SUB-BASIN ASSESSMENT AND TOTAL MAXIMUM DAILY LOADS OF LAKES AND STREAMS LOCATED ON OR DRAINING TO THE RATHDRUM PRAIRIE (17010305)

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1. Executive Summary

The streams and lakes flowing or draining to the Rathdrum-Spokane Aquifer are assessed. The section 303(d) listed streams are Fish and Rathdrum Creeks. The listed lakes are Hauser, Hayden, Spirit and Twin Lakes. The sub-basin assessment reviews the existing data for the streams and lakes. The Spokane River's water temperature is assessed. Sediment model results are provided for Fish and Rathdrum Creek. The assessment finds that the temperature limitation of the Spokane River is caused by natural conditions. It recommends the river be redesignated as a seasonal cold water biota supported by a temperature standard reflecting temperatures attained during hot, dry summers. The assessment recommends nutrient total maximum daily loads (TMDLs) be developed for Hauser, Hayden and Twin Lakes. Dissolved oxygen limitation of Hauser Lake is dependent on total phosphorous reductions. The most recent monitoring data (1993-1999) indicates that Spirit Lake is meeting and is often below its total phosphorous goal of 12 ug/L. Dissolved oxygen data indicates the lake meets the standards. Biotic data and sediment modeling of Fish and Rathdrum Creeks indicate these water bodies are not water quality limited by sediment. Both water bodies are well below or near the threshold of 50% above background sedimentation rates. Bacteria analyses indicate the standards are met for Fish and Rathdrum Creeks as well as Upper Twin Lake. Although nutrient data demonstrates Fish and Rathdrum Creeks are not limited by nutrients, the nutrient TMDL developed for Twin Lakes will, by necessity, address Fish and Rathdrum Creeks.

No TMDLs are required for the Fish Creek, Rathdrum Creek and Spirit Lake. Bacteria and sediment TMDLs are not required for Twin Lakes. Sediment TMDLs are not required for Hayden, Spirit or Twin Lakes. The Department of Environmental Quality will be de-listing these segments for these pollutants as part of its 2002 303(d) listing process.

If the Spokane River is redesignated as recommended, its three segments will meet the more appropriate standards. The TMDLs for temperature of the Spokane River are deferred until the redesignation process has proceeded to its end point. The nutrient TMDL should address the dissolved oxygen limitation of Hauser Lake. The dissolved oxygen TMDL for Hauser Lake is deferred until nutrient limitation has an opportunity to reduce the lake productivity and oxygen demand. The recommendations of the sub-basin assessment for TMDL development, segment - pollutant de-listing and TMDL deferment are summarized in Table 1.

Total phosphorous total maximum daily loads (TMDLs) have been developed for Hauser, Hayden and Twin Lakes based on the goals of their respective lake management plans and nutrient loading analyses. The TMDLs allocate yearly total phosphorous loads to the sources of phosphorous to the lakes and apportions total phosphorous load reductions required of the manageable sources.

Lake management plans addressing nutrients reductions have been developed for Hauser, Hayden, and Twin Lakes. These plans will serve as the starting points for TMDL implementation plans for the three lakes.

Table 1: Results of sub-basin assessment based on application of the available data.

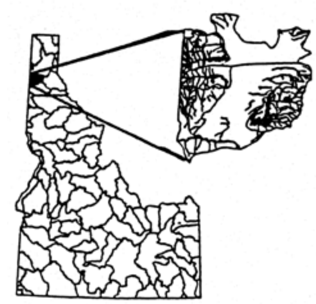
Water body Name and HUC Number	**Assessed Support Status**	**Reasons segment to be de-listed for pollutant**	**Reason TMDL deferred**
Spokane River 17010305 3552	CWB temperature standard exceeded	N.A.	TMDL deferred until temperature and/or beneficial use standards reviewed/revised
Spokane River 17010305 3553	CWB temperature standard exceeded	N.A.	TMDL deferred until temperature and/or beneficial use standards reviewed/revised
Spokane River 17010305 4554	CWB temperature standard exceeded	N.A.	TMDL deferred until temperature and/or beneficial use standards reviewed/revised
FishCreek 17010305 3561	Sediment modeling and nutrient data indicate cold water biota supported.	Sediment modeled at below 50% above background. Nutrients concentrations of Fish Creek well below stream guidelines. Twin Lakes nutrient TMDL will address Fish Creek	N.A.
Twin Lakes 17010305 7561 .	CWB impaired by nutrients; nutrient TMDL required.	CWB not impaired by sediment. Sediment not impacting salmonid sight feeding beneficial use directly; listing in error	N.A
Rathdrum Creek 17010305 3560 .	Sediment modeling and nutrient data indicate cold water biota supported. Bacteria standard not exceeded indicating secondary contact recreation supported.	Sediment below 100% above background and near lowest threshold of 50% above background. Nutrient concentrations below stream guidelines. Nutrient TMDL for Twin Lakes will address Rathdrum Creek. Bacteria standard not exceeded.	N.A.
Hauser Lake17010305 3562	CWB impaired by nutrients; nutrient TMDL required. CWB impaired by dissolved oxygen deficit created by organic matter resulting from lake productivity	N.A.	Dissolved oxygen TMDL deferred until nutrient reduction approach is assessed to determine if dissolved oxygen recovers.
Hayden Lake 17010305 7555	CWB threatened by nutrients; nutrient TMDL required.	CWB not impaired by sediment. Sediment not impacting salmonid sight feeding beneficial use directly; listing in error	N.A.
Spirit Lake 17010305 3438	CWB supported by measured dissolved oxygen, and nutrients. CWB not impaired by sediment.	Sediment not impacting salmonid sight feeding beneficial use directly; listing in error. Dissolved oxygen meeting water quality standards. Total phosphorous at or below the lake plan goals.	N.A.

Note: N.A. - Not Applicable

2. SUB-BASIN ASSESSMENT OF LAKES AND STREAMS LOCATED ON OR DRAINING TO THE RATHDRUM PRAIRIE (17010305)

2.0 Rathdrum-Spokane Sub-basin Water Quality at a Glance

<u>Water Quality at a Glance:</u>



Hydrologic Unit Code.................... 17010305
Water Quality Limited Segments..... Hauser Lake; Hayden Lake; Spirit Lake; Fish Creek-Twin Lakes-Rathdrum Creek
Beneficial Uses affected................. Cold Water Biota, salmonid Spawning, Primary Contact Recreation
Pollutants of Concern..................... Nutrients, sediment, D.O. and bacteria
Known Land Uses........................... Forestry, agriculture, urban

2.0.1 Prologue:

The impact of the trace (heavy) metals cadmium, lead and zinc on the Spokane River has been addressed in assessments of the Spokane River and the Coeur d'Alene Lake Plan (Gugliomone, 1992; IDEQ, 1996a). A total maximum daily load document has been developed for these pollutants (IDEQ, 1998a; EPA, 2000). This subbasin assessment addresses the nonmetallic pollutants of concern for the entire subbasin. For background on the Spokane River, the reader is referred to the documents cited.

2.1. Characterization of the Watershed

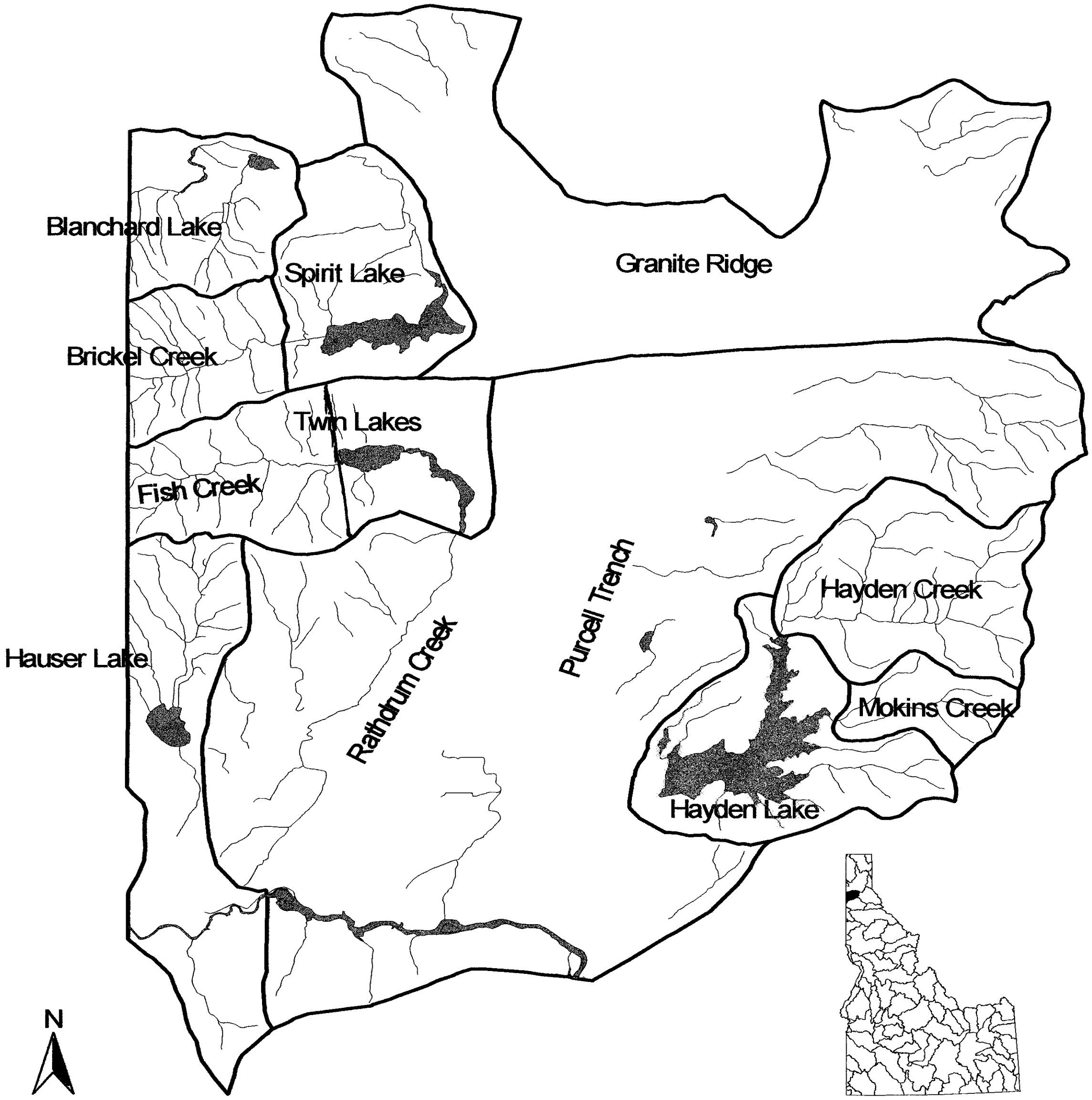
The Rathdrum Prairie is a 209 square mile area located west of the Coeur d'Alene Mountains, north of Coeur d'Alene Lake and south of Lake Pend Oreille (Figure 1). In addition to the two large lakes, five smaller lakes (Blanchard, Hauser, Hayden, Spirit and Twin) are located at the fringes of the prairie. Streams flow from the mountains adjacent to the prairie, either into the lake basins or onto the prairie, where these streams dewater rapidly to the underlying Rathdrum-Spokane Aquifer. The lakes at the margin of the prairie discharge in part, (Blanchard, Coeur d'Alene, Pend Oreille and Twin), or nearly wholly, to the aquifer (Hauser, Spirit and Hayden). The Spokane River traces the southern boundary of the watershed on its route from Coeur d'Alene Lake to the Washington border. The majority of the population of northern Idaho lives in the subbasin on or adjacent to the prairie.

2.1.1. Physical and Biological Characteristics

2.1.1.1 Climate

The Rathdrum Prairie sub-basin is located in the Northern Rocky Mountain physiographic region

Figure 1: Rathdrum Aquifer Watershed (HUC 17010305)

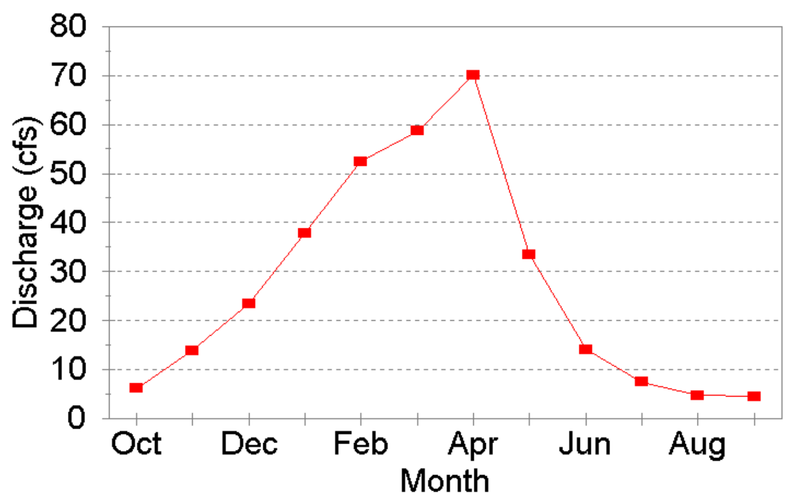


to the west of the Bitterroot Mountains. The local climate is influenced by both pacific maritime air masses from the west as well as continental air masses from Canada to the north. The annual weather cycle generally consists of cool to warm summers with cold and wet winters. The relative warmth of summers or winters depends on the dominance of pacific or continental air masses. Precipitation amounts are most generous in the winter months. Precipitation takes the form of rain on the prairie and in the adjacent mountains below 3,000 feet of elevation, while it is in the form of snow in the mountains above 4,500 feet. The transitional zone between 3,000 and 4,500 feet holds a transient snow pack, which is subject to rapid melt when warm wet pacific air masses predominate. The result of these snow melt events is high discharge rain on snow events.

2.1.1.2. Hydrology

The average discharge hydrograph of Hayden Creek near its mouth is provided in Figure 2 (USGS, 1992-1997). The hydrograph is representative of streams of the sub-basin. The discharge of the streams of the sub-basin is dominated by the spring snowmelt. The streams draining the Coeur d'Alene and Selkirk Mountains have watersheds predominantly in the elevation range (3,000 - 4,500 feet) subject to winter "rain on snow" discharge events. The relative low elevation of the watersheds causes earlier maximum discharge (early-April), than from the majority of the watersheds of the Coeur d'Alene Mountains to the east or the Selkirk Mountains to the north. The lakes discharge to the aquifer with no back flow from the aquifer to the lakes. Lake levels are controlled by tributary stream discharge from their watersheds and the rate of discharge to the aquifer. The levels of Coeur d'Alene, Pend Oreille and Twin Lakes are controlled by discharge structures.

Figure 2: Hayden Creek Discharge
1992-1997



2.1.1.3 Land Forms, Geology and Soils

The Rathdrum Prairie is a large sand, gravel and cobble deposit resulting from the out wash of the Pleistocene Missoulian floods. The deposit is believed to have partially or wholly impounded Coeur d'Alene Lake as well as Hayden, Hauser, Twin and Spirit Lakes (Anderson, 1927). The prairie deposit is ringed by mountainous lands to the east (Coeur d'Alene Mountains), north, west and south (Selkirk Range). A gap in the Selkirk Range at the southwest edge of the prairie is the outlet for both the Spokane River as well as the Rathdrum-Spokane Aquifer.

The watersheds of the sub-basin draining the western flank of the Coeur d'Alene Mountains are generally underlain by rocks of the Belt Supergroup meta-sedimentary terrain. Isolated granitic intrusions and Miocene basalt flow formations are found in these watersheds as well. The Belt terrene weathers to predominantly silt size particles with rounded cobbles as the primary transitional material found in the higher gradient streams. The Selkirk Range forms the watersheds of streams flowing from the north and west to the lakes or the prairie. The range is a granitic formation. However, some remnant Belt geologies exist in some watersheds. These granitic substrates weather to sandy substrates. The predominant bedload of these streams is sand. Soils of the Coeur d'Alene Mountain watersheds are silty and stony podzols developed under predominantly cool conditions and mixed coniferous forest. Soils of the Selkirk Mountain watersheds are sandy podzols developed under predominantly cool conditions and mixed coniferous forest.

