Idaho Department of
Environmental Quality

Lower Boise River Nutrient Subbasin Assessment

December 2001

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1.0 Executive Summary

The lower Boise River is the 64 mile stretch that flows from Lucky Peak Dam above Boise, Idaho to the Snake River below Parma, Idaho. The river flows primarily through Ada and Canyon Counties, but also drains portions of Elmore, Gem, Payette, and Boise counties. The watershed encompasses 1290 square miles of rangeland, forests, agricultural lands, and urban areas. The river flows in a northwesterly direction from its origin at Lucky Peak Dam to its confluence with the Snake River. Major tributaries include (but are not limited to) Fifteenmile Creek, Indian Creek, Mason Creek, Conway Gulch, and Dixie Drain. The 1998 303(d) listed tributaries include Blacks Creek, Fivemile Creek, Tenmile Creek, Mason Creek, Indian Creek and Sand Hollow Creek. These tributaries are not addressed in this document due to their hydrologic complexity. Rather, they are addressed in separate assessments.

Section 303(d) of the Federal Clean Water Act requires states to develop a Total Maximum Daily Load (TMDL) allocation plan for water bodies determined to be water quality limited. A TMDL allocation plan documents the amount of a pollutant a water body can assimilate without exceeding a state's water quality standards, and allocates that amount as loads to point and nonpoint sources. TMDLs are defined in 40 CFR Part 130 as the sum of the individual Waste Load Allocations (WLA) for point sources and Load Allocations (LA) for nonpoint sources, including a margin of safety and natural background conditions.

For purposes of designating beneficial uses, the *Idaho Water Quality Standards and Wastewater Treatment Requirements* (IDAPA 58.01.02) delineate the lower Boise River by segments. The river is designated for cold water biota, primary contact recreation and domestic water supply from Lucky Peak Dam to the Barber Diversion. From Barber Diversion to River Mile 50 (Veteran's Parkway) the river is designated for cold water biota, salmonid spawning, primary contact recreation and domestic water supply. Above River Mile 50 the river is also designated as a special resource water. From River Mile 50 to Indian Creek the river is designated for cold water biota, salmonid spawning and primary contact recreation. From Indian Creek to its mouth the river is designated for cold water biota and primary contact recreation. The river is 303(d) listed for nutrients from Star (~ River Mile 35) to the mouth.

The *Idaho Water Quality Standards and Wastewater Treatment Requirements* (IDAPA 58.01.02) are designed to provide protection for designated and existing beneficial uses. If the numeric water quality criteria are not met, the associated beneficial uses are typically not fully supported. The state of Idaho does not have a numeric water quality criterion for nutrients. Rather, the standard is narrative. The standard says: *"Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses (IDAPA 58.01.02.200.06)."* The narrative standard is interpreted as indicating that if the designated and existing beneficial uses are not impaired by the effects of excessive nutrients in the water body, nutrients are not exceeding the narrative water quality standard.

In determining the support status of beneficial uses in the lower Boise River as they relate to nutrients, suspended and benthic chlorophyll-a levels are used as a surrogate to algal biomass, and hence excessive nutrients. The volume of macrophytes and other bulky aquatic species in the river are also investigated. The effects of excessive algal biomass on water chemistry (DO, pH) are evaluated to determine the direct effects on aquatic life. Historical and recent complaint data and antecdotal recreational information are reviewed to determine the public perception and aesthetic quality of the river.

The analysis indicates that nutrients are not impairing aquatic life or recreational beneficial uses in the lower Boise River. Thus, nutrients will be proposed for 303(d) de-listing. However, nutrients that originate in the lower Boise River watershed are contributing to the impairment of beneficial uses in the Snake River and Brownlee Reservoir. 40 CFR 131.10(b) says that the State shall take into consideration the water quality and standards of downstream waters and shall ensure that its water quality standards provide for the attainment and maintenance of water quality standards of downstream waters. For this reason, nutrient allocations driven by the Snake River - Hells Canyon TMDL (due December 2001) may be necessary.

The Snake River - Hells Canyon TMDL may allocate a total phosphorus load to the mouth of the lower Boise River to help restore the impaired beneficial uses to full support. The phosphorus sources in the lower Boise River watershed will then be allocated loads and waste loads to meet the load allocation for the lower Boise River. Upon completion of the allocations, an implementation plan will be developed within 18 months by the Lower Boise River Watershed Advisory Group and supporting agencies.

2.0 Subbasin Assessment

2.1 Watershed Characterization (17050114)

The lower Boise River watershed, Hydrologic Unit Code (HUC) 17050114, is located in southwest Idaho (Figure 1). The watershed drains 1290 square miles of rangeland, forests, agricultural lands, and urban areas. The lower Boise River is a 64-mile stretch that flows through Ada and Canyon counties and the cities of Boise and Caldwell, Idaho. The watershed also drains portions of Elmore, Gem, Payette, and Boise counties. The river flows in a northwesterly direction from its origin at Lucky Peak Dam to its confluence with the Snake River near Parma, Idaho. Major tributaries include Indian Creek, Fivemile Creek, Tenmile Creek and Mason Creek (Figure 2).

Topography of the watershed is diverse, consisting of the Boise Front foothills and mountains which terminate abruptly along the north side of the flat, Boise River valley floor. The area also includes remnants of seven alluvial, step-like terraces (north and south of the river), and a lava plain dotted with several shield volcanos and cinder cones in the southern region of the watershed. Streams flowing off the Boise Front generally flow southwesterly; south of the Boise River, the streams flow northwesterly. Elevation in the watershed ranges from 6575 feet at Boise Peak to 2200 feet at the mouth of the Boise River. Relief varies according to topography; terraces are level while areas of the Boise Front are quite steep (30% to 65% slopes).

Geology

The lower Boise watershed lies within the western Snake River Plain. The rocks within and northeast of the Boise Front are granites of the Idaho batholith. Northern margins of the river valley (foothills area) are basin-fill sediments composed of interbedded gravels, sands, silts, and clays. Multiple terraces that developed throughout the Quaternary period comprise much of the valley. All terrace deposits are pebble to cobble gravel with a coarse sand matrix. Thin wind-blown deposits of loess differentially cover the terrace surfaces. Shield volcanos, basaltic cones, and lava flows bound and cover the southern region of the watershed. Some basalt flows bury former alluvial surfaces and all flows are differentially covered by thin loess deposits (Othberg, 1994).

Soils in the valley are derived predominantly from river and wind-born materials. The soils generally have weakly developed profiles, are unleached, alkaline, and have high natural fertility. Soil textures found in the watershed are silty and sandy loams in the river bottoms and terraces and loamy sands and sandy loams in the foothills (Collett, 1980 and Priest et al., 1972).

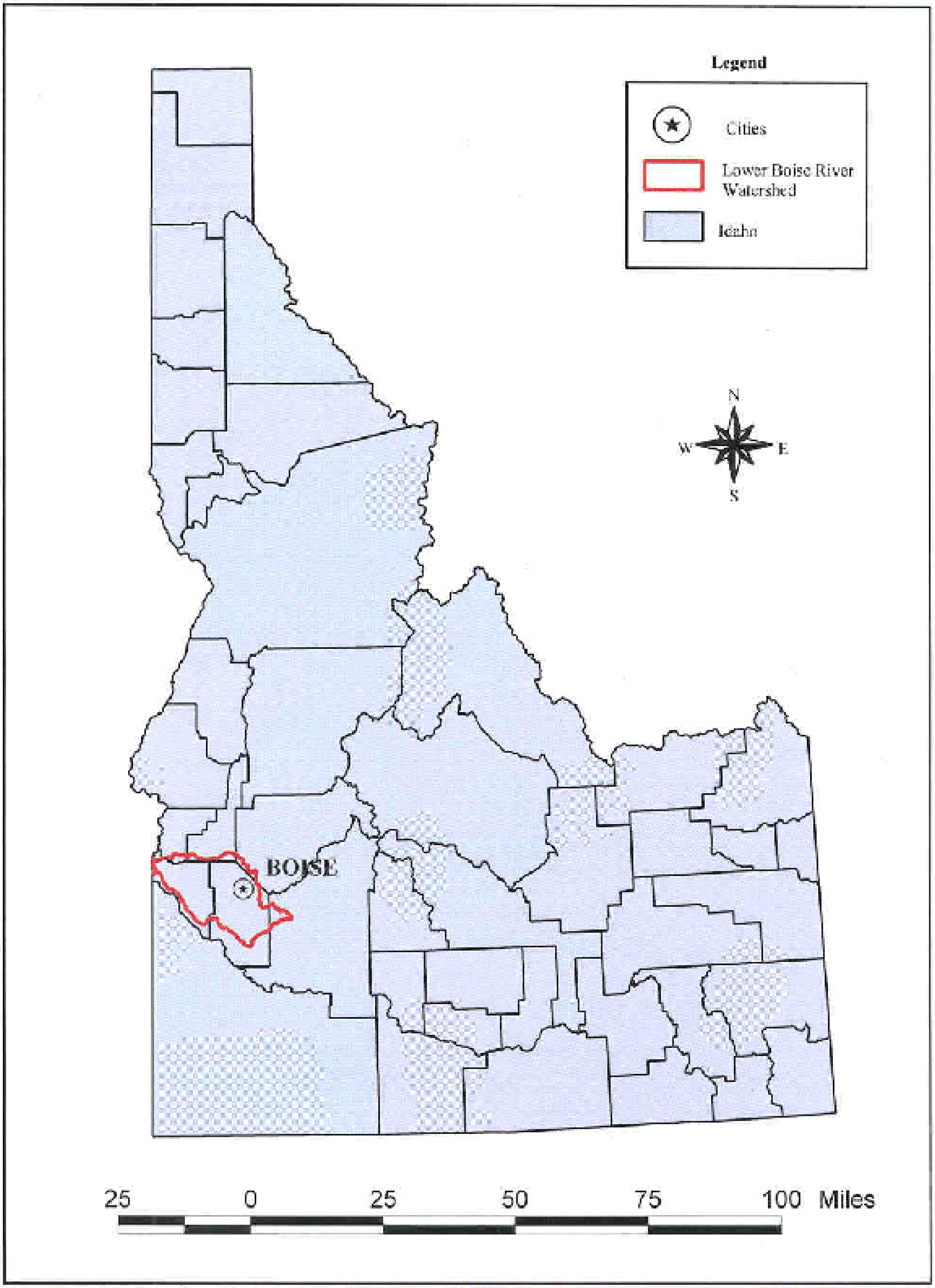

Figure 1. Location of the lower Boise River watershed.

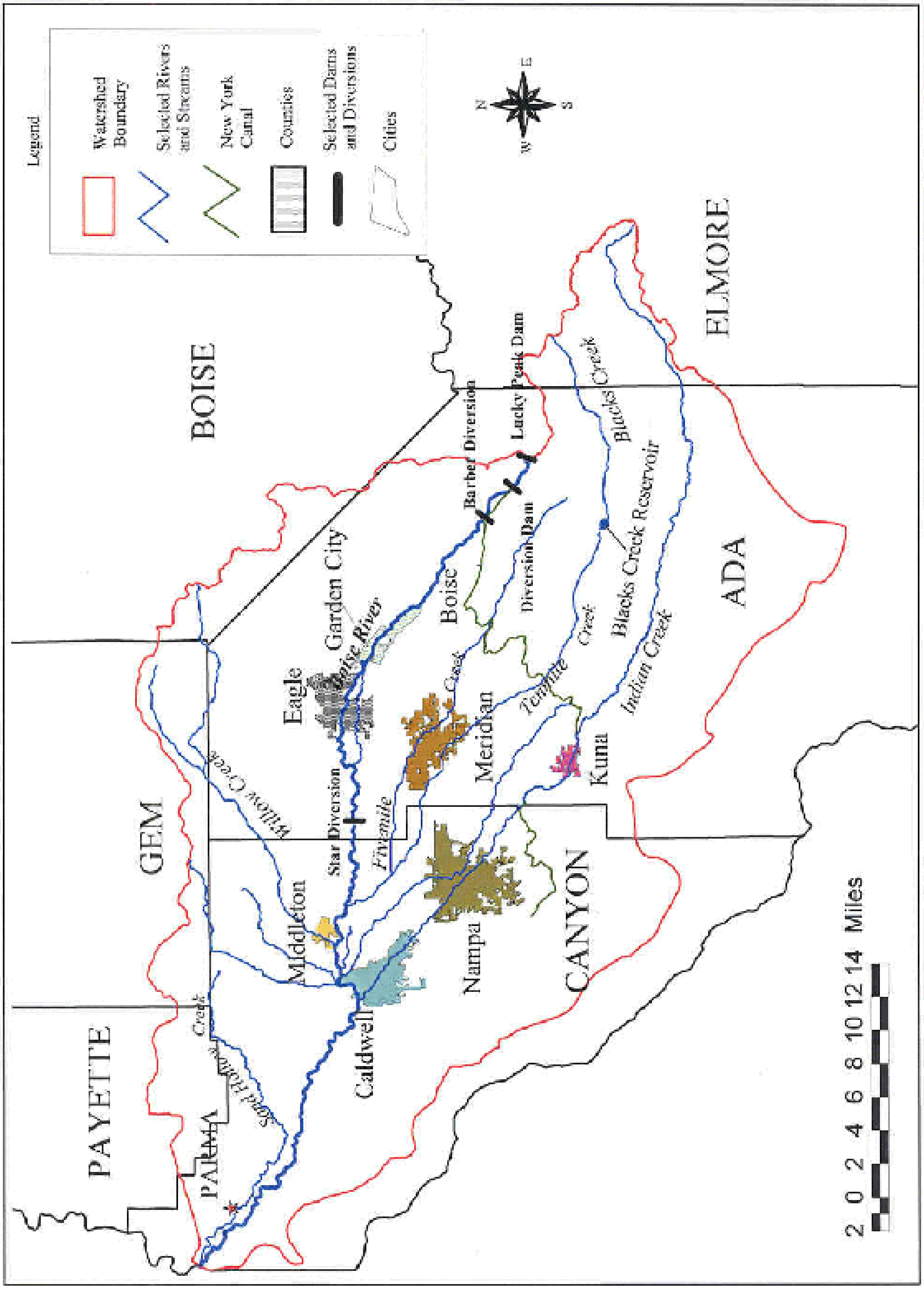

Figure 2. Major cultural features and tributaries in the lower Boise River watershed.

Climate

The climate within the watershed is mild. The summer months are hot and dry while the winters are cold and wet, though generally not severe. The average summer temperature during the period of 1975-1995 was 70.4°F in Boise, with an average daily maximum temperature of 86.1°F. In winter, the average temperature in Boise from 1975-1995 was 30.9°F and the average daily maximum temperature was 39.0°F (Climate Data Center, 1997). Average annual precipitation of the watershed ranges from about 24 inches at higher elevations of the Boise Front to around 8 inches in the southernmost region of the watershed. Average annual precipitation during the period of 1975 -1996 in Boise was 12.3 inches and 10.6 inches at Parma (Climate Data Center, 1997). Most precipitation falls during the colder months. Snow accumulation is typically light in the lowlands and usually melts shortly after it falls.

Surface Hydrology

The presence of upper Boise (Anderson Ranch and Arrowrock) and lower Boise (Lucky Peak, Diversion Dam, and Barber Dam) reservoirs and dams, numerous diversions, and local flood control policies have significantly altered the natural flow regime and the physical and biological characteristics of the lower Boise River (Figure 3). Lucky Peak Dam, the structure controlling flow at the upstream end of the watershed, was constructed and began regulating flow in 1957. Water is released from the reservoir to the Boise River just a few miles upstream from Boise. Water releases from the reservoir are managed primarily for flood control and irrigation. Other management considerations include power generation, recreation, maintenance of minimum stream flows during low flow periods and release of water to augment salmon migration flows in the Snake River. Figure 4 shows mean monthly flows for the Boise River below Lucky Peak Dam, United States Geological Survey (USGS) Station 13202000, before construction of Lucky Peak Dam and under current regulated flow conditions. Flow regulation for flood control has replaced natural, short duration (two to three months), flushing peak flows with longer (four to six months), greatly reduced, peak flows. Water management has increased discharge during the summer irrigation season and significantly decreased winter low flows.

The regulated annual hydrograph can be divided into three flow regimes. Low flow conditions generally begin in mid-October when irrigation diversions end. The low flow period extends until flood control releases begin, sometime between the end of January and March. Flood flows generally extend through June, and releases for irrigation control flows from July through mid-October.

Figure 4 shows mean monthly flow for the Boise River near Boise from 1984-1999. The current flow management regime began in 1984. The U.S. Bureau of Reclamation (USBR) reserves 102,300 acre-feet of Lucky Peak Reservoir storage space to maintain lower Boise River instream flows during the winter low flow period. The desirable Lucky Peak Reservoir minimum instream flow release to the Boise River is 240 cfs with the more sustainable minimum flow release target being 150 cfs for fish protection. The Lucky Peak Reservoir storage space provides water for a Lucky Peak Reservoir 80 cfs instream flow release to the lower Boise River. Idaho Department of Fish and Game's 50,000 acre-feet of Lucky Peak Reservoir storage space provides for the remainder of the flow release to the lower Boise River to meet the desirable or target minimum instream flows. The type of water year (whether it be dry, average, or above average) determines if the desired 240 cfs, target 150 cfs or the minimal 80 cfs release is made from Lucky Peak Reservoir. Flood season flows for the Boise River below Lucky Peak Dam range from about 2000 to 6500 cfs. Irrigation season flows range from 2000 to 4000 cfs.

