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Beneficial Use Evaluation for Selected Tributaries in the Lower Boise River

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Background

The Lower Boise River watershed is a complex network of natural drainages and man-made storage facilities and irrigation canals/drains. This watershed drains 1,290 square miles of rangeland, forests, agricultural lands, and urban areas. Flowing in a northeasterly direction from its origin at Lucky Peak Dam to its confluence with the Snake River near Parma, the Lower Boise River is connected to over 60 tributaries and/or irrigation conduits. This memorandum focuses on three tributaries in the Lower Boise River basin: Upper Indian Creek, Mason Creek, and Sand Hollow Creek (Figure 1). The purpose of this memorandum is to present and use the available physical, chemical, and biological data for each of the tributaries to support a beneficial use evaluation. The data will be evaluated in accordance with appropriate guidance documents, which include *Water Body Assessment Guidance* (IDEQ 1996), *Region 10 Final Draft–Use Attainability Analysis Policy and Guidance* (EPA 1993), and *Water Quality Standards Handbook* (EPA 1994). The draft version of the more recent *Water Body Assessment Guidance* (IDEQ 2000b) was not used in this assessment because it has not been finalized and it pertains to perennial streams only.

Although the waterbodies addressed in this document are referred to as tributaries of the Lower Boise River and carry the label “creek”, all of the waterbodies function to convey irrigation water and are not typical tributaries as would be expected in natural riverine environments. Between the mid 1800s and early 1900s, an estimated 465 miles of man-made canals, ditches, and laterals were constructed to convey irrigation water throughout the river valley (U.S. Bureau of Reclamation [USBR] 1996). The irrigation conveyances were historically constructed by straightening or deepening either 1) existing creek drainages or 2) slight depressions or swales that carried spring run-off toward the river. Presently, these tributaries are essentially ditches that carry water primarily throughout the irrigation season, which is generally defined as early-April to mid-October (USBR 1996). As a result of long-term and wide-spread irrigation activities, groundwater levels have risen throughout the valley and now contribute to return flows that may be present in larger canals during the non-irrigation season.

Canals and laterals currently transport water to over 400,000 acres of irrigated crops in the Lower Boise River basin. Once the water has been used for irrigation, it is transported back toward the river in drains via land surface runoff and groundwater return flows. Much of the water is used by different irrigators multiple times before eventually returning to the

Boise River. Irrigation districts consider the subject tributaries to be operating facilities used for the express purpose of providing irrigation water to customers (USBR 2000). As such, the irrigation districts routinely clean the bottom and sides of the ditches to remove sediments, plants, and debris that obstruct the flow of water (these activities are specifically allowed under IDAPA 37.03.07.025.03). The removed material is often deposited on the ditch banks. In addition, the districts commonly use chemical methods to control aquatic weeds, including the application of copper sulfate and acrolein, in accordance with Idaho's noxious weed laws (USBR 2000).

Photographs of each of the tributaries are provided in Appendix A. These photographs represent typical conditions of the tributaries and reflect adjacent land management practices. It is evident that throughout the length of these waterbodies, fundamental habitat characteristics such as adequate canopy cover and riparian zones are largely lacking. These observations of generally poor habitat are supported by quantitative habitat evaluations conducted by IDEQ, as detailed in later sections of this memorandum.

The memorandum provides a brief overview of the regulatory framework for the beneficial use evaluation, summarizes available data for each tributary, and provides recommendations for beneficial use designations and modified water quality criteria.

Regulatory Framework

The Idaho Department of Environmental Quality (IDEQ) is responsible for implementing the Clean Water Act (CWA) in Idaho and has promulgated state water quality rules to meet this responsibility in IDAPA 58.01.02–*Water Quality Standards and Wastewater Treatment Requirements*. These rules establish both designated uses and appropriate criteria; designated uses are those beneficial uses specified for given water bodies and criteria are conditions presumed to support or protect the designated uses (IDEQ 1996). These rules were most recently updated in April 2000.

Prior to determining appropriate water quality criteria for a given water body, designated beneficial uses are assigned. Within the context of the Lower Boise River Total Maximum Daily Load (TMDL) process, the beneficial use designations of the river's tributaries (including Upper Indian Creek, Mason Creek, and Sand Hollow Creek) directly affect the determination of appropriate endpoints for parameters such as temperature, dissolved oxygen, sediments, and nutrients. If the appropriate beneficial uses are not correctly identified, appropriate water quality criteria are not used.

According to IDAPA 58.01.02, Idaho surface water use designations include:

- <u>Aquatic life</u>:
    - Coldwater biota (CWB)
    - Salmonid spawning (SS)
    - Seasonal coldwater biota (SCWB)
    - Warmwater biota (WWB)
    - Modified cold or warmwater biota (MOD)

- Recreation:
  - Primary contact recreation (PCR)
  - Secondary contact recreation (SCR)
- Water supply:
  - Domestic
  - Agricultural
  - Industrial
- Wildlife habitats
- Aesthetics

The most important primary use designations fall under the aquatic life and recreational categories because agricultural/industrial water supply, wildlife habitats, and aesthetics uses are designated beneficial uses for all water bodies in the state. The aquatic life category is used to protect and maintain a viable aquatic life community of cold or warmwater species, as appropriate. SS conditions apply to waters that provide for active, self-propagating populations of salmonid fishes. If applicable, SCWB criteria only apply between June 21–September 21 of each year. Finally, MOD uses may be appropriate when the aquatic community is limited due to one or more of the following conditions (as adapted from 40 CFR 131.10(g)):

(1) Naturally occurring pollutant concentrations prevent the attainment of the use; or
(2) Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating State water conservation requirements to enable uses to be met; or
(3) Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place; or
(4) Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in the attainment of the use; or
(5) Physical conditions related to the natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses; or
(6) Controls more stringent than those required by Sections 301(b) and 306 of the Clean Water Act would result in substantial and widespread economic and social impact.

Because these conditions preclude attainment of reference streams or conditions, attainable site-specific aquatic life criteria that are protective of the modified community are established and incorporated into the rule-making process. Table 1 provides a comparison of the aquatic life criteria for each of the aquatic life categories.

TABLE 1. COMPARISON OF SELECTED WATER QUALITY CRITERIA FOR AQUATIC LIFE CATEGORIES

Parameter	CWB	SS	SCWB	WWB	MOD[1]
Dissolved Oxygen					
(mg/L)	6	6	6	5	- -
(% saturation)	- -	90% (plus intergravel)	- -	- -	- -
Temperature (°C)					
Daily maximum	22	13	26	33	- -
Daily average	19	9	23	29	- -
Turbidity					
(NTU)	50	- -	- -	- -	- -
(NTE bkground)	+25 for 10 days	- -	- -	- -	- -
pH	6.5–9.0	6.5–9.0	6.5–9.0	6.5–9.0	- -

NOTES:
1 – Water quality criteria for MOD are developed on a site-specific basis.

In terms of recreation beneficial uses, PCR is based on prolonged and intimate contact wherein ingestion of water is likely (e.g., swimming, skiing, diving). In contrast, SCR is an appropriate use where ingestion of water is not likely (e.g., boating, fishing, wading, infrequent swimming). Table 2 provides a comparison of the water quality criteria between recreational categories.

TABLE 2. COMPARISON OF SELECTED WATER QUALITY CRITERIA FOR RECREATIONAL CATEGORIES

Parameter	PCR	SCR
E. coli [1]		
Single sample	406	576
Geometric mean	126	126

NOTES: 1 - Units for *E. coli* are presented as # of organisms per 100 mL (# / 100 mL).

There are three types of nondesignated waters in IDAPA 58.01.02:

- Undesignated surface waters–IDEQ presumes that these water bodies can support CWB and PCR/SCR beneficial uses unless proven otherwise.
- Man-made waterways–These drainages are to be protected for the uses for which they were developed.
- Private waters–These water bodies must be wholly located upon a person's land and are not protected specifically for any beneficial uses.

In addition to these categories, IDAPA 58.01.02.003 defines an intermittent waterbody which has a period of zero flow for at least 1 week during most years and a 7Q2 of less than 0.1 cfs (if available). Also, streams with natural perennial pools containing significant aquatic life are not intermittent. Water quality standards (including both beneficial use designations and water quality criteria) apply to intermittent waters during optimum flow periods, which are defined as ≥ 5 cfs for recreation and water supply uses and ≥ 1 cfs for aquatic life. There is no ephemeral waterbody category included in the IDAPA 58 regulations.

It is important to distinguish between designated, existing, and attainable uses. Designated uses are those formally specified in IDAPA 58.01.02.110–160 that have been established through the rule-making process. Existing beneficial uses are those uses that exist in a given water body any time after November 28, 1975, whether or not the use is formally designated for the water body. Attainable uses are those uses that would be expected to be present if all point and non-point sources were controlled. While a designated use can be downgraded to a use requiring less stringent criteria, an existing use can only be upgraded to a use requiring more stringent criteria (EPA 1994). Furthermore, designated uses can be removed only if they are neither existing nor attainable, due to at least one of the 40 CFR 131.10(g) conditions (i.e., designated uses may not be removed if the uses could be attained by implementing effluent limits for point sources and by implementing BMPs for non-point sources). When designated uses are different than attainable uses, standards can be revised to reflect uses actually being attained through a use attainability analysis (UAA).

Upper Indian Creek, Mason Creek, and Sand Hollow Creek vary in terms of their designations. The current status of each of the three tributaries (as defined for Subbasin HUC 17050114 in IDAPA 58.01.02.140.12) is summarized below:

Upper Indian Creek–This tributary is designated as CWB/SS and PCR from its headwaters to Sugar Avenue in Nampa (T03N, R02W, Sect. 15). It has been listed on Idaho's 1998 303(d) list as impaired for dissolved oxygen (downstream from New York Canal only), sediment, and nutrients. In May 2000, EPA partially approved Idaho's 1998 303(d) list, with the addition of a number of segments believed to be impaired (Smith 2000). Indian Creek (headwaters to Boise River) was listed for temperature.

Mason Creek–This tributary is undesignated; therefore, IDEQ presumes that the water body can support CWB and PCR/SCR. It has been listed on Idaho's 1998 303(d) list as impaired for dissolved oxygen, sediment, and nutrients.

Sand Hollow Creek–Although this tributary drains directly into the Snake River, IDEQ groups it with other Lower Boise River tributaries in Subbasin HUC 17050114. This tributary is undesignated; therefore, IDEQ presumes that the water body can support CWB and PCR/SCR. It has been listed on Idaho's 1998 303(d) list as impaired for dissolved oxygen, sediment, and nutrients.

It is important to comment on the use of the terms "impaired" and "degraded." Throughout this document, these terms are used to describe conditions in the subject reaches. These descriptions do not imply that the creeks were once pristine and have since been impaired and degraded. Rather, the terms are used to compare conditions in the subject reaches to typical pristine reference environments. These creeks were never intended, constructed, or managed to be pristine riverine environments; describing these systems as “impaired” and “degraded” reflects the typical nature of irrigation conveyance canals.

Although only one of three tributaries (Indian Creek) is formally designated, this document has been prepared for all three waterbodies because the existing and attainable uses are different than the designated or presumed designated uses for this creek. More detailed information for the tributaries is presented in the following sections as part of the waterbody assessment.

Tributary Waterbody Assessment

As specified by IDEQ (1996) and EPA (1994), water quality is comprised of three inter-related conditions: physical, chemical, and biological. Federal and state agencies have collected data on these conditions for all three subject tributaries from the 1970s to the present; no additional data were collected to support the beneficial use evaluation. A summary of available data is provided below and in Table 3.

- IDEQ (1997b) prepared a draft water body description and beneficial use recommendation document for the tributaries. This document includes historical and current information on hydrologic boundaries.
- The Idaho State Department of Agriculture (ISDA), in conjunction with the Soil Conservation Commission (SCC), has collected physical and chemical data on a bimonthly basis for numerous stations along selected tributaries between 1998–2000 (ISDA / SCC 2000). These efforts have been conducted as part of the Lower Boise River Water Quality Monitoring Project. In August 2000, a photo survey was also conducted by ISDA / SCC throughout each of the subject tributaries.
- Between 1995–1997, IDEQ (1997a) conducted a Beneficial Use Reconnaissance Project (BURP) throughout the Lower Boise River basin. BURP is a reconnaissance-level field monitoring program with an emphasis on biological and physical habitat measures. These efforts are coupled with limited fish electroshocking activities and field reconnaissance efforts undertaken during the 1999 and 2000 irrigation seasons (IDEQ 2000a).
- The status of fish data for selected tributaries was communicated by the Idaho Department of Fish and Game ([IDFG] 1997) to support the TMDL process on the Lower Boise River. An updated status report was obtained to support this evaluation (Grunder, pers. comm., 2000).
- IDEQ has also collected additional monthly water quality data and occasional fish population data at selected monitoring sites (some of which coincide with the BURP locations) on all three tributaries during the 1999 and 2000 irrigation seasons.
- The Boise Project Board of Control ([BPBOC] 2000) tracks flows in the New York Canal during the irrigation season. Data from the 1999 and 2000 irrigation seasons were used in this evaluation.
- Idaho Department of Water Resources (IDWR) routinely tracks discharges at selected gages on each of the tributaries. The period of record varies by gage location.

- To support a draft Environmental Assessment of proposed title transfers in the Nampa and Meridian Irrigation District (which controls the operation of portions of Mason Creek), the USBR (2000) summarized limited observations regarding fish populations.
- Daily discharges have been measured at selected gages by the U.S. Geological Survey ([USGS] 2000a) from 1979–present. These data are not necessarily continuous and the period of record varies by gage location.
- Limited water quality data were collected by USBR and other agencies during the early 1970s and late 1990s. These data were accessed via EPA's water quality database STORET (EPA 2000).
- Clark and Bauer (1983) collected water quality and fish population data in Sand Hollow Creek as part of a status report on water quality in Lower Boise River drains.
- USGS has also collected water quality data at the mouth of the major tributaries to the Boise River, including Mason Creek. Chemical data collected between 1994-1997 (USGS 1997) and bacteria data collected between 1998-2000 (USGS 2000b) are summarized.

TABLE 3. SUMMARY OF AVAILABLE PHYSICAL, CHEMICAL, AND BIOLOGICAL DATA SOURCES

	Mason Creek (NYC to Boise River)	**Upper Indian Creek (HW to Sugar Avenue)**	**Sand Hollow Creek (HW to Snake River)**
Physical Parameters			
Flow / Discharge	B,D,E,G,I	B,D,E,F,G,I	B,D,E,I,K
Habitat Conditions	A,B,D	A,B,D	A,D,B
Chemical Parameters	B,E,J,L	B,E,J,L	B,E,J,K,L
Biological Parameters			
Fish	H	C,E	C,K
Macroinvertebrates	D	D	D

Notes: Letters refer to available data sources (with the associated period of record).

A IDEQ (1997)
B ISDA/SCC Monitoring (1998-2000)
C IDFG (1997)
D BURP Data (1995-1997)
E IDEQ Monitoring Sites (1999-2000)
F BPBOC (1999-2000)
G IDWR (1994-1998)
H USBR (2000)
I USGS Gage Data (1979-1998)
J EPA STORET (1971-1998)
K Clark and Bauer (1983)
L USGS Monitoring (1994-2000)

Each of the tributaries is addressed separately. Available data for all three tributaries are provided in the following figures:

- Figure 2. Station locations
- Figure 3. Discharge data
- Figure 4. Habitat conditions
- Figure 5. Temperature data
- Figure 6. pH data

- Figure 7. Dissolved oxygen data
- Figure 8. Total suspended sediments (TSS) data
- Figure 9. Total phosphorus data
- Figure 10. Fecal coliform data
- Figure 11. *E. coli* data
- Figure 12. Fish community data
- Figure 13. Macroinvertebrate community data

To evaluate aquatic community data, IDEQ calculated habitat and macroinvertebrate indices (IDEQ 1997a and 2000a). The habitat index (HI) and macroinvertebrate biotic index (MBI) can be used to compare conditions in a particular reach against pristine conditions in the Snake River Basin / High Desert Ecoregion (IDEQ 1996). Although these creeks have never been pristine waterbodies (with the possible exception of Upper Indian Creek), these indices provide a quantitative reference of habitat quality and aquatic community integrity. For the Snake River Basin / High Desert Ecoregion, the following thresholds are used:

HI:
HI < 58 = impaired
59 < HI < 88 = needs verification
89 > HI = not impaired

MBI:
MBI < 2.5 = impaired
2.5 < MBI < 3.5 = needs verification
3.5 > MBI = not impaired

Upper Indian Creek

As indicated earlier, the portion of Indian Creek addressed by this use evaluation extends from the drainage headwaters to Sugar Avenue. Indian Creek flows from its headwaters in the Danskin Mountains to the confluence with the Boise River at RM 19.7[1]. As shown on Figure 1, to the southeast of Kuna the Upper Indian Creek drainage coincides with the New York Canal for approximately 8 miles. Prior to entering Kuna, the drainage becomes independent again as the New York Canal splits to the southwest toward Lake Lowell. Beneficial uses have been designated for Upper Indian Creek as part of the Lower Boise Subbasin (as specified in IDAPA 58.01.02.140.12). These uses include CWB, SS, and PCR.

For the purposes of the use evaluation, Indian Creek has been divided into five distinct reaches (see Figure 1):

- IC:A- Headwaters to Indian Creek Reservoir (14.2 miles)
- IC:B- Indian Creek Reservoir (128 acres)
- IC:C- Indian Creek Reservoir to New York Canal (24.4 miles)
- IC:D- New York Canal to Canal / Creek Split (6.7 miles)
- IC:E- Canal / Creek Split to Sugar Avenue (5.6 miles)

[1] River miles reference the Boise River starting at the mouth and going upstream.

These reaches were differentiated based primarily on hydrologic regime; a more accurate description of the flow regime in Indian Creek is provided below. Available physical, chemical, and biological parameters are summarized for each of the reaches below. (Table 3 provides a summary of data sources for this tributary's physical, chemical, and biological parameters.)

IC:A– Headwaters to Indian Creek Reservoir

Physical Parameters–The headwater area is characterized by a braided morphology resulting from large seasonal influxes of weathered granite (IDEQ 1997b). In this area, the stream bottom and banks are composed of unconsolidated coarse-sand to fine-gravel sediment. As the creek exits the Danskin Mountains, the drainage incises gravel formations. The geomorphology is characterized by a flat channel bottom with primarily sand- and silt-sized sediments (IDEQ 1997a, 1997b). Although flows in this reach result from spring melt of snowpack, the sandy nature of the substrate creates a patchwork of areas with flows during the spring. This patchwork results in areas where surface water completely percolates into underlying groundwater prior to reaching Indian Creek Reservoir. Periodic observations indicate that the reach often has low flows (<2 cfs) or is dry during the non-spring run-off period (Figure 3). Nace et al. (1957) classified groundwater levels in this area as being at least 100 ft below ground surface. Although groundwater levels have generally declined in the Boise area since 1970, probably due to population growth and drought conditions (Tungate and Berenbrock 1994), land use practices (including limited irrigation and grazing) in this reach have not changed significantly and groundwater levels are believed to be at approximately the same depth below surface. Based on these observations, the reach cannot be considered perennial and should be classified as intermittent.

Throughout this reach, riparian vegetation is lacking (Figure 4) and grazing occurs along the waterbody. Aquatic habitat appears to be limited during some portions of the year in the upper reach, as indicted by very shallow conditions (few deep pools), lack of instream cover, lack of adequate riparian vegetation, and potential bank stability problems. Using IDEQ habitat assessment methodologies (1996), a habitat index (HI) score of 23 was assigned to this reach (Figure 4; IDEQ 1997a).

Chemical Parameters–When water is present, summer temperatures in this reach range from 15.0-15.4 degrees C (Figure 5). No other water quality data have been collected in this reach (Figures 6-11).

Biological Parameters–No fish have been observed in this reach in both the 1997 and 2000 summer seasons, presumably due to lack of water (Figure 12). Very few macroinvertebrate taxa were present in this reach; none of the taxa collected represent coldwater temperature preference species, and most are considered midrange in pollution tolerance (IDEQ, 1996). A macroinvertebrate biotic integrity (MBI) score of 2.38 determined for this reach indicates potential impairment (Figure 13).