Tributaries to the lakes flowing from the mountains are high gradient streams (Rosgen B) channels. Streams flowing onto the prairie are similar. As these streams enter the prairie formation, an abrupt transition to lower gradient channels occurs in their final half miles. Streams quickly dewater into the sands and gravels. The lakes discharge to the prairie formation to feed the Rathdrum-Spokane Aquifer. Blanchard, Hauser Hayden and Spirit Lakes have either no or modest outlets which rapidly dewater. The exception is Twin Lakes, which forms Rathdrum Creek. This Creek flows at the edge of the prairie for approximately seven miles before it dewaters into the prairie gravels.

2.1.1.4. Vegetation

The predominant vegetation of the Coeur d'Alene and Selkirk Mountains, adjacent to the prairie, is mixed coniferous forest at higher elevations. Dominant conifers of the mixed forest are pines, true fir, Douglas fir, tamarack and red cedar. Cottonwood, aspen and alder are the predominant broadleaf species. Lower elevation slopes supported a dryer ponderosa pine forest, which was kept sparse by a more frequent fire occurrence. Fire suppression in the past ninety years has caused the conversion of most of these stands to Douglas fir forest. Riparian areas would be dominated by cottonwood, alder and red cedar. The prairie was grassland with a stony surface prior to European settlement. This vegetation formation was likely maintained by frequent burning practiced by the indigenous peoples. The grasslands and wooded areas would have expanded and contracted dependent on the fire cycle.

2.1.1.5. Aquatic Fauna

The native salmonids of the sub-basin's streams are cutthroat trout, whitefish and bull trout. Sculpin, shiners and bullhead catfish are also natives. The tailed frog, giant salamander and turtles completed the vertebrate species. The fish fauna of the lakes and some streams have been greatly altered by the introduction of several trouts, salmon and warm water species. A detailed discussion of the current fishery of Coeur d'Alene Lake is available in the Coeur d'Alene Lake Management Plan (IDEQ, 1996a). Similar introductions were made to the smaller lakes of the sub-basin with the collateral impact to their tributary streams. Although the lakes and some streams have highly altered aquatic fauna due to introductions, some headwater streams retain native species with the addition of rainbow and brook trout and the loss of bull trout. Although fish composition appears stable in the headwaters, fish abundance is generally believed to be reduced from historic levels observed during settlement of the area.

2.1.2 Cultural Impacts:

The watersheds of the Coeur d'Alene and Selkirk Mountains which drain to the lakes or directly to the prairie formation are managed primarily for timber production and dispersed recreation. Timber management has been moderately intense with large clear-cut areas and dense road development. Land management in this area is primarily by the U.S. Forest Service in the Coeur d'Alene Mountains. Large tracts of private industrial and private forestland exist in the Selkirk Mountains. The Inland Empire Paper Company has large timber land holdings in the watersheds of Hauser, Twin and Spirit Lakes as well as the watersheds draining south to the prairie formation. Near the population center of Coeur d'Alene, Hayden Lake and Dalton, timber management has been less intense to protect scenic values. Some forested watersheds were logged using railroad systems (Hayden and Fish Creeks).

Agriculture on the Rathdrum Prairie is primarily bluegrass seed and small grain production. No streams are present on the prairie to be affected by these practices. Agricultural burning (Falter and Hallock, 1987) has been suggested as a source of atmospheric nutrient deposition to the lakes, but the level of contribution has not been quantified. Grazing occurs on some tributaries to the lakes. Lancaster Creek, a tributary to Hayden Creek, and Fish Creek, as well as the shoreline of Upper Twin Lake, remain areas of intense cattle grazing. Grazing continues in the Brickel Creek watershed, which is the primary tributary to Spirit Lake. Cattle have been excluded from the stream by fencing.

The Rathdrum Prairie sub-basin has the largest population concentration in northern Idaho. The main population center in the sub-basin is the City of Coeur d'Alene on the northern shore of the lake. The Hayden, Hayden Lake and Dalton communities are arrayed along the eastern edge of the prairie. Many residences are located in the watersheds of tributaries to the lakes or streams flowing onto the prairie. The city of Post Falls is located along the Spokane River six miles west of Coeur d'Alene. Rathdrum is located on the western edge of the prairie. Twin Lakes Village is located at the foot of Twin Lakes, while the City of Spirit Lake is located to the north near Spirit Lake. The town of Athol is situated on the northeast edge of the prairie. Rural residences and businesses are found across the prairie and in the adjacent mountains. Lakeside residences and cabins fill the shores of all the lakes. The cities of Coeur d'Alene, Post Falls, Hayden, Hayden Lake, Dalton and Rathdrum have centralized sewage collection and treatment. Many rural residences and lakeside homes or cabins use on-site wastewater treatment systems of varying efficiency. Lot size restrictions have been imposed on the Rathdrum Prairie to protect the Rathdrum-Spokane Aquifer from contamination. For additional information on the land use and demographics of the Coeur d'Alene Basin refer to the Coeur d'Alene Lake Management Plan (IDEQ, 1996a).

2.2. Regulatory Requirements:

2.2.1. Segments of Concern:

The stream segments listed in 1998 under Section 303(d) Clean Water Act for nonmetallic pollutants in sub-basin 17010305 are provided in Table 1. Two additional water bodies had been listed on the 1996 list. These were Mokins Creek (17010305 3557), which was listed for nutrients, sediment and habitat alteration and Brickel Creek (17010305 3437, which was listed for sediment. Mokins and Brickel Creeks were removed from the list when analysis of more recent water quality data provided scores sufficiently high for delisting (IDEQ 1996b).

Table 1: List of 1998 Section 303(d) Clean Water Act listed water bodies.

Water body Name	**HUC Number**	**Boundaries**	**Pollutant(s)**
Spokane River	17010305 3552	CdA Lake to Huetter	Temperature
Spokane River	17010305 3553	Huetter to Post Falls Bridge	Temperature
Spokane River	17010305 4554	Post Falls Bridge to WA Border	Temperature
Fish Creek	17010305 3561	WA Border to Twin lakes	Nutrients and sediment
Twin Lakes	17010305 7561		Bacteria, nutrients and sediment
Rathdrum Creek	17010305 3560	Twin Lks Outlet to E. Green acres Diversion	Nutrients and sediment
Hauser Lake	17010305 3562		Dissolved oxygen and nutrients
Hayden Lake	17010305 7555		Nutrients and sediment
Spirit Lake	17010305 3438		Nutrients, dissolved oxygen and sediment

2.2.2 Beneficial uses:

Of the listed water bodies, the Spokane River, Hauser, Hayden, Spirit and Twin Lakes have beneficial uses specifically designated in the Idaho Water Quality Standards (IDAPA 58.01.02.)(IDEQ, 2000). Beneficial uses of the other water bodies listed (Fish and Rathdrum Creeks) would be by interpretation of the standards, cold water biota and secondary contact recreation (IDAPA 58.01.02101.01.a).

The Spokane River (P-3, P-4) has designated uses in the Idaho water quality standards (IDAPA 58.01.02110.12.) of domestic water supply, agricultural water supply, cold water biota, primary and secondary contact recreation and salmonid spawning. Twin Lakes (P-13) have designated uses of domestic water supply, agricultural water supply, cold water biota, primary and secondary contact recreation (IDAPA 58.01.02110.12.). Hayden Lake (P-5) has designated uses of domestic water supply, agricultural water supply, cold water biota, salmonid spawning and primary and secondary contact recreation (IDAPA 58.01.02110.12.). It is designated as a special resource water as well. Hauser Lake (P-16) has designated uses of domestic water supply, agricultural water supply, cold water biota, primary and secondary contact recreation (IDAPA 58.01.02110.12.). Hauser and Twin Lakes have salmonid spawning protected for future use. Spirit Lake (P-9) has designated beneficial uses of domestic water supply, agricultural water supply, cold water biota, salmonid spawning, primary and secondary contact recreation and special resource water (IDAPA 58.01.02110.05.)

The Idaho Water Quality Standards and Wastewater Treatment Requirements are currently undergoing major revision under the Idaho Administrative Procedures Act requirements. Among the revisions are changes to the designated uses of several water bodies including those listed in Table 1. Agricultural water use would be dropped from all these water bodies. Secondary contact recreation is dropped as redundant, when primary contact recreation is designated. Primary contact recreation requires more stringent support criteria than secondary contact recreation. The protection of salmonid spawning for future use is dropped for Hauser and Twin Lakes. These changes have been adopted by the Idaho Board of Health & Welfare and approved by the Legislature. These changes are currently under review by the EPA.

2.2.3. Water Quality Criteria:

Water quality criteria supportive of the beneficial uses are stated in the Idaho Water Quality Standards and Wastewater Treatment Requirements (IDHW 1996b). The standards supporting the beneficial uses are outlined in Table 2. In addition to these standards cold water biota and salmonid spawning are supported by two narrative standards. The narrative sediment standard states:

Sediment shall not exceed quantities specified in section 250 or, in the absence of specific sediment criteria, quantities, which impair designated beneficial uses. Determinations of impairment shall be based on water quality monitoring and surveillance and the information utilized as described in Subsection 350.02.b. (IDAPA 58.01.02.200.08).

The excess nutrients standard states:

Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other aquatic growths impairing designated beneficial uses. (IDAPA 58.01.02.200.06).

Table 2: Water quality criteria supportive of beneficial uses.

Designated Use	Primary Contact Recreation	Secondary Contact Recreation	Cold Water Biota	Salmonid Spawning
Coliforms and pH	406 EC/100mL	576 EC/100mL	pH between 6.5 and 9.5	pH between 6.5 and 9.5
Coliforms and dissolved gas	126 EC/100mL geometric mean over 30days	126 FC/100mL geometric mean over 30 days	dissolved gas not exceeding 110%	dissolved gas not exceeding 110%
chlorine			total chlorine residual less than 19 ug/L/hr or an average 11 ug/L/4 day period	total chlorine residual less than 19 ug/L/hr or an average 11 ug/L/4 day period
toxics substances			less than toxic substances set forth in 40 CFR 131.36(b)(1) Columns B1, B2, D2	less than toxic substances set forth in 40 CFR 131.36(b)(1) Columns B1, B2, D2
dissolved oxygen			exceeding 6 mg/L D.O.	exceeding 5 mg/L intergraval D. O.; exceeding 6 mg/L surface
temperature			less than 22°C (72°F) instantaneous; 19°C (66°F) daily average	less than 13°C (55°F) instantaneous; 9°C (48°F) daily average
ammonia			low ammonia (formula/tables for exact concentration	low ammonia (formula/tables for exact concentration
turbidity			less than 50 NTU instantaneous greater than background; 25 NTU over 10 days greater than background	

2.3. Water Quality Concerns and Status:

2.3.1 Pollutant Sources

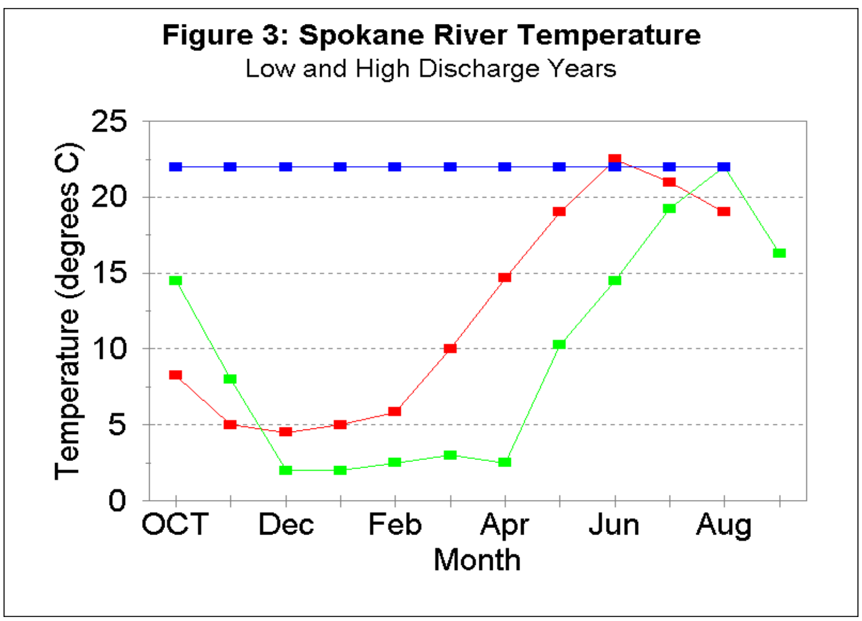
The water bodies listed in the sub-basin have reported pollutant exceedences for one or more of the following pollutants: bacteria, nutrients, sediment, dissolved oxygen and temperature. Bacterial contamination would be predominantly from livestock grazing. Some bacterial contamination may be from insufficient treatment of human wastes at lakeshore cabins. Excess nutrients normally are the result of human residential development or livestock grazing activities in the waters under assessment. Nutrients may also naturally build up in a lake over time causing a naturally eutrophic lake. Shallow lakes, which have limited water flow through the lake on an annual basis, are more likely to be eutrophic. Any water body, which has its source in a nutrient enriched lake, will itself be rich in nutrients. Sediment is a water constituent naturally yielded by watersheds to water bodies.

Excess sedimentation most often has its origin in roads developed for logging or access to a watershed. Roads may yield sediment directly from their surfaces or bed through mass wasting or their locations may cause the adjacent stream to begin bank and channel cutting. Dissolved oxygen may be deficient in lakes and some streams as the result of the presence of biological oxygen demanding materials. Often eutrophic lakes have sufficient algal and weed growth to engender dissolved oxygen problems. Dissolved oxygen deficits normally appear initially in the hypolimnetic waters of lakes, which thermally stratify. Streams often have insufficient dissolved oxygen as a result of temperature exceedences. Oxygen solubility declines with increased water temperature. Temperature exceedences in these waters are often due either to insufficient water flow, alteration of the stream structure to a broad shallow morphology or lack of riparian vegetation to supply shading. Streams which have their source in shallow warm lakes often are warm as well.

2.3.2. Available Water Quality Data:

2.3.2.1. Spokane River

Water temperature data has been collected on the Spokane River by the US Geological Survey at its Post Falls gauging station, Idaho Department of Environmental Quality, Spokane River Dischargers Group and others. Gugliomone (1992) summarized much of this data. During the late summer months of drought years, the Spokane River exceeds the temperature criteria (Figure 3) for cold water biota and salmonid spawning.



Note: Red: Low discharge year; Green: High discharge year; Blue: Temperature standard

The river is formed by the discharge of Lake Coeur d'Alene. A natural discharge control at the outlet of the lake governed discharge from the lake prior to creation of the Post Falls impoundment (Davenport, 1921). Water entering the river is epilimnion water from the upper surface of the lake. During summer conditions this water is the warmest in the lake (Woods and Beckwith, 1996).

The Post Falls, prior to impoundment, was 8 feet lower than the lake outlet. Surveys completed by the Army Corp of Engineers in the late 1940s indicate the lowest elevation of the outlet cross section is 2,118 feet, while the lowest point of the pre-development Post Falls is 2,110 feet (Stockinger, 1998). Under pre-development conditions, the mid to late summer flow of the Spokane River would have been low, dependent on the year. This discharge would consist of warm epilimnion water. The water would traverse a channel capable of carrying up to 30,000 cubic feet per second high flow discharges. It is most probable that the Spokane River was generally shallow and not well shaded during the summer low flow conditions. The Spokane River below the Post Falls Dam generally meets this description today under low flow conditions. Thus the warm water from the lake may have been further heated as it traversed the Spokane River. Thermal exceedence most likely occurred during summer low flow conditions prior to dam development.

The effect of the Post Falls Dam has been to impound the river upstream to the lake, enlarge the lake surface area and increase the retention time of water in the channel above the dam. The river continues to receive warm epilimnetic water during the summer months. The water held in the channel above the dam is deeper, but is retained for a longer period. For this reason it is more resistant to warming than a shallower stream configuration, but the water is retained for a longer period to warm. The Post Falls Dam might function to marginally increase thermal gain by the river during summer low flow conditions as a result of lake surface augmentation and change in the retention time of the water. The marginal increase would be in the range of one or two degrees centigrade. Since the lake epilimnion can exceed the cold water biota standard by four to five degrees centigrade during a warm summer (Woods and Beckwith, 1996), the effect of the dam is not critical to the temperature exceedences. The only feasible remedy would be dam removal.

