L) (USGS 2001). Nearly 40 percent (23 samples) of the total data set showed TP concentrations less than or equal to 0.02 mg/L. The data represent year-round sampling. Winter sampling was slightly less frequent (approximately 19 percent of the total) than spring, summer, or fall.

Natural phosphorus concentrations were not assessed as part of the Blackfoot River TMDL (DEQ 2001). Total phosphorus concentrations in the Blackfoot River, measured near the mouth from 1990 to 1999, averaged 0.069 mg/L (range ≤ 0.01 to 0.43 mg/L, median = 0.04 mg/L, mode = 0.03 mg/L) (USGS 2001). Nearly 23 percent (12 samples) of the total data set showed TP concentrations less than or equal to 0.02 mg/L. The data represent year-round sampling. Winter sampling was less frequent (approximately 13 percent of the total) than spring, summer or fall.

Natural phosphorus concentrations were not assessed for the Portneuf River TMDL (DEQ 1999). Total phosphorus concentrations in the Portneuf River, measured near the mouth from 1990 to 1998, averaged 0.085 mg/L (range ≤ 0.01 to 0.28 mg/L, median = 0.069 mg/L, mode = 0.03 mg/L) (USGS 2001). Nearly 21 percent (6 samples) of the total data set showed TP concentrations less than or equal to 0.02 mg/L. The data represent year-round sampling. Winter sampling represented approximately 22 percent of the total.

The fact that very low total phosphorus concentrations were observed routinely (more than 20 percent of the time) in the mainstem Snake River, the Blackfoot River, and the Portneuf River, all watersheds with a high level of use and management, shows that the natural loading levels are likely below detection limit concentrations. The additional fact that these low concentrations were observed in watersheds in much closer proximity to the rich geological phosphorus deposits than those in the Raft River Subbasin indicates that these deposits likely do not represent a significant source of high, natural loading to the Raft River TMDL reaches, located in close proximity to the watersheds identified.

Given the above discussion, the natural background concentration for TP in the mainstem Snake River has been estimated as at or below 0.02 mg/L for both the Mid Snake River/Succor Creek and SR-HC TMDL reaches. This value is based on the available data set. Data from the Snake River upstream of RM 409 were included in this data set to address the concern of enrichment of surface waters by the phosphoric deposits located in central and eastern Idaho (Hovland and Moore 1987). Due to the fact that there are substantial anthropogenic influences in Snake River Basin, the lower 15^{th} percentile value for total phosphorus concentration was selected as a conservative estimate of the natural phosphorus concentration. In this manner, natural concentration levels for the mainstem Snake River were calculated conservatively. This initial estimate will be reviewed as additional data become available and revisions will be made as appropriate.

The estimated natural background loading concentration for the mainstem Snake River (0.02 mg/L) is most likely an overestimation of the natural loading but represents a conservative estimate for the purposes of load calculation. In addition, this concentration correlates well with other studies that have been completed and closely approximates the TP concentration identified for a reference system (relatively unimpacted) by the EPA (USEPA 2000; Dunne and Leopold 1978). Because phosphorus concentrations had dropped to below the detection limit in the Blackfoot watershed after implementation of BMPs, background was assessed at 0.02 mg/L based on the lowest 15^{th} percentile value for phosphorus. This choice of percentile addressed bias introduced by using a lower percentile that contained values below the detection limit and a lack of data located directly below the natural source of phosphorus.

Bacteria

Background bacteria colonies enter the stream from many sources not controllable through the TMDL process. Generally, these sources are from the wildlife that use the stream. In some cases, waterfowl have been shown to be a significant contributor of *E. coli* (Campbell 2001). Other studies have indicated that skunks, ground squirrels, and other small mammals may be significant contributors. No work has been done in the Raft River Subbasin to partition these sources from the overall counts. This would entail genetic differentiation of the *E. coli* found within each watershed. Rather than a detailed genetic study of the *E. coli*, DEQ opted to make some simple assumptions about the sources. The first of these is that the contributions from wildlife sources of *E. coli* are similar throughout the year. The second is that anthropogenic sources (recreation and grazing) are more heavily concentrated during the summer. If these two assumptions are met, then the uncontrollable portion, that from the wildlife sources, could be identified as the average counts for the period when anthropogenic sources are minimized. This count would vary from watershed to watershed depending on the utilization of the watershed by the local wildlife population.