IC:B– Indian Creek Reservoir

Physical Parameters–This man-made reservoir is used for fishing year-round, except during extreme dry years such as 1987, and the waterbody is surrounded by cattails and wetlands (Figure 4). Flows from Indian Creek are believed to enter the reservoir primarily during excessive spring runoff periods (the reservoir is also refilled by other unnamed streams to the north) and limited volumes of water are diverted for private irrigation only.

Chemical Parameters– Although no water quality data have been collected in this waterbody (Figures 5-11), the reservoir supports a warmwater fishery.

Biological Parameters–IDFG routinely stocks Indian Creek Reservoir with bluegill and large-mouth bass (Figure 12). Some portion of the fishery is self-sustaining because the bass are closed to harvest between January 1 and June 30, presumably for natural reproduction.

IC:C– Indian Creek Reservoir to New York Canal

Physical Parameters–This reach of Indian Creek tends to be dry with occasional patches of swamp areas during the summer months (Figure 3; IDEQ 1997b). These swampy areas are disconnected and believed to be remnant pools of spring runoff, as the depth to groundwater in this area is more than 100 ft below ground surface (Nace et al. 1957). Based on these observations, the reach cannot be considered perennial and should be classified as intermittent. The channel cuts through basalt, and riparian vegetation and canopy cover are lacking (Figure 4). Extensive channel damage has been observed due to motorcycle and off-road vehicle use in the creek bed (IDEQ 1997a).

Chemical Parameters–In 1979, one set of samples was collected in July from the creek upstream from the confluence with the New York Canal (Station STOR SIC in Figure 2). The water temperature was 30 degrees C, pH was 8.1, dissolved oxygen was 3.5 mg/L, total phosphorus was 0.77 mg/L, and fecal coliform was 1,800 /100mL (Figures 5-11).

Biological Parameters–No fish have been observed in this reach, presumably due to its intermittent nature (Figure 12). In addition, upstream and downstream fish passage is blocked in this reach by a railroad culvert that is located 10 ft above the creek bed. There are no macroinvertebrate data for this reach (Figure 13).

IC:D– New York Canal to Canal/Creek Split

Physical Parameters–The BPBOC (which is comprised of Big Bend Irrigation District, Boise-Kuna Irrigation District, Nampa & Meridian Irrigation District, New York Irrigation District, and Wilder Irrigation District) operates the New York Canal. This is a major canal that conveys irrigation water that has been diverted from the Boise River upstream from Barber Park. As part of canal construction in the late 1890s (USBR 1997), this reach of Indian Creek was modified from its natural state into a trapezoidal canal. Current management entities, including BPBOC and USBR, consider Indian Creek a natural stream, through which passes New York Canal irrigation water during the irrigation season (approximately April-October). During the irrigation season, discharge averages >600 cfs (Figure 3) and kayakers use this reach during high flows. During the non-irrigation season, flows in the canal essentially dry up until water is diverted from the Boise River for the next irrigation season. Based on these observations, the reach should be classified as intermittent.

Chemical Parameters–Limited water quality data have also been collected on the water that has been diverted from the Boise River at Stations STOR ICSR, STOR NYCK, and STOR ICBC. Recent water temperatures are generally about 15 degrees C (Figure 5) and pH was measured at 8.0 (Figure 6), while minimum dissolved oxygen is 9.0 mg/L (Figure 7). Historical TSS values were 10.7 mg/L (Figure 8), and recent total phosphorus concentrations are <0.04 mg/L (Figure 9). Historical and recent maximum fecal coliform concentrations are <65 /100mL (Figure 10), and historical *E. coli* concentrations were only 2 /100mL (Figure 11). It is believed that copper sulfate is added occasionally to the New York Canal to control vegetation in the canal system. Effects to water quality and the aquatic community resulting from the addition of copper sulfate are unknown.

Biological Parameters–A fish survey conducted in this reach in November 1999 recorded no rainbow trout, multiple dace, multiple suckers, and two sculpin (Figure 12). These fish likely are diverted from the Boise River into the New York Canal during the irrigation season because there is no upstream passage between lower Indian Creek and the canal and the reach above the canal is dry most of the year. In addition, based partly on the lack of suitable habitat, IDFG has concluded that aquatic biota in Indian Creek are impaired and IDFG does not currently have management goals for fish in this tributary (IDFG 1997; Grunder, pers. comm., 2000). There are no macroinvertebrate data for this reach (Figure 13).

IC:E– Canal/Creek Split to Sugar Avenue

Physical Parameters–This reach begins where the New York Canal separates from the historic creek bed. Discharges from the canal to the creek primarily occur via bank overtopping during high flow events and limited seepage. Average flows increase through the reach as a result of return base flows and range from approximately 10 cfs downstream from the New York Canal to >50 cfs in Nampa during the irrigation season (Figure 3). Average flows during the non-irrigation season are roughly 60 percent of average irrigation flows. USGS Gage 13211309, which is located just downstream from Sugar Avenue, recorded a continuous daily flow between 1981-96. The available discharge data indicate that flows within this reach of Indian Creek (downstream from the point at which the New York Canal splits toward Lake Lowell) should be classified as perennial. The creek cuts through basalt in its historical channel and the condition of the riparian and canopy cover are directly related to adjacent land management (Figure 4). In areas where livestock access to the creek is restricted, the riparian zone is of moderate quality. In areas with free access, the condition of the creek is poor. A HI score of 55 was recorded in this reach (IDEQ 2000a), which is slightly below the threshold for habitat impairment of 58. The impairment is due primarily to a lack of pools and pool variability, poor riparian and canopy cover, and poor channel sinuosity.

Chemical Parameters–Historical and recent water quality data are available for this reach and a comparison of the two data sets indicates relatively stable chemical conditions over time. Recent average daily water temperatures range between 9.9–17.8 degrees C, while daily maximum water temperatures vary between 13.0–23.0 degrees C (Figure 5). pH values in this reach range between 6.8–8.8 (Figure 6). The minimum dissolved oxygen value recently recorded in this reach is 6.1 mg/L (Figure 7). TSS values are consistently <25 mg/L (Figure 8), and recent total phosphorus ranges between 0.16-0.22 mg/L (Figure 9). Recent average fecal coliform concentrations were as high as 1,922

/100mL during the irrigation season (Figure 10), and maximum *E. coli* concentrations were 1,371 /100mL (Figure 11).

Biological Parameters–Fish passage into this reach is blocked on the downstream end by Riverside Diversion Dam and on the upstream end by the New York Canal. Before 1986, a wild rainbow trout population was known to exist in this reach based on electrofishing sampling and fish kill assessments (IDFG 1997). In 1986, at least 1,100 wild rainbow trout were killed following an accidental waste discharge from the Armour Fresh Meats Company in Nampa. IDFG (1997; Grunder, pers. comm. 2000) is not aware of any recovery since the spill. Further, IDFG has concluded that aquatic biota in Indian Creek are impaired and IDFG does not track wild fish populations in Indian Creek because fish habitat conditions are so degraded. In November 1999, IDEQ conducted electroshocking in this reach (Figure 12) and observed four rainbow trout that ranged in length between 160-300+ mm (IDEQ 2000a). No young-of-the-year or juveniles were present in these collections.

Mason Creek

The portion of Mason Creek addressed by this use evaluation extends from the drainage headwaters at the New York Canal to the confluence with the Boise River at RM 23.2 (natural headwaters for Mason Creek are undefined [IDEQ 1997b]). Historic topographic maps suggest that the original drainage was only a slight depression or swale that was enhanced by deepening and straightening for irrigation purposes in the late 1800s or early 1900s (IDEQ 1997b). No beneficial uses have been designated for Mason Creek as part of the Lower Boise Subbasin (as specified in IDAPA 58.01.02.140.12); therefore, the creek is presumed to support CWB and PCR.

For the purposes of the use evaluation, Mason Creek has been divided into two distinct reaches (see Figure 1):

- MC:A- New York Canal to Ridenbaugh Canal (18.4 miles)
- MC:B- Ridenbaugh Canal to Boise River (15.1 miles)

These reaches were differentiated based primarily on hydrologic regime; a more accurate description of the flow regime in Mason Creek is provided below. Available physical, chemical, and biological parameters are summarized for each of the reaches below. (Table 3 provides a summary of data sources for this tributary's physical, chemical, and biological parameters.)

<u>MC:A– New York Canal to Ridenbaugh Canal</u>

Physical Parameters–This reach is also known as Mason Creek Feeder, which is a man-made conveyance that transports water from the New York Canal to the Ridenbaugh Canal. Flows in this reach are controlled by flows in the New York Canal, which was completed in 1900 for irrigation water conveyance (USBR 1996), and occasional releases from Hubbard Reservoir. The reservoir is used for emergency short-term storage in the event of canal failure or flooding. At the downstream limit, water is diverted into the Ridenbaugh Canal. During the irrigation season (approximately April-October), average discharges of 108 cfs have been recorded in this reach (Figure 3). During the non-irrigation season, flows in the canal and this reach essentially dry up until water is diverted from the Boise River for the next irrigation season. Based on these observations, the reach should be classified as intermittent. Habitat in this area is poor because the historic swale has been straightened and deepened (Figure 4), and livestock access to the canal is not restricted at all locations.

Chemical Parameters–Limited water quality data have been collected on water that has been diverted from the Boise River at Stations IDEQ MC-1 and STOR MCAR. Recent daily mean water temperatures are 16.6 degrees C, while daily maximum water temperatures are 16.7 degrees C (Figure 5). Historical pH values in this reach ranged between 7.6–8.7 (Figure 6). The average historic dissolved oxygen value recorded in this reach is 9.0 mg/L (Figure 7). Recent TSS values are consistently <15 mg/L (Figure 8), and recent total phosphorus concentrations are 0.03 mg/L (Figure 9). Although historic fecal coliform concentrations averaged >2,600 /100mL, recent average fecal coliform concentrations were 7 /100mL (Figure 10). Recent average *E. coli* concentrations are 21 /100mL (Figure 11). It is believed that copper sulfate is added occasionally to the New York Canal to control vegetation in the canal system. Effects to water quality and the aquatic community resulting from the addition of copper sulfate are unknown.

Biological Parameters–Fish species that have been observed in larger drain segments in the area, and which could conceivably occur in this reach, include rainbow trout and redside shiner (USBR 2000). These species are not believed to be native to the larger drains and likely are diverted from the Boise River. IDFG does not currently have management goals for fish in this tributary (IDFG 1997; Grunder, pers. comm., 2000). No formal fish surveys are available for this reach and no macroinvertebrate data have been collected (Figures 11 and 12).

<u>MC:B– Ridenbaugh Canal to Boise River</u>

Physical Parameters–Mason Creek flows to the confluence with the Boise River through basalts and gravel terraces. Below the Ridenbaugh Canal, which is not believed to release water into this reach, flows range from <1 cfs and increase to >125 cfs near the mouth during the irrigation season (Figure 3). Flows during the non-irrigation season decrease by more than 50 percent throughout the reach. Based on these observations, the reach should be classified as perennial. A HI score of 51 was observed in this reach (Figure 4; IDEQ 2000a), which is slightly below the threshold for habitat impairment of 58. Habitat in this reach has been classified as impaired based on riparian disturbances, lack of pools and pool variability, and poor canopy cover.

Chemical Parameters–Water quality data have been collected throughout this reach at three IDEQ monitoring stations, six ISDA monitoring stations, three STORET stations, and three USGS gaging stations. Daily mean water temperatures range between 12.1–19.9 degrees C, while daily maximum water temperatures vary between 18.0–24.8 degrees C (Figure 5). Recent pH values in this reach range between 7.4–8.8 (Figure 6). The minimum dissolved oxygen value recorded in this reach is 7.4 mg/L (Figure 7). TSS concentrations range between 17.5–>100 mg/L, with higher values observed during the irrigation season at those stations that are near the mouth (Figure 8). Recent total phosphorus values range between 0.20-0.42 mg/L (Figure 9) and phosphorus levels appear to increase closer to the mouth. Recent average fecal coliform concentrations were as high as 5,233 /100mL during the irrigation season near the mouth (Figure 10), and average *E. coli* concentrations range as high as 3,800 /100mL (Figure 11).

Biological Parameters–Although no fish surveys are available for this reach, USBR (2000) has indicated that rainbow trout and redside shiner have been historically observed in various Nampa & Meridian Irrigation District canals (Figure 12). USBR reports that these fish could be diverted from the Boise River via the network of irrigation canals (which may or may not include Mason Creek). IDFG does not currently have management goals for fish in this tributary (IDFG 1997; Grunder, pers. comm., 2000). Macroinvertebrate data were collected; however, the raw benthic macroinvertebrate data were not converted into an MBI score (Figure 13). Although the community structure was diverse, several intolerant groups that would be expected in higher quality streams were missing (Plecoptera and Trichoptera). Quite a few tolerant groups were present (Ostracoda, Physidae, Hydrobiidae, Acari, Coenagrionidae, and Corixidae). None of the taxa (groups) listed are considered temperature-preference cold (IDEQ, 1996).

Sand Hollow Creek

The portion of Sand Hollow Creek (also referred to as Sand Run Gulch) addressed by this use evaluation extends from the C-line Canal to its mouth at the Snake River (natural headwaters are defined as the drainage divide between the Payette and Boise Rivers [IDEQ 1997b]). The water body is incised primarily into fluvial and lacustrine sediments (IDEQ 1997b). No beneficial uses have been designated for Sand Hollow Creek as part of the Lower Boise Subbasin (as specified in IDAPA 58.01.02.140.12); therefore, the creek is presumed to support CWB and PCR.

For the purposes of the use evaluation, Sand Hollow Creek has been divided into two distinct reaches (see Figure 1):

- SHC:A- Headwaters/C-Line Canal to Sand Hollow Wasteway (4.5 miles)
- SHC:B- Sand Hollow Wasteway to Snake River (19.9 miles)

These reaches were differentiated based primarily on hydrologic regime; a more accurate description of the flow regime in Sand Hollow Creek is provided below. Available physical, chemical, and biological parameters are summarized for each of the reaches below. (Table 3 provides a summary of data sources for this tributary's physical, chemical, and biological parameters.)

<u>SHC:A– Headwaters/C-Line Canal to Sand Hollow Wasteway</u>

Physical Parameters–This reach extends from the C-Line Canal to the confluence with spillway for the Sand Hollow Wasteway. Although this reach begins at the C-Line Canal, the headgates are locked and do not appear to be used frequently (Griswold, pers. comm., 2000). Flows may be present in this reach when water seeps from the C-Line Canal into the creekbed or during spring run-off. Periodic observations indicate that the reach is often dry or flow is <5 cfs during the non-spring run-off period (Figure 3). Based on these observations, the reach should be classified as intermittent. Habitat in this area is poor primarily because flows are typically low. The substrate and banks are silty, with moderate riparian coverage. A HI score of 21 was observed in this reach (IDEQ 2000a), which indicates habitat impairment (Figure 4).

Chemical Parameters–When water is present, summer temperatures have been observed at 16 degrees C (Figure 5). No other water quality data are available for this reach (Figures 6-10).

Biological Parameters–No fish were observed in this reach in the 1996 or 1997 summer seasons, presumably due to limited water (Figure 12). During the 1970s and 1980s, IDFG reportedly stocked the lower portion of this tributary with rainbow trout; however, it is unknown whether the trout migrated as far upstream as this reach. IDFG does not currently have management goals for fish in this tributary (IDFG 1997; Grunder, pers. comm., 2000). No macroinvertebrate data have been collected in this reach (Figure 13).

<u>SHC:B– Sand Hollow Wasteway to Snake River</u>

Physical Parameters–Sand Hollow Creek flows to the confluence with the Snake River through riverine sediments. The Sand Hollow Wasteway drains water from the Black Canyon basin and joins Sand Hollow Creek at a triple point with the D-Line Canal, the H-Line Canal, and the C-Line Canal. The lower portion of the reach that runs parallel to the Boise River was completely man-made for irrigation purposes (IDEQ 1997b). During the irrigation season, discharges in this reach range from approximately 5 cfs near the upstream margin and steadily increase to >110 cfs near the mouth (Figure 3). Flows during the non-irrigation season decrease by approximately 50 percent throughout the reach. Based on these observations, the reach should be classified as perennial. Throughout this reach, riparian vegetation is poor and the waterbody is used for grazing. HI scores of between 19-61 were observed (Figure 4; IDEQ 1997a and 2000a). Scores were lowest in the upper portion of the reach (19-29), which indicates habitat impairment. Although scores improved in the downstream direction (50-61), these values are still lower than or near the habitat impairment threshold of 58. Habitat in this reach has been classified as impaired based on sandy/silty substrate, lack of pools and pool variability, poor canopy cover, and poor riparian zones.

Chemical Parameters–Water quality data have been collected throughout this reach at eight IDEQ monitoring stations, three ISDA monitoring stations, one STORET station, and one USGS gage station. Daily mean water temperatures range between 10.2–18.0 degrees C, while daily maximum water temperatures vary between 18.0–23.0 degrees C (Figure 5). pH values in this reach range between 7.5–8.9 (Figure 6). The minimum historical dissolved oxygen value recorded in this reach is 4.8 mg/L (Figure 7). TSS concentrations range between <15 – >150 mg/L, with higher values observed during the irrigation season at those stations that are near the mouth (Figure 8). Recent total phosphorus values range between 0.16-0.43 mg/L (Figure 9) and phosphorus levels appear to increase closer to the mouth. Recent average fecal coliform concentrations were as high as 2,215 /100mL during the irrigation season near the mouth (Figure 10), and average *E. coli* concentrations range between 290-1,174 /100mL (Figure 11).

Biological Parameters–A number of fish surveys have been conducted in this reach (Clark and Bauer 1983; IDEQ 1997b). These surveys indicate that only a handful of adult rainbow trout have been observed, as well as limited numbers of suckers, shiners, dace, and carp (Figure 12). In addition, although IFDG (1997) states that wild rainbow trout were collected post-1975 by Clark and Bauer (1983), the actual Clark and Bauer report does not specifically identify the only rainbow trout that was collected as wild. Although IDFG reportedly stocked this creek with rainbow trout during the 1970s and 1980s, the creek is not currently stocked nor does the agency have management goals for fish in this tributary (IDFG 1997; Grunder, pers. comm., 2000). Any fish that are present, including the three adult rainbow trout collected in 1997 by IDEQ, likely are diverted from the Boise River via the irrigation network. Macroinvertebrate data were collected and converted into an MBI score of 2.86 (Figure 13). Benthic macroinvertebrate community structure was not very diverse. None of the taxa were considered to have a coldwater preference, and many of the taxa were considered mid-range for pollution tolerance (IDEQ, 1996).

Data Summary and Recommendations

A summary of available data for each of the tributaries is presented in Table 4.

To determine attainable beneficial uses, all three types of data (physical, chemical, and biological) must be evaluated. In this case, habitat conditions (i.e., physical characteristics) for all of the tributaries dominates the determination of attainable beneficial uses because the waterbodies are not typical “creeks” as would be expected in a natural riverine system. While Upper Indian Creek has been modified from its original natural state, Mason Creek and Sand Hollow Creek were constructed or modified specifically to convey irrigation water over a century ago (USBR 1996). As such, these reaches are used for irrigation purposes on a largely intermittent basis and these ditches are generally lacking suitable habitat for reproducing coldwater biota populations. The creeks are characterized by poor sinuosity and poor canopy cover, which is typical along ditches in rural irrigation areas. In addition, the substrate is comprised primarily of silts and sands. The few gravels and cobbles that are present are highly embedded.

The lack of consistent riparian buffer zones, due to continued urban encroachment and contractual management activities, intensifies the sediment problem. Normally, riparian buffer zones trap naturally-eroding sediment and prevent it from entering the waterbody. In this situation, agricultural activities (including surface run-off of irrigation water) and grazing activities increase the amount of eroded sediment that reaches the waterbody. Furthermore, the irrigation districts have a legal responsibility to their customers to provide water and maintain the function of the ditches. The resulting dredging activities dramatically alter the substrate and the adjacent riparian areas where the dredged materials are placed.