The summer thermal limitation of the Spokane River is probably a natural situation caused by its source of lake epilimnion water and some additional warming in the channel. These conditions would occur with or without human intervention, although the Post Falls Dam likely adds some thermal gain. Since the limitation is of natural origins, no feasible corrective strategy exists. The Spokane River should be redesignated as seasonal cold water biota to account for its natural thermal gain and delisted for temperature.

2.3.2.2. Twin Lakes Watershed (Fish Creek -Twin Lakes - Rathdrum Creek):

2.3.2.2.1 Fish Creek:

Fish Creek is the largest tributary to Upper Twin Lake accounting for 88.6% of the annual discharge to Twin Lakes (Falter and Hallock, 1987). Waters of Upper Twin Lakes move through a narrow channel into Lower Twin Lake.

Habitat assessment by DEQ beneficial use reconnaissance teams of two reaches of the stream indicated an average residual pool volume of 9,181 ft^3/mile. Compared to other streams of its size in granitic terrenes, this is a respectable level of pool volume (IDEQ, 1998b). Macroinvertebrate data collected in 1995, 1996, 1998 and 1999 results in macroinvertebrate biotic indices in excess of 3.5 in every case except one (Appendix D). A single measurement of 3.37 occurred at the upper stream site in June 1995. Subsequent measurement in 1996, 1998 and 1999 result in MBI scores well in excess of 3.5. A modeled sediment yield from the stream is provided in the section below. Few impacts to the stream are apparent with the exception of the lower one-half mile, along which bank damage from grazing has occurred.

Bacteria were measured in Fish Creek during the summer 1999. Bacteria levels in the creek were 115 *Escherichia coli* (E. Coli) per 100 mL. The value does not exceed the trigger value of 126 E. coli per 100 mL.

Plant growth nutrient (total phosphorous and nitrogen) concentrations were measured in Fish Creek as part of the investigation of the nutrient loading of Twin Lakes (Falter and Hallock, 1987). The total phosphorous concentration guideline for nuisance weed growth in streams is 100 ug/L (USEPA, 1986). In a flowing stream, nitrogen would be primarily in the nitrate-nitrite forms. The guideline for excess nitrate is 300 ug/L as nitrogen (Sawyer, 1947; Müller, 1953). None of the concentrations measured approach these guidelines.

2.3.2.2.2 Twin Lakes:

The limnology of the Twin Lakes was investigated in depth by Falter and Hallock (1987). Both Upper and Lower Twin Lakes were assessed by Falter and Hallock (1987) as moderately productive oligo-mesotrophic to mesotrophic. The assessment was based on annual nutrient loads, in-lake phosphorous and chlorophyll a concentrations, Secchi depths (the depth at which a bicolor disc can be observed in the water to measure clarity), hypolimnetic oxygen depletion, algal biovolume and species, benthic fauna and macrophyte cover. Algal bioassay of an earlier eutrophication survey indicated that phosphorous was the limiting nutrient to vegetation growth. Lake data suggested primary limitation by nitrogen throughout the sampling year (USEPA, 1977a). A phosphorous loadings of 645.5 kg P/year to the upper lake and 537.5 kg P/year to the lower lake were estimated (Falter and Hallock, 1987). Loadings from human activities were estimated to be 109 kg/year (16.6%) to the upper lake and 61 kg/year (11%) to the lower lake. A relatively short retention time (0.29 years) and extensive growths of macrophytes reduce some effects of the moderately high phosphorous loads to the upper lake. Phosphorous processing in the upper lake reduces impacts in the lower lake (Falter and Hallock, 1987).

The estimated two years averaged sources of nitrogen and phosphorous contribution to the Twin Lakes from various sources is provided in Table 3. It should be noted the contribution of grazing in the Table 3 is to the upper lake only and does not account for nutrient loading to lower Fish Creek from grazing.

Table 3: Estimated two year (1985-86) averages of the nitrogen and phosphorous contribution to Upper and Lower Twin Lakes by source.

a) Upper Twin Lake

Source	Total N (kg)	% of Total N Loading	Total P (kg)	% of Total P Loading
Tributaries	5,300	73.1	568	76.8
Precipitation	1,521	20.9	77	10.4
Wastewater	164	2.3	31	4.3
Grazing	240	3.4	39	5.4
Internal	---	---	23	3.1
Motorboats	25	0.3	0.1	0.0
Total	7,250	100	738	100

b) Lower Twin Lake

Source	Total N (kg)	% of Total N Loading	Total P (kg)	% of Total P Loading
Tributaries	5,443	77.1	305	57.7
Precipitation	1,230	17.6	63	12.0
Wastewater	317	4.7	59	11.1
Internal	---	---	101	19.2
Motorboats	43	0.6	0.1	0.0
Total	7,033	100	528	100

A water quality management plan has been developed for the Twin Lakes. The plan has a goal of 25% reduction (CLCC, 1991).

Citizens volunteer water quality monitoring (CVMP) has assessed the Secchi depth, total phosphorous and chlorophyll a concentration of Upper and Lower Twin Lakes for six of the nine summer seasons between 1992 and 1999 (Mosier, 1999; Appendix C). The average Secchi depths of the upper and lower lakes over this period are 2.7 and 3.8 meters. T he upper lake did not exceed a Secchi depth of 4 meters, while the lower lake did not exceed a Secchi depth of 5 meters. Average total phosphorous in the surface waters of the upper lake was 29.8 ug/L, while the water near the bottom averaged 29.6 ug/L. These values essentially identical because the upper lake is shallow, eutrophic and does not stratify. Average total phosphorous in the surface waters of the lower lake is 15.4 ug/L, while the water near the bottom averaged 141.7 ug/L. These data indicate the deeper, lower lake stratifies in the summer months, is mesotrophic and the bottom waters become sufficiently low in oxygen (anoxic) to allow the release of phosphorous from the bottom sediments. Chlorophyll a concentration is a measurement of lake productivity. The upper lake has an average chlorophyll a concentration of 7.1 ug/L, while the lower lake averaged 3.8 ug/L. These data indicate the shallow upper lake is nearly twice as productive in algal as the lower lake. The data collected by the citizens supports the view that the upper lake is eutrophic, but too shallow to stratify and allow anoxic conditions which would mobilize phosphorous from its sediments. The upper lake is likely a phosphorous sink. The CVMP data indicates the lower lake is mesotrophic. A large component of the lake's phosphorous is supplied from bottom sediment during anoxic conditions. The data values have not shifted greatly since the work completed by Falter and Hallock (1987).

The CVMP monitoring collected a few bacteria samples during the summer 1999 (Appendix C). *Escherichia coli* (*E. coli*) numbers near the upper lake boat ramp averaged at 27 per 100 mL. Only one sample was collected in the channel between the upper and lower lakes. This sample had 400 *E.coli* per 100 mL. Two bacteria samples were collected in the lower lake near Echo Beach. These contained 23 and 11 *E. coli* per 100 mL. *Escherichia coli* was measured at the upper lake boat ramp and near Echo Beach in the lower lake. Both samples were below the detection limit of 2 per 100 mL. These data indicate bacteria does not exceed the current trigger values in the lakes. The channel measurement does not exceed the primary contact recreation instantaneous standard, but additional measurements should be made.
Sediment contribution to the upper lake is primarily from Fish Creek. This sediment source has declined in recent years. Sediment contribution to the lower lake is minimal. Examination of Secchi measurements of the lake early in the season (May and early June) indicates a pattern of higher clarity (4-5 meters) during and shortly after the high runoff period (Appendix C). This result indicates that sediment delivery is not exceeding the salmonid sight-feeding standard. Turbidity of 25 NTU (chronic standard) would equate to a Secchi depth of approximately 0.5 meters. Fisheries population information provided by Fish and Game do not indicate that sediment impairs in lake spawning. The original listing that sediment was exceeding a water quality standard was in error. Other than the impact of sediment bound phosphorous on the phosphorous concentration of the lake, an impact of sediment to a beneficial use of the lake could not be demonstrated.

2.3.2.2.3 Rathdrum Creek:

Rathdrum Creek receives the discharge from Lower Twin Lake. The lake filters out any upstream sediment sources. Although the stream is listed for nutrients and sediment, no data could be located on sediment loads. Sediment would be expected from bank erosion and the only major tributary, Spring Creek, flowing from Rathdrum Mountain. This creek enters Rathdrum Creek below the majority of its course. Field inspection of the stream found generally stable banks except for isolated areas within the City of Rathdrum. The stream has fine sediment over most of its course with a little cobble near the Spring Creek confluence. Habitat assessment by DEQ beneficial use reconnaissance teams indicated no pools and no residual pool volume. The single beneficial use assessment of the stream provided a low macroinvertebrate biotic index (Appendix D). An explanation of the low MBI score may be the sand bottom nature of the stream. A sandy bed would have lower species diversity and lower diversification of May, stone and caddis flies. Although electrofishing was not conducted, fish were noted as present in the stream. Sediment modeling of Fish and Rathdrum Creeks provided in the next section.

Rathdrum Creek received 87 kg P/year and 2391 kg N/year from lower Twin Lake (Falter and Hallock, 1987). Mean total phosphorous concentration was 10.5 ug/L (range 4 - 20 ug/L). Mean total nitrogen concentration was 265 ug/L (range 180 - 360). The total phosphorous concentration of the outlet water was nearly an order of magnitude lower than the guideline of 100 ug/L normally applied for nuisance weed growth in streams (USEPA, 1986). In a flowing stream, nitrogen would be primarily in the nitrate-nitrite forms. The guideline for excess nitrate is 300 ug/L as nitrogen (Sawyer, 1947; Müller, 1953). The concentrations measured in Rathdrum Creek are generally below the guideline.

No cultivated agriculture is practiced along Rathdrum Creek. The creek traverses pasture and hay lands. Some grazing occurs along the stream (Brown, 1999). Nutrients could enter the creek from septic systems along the course of the creek between Twin Lakes Village and the City of Rathdrum. Twin Lakes Village has a community wastewater treatment system currently discharging to a drain field well removed from the stream. The City of Rathdrum has a centralized sewage collection system (Gaffney, 1999). No surveys of septic systems or their competency have been made of systems along Rathdrum Creek (Hale, 1999).
Bacteria were assessed in Rathdrum Creek. Bacteria concentrations of 420 E. coli per 100 mL were measured. The value does not exceed the 576 fecal coliform per 100-mL secondary contact recreation trigger value.

2.3.2.2.4 Sedimentation Estimates for Fish and Rathdrum Creeks:

2.3.2.2.4.1 Land Use and Road Density

Land use classifications and road inventory data are provided in Table 4. These data were developed from photo-orthoquads covering the two watersheds. After inspection of the watersheds by Idaho Department of Lands specialists, cumulative watershed effects (CWE) scores were developed. These scores are estimates, which are developed by a team approach. Sediment model assumptions and documentation are provided in Appendix A. Sediment model spreadsheets are provided in Appendix B.

2.3.2.2.4.2 Sediment Yield and Export Coefficients

Sediment yields were developed separately for agricultural, forestlands and forest roads.

2.3.2.2.4.2.1 Agricultural land sediment yield and export.

Sediment yield was estimated from agricultural lands (rangeland, pasture and dry agriculture) using the Revised Universal Soil Loss Equation (RUSLE) (equation 1)(Hogen, 1999).

Equation 1: A = (R)(K)(LS)(C)(D) tons per acre per year where:
: A is the average annual soil loss from sheet and rill erosion
: R is climate erosivity
: K is the soil erodibility
: LS is the slope length and steepness

: C is the cover management and
: D is the support practices.

RUSLE does not take into account bank erosion, gully erosion or scour. RUSLE applies to cropland, pasture, hayland or other land, which has some vegetation improvement by tilling or seeding. Based on these soils characteristics of the agricultural and the slope, sediment yield was developed for the agricultural lands of each watershed. The yield coefficients are provided in Table 5.

Bank erosion, caused by agricultural practices, was independently estimated based on data developed for Wolf Lodge Creek. The fieldwork required to develop more accurate estimates was not permitted by the private landowner.

Table 4: Land use and roads of the Fish and Rathdrum Creek Watersheds.

Watershed	Fish Creek[1]	Spring Creek[1]
Pasture (ac)	452	81
Forest Land (ac)	13,690	1,584
Unstocked Forest Land (ac)	800	0
Highway (ac)	0	0
Ave road density (mi/mi ^{2})	4.0	4.8
Forest Roads (mi)	92.9	12.6
Forest road xing frequency	0.8	2.0
Road Crossing number	75	25
Encroaching Road (mi)	5.6	3.5
CWE score	28	12
Unpaved county & private roads (mi)	2.0	1.0
Paved county roads (mi)	0	1.7

2.3.2.2.4.2.2 Forest land sediment yield and export.

Forest land sediment yield was based on sediment production rates used in the Forest Service WATSED Model (Patten, 1998.). This is 25 tons per square mile per year with a range from 22-35 for the Kaniksu granitic terrene. The mean value was used for all forestland except that not stocked with trees to the number required by the Idaho Forest Practices Act. The highest values in the range were used for non-stocked (unstocked) forestlands. The lowest value was applied to highway rights of way. These values were divided by 640 acres per square mile to convert them to tons per acre per year (Table 6). Sediment yield from forestlands was estimated by applying the sediment yield coefficients to the land area in forest use (Table 4).

Table 5: Estimated sediment yield coefficients for pasture

Watershed	Fish Creek	Spring Creek
Pasture (ton/ac//yr)	0.025	0.03

Table 6: Estimated sediment yield coefficients for forestland uses on the terrenes of the watersheds.

Land use type sediment export coefficient	Kaniksu Granitic
Forest land (tons/ac/yr)[2.]	0.038
Unstocked land (tons/ac/yr)[2.]	0.055
Highway (tons/ac/yr)[3.]	0.034

Table 7: Estimated sediment export based on land use for Fish Creek and Rathdrum Creek's only sediment producing stream, Spring Creek.

Watershed	Fish Creek	Spring Creek
Pasture/ dry ag (tons/yr)	11.3	2.4
Forest Land (tons/yr)	520.3	60.2
Unstocked Forest Land (tons/yr)	44.0	0

Highway (tons/yr)	0	0
Bank erosion (tons/yr)	15.5	0.0
Land use total (tons/yr)	591.1	62.2

2.3.2.2.4.2.3 Forest Roads

Forest road sediment yield was estimated using a relationship between CWE score and the sediment yield per mile of road (IDEQ, 1999, Figure 6). The relationship was developed for roads on a Kaniksu granitic terrane in the LaClerc Creek watershed and is directly applicable to the Fish and Rathdrum Creek watersheds (McGreer, 1998). The watershed CWE score was used to develop a sediment tons per mile, which was multiplied by the estimated road mileage associated with stream crossings in the watershed. These values are reported as ton fine sediment per year (Table 7). In the case of roads, it was assumed that all sediment was delivered to the stream system. This is a conservative over estimate of actual delivery.

Unlike the Belt Supergroup terrane, which produces significant amounts of cobble as a weathering product, the Kaniksu granitic weather primarily to coarse and fine sands. Accordingly the bedload is primarily a sandy substrate.

2.3.2.2.4.2.4 Sedimentation Estimates

Sedimentation estimates were developed by addition of the various sediment yields (Table 8; Appendix B). The values reflect delivery of all sediment to the channel. Land use and bank erosion estimates for Rathdrum Creek are added to the sediment yield from its tributary, Spring Creek.

Table 8: Estimated sediment export of watersheds listed for sediment impairment from roads.

Watershed	Fish Creek	Rathdrum Creek
Land use sediment (tons/yr)	591.1	129.8
Forest Roads	90.5	42.3
County & Private Roads	9.5	5.1
Total sediment (tons/yr)	691.1	177.2

Estimated backgrounds based on the assumption of totally forested watersheds would be 567.8 and 115 tons per year. Fish Creek sediment modeling provides a value 21.7% above the natural background, while Rathdrum Creek sediment modeling provides a value 54% above natural background. Model results for neither creek exceed the 100% above natural background and threshold indicative of water quality impairment, while Fish Creek is below the 50% above natural background lower limit and Rathdrum Creek is only 4% above this lower limit (Washington Forest Practices Board, 1995).