Temperature

Background for temperature is considered to be the amount of heat in the water when the maximum riparian potential is met. Thus, the background temperature is the same as the LC.

Reserve

An allowance in the TMDL for a portion of the LC to be set aside for future growth is permissible and encouraged. Careful documentation of the decision making process must accompany the TMDL. This allowance for future growth must be based on existing or readily available data at the time of the TMDL development if it is to be applicable to the assumptions and calculations used to develop the TMDL loads. In the Raft River Subbasin, little discussion with the local stakeholders has occurred in regards to a reserve load. In fact, the Lake Walcott WAG has chosen to forgo the use of a reserve in the past. Further discussions with the Raft River stakeholders are required. If it is deemed feasible, a reserve may be developed in a fashion similar to the reserve the Wood River WAG used (the reserve will be developed during the implementation of the TMDL). Nevertheless, it should be noted that developing a reserve post hoc will result in more stringent load reductions than presented in the various TMDLs.

Remaining Available Load

Table 43 is a tabular summarization of the SBA and TMDL processes. The table also meets the legal definition of a TMDL such that:

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

Table 43. Raft River Subbasin TMDLs.

Creek	Pollutants	Critical Period	Critical Flow (m^3/s)[a]	Load Capacity	Background	Total Load	Margin of Safety[b]	Nonpoint Source Load Allocation	Load Reduction	Percent Reduction	Units[c]
Raft River	Bacteria	Jun-Aug	0.46	576	69	967	58	449	518	54	col/100 ml
Raft River	Temperature	Jun-Aug	0.46	4.1	4.1	6.9	0.4	3.7	3.2	46	$kwh/m^2/day$
Raft River	Sediment	Mar-May	0.46	951	951	5,626	Imp	951	4,675	83	Mg/year
Cassia Creek	Sediment	Mar-May	0.5	437	437	2,763	Imp	437	2,326	84	Mg/year
Cassia Creek	Nutrients	Mar-May	0.5	4.32	0.86	8.42	0.43	3.02	5.40	64	kg/day
Cassia Creek	Bacteria	Mar-May	0.5	576	41	937	58	477	460	49	col/100 ml
Fall Creek	Nutrients	May-Oct	0.03	0.13	0.05	0.29	0.01	0.06	0.23	78	kg/day
Fall Creek	Bacteria	May-Oct	0.03	576	84	1114	58	434	680	61	col/100 ml
Lake Fork Creek	Nutrients	May-Oct	0.04	0.17	0.07	0.27	0.02	0.09	0.18	68	kg/day
Sublett Creek Upper	Nutrients	May-Oct	0.11	0.48	0.19	0.39	0.05	0.24	0.15	39	kg/day

[a] m^3/s = cubic meters per second. [b] imp = implicit. [C] kg/day = kilograms per day, col/100 ml = colonies of bacteria per 100 milliliters, $kwh/m^2/day$ = kilowatt hours per square meter per day, Mg/year = metric tons per year.

There are no point sources within the watersheds. Therefore, no WLAs were made. Nonpoint sources were allocated by subwatershed. It is incumbent upon the land management agencies and private individuals to develop the appropriate BMPs to meet the nonpoint source LAs during the implementation plan development. A finer allocation based upon land ownership, land use, or another mechanism is not needed so long as water quality targets can be met by the aggregate reductions of those sources that are prescribed a reduction in load through the implementation plan. Reach by reach sediment allocations based upon stream bank erosion inventories are presented in Tables 44 and 45 for Raft River and Cassia Creek.

Table 44. Raft River Stream Bank Erosion Estimates.

Reach	Existing		Proposed			
	Erosion Rate (Mg/mi/y)[a]	Total Erosion (Mg/y)[b]	Erosion Rate (Mg/mi/y)[a]	Total Erosion (Mg/y)[b]	Erosion Rate Percent Reduction	Percent of Existing Total Load
Utah/Idaho Border to The Narrows	197.6	2171.2	32.6	357.8	84	38.59
The Narrows	8.3	146.6	19.5	344.1	0	2.61
The Narrows to Malta	385.3	5,479.3	42.7	606.9	89	97.39
	Total Erosion (Mg/y)[b]	5,625.9		951.0	83.10	100.00

[a] Metric tons per mile per year
[b] Metric tons per year

Table 45. Cassia Creek Stream Bank Erosion Estimates.