Transforming these ditches, which were not created or modified to provide good-quality aquatic habitat, into suitable waterbodies for coldwater fish populations is not feasible. These three tributaries alone consist of almost 100 miles, over half of which is used exclusively for irrigation conveyance. This length doesn’t take into account the other hundreds of miles of canals and drains in the valley that are used for similar purposes. Creating good-quality habitat that will support coldwater aquatic life throughout the length

TABLE 4. TRIBUTARY PHYSICAL, CHEMICAL, AND BIOLOGICAL DATA SUMMARY

	Upper Indian Creek					Mason Creek		Sand Hollow Creek	
	IC: A HW to IC Res	IC: B IC Res	IC: C IC Res to NYC	IC: D NYC to Split	IC: E Split to Sugar	MC: A NYC to Ridenbaugh	MC: B Ridenbaugh to BR	SHC: A HW to SH Wasteway	SHC: B SH Wasteway to SR
Physical									
Hydrology	Intermittent	n/a	Intermittent	Intermittent	Perennial	Intermittent	Perennial	Intermittent	Perennial
Habitat Structure	Poor	n/a	Poor	Poor	Poor-Moderate	Poor	Poor-Moderate	Poor	Poor-Moderate
Habitat Index[1]	(HI = 23)	n/a			(HI = 55)		(HI = 51)	(HI = 21)	(HI = 19-61)
Chemical[2]									
Temperature (C)	15 - 15.4	- -	30	12.0 - 15.5	9.9 - 17.8	14.0 - 16.6	12.1 - 19.9	16	10.2 - 18.0
DO (mg/L)	- -	- -	3.5	9.0 - 9.2	6.1 - 11.0	9.0	7.4 - 8.8	- -	6.5 - 7.6
TSS (mg/L)	- -	- -	- -	10.7	12.6 - 21.8	5.5 - 12.0	17.5 - 234	- -	11.3 - 339
Total Phosphorus (mg/L)	- -	- -	0.77	0.002 - 0.04	0.16 - 0.22	0.03 - 0.17	0.20 -0.42	- -	0.16 - 0.43
Fecal Coliform (#/100mL)	- -	- -	1,800	16.0 - 62.2	340 - 1,922	7.0 - 2,608	927 - 5,233	- -	197 - 2,215
E Coli (#/100mL)	- -	- -	- -	2	730 - 1,371	21	615 - 3,800	- -	290 - 1,174
Biological									
Fishes	None observed via electro-shocking	IDFG stocks with bluegill and largemouth bass	None observed, fish passage barriers	Dace, sucker, sculpin (2)	1999: RBT (4 btwn 160-300 mm) but no large stock recovery since 1986 spill	Anecdotal evidence suggests that fishing may occur in this reach during the irrigation season	Minnows observed	None observed, fish passage barriers, anecdotal evidence suggests that fishing may occur in this reach during the irrigation season	Between 80-97: RBT (4 btwn 108-121 mm); leopard dace (6); redside shiner (6); bridgelip, largescale, and mountain suckers (19); carp (1)
Macroinvertebrates	Mid-range tolerance, no cold-preference species	- -	- -	Mid-range tolerance, no cold-preference species	- -	- -	Diverse structure, tolerant species dominant, no cold-preference species	- -	Non-diverse structure, mid-range tolerance, no cold-preference species
MBI Score[3]	(MBI = 2.38)			(MBI = 3.36)			(MBI = not calculated)		(MBI = 3.6 and 2.86)

1- Habitat Index (HI) for Snake River Basin/High Desert Ecoregion:
   HI < 58 = impaired
   59 < HI < 88 = needs verification
   89 < HI = not impaired
2- Values are generally average recent measurements (except for minimum DO) collected during irrigation season (approx. Apr 1-Oct 1).
3- Macroinvertebrate Biotic Index (MBI):
   MBI < 2.5 = impaired
   2.5 < MBI < 3.5 = needs verification
   3.5 < MBI = not impaired

BR	Boise River
DO	dissolved oxygen
HW	headwaters
IC Res	Indian Creek Reservoir
NYC	New York Canal
RBT	rainbow trout
SH	Sand Hollow
SR	Snake River
TSS	total suspended sediment

TABLE 4. TRIBUTARY PHYSICAL, CHEMICAL, AND BIOLOGICAL DATA SUMMARY (CON'T.)

	Upper Indian Creek					Mason Creek		Sand Hollow Creek	
	IC: A HW to IC Res	IC: B IC Res	IC: C IC Res to NYC	IC: D NYC to Split	IC: E Split to Sugar	MC: A NYC to Ridenbaugh	MC: B Ridenbaugh to BR	SHC: A HW to SH Wasteway	SHC: B SH Wasteway to SR
Classification									
Intermittent	X		X	X		X		X	
Perennial		X			X		X		X
Recommended Attainable Beneficial Uses[4]	- -		- -						
Aquatic									
COLD					X[5]				
Salmonid spawning					X[5]				
Seasonal COLD	X								
WARM		X							
MOD[6]			X[6]	X[6]		X[6]	X[6]	X[6]	X[6]
(40 CFR 131.10(g))			2,5	2,4,5		2,4,5	4,5	2,4,5	4,5
Recreation									
Primary contact		X							
Secondary contact	X		X	X	X	X	X	X	X

4- See Table 5 for rationale for recommended attainable beneficial uses.
5- Aquatic use designation based on existing uses (since November 1975 as per IDAPA 58.01.02.003.35) of large pre-1986 rainbow trout population near Sugar Avenue.
6- 40 CFR 131.10(g):
(1) Naturally occurring pollutant concentrations prevent the attainment of the use; or
(2) Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating State water conservation requirements to enable uses to be met; or
(3) Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place; or
(4) Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in the attainment of the use; or
(5) Physical conditions related to the natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses; or
(6) Controls more stringent than those required by sections 301(b) and 306 of the Act would result in substantial and widespread economic and social impact.

of the creeks is infeasible given the current and foreseeable irrigation management program, the scope of the project, and the multiple stakeholders involved.

Apart from the habitat issue, the ability of these waterbodies to support their designated and existing uses is addressed below. The major impairments for each reach have been previously identified. The attainability analysis in Table 5 further describes the causes for these impairments and recommends the highest attainable use for each reach.

TABLE 5. WATERBODY USE ATTAINABILITY ANALYSIS

Reach[1]	Designated Use	Existing Use[2]	Attainable Use[2]	Attainability Comments
IC:A	CWB, SS	SCWB	SCWB	This reach is intermittent and only carries water during the spring runoff period. Some of this water may be hydraulically connected to Indian Creek Reservoir (Reach IC:B) during limited periods of excessive spring run-off. Any aquatic life that may exist in this reach would likely migrate upstream from the warm-water reservoir. However, because the runoff is snowmelt driven, a SCWB use better reflects presumed conditions during those limited periods when the channel carries water. A SCWB designation is protective of downstream reaches, as required by 40 CFR 131.10(b).
	PCR	SCR	SCR	Designating SCR reflects the current existing use in this reach during those limited periods when excessive spring-runoff is present. The same conditions that preclude the presence of a viable wild CWB population (e.g., intermittent flows and lack of canopy cover) also make this reach unsuitable for PCR.
IC:B	CWB, SS	WWB	WWB	CWB not attainable because hydrologic modification (construction of reservoir) created a shallow water body suitable for warmwater fishes. As such, the IDFG stocks the reservoir as a warmwater fishery. In addition, the unit is hydrologically separate from upstream reach, except during limited periods of excessive spring run-off, and completely hydrologically disconnected from downstream reach.
	PCR	PCR	PCR	No recreational use changes are recommended.
IC:C	CWB, SS	MOD (2,5)	MOD (2,5)	This reach is intermittent and only carries water during the spring runoff period. Aquatic community that may be present would be an adapted community consisting of a transient adult stocked fish population that presumably is diverted from the Boise River via the New York Canal during the irrigation season only. This adapted community represents a modified system because intermittent flow conditions and the operation of the downstream irrigation canal precludes the presence of year-round aquatic life. In addition, the reach contains numerous fish passage barriers that preclude a viable CWB population and SS uses.
	PCR	SCR	SCR	Designating SCR is consistent with Lower Indian Creek and reflects the current existing use of this reach. The same conditions that preclude the presence of a viable wild CWB population (e.g., intermittent flows and lack of canopy cover) also make this reach unsuitable for PCR.

TABLE 5. WATERBODY USE ATTAINABILITY ANALYSIS

Reach[1]	Designated Use	Existing Use[2]	Attainable Use[2]	Attainability Comments
IC:D	CWB, SS	MOD (2,4,5)	MOD (2,4,5)	Aquatic community that is present is an adapted community consisting of a transient adult stocked fish population that presumably is diverted from the Boise River via the New York Canal during the irrigation season only. This adapted community represents a modified system because intermittent flow conditions and the operation of the irrigation canal precludes the presence of year-round aquatic life. In addition, the modification of the facility as an irrigation ditch has resulted in lack of proper substrate, canopy cover, riparian zones, and presence of pools that would be required to support a viable CWB population and SS uses.
	PCR	SCR	SCR	Designating SCR is consistent with Lower Indian Creek and reflects the current existing use of this reach. The same conditions that preclude the presence of a viable wild CWB population (e.g., intermittent flows, operation as an irrigation ditch, and lack of canopy cover) also make this reach unsuitable for PCR. It is important to note that although SCR is an existing use, the irrigation districts do not condone or encourage the use of the waterbody for infrequent swimming or fishing by trespassers.
IC:E	CWB, SS	CWB, SS	CWB, SS	No change in the aquatic life uses are recommended due to over 1,000 rainbow trout that were present before being killed during 1986 spill; however, recovery of this population has not occurred and any fish present are likely recruited from the New York Canal during periods of high flows.
IC:E	PCR	SCR	SCR	Designating SCR is consistent with Lower Indian Creek and reflects the current existing use of this reach. PCR uses are limited by hydrologic irrigation operations that control flows. In some cases flows are <5 cfs and in other cases, flows are too rapid for safe swimming or fishing activities. It is important to note that although SCR is an existing use, the irrigation districts do not condone or encourage the use of the waterbody for infrequent swimming or fishing by trespassers.
MC:A	CWB[3]	MOD (2,4,5)	MOD (2,4,5)	Aquatic community that is present is an adapted community consisting of a transient adult stocked fish population that presumably is diverted from the Boise River via the New York Canal during the irrigation season only. This adapted community represents a modified system because intermittent flow conditions and the operation of the irrigation canal precludes the presence of year-round aquatic life. In addition, the construction of the facility as an irrigation ditch has resulted in lack of proper substrate, canopy cover, riparian zones, and presence of pools that would be required to support a viable CWB population.
	PCR or SCR[3]	SCR	SCR	No changes are recommended from the presumed recreational use. It is important to note that although SCR is an existing use, the irrigation districts do not condone or encourage the use of the waterbody for infrequent swimming or fishing by trespassers.

TABLE 5. WATERBODY USE ATTAINABILITY ANALYSIS

Reach[1]	Designated Use	Existing Use[2]	Attainable Use[2]	Attainability Comments
MC:B	CWB[3]	MOD (4,5)	MOD (4,5)	Aquatic community that is present is an adapted community consisting of a transient adult stocked fish population that presumably is diverted from the Boise River. This adapted community represents a modified system because the operation of numerous irrigation canals and drains represent hydrologic modifications that limit the viability of CWB communities. In addition, the construction of the facility as an irrigation ditch has resulted in lack of proper substrate, canopy cover, riparian zones, and presence of pools that would be required to support a viable CWB population.
	PCR or SCR[3]	SCR	SCR	No changes are recommended from the presumed recreational use. It is important to note that although SCR is an existing use, the irrigation districts do not condone or encourage the use of the waterbody for infrequent swimming or fishing by trespassers.
SHC:A	CWB[3]	MOD (2,4,5)	MOD (2,4,5)	Aquatic community that is present is an adapted community consisting of a transient adult stocked fish population that may be diverted from the C-Line Canal or the Boise River during the irrigation season only. This adapted community represents a modified system because intermittent flow conditions and the operation of the irrigation canal precludes the presence of year-round aquatic life. In addition, the modification of the facility as an irrigation ditch has resulted in lack of proper substrate, canopy cover, riparian zones, and presence of pools that would be required to support a viable CWB population.
SHC:A	PCR or SCR[3]	SCR	SCR	No changes are recommended from the presumed recreational use. It is important to note that although SCR is an existing use, the irrigation districts do not condone or encourage the use of the waterbody for infrequent swimming or fishing by trespassers.
SHC:B	CWB[3]	MOD (4,5)	MOD (4,5)	Aquatic community that is present is an adapted community consisting of a transient adult stocked fish population that may be diverted from the Boise River (IDFG does not stock this tributary any longer). This adapted community represents a modified system because the operation of numerous irrigation canals and drains represent hydrologic modifications that limit the viability of CWB communities. In addition, the construction of the facility as an irrigation ditch has resulted in lack of proper substrate, canopy cover, riparian zones, and presence of pools that would be required to support a viable CWB population.
	PCR or SCR[3]	SCR	SCR	No changes are recommended from the presumed recreational use. It is important to note that although SCR is an existing use, the irrigation districts do not condone or encourage the use of the waterbody for infrequent swimming or fishing by trespassers.

TABLE 5. WATERBODY USE ATTAINABILITY ANALYSIS

Reach[1]	Designated Use	Existing Use[2]	Attainable Use[2]	Attainability Comments

NOTES:
1 – See Figure 1 for reach delineations.
2 – Existing and attainable MOD uses are classified based on 40 CFR 131.10(g) conditions.
3 – IDEQ presumes that CWB and PCR/SCR are beneficial uses in all undesignated streams.

The effects of the proper use designation on downstream reaches must be considered (40 CFR 131.10(b)). For the subject tributaries, there are two cases that were evaluated:

1) The affects of an intermittent designation on downstream perennial reaches

2) The affects of a non-CWB designation (i.e., with less stringent criteria) on downstream reaches.

In the first case, perennial aquatic life beneficial uses cannot be impaired in a segment that is immediately downstream from a segment that is classified as intermittent (which is associated with less stringent water quality criteria). The attainable uses specified in Table 5 provide for this protection because of the nature of how these systems are operated. Each intermittent reach is exclusively used for irrigation conveyance and is disconnected hydraulically from the next downstream reach due to irrigation diversions:

- Reach IC:C (Indian Creek Reservoir to New York Canal) is disconnected from Reach IC:D (New York Canal) because no flows are allowed into the New York Canal from Upper Indian Creek. Water may only be able to enter the canal through limited bank seepage during excessive spring run-off events.
- Reach IC:D (New York Canal to Split) is disconnected from Reach IC:E (Split to Sugar Avenue) because as the New York Canal splits from the creek, water can reach the original creekbed below the canal primarily through limited bank seepage or emergency spill overflows during peak flow events. Small perennial flows (<10 cfs) in the creek just downstream from the split are believed to be a result of groundwater base flow.
- Reach MC:A (New York Canal to Ridenbaugh) is disconnected from Reach MC:B (Ridenbaugh to Boise River) because flows that are channeled through the Mason Creek Feeder are largely diverted into the Ridenbaugh Canal for conveyance elsewhere. Small perennial flows (<3 cfs) in the creek just downstream from the Ridenbaugh are believed to be a result of groundwater base flow.
- Reach SHC:A (C-Line to Sand Hollow Wasteway) is disconnected from Reach SHC:B (Sand Hollow Wasteway to Snake River) because flows are largely diverted into either the C-Line, D-Line, or H-Line canals for conveyance elsewhere. Small perennial flows (<7 cfs) in the creek just downstream from the triple point are believed to be a result of groundwater base flow.

Because these systems are operated for irrigation conveyance within a complex network of canals and drains, the recommended intermittent classification does not appear to have the potential to negatively impact downstream reaches.

In the second case, the effects of a non-CWB designation on downstream reaches was also evaluated. The attainable uses specified in Table 5 provide for this protection because downstream reaches have less stringent criteria, downstream reaches are either hydraulically disconnected, or calculations show that existing uses in the downstream reaches are not impaired:

- Reach IC:A (Headwaters to Indian Creek Reservoir) has been proposed for SCWB beneficial uses. This would be protective of the next downstream reach (IC:B- Indian Creek Reservoir) because during the limited excessive spring runoff period, the SCWB criteria that apply in the upstream reach would be more protective than the less-stringent WWB criteria that would apply within the reservoir.
- Reach IC:B (Indian Creek Reservoir) has been proposed for WWB beneficial uses. This would be protective of the next downstream reach (IC:C- Indian Creek Reservoir to New York Canal) because the two reaches are hydraulically disconnected and there are no releases from the reservoir into the downstream creek.
- Reach MC:B (Ridenbaugh to Boise River) has been proposed for MOD beneficial uses and discharges into the Boise River. As discussed in the following section, the MOD beneficial uses primarily modify the DO numeric water quality criteria to a less stringent level. An analysis conducted by IDEQ (2001) using empirical monitoring data concluded that changing the DO criterion in Mason Creek "will not have detrimental effects on the aquatic life in the lower Boise River. Additionally, the state criterion... in the lower Boise Rive will not be violated as a result of the change." This analysis will be discussed in more detail in the following section and is included as Appendix B to this memorandum.
- Reach SHC:B (Sand Hollow Wasteway to Snake River) has been proposed for MOD beneficial uses and discharges into the Snake River. Although no empirical DO monitoring data are available, a simple mass balance calculation shows that mean annual flows at the mouth of Sand Hollow Creek (97.4 cfs) typically represent less than 0.4 percent of mean annual flows in the Snake River near Nyssa, Oregon (22,500 cfs; USGS 2000a). Therefore, it is extremely unlikely that less stringent water quality criteria would have detrimental effects on the aquatic life in the Snake River or that state criteria would be violated as result of the proposed change.

Recommended Modified Use Criteria

Modified water quality criteria are only applicable to aquatic life beneficial uses. To better understand what criteria might be appropriate, it is important to define the limited and adapted aquatic community that is to be protected. Recognizing that aquatic life, including primarily fish and invertebrates, exists in these systems when water is present, these communities represent a specialized ecosystem that has adapted to its environment. Based on the available data and anecdotal information, it is believed that the fish that are present in these systems have been diverted from the Boise River during the irrigation season. IDFG stocks catchable-sized rainbow trout in the Boise River on an annual basis; numbers vary according to yearly fluctuations in flows. Other non-game fish that have been observed in these creeks are believed to be primarily wild, reproducing populations that are also diverted in the irrigation season. This transient population includes primarily suckers and shiners that are typically associated with coolwater to warmwater conditions (IDEQ 1996), as well as limited numbers of coldwater fish such as sculpin. Habitat conditions in these tributaries do not support viable coldwater aquatic life communities for the following reasons:

- Gravel beds and non-sediment laden waters would be required for successful spawning.
- Varied habitat structure, including pools, is extremely limited.
- Canopy cover to mitigate elevated temperature conditions and provide protection from predators is lacking.

Although some of these species are native, insectivorous fish that are moderately tolerant of degraded habitat (e.g., redside shiner and dace), these fish are likely present because they are diverted from the river on a transient basis, not because the creek provides adequate long-term habitat and flow conditions. Therefore, the adapted community can best be described as a transient population of non-game fish and stocked rainbow trout that have been diverted from the Boise River.

Water quality criteria have been recommended that provide protection for such a limited community before it is fished out over a few-month period during the irrigation season. Those fish that are not caught by recreational fisherman during this timeframe die naturally at the end of the irrigation season (usually by mid-October) when water levels dramatically decrease or disappear altogether. In fact, “salvage” fishing in these drains is authorized by IDFG near the end of the irrigation season (IFDG does not maintain catch records from these activities).