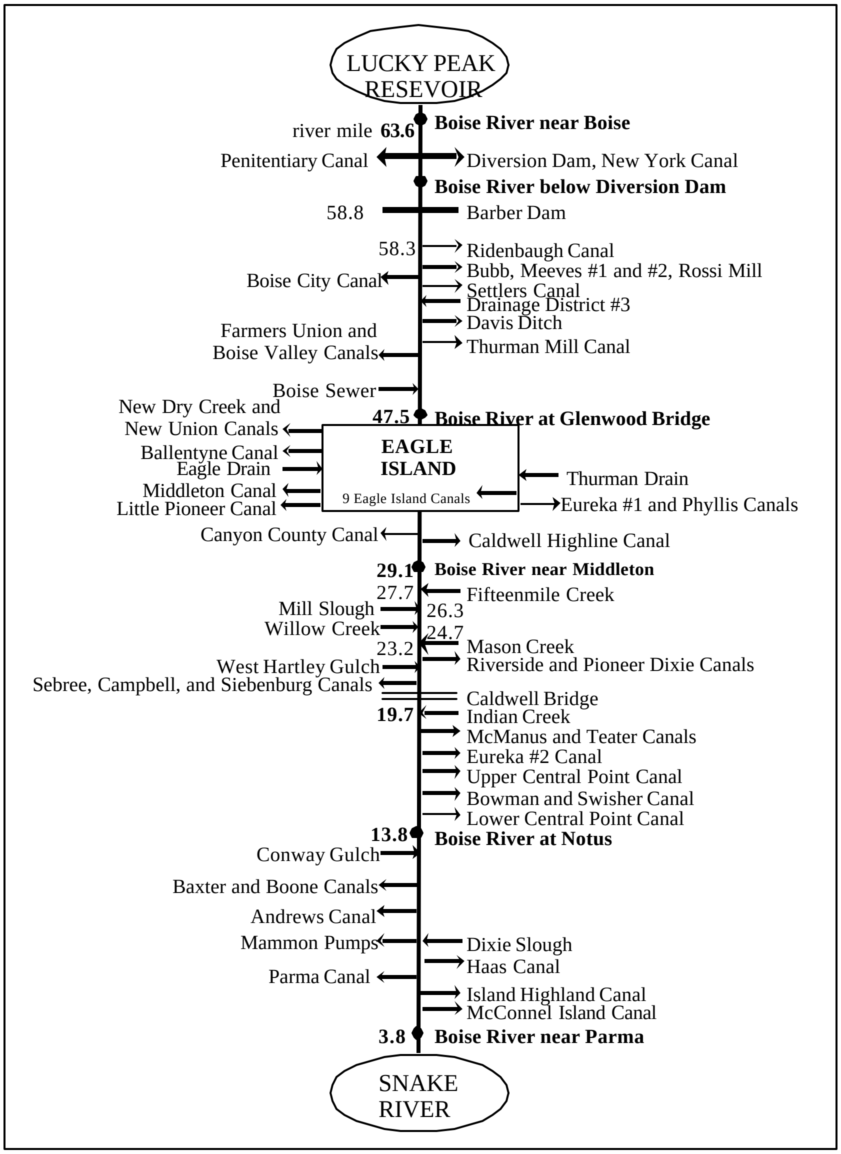

Figure 3. Locations of primary diversions, dams, and drains along the lower Boise River (revised from Warnick and Brockway, 1974). USGS gaging stations in bold type. Diagram is not to scale.

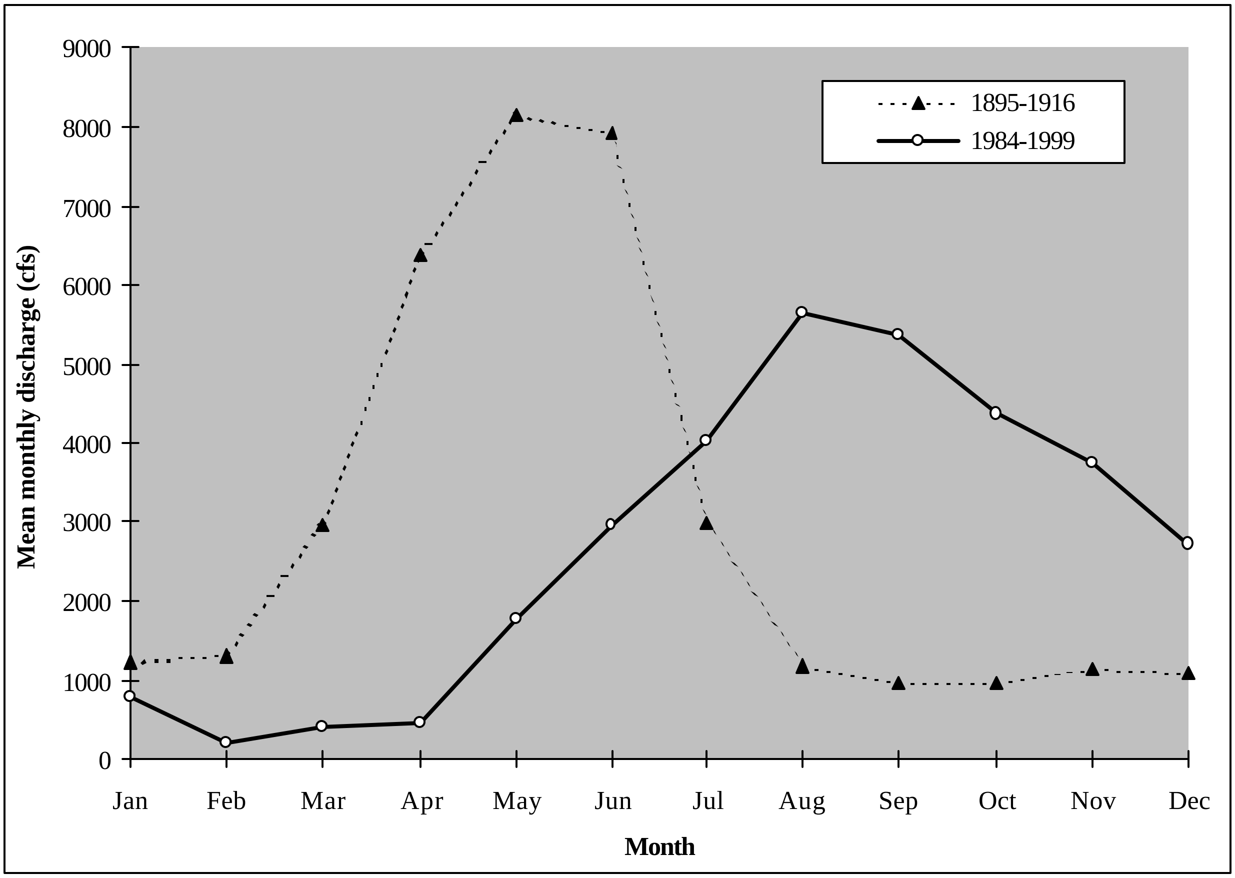

Figure 4. Regulated (1984-1999) and unregulated (1895-1916) mean monthly discharge in the Boise River near Boise, USGS gaging station 13202000.

Figure 5 shows mean annual discharge in the Boise River near Boise, which is located just below Lucky Peak Dam. The last twenty years of flow records show that a prolonged period of below average flows occurred from 1987 through 1995 (a drought period).

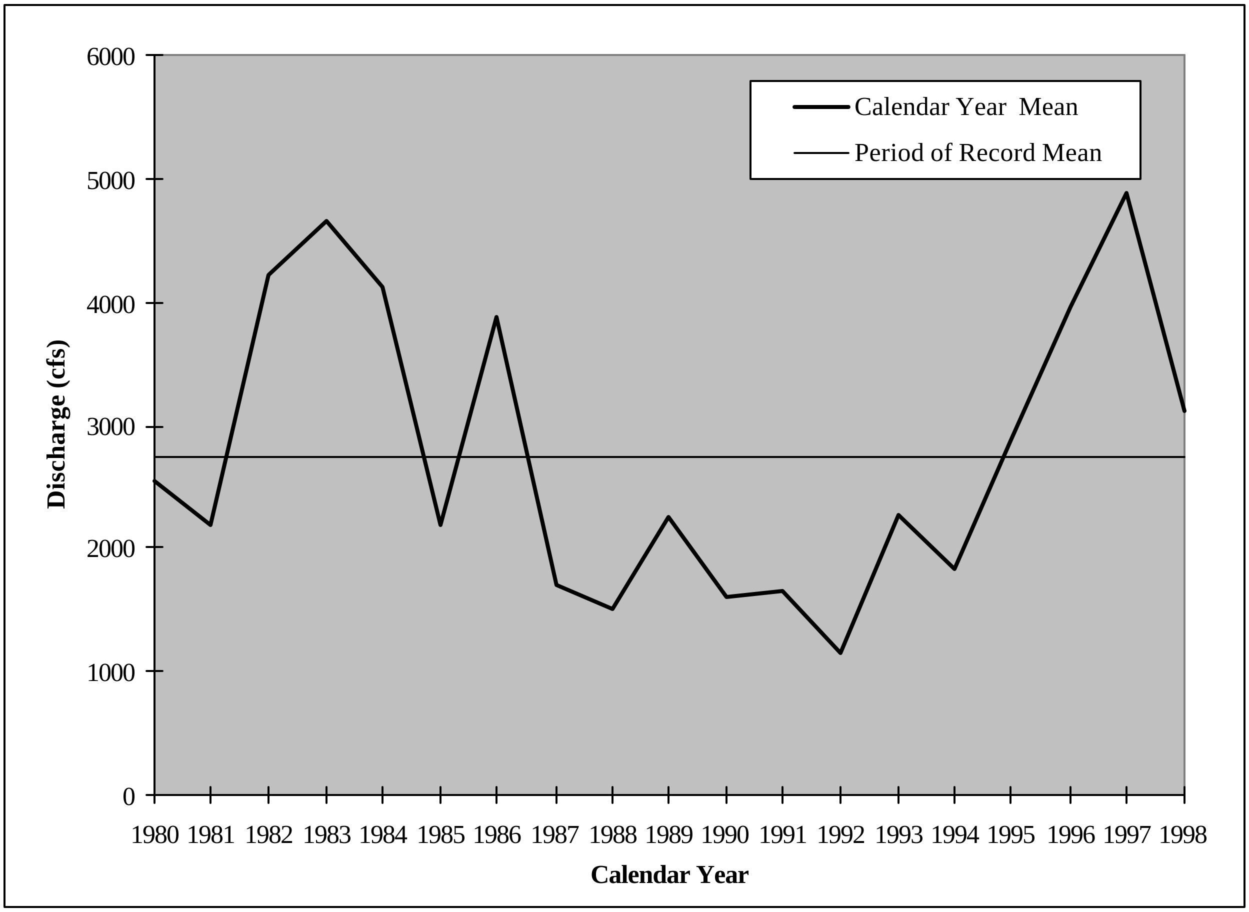

Figure 5. Mean annual discharge, Boise River near Boise (above Diversion Dam), USGS gaging station 13202000.

During the irrigation season, numerous diversions carry water to irrigate fields along the north and south sides of the river. Based on location and quantity of diversions and drains, the lower Boise River can be hydrologically divided in two parts at Middleton. The majority of the water that is diverted from the river is removed beginning at Diversion Dam and ending at the Star Road diversion. Over half of the average annual discharge of the river is diverted before it passes the City of Boise. Most drains return to the river below Middleton. Many return flows join the river in the vicinity of Caldwell, while two other large return flows enter between Caldwell and Parma.

The reach from Middleton to Caldwell usually has the lowest flows during the irrigation season. Figure 6 shows that monthly average flows at Middleton are typically equal to or less than the Lucky Peak Dam release all year round. During the irrigation season, the monthly average flows at Middleton and Parma are significantly less than at the upstream gaging station. In low water years, diversions have reduced instream flows to as low as 200 cfs at Middleton during the irrigation season.

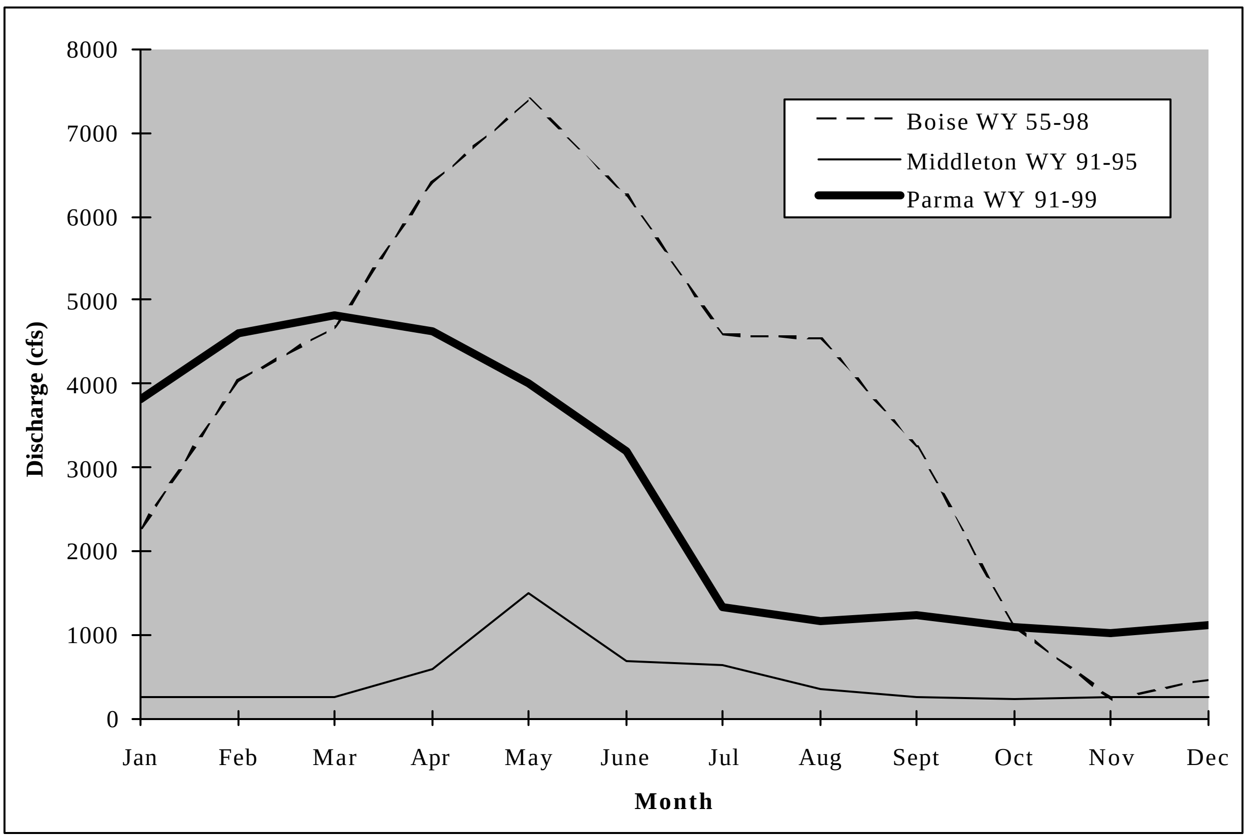

Figure 6. Monthly average discharge in the Boise River at USGS gages near Boise, Middleton, and Parma.

Diversions from the Boise River typically exceed total river discharge in low flow years, because return flows are re-diverted for irrigation in a lower stretch of the river. The repeated use and reuse of water is a complicating factor in determining the fate of pollutants discharged to the river and the effects of pollutant reductions at different locations. The shear number of canals and laterals in the watershed suggest the complexity of interpreting flow conditions and pollutant fate (Figure 7).

In addition to affecting river flows, irrigation practices have also altered drainage patterns in the watershed. Water does not follow natural drainage paths in much of the lower Boise valley. Natural drainages in the lowlands and irrigated areas of the valley have been deepened, lengthened, straightened, and diverted while drains, laterals, and canals have been constructed. The stream alterations and man-made waterways have created new drainage areas that are significantly different from the natural subwatershed areas. Figure 8 depicts the current drainage areas of the lower Boise watershed (David Ferguson, unpub. data, 1997). The boundaries were field mapped in the summer of 1997 using 1:24,000 topographic maps. The subwatersheds are shown in Figure 9. Subwatersheds were delineated by the Idaho Department of Water Resources (IDWR), in cooperation with other agencies, using USGS 1:100,000 hydrography information. Drainage areas delineated by Ferguson will be used for this assessment because they more accurately identify the lands contributing to each drain that enters the Boise River.