Reach	Existing		Proposed			
	Erosion Rate (Mg/mi/y)[a]	Total Erosion (Mg/y)[b]	Erosion Rate (Mg/mi/y)[a]	Total Erosion (Mg/y)[b]	Erosion Rate Percent Reduction	Percent of Existing Total Load
Public Lands Reference	2.5	7.3	7.9	23.6	0	0.26
BLM to Cross Creek	3.4	7.4	7.3	15.9	0	0.27
Cross Creek to Clyde Creek	0.5	1.1	6.3	15.3	0	0.04
Clyde Creek to Jones Hollow	0.9	2.3	6.3	16.0	0	0.08
Jones Hollow to Conner Creek	11.8	33.7	10.7	30.6	0	1.22
Conner Creek to Park Creek	5.5	43.1	14.9	116.2	0	1.56
Park Creek to	12.7	27.1	20.7	44.1	0	0.98

Reach	Existing		Proposed			
	Erosion Rate (Mg/mi/y)[a]	Total Erosion (Mg/y)[b]	Erosion Rate (Mg/mi/y)[a]	Total Erosion (Mg/y)[b]	Erosion Rate Percent Reduction	Percent of Existing Total Load
Hudspeth Cutoff						
Hudspeth Cutoff to Malta	63.2	186.0	39.3	39.3	38	6.73
Malta to Raft River	442.4	2,455.2	24.5	136.0	94	88.85
	Total Erosion (Mg/y)[b]	2,763.2		437.0	84.19	100.00

[a] Metric tons per mile per year
[b] Metric tons per year

5.5 Implementation Strategies

The purpose of this implementation strategy is to outline the pathway by which a larger, more comprehensive, implementation plan will be developed 18 months after TMDL approval. The comprehensive implementation plan will provide details of the actions needed to achieve load reductions (set forth in the TMDL) and a schedule of those actions and will specify monitoring needed to document actions and progress toward meeting state water quality standards. These details are typically set forth in the plan that follows approval of the TMDL. In the meantime, a cursory implementation strategy is developed to identify responsible parties, set a time line, and establish a monitoring strategy for determining progress toward meeting the TMDL goals outlined in this document.

Overview

The objective of the Raft River TMDLs is to allocate allowable loads among different pollutant sources so that the appropriate control actions can be taken and water quality standards achieved. The total pollutant load on these water bodies is derived from nonpoint and background sources. The creators of the Raft River Subbasin TMDLs have attempted to consider the effect of all activities and processes that cause or contribute to the water quality limited conditions of not just the water bodies listed on the 1998 §303(d) list, but the effects of these activities and processes on all water bodies within the §303(d) listed watersheds. Control measures to implement this TMDL do not contain NPDES authorities, but are based on the reasonable assurance that state and local authorities will take actions to reduce nonpoint source pollution. The Raft River TMDLs have LAs calculated with margins of safety to meet water quality standards. The allocations; however, are based on estimates that have used available data and information. Therefore, monitoring for the collection of new data is necessary and required. The reasonable assurance that the Raft River Subbasin TMDLs will meet the water quality standards is based on two components: 1) nonpoint source implementation of BMPs based on land management agencies' assurance that reductions will occur; and 2) trend monitoring that will be used to document relative changes in wtaer quality over a 25-year period.

Responsible Parties

Development of the final implementation plan for the Raft River Subbasin TMDLs will proceed under the existing practice established for the state of Idaho. The plan will be cooperatively developed by DEQ, the Raft River committee of the Lake Walcott WAG, the affected private landowners, and other "designated agencies" with input via the established public process. Of the four entities, the WAG committee will act as the integral part of the implementation planning process to identify appropriate implementation measures. Other individuals may also be identified to assist in the development of the site-specific implementation plans as their areas of expertise are identified as beneficial to the process.