To recommend appropriate water quality criteria that will be protective of the limited and adapted aquatic community present in these tributaries, numeric criteria from the EPA Gold Book (EPA 1986), and numeric criteria were assessed from other states that have attempted to address limited waterbodies that are comparable to the subject tributaries (including Nevada, Utah, Wyoming, Nebraska, and Ohio). In addition, values from available scientific literature were reviewed. Based on this analysis, numeric criteria have been recommended for three parameters: dissolved oxygen, temperature, and pH. In addition, possible TMDL targets for TSS have been evaluated using a similar methodology used to determine appropriate targets for the recent mainstem Boise River TMDL (LBRWQP 1999).

Water quality criteria developed to protect non-pristine freshwater environments that still support some aquatic life were evaluated. For example, Nevada has promulgated numeric criteria for Class C waters, which are waters located in areas of moderate to urban human habitation, moderate industrial development, intensive agriculture, and considerable watershed alteration by man (Chapter 445A: Water Pollution Control). Aquatic life is to be protected in these waters, but at less stringent levels than would be required for viable, self-producing coldwater aquatic fish communities. Similarly, coolwater criteria were also assessed because although these environments typically contain coldwater biota during part or all of the year, these biota do not form the dominant community structure. Finally, recommended criteria for early life stages were not considered in this analysis because the aquatic community to be protected consists primarily of either stocked adult rainbow trout or non-game cool to warm water fish that are present for a limited period of time (typically less than 2 months) only until they are fished out of the system or the irrigation season ends.

Dissolved Oxygen

Depletions in dissolved oxygen can negatively affect the aquatic community in freshwater systems. It is important to note that intergravel dissolved oxygen does not appear to be a relevant factor in determining the appropriate numeric criteria because no spawning activity is anticipated. To be consistent with current Idaho standards, a modified dissolved oxygen numeric criterion should be expressed as an absolute minimum value. A summary of relevant numeric criteria from other sources follows:

- Utah specifies an absolute minimum of 3.0 mg/L for Class 3C waters that support non-game fish and other aquatic life.
- Similarly, Wyoming protects Class 3 non-game fish with dissolved oxygen levels of 3.0 mg/L for non early-life stages.
- Ohio protects limited resource waters (highly modified drainage-ways that do not posses the stream morphology or habitat characteristics necessary to support full aquatic beneficial uses) by setting an outside mixing zone average of 3.0 mg/L and an outside mixing zone minimum of 2.0 mg/L.
- EPA (1986) recommends an absolute coldwater minimum of 4.0 mg/L for non-early life stages.
- Nebraska protects Class B waters (limitations on flow, substrate, and habitat preclude naturally reproducing coldwater species and non-early life stages) using an absolute minimum of 4.0–5.0 mg/L, with 4.0 mg/L specified between July–March.

These criteria, which reflect the subject systems to some degree, range between an absolute minimum of 2.0-5.0 mg/L. In addition to these published criteria, previous studies have been conducted to determine acute lethality levels for salmonids such as adult rainbow trout and non-salmonids such as sculpin. Acute lethality appears to be the appropriate endpoint to consider given the nature of the modified aquatic communities that exist in these tributaries. As summarized in Ecology (2000), Burdick et al. found that rapid lethality (LC50 in 1-4 hours) for rainbow trout ensued in 20-21 degrees C waters at median concentrations of 1.49-1.83 mg/L. Gnaiger concluded that complete winter-kill occurred in rainbow trout when oxygen levels in the water column dropped to 1.92 mg/L. Based on other data compiled to support Washington State's proposed revised dissolved oxygen levels for salmonids, "mortality would not be expected when minimum oxygen concentrations are at 3.5-4.0 mg/L or higher, even in very warm (20 degrees C) waters" (Ecology 2000). In addition to salmonid laboratory studies, Burdick et al. found that small-mouth bass experienced median acute (8 hours) mortality at concentrations of 1.03-1.17 (26.7 degrees C) and 0.63-0.72 (12 degrees C). Davison et al. noted that sculpin had a median tolerance limit (4-day exposure) of about 1.46 mg/L. Again, based on other data compiled to support Washington State's proposed revised minimum oxygen levels for non-salmonids, "acute lethality would be prevented… where dissolved oxygen concentrations are continuously maintained above 2.0-2.5 mg/L" (Ecology 2000).

Therefore, the dissolved numeric criteria associated with EPA's GoldBook standard of 4.0 mg/L is recommended for the modified aquatic systems in the three subject tributaries. Although the proposed criterion is less stringent than the current Idaho criterion of 6.0 mg/L for CWB and SS aquatic life uses and the WWB criterion of 5.0 mg/L, this value represents a conservative number in light of other available criteria for modified systems and acute lethality literature values. Available dissolved oxygen data (Figure 7 and Table 4) indicate that the subject tributaries meet the current CWB criterion (6.0 mg/L) at least 90% of the time and the recommended modified criterion (4.0 mg/L) more than 95% of the time.

The issue of whether the less stringent DO criterion in upper reaches would have the potential to negatively impact downstream reaches was evaluated in accordance with 40 CFR 131.10(b), as described earlier. IDEQ (2001) performed an analysis of potential effects from a DO criterion change in lower Mason Creek (Reach MC:B) on the next downstream reach in the Lower Boise River. This analysis, which was based on empirical DO monitoring data for both Mason Creek and the Lower Boise River, was based on the Streeter-Phelps equation for DO and is included in Appendix B to this memorandum. Based on modeling results for low flow, medium flow, and high flows, IDEQ concluded that "...if Mason Creek were to discharge DO concentrations of 4.0 mg/L to the Lower Boise River, the river would not fall below 6.0 mg/L. This remains the case in high, medium and low flow years, as well as [throughout] the growing season of the medium flow year. Using the Streeter-Phelps model as a basis, it is Idaho DEQs opinion that changing the dissolved oxygen criterion in Mason Creek from 6.0 mg/L to 4.0 mg/L will not have detrimental effects on the aquatic life in the lower Boise River. Additionally, the state criterion of 6.0 mg/L in the Lower Boise River will not be violated as a result of the change."

The only other reach where the upstream DO criterion would be less stringent than the existing downstream DO criterion is Reach SHC:B (Sand Hollow Wasteway to Snake River) that discharges to the Snake River. Although no empirical DO monitoring data are available, a simple mass balance calculation shows that mean annual flows at the mouth of Sand Hollow Creek (97.4 cfs) typically represent 0.4 percent of mean annual flows in the Snake River near Nyssa, Oregon (22,500 cfs; USGS 2000a). If the DO criterion in Sand Hollow Creek was changed from 6.0 mg/L to 4.0 mg/L, Idaho and Oregon state criteria in the Snake would not be violated as result of the proposed change. It is extremely unlikely that the proposed water quality criteria would have detrimental effects on the aquatic life in the Snake River.

Temperature

Temperature is one of the primary factors that affects the spatial and temporal dynamics of fish. Recognizing that there are other aquatic communities in addition to just coldwater and warmwater communities, IDEQ has developed the SCWB aquatic life use that may be appropriate when coldwater aquatic life may be absent during, or tolerant of, seasonally warm temperatures. To support revised Idaho SCWB temperature criteria, BioAnalysts (1999) conducted an extensive literature search regarding optimum temperature ranges for cool- and coldwater species, many of which are known to be present in the Boise River system. In the subject tributaries, maximum stream temperatures range between 23.0–24.8 degrees C (Figure 5), and yet rainbow trout have been observed in these reaches. This suggests that the same rationale developed for the SWCB temperature criteria could be considered for the modified use temperature criteria.

To be consistent with current Idaho standards, a modified temperature numeric criterion should be expressed for both daily average and daily maximum values. A summary of relevant numeric criteria from other sources follows:

- Idaho's proposed rule for SCWB temperature criteria specifies 23.0 degrees C (daily average) and 26.0 degrees C (daily maximum). These values are based on an extensive literature search (BioAnalysts 1999) that incorporates many of the species observed in the subject tributaries, including rainbow trout, leopard dace, redside shiner, and bridgelip sucker (Figure 12).
- Montana specifies a maximum daily temperature of 19.4 degrees C for Class C-2 waters that support growth and marginal propagation of salmonid fishes and associated aquatic life.
- Nevada protects Class C aquatic life in waters associated with intensive agriculture that contain trout with a maximum temperature of 20 degrees C.
- Utah specifies a maximum daily temperature of 27.0 degrees C for Class 3C waters that support non-game fish and other aquatic life.
- Finally, Wyoming protects Class 3 non-game fish with a maximum temperature of 32.2 degrees C.

These criteria, which all reflect the subject systems to some degree, range between a daily maximum of 19.4–32.2 mg/L. Because the Idaho SCWB temperature criteria were developed to protect adapted communities similar to those believed to be present in the subject tributaries, the same criteria are recommended for the modified aquatic systems (26.0 degrees C daily maximum and 23.0 degrees C daily average). These values are less stringent than the current Idaho CWB criteria for CWB and SS aquatic life uses, but more stringent than the Idaho WWB temperature criteria. Available data indicate that the creeks meet these recommended temperature criteria (Figure 5 and Table 4).

pH

pH is an important factor in the chemical and biological systems of natural waters. To be consistent with current Idaho standards, a modified pH criterion should be expressed as a range. A summary of relevant numeric criteria from other sources follows:

- Utah specifies a pH range of 6.5–9.0 for Class 3C waters that support non-game fish and other aquatic life.
- Similarly, Wyoming protects Class 3 non-game fish with a pH range of 6.5–9.0.
- EPA (1986) recommends a pH range of 6.5–9.0 for freshwater systems.
- Montana specifies a pH range of 6.5–9.0 for Class C-2 waters that support growth and marginal propagation of salmonid fishes and associated aquatic life.
- Finally, Nevada protects Class C aquatic life in waters associated with intensive agriculture that contain trout with a pH range of 6.5–8.5.

These criteria, which all reflect the subject systems to some degree, largely range between Idaho's currently proposed rule for pH of 6.5–9.0. Therefore, no change in pH values from the current CWB, SS, and WWB aquatic life standards is recommended for the modified aquatic systems in the three subject tributaries. Available data indicate that the creeks meet the recommended pH criterion (Figure 6).

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Figures

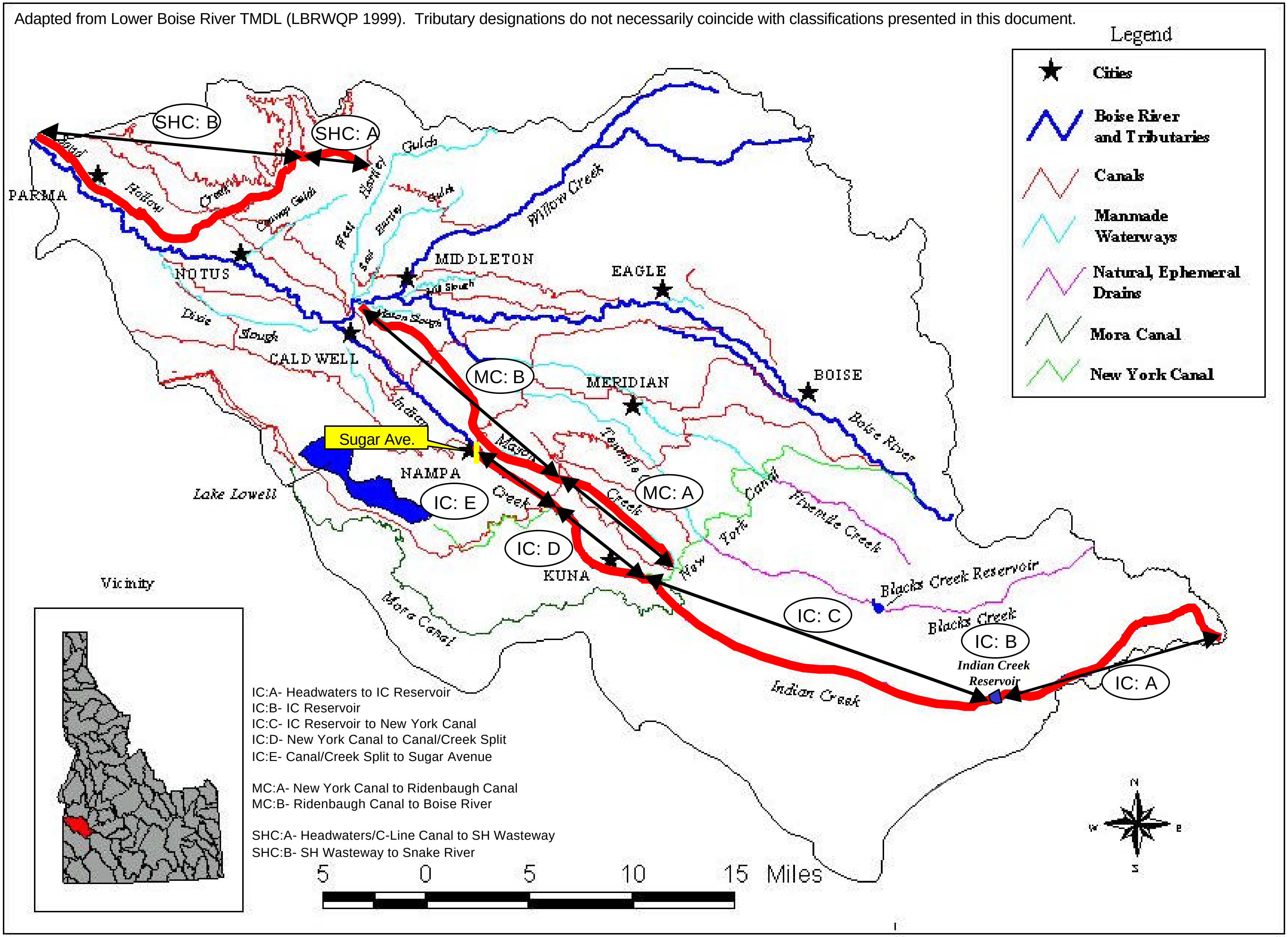

Figure 1. Basin map and Upper Indian Creek, Mason Creek, and Sand Hollow Creek tributaries.

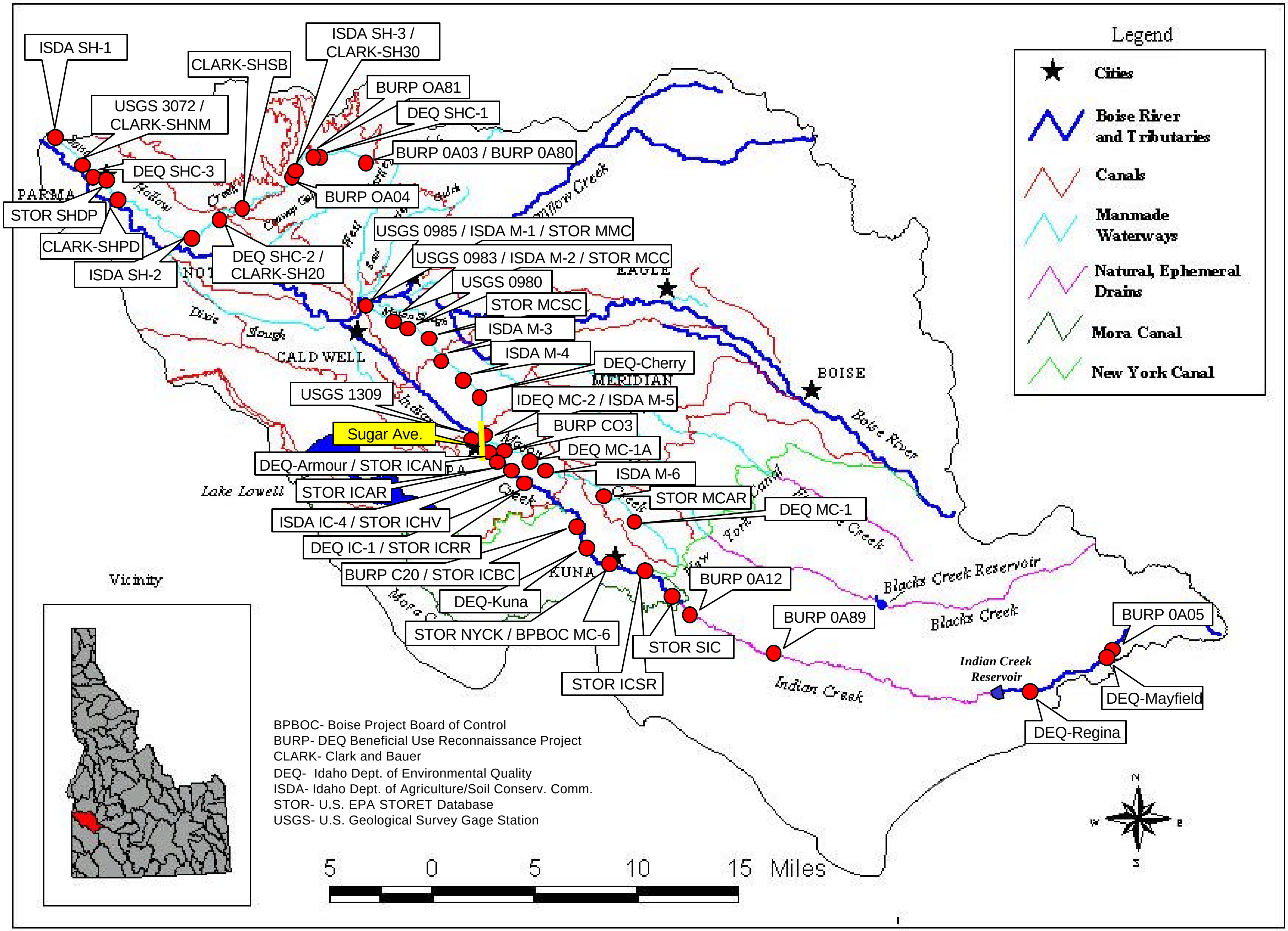

Figure 2. Station locations on Upper Indian Creek, Mason Creek, and Sand Hollow Creek.

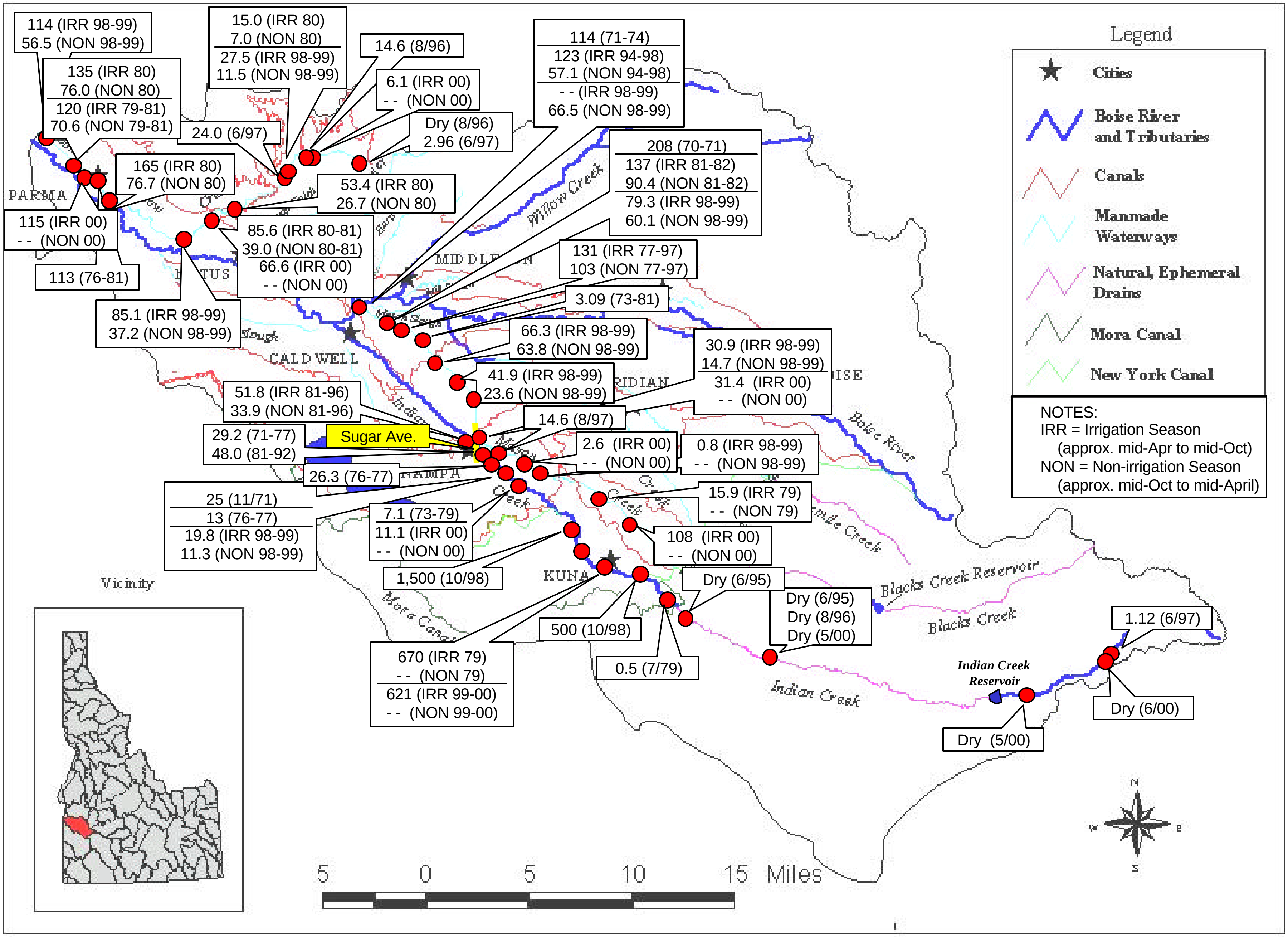

Figure 3. Mean discharge data (cfs) for Upper Indian Creek, Mason Creek, and Sand Hollow Creek.