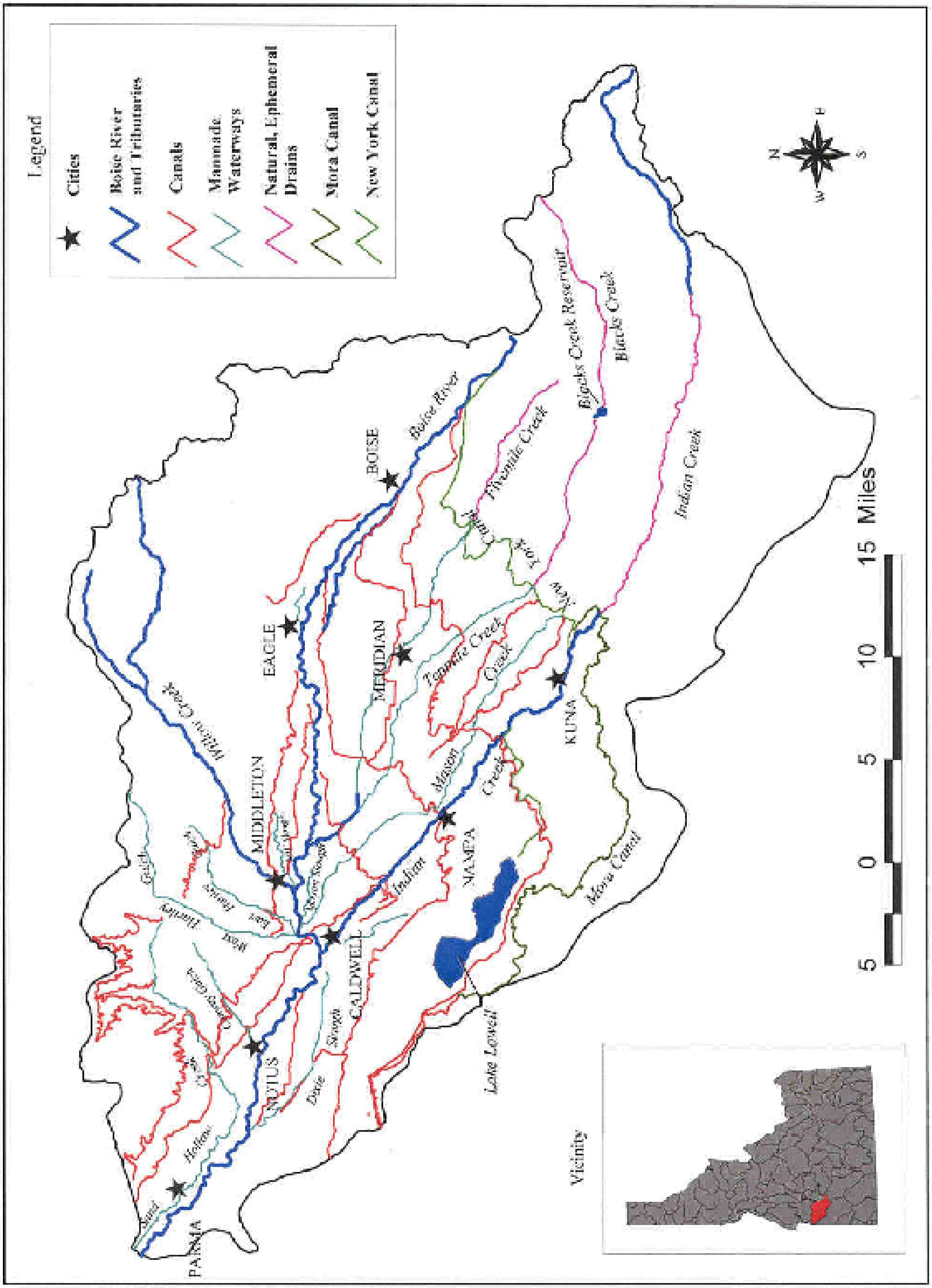

Figure 7. Lower Boise River watershed surface hydrology.

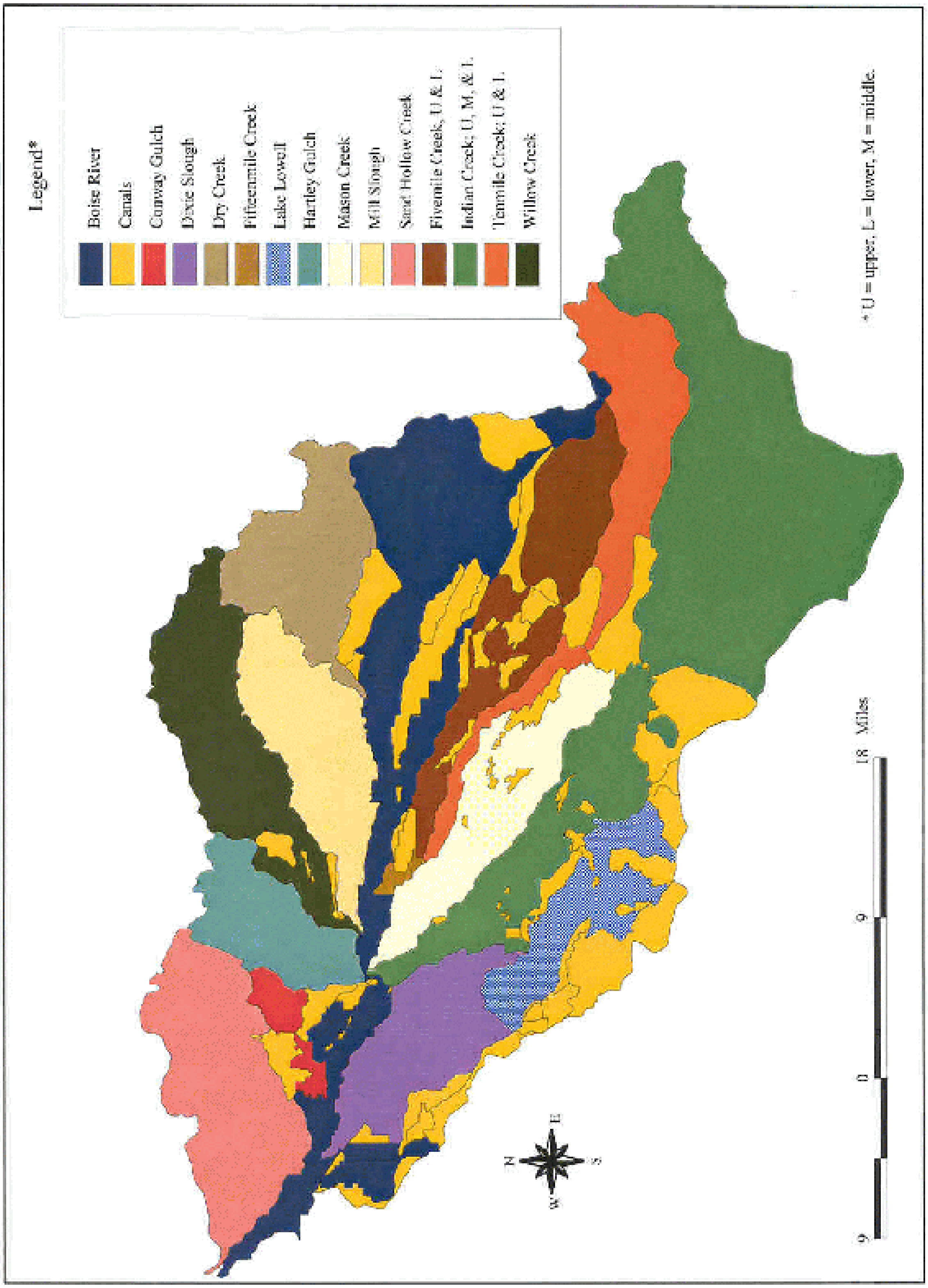

Figure 8. Drainage areas in the lower Boise River watershed.

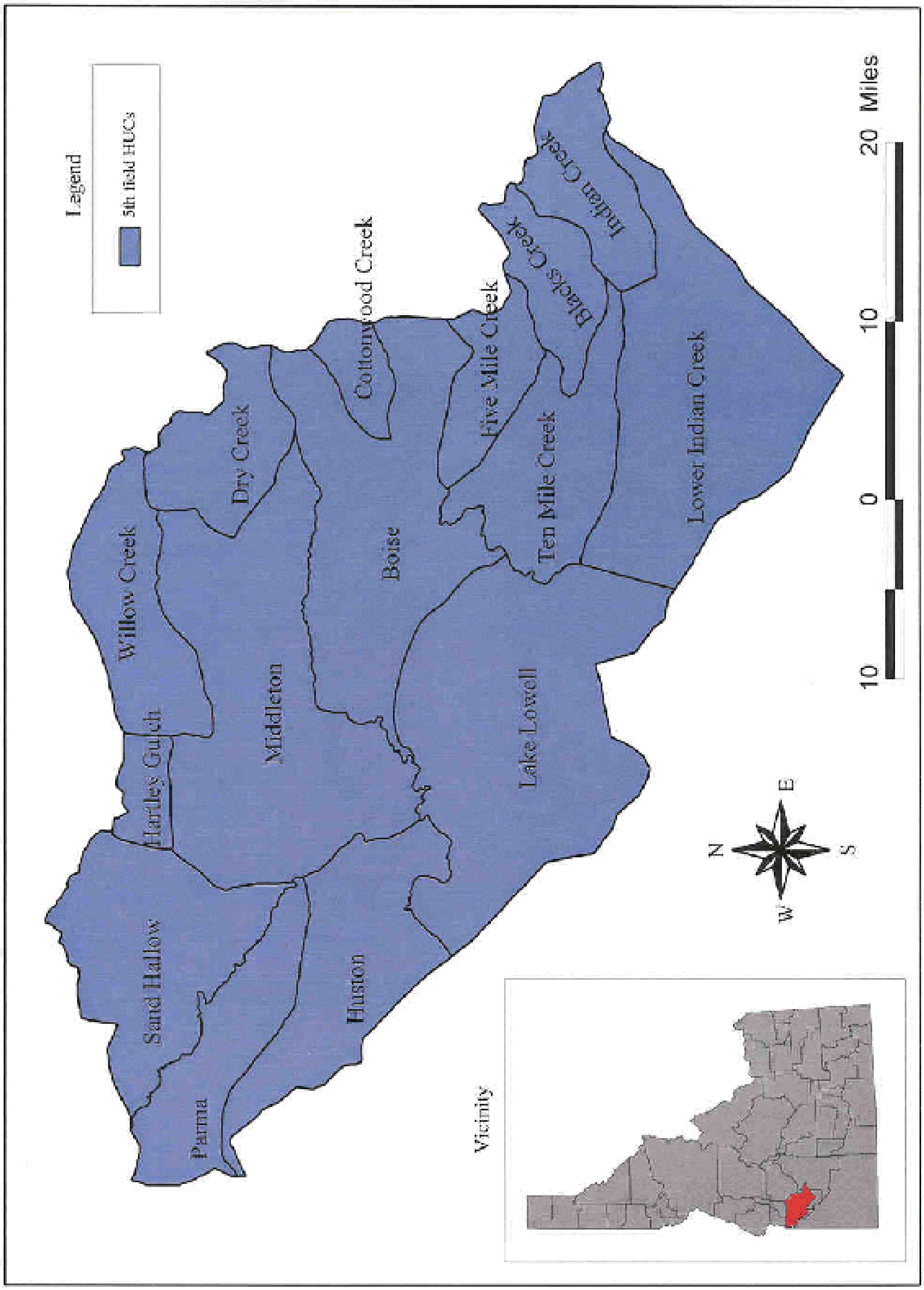

Figure 9. Subwatersheds in the lower Boise River watershed.

Ground Water Hydrology

The lower Boise valley is underlain by two major cold water (less than 85°F) aquifers: 1) the shallow, unconfined Boise River gravel aquifer and 2) deep, semi-confined to confined Idaho Group aquifer. The boundaries of the confined, semi-confined, and unconfined aquifer system are related to changes in the types and occurrence of lake and river sediments, and crustal faulting. Primary water yielding strata are interbedded sand, silt, and claystone of the Idaho Group (Squires et al., 1992). Studies by Dion (1972) and Burnham (1979) show canal seepage and irrigation application as a major source of recharge to the shallow aquifer.

Historically, ground water levels were lower than they are today (Paul, 1916). Starting as early as the 1860's, farmers in the valley started diverting water from the river for irrigation. As the extent of irrigated area increased, large amounts of water were applied to the surface by flood or furrow irrigation methods and ground water levels rose throughout a large part of the valley by tens of feet (Paul, 1916). High ground water levels began to interfere with soil and crop health. In response, numerous drains were constructed and existing ephemeral drainage ways were deepened and widened in the early 1900's to drain excess ground water.

Ground water levels have been relatively stable in the lower Boise valley since the many drains and wells were dug back in the 1910's and 1920's . Recent studies by Squires et al. (1993) and Tungate and Berenbrock (1995) show declining water levels in the Boise City area. Ground water table maps show an average decline of ten feet in 90% of the Boise City area during the period of 1970-1992 (Tungate and Berenbrock, 1995). A slight increase was seen in five small areas around the Boise River and Boise Front. These declines have been attributed to increased ground water withdrawals and artificially induced ground water gradients from long-term wells in southeast Boise and to the west (Squires et al., 1993). The Treasure Valley Hydrologic Project is currently developing a series of reports that will help refine what is currently known about the groundwater hydrology in the lower Boise River basin.

The Boise River both gains and loses ground water depending on location and season. Generally, the river loses water to ground water in the reach above Glenwood Bridge, although it also gains in this reach depending on season and flow conditions. From Glenwood Bridge to the mouth the river generally gains water from ground water. During flood flow conditions between March and June the river may lose water to ground water, when ground water levels are lowest.

Channel and Substrate Characteristics

The valley of the lower Boise River is broad, sloping gently to the northwest with multiple river terraces positioned laterally along its flood plain. The river channel is classified as a type F from Lucky Peak Reservoir to Diversion Dam and a type C from Diversion Dam to its mouth according to the Rosgen classification scheme (Rosgen, 1994). The F type channel is deeply entrenched, low gradient (<0.02), has a high width/depth ratio, and a riffle/ pool morphology. The C type channel is characterized as low gradient (<0.02) and meandering with a riffle/ pool morphology, high width/depth ratio, and a broad, well-defined flood plain. At low flows (fall and winter) the reach from Diversion Dam to the mouth is often a braided, type D channel. The Boise River has a gradient of 0.002 and width/depth ratios of greater than 30 along its length (Asbridge and Bjornn, 1988).

The river bottom from Lucky Peak Dam to Barber Dam is composed of cobble-size (64 to 256 mm) material and sand-size (<2 mm) sediment. During high flows sand-size sediment builds up behind Diversion Dam. After the irrigation season (mid-October) the gates at the base of Diversion Dam are opened and the sediment is washed downstream. Sediment is retained behind Barber Dam and is flushed downstream only during high flows. Gravel recruitment below Lucky Peak Dam is limited by the presence of the dams, thus the river below Barber Dam is said to be "sediment starved". Cobbles embedded primarily in sand armor the channel bottom from Barber Dam to the river's confluence with the Snake River. Pebble (8 to 64 mm) and sand size material are found in point-bar and transverse bar deposits along the length of the river and the interstices between cobbles.

The Boise River exhibits other characteristics typical of a river with managed flow. Flow regulation has caused narrowing of the river channel and channel degradation immediately downstream of Lucky Peak Dam with aggrading conditions further downstream. Braiding and sinuosity are largely absent because the sediment supply and peak flows have been reduced. Channelization and the construction of dikes and levees for irrigation have also contributed to the loss of braiding and sinuosity, which are important for bedform construction.

In addition, flood plains of the river are being converted to residential and commercial land use resulting in changes in river morphology, hydrology and water quality. Bank armoring to prevent loss of land during high flow conditions and numerous diversion structures have altered instream flow characteristics.

Wildlife Characteristics

The lower Boise River is home to numerous species of wildlife. The canopy along the river reach near Barber Dam provides winter roosts for bald eagles. Downstream, Eagle Island hosts a great blue heron rookery (Resource Systems, Inc., 1983). Other birds and mammals living in the lower Boise River corridor include but, are not limited to egrets, ducks, geese, deer, beaver, and muskrat. The river corridor supports two heron rookeries, in the Wood Duck Island subdivision and near the Monroc facility in Eagle.

The lower Boise River supports a natural and stocked fishery. Two reaches, Lucky Peak to Star and Star to the mouth, support distinctly different fish. The river above Star is a cold water fishery composed primarily of the salmonids mountain whitefish, rainbow trout, and brown trout. Above Star the river is regularly stocked with rainbow trout by Idaho Fish and Game (IDFG). Cool and warm water species dominate the river below Star with suckers, dace, carp, and large and small mouth bass being most abundant. The river below Star supports few if any trout species, however mountain whitefish are seasonally abundant, especially in the fall-winter period.

Cultural and Political Characteristics

The Boise River valley was first explored in 1811 by overland explorers of John Jacob Astor's Pacific Fur company. The Boise valley was settled in 1863. Gold discoveries in 1862 in the nearby mountains prompted the founding of Boise City. Soon thereafter bottomland three to five miles north and south of the Boise River, from Boise to its confluence with the Snake River, was claimed and cultivated. Eventually, settlements such as Caldwell, Notus and Parma emerged along the Boise River.

The first water conveyances were constructed in response to low water years and increased settlement along the river. Small canals were built as early as 1863 by individuals and large groups. The small canals provided water to the bottomlands and low benches of the lower Boise River valley. Early settlement beyond the low benches was uncommon due to the lack of accessible water.

The valley began to change with the coming of the Oregon Shortline Railroad in 1887 and completion of the Phyllis and Ridenbaugh Canals in 1890 and 1891 respectively. The canals provided water to the desert and enabled settlement beyond the Boise River bottomlands. By 1900 it is estimated that 465 miles of canals, ditches, and laterals had been constructed in the Boise Valley, capable of serving 100,000 acres of land (United States Bureau of Reclamation, 1996). The federal Reclamation Act of 1902 allocated funds to support the Boise Project's (1904) continued reclamation of the Boise Valley. The Boise Project, overseen by the U.S. Bureau of Reclamation, included construction of the following: Diversion Dam (1908), New York Canal (1909 and 1912), Lake Lowell (1909 and 1911), Arrowrock Dam (1915). Additional dams on the lower Boise include Barber Dam (1905) and Lucky Peak Dam (1957).