2.3.2.2.5 Fish Population Data:

Sedimentation can interfere with natural trout recruitment and cause the filling of pools. The impact should be reflected in the trout populations. Trout population density has been assessed in some tributaries of the lakes by DEQ beneficial use reconnaissance teams (IDEQ, 1998b). Brook and cutthroat trout are the salmonids found in Fish Creek. Trout population densities (salmonid/m^2/ hour effort) were 0.072 and 0.230 in the two reaches of Fish Creek assessed. Sculpin populations (sculpin/m^2/ hour effort) were 0.028 and 0.061. Three age classes of brook trout, the most abundant fish, were found. Fish populations were not assessed in Rathdrum Creek. Reference streams, in the Priest Lake Basin (Two Mouth and Trapper Creeks), range from 0.1 - 0.3 salmonid/m^2/hour effort and 0.1 - 0.5 sculpin/m^2/hour effort (IDEQ, 1999). It is necessary to default to these reference streams, because no appropriate references have been assessed in the sub-basin. Fish density can be affected by other factors such as harvest and disease. In this case, however, fish densities and age class distribution data support the conclusion that Fish Creek is not water quality limited by sediment.

Twin Lakes was a west slope cutthroat trout fishery prior to European settlement of the area. Trout remains an important part of the fishery with some tributary production of trout. Tributary trout production is insufficient to support the lake population under fishing pressure. The trout population is augmented by stocking. Upper Twin Lake becomes too warm to support trout during August and September of most summers. Warm water species have been introduced to the lakes. Bass, pike, crappie, sunfish and bullhead catfish make up the important warm water biota (Horner, 1999).

2.3.2.3. Hayden Lake:

2.3.2.3.1 Limnology and Nutrient Loading

The limnology of the Hayden Lake was investigated in depth by Soltero and Associates (1986) and Bellatty (IDEQ, 1990). Hayden Lake was assessed as oligotrophic bordering on mesotrophy. The assessment was based on nutrient concentration, primary productivity and chlorophyll a concentrations. Algal bioassay of an earlier eutrophication survey indicated that phosphorous was the limiting nutrient to vegetation growth. During spring and fall, while nitrogen limits growth during the summer (USEPA, 1977b). Later more detailed investigations, by Soltero and his associates (1986), Bellatty (1990) and the Panhandle Health District (PHD 1994) indicate that phosphorous is the nutrient limiting algal growth in Hayden Lake. Volunteer monitoring completed between 1990 and 1999 indicates that phosphorous, chlorophyll a and clarity have remained rather stable at the mid lake station. The ten-year average total phosphorous concentration for the lake in its photic zone is 7.75 ug/L. The ten-year average chlorophyll a concentration in the Secchi zone is 1.4 ug/L, while the ten-year average Secchi depth is 8.4 meters (Appendix C). These values are consistent with an oligotrophic lake, limited by phosphorous concentration (Ryding and Rast, 1989). Chlorophyll a and total phosphorous are considerably higher in near shore areas (Honeysuckle Beach) and in the shallow northern arm of the lake, while Secchi depths are more shallow. (Mosier, 1999).

Soltero and associates (1986) and later data (PHD, 1994) estimated the annual phosphorous loading at 3610 kg P/yr. The source of phosphorous loadings was estimated as 33% (1,200 kg P/yr) from the Hayden Creek watershed, 7% (240 kg P/yr) from Mokins Creek, 7% (250 kg P/yr) from the other tributaries, 17% (630 kg P/yr) from atmospheric fallout, 32% (1,170 kg P/yr) from residential storm water and 3% (120 kg P/yr) from shoreline septic systems. Water leaves Hayden Lake by evaporation, discharge to the Rathdrum Prairie Aquifer or through a very limited seasonal outlet. Effectively, phosphorous entering the lake remains in the lake system primarily in the bottom sediments.

Sediment contribution to Hayden Lake is primarily from Hayden Creek. Sediment contribution from the other tributaries is minimal. Examination of Secchi measurements of the lake early in the season (May and early June) indicates a pattern of higher clarity (5-7 meters) during and shortly after the high runoff period (Appendix C). This result indicates that fine sediment delivery is not exceeding the salmonid sight-feeding standard. Fisheries population information provided by Fish and Game do not indicate that sediment impairs in lake spawning. The original listing that sediment was exceeding a water quality standard was in error. Other than the impact of sediment bound phosphorous on the phosphorous concentration of the lake, an impact of sediment to a beneficial use of the lake could not be demonstrated.

2.3.2.3.2 Fisheries

Hayden Lake was a west slope cutthroat trout fishery prior to settlement of the area. Trout remains an important part of the fishery with significant tributary production of trout. Most trout production occurs in Hayden Creek where fishing is prohibited. Tributary trout production is insufficient to support the lake population under fishing pressure. The trout population is augmented by stocking. Warm water species have been introduced to the lake. Bass, pike, crappie, sunfish and bullhead catfish make up the important warm water biota. This fishery is limited to the bays and northern arm of this cold and deep lake. The small mouth bass, largemouth bass and crappie are managed as high quality fisheries (Horner, 1999).

2.3.2.4. Hauser Lake:

2.3.2.4.1 Limnology and Nutrient Loading

The limnology of the Hauser Lake was investigated by Entranco Engineers (1990). Hauser Lake was assessed as mesotrophic with a small margin of safety protecting it from eutrophic conditions. The assessment was based on nutrient concentration, chlorophyll a concentrations and Secchi depths. Algal bioassay of an earlier eutrophication survey indicated that phosphorous was the limiting nutrient to vegetation growth during June, while nitrogen was limiting in late summer and fall. Data from the study suggested that nitrogen might be limiting vegetation growth throughout the growing season (USEPA, 1977c).

Hauser Lake develops a low oxygenation zone which approaches anoxic conditions in the lower four meters of its depth during the late summer months when the lake is stratified (Entranco Engineers, 1990). Similar results were developed by Mossier during July 1991 (1993) and more recently during summer 1998 (IDEQ, 1998c). All three data sets indicate that the oxygen concentration is below 6 mg/L in the metalimnion portion of the water column. This condition violates the dissolved oxygen criterion protective of cold water biota use (IDAPA 58.01.02.250.02.c.1.), which excludes the hypolimnion of lakes from the dissolved oxygen standard (IDAPA 58.01.02.250.02.c.1.(3)), but not the epilimnion or metalimnion. The exceedence of oxygen standards in Hauser Lake is attributed to high lake productivity resulting from nutrient enrichment (Entranco Engineers, 1990; Mossier 1993). The production of biomass and its subsequent death and decay creates a biological oxygen demand, which can deplete dissolved oxygen below the standard. The ten-year average for chlorophyll a in the Secchi zone is 4.6 ug/L, while the ten-year average Secchi depth is 3.8 meters. The ten-year average total phosphorous is 17 ug/L (Appendix C). These values are consistent with a mesotrophic lake, limited by phosphorous concentration (Ryding and Rast, 1989).

Entranco Engineers (1990) estimated the annual phosphorous loading at 878 kg P/yr. The estimated sources of phosphorous loading were characterized as external loading (512 kg P/yr) and internal loading (366 kg P/yr). The total annual loading was estimated as 48% (418 kg P/yr) from the watershed with Hauser Creek as the single largest tributary, 33% (288 kg P/yr) from sediment release, 7% (62 kg P/yr) from atmospheric fallout (precipitation), 5% (46 kg P/yr) from aquatic plant decay, 4% (32 kg P/yr) from waterfowl and 3% (32 kg P/yr) from groundwater. The Entranco estimates did not include the loading from storm water runoff. The population density is not as high in the immediate Hauser Lake watershed as it is in the Hayden Lake watershed. The relief around the lake is also not as steep. However, Hauser Lake has many more ranchettes with livestock. Based on the development in the immediate watershed of Hauser Lake, storm water runoff contribution is estimated to be half that estimated for Hayden Lake or fifteen percent. This fifteen-percent is added to the Entranco estimates as 132 kg P/yr, revising the total phosphorous load to 1,010 kg P/yr. Water leaves Hauser Lake by evaporation, discharge to the Rathdrum Prairie Aquifer or through a very limited seasonal outlet. Effectively, phosphorous entering the lake remains in the lake system primarily in the bottom sediments.

The CVMP has monitored Secchi depth (clarity), total phosphorous and chlorophyll a concentration in Hauser Lake for six of the nine summer seasons between 1992 and 1999 (Mosier, 1999; Appendix C). Secchi depth of the lake averaged 3.7 meters and with maximum depths of 6 meters. Total phosphorous averaged 21.2 ug/L in the surface waters and 182.3 ug/L near the lake bottom. These values indicate the lake stratifies during the summer months and that the bottom waters become sufficiently low in oxygen (anoxic) to permit the release of phosphorous from the bottom sediments. The chlorophyll a concentration of the surface waters averaged 4.1 ug/L. The data collected by the CVMP is consistent with a mesotrophic lake, which is close to eutrophic conditions.

2.3.2.4.2 Fisheries

Hauser Lake was a west slope cutthroat trout fishery prior to settlement of the area. Trout remains an important part of the fishery. Tributary trout production is poor and insufficient to support the lake population under fishing pressure. The trout population is augmented by stocking. During some warm summers a large percentage of Hauser Lake's water column becomes too warm or too low in dissolved oxygen to support trout (IDEQ, 1998c). Under these conditions only a small portion of the thermocline is available as trout habitat. Warm water species have been introduced to the lake. Bass, pike, crappie, sunfish and bullhead catfish make up the important warm water biota (Horner, 1999).

2.3.2.5 Spirit Lake

2.3.2.5.1 Limnology and Nutrient Loading

The limnology of Spirit Lake was initially investigated by Soltero and Hall (1985). Their study was triggered by the concern from long time residents of the lake that the water quality had declined. Spirit Lake was assessed in this study as an oligotrophic lake, which was verging on mesotrophy. This conclusion was based on chlorophyll a concentration in the surface waters, clarity, total phosphorous concentrations and planktonic composition. Phosphorous was determined to be the nutrient limiting the algal productivity of the lake. Brickel and Birch Creeks were determined to be the primary nutrient sources to the lake accounting for 82.5% of the phosphorous loading. Lake water quality assessment was completed on the lake in 1991 (Mossier, 1993). The assessment demonstrated that the dissolved oxygen of the lake met the Idaho standard in the epilimnion and metalimnion and remained above the standard through most of the hypolimnion. Total phosphorous and chlorophyll a concentration in the surface waters were consistent with oligotrophic to mesotrophic conditions. Submergent macrophytes analysis indicated that most plants were consistent with an oligotrophic lake, while plants found in some bays were consistent with a mesotrophic lake. Citizens volunteer monitoring data provides a ten-year average Chlorophyll a concentration in the Secchi layer of 3.7 ug/L and a ten-year average Secchi depth of 4.3 meters. Ten-year average total phosphorous is 11.7 ug/L. Since 1992, when cattle were fenced off Brickel Creek, the total phosphorous average is 10.1 ug/L.

Soltero and Hall (1985) estimated the phosphorous loading from Brickel and Birch Creeks to be 1,045 kg/yr, while the loadings from precipitation and septic system leakage were estimated to be 177 kg/yr and 285 kg/yr. These latter estimates were made from literature values. Bellatty (1989) completed limited monitoring on the tributaries and modeled other phosphorous sources with yield coefficients. Based on Soltero and Hall's measured tributary phosphorous loading of 1,045 kg/yr, the estimation that this is 82.5% of the phosphorous load and the percentages developed by Bellatty (1989), background phosphorous sources are estimated at 1,000 kg/yr (78.9%), residential development (storm water) at 90 kg/yr (7.1%), domestic wastewater at 89 kg/yr (7.0%), forest harvest at 51 kg/yr (4%) and grazing at 37 kg/yr (2.9%). Nichols and Rabe (1988) demonstrated that nutrient levels doubled in lower Brickel Creek as it passed through areas grazed by cattle. The marsh near the mouth of Brickel Creek was identified as a sink for nutrients.

Sediment contribution from the tributaries is minimal. Examination of Secchi measurements of the lake early in the season (May and early June) indicates a pattern of higher clarity (3.5-5 meters) during and shortly after the high runoff period (Appendix C). This result indicates that sediment delivery is not exceeding the salmonid sight-feeding standard. Fisheries population information provided by Fish and Game do not indicate that sediment impairs in lake spawning. The original listing that sediment was exceeding a water quality standard was in error. Other than the impact of sediment bound phosphorous on the phosphorous concentration of the lake, an impact of sediment to a beneficial use of the lake could not be demonstrated.

A Spirit Lake water quality management plan was developed in 1993 by the Clean Lakes Coordinating Council (PHD, 1993). The plan set a ten-year average total phosphorous concentration goal in the Secchi layer of 12 ug/L or less. The plan contains many action items to protect the lake's water quality. As the plan was under development cattle grazing along Brickel Creek was excluded with a fencing system developed by the rancher and the Kootenai-Shoshone Soil Conservation District (Brown, 2000). Spirit Lake has met the total phosphorous goal or been below the goal, since grazing restrictions were implemented.

2.3.2.5.2 Fisheries

The native fishery of Spirit Lake would have been a cutthroat trout fishery. The dominant fishery of the lake is Kokanee Salmon. Some rainbow and cutthroat trout use the lake. Some Kokanee spawn in Brickel and Birch Creeks, but the majority (80%) are lakeshore spawners. Kokanee populations are augmented by stocking. Fingerling cutthroat trout are stocked. Brickel and Birch Creeks hold brook trout as well as Kokanee Salmon and Cutthroat Trout. Warm water fish have been introduced to the lake by private interests. The warm water species include crappie, largemouth bass, perch, pumpkinseed sunfish, bullhead catfish and northern pike. This fishery is restricted to the warm bays and the mill pond end of the lake.

2.3.3 Beneficial Use Support Status

The assessed support status of the water bodies based on the data available is provided in Table 10. The need for development of a TMDL is noted.

Table 10: Results of sub-basin assessment based on application of the available data.

Water body Name and HUC Number	**Assessed Support Status**	**Reasons segment to be de-listed for pollutant**	**Reason TMDL deferred**
Spokane River 17010305 3552	CWB temperature standard exceeded	N.A.	TMDL deferred until temperature and/or beneficial use standards reviewed/revised
Spokane River 17010305 3553	CWB temperature standard exceeded	N.A.	TMDL deferred until temperature and/or beneficial use standards reviewed/revised
Spokane River 17010305 4554	CWB temperature standard exceeded	N.A.	TMDL deferred until temperature and/or beneficial use standards reviewed/revised
Fish Creek 17010305 3561	Sediment modeling and nutrient data indicate cold water biota supported.	Sediment modeled at below 50% above background. Nutrients concentrations of Fish Creek well below stream guidelines. Twin Lakes nutrient TMDL will address Fish Creek	N.A.
Twin Lakes 17010305 7561 .	CWB impaired by nutrients; nutrient TMDL required.	CWB not impaired by sediment. Sediment not impacting salmonid sight feeding beneficial use directly; listing in error	N.A
Water body Name and HUC Number	**Assessed Support Status**	**Reasons segment to be de-listed for pollutant**	**Reason TMDL deferred**
Rathdrum Creek 17010305 3560 .	Sediment modeling and nutrient data indicate cold water biota supported. Bacteria standard not exceeded indicating secondary contact recreation supported.	Sediment below 100% above background and near lowest threshold of 50% above background. Nutrient concentrations below stream guidelines. Nutrient TMDL for Twin Lakes will address Rathdrum Creek. Bacteria standard not exceeded.	N.A.
Hauser Lake17010305 3562	CWB impaired by nutrients; nutrient TMDL required. CWB impaired by dissolved oxygen deficit created by organic matter resulting from lake productivity	N.A.	Dissolved oxygen TMDL deferred until nutrient reduction approach is assessed to determine if dissolved oxygen recovers.
Hayden Lake 17010305 7555	CWB threatened by nutrients; nutrient TMDL required.	CWB not impaired by sediment. Sediment not impacting salmonid sight feeding beneficial use directly; listing in error	N.A.
Spirit Lake 17010305 3438	CWB supported by measured dissolved oxygen, and nutrients. CWB not impaired by sediment.	Sediment not impacting salmonid sight feeding beneficial use directly; listing in error. Dissolved oxygen meeting water quality standards. Total phosphorous at or below the lake plan goals.	N.A.