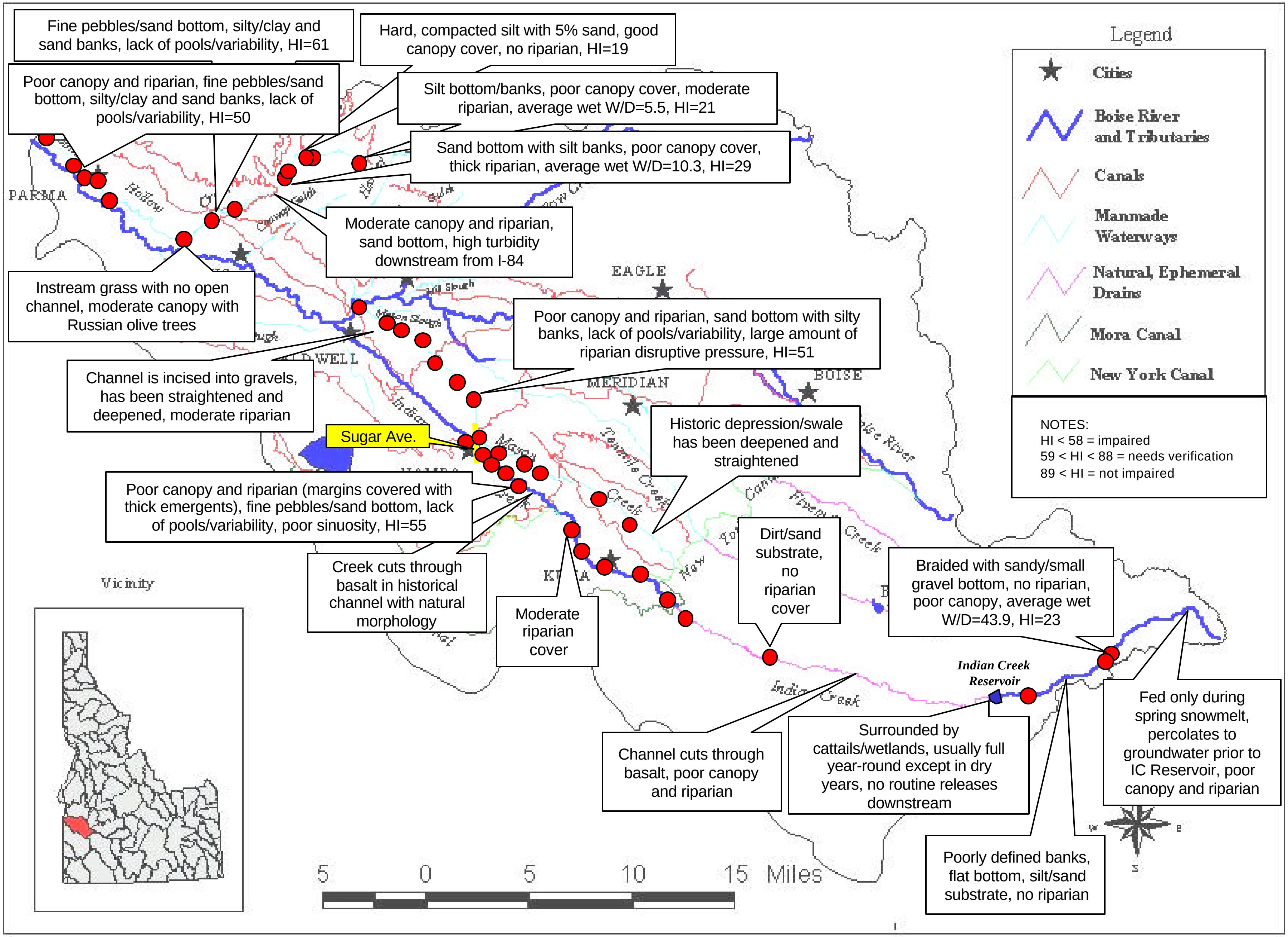

Figure 4. Habitat conditions for Upper Indian Creek, Mason Creek, and Sand Hollow Creek.

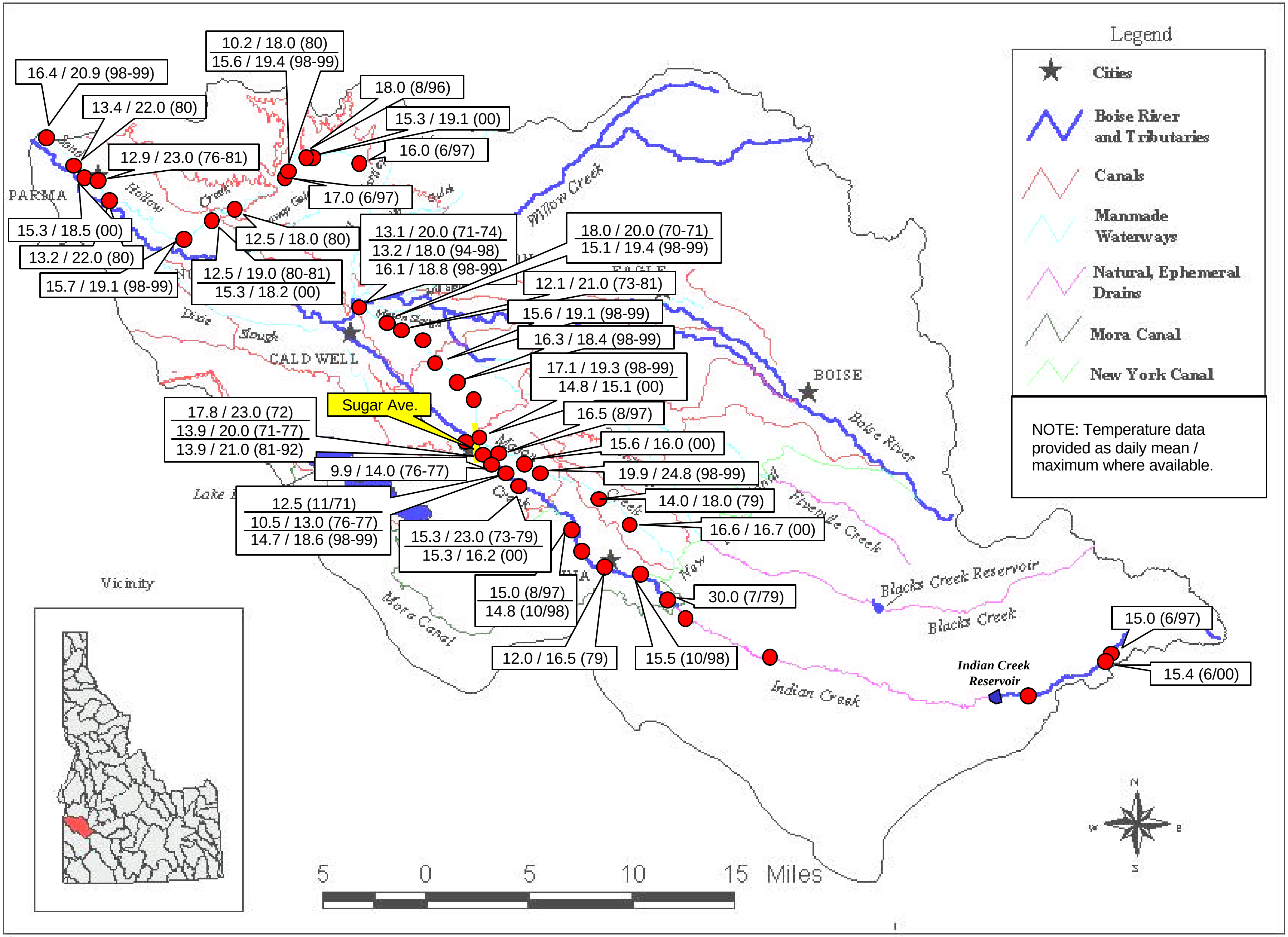

Figure 5. Temperature data (C) for Upper Indian Creek, Mason Creek, and Sand Hollow Creek.

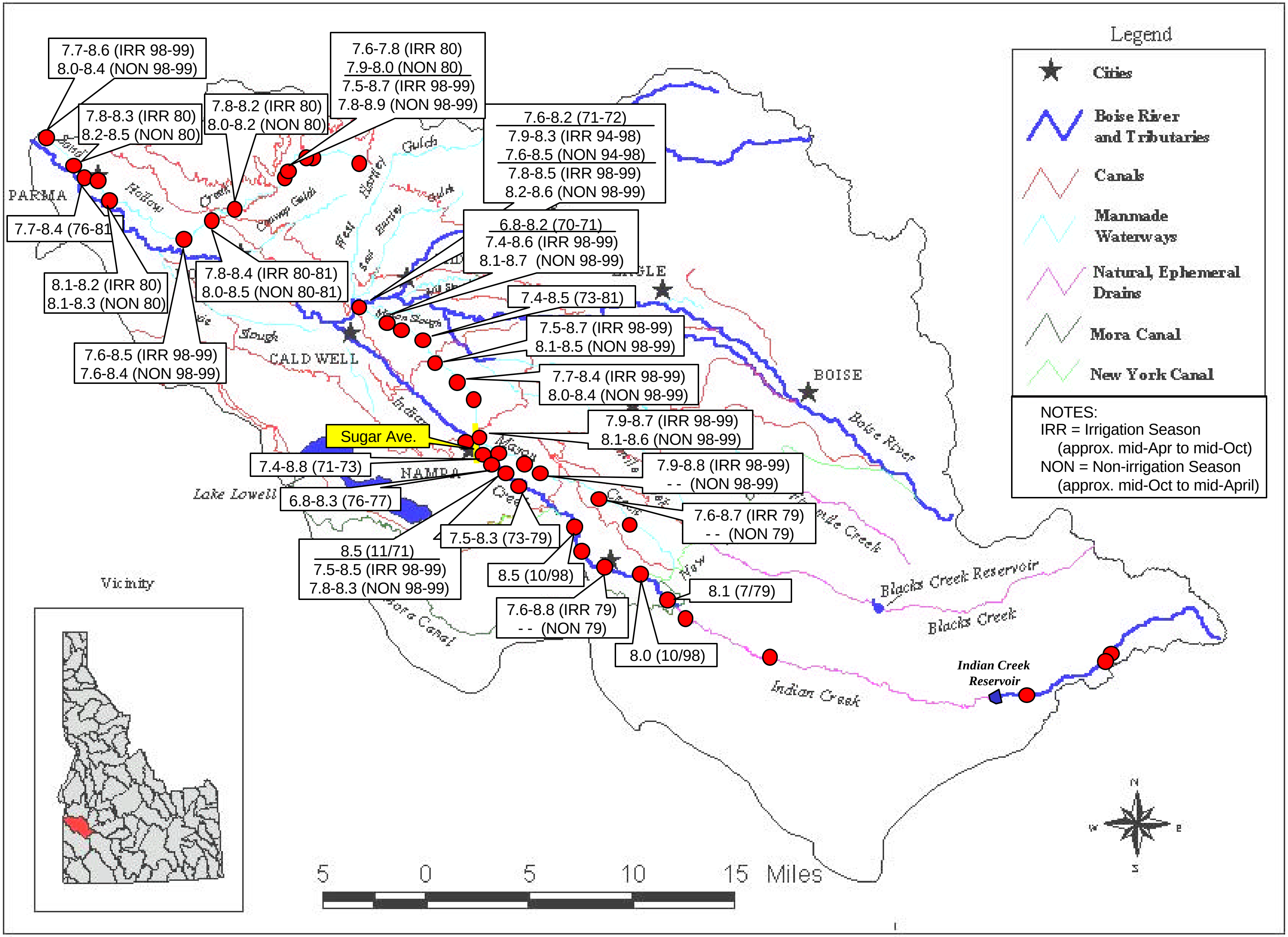

Figure 6. Range of pH values (pH units) for Upper Indian Creek, Mason Creek, and Sand Hollow Creek.

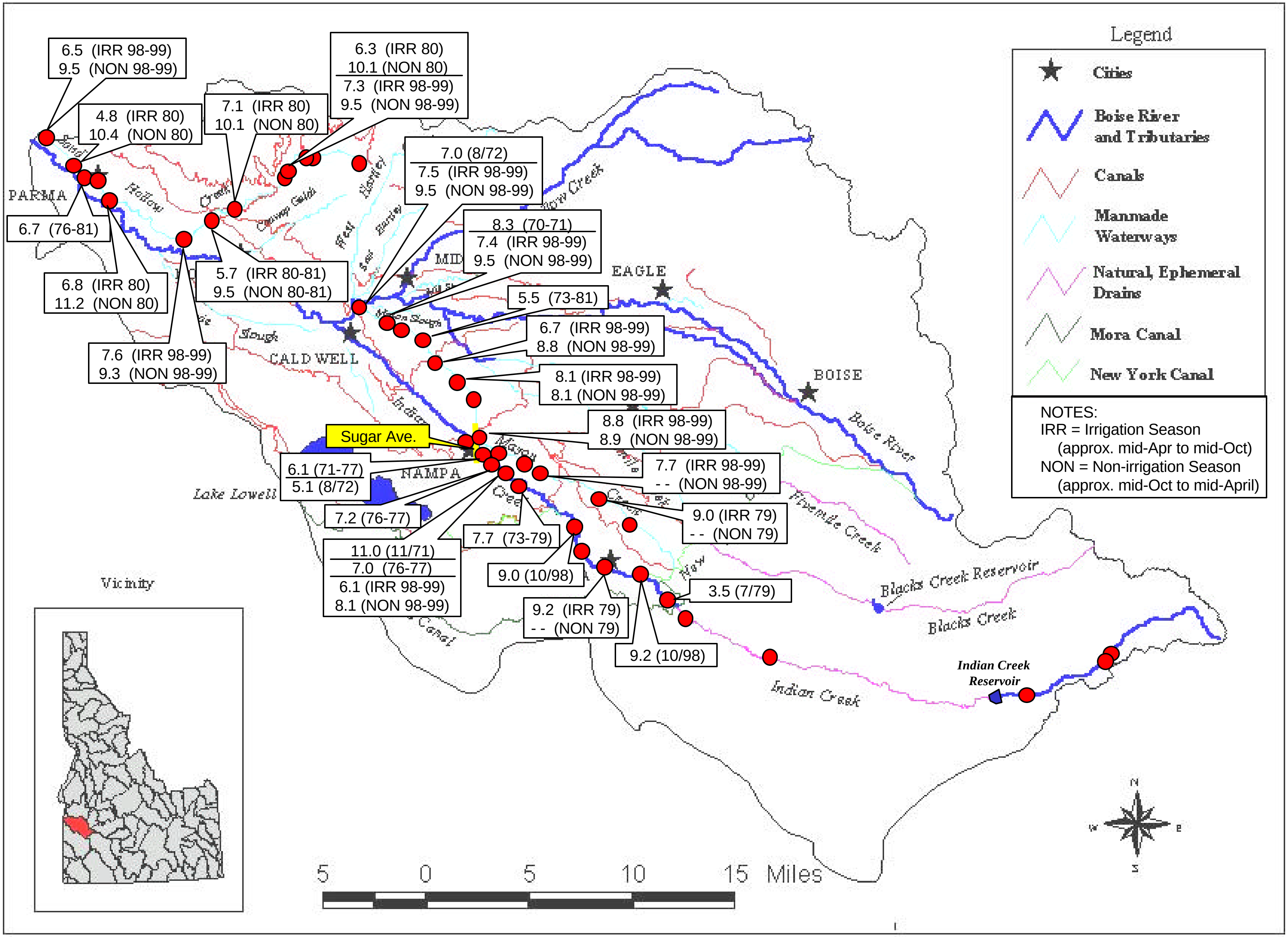

Figure 7. Minimum dissolved oxygen (mg/L) for Upper Indian Creek, Mason Creek, and Sand Hollow Creek.

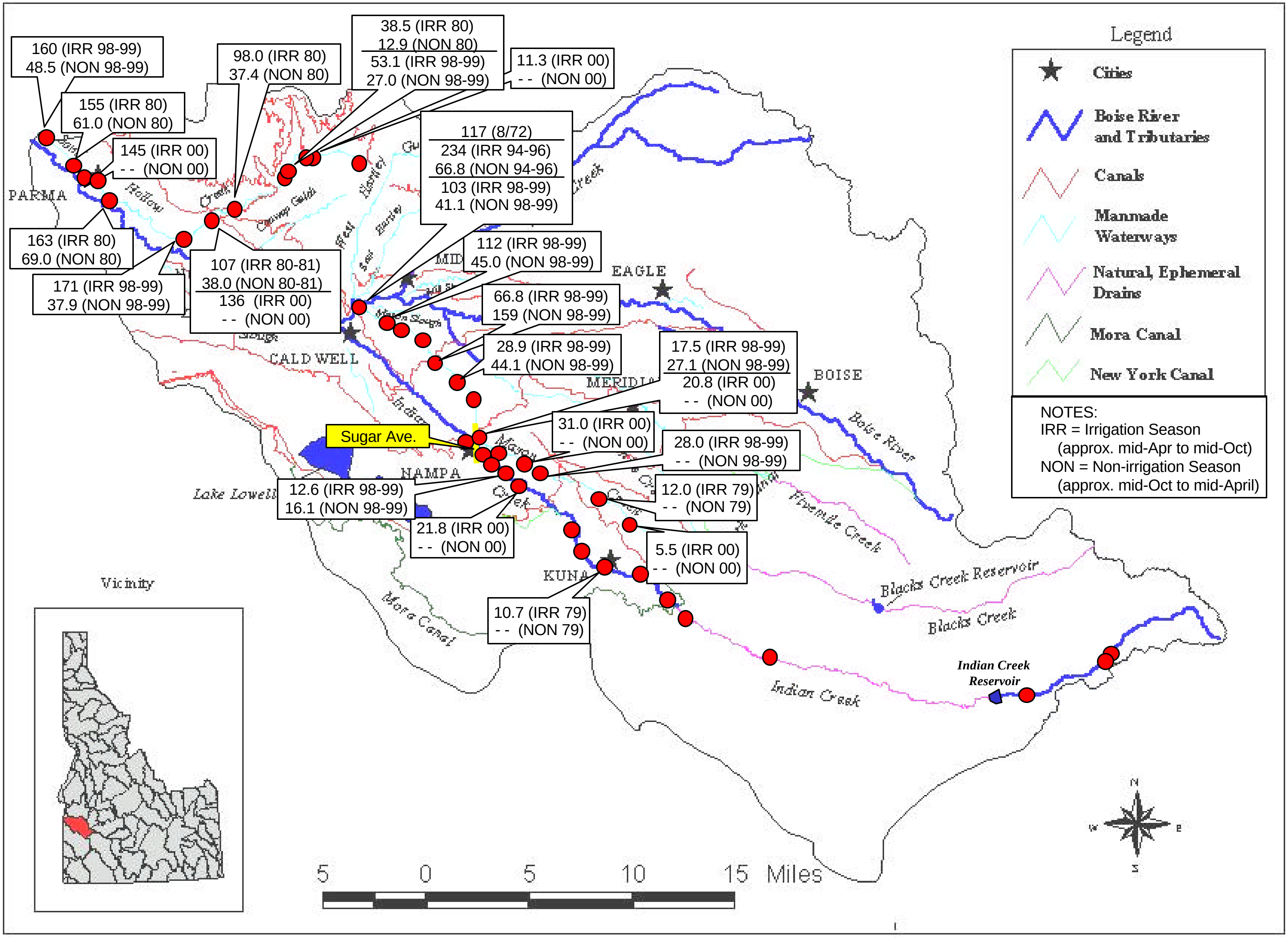

Figure 8. Mean TSS data (mg/L) for Upper Indian Creek, Mason Creek, and Sand Hollow Creek.