The Boise Project, completed in 1915, provided irrigation water to many acres beyond the Boise River flood plain. Additional canals and diversions were added throughout the valley to further supplement irrigation efforts by 1927. However, problems with excessive standing water in some areas of the valley began to arise as early as 1910. Nace et al. (1957) documented the rise of ground water levels of 140 feet or more between 1914 and 1953 in some parts of the valley. To combat the rising water table, ditches were dug (325 miles by 1953) and pumps were installed to drain excess ground water (Nace et al., 1957).

Passage of the Clean Water Act in 1972 brought about reductions in point source discharges of pollutants through the National Pollutant Discharge Elimination System (NPDES) permitting program. The permit program is used to control and monitor point sources that discharge into waters of the United States. Major point sources discharging to the lower Boise River and its tributaries are shown in Table 1.

Table 1. Municipal wastewater treatment plants (WWTP) and selected major point sources discharging to the lower Boise River and its tributaries.

Point Source	Design/Permit	Receiving Water
City of Boise - Lander Street WWTP	15	Boise River
City of Boise - West Boise WWTP	24	Boise River, South Channel
City of Meridian WWTP	4	Fivemile Creek and Boise River
Star Water and Sewer District	0.33	Lawrence-Kennedy Canal
City of Nampa WWTP	11.76	Indian Creek
City of Middleton WWTP	1.83	Boise River
City of Caldwell WWTP	8.48	Boise River
City of Wilder WWTP	0.12	Wilder Ditch Drain
City of Notus WWTP	0.056	Conway Gulch
City of Parma WWTP	0.31	Sand Hollow Drain
IDFG Fish Hatchery	20	Wilson Drain
Armour Fresh Meats	0.74	Indian Creek

The lower Boise River is a natural resource used by everyone in the community. Consumptive use of the lower Boise River is primarily for irrigation of agricultural cropland. The river also serves as a partial drinking water supply for the city of Boise and as an industrial water source for several industries of the valley. Within the city of Boise, the river is a focal point for recreational use. Activities such as swimming, floating the river in inner tubes, rafting, kayaking and fishing are common in the river during the summer and fall. Adjacent to the river is the Boise River greenbelt which is used by many for walking, biking, and rollerblading.

Demographics and Economics

The lower Boise River watershed has experienced rapid population growth over the last decade. Ada County was one of the fastest growing counties in the state from 1990 to 1999 with population increases of more than 37%. Population increased over 38% in Canyon County for the period of 1990 to 1999. Population projections for the two counties show continued growth at slower rates. According to the Census Bureau (2000), the population of Ada County for 1999 was 283,402 with projected populations of 305,084 for the year 2005 and 334,889 for the year 2010. Canyon County population in 1999 was estimated to be 124,442 and is projected to be 141,251 in the year 2005 and 156,572 in the year 2010. By year 2005, Ada and Canyon counties will likely represent one-third of the state's population.

Primary economic centers of the watershed are located in Ada and Canyon Counties. Ada County is a government, corporate headquarters and financial center. Canyon County has a strong agricultural base and is an important center for production and processing of agricultural goods.

Land Ownership and Land Use

Land ownership in the watershed is a mixture of federal, state, county, municipal and private ownership. Ada County is approximately 47% private and 45% federal, in contrast to Canyon county which is approximately 93% privately owned. Land use in the watershed is shown in Table 2. Rangeland comprises 51% of the watershed; irrigated croplands and pasture together comprise 31%. These land uses dominate the southern portion of the watershed, but occur throughout the basin. Throughout the watershed agricultural lands are being converted to suburban residential and commercial land use. An example of the land conversion trend is seen in Canyon County, where the number of very small farms or ranchettes (less than 10 acres) increased by nearly 40% during the period of 1978 to 1987 (Canyon County, 1995).

Table 2. Land use in the lower Boise River watershed (Idaho Department of Water Resources)

Land Use/Land Cover	Acres	Percent of Total Area
Rangeland	425,731	50.7
Water	8,154	1.0
Riparian, Wetland	12,994	1.5
Barren (without vegetation)	4,377	0.5
Rural Residential and Farmstead	23,199	2.7
Urban Residential and Subdivisions	30,132	3.5
Commercial, Industrial and Transportation	15,672	1.8
Public (parks, schools, churches, hospitals, cemeteries, state and federal facilities)	4,018	0.5
Recreation	3,745	0.4
Sewage Treatment	560	0.1
Irrigated Cropland	245,653	29.3
Orchards and Vineyards	2,892	0.3
Idle, Abandoned and Other Agriculture	18,778	2.2
In Transition	3,623	0.4
Feedlots and Dairies	3,208	0.4
Airports	807	0.1
Pasture	33,220	4.0
Unknown	113	<0.1

Public Involvement

Two groups affiliated with DEQ are actively working to enhance the health and environment of the lower Boise River. The Lower Boise River Water Quality Plan (LBRWQP) was initiated in 1992 by stakeholders interested in water quality in the river, and was designated as the Watershed Advisory Group (WAG) for this watershed in July 1996. As the WAG, the group is responsible for advising the Idaho Department of Environmental Quality (DEQ) on the development of TMDLs in the watershed.

The WAG is also the driving force in preparing the TMDL implementation plans. Boise River 2000 focuses on issues related to the management of water quantity and flood control. Both groups are comprised of representatives from local and state government, environmental and recreation groups, agriculture, industry, flood control and drainage districts and concerned citizens. The primary goal of each group is to help improve and maintain the overall quality of the Boise River.

2.2 Water Quality Concerns and Status

Two segments of the lower Boise River are listed for nutrients on the 1998 Section 303(d) list for the state of Idaho. The two segments are summarized in Table 3. Figure 10 shows the location of the listed segments.

Table 3. Summary of Section 303(d) listed stream segments in the lower Boise River.

WATER BODY NAME	BOUNDARIES	POLLUTANTS 1998 303(d) list	Pollutants with approved TMDLs
Boise River	Star to Notus	Nutrients, Temperature Sediment, Bacteria	Sediment, Bacteria
Boise River	Notus to Snake River	Nutrients, Temperature Sediment, Bacteria	Sediment, Bacteria

TMDLs for sediment and bacteria were prepared by the DEQ and approved by EPA in January of 2000. Temperature conditions in the river were found to be largely correlated with ambient air conditions. Subsequently, temperature allocations were not recommended for the river (Appendix A).

Surface Water Beneficial Use Classifications

Surface water beneficial use classifications are intended to protect the various uses of the state's surface water. Idaho water bodies that have designated beneficial uses are listed in *Idaho's Water Quality Standards and Wastewater Treatment Requirements.* They are comprised of five categories: aquatic life, recreation, water supply, wildlife habitat and aesthetics.

Aquatic life classifications are for water bodies that are suitable or intended to be made suitable for protection and maintenance of viable aquatic life communities of aquatic organisms and populations of significant aquatic species. Aquatic life beneficial uses include cold water biota, seasonal cold water, warm water biota, salmonid spawning, and modified.

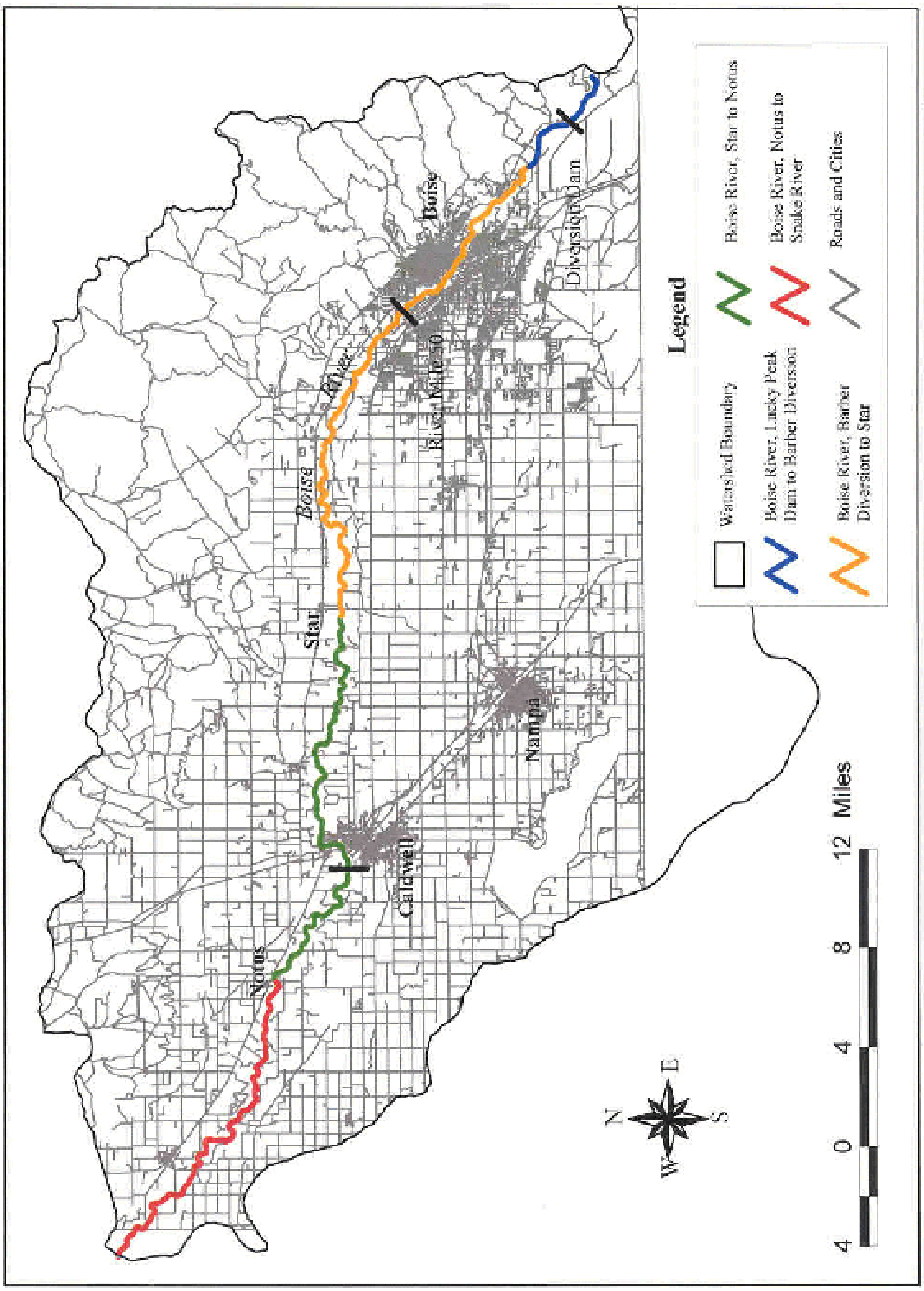

Figure 10. 303(d) listed stream segments for the lower Boise River.

Recreation classifications are for water bodies which are suitable or intended to be made suitable for primary and secondary contact recreation. Primary contact recreation is prolonged and intimate human contact with water where ingestion is likely to occur, such as swimming, water skiing and skin diving. Secondary contact recreation consists of recreational uses where raw water ingestion is not probable, such as wading and boating.

Water supply classifications are for water bodies which are suitable or intended to be made suitable for agriculture, domestic and industrial uses. Industrial water supply applies to all waters of the state. Wildlife habitat waters are those which are suitable or intended to be made suitable for wildlife habitat. Wildlife habitat applies to all waters of the state.

The aesthetics beneficial use is ambiguous in that the interpretation of support status pertains to the perception of good or bad water quality engendered by each individual. In general, the aesthetics beneficial use implies that the water body is visually pleasing to the eye and does not discourage contact recreation. Aesthetics applies to all waters of the state.

IDAPA 58.01.02.140 designates beneficial uses for selected water bodies in the Southwest Idaho Basin. Undesignated water bodies are presumed to support cold water biota and primary or secondary contact recreation unless the Department of Environmental Quality determines that other uses are appropriate.

Beneficial Uses of the Lower Boise River

Beneficial uses are designated in IDAPA 58.01.02.140 for three segments of the Boise River below Lucky Peak Dam. The two lower segments (RM 50 to Indian Creek and Indian Creek to the Snake) apply to this assessment. The designated uses for each segment are shown in Table 4. The boundaries for lower Boise River segments on the Section 303(d) list do not correspond to the boundaries for the designated uses. Figure 10 shows the listed stream segments.

In addition to designated uses, water bodies are also protected for existing uses. Secondary contact recreation is an existing use in all segments of the river. Data collected by the USGS in December 1996 and August 1997 suggest that salmonid spawning is an existing use for the Boise River from Indian Creek to the mouth. Fish sampling showed mountain whitefish present on both dates and the December 1996 sampling included multiple age classes of mountain whitefish. Mountain whitefish typically spawn between October and March. The presence of warm and cool water species, such as large and small mouth bass and catfish, in the Boise River from Indian Creek to the mouth indicate that warm water biota is also an existing use in this reach.

The Boise River from Lucky Peak Dam to River Mile 50 is also designated as a Special Resource Water (SRW), which affords this segment additional protection from pollutants discharged by point sources and ensures that beneficial uses in the river will be intensively protected.

Table 4. Designated beneficial uses for the Boise River below Diversion Dam.

Segment	Designated Uses
Boise River, Diversion Dam to River Mile 50 (Veteran's Parkway)	Domestic Water Supply Cold Water Biota Salmonid Spawning Primary Contact Recreation
Boise River, River Mile 50 (Veteran's Parkway) to Indian Creek (Caldwell)	Cold Water Biota Salmonid Spawning Primary Contact Recreation
Boise River, Indian Creek to mouth	Cold Water Biota Primary Contact Recreation

Applicable Water Quality Criteria

The *Idaho Water Quality Standards and Wastewater Treatment Requirements* contain narrative and numeric water quality criteria designed to protect beneficial uses. The following water quality criteria are applicable to the nutrient listing on the 1998 Section 303(d) list for existing and designated uses in the Boise River.

Floating, Suspended or Submerged Matter
Surface waters of the state shall be free from floating, suspended or submerged matter of any kind in concentrations causing nuisance or objectionable conditions or that may impair designated beneficial uses (IDAPA 58.01.02.200.05).

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

Oxygen-Demanding Materials
Surface waters of the state shall be free from oxygen-demanding materials in concentrations that would result in an anaerobic water condition (IDAPA 58.01.02.200.07).

Dissolved Oxygen
For Cold Water Biota, waters are to exhibit the following characteristics:

Dissolved Oxygen concentrations exceeding six (6) mg/l at all times (IDAPA 58.01.02.250.02.a)

For Warm Water Biota, waters are to exhibit the following characteristics:

Dissolved Oxygen concentrations exceeding five (5) mg/l at all times (IDAPA 58.01.02.250.04.a)

For Salmonid Spawning, waters are to exhibit the following characteristics:

A one (1) day minimum water column dissolved oxygen level of not less that six point zero (6.0) mg/l or ninety percent (90%) of saturation, which ever is greater

A one (1) day minimum intergravel dissolved oxygen level of not less that five point zero (5.0) or a seven (7) day average mean of not less than six point zero (6.0) (IDAPA 58.01.02.250.02.e.1)

pH

Hydrogen Ion Concentration (pH) values within the range of six point five (6.5) to nine point five (9.5) (IDAPA 58.01.02.250.01.a)

Summary and Analysis of Existing Water Quality Data

Numerous sources of data are available within the lower Boise River watershed to describe physical and chemical water quality, biological communities, habitat, geology, and climate. Geologic studies of the Treasure Valley are available, dating to the late 1800's. The Idaho Climate Data Center routinely records weather information at three sites in the Treasure Valley. At some sites, climate records date back to the turn of the century. The USGS has collected flow and water quality data in the Boise River below Diversion Dam, Glenwood Bridge (in Boise), near Middleton and near Parma from the early 1970's to the present. The monitoring sites are shown in Table 5 and in Figure 11. Water quality data have also been collected by the USBR and municipalities with NPDES permits for wastewater treatment plants and stormwater discharge.

Recent data collected by the USGS from the Boise River and selected tributaries are part of a multi-year monitoring plan jointly funded by DEQ, LBRWQP and the USGS. The current monitoring project includes collection of water quality data from four Boise river sites and four tributaries, aquatic macroinvertebrate and periphyton data from five river sites and one watershed- wide synoptic monitoring event that includes the river and 12 tributaries. The USGS currently monitors a full suite of water quality parameters at the mouth of the following tributaries to the Boise River: Fivemile Creek, Tenmile Creek, Mason Creek and Indian Creek. The tributary monitoring events occur monthly. However, during the months of May, June and July for water year 2001, the tributaries will be monitored bi-monthly.

The USGS also collects data about the abundance, makeup and distribution of fish populations in the river, benthic macroinvertebrates, and algae (Table 5). The USGS began biological monitoring in 1995, and collects samples once per year at Eckert Road, Glenwood Bridge, Middleton, Caldwell, and Fort Boise (the mouth of the river). IDFG has collected data on fish populations and aquatic habitat, primarily for the reach of the river between Barber Park and Star where there is extensive angling pressure. Habitat assessments are few and limited to the river near the City of Boise. Asbridge and Bjornn (1988) evaluated habitat conditions in the river above Star. With the exception of data collected by the USGS in 1997, very little quantified information about habitat is available downstream of Star.

Table 5. Dates of water quality and biological (algae) monitoring data at USGS sampling sites.