Note: N.A. - Not Applicable

The TMDLs required for HUC 17010305 can be grouped in one case. A nutrient TMDL addressing Fish Creek, Twin Lakes and Rathdrum Creek can be prepared with a nutrient TMDL for Lower Twin Lake. Sedimentation of Rathdrum Creek is low. Sediment TMDLs are not required for Fish and Rathdrum Creeks. Nutrient TMDLs are required for Hauser and Hayden Lakes.

Lake management plans have been developed for Hauser, Hayden, Spirit and Twin Lakes (CLCC, 1990; PHD, 1994; PHD, 1993; CLCC, 1991). These plans contain the necessary information for TMDL development and constitute the start of implementation plans. Three lakes require total phosphorous TMDLs, while Spirit Lake is meeting or below its total phosphorous goal and for this reason does not require a TMDL.

The Spokane River exceeds temperature standards as a result of natural conditions. The stream should be redesignated as a seasonal cold water biota protected with a standard reflecting the upper limit of lake epilimnion temperatures observed during warm dry summers. This approach will recognize natural conditions. A temperature TMDL should be deferred until water quality standards issues are resolved.

2.4. Pollution Control

2.4.1. Control Efforts to Date

Pollution control efforts to date have been in place on some of the watershed requiring additional TMDL measures.

Analysis of sediment in the two watersheds of the basin listed indicates roads are the primary sediment producing infrastructures. Forest harvest methods have progressed from logging systems heavily dependent on harvest roads to those less dependent of high road densities. Most forest roads in the Fish, Hauser and Brickel and Birch Creeks watersheds belong to Inland Empire Paper Company. The company has a program through which ten miles of road are reclaimed per year in these watersheds and main haul roads have gravel applied. Application of gravel decreases the fine sediment yield by roads nearly 80%. These activities are likely responsible for lower combined CWE scores (28 -1995 to 12.5 -2000) in the Fish Creek watershed. A grazing management plan has been developed for livestock using pastures adjacent to lower Fish Creek and Upper Twin Lake (Brown, 1999) and Brickel Creek (Brown, 2000). Implementation of Fish Creek and Upper Twin Lakes grazing plans on the ground has not fully occurred. Grazing plans have been implemented on Brickel Creek. This implementation coincides with the lower total phosphorous concentrations observed in Spirit Lake since 1993.

Lake management plans have been developed for the three water quality limited lakes. These plans identify the nutrient sources and prescribe remedial approaches to limit some nutrient sources. Some approaches have been implemented. Kootenai County has implemented a "grading ordinance" as part of its building codes. A set of storm water runoff best management practices has been developed for urbanized areas around the lakes, especially Hayden Lake. Many of the residences on the shore of Hayden Lake are now served by the Hayden Area Regional Sewer Board, which collects and treats wastewater at a centralized facility (PHD, 1994). Twin Lakes Village near Twin Lakes has a sewage collection and treatment at a community facility remote from the lake (Gaffney, 1999).

2.4.2. Pollution Control Strategies

Pollution control strategies have been developed for the three lakes assessed as water quality limited. The required TMDLs for nutrient in Twin, Hauser and Hayden Lakes will closely mirror the existing lake management plans. Nutrient management of Twin Lakes will address the nutrient yield to Fish Creek both from grazing and logging practices. The Twin Lakes nutrient TMDL should address the nutrient problems in Rathdrum Creek.

Phosphorous attached to sediment can be controlled in Fish Creek by the obliteration of unnecessary encroaching forest roads and graveling of those roads still needed. Bank erosion related to grazing must also be addressed as a part of nutrients from grazing activities.

2.5 References

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3.0 Total Maximum Daily Loads for the Water Quality Limited Water Bodies Located on or Draining to the Rathdrum Prairie (17010305)

3.1. Hayden Lake Total Maximum Daily Load

3.1.1. Introduction

The limnology and water quality of Hayden Lake has been investigated in depth (Soltero et. al., 1986; Bellatty, 1990). The lake has the nutrient status and biological productivity consistent with oligotrophy bordering on mesotrophy. The lake is phosphorous limited. Phosphorous entering the lake remains in the lake or its bottom sediments, because the lake discharges nearly completely to the Rathdrum-Spokane Aquifer.

The phosphorous loading budget of the lake is provided in Table 1.

Table 1: Total Phosphorous budget of Hayden Lake (Saltero et. al., 1986; PHD, 1994)

Phosphorous Source	**Phosphorous Load (kg/year)**	**Percentage**
Hayden Creek	1,200	33%
Mokins Creek	240	7%
Other Tributaries	250	7%
Atmospheric Fallout	630	17%
Residential Storm Water	1,170	32%
Shoreline Septic Systems	120	3%
Total	3,610	99%

The Hayden Lake Watershed Management Plan (PHD, 1994) has a goal for Hayden Lake of:

: Total Phosphorous at Secchi depth of 7 ug/L (10-year average)

: Average secchi depth of 10 meters

: Minimum dissolved oxygen of 6 mg/L or 90% of saturation whichever is greater.

Average total phosphorous is designated as the primary indicator of lake productivity and water quality (PHD, 1994).

The total phosphorous ten-year average in the Secchi zone is 7.75 ug/L (Mossier, 1993; CVMP, 1992-1999, Appendix C). The ten-year total phosphorous average is 10.7% above the Hayden Lake Management Plan goal.

3.1.2. TMDL Authority

Section 303(d)(1) of the Clean Water Act requires states to prepare a list of waters not meeting state water quality standards in spite of technology based pollution control efforts and the application of best management practices for nonpoint sources. This list must include a priority ranking "... taking into account severity of the pollution and the uses to be made of such waters." The prescribed remedy for these water quality limited waters is for states to determine the total maximum daily load (TMDL) for pollutants □... at a level necessary to implement applicable water quality standards with seasonal variations and a margin of safety ...□ A margin of safety is included to account for any lack of knowledge about how limiting pollutant loads will attain water quality.

Section 303(d)(2) requires both the list and any total maximum daily loads developed by the state be submitted to the Environmental Protection Agency (EPA). The EPA is given thirty days to either approve or disapprove the state's submission. If the EPA disapproves, the agency has another thirty days to develop a list or TMDL for the state. Both the list and all TMDLs, either approved or developed by EPA, are incorporated into the state's continuing planning process as required by section 303(e).

3.1.3. Loading Capacity

Based on the management plan goal of 7 ug/L in the Secchi zone and the ten-year average phosphorous of 7.75 ug/L, a 10.7% (7.75/7.0 x 100) reduction in total phosphorous is required by the plan. Since the measured load to the lake is 3,610 kilograms total phosphorous per year, the loading capacity required to meet the management plan is 3,223 kilograms total phosphorous per year ((3,610- (3,610 X 0.107). This value is the total phosphorous loading capacity of Hayden Lake. An estimated total phosphorous load reduction of 386.3 kilograms phosphorous per year is required to meet the lake plan goal.

3.1.4. Margins of Safety

The chemical measurements used to develop the ten-year total phosphorous average and nutrient loads have a precision margin of error of 5%. Discharge measurements contain a margin of error of 5%. Based on these two errors an additive margin of safety of 10% is applied. This additional total phosphorous load is deducted from the loading capacity to develop an allocable phosphorous load of 2,901 kilograms per year (3,223 - (3,223 X 0.1). An additional margin of safety is the deposition of phosphorous mineral in the lake bottom. The level of this mechanism has not been estimated and is ignored in the loading capacity calculations.

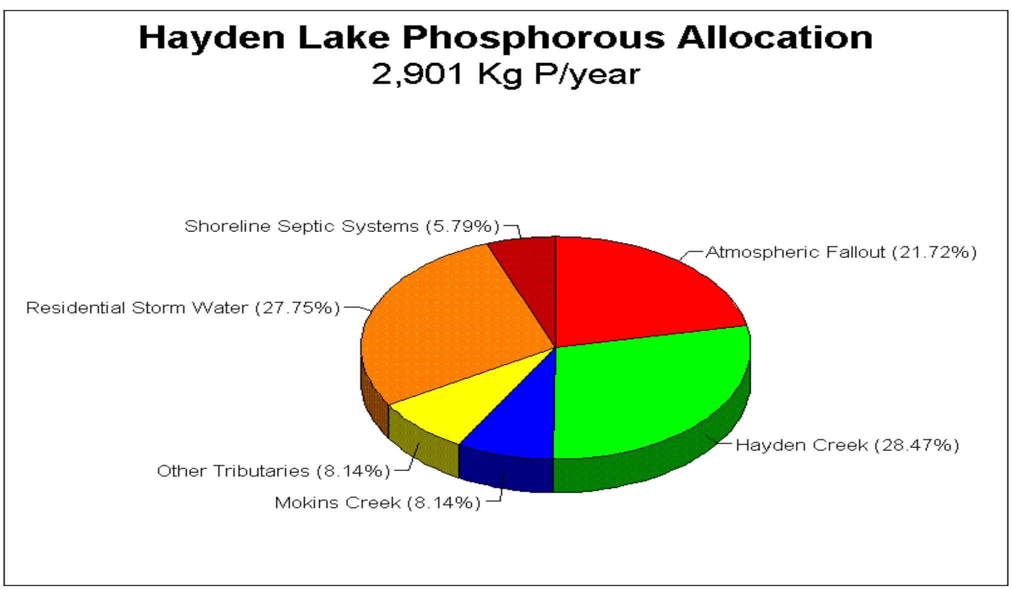
3.1.5. Total Phosphorous Load Allocation

All sources of phosphorous to Hayden Lake are nonpoint sources. Phosphorous load cannot be allocated evenly to the sources to the lake. Atmospheric fallout cannot realistically be controlled. The load allocation is constructed by removing the full load of atmospheric fallout from the allocable phosphorous load. Atmospheric fallout is 17% of the phosphorous load to the lake. Three and four-tenths percent (17%/5) is deducted from the load percentage of the five controllable sources to develop the load allocation (Table 2) (Figure 1).

Table 1: Total phosphorous allocation for Hayden Lake.

Phosphorous Source	Adjusted Percentage after Fallout Removed	Allocated Phosphorous Load (kilograms/year)	Total phosphorous load reduction required.
Atmospheric Fallout	-	630	0
Hayden Creek	36.4%	826	257
Mokins Creek	10.4%	236	74
Other Tributaries	10.4%	236	74
Residential Storm Water	35.4%	805	251
Shoreline Septic Systems	7.4%	168	53
Total	100%	2,901	709

Figure 1: Total phosphorous allocation for Hayden Lake.



3.1.6. Total Phosphorous Load Reduction Allocation

Phosphorous load reduction actions are discussed in depth in the Hayden Lake Management Plan (PHD, 1994). The sources and the responsible agencies or governments are designated in the plan's action items. The load reduction required, including the margin of safety (10%; 322 kilograms phosphorous per year) is 709 kilograms per year. The load reductions required of each source are provided in Table 2, column 4. The reductions are provided graphically in Figure 2.

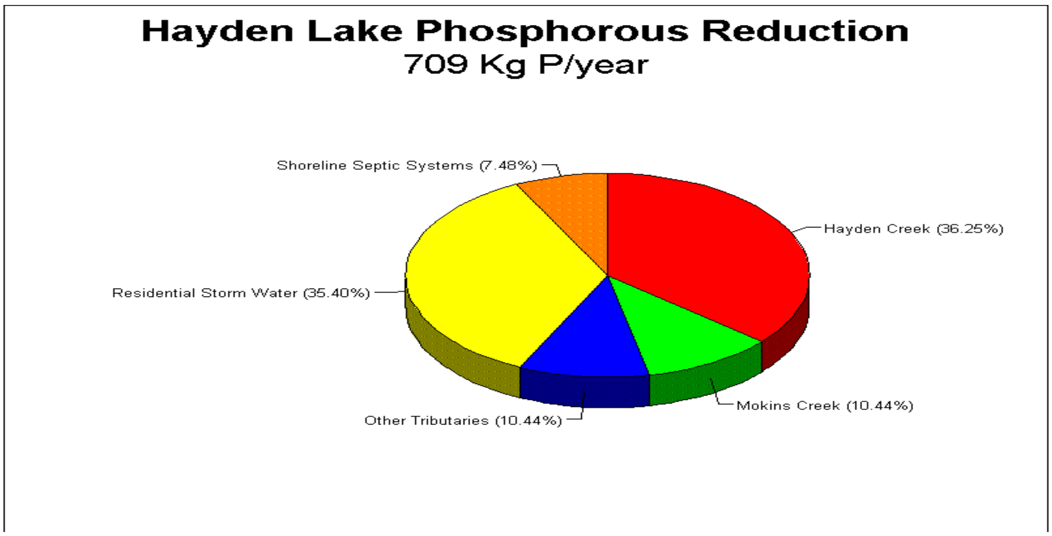


Figure 2: Hayden Lake Total Phosphorous Reductions

3.1.7. Seasonal critical conditions

The issue of critical conditions has importance in a stream which experiences radical changes in discharge (water volume) throughout the year. A lake, by its very nature as a watershed sink integrates and buffers seasonal flows. Plant growth conditions are critical during the summer months, but the growth nutrients are conserved by the lake. For this reason, lake nutrient TMDLs seek yearly reductions in the nutrient load without regard to seasonality.

3.1.8. Reasonable assurance

No point sources of nutrients are present in the watershed. The only assurance that the TMDL will be implemented is the ongoing implementation of remedial actions by Kootenai County, lakeshore owner's association and the State.

3.1.9. Monitoring Provisions

Hayden Lake has been monitored by a Citizens Volunteer Monitoring Program (CVMP) for the past ten years. The program has reliably provided phosphorous, clarity and chlorophyll a data collected during four and some years five summer months. This program will be relied upon to provide the water column data necessary to assess the effectiveness of the phosphorous load reductions required by the TMDL.

3.1.10. Feedback Provisions

Data from which the problem assessment and TMDL for Hayden Lake were developed are fairly accurate measurements. The loading analysis was completed more than a decade ago. As more up to date measurements are developed, these will be added to a revised TMDL as required.

When total phosphorous concentration declines below 7 ug/L, and remains at this level, further phosphorous load reduction will not be required of the sources. Best management practices for forest and road practices will be prescribed by a revised TMDL with erosion abatement structure maintenance provisions. Regular monitoring of the lake will be continued for an appropriate period to document maintenance of the full support.

3.1.11. References:

Bellatty, J., 1990. Hayden Lake, Kootenai County, Idaho 1987. Idaho Department of Health and Welfare, Division of Environmental Quality, Coeur d'Alene Regional Office, 2110 Ironwood Parkway, Coeur d'Alene ID 83814. 26p.

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3.2. Hauser Lake Total Maximum Daily Load

3.2.1. Introduction

The limnology and water quality of Hauser Lake has been investigated in depth (Entranco Engineers, 1990). The lake has the nutrient status and biological productivity consistent with mesotrophy deteriorating towards eutrophy. The lake is phosphorous limited. Phosphorous entering the lake remains in the lake or its bottom sediments, because the lake discharges nearly completely to the Rathdrum-Spokane Aquifer.

The phosphorous loading budget of the lake is provided in Table 1.

Table 1: Total Phosphorous budget of Hauser Lake (Entranco Engineers, 1990; CLCC, 1990)

Phosphorous Source	**Phosphorous Load (kg/year)**	**Percentage**
Hauser Creek	418	41.3%
Internal Sediment Loading	288	28.5%
Estimated Storm Water Runoff	132	13%
Atmospheric Fallout (precip)	62	6.1%
Aquatic plant decay	46	4.5%
Waterfowl	32	3.2%
Shoreline Septic Systems (ground water)	32	3.2%
Total	1,010	99.8%

The Hauser Lake Management Plan (CLCC, 1994) has a goal for the lake of reduction of surface total phosphorous. No numeric goal is provided. The average total phosphorous concentration of Hauser Lake surface water is 17.4 ug/L. A 25 % reduction would indicate the goal:

: Total Phosphorous at Secchi depth of 13 ug/L (10-year average)

The phosphorous concentration reduction would decrease algal and water plant growth, improving clarity and reducing demand for dissolved oxygen. The plan indicates that the phosphorous concentration reduction should protect clarity and would increase dissolved oxygen to meet water quality standards.