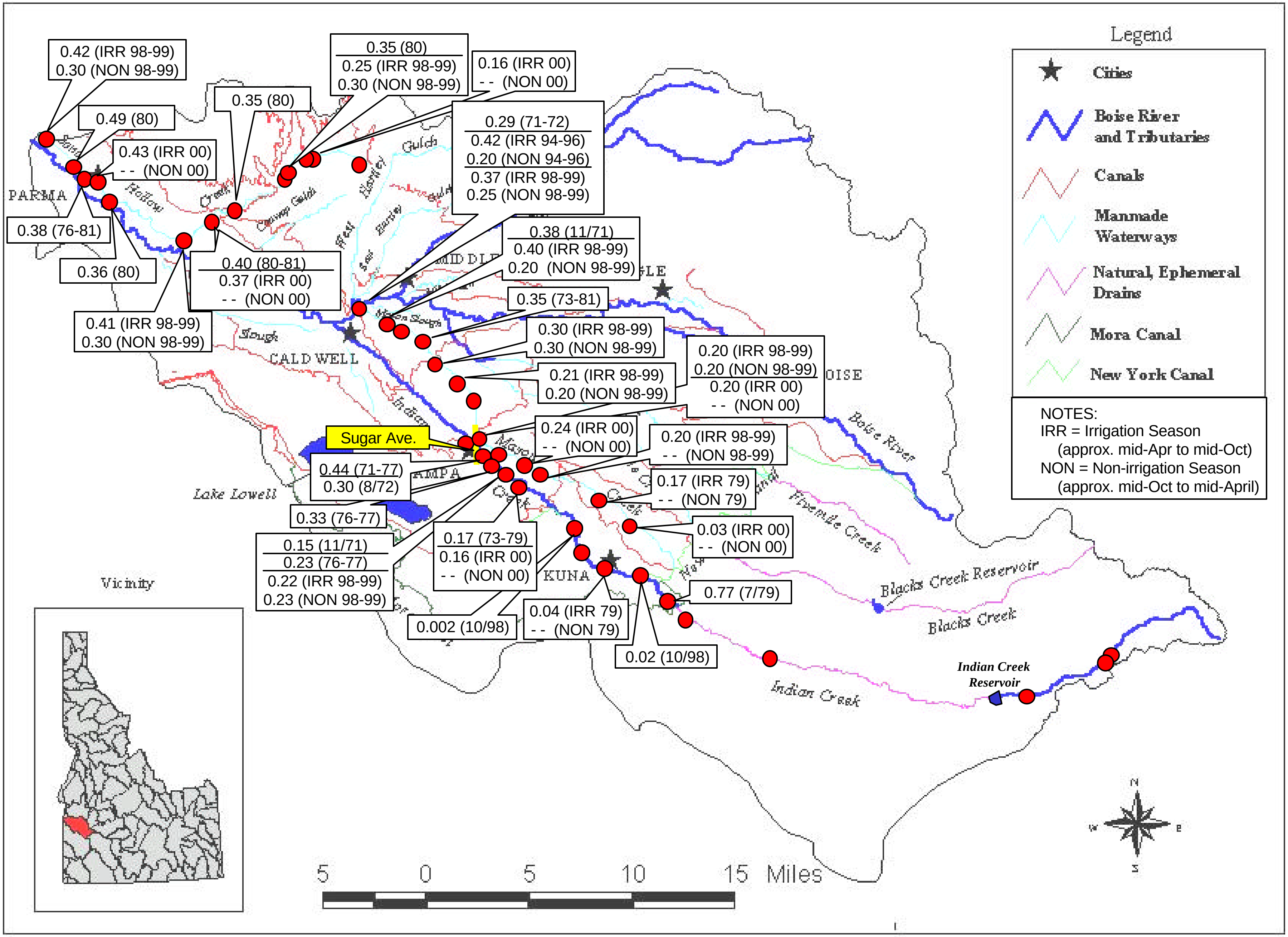

Figure 9. Mean total phosphorus (mg/L) for Upper Indian Creek, Mason Creek, and Sand Hollow Creek.

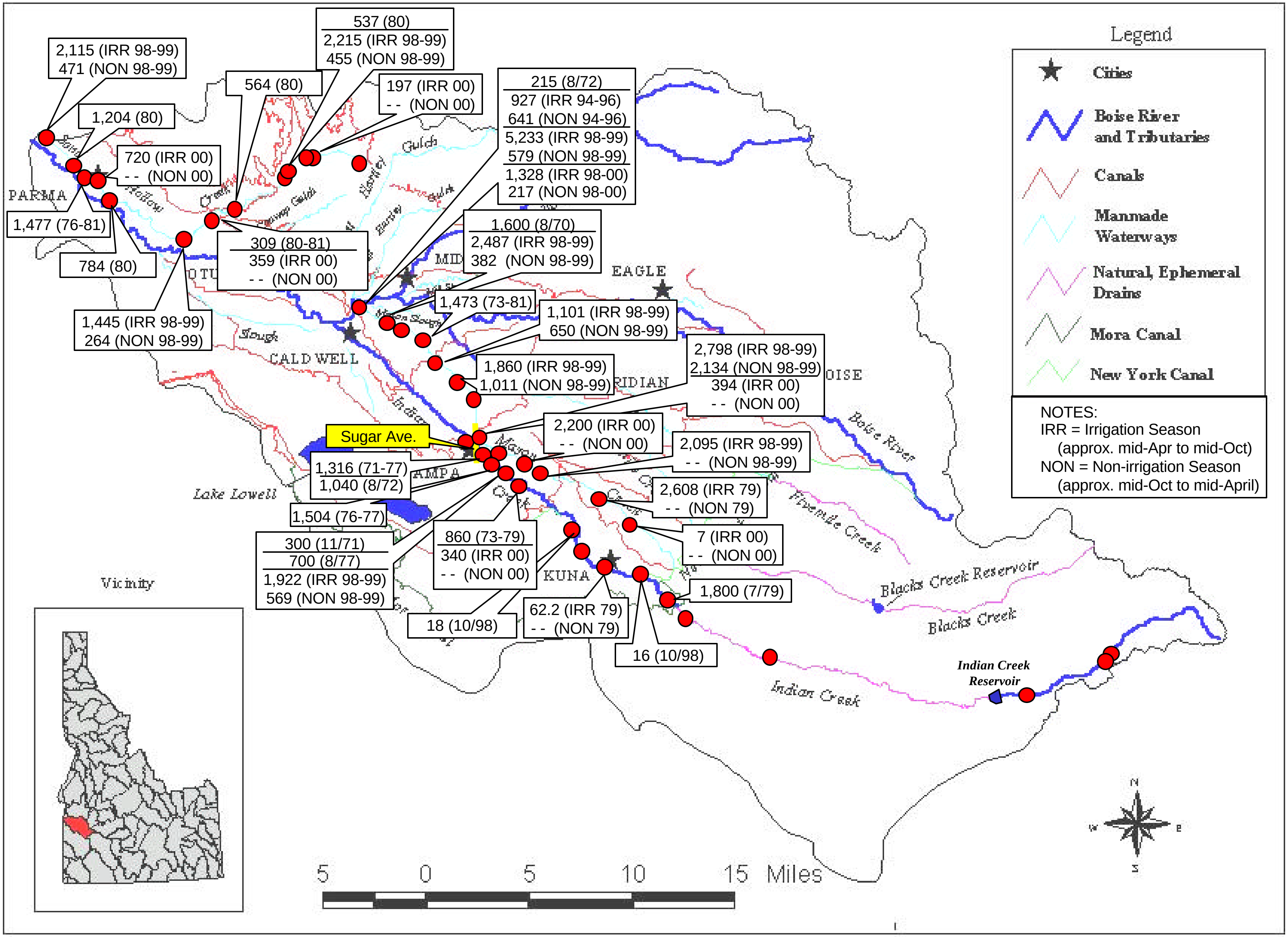

Figure 10. Mean fecal coliform (#/100 per mL) for Upper Indian Creek, Mason Creek, and Sand Hollow Creek.

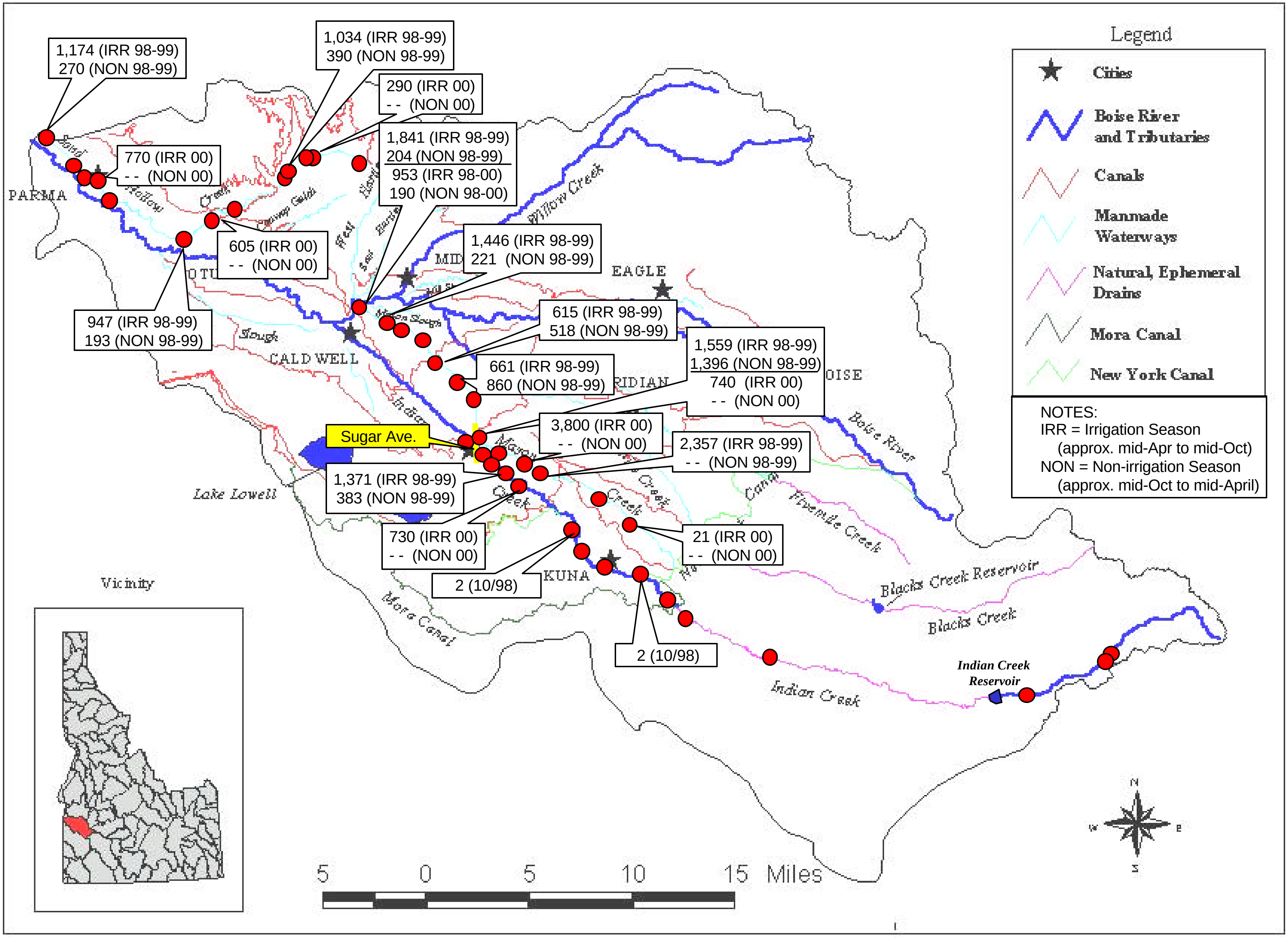

Figure 11. Mean *E coli* (#/100 per mL) for Upper Indian Creek, Mason Creek, and Sand Hollow Creek.

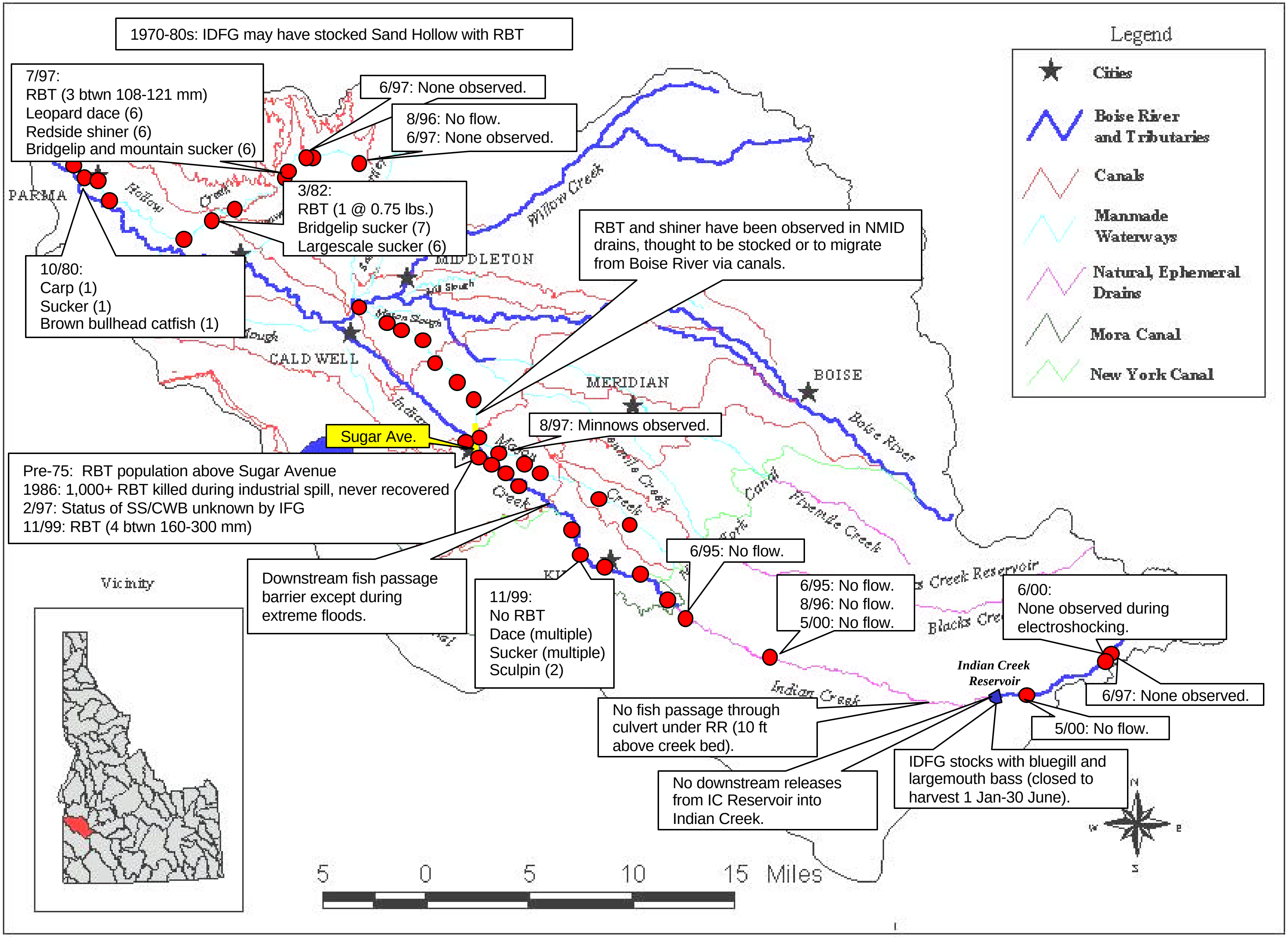

Figure 12. Fish community data for Upper Indian Creek, Mason Creek, and Sand Hollow Creek.

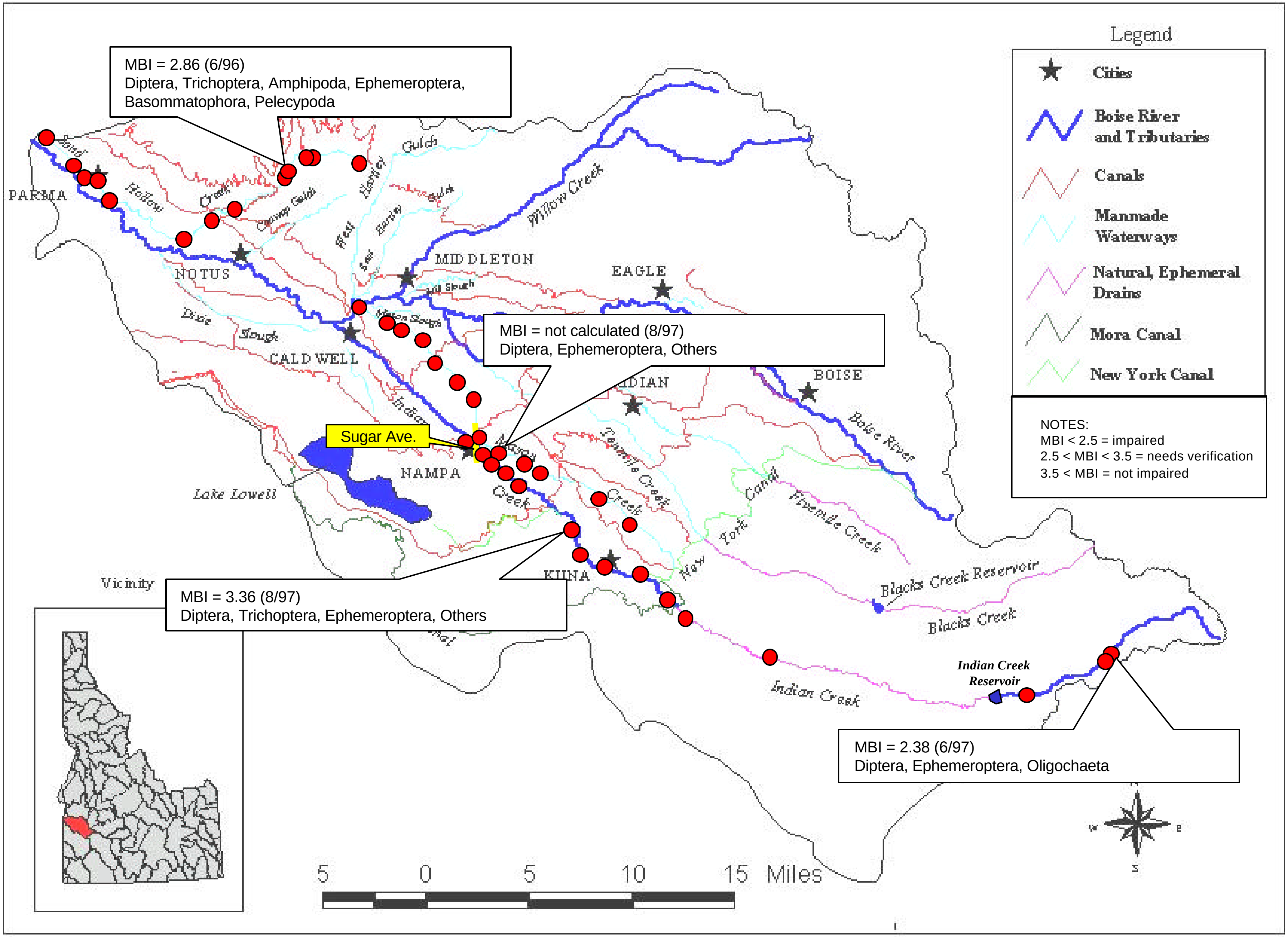

Figure 13. Macroinvertebrate community data for Upper Indian Creek, Mason Creek, and Sand Hollow Creek.