Site	Water Quality Monitoring Dates	Algae Monitoring Dates
Diversion Dam	Nov. 1990 to Sept. 1991 Oct. 1992 to the present	Oct. 1996
Eckert Road	NONE	Oct. 1995, Oct. 1996, Aug. 1997, Oct. 1998, Nov 1999
Glenwood	Oct. 1970 to Sept. 1973 Oct. 1987 to Sept 1988 Oct. 1989 to the present	Oct. 1995, Oct. 1996, Aug. 1997, Oct. 1998, Nov 1999
Middleton	Oct. 1976 to Sept. 1977, Nov. 1991 to the present	Oct. 1995, Oct. 1996, Aug. 1997, Nov. 1998, Nov 1999
Caldwell	Temperature only, 1996,1997	Oct. 1995, Oct. 1996, Aug. 1997, Nov. 1998, Nov 1999
Parma	Various dates 1973 to 1976 Oct. 1986 to the present	NONE
Fort Boise	NONE	Oct. 1995, Oct. 1996, Aug. 1997, Nov. 1998, Nov 1999

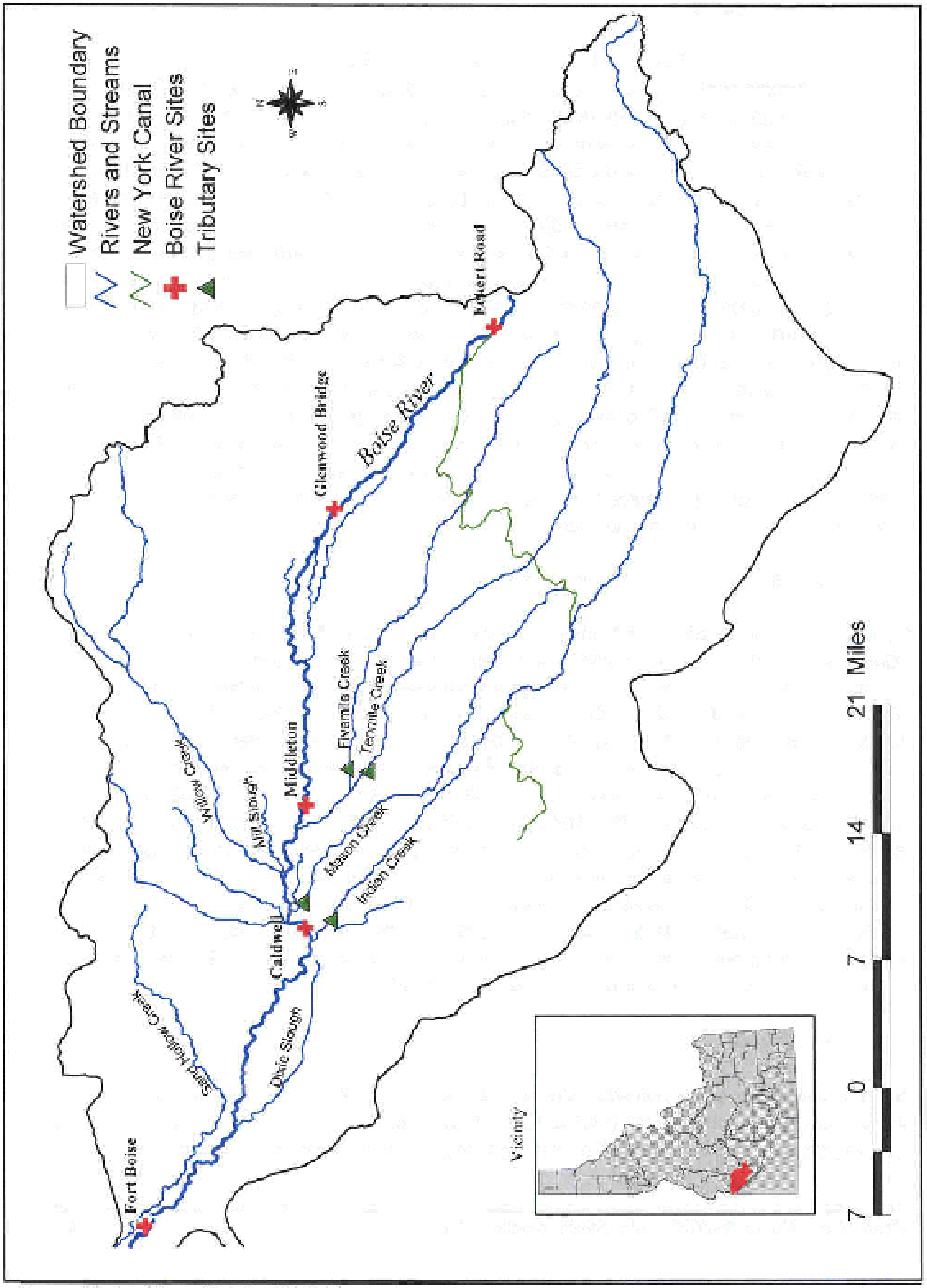

Figure 11. Current USGS monitoring sites in the Lower Boise River Watershed

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Water Quality Conditions

DEQ used water quality, biological, hydrological and historical complaint data to assess the effects of nutrients on beneficial uses in the river. Normally, the concentrations of listed pollutants in relation to applicable numeric criteria are in part used to assess the status of beneficial uses and pollutants contributing to impairment. In the case of nutrients, the state of Idaho's criteria is narrative, making beneficial use support status determination difficult and in part open to interpretation by the state. The exact nutrient levels at which algae growth become categorized as nuisance are not well defined, primarily because the nutrient level and the mass of algae that constitutes excessive growth is different in nearly every water body. The growth rate and potential of algae is often dictated by factors other than nutrient availability, such as water velocity, substrate type, substrate stability, ground water nutrient dynamics and light penetration. Without quantitative nutrient criteria in place, the determination of nuisance algae growth is commonly based on surrogate measures such as suspended and benthic algal biomass levels, dissolved oxygen levels, pH levels and the implied recreational value. All of these factors in turn give direct and indirect information about the status of beneficial uses. It is important to note that the mere presence of algae, even at high levels, does not constitute impairment. From an aquatic ecology standpoint each water body is slightly different, and in the state of Idaho impairment is based on the linkage between the pollutant of concern and its effect on the designated and existing beneficial uses.

Nutrients and Nuisance Aquatic Growth

Algae are an integral part of the aquatic ecosystem in that they provide a food source for many aquatic insects, which in turn provide a food source for fish. Algae grow naturally where nutrients (nitrogen, phosphorus) in combination with suitable flows, substrate conditions, temperatures, and sunlight penetration into the water combine to produce conditions suitable for photosynthetic growth. When algae levels (suspended or benthic) become voluminous they can adversely impact aquatic life and recreation. When nutrients exceed the minimum quantity needed to support primary productivity, and other conditions are not limiting, various types of excessive algal biomass can form. These often include surface algae blooms and submergent and emergent macrophyte beds. When algae die their decomposition creates an oxygen demand. If the demand is high enough, in the case of excessive algae die-off, dissolved oxygen (DO) concentrations in the water body may decline to levels that harm fish. Algae blooms and excessive aquatic macrophytes can also physically interfere with recreational uses such as boating, swimming and wading. Decomposing algae can also create objectionable odors and some species may produce toxins that could impair agricultural water supply.

Phosphorus

High concentrations of phosphorus have been documented in the Boise River at Glenwood Bridge from 1989 through 1999 (Figure 12). The river is also significantly phosphorus-enriched at Middleton and Parma (Figure 13). If phosphorus concentrations are considered exclusively, algae blooms may be possible under the right conditions. Total phosphorus concentrations in samples collected by the USGS since 1994 range from well below the EPA guideline value for flowing waters of 0.1 mg/l at Diversion Dam to as high as 1.3 mg/l at Middleton and 0.6 mg/l at Parma. The highest concentrations occur during low flow conditions, which are generally in the winter when aquatic plant growth is less of a concern. Exceptionally high concentrations were measured at Glenwood Bridge and Middleton in 1992 when the lowest flow on record occurred in the Boise River.

Ortho-phosphate concentrations follow a similar pattern to total phosphorus with respect to flow conditions and location. Highest concentrations are during low flow periods, concentrations increase downstream, and ortho-phosphate is more than adequate to support nuisance aquatic growth under the right conditions. Bothwell (1988, 1989) and Horner et al. (1983) have shown that phosphorus concentrations as low as 25 to 50 ug/l are sufficient to support growth of periphyton communities. The data indicate that ortho-phosphate comprises 75% to 80% of total phosphorus concentrations in the Boise River.

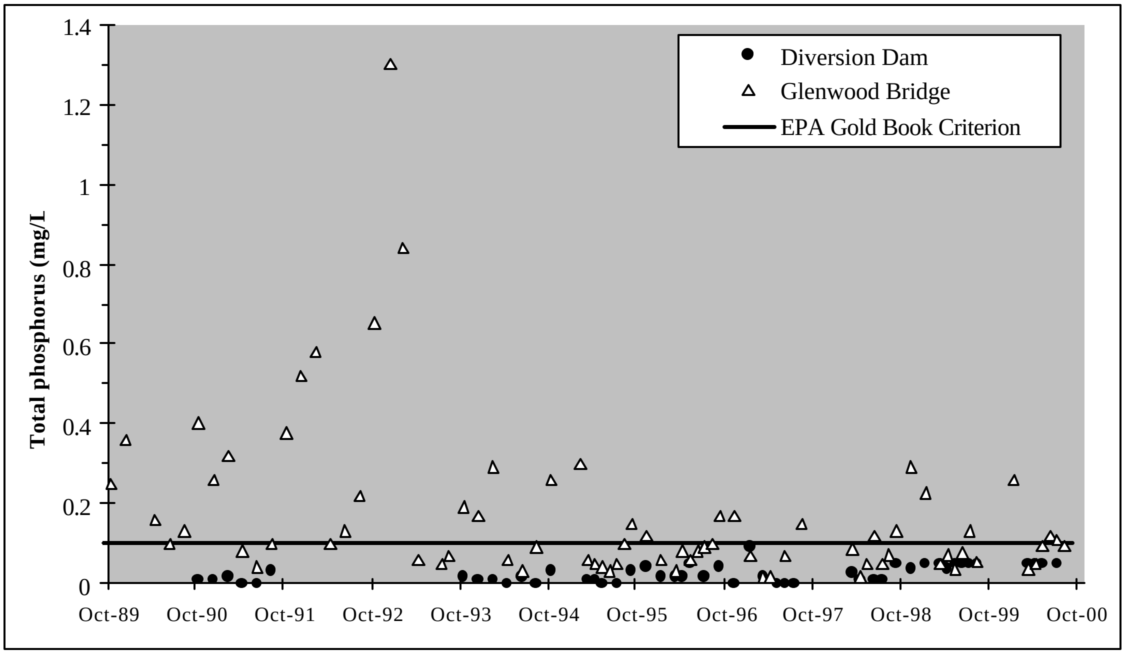


Figure 12. Total phosphorus levels in the Boise River at Diversion Dam and Glenwood Bridge: 1989-2000.

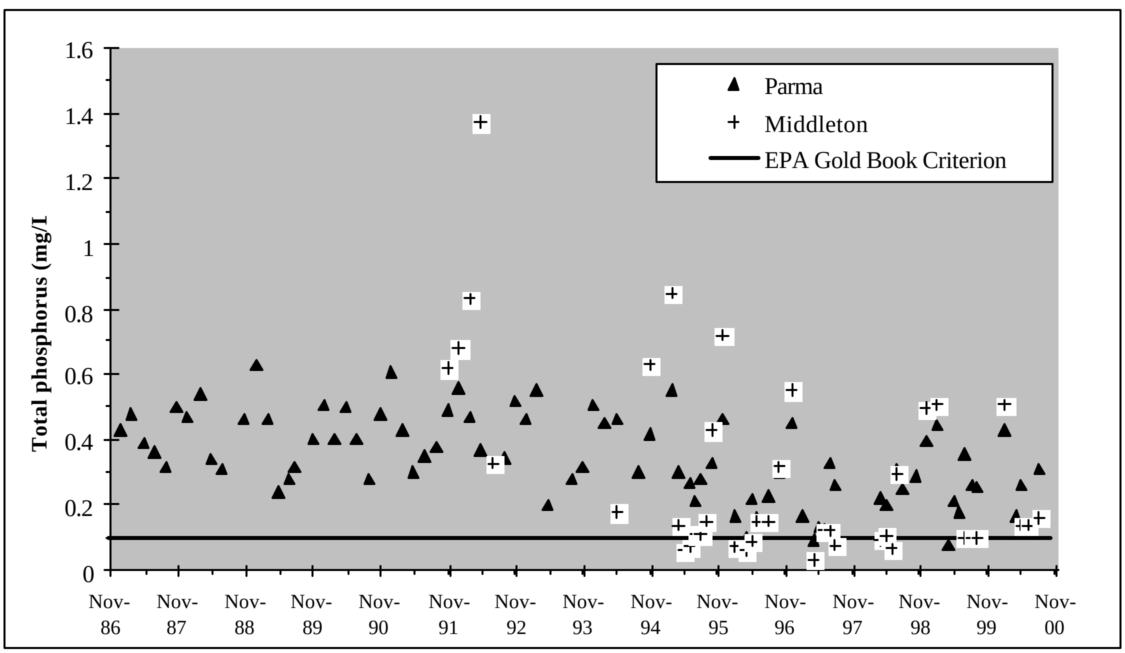


Figure 13. Total phosphorus levels in the Boise River near Parma and Middleton: 1986-2000.

Nitrogen

Total nitrogen, which is the combined total of dissolved inorganic nitrogen, particulate nitrogen (e.g., plankton, detritus, etc.) and dissolved organic nitrogen, is often viewed as one of the best indicators of nitrogen levels in streams. In general, total nitrogen levels in excess of 1.5 mg/l indicate enrichment in streams and rivers (Dodds et al., 1998, Omernik, 1977). The data indicate that the river is nitrogen rich from Glenwood to Parma (Figures 14 and 15).

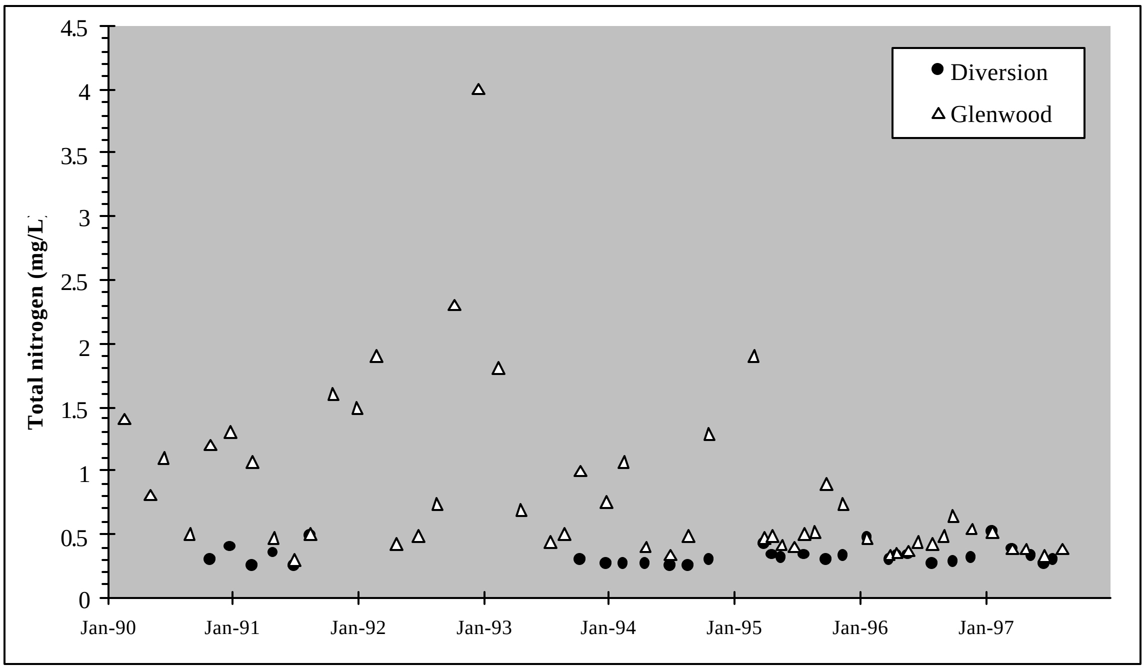


Figure 14. Total nitrogen levels in the Boise River at Diversion Dam and Glenwood Bridge, 1990 - 1997