Additional goals would be:

- : Average secchi depth of 4.5 meters
- : Minimum dissolved oxygen of 6 mg/L.

Average total phosphorous is designated as the primary indicator of lake productivity and water quality. Secchi depth and dissolved oxygen concentration would be expected to increase in the surface zone as total phosphorous is reduced to 13 ug/L.

The total phosphorous ten-year average in the Secchi zone is 17.4 ug/L (Mossier, 1993; CVMP, 1992-1999, Appendix C). The ten-year total phosphorous average is 33% above the goal developed for Hauser Lake.

3.2.2. TMDL Authority

Section 303(d)(1) of the Clean Water Act requires states to prepare a list of waters not meeting state water quality standards in spite of technology based pollution control efforts and the application of best management practices for nonpoint sources. This list must include a priority ranking "... taking into account severity of the pollution and the uses to be made of such waters." The prescribed remedy for these water quality limited waters is for states to determine the total maximum daily load (TMDL) for pollutants □... at a level necessary to implement applicable water quality standards with seasonal variations and a margin of safety ...□ A margin of safety is included to account for any lack of knowledge about how limiting pollutant loads will attain water quality.

Section 303(d)(2) requires both the list and any total maximum daily loads developed by the state be submitted to the Environmental Protection Agency (EPA). The EPA is given thirty days to either approve or disapprove the state's submission. If the EPA disapproves, the agency has another thirty days to develop a list or TMDL for the state. Both the list and all TMDLs, either approved or developed by EPA, are incorporated into the state's continuing planning process as required by section 303(e).

3.2.3. Loading Capacity

Based on the management plan goal of 13 ug/L in the Secchi zone and the ten-year average phosphorous of 17.4 ug/L, a 33% (17.4/13 x 100) reduction in total phosphorous load is required to improve the water quality. Since the estimated load to the lake is 1,010 kilograms total phosphorous per year, the loading capacity required to meet the management plan is 676 kilograms total phosphorous per year ((1,010- (1,010 X 0.33). This value is the total phosphorous loading capacity of Hauser Lake. An estimated total phosphorous load reduction of 333 kilograms phosphorous per year is required to meet the nutrient reduction goal.

3.2.4. Margins of Safety

The chemical measurements used to develop the ten-year total phosphorous average and nutrient loads have a precision margin of error of 5%. Discharge measurements contain a margin of error of 5%. Based on these two errors an additive margin of safety of 10% is applied. This additional total phosphorous load is deducted from the loading capacity to develop an allocable phosphorous load of 608 kilograms per year (676 - (676 X 0.1).

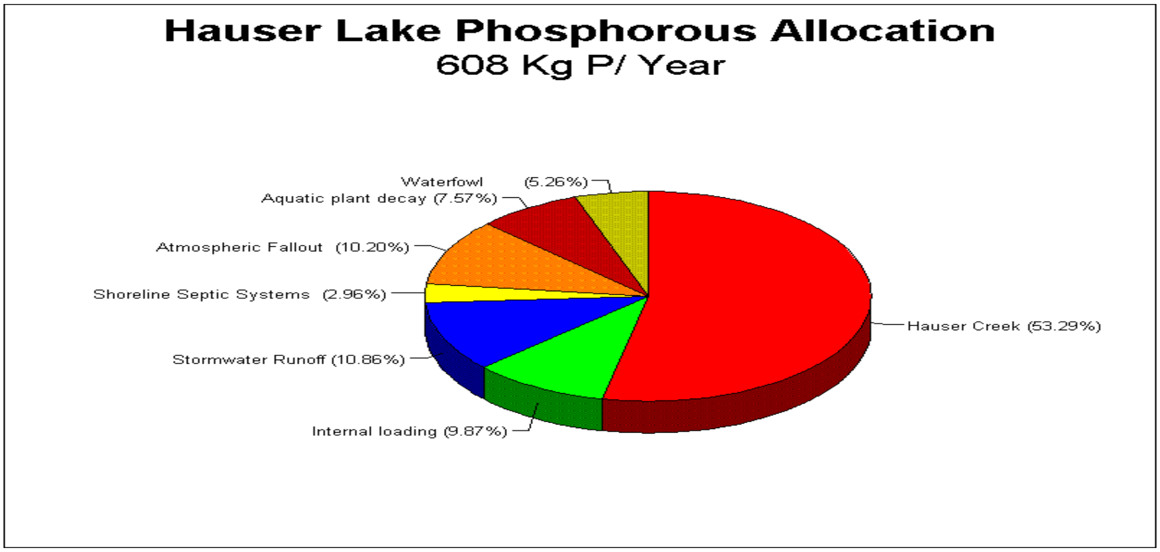
3.2.5. Total Phosphorous Load Allocation

All sources of phosphorous to Hauser Lake are nonpoint sources. Phosphorous load cannot be allocated evenly to the sources to the lake. Atmospheric fallout and waterfowl inputs cannot realistically be controlled. Control of aquatic plants could adversely affect the fishery. Atmospheric fallout, waterfowl and aquatic plants are 13% of the phosphorous load to the lake. These three sources are assigned allocations equal to their current load. Phosphorous loading from internal sediments (internal fertilization) is 28.5% of the estimated load. Control of the internal contribution is critical to reducing the nutrient concentration of the lake. It will require alum treatment to achieve control of this portion of the load. Alum treatment is 95% effective. The allocation based on the efficient reduction of internal-fertilization by alum treatment is provided in Table 2 and Figure 1.

Table 2: Total phosphorous allocation for Hayden Lake.

Phosphorous Source	**Allocated Phosphorous Load (kilograms/year)**	**Total phosphorous load reduction required.**	**Percent Reduction**
Hauser Creek	324	94	22.
Internal loading	60	228	79.1
Stormwater Runoff	66	66	50.0
Shoreline Septic Systems (ground water)	18	14	43.8
Atmospheric Fallout (precip)	62	0	0
Aquatic plant decay	46	0	0
Waterfowl	32	0	0
Total	608	402	

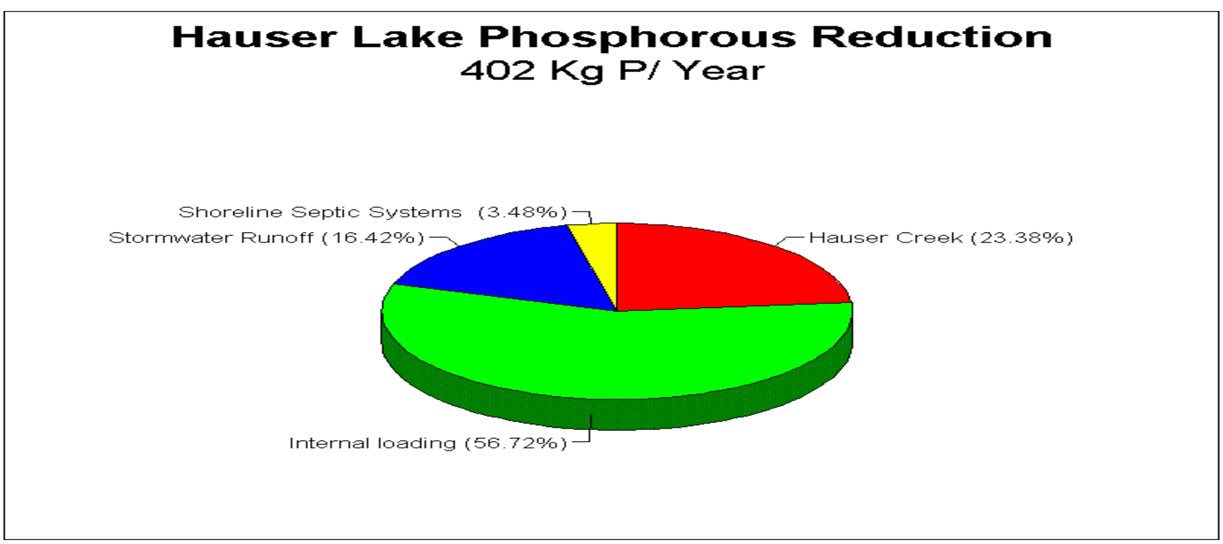
Figure 1: Total phosphorous allocation for Hauser Lake.



3.2.6. Total Phosphorous Load Reduction Allocation

Many phosphorous load reduction actions are discussed in depth in the Hauser Lake Management Plan (CLCC, 1994). A storm water management plan will be required to meet the allocation. The sources and the responsible agencies or governments are designated in the plan's action items. The load reduction required, including the margin of safety (10%; 68 kilograms phosphorous per year) is 402 kilograms per year. The load reductions required of each source are provided in Table 2, column 3. The reductions are provided graphically in Figure 2.

Figure 2: Hauser Lake Total Phosphorous Reduction



3.2.7. Seasonal critical conditions

The issue of critical conditions has importance in a stream which experiences radical changes in discharge (water volume) throughout the year. A lake, by its very nature as a watershed sink integrates and buffers seasonal flows. Plant growth conditions are critical during the summer months, but the growth nutrients are conserved by the lake. For this reason, lake nutrient TMDLs seek yearly reductions in the nutrient load without regard to seasonality.

3.2.8. Reasonable assurance

No point sources of nutrients are present in the watershed. The only assurance that the TMDL will be implemented is the ongoing implementation of remedial actions by Kootenai County, lakeshore owner's association and the State.

3.2.9. Monitoring Provisions

Hauser Lake has been monitored by a Citizens Volunteer Monitoring Program (CVMP) for the past ten years. The program has reliably provided phosphorous, clarity and chlorophyll a data collected during four and some years five summer months. This program will be relied upon to provide the water column data necessary to assess the effectiveness of the phosphorous load reductions required by the TMDL.

3.2.10. Feedback Provisions

Data from which the problem assessment and TMDL for Hauser Lake were developed are fairly accurate measurements. The loading analysis was completed more than a decade ago. As more up to date measurements are developed, these will be added to a revised TMDL as required.

When total phosphorous concentration declines below 13 ug/L, and remains at this level, further phosphorous load reduction will not be required of the sources. Best management practices for forest and road practices will be prescribed by a revised TMDL with erosion abatement structure maintenance provisions. Regular monitoring of the lake will be continued for an appropriate period to document maintenance of the full support.

3.2.11. References:

CLCC, 1990. Hauser Lake Management Plan, Kootenai County, Idaho. Clean Lakes Coordinating Council, 2195 Ironwood Court, Coeur d'Alene ID 83814, 42p.

CVMP, 1992-1999. Unpublished data collected by the Citizens Volunteer Monitoring Project. Buell Hollister, Hauser Lake.

Entranco Engineers, 1990. Phase I diagnostic and feasibility analysis for Hauser Lake, Kootenai County, Idaho. Entranco Engineers, Inc., Kirkland WA.

Mossier, J. 1993. Idaho lake water quality assessment report. Idaho Department of Health & Welfare-Division of Environmental Quality, Northern Idaho Regional Office, 2110 Ironwood Parkway, Coeur d'Alene ID 83814. Water Quality Status Report No. 105. 232p

3.3. Twin Lakes Total Maximum Daily Load

3.3.1. Introduction

The limnology and water quality of Twin Lakes has been investigated in depth (Falter and Hallock, 1987; CVMP, 1992-1999, Appendix C). The upper lake has the nutrient status and biological productivity consistent with a eutrophic lake. The lower lake has nutrient status and biological productivity consistent with a mesotrophic lake. Internal phosphorous liberation to the water column occurs in the lower lake. Productivity of the lower lake is phosphorous limited, while the upper lake is by definition not limited in its productivity. The phosphorous loading budget of the lake is provided in Table 1 a & b.

Table 1a: Total Phosphorous budget of Upper Twin Lake (Falter and Hallock, 1987; CLCC, 1991)

Phosphorous Source	**Phosphorous Load (kg/year)**	**Percentage**
Tributaries	568	76.8
Precipitation	77	10.4
Wastewater	31	4.3
Grazing	39	5.4
Internal (aquatic plant decay)	23	3.1
Motorboats	0.1	0.0
Estimated Storm Water Runoff	0	0.0
Total	738	100

Table 1b: Total Phosphorous budget of Lower Twin Lake (Falter and Hallock, 1987; CLCC, 1991)

Phosphorous Source	**Phosphorous Load (kg/year)**	**Percentage**
Tributaries	305	54.9
Precipitation	63	11.3
Wastewater	59	10.6
Internal	101	18.2
Motorboats	0.1	0.0
Estimated Storm Water Runoff	28	5.0
Total	556	100

The Twin Lakes Management Plan (CLCC, 1990) has a goal for the lake of 25% reduction of total phosphorous. The average total phosphorous concentration of Upper Twin Lake surface water is 29.8 ug/L and Lower Twin Lake is 15.5 ug/L. A 25 % reduction would indicate goals:

: Upper lake total phosphorous at Secchi depth of 22 ug/L (10-year average)
: Lower lake total phosphorous at Secchi depth of 11.5 ug/L (10-year average).

The phosphorous reduction goal is applied to the eutrophic upper lake as well as the lower lake to improve the general water quality of the lower lake. A 25% reduction of total phosphorous in the upper lake will decrease the trophic status of the lake. The total phosphorous reduction necessary to make the shallow and naturally eutrophic upper lake, mesotrophic would be a 50% reduction. This level of reduction is most probably impractical, given the shallow lake, which is filled seasonally with macrophytes, which tap the lake bed phosphorous source.

Additional goals would be:

: Average secchi depth of 3 meters (Upper Twin) and 4.5 meters (Lower Twin)

: Minimum dissolved oxygen of 6 mg/L in the epilimnion and metal limnion of the lower lake.

Average total phosphorous is designated as the primary indicator of lake productivity and water quality. Secchi depth and dissolved oxygen concentration would be expected to increase in the surface zone as total phosphorous is reduced to 22 and 11.5 ug/L in the upper and lower lakes, respectively.

The total phosphorous seven-year average in the Secchi zone is 29.8 (upper) and 15.4 (lower) ug/L (Mossier, 1993; CVMP, 1992-1999, Appendix C). The ten-year total phosphorous averages are 35 % and 34% above the goals developed for the Twin Lakes.

3.3.2. TMDL Authority

Section 303(d)(1) of the Clean Water Act requires states to prepare a list of waters not meeting state water quality standards in spite of technology based pollution control efforts and the application of best management practices for nonpoint sources. This list must include a priority ranking "... taking into account severity of the pollution and the uses to be made of such waters." The prescribed remedy for these water quality limited waters is for states to determine the total maximum daily load (TMDL) for pollutants "... at a level necessary to implement applicable water quality standards with seasonal variations and a margin of safety ..." A margin of safety is included to account for any lack of knowledge about how limiting pollutant loads will attain water quality.

Section 303(d)(2) requires both the list and any total maximum daily loads developed by the state be submitted to the Environmental Protection Agency (EPA). The EPA is given thirty days to either approve or disapprove the state's submission. If the EPA disapproves, the agency has another thirty days to develop a list or TMDL for the state. Both the list and all TMDLs, either approved or developed by EPA, are incorporated into the state's continuing planning process as required by section 303(e).

3.3.3. Loading Capacity

3.3.3.1 Upper Twin Lake

Based on the interpreted management plan goal of 22 ug/L in the Secchi zone and the seven-year average phosphorous of 29.8 ug/L, a 35% (100-(29.8/22 x 100) reduction in total phosphorous load is required to improve the water quality. Since the estimated load to the lake is 738 kilograms total phosphorous per year, the loading capacity required to meet the management plan is 480 kilograms total phosphorous per year ((738- (738 X 0.35). This value is the total phosphorous loading capacity of Upper Twin Lake. An estimated total phosphorous load reduction of 258 kilograms phosphorous per year is required to meet the nutrient reduction goal.

3.3.3.2 Lower Twin Lake

Based on the interpreted management plan goal of 11.5 ug/L in the Secchi zone and the seven-year average phosphorous of 15.4 ug/L, a 34% (100-(15.4/11.5 x 100) reduction in total phosphorous load is required to improve the water quality. Since the estimated load to the lake is 556 kilograms total phosphorous per year, the loading capacity required to meet the management plan is 367 kilograms total phosphorous per year (556- (556 X 0.34). This value is the total phosphorous loading capacity of Lower Twin Lake. An estimated total phosphorous load reduction of 189 kilograms phosphorous per year is required to meet the nutrient reduction goal.