Appendix A:
Photographs of Subject Tributaries

Typical Photographs of Upper Indian Creek

Reach IC:A- Near Mayfield, upstream from Indian Creek Reservoir.

Reach IC:A- Upstream from Indian Creek Reservoir.

Reach IC:B- Indian Creek Reservoir looking toward inlet at I-84

Reach IC:D- Indian Creek prior to confluence with Mora Canal.

Typical Photographs of Mason Creek

Reach MC:B- View off of County Line Road downstream from Ridenbaugh Canal.

Reach MC:B- View of Mason Creek as it passes underneath Phyllis Canal.

Reach MC:B- Typical condition of Mason Creek through farmland in lower reaches.

Reach MC:B- Confluence of Mason Creek with Boise River.

Typical Photographs of Sand Hollow Creek

Reach SHC:A- View upstream from sampling station DEQ SHC-1.

Reach SHC:B- View upstream from sampling station DEQ SHC-2.

Reach SHC:B- View downstream from sampling station DEQ SHC-2.

Reach SHC:B- View downstream from sampling station DEQ SHC-3.

Appendix B: IDEQ's Evaluation of a Potential Dissolved Oxygen Sag in the Lower Boise River due to a Criterion Change in Mason Creek

An Evaluation of a Potential Dissolved Oxygen Sag in the Lower Boise River due to a Criterion Change in Mason Creek

- Prepared as a supplement to "Beneficial Use Evaluation for Selected Tributaries in the Lower Boise River", **CH2M** Hill, 2001

Code of Federal Regulations 40 131.10(b) says that the effects of the appropriate criteria for a water body must 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.

This technical analysis addresses the possibility of dissolved oxygen concentrations in the lower Boise River falling below 6.0 mg/L as a result of a proposed dissolved oxygen criterion change in Mason Creek from 6.0 mg/L to 4.0 mg/L. A detailed explanation of the rationale behind the proposed criterion change can be found in the document entitled "Beneficial Use Evaluation for Selected Tributaries in the Lower Boise River" (CH2M Hill 2001).

The Streeter-Phelps equation is a dissolved oxygen sag equation based on a mass balance which is affected by two processes: 1) the biochemical oxygen demand of the discharge and receiving water, 2) the reaeration rate of the receiving water. The Streeter-Phelps equation can predict the mixed downstream dissolved oxygen concentration when supplied physical variables such as source and receiving water temperature, dissolved oxygen concentration and biochemical oxygen demand.

An Excel spreadsheet application of the Streeter-Phelps equation developed by the Washington State Department of Ecology to aid NPDES permit writers has been acquired for this analysis. The spreadsheet is referred to in Ecology's Permit Writer's Manual (Department of Ecology Publication Number 92-109).

To address the variability in dissolved oxygen conditions that may occur in low, medium and high flow years; separate analyses were performed for a month of the growing season for a year that represents each of the flow conditions. To add certainty to the analysis, a separate analysis was performed for the entire growing season of the medium flow year, when dissolved oxygen concentrations would be at the lowest. In each analysis the dissolved oxygen concentration in Mason Creek was assumed to be 4.0 mg/L. Table 1 outlines the results of each analysis. A copy of the spreadsheet and the assumptions used for each scenario is also attached.

Table 1. Mixed dissolved oxygen concentrations in the lower Boise River, assuming a Mason Creek concentration of 4.0 mg/L

Flow Condition	Date	Boise River dissolved oxygen concentration, upstream of Mason Creek at Middleton Bridge	Initial mixed DO in the Boise River, without considering BOD and reaeration	Critical DO in the Boise River, considering BOD and reaeration
High	June 1996	9.7 mg/L	9.6 mg/L	9.04 mg/L
Medium	July 1999	13.8 mg/L	12.1 mg/L	7.71 mg/L
Low	May 1994	10.6 mg/L	8.3 mg/L	7.92 mg/L
Medium, growing season monthly average	April – Sept 1999	12.9 mg/L	11.1 mg/L	8.05 mg/L

The data presented in Table 1 show that if Mason Creek were to discharge dissolved concentrations of 4.0 mg/L to the lower Boise River the river concentrations would not fall below 6.0 mg/L. This remains the case in high, medium and low flow years as well as the growing season of the medium flow year.

Using the Streeter-Phelps model as a basis, it is Idaho DEQs opinion that changing the dissolved oxygen criterion in Mason Creek from 6.0 mg/L to 4.0 mg/L will not have detrimental effects on the aquatic life in the lower Boise River. Additionally, the state criterion of 6.0 mg/L in the lower Boise River will not be violated as a result of the change.

Streeter-Phelps analysis of critical dissolved oxygen sag potential

Mason Creek discharge to the lower Boise River

Scenario - Low Flow (May 1994)

INPUT		Citation / Source (see assumptions)
1. EFFLUENT CHARACTERISTICS (Mason Creek)		
Discharge (cfs):	126	USGS Data
CBOD5 (mg/L):	1.4	Baird, 1995 + MOS
NBOD (mg/L):	8	City of Boise + MOS
Dissolved Oxygen (mg/L):	4	USGS Data
Temperature (deg C):	13.8	USGS Data
2. RECEIVING WATER CHARACTERISTICS (Boise River)		
Upstream Discharge (cfs):	234	USGS Data
Upstream CBOD5 (mg/L):	1.4	Baird, 1995 + MOS
Upstream NBOD (mg/L):	8	City of Boise + MOS
Upstream Dissolved Oxygen (mg/L):	10.6	USGS Data
Upstream Temperature (deg C):	16.2	USGS Data
Elevation (ft NGVD):	2493	ITD 1:100,000 K
Downstream Average Channel Slope (ft/ft):	0.00175	USGS 1:2400 K
Downstream Average Channel Depth (ft):	3	LBR TMDL
Downstream Average Channel Velocity (fps):	2	LBR TMDL
3. REAERATION RATE (Base e) AT 20 deg C (day^-1):	3.53	O'Connor and Dobbins

Reference	Applic. Vel (fps)	Applic. Dep (ft)	Suggested Values
Churchill	1.5 - 6	2 - 50	3.61
O'Connor and Dobbins	.1 - 1.5	2 - 50	3.53
Owens	.1 - 6	1 - 2	4.50
Tsivoglou-Wallace	.1 - 6	.1 - 2	14.50

4. BOD DECAY RATE (Base e) AT 20 deg C (day^-1):	0.58		Wright and McDonnell, 1979

Reference	Suggested Value
Wright and McDonnell, 1979	0.58

OUTPUT

1. INITIAL MIXED RIVER CONDITION	
CBOD5 (mg/L):	1.4
NBOD (mg/L):	8.0
Dissolved Oxygen (mg/L):	8.3
Temperature (deg C):	15.4
2. TEMPERATURE ADJUSTED RATE CONSTANTS (Base e)	
Reaeration (day^-1):	3.16
BOD Decay (day^-1):	0.47
3. CALCULATED INITIAL ULTIMATE CBODU AND TOTAL BODU	
Initial Mixed CBODU (mg/L):	2.1
Initial Mixed Total BODU (CBODU + NBOD, mg/L):	10.1
4. INITIAL DISSOLVED OXYGEN DEFICIT	
Saturation Dissolved Oxygen (mg/L):	9.120
Initial Deficit (mg/L):	0.83
5. TRAVEL TIME TO CRITICAL DO CONCENTRATION (days):	0.47
6. DISTANCE TO CRITICAL DO CONCENTRATION (miles):	15.39

7. CRITICAL DO DEFICIT (mg/L):	1.20
8. CRITICAL DO CONCENTRATION (mg/L):	7.92

Streeter-Phelps analysis of critical dissolved oxygen sag potential

Mason Creek discharge to the lower Boise River

Scenario - Medium Flow (July 1999)

INPUT		Citation / Source
1. EFFLUENT CHARACTERISTICS (Mason Creek)		
Discharge (cfs):	162	USGS Data
CBOD5 (mg/L):	1.4	Baird, 1995 + MOS
NBOD (mg/L):	8	City of Boise + MOS
Dissolved Oxygen (mg/L):	4	USGS Data
Temperature (deg C):	17.7	USGS Data
2. RECEIVING WATER CHARACTERISTICS (Boise River)		
Upstream Discharge (cfs):	757	USGS Data
Upstream CBOD5 (mg/L):	1.4	Baird, 1995 + MOS
Upstream NBOD (mg/L):	8	City of Boise + MOS
Upstream Dissolved Oxygen (mg/L):	13.8	USGS Data
Upstream Temperature (deg C):	19.6	USGS Data
Elevation (ft NGVD):	2493	ITD 1:100,000 K
Downstream Average Channel Slope (ft/ft):	0.00175	USGS 1:2400 K
Downstream Average Channel Depth (ft):	3	LBR TMDL
Downstream Average Channel Velocity (fps):	2	LBR TMDL
3. REAERATION RATE (Base e) AT 20 deg C (day^-1):	3.53	O'Connor and Dobbins

Reference	Applic. Vel (fps)	Applic. Dep (ft)	Suggested Values
Churchill	1.5 - 6	2 - 50	3.61
O'Connor and Dobbins	.1 - 1.5	2 - 50	3.53
Owens	.1 - 6	1 - 2	4.50

Tsivoglou-Wallace	.1 - 6	.1 - 2	14.50

4. BOD DECAY RATE (Base e) AT 20 deg C (day^-1): 0.39 — Wright and McDonnell, 1979

Reference	Suggested Value
Wright and McDonnell, 1979	0.39

OUTPUT

1. INITIAL MIXED RIVER CONDITION	
CBOD5 (mg/L):	1.4
NBOD (mg/L):	8.0
Dissolved Oxygen (mg/L):	12.1
Temperature (deg C):	19.3
2. TEMPERATURE ADJUSTED RATE CONSTANTS (Base e)	
Reaeration (day^-1):	3.47
BOD Decay (day^-1):	0.38
3. CALCULATED INITIAL ULTIMATE CBODU AND TOTAL BODU	
Initial Mixed CBODU (mg/L):	2.1
Initial Mixed Total BODU (CBODU + NBOD, mg/L):	10.1
4. INITIAL DISSOLVED OXYGEN DEFICIT	
Saturation Dissolved Oxygen (mg/L):	8.410
Initial Deficit (mg/L):	-3.66
5. TRAVEL TIME TO CRITICAL DO CONCENTRATION (days):	1.16
6. DISTANCE TO CRITICAL DO CONCENTRATION (miles):	38.13

7. CRITICAL DO DEFICIT (mg/L):	0.70
8. CRITICAL DO CONCENTRATION (mg/L):	7.71

Streeter-Phelps analysis of critical dissolved oxygen sag potential

Mason Creek discharge to the lower Boise River

Scenario - High Flow (June 1996)

INPUT		Citation / Source (see assumptions)
1. EFFLUENT CHARACTERISTICS (Mason Creek)		
Discharge (cfs):	124	USGS Data
CBOD5 (mg/L):	1.4	Baird, 1995 + MOS
NBOD (mg/L):	8	City of Boise + MOS
Dissolved Oxygen (mg/L):	4	USGS Data
Temperature (deg C):	16.5	USGS Data
2. RECEIVING WATER CHARACTERISTICS (Boise River)		
Upstream Discharge (cfs):	4610	USGS Data
Upstream CBOD5 (mg/L):	1.4	Baird, 1995 + MOS
Upstream NBOD (mg/L):	8	City of Boise + MOS
Upstream Dissolved Oxygen (mg/L):	9.7	USGS Data
Upstream Temperature (deg C):	12	USGS Data
Elevation (ft NGVD):	2493	ITD 1:100,000 K
Downstream Average Channel Slope (ft/ft):	0.00175	USGS 1:2400 K
Downstream Average Channel Depth (ft):	3	LBR TMDL
Downstream Average Channel Velocity (fps):	2	LBR TMDL
3. REAERATION RATE (Base e) AT 20 deg C (day^-1):	3.53	O'Connor and Dobbins

Reference	Applic. Vel (fps)	Applic. Dep (ft)	Suggested Values
Churchill	1.5 - 6	2 - 50	3.61
O'Connor and Dobbins	.1 - 1.5	2 - 50	3.53
Owens	.1 - 6	1 - 2	4.50

Tsivoglou-Wallace	.1 - 6	.1 - 2	8.06

4. BOD DECAY RATE (Base e) AT 20 deg C (day^-1): 0.39 — Wright and McDonnell, 1979

Reference	Suggested Value
Wright and McDonnell, 1979	0.39

OUTPUT

1. INITIAL MIXED RIVER CONDITION

CBOD5 (mg/L):	1.4
NBOD (mg/L):	8.0
Dissolved Oxygen (mg/L):	9.6
Temperature (deg C):	12.1

2. TEMPERATURE ADJUSTED RATE CONSTANTS (Base e)

Reaeration (day^-1):	2.93
BOD Decay (day^-1):	0.27

3. CALCULATED INITIAL ULTIMATE CBODU AND TOTAL BODU

Initial Mixed CBODU (mg/L):	2.1
Initial Mixed Total BODU (CBODU + NBOD, mg/L):	10.1

4. INITIAL DISSOLVED OXYGEN DEFICIT

Saturation Dissolved Oxygen (mg/L):	9.796
Initial Deficit (mg/L):	0.25

5. TRAVEL TIME TO CRITICAL DO CONCENTRATION (days): 0.79

6. DISTANCE TO CRITICAL DO CONCENTRATION (miles): 25.93

7. CRITICAL DO DEFICIT (mg/L):	0.75
8. CRITICAL DO CONCENTRATION (mg/L):	9.04

Streeter-Phelps analysis of critical dissolved oxygen sag potential

Mason Creek discharge to the lower Boise River

Scenario - Medium Flow (1999 Growing / Irrigation Season (April - September monthly average))

INPUT		Citation / Source (see assumptions)
1. EFFLUENT CHARACTERISTICS (Mason Creek)		
Discharge (cfs):	161.9	USGS Data
CBOD5 (mg/L):	1.4	Baird, 1995 + MOS
NBOD (mg/L):	8	City of Boise + MOS
Dissolved Oxygen (mg/L):	4	USGS Data
Temperature (deg C):	14.3	USGS Data
2. RECEIVING WATER CHARACTERISTICS (Boise River)		
Upstream Discharge (cfs):	660.1	USGS Data
Upstream CBOD5 (mg/L):	1.4	Baird, 1995 + MOS
Upstream NBOD (mg/L):	8	City of Boise + MOS
Upstream Dissolved Oxygen (mg/L):	12.9	USGS Data
Upstream Temperature (deg C):	18	USGS Data
Elevation (ft NGVD):	2493	ITD 1:100,000 K
Downstream Average Channel Slope (ft/ft):	0.00175	USGS 1:2400 K
Downstream Average Channel Depth (ft):	3	LBR TMDL
Downstream Average Channel Velocity (fps):	2	LBR TMDL
3. REAERATION RATE (Base e) AT 20 deg C (day^-1):	3.53	O'Connor and Dobbins

Reference	Applic. Vel (fps)	Applic. Dep (ft)	Suggested Values
Churchill	1.5 - 6	2 - 50	3.61
O'Connor and Dobbins	.1 - 1.5	2 - 50	3.53
Owens	.1 - 6	1 - 2	4.50

Tsivoglou-Wallace	.1 - 6	.1 - 2	14.50	
4. BOD DECAY RATE (Base e) AT 20 deg C (day^-1):			0.39	Wright and McDonnell, 1979
Reference			Suggested Value	
Wright and McDonnell, 1979			0.39	

OUTPUT

1. INITIAL MIXED RIVER CONDITION	
CBOD5 (mg/L):	1.4
NBOD (mg/L):	8.0
Dissolved Oxygen (mg/L):	11.1
Temperature (deg C):	17.3
2. TEMPERATURE ADJUSTED RATE CONSTANTS (Base e)	
Reaeration (day^-1):	3.31
BOD Decay (day^-1):	0.34
3. CALCULATED INITIAL ULTIMATE CBODU AND TOTAL BODU	
Initial Mixed CBODU (mg/L):	2.1
Initial Mixed Total BODU (CBODU + NBOD, mg/L):	10.1
4. INITIAL DISSOLVED OXYGEN DEFICIT	
Saturation Dissolved Oxygen (mg/L):	8.759
Initial Deficit (mg/L):	-2.39
5. TRAVEL TIME TO CRITICAL DO CONCENTRATION (days):	1.14
6. DISTANCE TO CRITICAL DO CONCENTRATION (miles):	37.28

7. CRITICAL DO DEFICIT (mg/L):	0.71
8. CRITICAL DO CONCENTRATION (mg/L):	8.05

Assumptions

Constituent	Value	Reference
$NBOB_5$	<4.0 mg/L	Always <4.0 mg/L at Eagle Road - Marcia Schmelzer - City of Boise, May 2001
CBOD - subset of $NBOD_5$	0.7 mg/L	Median for unpolluted waters in the US Baird, Colin. 1995. "Environmental Chemistry" Chapter 7: Natural Waters Contamination and Purification WH Freeman and Co. Pg. 296

Application of Constituent in Streeter-Phelps

$NBOB_5$	Mason Creek	used 8.0 mg/L in model- adds a 50% margin of safety to account for uncertainty between the measured values in the lower Boise River at Eagle Road and Mason Creek. No BOD data is available for Mason Creek
	Boise River	City of Boise data show no recorded concentrations >4.0 mg/L at Eagle Road used 8.0 mg/L in model - adds a 50% margin of safety to account for uncertainty between Eagle Road and Caldwell
CBOD	Mason Creek	used 1.4 mg/L in model - adds a 50%margin of safety to account for uncertainty between the literature value for unpolluted waters and Mason Creek
	Boise River	used 1.4 mg/L in model - adds a 50% margin of safety to account for uncertainty between the literature value for unpolluted waters and the lower Boise River

Use Attainability Analysis for Fivemile, Tenmile and Fifteenmile Drains, Nampa-Meridian and Pioneer Irrigation Districts, 2001

Fivemile and Tenmile Creek **Appendix A**

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

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Department of Environmental Quality Rationale for not Removing Secondary Contact Recreation as a Beneficial Use in Fivemile and Tenmile Creek

Fivemile and Tenmile Creek **Appendix B**

Department of Environmental Quality rationale for not removing secondary contact recreation as a beneficial use in Fivemile and Tenmile Creeks

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In June 2001 the Nampa-Meridian (NMID) and Pioneer irrigation districts completed a use attainability analysis for Fivemile Creek and Tenmile Creek. The analyses recommended changing the aquatic life beneficial use to modified[1] and removing the secondary contact recreation designation altogether. The recommendations are summarized in Table 1.

Table 1. Designated beneficial uses and recommended beneficial uses for Fivemile and Tenmile Creek, as per NMID and Pioneer UAA

Stream	Designated Uses	Recommended Uses
Fivemile Creek	Cold Water Biota Secondary Contact Recreation	Modified Aquatic Life
Tenmile Creek	Cold Water Biota Secondary Contact Recreation	Modified Aquatic Life

After considering the proposed changes and reviewing the comments received during the public comment period, DEQ determined that the changed to modified aquatic life was appropriate, but that completely removing contact recreation as a beneficial use was not justified. DEQ's justification for not removing the contact recreation beneficial use is described below.