Designated state agencies are responsible for assisting with preparation of specific implementation plans, particularly for those sources for which they have regulatory authority or programmatic responsibilities. Idaho's designated state land management agencies are:

- Idaho Department of Lands (IDL): timber harvest, oil and gas exploration and development, mining.
- Idaho Soil Conservation Commission (ISCC): grazing and agriculture.
- Idaho Department of Transportation (IDT): public roads.
- Idaho Department of Agriculture (IDA): aquaculture, animal feeding operations (AFOs), CAFOs.
- Department of Environmental Quality: all other activities.

To the maximum extent possible, the implementation plan will be developed with the participation of federal partners and land management agencies (i.e., NRCS, USFS, BLM, U.S. Bureau of Reclamation, etc.). In Idaho, these agencies, and their federal and state partners, are charged by the CWA to lend available technical assistance and other appropriate support to local efforts/projects for water quality improvements.

All stakeholders in the Raft River Subbasin have a responsibility for implementing the TMDLs. DEQ and the designated agencies in Idaho have primary responsibility for overseeing implementation in cooperation with landowners and managers. The general responsibilities of the designated agencies are outlined below.

- DEQ will oversee and track overall progress on the specific implementation plan and monitor the watershed response. DEQ will also work with local governments on urban/suburban issues.
- IDL will maintain and update approved BMPs for forest practices and mining. IDL is responsible for ensuring use of appropriate BMPs on state and private lands.
- ISCC, working in cooperation with local soil and water conservation districts, IDA, and NRCS, will provide technical assistance to agricultural landowners. These agencies will help landowners design BMP systems appropriate for their property and identify and seek appropriate cost-share funds. They also will provide periodic project reviews to ensure BMPs are working effectively.

- IDT will be responsible for ensuring appropriate BMPs are used for construction and maintenance of public roads.
- IDA will be responsible for working with aquaculture to install appropriate pollutant control measures. Under a memorandum of understanding with EPA and DEQ, IDA also inspects AFOs, CAFOs, and dairies to ensure compliance with NPDES requirements.

The designated agencies, WAG members, and other appropriate public process participants are expected to:

- Develop BMPs to achieve LAs.
- Give reasonable assurance that management measures will meet LAs through both quantitative and qualitative analysis of management measures.
- Adhere to measurable milestones for progress.
- Develop a timeline for implementation, with reference to costs and funding.
- Develop a monitoring plan to determine if BMPs are being implemented, individual BMPs are effective, LAs and WLAs are being met, and water quality standards are being met.

In addition to the designated agencies, the public, through the WAG and other equivalent processes, will be provided with opportunities to be involved in developing the implementation plan to the maximum extent practical. Public participation will significantly affect public acceptance of the document and the proposed control actions. Stakeholders (landowners, local governing authorities, taxpayers, industries, and land managers) are the most educated regarding the pollutant sources and will be called upon to help identify the most appropriate control actions for each area. Experience has shown that the best and most effective implementation plans are those that are developed with substantial public cooperation and involvement.

Feedback Loop and Adaptive Management

The feedback loop is a component of the Raft River Subbasin TMDL strategy that provides for accountability of plan goals for various pollutants. As part of the TMDL process, the Raft River TMDLs will use adaptive management as a style and process whereby management of the watershed is initiated by the state, federal agencies, and the water user industries. then, an evaluation process will ascertain the direction in which the reductions are progressing, and, based on monitoring information collected from various agencies, organizations, and water users, the goals, targets, and BMPs will be refined based on short-term and long-term objectives for ecosystem management of the Raft River Subbasin. Past management experiences may be used to evaluate both success and failure and to explore new management options where necessary. By learning from both successes and failures, the Raft River TMDL will be iterative to allow implementation of those techniques which may be most useful and helpful, as well as gain insights into which practices best promote recovery for restoration of beneficial uses and state water quality standards (Williams et al. 1997).

For the Raft River Subbasin the main goals are to reach the preliminary in-stream water quality target of 576 col/100 ml *E. coli* for all tributaries and to maintain the low TSS annual mean value already existing in most of the other systems. An additional goal is to reach the preliminary in-stream water quality target of 0.05 mg/L TP for the stream systems feeding Sublett Reservoir. These preliminary targets are set up in this way to allow for modifications in the targets over the next 10-15 years as necessary to attain beneficial uses and state water quality standards. The final goal is to develop and implement BMPs along Cassia Creek and Raft River that enable perennial flow to be maintained in these two systems. At that time the nutrient, temperature, bacteria, and sediment TMDLs will become realistic management goals.