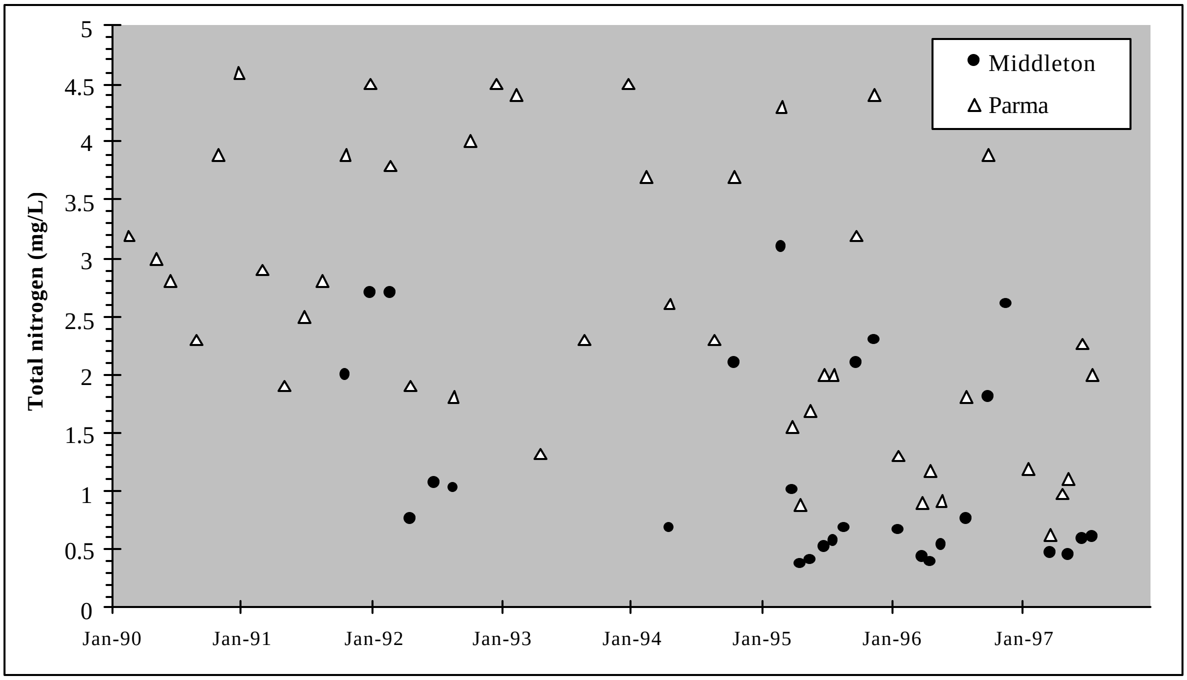


Figure 15. Total nitrogen levels in the Boise River at Middleton and Parma, 1990 - 1997

Defining the Limiting Nutrient

The first step in identifying a watershed's response to nutrient flux is to define which of the critical nutrients is limiting growth. The nutrient that is in the shortest supply is defined as the limiting nutrient because its relative quantity affects the rate of production of aquatic biomass. In fresh water the most common limiting nutrient is phosphorus. However, several authors have shown that under the right conditions nitrogen can be the limiting nutrient in streams and rivers (Grimm and Fisher, 1986, Hill and Knight, 1988, Lohman et. al, 1991). Determining the limiting nutrient is often difficult. For this reason, the ratio of the amount of N to the amount of P is commonly used to make the determination (Thomann and Mueller, 1987). With all other limiting factors held equal, algal biomass in waters with an N:P ratio (ratio of nitrogen to phosphorus) greater than 14:1 tend to respond to phosphorus addition, whereas algae in waters with a lower N:P ratio are nitrogen-limited. This ratio is referred to as the Redfield ratio. The important implication for water bodies is that an in-flux of the limiting nutrient may cause a significant and rapid growth of aquatic biomass. However, this phenomenon assumes other factors such as hydrology, substrate and light penetration are not limiting.

Figure 16 shows the Redfield ratios for the lower Boise River during the irrigation and non-irrigation season for the combined years 1990 through 1997. At all locations in the river the irrigation and non-irrigation season N:P ratios are essentially the same, indicating that an increased nutrient input during the irrigation season does not shift nutrient limitation. Phosphorus appears to be limiting at the Diversion dam, whereas in the remaining portions of the river, nitrogen appears to be limiting. At first glance, these data indicate that an influx of nitrogen at Glenwood Bridge may cause an increase in aquatic biomass. However, as illustrated in figures 14 and 15 the lower Boise River is nitrogen as well as phosphorus enriched. The ambient level for both nutrients is high enough to support primary algae growth. The fact that the river is enriched by nitrogen and phosphorus indicates that neither one of the nutrients is limiting excessive algae growth. Excessive algae growth is being limited by another factor or combination of factors.

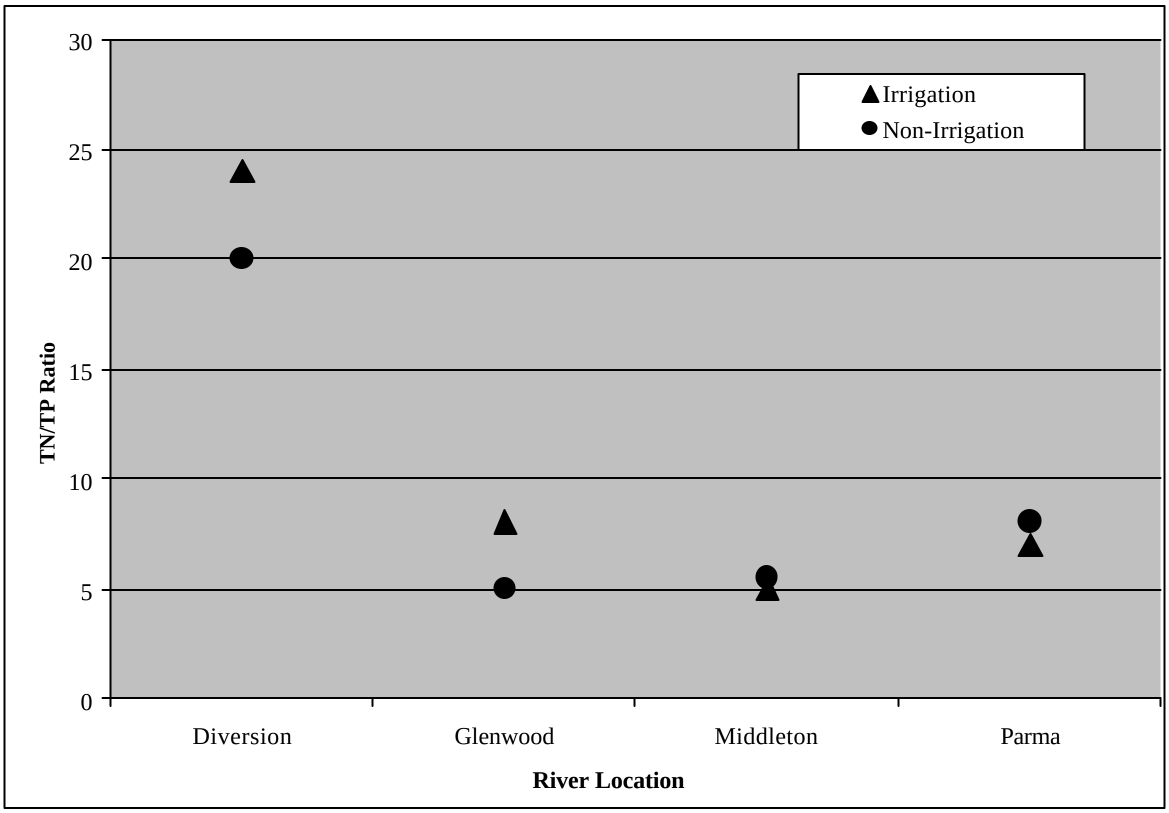


Figure 16. Nitrogen / Phosphorus ratios in Boise River at Diversion dam, Glenwood, Middleton and Parma, 1990-1997.

Dissolved Oxygen

Dissolved oxygen can be a direct indicator of nuisance aquatic growth in that as aquatic algal biomass increases, the amount of night-time respiration increases as well. As respiration increases, the volume of oxygen removed from the water increases. In excessive algae growth situations, the result is often low DO concentrations that stress or even kill sensitive species of fish and macroinvertebrates.

No DO concentrations less than 6.0 mg/l, the cold water biota criterion, have been recorded from Lucky Peak to the mouth of the river. The data span the years 1986 to 1999.

Table 6. DO data for the lower Boise River watershed, 1986 to 1999.

Site	Sampled By	Frequency	Dates
Boise River below Diversion Dam	USGS	Bimonthly or Monthly	November 1990 - Sept 1999
Boise River at Glenwood Bridge	USGS	Bimonthly or Monthly	November 1989 - Sept 1999
Boise River near Middleton	USGS	Bimonthly or Monthly	November 1991 - Sept 1999
Boise River near Parma	USGS	Bimonthly or Monthly	November 1986 - Sept 1999
Boise River at Eckert Road, Glenwood Bridge, Middleton, Caldwell and Parma	USGS	Hourly 24 hour periods	August 1997
Boise River at Veteran's Parkway, Glenwood Bridge and Eagle Bridge	City of Boise	Quarterly	January 1993 to December 1996
South Channel Boise River at Eagle Island, upstream and downstream of discharge	City of Meridian	Daily	April 24, 1992 to December 31, 1996

In August 1997, the USGS took hourly DO measurements over 24-hour periods at five sites in the river to assess the possibility that DO might fall below the criteria during a DO sag in the late evening or early morning. The expected night-time sag in DO concentrations was observed but the concentrations never dropped below the criteria. The lowest 24-hour average DO concentration (7.5 mg/l) occurred at Middleton.

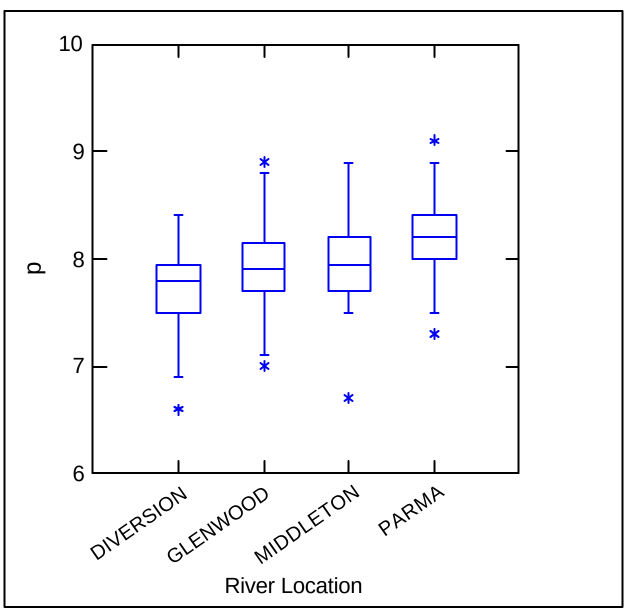
During the salmonid spawning season, a few DO measurements have been slightly less than the 75% of saturation required by the water quality standards. DEQ concluded that the few times DO fell below 75% of saturation aquatic life was not threatened, because occurrences are rare, close to the criterion (67% to 74.5% of saturation) and water column concentrations of DO always meet or exceed the required 6.0 mg/l.

Dissolved oxygen was removed as a pollutant of concern during the 1998 303(d) listing cycle based on the aforementioned analysis, see appendix B.

pH

pH is a measure of the concentration of hydrogen ions. Streams that display a very high or very low ionic concentration typically have restricted flora and fauna, in both species richness and abundance (Allan, 1995). The effects of excess nutrients on pH levels in lotic waters such as the lower Boise River are in part a function of the nutrient-algae relationship, and ultimately a function of the algal biomass in the system. When algal biomass conditions become excessive the water body typically experiences an increased volume of carbon dioxide in the water at night due to plant respiration. This increase in carbon dioxide beyond the normal range disrupts the stream's ability to buffer itself. When carbon dioxide levels increase, the pH typically drops.

Figure 17 shows the range of pH values in the Boise River from the years 1990 to 1998. The data were collected by the USGS and include values from the growing season of each year (April-September). As expected, pH increases in the lower portion of the river as the river becomes nutrient rich. However, despite the enrichment, the range of pH values is within the state criteria and is within the normal range for natural waters.



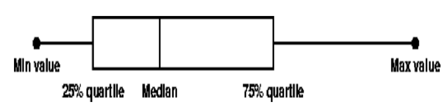


Figure 17. pH values in the lower Boise River, 1990-1998

Suspended Chlorophyll-a

Chlorophyll-a is the essential photosynthetic pigment found in aquatic plants. The amount of chlorophyll-a in water column (suspended) algae and in the algae attached to rocks (periphyton) is commonly used to measure algal productivity. While chlorophyll-a concentrations vary from species to species, it remains a viable surrogate for algae biomass (Carlson, 1980, Watson et al., 1992). The EPA also suggests that chlorophyll-a is a desirable endpoint because it can usually be correlated to loading conditions (EPA, 1999). While the state of Idaho does not have a numeric criterion for chlorophyll-a, Oregon's threshold is 15 ug/l. When the Oregon threshold is exceeded in an average of three samples collected over consecutive months at a representative location, a follow-up is made to ascertain if a beneficial use is adversely impacted. Hence, a value of greater than 15 ug/l does not necessarily indicate impairment. North Carolina has a chlorophyll-a criterion of 40 ug/l, which according to the state of North Carolina indicates impairment. Raschke (1994) proposed a level of 25 ug/l for surface waters used for viewing pleasure, boating, safe swimming and fishing. In cooperation with USBR and the City of Boise, the USGS collected suspended chlorophyll-a in the Boise River at Diversion Dam, Glenwood Bridge, Middleton, and Parma from 1995 to 2000 (Figure 18 and Figure 19). None of the measured values exceed 40 ug/l and only four in a five year period exceed 25 ug/l. Comparing the USGS data to these criteria, and considering that the USGS has not measured a single exceedence of the 6 mg/l DO criterion for aquatic life, DEQ has concluded that nutrients are not causing excessive growth of water column algae and that water column algae are not impairing aquatic life or recreational beneficial uses.

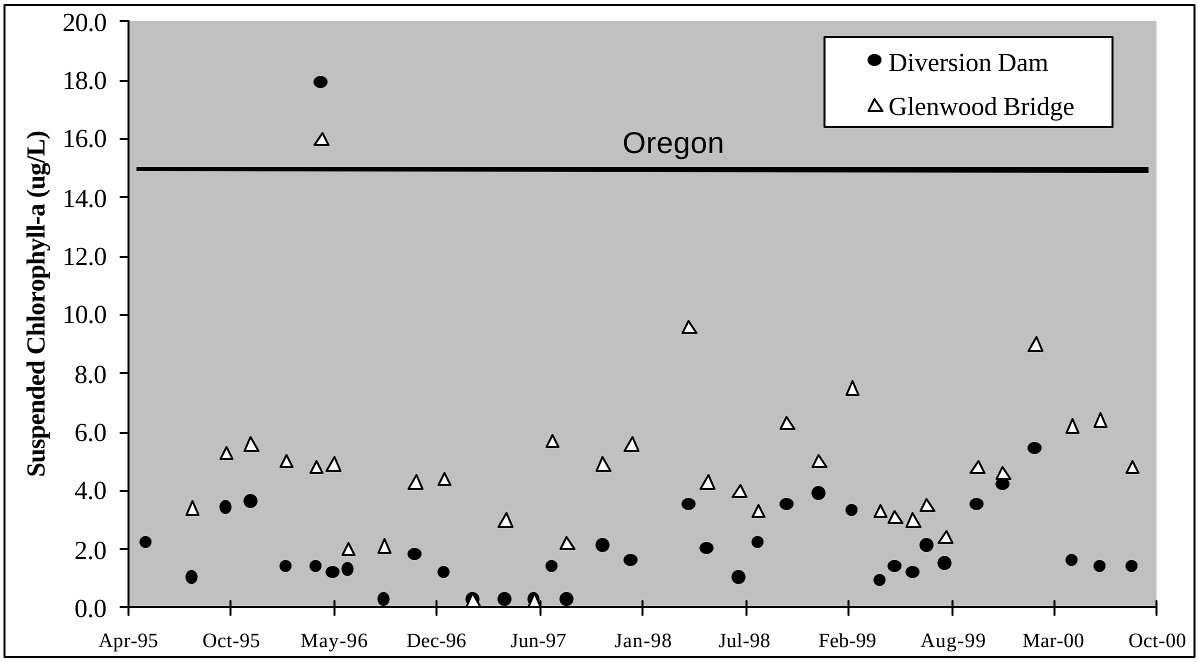


Figure 18. Suspended chlorophyll-a concentrations in the Boise River at Diversion Dam and Glenwood Bridge, 1995 - 2000.

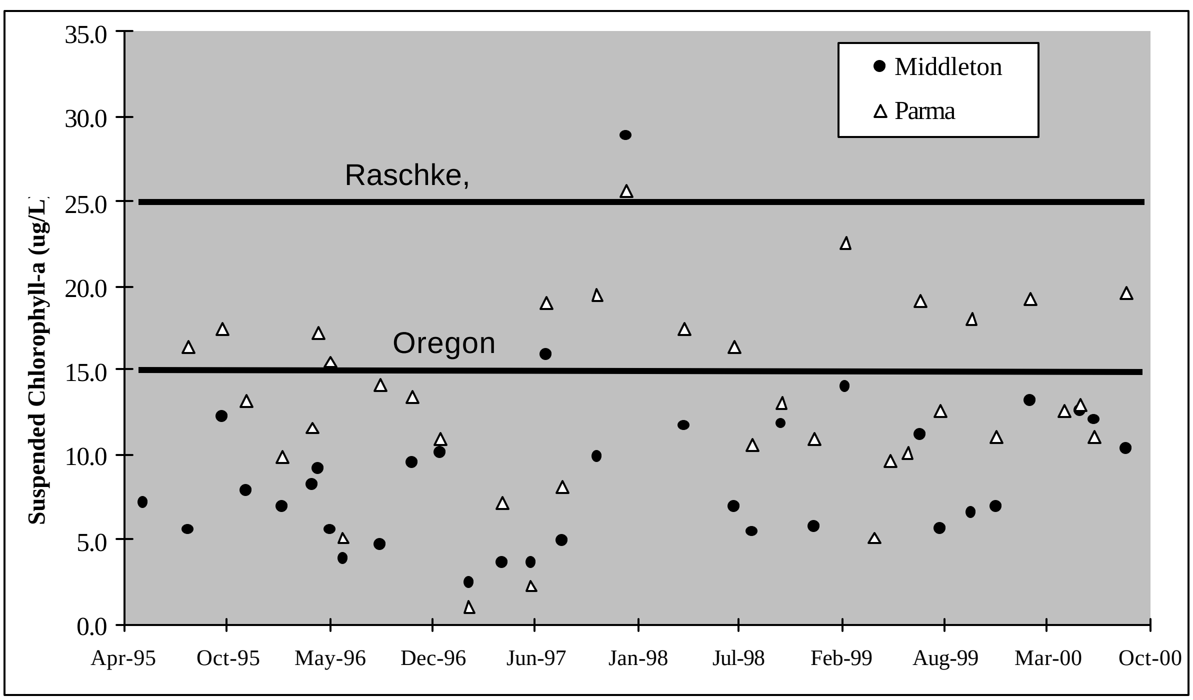


Figure 19. Suspended chlorophyll-a concentrations in the Boise River at Middleton and Parma, 1995 - 2000.