3.3.4. Margins of Safety

The chemical measurements used to develop the ten-year total phosphorous average and nutrient loads have a precision margin of error of 5%. Discharge measurements contain a margin of error of 5%. Based on these two errors an additive margin of safety of 10% is applied. This additional total phosphorous load is deducted from the loading capacity to develop an allocable phosphorous load of 432 kilograms per year (480 - (480 X 0.1) for the upper lake and 330kilogram per year (367-(367 x 0.1) for the lower lake.

3.3.5. Total Phosphorous Load Allocation

All sources of phosphorous to the Twin Lakes are nonpoint sources. Phosphorous load cannot be allocated evenly to the sources to the lake. Motorboat inputs are negligible. Precipitation inputs can not realistically be controlled. Precipitation is approximately 11% of the phosphorous load to each lake. This source is assigned an allocation equal to its current load.

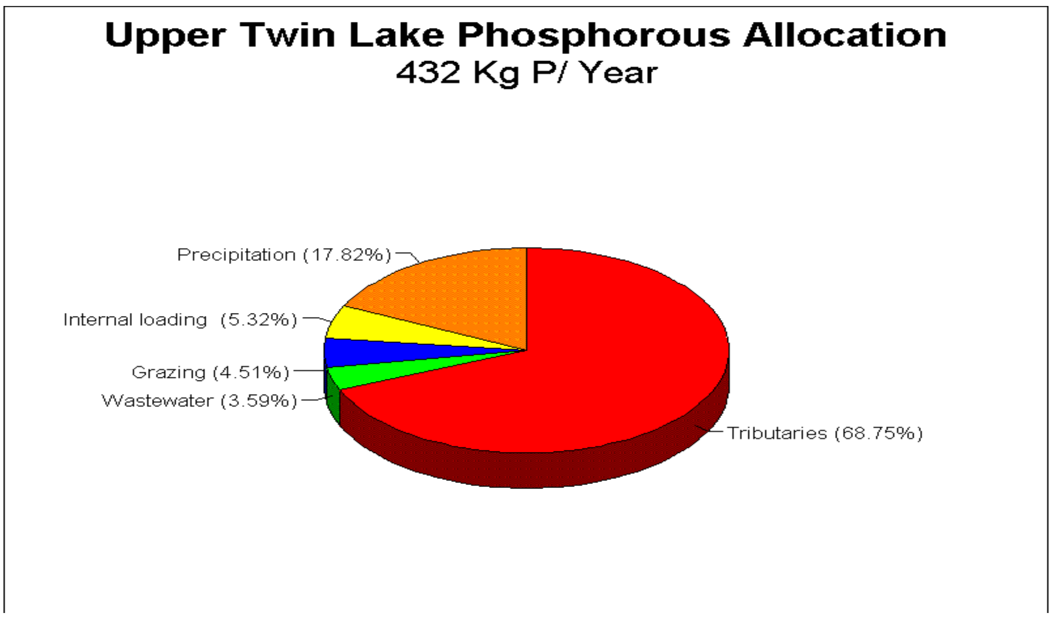
3.3.5.1 Upper Twin Lake Allocation

The total phosphorous load allocation to Upper Twin Lake is provided in Table 2 and Figure 1. Internal loading in this lake is due primarily to aquatic plant decay. Aquatic plants could not be addressed without a weed-harvesting program, which could be detrimental to the warm water fishery. No phosphorous reduction was sought from this source.

Table 2: Total phosphorous allocation for Upper Twin Lake.

Phosphorous Source	**Allocated Phosphorous Load (kilograms/year)**	**Total phosphorous load reduction required.**	**Percent Reduction**
Tributaries	297	271	47.7
Wastewater	15.5	15.5	50.0
Grazing	19.5	19.5	50.0
Internal loading (aquatic plant decay)	23	0	0
Precipitation	77	0	0
Total	432	306	

Figure 1: Total phosphorous allocation for Upper Twin Lake.



3.3.5.2 Lower Twin Lake Allocation

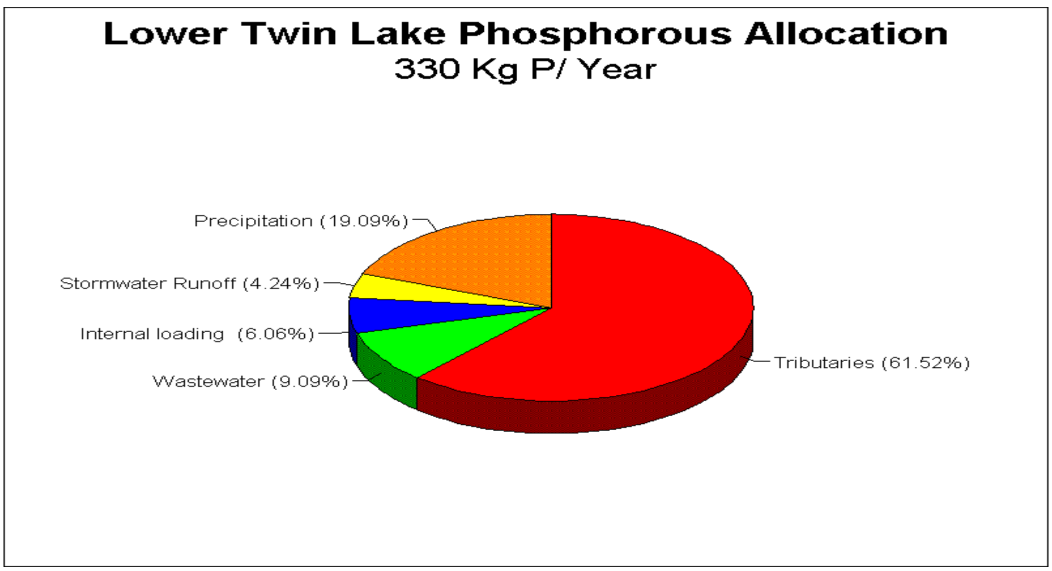
The total phosphorous load allocation for Lower Twin Lake is provided in Table 3 and Figure 2. The allocation does not reduce precipitation or motorboat loads for the reasons stated for the upper lake. The allocation assumes a new tributary load of 178 kilograms phosphorous per year based on the phosphorous reduction in the water of the upper lake, which is the primary tributary of the lower lake. This value was developed by rationing the current lower lake tributary load to the current and projected upper lake phosphorous loads. No other rationale could be found to account for the lower lake tributary reduction expected by the phosphorous limits to the upper lake. The new tributary load is 127 kilograms phosphorous per year less than the lower lake tributary value provided in

Table 1b.

Table 3: Total phosphorous allocation for Lower Twin Lake.

Phosphorous Source	**Allocated Phosphorous Load (kilograms/year)**	**Total phosphorous load reduction required.**	**Percent Reduction**
Tributaries	203	102 (172 from Upper Lake)	33.4
Wastewater	30	29	49.1
Internal loading	20	81	80.2
Stormwater Runoff	14	14	50.0
Precipitation	63	0	0
Total	330	226	

Figure 2: Total phosphorous allocation for Upper Twin Lake.



3.1.6. Total Phosphorous Load Reduction Allocation

Many phosphorous load reduction actions are discussed in depth in the Twin Lakes Management Plan (CLCC, 1991). Some alum treatment of the lake will be required to control internal phosphorous loading. A storm water management plan will be required to meet the lower lake allocation. The sources and the responsible agencies or governments are designated in the plan's action items. The load reduction required, including the margins of safety (10%; 48 and 37 kilograms phosphorous per year, respectively) are 306 and 226 kilograms per year. The load reductions required of each source are provided in Tables 2 & 3, column 3. The reductions are provided graphically in Figure 4 a & b.

Figure 4a: Upper Twin Lake Total Phosphorous Reduction

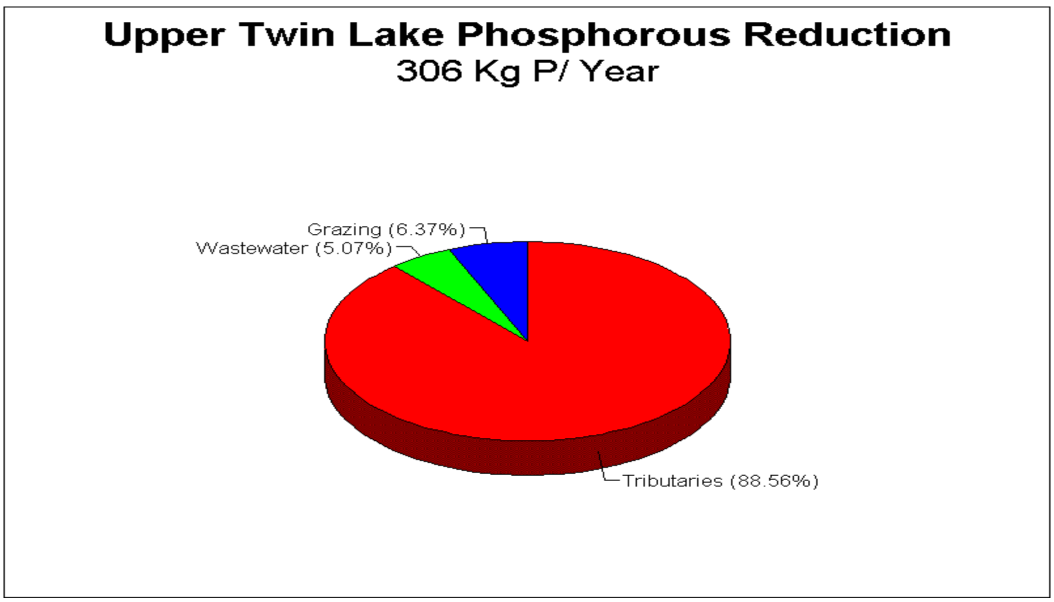
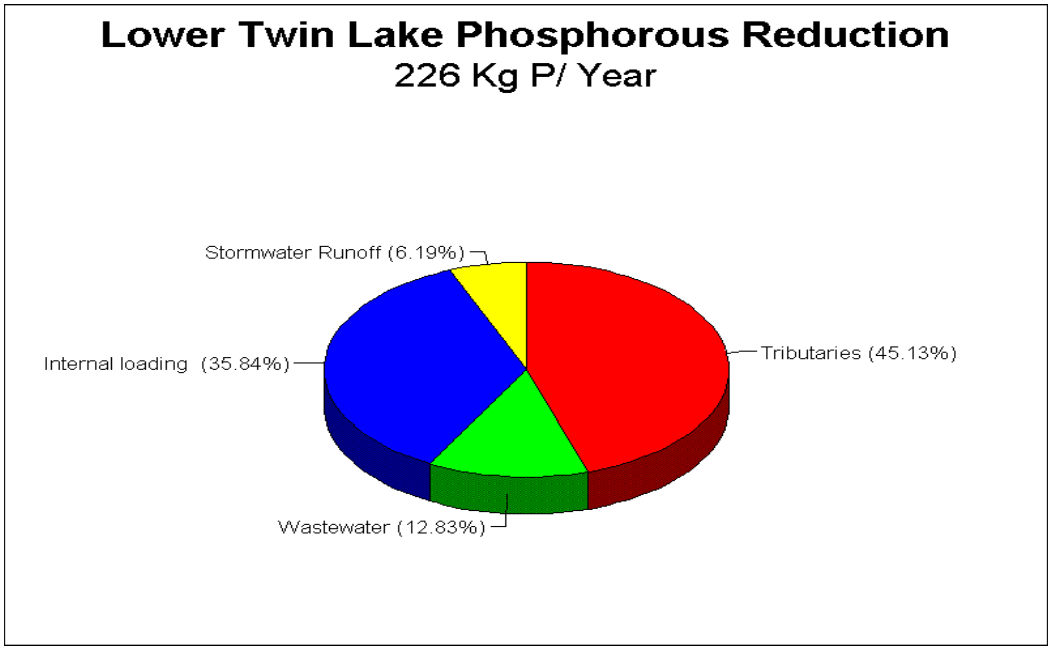


Figure 4b: Lower Twin Lake Total Phosphorous Reduction



3.3.7. Seasonal critical conditions

The issue of critical conditions has importance in a stream which experiences radical changes in discharge (water volume) throughout the year. A lake, by its very nature as a watershed sink integrates and buffers seasonal flows. Plant growth conditions are critical during the summer months, but the growth nutrients are conserved by the lake. For this reason, lake nutrient TMDLs seek yearly reductions in the nutrient load without regard to seasonality.

3.1.8. Reasonable assurance

No point sources of nutrients are present in the watershed. The only assurance that the TMDL will be implemented is the ongoing implementation of remedial actions by Kootenai County, lakeshore owner's association and the State.

3.3.9. Monitoring Provisions

The Twin Lakes have been monitored by a Citizens Volunteer Monitoring Program (CVMP) for the past seven years. The program has reliably provided phosphorous, clarity and chlorophyll a data collected during four and some years five summer months. This program will be relied upon to provide the water column data necessary to assess the effectiveness of the phosphorous load reductions required by the TMDL.

3.3.10. Feedback Provisions

Data from which the problem assessment and TMDLs for the Twin Lakes were developed are fairly accurate measurements. Some assumptions were necessary on the reduction of tributary load once the upper lake allocation is achieved. The loading analysis was completed more than a decade ago. As more up to date measurements are developed, these will be added to a revised TMDL as required.

When total phosphorous concentration declines below 22 (upper) and 11.5 (lower) ug/L, and remains at this level, further phosphorous load reduction will not be required of the sources. Best management practices for forest and road practices will be prescribed by a revised TMDL with erosion abatement structure maintenance provisions. Regular monitoring of the lakes will be continued for an appropriate period to document maintenance of the full support.

3.3.11. References:

CLCC, 1991. Twin Lakes Management Plan, Kootenai County, Idaho. Clean Lakes Coordinating Council, 2195 Ironwood Court, Coeur d'Alene ID 83814. 95p.

CVMP, 1992-1999. Unpublished data collected by the Citizens Volunteer Monitoring Project. Bill Carr and Chet Park, Twin Lakes.

Falter, C.M. and D. Hallock, 1987. Limnological study and management plan for upper and lower Twin Lakes, Kootenai County, Idaho. Department of Fish and Wildlife, College of Forestry, Wildlife and Range Science. Idaho Water Resources Research Institute, University of Idaho, Moscow ID 83843. 185p.

Mossier, J. 1993. Idaho lake water quality assessment report. Idaho Department of Health & Welfare, Division of Environmental Quality, Northern Idaho Regional Office, 2110 Ironwood Parkway, Coeur d'Alene ID 83814. Water Quality Status Report No. 105. 232p

4.0 Response to Comments on the Upper Spokane (Rathdrum - Spokane Sub-basin Assessment and Hauser, Hayden and Twin Lakes TMDLs.

4.1. Introduction

The Upper Spokane (Rathdrum-Spokane) Sub-basin Assessment and the Hauser, Hayden and Twin Lakes TMDLs were submitted for a thirty-day public comment period between August 25, 2000 and September 25, 2000. The public comment period was advertised in three local newspapers: the Coeur d'Alene Press, Bonner County Daily Bee and the Spokesman Review. During the public comment period the Panhandle Basin Area Group met on September 20, 2000. The Upper Spokane Sub-basin Assessment and TMDLs were on the agenda of this meeting. The opportunity was afforded the public to comment on the documents. A copy of the documents was supplied to the EPA point of contact.

No written comment on the documents was received during the comment period. A single verbal comment was telephoned to IDEQ by Marita Little of Upper Twin Lake. This comment was followed up with a further discussion with the commenting party. A letter of comment was received from EPA on November 2, 2000. These comments are addressed in the text of the sub-basin assessment and TMDLs, where appropriate, and in the responsiveness summary.

4.2 Comment Received

4.2.1 Comment of Marita Little

Marita Little: She felt that even though livestock grazing is being managed many betters than in previous years, the cattle were still a source of bacteria at times. She also believes logging activities contribute to the sediment problems. She estimated that sedimentation has reduced the upper lake's depth by 3-5 feet over a 35-year period. She would rather not see the lake de-listed for bacteria and sediment.