In order for the feedback loop to be successful in the Raft River TMDLs, a concrete mechanism has to be designed with short-term and long-term goals for DEQ, other agencies, and the Raft River citizen groups. These entities must regularly review implementation progress and monitoring results and evaluate plan effectiveness. Sufficient flexibility in management plans must be incorporated to allow for corrections in management strategies that may not be effective in achieving beneficial uses or meeting state water quality standards. Nonpoint source industries will follow the feedback loop by: 1) identifying critical water quality parameter(s), 2) developing site-specific BMPs, 3) applying and monitoring BMPs, and 4) evaluating effectiveness of BMPs by comparing established water quality standards and modifying the BMPs where needed to achieve water quality goals.

DEQ will review all monitoring results and will provide an opportunity for the Raft River residents and EPA to review and comment. Each industry should provide summary review reports to DEQ on its monitoring efforts, strategies, and on-going reduction mechanisms. Each industry should provide its own data in its reports. Based on these reports and other data, the Raft River Subbasin TMDL will be revised accordingly as an iterative plan. All industry plans will also be iterative and further developed through adaptive management as new knowledge and technology is discovered for pollution reduction efforts.

Additionally, because of the diverse nature of the partnerships and commitments within the Raft River Subbasin citizen groups from various agencies, organizations, and water users, both restoration and education efforts will be guided by DEQ via the SCC. The citizen groups will take advantage of technical knowledge, experience, existing management plans, and resources in determining which types of activities are appropriate for continued implementation of the Raft River Subbasin TMDL. The Raft River committee of the Lake Walcott WAG will continue to meet as needed. If needed, a technical advisory committee may be developed through the SCC and DEQ. As a result, the citizen groups would have available to them the technical expertise of biologists, hydrologists, range conservationists, foresters, and other water quality and watershed specialists. Monitoring done by the various agencies, organizations, and water users will be evaluated by DEQ, the technical advisory committee (if formed), and citizen groups as a feedback mechanism. This will provide to the citizens of the Raft River Subbasin an evaluation that is scientifically based, an understanding of local constraints. Scientific knowledge will be adapted to the task of watershed restoration by the residents of the subbasin almost immediately.

Monitoring and Evaluation

The objectives of a monitoring effort are to demonstrate long-term recovery, better understand natural variability, track implementation of projects and BMPs, and track effectiveness of TMDL implementation. This monitoring and feedback mechanism is a major component of the "reasonable assurance of implementation" for the TMDL implementation plan.

The implementation plan will be tracked by accounting for the numbers, types, and locations of projects, BMPs, educational activities, and other actions taken to improve or protect water quality. The mechanism for tracking specific implementation efforts will be reports to be submitted to DEQ.

The "monitoring and evaluation" component has two basic categories:

- Tracking the implementation progress of specific implementation plans; and
- Tracking the progress of improving water quality through monitoring physical, chemical, and biological parameters.

Monitoring plans will provide information on progress being made toward achieving TMDL allocations and achieving water quality standards, and will help in the interim evaluation of progress as described under the adaptive management approach.

Implementation plan monitoring has two major components:

- Watershed monitoring and
- BMP monitoring.

While DEQ has primary responsibility for watershed monitoring, other agencies and entities have shown an interest in such monitoring. In these instances, data sharing is encouraged. The designated agencies have primary responsibility for BMP monitoring.

Watershed Monitoring

Watershed monitoring measures the success of the implementation measures in accomplishing the overall TMDL goals and includes both in-stream and in-river monitoring. Monitoring of BMPs measures the success of individual pollutant reduction projects. Implementation plan monitoring will also supplement the watershed information available during development of associated TMDLs and fill data gaps.

In the Raft River Subbasin TMDLs, watershed monitoring has the following objectives:

- Evaluate watershed pollutant sources,
- Refine baseline conditions and pollutant loading,
- Evaluate trends in water quality data,
- Evaluate the collective effectiveness of implementation actions in reducing pollutant loadings, and
- Gather information and fill data gaps to more accurately determine pollutant loading.