Benthic Chlorophyll-a

Periphytic (benthic) algae grows on pebbles and cobbles along the stream bed. In streams that do not experience an over abundance of nutrients, periphytic algae grow as single celled organisms called diatoms that are kept in check by the grazing of aquatic insects. When nutrient availability exceeds the basic needs of diatoms, other species, including bulky, filamentous algae such as *Cladophora* may grow on the stream bed. When the filamentous algae become excessive they can impede intergravel flow and decrease intergravel dissolved oxygen levels, both of which are detrimental to aquatic life. In excess, bulky filamentous algae can also cause significant aesthetic and water quality impairments including reduced water column DO concentrations, odors and clogging of irrigation pipes and ditches, all of which can be linked to impaired beneficial uses.

The state of Idaho does not have a numeric criterion for periphytic chlorophyll-a. Several authors have suggested that periphyton chlorophyll-a values from 100 to 200 mg/m^2 constitute a nuisance threshold, above which aesthetics are impaired (Horner et al., 1983, Watson and Gestring, 1996; Welch, et al., 1988; Welch, et al., 1989). However, no thresholds have been proposed in relation to the adverse impacts to aquatic life. Impacts to aquatic life are generally based on DO and pH problems and the reduction of living space for aquatic organisms due to excessive algae biomass.

The USGS collected periphyton samples in the Boise River at Eckert Road, Glenwood Bridge, Middleton, Caldwell and the mouth from 1995 to 1999. Samples were collected once per year during the growing season. Chlorophyll-a in periphyton ranges from a low of .025 mg/m2 at Eckert Road to a high of 933 mg/m2 at Caldwell (Figure 20). The highest values are consistently found at Middleton and Caldwell, where diversions result in lower flows and water temperatures begin to increase. The values reported in Figure 20 are the maximum values for each year. Hence, they represent the worst case scenario.

It should also be noted that all of the USGS algae sampling locations in the Boise river are normalized in terms of cross-sectional location. In order to maintain consistency for spatial analysis purposes the USGS located the sampling locations closer to the stream bank than the thalweg. This is because in the lower portion of the river the depth at the thalweg is too deep to collect a sample, whereas at above Middleton it would be possible to sample from the thalweg. The result is slightly higher than representative chlorophyll-a values from Middleton to the mouth of the river. The USGS has indicated that samples collected above Middleton are probably more representative of the true benthic chlorophyll condition in the river as a whole.

While periphytic chlorophyll-a values exceed the literature nuisance thresholds in these segments, the absence of DO sags and a normal range of pH values indicate that benthic periphyton is not causing impairment of aquatic life beneficial uses in the Boise River during the sampling periods. The absence of bulky, filamentous macrophytes and an over abundance of adnate positioned periphyton indicates that the macroinvertebrate and fish community have ample living space and that the intergravel flows

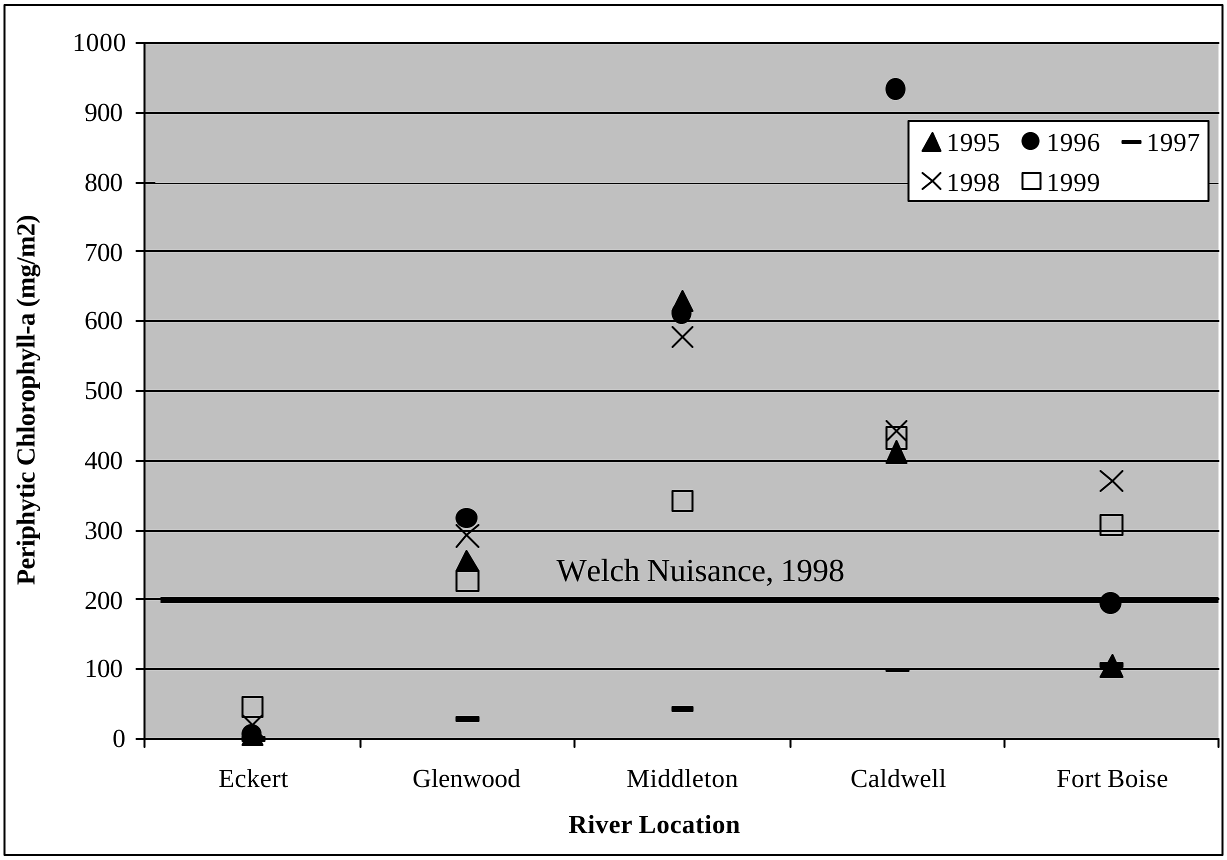


Figure 20. Maximum periphytic chlorophyll-a concentrations in the Boise River at Eckert, Glenwood, Middleton, Caldwell and Fort Boise, 1995-1999.

that rejuvenate dissolved oxygen are not impeded. From a contact recreation and aesthetics standpoint, the periphytic biomass levels are not such that they are causing unsafe swimming or wading conditions. There continues to be evidence of contact recreation at all locations in the river. The upper portion of the river remains a very popular fly fishery that is stocked annually with hatchery raised steelhead. A review of the DEQ complaint logs for the years January 1997 to January 2000 indicates that DEQ has received no recent reports of nuisance growth or any of the associated objectionable odors when large volumes of algae die and decompose. Furthermore, the irrigation companies and the other associated water users have not reported algal impediment at river withdrawal locations. When linked to the effects on beneficial uses, these information show that the recreational and aesthetics beneficial uses are not being impaired by benthic periphyton.

Macrophytes and other Bulky Species

As a general term, macrophytes refer to a diverse group of aquatic plants that are typically large enough to be observed by the naked eye. Macrophytes are found naturally in most water bodies and play an integral part of the aquatic ecosystem. Macrophytes provide in-stream cover for fish, stabilize the substrate, filter suspended sediment and serve as an important nutrient source when they die and cycle into the food chain. However, excess natural or cultural nutrient enrichment may yield an overabundance or nuisance level of macrophytes (EPA, 1973). In their attached form, which is the form most common in lotic waters, macrophytes generally rely on bottom sediments as their nutrient source. Water column nutrients generally must be incorporated in the bottom sediments before they are available for uptake by macrophytes (Chambers et al., 1999).

Similar to periphyton, the impairment of beneficial uses by excess macrophytes is generally based on the nuisance effects. From a recreational standpoint, excessive macrophyte growth reduces the visual appeal of the water, makes wading and swimming dangerous, fouls fishermen lines and nets and can clog boat motors. From an aquatic life standpoint, excessive macrophyte growth can cause diurnal fluctuation in DO and pH, interfere with intergravel flow and reduce living space for macroinvertebrates and fish.

Annual observations of the Boise River by the USGS and DEQ at the four USGS in-river monitoring locations over the past several years indicate that the distribution of macrophytic species is sparse, despite the increased nutrient enrichment that occurs below Middleton. In fact, from a visual standpoint there does not appear to be a noticeable difference throughout the river. Appendix C illustrates this point using pictures of the river taken at Eckert Road (upper), Glenwood Bridge (upper-middle), Middleton (lower-middle), Caldwell (lower-middle) and Parma (lower).

The lack of macrophytes in the lower Boise River can be explained by a number of factors. Other than nutrient availability, several authors have shown that the most important factors affecting the distribution and abundance of aquatic macrophytes in rivers are light availability (Chambers and Kalff 1985, Canfield et al. 1985), substrate characteristics (Pearsal, 1920, Barko et al., 1986), and current velocity (Thomann and Mueller, 1987).

River mile 29 (near Middleton) is the point in the river where most of the agricultural drains begin to return to the river. Associated with this irrigation water return is a large amount of suspended sediment. For example, on an average year Mill Slough and Mason Creek discharge as much as 11.2 and 34.1 tons/day of total suspended sediment into the river (DEQ, 2000). These sources in combination with the non-point and point sources significantly decrease the clarity of the water below Middleton. During the growing season, which closely corresponds with the irrigation season, the river substrate is not visible due to high levels of suspended sediment. For this reason, macrophytes that could conceivably establish roots in the substrate are limited by poor light availability.

The substrate composition in the lower, nutrient rich, portion of the river are is comprised of about one-half sand (.07-2 mm) and silt (.004-.06 mm) material. The remaining half is largely small gravel (3-64 mm) with a very small amount of cobble (65-256 mm) (Mullins 1999). These small substrate types are readily and frequently shifted by high water velocities, which do not allow macrophyte roots to easily anchor themselves.

Thomann and Meuller (1987) found that when water velocities exceed 1.6 fps, scouring typically occurs and periphyton, which are generally more resilient than macrophytes in terms of attachment, are not able to establish or are washed downstream. The hydrologic regime of the river is such that during the growing season water velocities nearly always exceed 1.6 feet per second in all portions of the river. A detailed description and further analysis of the hydrologic regime as it relates to water velocities and scouring in the lower Boise River was prepared by CH2M Hill, and is available in Appendix D.

While the aquatic live and recreation beneficial uses in the lower Boise River are not being impaired by nutrients, the high nutrient concentrations and low flow conditions in the Middleton and Caldwell reaches suggest that in severe drought years, if flows are low enough, conditions in the river may support sufficient algae growth to impair aquatic life or recreational uses. This possibility is partially supported by the presence of masses of filamentous algae and rooted aquatic macrophytes in canals in the Boise River valley. When the enriched river water is diverted into unshaded, low gradient canals with slower flow velocities, algae and rooted aquatic macrophytes grow freely. Further investigation into the nutrient dynamics in the lower Boise River tributaries need to be performed before this theory can be finalized.

As indicated above, it is possible that high sediment concentrations in the river below Middleton are preventing algae growth by limiting the amount of light that penetrates the water column. If sediment concentrations in the summer are reduced, algae growth in the reach of the river below Middleton may increase. However, Chen and Wells (1975) found that if the total suspended solids concentration were reduced to 20 mg/l, algae growth would not increase more that 10%. The river sediment TMDL calls for a 37% reduction of total suspended sediment below Middleton, where nutrient concentrations are the greatest. The in-river TSS target is 50 mg/l. A sediment mass balance for the river based on average flow conditions (July 1994) showed that under the 37% reduction scenario the in-river TSS concentration below Middleton could briefly reach 18 mg/l. The average concentration was 25 mg/l. These analyses, when coupled with Chen and Wells' analysis, suggest that when the sediment TMDL is implemented the algae level will probably not increase significantly due to increased water clarity. This conclusion is further founded by an analysis that was performed by CH2M Hill (Appendix E) in which a phytoplankton growth model from Thomann and Meuller (1987) was applied to the Boise River. The analysis indicates that phytoplankton chlorophyll-a levels peak at around 30 ug/l (below the level of concern) under peak growth and low velocity conditions.

Status of Beneficial Uses

The available data do not show impairment of aquatic or recreational beneficial uses in the lower Boise River due to nutrients, floating, suspended or submerged matter or oxygen demanding material (Table 7). While high nutrient concentrations in the lower portion of the river and periphytic algae levels above the suggested literature nuisance thresholds together imply that a potential for excessive algae growth exists, for this potential to be met there would need to be a near constant input of algae (Chen and Wells, 1975), and the residence time of the nutrient rich water would have to increase through hydrological modification, which does not seem likely.

The Snake River-Hells Canyon TMDL (due Dec 2001) is expected to seek total phosphorus reductions from the Boise River watershed. The DEQ has concluded that if beneficial uses are not being impaired under current conditions, it is unlikely that they will be impaired when nutrient levels are decreased further.

Table 7. Status of beneficial uses in the lower Boise River (Star to Snake River)

Segment	Designated uses	Existing uses	Impaired uses	Listed pollutants causing impairment	TMDLs in place
RM 50 to Indian Creek	CWB, SS, PCR	CWB, SS, PCR	CWB, SS, PCR	Sediment Bacteria Temperature	Sediment, Bacteria
Indian Creek to Snake	CWB, PCR	CWB, SS*, PCR	CWB, SS, PCR	Sediment Bacteria Temperature	Sediment, Bacteria

* Salmonid Spawning (mountain whitefish)

In addition to the impairing pollutants listed in Table 7, flow alteration and in-stream and riparian habitat modification contribute to the impairment of aquatic life beneficial uses in the river. These issues cannot be addressed in the TMDL arena because they are not allocatable pollutants. Rather, these issues should be addressed through cooperative efforts by the stakeholders in the watershed that have jurisdictional or other interests in the river.

Nutrient 303(d) Listing Status

The analysis indicates that nutrients are not impairing aquatic life or recreational beneficial uses in the lower Boise River. Hence, the DEQ proposes de-listing nutrients as a pollutant in the lower Boise River from the 2002 303(d) list. The proposal to de-list nutrients is consistent with 40 CFR 130.7 (6), whereby the state shall provide documentation that supports the listing determination. This assessment serves as the supporting documentation.

While nutrients are not impairing aquatic life or recreational beneficial uses in the lower Boise River, nutrients that originate from the point and non-point sources in the lower Boise River watershed appear to be contributing to the impairment of beneficial uses in the Snake River and Brownlee Reservoir. Code of Federal Regulations 40 131.10(b) says that the States shall take into consideration the water quality and standards of downstream waters and shall ensure that its water quality standards provide for the attainment and maintenance of water quality standards of downstream waters. For this reason, the Snake River - Hells Canyon TMDL (due December 2001) nutrient load allocation scenario may contain reduction implications for the lower Boise River. The implications are discussed below.

Implications of the Snake River - Hells Canyon TMDL

Nutrients are not impairing beneficial uses in the lower Boise River. However, nutrient loads from the lower Boise River may contribute to the impairment of beneficial uses in the Snake River and Brownlee Reservoir. The Boise River discharges to the Snake River near Fort Boise. Sampling conducted by Idaho Power Company (IPC) has shown that significant water column algae blooms develop in the Snake River just downstream from the mouth of the Boise River. From March through October of 1995, IPC staff sampled 80 drains and tributaries entering the Snake River from Celebration Park to Porter's Island. They found that the Boise River contributed from about 30% to 50% of the total ortho-phosphate entering that reach of the Snake River, including from the Snake River upstream of Murphy (Myers et al., 1997). Idaho Power Company has also shown that the nutrient and algae loads entering Brownlee Reservoir from the Snake River are primary causes of depressed DO concentrations in the metalimnion and epilimnion in the reservoir in summer months (Harrison and Anderson, 1997). Brownlee Reservoir has DO concentrations below applicable criteria every summer in some parts of the reservoir. Some years depressed DO concentrations result in fish kills.

A TMDL for the Snake River from the Oregon/Idaho border (RM 409) to the inflow of the Salmon River (RM 188), including the Brownlee/Hells Canyon dam complex is scheduled for completion in December, 2001. The Snake River-Hells Canyon TMDL may allocate a total phosphorus load to the mouth of the Boise River. If established, the load allocation will be re-allocated to the nutrient sources in the lower Boise River basin. Potential allocation method(s) in the lower Boise River basin have not been determined. The allocation of these loads would be based on meeting the Snake River - Hells Canyon TMDL load allocation. Of the 12 major tributaries that flow into the Boise River, four are on the 1998 303(d) listed for nutrients. The 303(d) listed tributaries that discharge to the river are Fivemile Creek, Tenmile Creek, Indian Creek and Mason Creek. Nutrient TMDLs will be established for these tributaries if their respective sub-basin assessments show that they are being impaired by nutrients.