Response: The filling of a lake by sediment is not a water quality impact addressed in the state standards. It may be an issue of water quantity. The sediment model applied to Fish Creek, the primary lake tributary, indicated an acceptable level of sediment yield, below 50% above background. The cumulative watershed impact assessment made preparatory to the modeling indicated that sedimentation sources had declined in the basin since a similar assessment was completed in 1994. Sediment will be addressed in the nutrient TMDL prepared for Twin Lakes. Almost all phosphorous entering the lake will be attached to sediment particles. Phosphorous controls will, in part, necessitate sediment control in the implementation plan.

Bacteria (pathogen) exceedences were not found in the lake or the streams. Based on these data and the improvement of grazing practices, a bacterial problem was not demonstrated. In a manner analogous to sediment, bacteria contamination should be further controlled by the nutrient TMDL. Animal wastes are the source of both bacteria and nutrients. The grazing at the head of Upper Twin Lake and along lower Fish Creek has a phosphorous allocation made to it and a phosphorous reduction goal assigned. Steps taken to meet the allocation and reduction goal will limit bacterial contamination as well.

4.2.2 Comment of EPA

4.2.2.1 Comments on TMDLs

Comment 1: The relationship between the goals of the lake nutrient TMDLs and the Idaho water quality standards for nutrients is questioned.

Response: The Idaho water quality standards do not contain numeric nutrient standards. The functional standard is the nuisance weed growth standard stated in the sub-basin assessment (page 7). In the case of lakes, the nuisance weeds are phytoplankton, which initially affect water clarity and as the situation becomes more extreme can affect dissolved oxygen concentration. The standard must be applied based on the perceived trophic status of the lake and the ability to affect that trophic status. Each of the lake studies cited in the sub-basin assessment made an assessment of the lake, its limiting nutrient to plant growth and the trophic status of the lake. Hayden Lake is an oligotrophic lake, while Hauser and Lower Twin Lake are mesotrophic and Upper Twin Lake is eutrophic. Based on this information, each of the lake plans developed a nutrient reduction goal that would reduce the nuisance weed growth and was achievable in the lake addressed by the management plan. The difference in lake plan goals and TMDL goals arise from the difference in the lakes documented briefly in the sub-basin assessment and more fully in the cited lake studies and management plans.

Comment 2: Points on the TMDL checklist concerning critical periods (seasonality) and reasonable assurance were not addressed in the three TMDLs.

Response: Sections have been added to the TMDLs addressing these points. These points were overlooked because lakes integrate seasonal discharge and these lakes have no point discharges of nutrients.

Comment 3: The lake plans are provided as the implementation plans, but are not up to date with the TMDLs. A relationship between the proposed actions of the lake plans and nutrient reduction must be demonstrated.

Response: The lake plans are certainly starting points for TMDL implementation plans. The action items in each plan are designed to reduce erosion of sediment, which carries phosphorous into the lakes and nutrients from other sources. Some action items in these plans have been applied, notably the Kootenai County site grading ordinance. Others have not. In certain cases only alum treatment will achieve the goals of the TMDL. These plans will be revised after approval of the nutrient TMDLs by EPA. The relationship between action items developed. In cases where additional action items are required (alum treatment of Hauser and lower Twin Lake), these should be added.

Comment 4: Forest practices best management practices (BMPs) should be included in this TMDL.

Response: The Idaho Forest Practices Rules and Regulations are the BMPs for forest practices in Idaho and are required by law. By their very nature BMPs are preventive of water quality pollution, but are not typically remedial. The BMPs are currently prescribed. However, they should not be a part of the TMDL until such time that the beneficial use is fully supported. At that time, the BMPs' preventive role becomes important.

Comment 5: Age of the water quality studies on the lakes noted.

Response: TMDLs are to be developed with the best available data. The lake studies employed as the basis of the TMDLs are the best available data. In addition the Citizens Volunteer Monitoring Program (CVMP) results (Appendix C) link the earlier data to the present. These trends indicate that the nutrient status of the four lakes has not changed. We did not expect the nutrient loading percentages to change radically without implementation of remedial activities. The state cannot develop new water quality studies and meet the TMDL deadlines. It must abide by the rule of best available data.

Comment 6: It should be demonstrated how reduction in total phosphorous in Hauser Lake would cause increases in oxygen concentration in Hauser Lake. Regular monitoring of Hauser Lake should be implemented. The State of Washington should comment on the Hauser Lake TMDL and a discussion added on how Washington will address the TMDL.

Response: It is common limnological science that oxygen deficits in lakes are caused by increase of organic matter decomposition. It is also common knowledge that reduction in total phosphorous decreases plant biomass productivity. The Hauser Lake study, as well as its management plan, points these facts out. The text of the sub-basin assessment points out this relationship. In addition, alum treatment of a lake not only binds phosphorous into the sediments, it removes organic matter. The reduction of phosphorous inputs due to watershed management and alum treatment removal of self fertilization will result in less organic matter production and hence, less oxygen demand. A secondary benefit of alum is the binding of colloidal organic matter. The TMDL, which is a prescriptive document, does assume the reader has some knowledge of limnology from the sub-basin assessment and references.

Regular monitoring of Hauser Lake has occurred through the CVMP program through the 1990s and is expected to continue. Dissolved oxygen measurements are part of this assessment during four or five months of the spring and summer.

A good point is made concerning the across boundary nature of the Hauser Lake watershed. It is also an issue for the Twin Lakes TMDL because the upper watershed of Fish Creek is within the State of Washington. It is, however, the responsibility of EPA to address and coordinate across boundary issues between the states. The sub-basin assessment and TMDLs were supplied to EPA well in advance that this responsibility could be discharged. The State of Idaho would not write an implementation plan for that part of the watershed in the State of Washington. This is the responsibility of either the State of Washington or EPA, but certainly not the responsibility of Idaho.

Comment 7: The Twin Lakes TMDL does not address a nutrient limitation of Fish Creek or Rathdrum Creek. Dissolved oxygen limitation of lower Twin Lakes is suggested in the Twin Lakes Management Plan.

Response: Plant growth nutrients were monitored in Fish Creek during the Twin Lakes study. These levels of nutrients do not exceed the guidelines stated in the sub-basin assessment. The TMDL calls for a 47.7% reduction of phosphorous from the tributaries to Upper Twin Lake. There is only one major tributary, Fish Creek. The lower Twin lake allocation calls for a 33.4 % reduction from the tributaries, which includes the major tributary, the upper lake. These reductions dictate nutrient and sediment, to which phosphorous is attached, reductions from Fish Creek.

The sub-basin assessment demonstrates that Rathdrum Creek does not have total phosphorous concentrations above the guidelines, while on an average, nitrogen is not above the guidelines. The assessment also catalogs the possible sources along the creek. These are few. Given that the creek typically meets the nutrient guidelines for streams, we believe it safe to assume that it will after nutrients are reduced in its main source of nutrients, lower Twin Lake.

The CVMP monitoring provided in Appendix C clearly demonstrates that low dissolved oxygen concentrations are found in the hypolimnion of the lake where such departures are permitted by State standards. In any case, reduction in plant growth nutrients in this lake in a manner similar to that in Hauser Lake decreases productivity, which in turn decreases the biological demand for oxygen, hence increasing oxygen concentrations.

Editorial Comments:

Comment 1: Table 2 shows water quality criteria for streams, it would be helpful to have these for lakes.

Response: Table 2 is meant as a general summary of the standards. Dissolved oxygen standards are more complex for the oxygen level in lakes. These would be difficult to summarize. As noted earlier, dissolved oxygen standards do not apply to hypolimnetic waters.

Comment 2: Low sculpin densities contradict the conclusion that fishery not impaired.

Response: Low sculpin densities are not atypical of streams draining granitic terrane with relatively more sand bottom. Similar low levels were observed in sandy bottom streams of granitic terrane flowing from the west into Coeur d'Alene Lake, even though trout were present in densities typical of full support. The important species is the fishable species, trout.

Comment 3: Upper Twin Lake becomes too warm to support salmonids in the summer months. Should it be listed as temperature limited?

Response: In the sub-basin assessment, it is pointed out that the Upper Lake is 5 meters deep. It is a shallow eutrophic lake, which warms above cold water biota temperature standards during the summer. Records indicate it has always been shallow. A better approach is to designate the Upper Lake as seasonal cold water biota.

Comment 4: Editorial

Response: Change made

Comment 5: Editorial

Response: First error corrected; second error was not found. The second error may have been corrected earlier.

Comment 6: Editorial

Response: Correction was made.

Comment 7: Editorial

Response: Correction was made

4.2.2.2 Comments on proposed de-listings

Comment 1: Those streams recommended for de-listing should be clearly identified and the reasons clearly laid out.

Response: These points have been clarified in a revised Table 10 on pages 22 and 23. This table is also placed in the Executive Summary. The table identifies each listed segment by name and number. It provides an assessment of the support status and recommends a TMDL allocation where appropriate. It provides the reasons a stream should be de-listed for each specific pollutant. It provides a reason for the deferment of a TMDL, if appropriate.

Comment 2: The relationship between nutrients and dissolved oxygen in lakes should be further explained. However, a TMDL addressing nutrients would not cause the de-listing of the related dissolved oxygen listing.

Response: The effect of nutrients of lake productivity and hence on biological oxygen demand and dissolved oxygen concentration has been referred to in the assessment and certainly in the attached lake management plans. The dissolved oxygen limitation on Hauser Lake has not been recommended for de-listing in Table 10, but rather for deferment until the expected results of nutrient reduction on lake water oxygen concentration can be assessed.

Comment 3: In reference to the Spokane River, standard must be changed and approved before the segment can be de-listed based on the new standard.

Response: The sub-basin assessment recommends the standard be changed to seasonal cold water biota with a specific support standard based on the temperature observed during hot dry summers as 1992 and 1994. The temperature TMDL is deferred until this standard change is made or is disapproved.

Comment 4: The definition of secchi depth and what it measures requested.

Response: Secchi depths as a measure of clarity are a technique in use since the 1850s. It is understandable that its meaning in a limnological discussion would be assumed as understood. However a brief statement of the technique and what it measures has been added to page 12.

Comment 5: A CWE process explanation was requested.

Response: The Cumulative Watershed Effects process and the measurements it makes are described in Appendix A, Sediment Model Assumptions and Documentation.

4.2.2.3 Comments on individual sections

4.2.2.3.1 Impact of sediments

Comment 1: The impact of sediment or lack thereof on the lake's beneficial use is not properly documented to permit de-listing.

Response: In the three cases where sediment is listed as limiting to lakes, Hayden, Twin and Spirit Lakes, the most reasonable impacts are to the salmonid sight feeding turbidity standard or to some narrative interference with the fishery. Secchi depths were measured by CVMP volunteers during or shortly after the high flow period (May and early June) on all the lakes. These ranges are now stated in the text for each lake. These range from 3 -7 meters. The 25 NTU chronic standard would equate to a Secchi depth of less than one-half meter. The fisheries of each lake were described from Fish and Game accounts. These accounts indicate self-sustaining fisheries with the exception of fishing pressure. In neither case were the two sediment standards exceeded. The evidence indicates sediment was listed as a pollutant of concern in error. The text still notes the role of sediment as a nutrient carrier, but in all fairness this is a nutrient and not a sediment issue.

Comment 2: The WBAG process was departed from in favor of sediment modeling a fish density data.

Response: The BURP macro invertebrate data for Fish and Rathdrum Creeks have been added to the text and as Appendix D. The vast majority of the macro invertebrate biotic indices (MBIs) for Fish Creek are above the full support level of 3.5, while the one value for Rathdrum Creeks is quite low. The sub-basin assessment process is to use the BURP information as well as other pertinent data to come to support conclusions. This WBAG+ process recognizes that MBI scores are not sufficient and often misleading for purposes of listing or de-listing. Hence, the assessment has where data is available, looked at fish densities and compared them to control streams in the Priest Basin as noted in the sub-basin assessment text. It has looked at other fish species, at residual pool volume and has modeled the sediment contributions from actual sediment sources. On the weight of the evidence, the additional data reinforces the Fish Creek MBIs. Trout densities are comparable to control streams in the Priest Basin which is also granitic even though sculpins are in lower density which is often seen in streams on granitic terrane with relatively more sand. Model results are well below the 50% above background threshold cited by the referenced Washington Forest Practices Board (1995) as the lowest threshold for sediment impacts. In the case of Rathdrum Creek, less data is available. It is a sand bottom low gradient stream over most of its length as pointed out in the text. Such a stream is a possible candidate for lower macro invertebrate species diversity and hence a lower MBI. The stream flows from a lake; hence there is not an upstream sediment source. The two sediment sources, its banks and Spring Creek are modeled. The creek models at 54% above background, which is very close to the 50% threshold discussed above. On the weight of this evidence, the assessment concludes that neither Fish nor Rathdrum Creeks is sediment limited.

The author of the comment grossly misinterprets the goal of previous sediment TMDLs developed in the Northern Region. The natural background goals of these TMDLs are clearly stated as "interim" goals, which are believed to be well below the level of sedimentation at which uses are fully supported. Verification of the sediment models clearly demonstrates that only unentered watersheds approach natural background sedimentation levels and often these do not because of forest fire impacts. For the interpretation of model sediment results, the cited reference is the Washington Forest Practices Board (1995) publication which indicates that water quality impacts from sediment are likely above at 100% of background and are not predicted below 50% above natural background. It is disingenuous to apply interim TMDL sedimentation goals, chosen specifically to be below a level where sediment impacts to water quality occur, to benchmarks by which the modeled sediment data is compared to assess sediment impacts.

4.2.2.3.2 Fish population data

Comment 1: Why was electrofishing from which fish population data could be developed not conducted on Rathdrum Creek?

Response: It was not among the subset of streams chosen to be electrofished in the BURP process. Even though it was not electrofished, BURP assessors did observe fish in the stream and fishing is conducted along the stream primarily by children.

4.2.2.3.3 Beneficial support status

Comment 1: Several issues are raised concerning the clarity and logic of Table 10.

Response: Table 10 has been revised. The boundaries column is omitted as redundant of earlier tables. The stream name and HUC number are combined into a single column. The assessed support status is stated in the second column, as is the reason for the determination. The reason a stream is proposed for de-listing is provided in the third column. If this column is not applicable, it is so marked. The reason a TMDL is proposed to be deferred is stated in the fourth column. If this is not applicable, it is so marked. The new table addresses the issues raised in the comment except for the issue of upstream effects to Coeur d'Alene Lake.

An assessment of the impact of impoundment of Coeur d'Alene Lake is provided in the sub-basin assessment. The comment suggests human activities may have raised the temperature of the lake, presumably in its tributaries, or possibly by use (boating, swimming). The portion of the lake that feeds the Spokane River is its epilimnetic waters. This top approximately ten meters of the lake increase in temperature each summer from direct exposure to the sun. The sun's impact on the many square miles of exposed lake surface far outweighs the thermal inputs from streams or human activities on the lake. A further quantitative argument can be made if deemed necessary by EPA.

4.3 References

Washington Forest Practices Board, 1995. Board Manual: Standard Methodology for Conducting Watershed Analysis under Chapter 222-22 WAC Version 3.0 November 1995.

5.0 Implementation Plans

5.1 Background:

During the 1980's and early 1990's the large lakes (Pend Orielle, Coeur d'Alene and Priest) and many of the heavily developed smaller lakes (Cocollala, Hauser, Hayden, Spirit and Twin Lakes) received limnological study and based on these studies lake management plans were developed. This work was completed as a result of the Idaho Nutrient Management Act and legislation creating the Clean Lakes Coordinating Council. Lake plans have been in place for all the lakes listed above for several years. Implementation of these plans is in many cases well advanced. The Hayden Lake, Hauser Lake and Twin Lakes plans set nutrient goals, recognize that actions which remove phosphorous loading will remove nitrogen loading and provide concrete action items to reduce nutrient loading. These plans with minor revision in some cases are applicable TMDL implementation plans.

5.2 List of lake Management Implementation Plans:

Hauser Lake Management Plan (Appendix D)

Hayden Lake Watershed Management Plan (Appendix E)

Twin Lakes Management Plan (Appendix F)

Spirit Lake Watershed Management Plan (Appendix G)