BMP/Project Effectiveness Monitoring

Site or BMP-specific monitoring may be included as part of specific treatment projects if determined appropriate and justified and will be the responsibility of the designated project manager or grant recipient. The objective of an individual project monitoring plan is to verify that BMPs are properly used, maintained, and working as designed. Monitoring for pollutant reductions at individual projects typically consists of spot checks, annual reviews, and evaluation of advancement toward reduction goals. The results of these reviews can be used to recommend or discourage similar projects in the future and to identify specific watersheds or reaches that are particularly ripe for improvement.

Evaluation of Efforts Over Time

Reports on progress toward TMDL implementation will be prepared to provide the basis for assessing and evaluating progress. Documentation of TMDL implementation activities, actual pollutant reduction effectiveness, and projected load reductions for planned actions will be included. If water quality goals are being met, or if trend analyses show that implementation activities are resulting in benefits that indicate that water quality objectives will be met in a reasonable period of time, then implementation of the plan will continue. If monitoring or analyses show that water quality goals are not being met, the TMDL implementation plan will be revised to include modified objectives and a new strategy for implementation activities.

Implementation Time Frame

The implementation plan must demonstrate a strategy for implementing and maintaining the plan and the resulting water quality improvements over the long term. The timeline should be as specific as possible and should include a schedule for BMP implementation and/or evaluation, monitoring schedules, reporting dates, and milestones for evaluating progress. An initial general timeline is presented in Table 45. There may be disparity in the timelines for different subwatersheds. This is acceptable as long as there is reasonable assurance that milestones will be achieved. A definitive timeline for implementing the TMDL and the associated allocations will be developed as part of the implementation plan. This timeline will be developed in consultation with the WAG, the designated agencies, and other interested publics.

The implementation plan will be designed to reduce pollutant loads from sources to meet TMDLs, their associated loads, and water quality standards. DEQ recognizes that where implementation involves significant restoration, water quality standards may not be met for quite some time. In addition, DEQ recognizes that technology for controlling nonpoint source pollution is, in some cases, in the development stages and will likely take one or more iterations before effective techniques are developed.

Table 46. Implementation strategy goals for nonpoint sources.

Industry	Year 1.5	Year 3	Year 5	Year 15	Year 25
Agriculture	Develop implementation plan for private lands	Begin BMP[a] implementation	Document BMP implementation progress for DEQ database	Reevaluate targets and reductions	Meet reviewed TMDL targets; beneficial uses fully supported
Grazing	Federal agencies review allotment management plans	Begin allotment management adjustments as necessary	Document BMP implementation progress for DEQ database	Reevaluate targets and reductions	Meet reviewed TMDL targets; beneficial uses fully supported
DEQ	Maintain database; review NPS[b] efficacy data; seek funding	Collect data to determine water quality trend	Collect data to determine water quality trend, BMP effectiveness, and beneficial use support	Reevaluate targets and reductions, assess beneficial uses	Collect data to determine water quality trend, BMP effectiveness, and beneficial use support

[a] BMP = Best management practices.
[b] NPS = nonpoint source

5.6 Conclusions

The Raft River SBA and TMDL analysis has been developed to comply with Idaho's TMDL schedule. The SBA describes the physical, biological, and cultural setting; water quality status; pollutant sources; and recent pollution control actions in the Raft River Subbasin located in south central Idaho. The first part of this document, the SBA, is an important first step in leading to the actual development of TMDLs or pollution budgets for the water quality limited streams of the subbasin. The starting point for this assessment was Idaho's current 1998 §303(d) list of water quality limited water bodies. Six segments in the Raft River Subbasin were on this list. However, there were 24 water body/pollutant combinations. An additional water body, Lake Fork Creek, was assessed due to reservoir monitoring needs, bringing the total number of potential TMDLs to 25. The SBA portion of this document examined the current status of all of these waters, and defined the extent of impairment and causes of water quality limitation throughout the subbasin. Sediment, nutrients, temperature, and bacteria are the listed pollutants in the subbasin. These pollutants were listed for the listed water bodies within the subbasin on the 1996 §303(d) list. Other listed pollutants and stressors include habitat alteration, flow alteration, ammonia, salinity, and unknown. By far the most influential stressor, as noted by the SBA, was flow alteration. In general, the impacts to the beneficial uses were determined by assessing the biological communities and the limited water chemistry data available. When these two data sets were in agreement with one another, appropriate actions, such as completing a TMDL or delisting the stream, were undertaken.