Data Gaps

This assessment has identified several data gaps that limit full assessment of the effects of nutrients on beneficial uses. While the best available data were used to develop the current SBA, DEQ acknowledges that additional data would be useful. The data gaps are outlined in Table 8.

Efforts to gather additional nutrient and dissolved oxygen data are either underway or have been planned by DEQ, the WAG and the USGS. Based on the trends to date, the information developed through these efforts will likely substantiate the findings of the sub-basin assessment. If not, the assessment may be re-evaluated. Changes in the assessment will not result in the production of a new document. Minor changes will be handled through a letter amending the existing document(s), more extensive changes will be handled through supplementary documentation or replacing chapters or appendices. The goal will be to build upon rather than replace the original work wherever practical. Additional effort on the part of DEQ to revise the basin assessment must be addressed on a case-by-case basis as additional funding becomes available.

Table 8. Data gaps identified during development of the lower Boise River SBA.

Pollutant or Other Factor	Data Gap
Dissolved Oxygen	diurnal dissolved oxygen levels during low flow periods at multiple locations in the river
Sediment	background sediment attached phosphorus levels
Nutrients	longitudinal and cross-sectional ground water nutrient concentrations and loads from the river channel
Algae	algae data for hot summer, drought conditions and associated DO levels
	additional algae data in the sensitive locations of the river (Middleton to Caldwell)

2.3 Pollution Source Inventory

Nutrients are discharged into the river from both point and nonpoint sources. None of the NPDES permits for wastewater treatment plants or the few industrial facilities in the valley include effluent limits for phosphorus and most limit ammonia but no other forms of nitrogen.

Phosphorus concentrations in effluent from the major wastewater treatment plants that discharge to the Boise River are shown in Table 9. These concentrations are indicative of the current treatment practices at each facility.

Table 9. Total phosphorus concentrations and flow in the major wastewater treatment plants in the lower Boise River Basin, 1999 and 2000 effluent.

Facility	Design Flow, MGD	Maximum Phosphorus Concentration, mg/l	Average Phosphorus Concentration, mg/l	Minimum Phosphorus Concentration, mg/l
City of Boise Lander Street	15	5.42	2.39	.60
City of Boise, West Boise	24	9.5	5.21	3.86
City of Nampa	11.76	18.8	7.18	3.2
City of Caldwell	8.48	5.6	2.67	.14

Nonpoint sources of nutrients include runoff from agricultural operations, including irrigated row crops, pasture, stormwater runoff, ground water and animal management operations. Agricultural activities have the potential to directly impact the habitat of aquatic species through physical disturbances caused by livestock or equipment, or through the management of water. Surface water runoff from agricultural lands to which nutrients have been applied may transport particulate-bound nutrients and soluble nutrients.

Most large confined animal feeding operations (CAFOs), confined feeding areas (CFAs) and dairies are subject to discharge limits under general NPDES permits. To be regulated under a general NPDES permit, CAFOs and CFAs must meet size criteria and be considered significant contributors of pollutants. All dairies that have a permit to sell milk are subject to the Idaho Department of Agriculture (IDA) dairy inspection program. Dairies are required to have adequate waste management practices subject to the Rules Governing Dairy Waste, IDAPA 58.01.02350.03.g and IDAPA 02.04.14. Smaller CAFOs and pasture grazing are not regulated.

Animal waste that is removed from dairies, CAFOs and CFAs in liquid or solid form may be applied to agricultural lands as a soil amendment. Operators subject to an NPDES permit are required to land apply waste at agronomic rates for nitrogen, phosphorus and potassium and maintain adequate record keeping of waste management. Nutrients that enter the river from ground water generally have their source in the same land use activities that contribute nutrients directly to surface water. A notable exception is septic systems. In areas that lack sewering and wastewater treatment, septic systems may contribute nutrients to ground water that eventually reach the Boise River directly or via drains.

The NPDES permitted point sources listed in Table 9 contribute slightly more than one-half of the entire total phosphorus load in the lower Boise River. The nonpoint sources in combination with an unknown ground water component contribute the remaining portion. Table 10 outlines the seasonal average total phosphorus loads from each source as defined for the 1996 No-Net-Increase policy in the lower Boise River (Appendix F). These loads are considered the baseline nutrient loads for the lower Boise River because they represent long term averages. The 1996 loads represent the date after which additional water quality controls can be credited toward nutrient reductions.

Table 10. Seasonal average total phosphorus loads from the point and non-point sources in the lower Boise River basin, based on 1996 NNI proposal.

Facility Name	Seasonal Average TP Load, lbs/day	Seasonal Total Load (lbs)		Tributary Name	Seasonal Average TP Load, lbs/day	Seasonal Total Load (lbs)
Lander Street	440	80939		Eagle Drain	30	5566
West Boise	778	143088		Thurman Drain	19	3563
Meridian	68	12579		Fifteenmile Creek	241	44411
Nampa	498	90713		Mill Slough	197	36277
Caldwell	230	42300		Willow Creek	30	5438
				Mason Slough	59	10863
Minor Municipals	14	2373		Mason Creek	340	62539
				East Hartley Gulch	96	17707
				West Hartley Gulch	40	7302
				Indian Creek	164	30219
				Conway Gulch	101	18648
				Dixie Drain	444	81672

3.0 Pollution Control Efforts

Nonpoint Sources

In both Ada and Canyon Counties, there are water quality programs for nonpoint source pollutant reductions. Most of the agricultural programs are federally funded through the Natural Resource Conservation Service (NRCS), through past and present Farm Bills authorized by the United States Congress. These programs are targeted at the agricultural community to assist with conservation practices. For example, in Canyon County, the Canyon Soil Conservation District (SCD) has a State Agricultural Water Quality Program (SAWQP) project in Conway Gulch that addresses on-farm sediment reductions. SAWQP is a State of Idaho water quality program to provide cost share incentives to local operators for pollutant reductions.

The agricultural community, through local SCDs, has demonstrated a willingness to protect water quality in the lower Boise River valley. The Conway Gulch SAWQP project treated about 9,279 acres of agricultural lands with BMPs to reduce sediment load to the river.   Ada SCD works with agricultural operators in Ada County to provide technical assistance for implementation of BMPs. Canyon SCD works with agricultural operators in Canyon County to provide the same service.

Current federal funding of the Environmental Quality Incentive Program (EQIP) has targeted livestock feeding operations (CAFOs and CFA). Participation from local operators has been competitive for available funds from this program.

Stormwater within the City of Boise is subject to a stormwater NPDES permit. Ada County Highway District, Drainage District 3, the City of Boise, Idaho Department of Transportation, District 3, and Boise State University are all co-applicants for the permit, which was recently issued. The permit requires implementation of BMPs to control stormwater pollutants such as sediment, oil/grease and bacteria within the affected area. Beginning in 2002, it is expected that some of the smaller municipalities in the basin will also be subject to NPDES permits as part of the Phase II stormwater rules.

Point Sources

The wastewater treatment plants that discharge to the lower Boise River or its tributaries all provide secondary treatment of wastewater from the municipalities. Boise, Caldwell and Nampa have all considered nutrient reduction alternatives in their wastewater treatment facility plans. The City of Boise upgraded its Lander Street plant to provide nitrification and de-nitrification. These improvements improve process control, reduce nitrogen in the effluent and will enable the plant to biologically remove phosphorus in the future.

The State of Idaho, through a revolving fund, offers facilities either grants or low interest loans for upgrades.

All of the municipalities are currently regulated under the NPDES permitting program. Armour Fresh Meats and IDFG's Nampa fish hatchery both discharge to Boise River tributaries, pursuant to NPDES permits. In addition there are eleven smaller facilities that are subject to NPDES permits in the valley. Wasteload allocations driven by the Snake River - Hells Canyon TMDL will be incorporated into NPDES permits for all facilities discharging nutrients directly into the lower Boise River. Those facilities that discharge to the 303(d) listed tributaries may have wasteload allocations driven by the tributary

TMDLs if the respective sub-basin assessments show nutrients to be impairing beneficial uses. If not, the wasteload allocation will also be driven by the Snake River - Hells Canyon TMDL. Each permitted facility is required to monitor their effluent to determine compliance with their individual NPDES permit. Existing permits will be modified and any pending new permits will be issued after the completion load and wasteload allocations .

In 1995 a Memorandum of Understanding (MOU) between the Environmental Protection Agency (EPA), DEQ and IDA was signed to provide IDA authority to oversee the waste management at dairies statewide. This MOU has provided an enforcement mechanism to assure dairies adequately manage animal waste.

In 1996 EPA reissued the Idaho general NPDES permit for CAFOs. This new general permit allows permitted facilities to discharge animal waste only during unusual climatic events. The new permit also requires permitted facilities to land apply animal waste at agronomic rates (as described above), and requires record keeping of animal waste management practices. It is believed these provisions will reduce discharges to surface waters, and reduce impacts to ground water.

Reasonable Assurance

The lower Boise River watershed has a combination of point and nonpoint sources. The pollution distribution is such that reduction goals set by the Snake River - Hells Canyon TMDL can only be achieved by including some nonpoint source reduction. The Snake River - Hells Canyon TMDL driven allocations must incorporate reasonable assurance that nonpoint source reductions will be implemented and effective in achieving the load allocation (EPA, 1991). The Snake River - Hells Canyon reduction goals will rely substantially on nonpoint nutrient reductions to meet the load capacity needed to achieve desired water quality and to restore designated beneficial uses. If appropriate load reductions are not achieved from nonpoint sources through existing regulatory and voluntary programs, then the unaccounted for reductions must come from point sources.

The state has responsibility under Sections 401, 402 and 404 of the Clean Water Act to provide water quality certification. Under this authority, the state reviews dredge and fill, stream channel alteration and NPDES permits to ensure that the proposed actions will meet Idaho's water quality standards.

Under Section 319 of the Clean Water Act, each state is required to develop and submit a nonpoint source management plan. Idaho's most recent Nonpoint Source Management Plan was finalized in September 1999. Among other things, the plan identifies programs to achieve implementation of nonpoint source BMPs, includes a schedule for program goals and milestones, outlines key agencies and agency roles and is certified by the state attorney general to ensure that adequate authorities exist to implement the plan and identifies available funding sources.

Idaho's nonpoint source management program describes many of the voluntary and regulatory approaches the state will take to abate nonpoint pollution sources.

One of the goals of the management plan is to achieve a balanced approach for meeting clean water objectives. The formation of Basin Advisory Groups (BAGs) and Watershed Advisory Groups WAGs (IDAPA 58.01.02.052) is an integral part of this process. The WAGs are to be established in high priority watersheds to assist DEQ and other state agencies in formulating specific actions needed to control point and nonpoint sources of pollution affecting water quality limited water bodies. Under the current TMDL rule, the designated WAG, with the assistance of appropriate federal and state agencies, will begin development of an implementation plan that is to be completed within eighteen months of TMDL development. Beginning in November 2001, TMDLs in the state of Idaho will be required to include an implementation plan upon submission to EPA.

The Idaho water quality standards refer to existing authorities to control nonpoint pollution sources in Idaho. Some of these authorities and responsible agencies are listed in Table 11.

Table 11. State of Idaho's regulatory authority for nonpoint pollution sources.

Authority	IDAPA Citation	Responsible Agency
Idaho Forest Practice Rules	58.01.02.350.03(a)	Idaho Department of Lands
Rules Governing Solid Waste Management	58.01.02.350.03(b)	Idaho Department of Health and Welfare
Rules Governing Subsurface and Individual Sewage Disposal Systems	58.01.02.350.03©	Idaho Department of Health
Rules and Standards for Stream-channel Alteration	58.01.02.350.03(d)	Idaho Department of Water Resources
Rules Governing Exploration and Surface Mining Operations in Idaho	58.01.02.350.03(e)	Idaho Department of Lands
Rules Governing Placer and Dredge Mining in Idaho	58.01.02.350.03(f)	Idaho Department of Lands
Rules Governing Dairy Waste	58.01.02.350.03.(g) or IDAPA 02.04.14	Idaho Department of Agriculture

The State of Idaho uses a voluntary approach to control agricultural nonpoint sources. However, regulatory authority can be found in the water quality standards (IDAPA 58.01.02.350.01 through 58.01.02.350.03). IDAPA 58.01.02.054.07 refers to the Idaho Agricultural Pollution Abatement Plan (Ag Plan) (IDHW and SCC, 1993) which provides direction to the agricultural community regarding approved BMPs. A portion of the Agricultural Plan outlines responsible agencies or elected groups (SCDs) that will take the lead if nonpoint source pollution problems need to be addressed. For agricultural activity, it assigns the local SCDs to assist the landowner/operator with developing and implementing BMPs to abate nonpoint source pollution associated with the land use. If a voluntary approach does not succeed in abating the pollutant problem, the state may seek injunctive relief for those situations that may be determined to be an imminent and substantial danger to public health or environment.

The Idaho Water Quality Standards and Wastewater Treatment Requirements specify that if water quality monitoring indicates that water quality standards are not being met, even with the use of BMPs or knowledgeable and reasonable practices, the state may request that the designated agency evaluate and/or modify the BMPs to protect beneficial uses. If necessary the state may seek injunctive or other judicial relief against the operator of a nonpoint source activity.

The water quality standards designate the agencies responsible for reviewing and revising nonpoint source BMPs. Designated agencies are the Department of Lands for timber harvest activities, oil and gas exploration and development and mining activities; the Soil Conservation Commission for grazing and agricultural activities; the Department of Transportation for public road construction; the Department of Agriculture for aquiculture; and DEQ for all other activities.

Best management practices for urban and suburban stormwater include educational activities, construction site runoff control, and on site detention of runoff. The Ada County Highway District makes use of 28 management practices, while the City of Boise applies 33 distinct management practices for stormwater. Appendix G of the technical appendices includes copies of Ada County Highway District and Boise City stormwater management practice lists.

IDAPA 58.01.02.054.06 indicates that pollutant trading is an appropriate mechanism for restoring water quality limited water bodies to compliance with water quality standards. In the lower Boise River, nutrients do not appear to exceed the narrative water quality standard and hence are not impairing beneficial uses. However, the nutrients in the river are contributing to the impairment of beneficial uses in the Snake River. For this reason, effluent trading will be a cost-effective way for helping improve water quality in the river. With inherent nutrient reduction requirements for point and nonpoint sources serving as the impetus, an effluent trading demonstration project was initiated in January 1998. The effluent trading framework revolved around developing a conceptual framework for activating trades between the multiple sources in the valley. The final framework document was completed in September 2000 and can be found on the DEQ website (www.state.id.us/deq).

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Acronyms

(Ag Plan)	Agricultural Pollution Abatement Plan
(BAG)	Basin Advisory Group
(BMP)	Best Management Practices
(CAFO)	Confined Animal Feeding Operation
(CFA)	Confined Feeding Areas
(CWB)	Cold Water Biota
(DEQ)	Idaho Division of Environmental Quality
(DO)	Dissolved Oxygen
(EPA)	Environmental Protection Agency
(EQIP)	Environmental Quality Incentive Program
(HUC)	Hydrologic Unit Code
(IDA)	Idaho Department of Agriculture
(IDAPA)	Idaho Administrative Procedures Act
(IDFG)	Idaho Fish and Game
(IDHW)	Idaho Department of Health and Welfare
(IDL)	Idaho Department of Lands
(IDWR)	Idaho Department of Water Resources
(IPC)	Idaho Power Company
(LBRWQP)	Lower Boise River Water Quality Plan
(MOU)	Memorandum of Understanding
(NRCS)	Natural Resource Conservation Service
(NPDES)	National Pollutant Discharge Elimination System
(NTU)	Nephelometric Turbidity Units
(SAWQP)	State Agricultural Water Quality Program
(SCC)	Soil Conservation Commission
(SCD)	Soil Conservation District
(TSS)	Total Suspended Sediment
(TMDL)	Total Maximum Daily Load
(USBR)	The U.S. Bureau of Reclamation
(USGS)	United States Geological Survey
(WAG)	Watershed Advisory Group
(WLA)	Wasteland Allocation
(WWTP)	Wastewater Treatment Plants

Abbreviations

°C	degrees Celsius
cfs	cubic feet per second
ft	foot
ha	hectare
kg	kilogram
km	kilometer
l	liter
m	meter
mg	milligram
mgd	million gallons per day
mgll	milligrams per liter
mi	mile
ml	milliliter
T	ton
ug	microgram
yr	year

APPENDICES

APPENDIX A
Temperature Conditions in the Lower Boise River

APPENDIX B
Proposed Changes to the 1998 303(d) List for the Lower Boise River - Dissolved Oxygen

APPENDIX C
Photo Documentation of the Lower Boise River at the USGS monitoring locations

APPENDIX D
Nutrient Issues in the Lower Boise River
Draft Technical Memorandum - CH2M Hill
Prepared for Curry Jones, EPA Region 10

APPENDIX E
Phytoplankton (Suspended Algae) Growth in the Lower Boise River
Draft Technical Memorandum - CH2M Hill
Prepared for Lower Boise River Watershed Advisory Group

APPENDIX F
No Net Increase Load Proposal for Total Phosphorus

APPENDIX G
City of Boise and Ada County Highway District Best Management Practices for Stormwater.

Technical Appendices are available at the Idaho Department of Environmental Quality - Boise Regional Office References Library.

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