> *Fivemile and Tenmile creeks are currently designated for secondary contact recreation. In order to remove this use, it must be demonstrated that the use is not existing and attaining the use is not feasible. 40 CFR 131.10(g). Upon consideration of the comments and further consideration of the issue, DEQ has determined it currently does not have the information necessary to remove the recreational use. The Nampa Meridian Irrigation District argues it holds easements or in some cases title to property for the use of the creeks as irrigation drains and prohibits the use of the drains for recreational purposes. There is insufficient information, however, to demonstrate that the irrigation district as an easement holder has the right to prohibit recreational uses in all cases. See Rehwalt v. American Falls Reservoir District, 97 Idaho 634, 550 P.2d 137 (1976) (consistent with the right to maintain an easement, is the power to exclude the servient landowner from access to the easement when such access is inconsistent with the primary purpose of the easement); Reynolds Irrigation District v. Sproat, 69 Idaho 315, 206 P.2d 774 (1949) (owners of servient estate subject to an easement are entitled to use the land occupied by irrigation ditch for any purpose not inconsistent with the easement); Pioneer Irrigation District v. Smith, 48 Idaho 734, 285 P. 474 (1930) (servient estate owner's hogs allowed to go upon right of way and irrigation ditch). See also, Idaho Code section 36-1601 (provides navigable rivers, sloughs or streams shall be open to public uses, including*

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[1] The modified aquatic life use describes streams that are limited in aquatic life diversity due to factors such as ephemeral or intermittent flow, naturally occurring pollutant levels or long-standing hydrologic modification.

recreational uses). There is also insufficient information to show that water quality prevents the attainment of the recreational use. Therefore, while DEQ agrees it is appropriate to discourage the recreational use of these waterbodies because of public safety concerns, DEQ has determined there is insufficient information to conclude the recreational uses are unattainable as required by the Clean Water Act.

Derivation of a TSS target for Modified (MOD) waters in the Lower Boise River Basin, based on Newcombe and Jensen (1996)

Fivemile and Tenmile Creek	**Appendix C**
Mason Creek	**Appendix B**
Sand Hollow Creek	**Appendix B**

Derivation of a total suspended sediment target for Modified waters in the lower Boise River Basin, based on an interpretation of Newcombe and Jensen (1996)

The effects of total suspended sediment (TSS) concentrations on salmonids (trout) and non-salmonids alike are important in terms of establishing a TSS target for the modified waters in the lower Boise River basin. Nearly all of the tributaries that enter the river from the south side and some from the north side have undergone significant hydrologic modification. The modifications began in the early 1900s by the United States Bureau of Reclamation and continue today as irrigation districts maintain bank stability and remove debris from streambeds and riparian areas to facilitate water conveyance. Another aspect of the hydrologic modification is the anthropogenicly-influenced hydrographs that have been created. All of the south-side and many of the north-side tributaries have become part of an intricate irrigation system that provides water to producers and municipalities during the growing season. The irrigation-driven nature of the waters has resulted in unnatural hydrographs that display instantaneously high flow in the spring when the irrigation systems are charged, followed by persistently high flows throughout the summer (due to water rights/water demand), and finally followed by rapidly decreasing flows when the irrigation season ends. For these and other reason discussed in the Beneficial Use Evaluation for Selected Tributaries in the Lower Boise River (Dupuis and Doran 2001) and Use Attainability Analysis for Fivemile, Tenmile Creek and Fifteenmile Drains (Farris 2001) the Idaho Department of Environmental Quality (DEQ) recently proposed changing the aquatic life beneficial use in Fivemile, Tenmile, Mason, and Sand Hollow Creeks from cold water biota to modified. The modified aquatic life use describes streams that are limited in aquatic life diversity due to factors such as ephemeral or intermittent flow, naturally occurring pollutant levels, or long-standing hydrologic modifications. The proposed use changes were made in coordination with the lower Boise River Watershed Advisory Group and it's associated stakeholders.

One of the major results of the long-standing hydrologic modifications in the aforementioned streams is the fact that the fisheries communities are limited to adult salmonids (primarily rainbow trout) and a few other non-salmonid species. Table 1 shows the fish species that have been found in the lower Boise River tributaries proposed for modified aquatic life. Except for the antecdotal information, the data were generated via electrofishing surveys. The salmonids that have been located in the streams are more than likely carried into the streams at the beginning of the irrigation season in water that is diverted from the lower Boise River. The fish remain in the streams throughout the irrigation season or move back into the river via the canal system. A few fish may remain in the lower segments of the streams throughout the year if water is present. The non-salmonids communities most likely experience the same effects, but often persist longer because they are less dependent on macroinvertebrates for food. The macroinvertebrate communities are also (among other factors) limited in diversity by the flushing flows.

Table 1. Fish species located in the lower Boise River tributaries proposed for MOD

Stream Name	Species	Year Found
Fivemile Creek	Redside Shiner, Northern Squawfish, Speckled Dace, Bridgelip Sucker, Chinese Winter Loach, Carp, Smallmouth Bass, Chub	1995
Tenmile Creek	Antecdotal information indicates adult rainbow trout are present during the fishing season	2000
Mason Creek	Antecdotal information indicates adult rainbow trout are present during the fishing season	2000
Sand Hollow Creek	Rainbow Trout*, Redside Shiner, Speckled Dace, Leopard Dace, Bridgelip Sucker	1997

*adult fish (150 mm in length)

The purpose of this evaluation is to show that a durational target of 148 mg/L TSS over a four-month exposure period is appropriate and protective of the fisheries communities in the modified streams listed above. CH2M Hill also developed an acute durational target of 800 mg/L over a 14-day period. However, this target is not used in the tributary sub-basin assessments, nor is it evaluated in this discussion.

Three issues must be addressed in showing the validity of the 148-mg/L target. First, the target is based on Newcombe and Jensen's severity-of-ill-effects (SEV) score of nine (9). Newcombe and Jensen establish an SEV rating of 0-14 based on exposure to TSS at different concentrations for different durations. An SEV of 0 is "no effect", while an SEV of 14 is >80-100% mortality. The behavioral effect associated with an SEV score of 9 is reduced growth rate, delayed hatching and reduced fish density. Except for reduced fish density, these behavioral effects, or more appropriately, developmental effects, are more critical for juvenile fish than adult fish. Based on this premise, it is reasonable to say that for *adult* fish the effects that are felt at the TSS concentrations used to establish an SEV of 9 are probably closer to that of an 8, which are a long-term reduction in feeding and feeding success. This adds an element of conservativeness to the 148 mg/L target. It is important to note that an SEV score of 9 does not allow for the mortality of fish. It is also important to note that even a very low SEV score, such as a 3 or 4 (on a scale of 1-14) allows for avoidance behavior and short-term reduction in feeding rate and success. In other words, even very low TSS concentrations result in measurable behavioral effects in fish. It is not practical to set a TSS target that illicits no measurable effect on fish. In fact, up to a certain concentration, fish are attracted to turbidity because there are often dislodged macroinvertebrates associated with disturbed substrate. DEQ feels that an SEV score of 9 is consistent with the modified aquatic life beneficial use and is protective of the fisheries community as it exists in Fivemile, Tenmile, Mason and Sand Hollow Creeks. The CH2M Hill scientist that developed the acute TSS target for modified waters based the target on as SEV of 9.5, so an SEV of 9 for a durational target is consistent with others, and perhaps more conservative.

The second issue that must be addressed in showing the validity of the 148 mg/L target is the 4 month duration on which is it based. DEQ chose to base the chronic target on a four month duration because a four-month duration is close the irrigation season period that yields the highest TSS concentrations (May-August) and because it represents a duration that has already been modeled by Newcombe and Jensen. By choosing a duration that has already been modeled by Newcombe and Jensen, much of the judgement that would occur if a non-modeled chronic duration were chosen is reduced. Figure 1 shows the dose-response model for adult salmonids on which the 148 mg/L target is based. Note that even with very low durations of exposure and short exposure periods, the fish show ill effects. For example, a four-month exposure to TSS concentrations as low as 20 mg/L yields an SEV of 8. This illustrates that the response model in itself is conservative.

Average severity-of-ill-effect score

TSS Conc.											
162755	11	11	12	12	13	13	14	14	_	_	_
59874	10	10	11	11	12	12	13	13	14	14	_
22026	9	10	10	11	11	12	12	13	13	14	14
8103	8	9	9	10	10	11	11	12	12	13	13
2981	8	8	9	9	10	10	11	11	12	12	13
1097	7	7	8	8	9	9	10	10	11	11	12
403	6	7	7	8	8	9	9	10	10	11	11
148	5	6	6	7	7	8	8	9	9	10	10
55	5	5	6	6	7	7	8	8	9	9	9
20	4	4	5	5	6	6	7	7	8	8	9
7	3	4	4	5	5	6	6	4	4	4	8
3	2	3	3	4	4	5	5	6	6	7	7
1	2	2	3	3	4	4	5	5	5	6	6
	1	3	7	1	2	6	2	7	4	11	30
	Hours			Days			Weeks		Months		

Figure 1. Dose-Response Model for Adult Salmonids (Newcombe and Jensen, 1996)

The third issue that must be addressed is a sensitivity discrepancy between salmonids and non-salmonids in the Newcombe and Jensen models. Figure 2 shows the dose response model for adult freshwater nonsalmonids. Note that the model shows an SEV of 11 when fish are exposed to the target of 148 mg/L over a four-month period. At first glance it appears that nonsalmonids in general are more sensitive to TSS that salmonids. In some cases, as illustrated by Newcombe and Jensen, they may be. However, a closer look at the method by which the nonsalmonid model was developed shows that the model is overly sensitive.

Average severity-of-ill-effect score

TSS Conc.											
162755	7	8	9	10	10	11	12	12	13	14	_
59874	7	8	9	9	10	11	11	12	13	14	14
22026	7	8	8	9	10	10	11	12	13	13	14
8103	7	7	8	9	9	10	11	12	12	13	14
2981	6	7	8	8	9	10	11	11	12	13	13
1097	6	7	7	8	9	10	10	11	12	12	13
403	6	6	7	8	9	9	10	11	11	12	13
148	5	6	7	8	8	9	10	10	11	12	13
55	5	6	7	7	8	9	9	10	11	12	12
20	5	6	6	7	8	8	9	10	11	11	12
7	5	5	6	7	7	8	9	10	10	11	12
3	4	5	6	7	7	8	9	9	10	11	11
1	4	5	6	6	7	8	8	9	10	10	11
	1	3	7	1	2	6	2	7	4	11	30
	Hours			Days			Weeks		Months		

Figure 2. Dose-Response Model for Adult Nonsalmonids (Newcombe and Jensen, 1996)

Comparatively speaking, most of the studies that have been performed regarding fish sensitivity to pollutants have been based on game species that are given a high economic value. Non-game species have also been studied, but the number of studies is far less. Newcombe and Jensen based their report of a meta-analysis of 80 published reports. Many of the reports contained numerous data points. As a result, Newcombe and Jensen were able to derive 435 “experimental units” or data sets. The nonsalmonid dose-response model shown in figure 2 is based on 22 data points, compared to 63 data points for the salmonid model shown in figure 1. In other words, the statistical rigor behind the development of the salmonid model far exceeds that of the nonsalmonid model. This must be considered when evaluating the nonsalmonid model. The difference in statistical rigor is evident when browsing the nonsalmonid model. According to the model, nonsalmonids experience an SEV of 10 when exposed to 1.0 mg/L TSS over a four-month period. Juvenile salmonids experience a SEV of 6 when exposed to the same concentration for the same duration (based on other Newcombe and Jensen work). This implies that adult nonsalmonids are more sensitive that juvenile salmonids, which is not the case.

Another factor that confounds the nonsalmonid model is an artifact of the small number of studies on nonsalmonid species. Due to the fact that comparatively few studies are present for nonsalmonids, Newcombe and Jensen had to rely on studies that used fine sediment (<75 µm) only when developing the nonsalmonid model, whereas the salmonid model is based on both course (75-205 µm) and fine sediment. Fine sediment is small enough to pass through the gill membranes and into the interlamellar spaces of the gill tissue, thereby causing more damage to the fish. Course particles, while still damaging due to gill abrasion, are less threatening to the fish on a chronic basis. In terms of the dose-response models, the result is a sensitivity discrepancy between salmonids and nonsalmonids that is based on study design, not on species tolerance.

References

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Newcombe, C.P. and J.O.T. Jensen. 1996. Channel suspended sediment and fisheries: A synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management 16, No. 4, pp. 693-727.

An Adaptive Management Approach for Reducing TSS Concentrations in Sand Hollow Creek, 17050114

Sand Hollow Creek **Appendix C**

An Adaptive Management Approach to Reducing Sediment Loads in the Sand Hollow Creek, 17050114

Background

The Federal Clean Water Act and the *Idaho Water Quality Standards and Wastewater Treatment Requirements* indicate that all feasible steps shall be taken to achieve the highest quality of water attainable. However, in watersheds where non-point sources are a major pollutant contributor, the feasible steps may be difficult to identify and implement. The concept of adaptive management as it applies to watershed management allows for on-the-ground implementation to proceed where uncertainty exists about how and when water quality targets will be met. The adaptive management approach acknowledges that the desired water quality may not be restored for a long period of time, but provides a short-term pathway by which to gauge progress toward that goal.

There are several steps within the adaptive management program, but the essential components of the framework are as follows:

1. ***Develop a pollutant management plan***
2. ***Establish a monitoring program***
3. ***Evaluate monitoring results***
4. ***Adjust the pollutant management plan***

Sand Hollow Creek Sediment Management Plan

The only point source that discharges to Sand Hollow Creek is the Parma Wastewater Treatment Plant (WWTP). The WWTP suspended solid loads are negligible in comparison to nonpoint source loads. Figure 9 and table 5 in the Sand Hollow Creek Subbasin Assessment show that irrigation season total suspended sediment loads are between two and five times higher than the non-irrigation season loads. This substantiates the thought that agricultural related activities are the primary cause of elevated suspended sediment concentrations in Sand Hollow Creek.

The National Resource Conservation Service (NRCS) provides conservation planning and technical guidance to producers by using local individuals, groups, and units of government as a vehicle. With local assistance, producers develop and implement plans to protect, conserve, and enhance natural resources within their social and economic interests.

Along with the NRCS, the Ada Soil & Water Conservation District (Ada SWCD), Canyon Soil Conservation District (Canyon SCD) and the Idaho Soil Conservation Commission (ISCC) are the governmental agencies that provide funding and technical assistance to local agricultural landowners. The Ada SWCD, Canyon SCD and the ISCC use the NRCS conservation planning process to reduce nonpoint source pollutant loads. NRCS employees work with conservation districts to establish objectives that reflect current issues in the district. Total Maximum Daily Load (TMDL) efforts are a major objective in lower Boise River basin. The success of conservation planning within the Sand Hollow Creek subbasin depends on the voluntary participation of producers. While participation is voluntary, the NRCS and other local personnel carry out outreach activities to educate producers and help ensure that farm practices are based on sound decisions that will help preserve natural resource and solve water quality problems.

Conservation planning requires balancing the need for short-term production demands with long-term sustainability of environment objectives. Production demands are usually driven by the necessity to make money on a crop, whereas environmental objectives are usually driven by the necessity to reduce pollutants in the environment. Many times the two do readily not coincide. For this reason, sediment reductions in Sand Hollow Creek should account for human demands and these demands should help shape the scope and extent of the corrective actions that are taken.

The conservation planning process in itself is well formulated to an adaptive management approach. The process takes a phased approach that relies on mid-course revisions if conservation goals are not being met. The following outline is from the NRCS Conservation Planning Handbook (NRCS 2000)[1]

Phase I - Collection and Analysis

Step 1—Identify Problems and Opportunities: within the Sand Hollow Creek subwatershed the problem identification process revolves around the long-standing need for sediment and nutrient reductions.

Step 2—Determine Objectives: objectives that are consistent with water quality objectives as well as on-the-farm conservation needs.

Step 3—Inventory Resources: technical and funding resources exist through a variety of state and federal programs, such as the Agricultural Water Quality Program for Idaho (AWQP), State Agricultural Water Quality Program (SAWQP) and the Federal Environmental Quality Incentives Program (EQIP). Producer contributions are essential for these programs to be effective.

Step 4—Analyze Resource Data: determine which resources are most appropriate for the producers within the subbasin. This must include an evaluation of economic and social issues related to the resources.

Phase II - Decision Support

Step 5—Formulate Alternatives: work with producers to formulate alternatives that will achieve on-the-farm objectives and help solve environmental problems at the same time.

[1] United States Department of Agriculture, National Resources Conservation Service. 2000. National Planning Procedures Handbook, amendment 3 180-vi-NPPH, January 2000.

Step 6—Evaluate Alternatives: evaluate the alternatives to determine their effects in addressing the producer's objectives and the environmental problems.

Step 7—Make Decisions: select the alternative(s) and work with the planner to schedule conservation system and practice implementation. The conservation planner prepares the necessary documentation.

Phase III - Application and Evaluation

Step 8—Implement the Plan: implement the selected alternative(s). The planner provides encouragement to the producer for continued implementation.

Step 9—Evaluate the Plan: evaluate the effectiveness of the plan as it is implemented and make adjustments as needed. On-the-farm evaluation is done using site-specific techniques. Water quality evaluations are done via ambient monitoring, as described below.

Conservation planning is currently underway in the Sand Hollow Creek subbasin. The Sand Hollow SAWQP was initiated in 1992 and is currently in process. Within the subwatershed, $399,751 in state matching funds and $321,695 in landowner funds have been spent to carry out conservation practices such as filter strips, sediment basins, conservation tillage, sprinkler systems, surge irrigation systems and other water conservation practices. At one time, the Canyon SCD was managing 33 active contracts and providing conservation treatment to 3,700 acres. In October 2001, a drain tile system and three additional surge irrigation systems were installed. In the coming two years it is anticipated that additional conservation practices will be implemented.

Sand Hollow Creek Monitoring Program

The impetus for developing an adaptive management monitoring plan is to document the progress toward achieving water quality objectives. An 'effectiveness' monitoring plan must be designed such that it can detect changes in land management at critical locations in the stream. Recognizing this necessity, the Idaho Department of Agriculture (IDA) and Department of Environmental Quality (DEQ) have, or are currently, monitoring water quality in Sand Hollow Creek. The monitoring programs were developed to help evaluate the effectiveness of the Sand Hollow Creek SAWQP and other management activities by tracking the water quality changes as conservation practices are installed. The IDA established three monitoring locations along the length of Sand Hollow Creek in 1998. The sites were monitored bimonthly through 1999. IDA anticipates reinitiating the monitoring in 2003. In 2000, DEQ established three monitoring sites at the same locations. DEQ samples monthly throughout the irrigation season, when sediment loading occurs.

Monitoring Results and Management Plan Evaluation

In cooperation with the agencies currently doing conservation planning in the Sand Hollow Creek subbasin, DEQ anticipates reviewing the progress toward sediment reductions on a five-year cycle. In conducting this review DEQ will evaluate the progress towards achieving the 148 mg/L target outlined in the Sand Hollow Creek Subbasin

Assessment. DEQ expects that the designated agencies will continue to track their progress in implementing the provisions of each respective farm plan. The effectiveness of the farm plans can be determined a variety of ways, including evaluating the water quality data on an annual basis. DEQ expects the designated agencies to help identify reasonable benchmarks for the attaining the sediment target. An example may be a 10% reduction in suspended sediment concentration every five years until the target is met.

Management Plan Adjustment

Evaluating the effectiveness of the management plans to ensure that they are functioning as planned and achieving the objectives is an integral part of the NRCS conservation planning process and the adaptive management process. Where the actual results differ from those anticipated, feedback should be incorporated into the planning process. Where implementation is ineffectiveness or management techniques are found to be inadequate, the designated agencies should review the conservation plans to determine if the deficiencies can be corrected or if additional practices can be implemented.

If DEQ, in consultation with the designated management agencies, conclude that all feasible steps have been implemented to meet the water quality target, or the associated target is not practical, the target may be revised as appropriate. The final decision to revise the target lies solely with DEQ.