To this end, it was determined that eight different TMDLs should be completed. Of the original listed water bodies DEQ proposes to delist none of the creeks. It was also determined that Lake Fork Creek, while not impaired by excess nutrients itself, was impairing Sublett Reservoir with excess nutrients. All other parameters studied in Lake Fork Creek were of exceptional quality during the assessment phase.

Often times the beneficial uses of all the creeks were impacted by flow alteration, which obscured the impacts, if any, of the other pollutants. Flow and habitat alteration issues were not discussed at great length in the assessment portion due to current DEQ policy. It is DEQ policy that flow and habitat alterations are pollution, but not pollutants for which TMDLs can be written. These forms of pollution will remain on the §303(d) list; however, TMDLs for these two parameters will not be completed on segments listed with altered flow or habitat as a pollutant at this time.

The next phase was the development of the loading analysis or pollution budgets for the eight different water body/pollutant combinations. The loading analysis quantifies pollutant sources and allocates responsibility for load reductions needed to return listed waters to a condition of meeting water quality standards. In addition, the pollution budgets must contain background levels, MOS, and seasonallity components.

The LC for each water body/pollutant combination was developed using the information gathered during the assessment phase. The most important of this information was the hydrography of a stream and time of the year in which the various beneficial uses were likely to be impaired by specific pollutants. Only three streams in the subbasin have USGS gauge information available. For the remaining streams a relationship with this gauged data was developed to predict the hydrology. In all but one case the relationship was significant and included much of the variability of the data.

Another component of LC is the targets for the different pollutants. In general, DEQ adopted targets developed in other TMDLs. For example the Raft River and Cassia Creek sediment targets include percent bank stability which was presented in TMDLs from the Idaho Falls Regional Office, and suspended sediment targets of 50 mg/L TSS as presented in TMDLs developed in the TFRO. In addition to these sediment targets, DEQ adopted nutrient targets from guidelines and recommendations from EPA. These targets are 0.100 mg/L TP in free flowing streams and 0.050 mg/L for streams entering into a lake or reservoir.

Seasonality plays a strong role in the Raft River Subbasin. In most cases, the beneficial uses are impacted during the summer months. The pollutants typically causing the impairments are sediment, nutrients, and bacteria. The change in pollutants has a strong correlation to grazing activities in the different watersheds, although no statistical interpretation of this correlation was made. In general, the rise in pollutants also coincided with summer base flow conditions. Therefore, the LC and other subsequent calculations were made using summer base flow or other appropriate design flows as indicated in the state water quality standards, such as greater than 1 cfs for cold water aquatic life.

A MOS is required in the TMDL regulations of the CWA to account for uncertainty in the TMDL and how that budget restores beneficial uses. In the Raft River Subbasin TMDLs the MOS was two-fold. The first of these was an explicit margin of 10 percent. It is often difficult to pin down the MOS in other TMDLs. The explicit margin allows DEQ greater freedom in other aspects of the TMDL process in that the implicit MOS can be assumed rather than arduously explained at every turn. That being said, the Raft River Subbasin TMDLs include an implicit MOS as well. The best example of this may lie in the bacteria TMDLs determination of background. The background levels used in these TMDLs may be slightly higher than actual background levels, as determined from other watersheds. These elevated levels reduce the available load for WLAs and Las, thereby providing an implicit margin for each watershed. In future studies the actual background level may be determined which in turn would reduce the implicit MOS. Therefore the explicit margin is a required element of these TMDLs.

As we move forward with implementation of the Raft River Subbasin TMDLs local stakeholders and concerned publics should see the value of adaptive management. As our understanding of the water quality issues grows so should our ability to change the current TMDLs. This is especiallyimportant as the current TMDLs were based upon a limited amount of data collected in a short amount of time.

Future iterations of the *Raft River Subbasin Assessment and Total Maximum Daily Loads* will include newly listed §303(d) listed water bodies. These will be added as addendum.