Water Quality in the Bear River Basin of Utah, Idaho, and Wyoming Prior to and Following Snowmelt Runoff in 2001

Scientific Investigations Report 2006-5292

U.S. Department of the Interior
U.S. Geological Survey

NATIONAL WATER-QUALITY ASSESSMENT PROGRAM

Cover photos:
Background—Soda Dam and hydroelectric plant on the Bear River near Soda Springs, Idaho.
Foreground (Upper)—Water-quality sampling on the Bear River, March 2001.
Foreground (Lower)—The Bear River in Black Canyon near Grace, Idaho.
(Photographs by Jay Cederberg, U.S. Geological Survey)

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By Steven J. Gerner and Lawrence E. Spangler

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DIRK KEMPTHORNE, Secretary

U.S. Geological Survey
Mark D. Meyer, Director

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FOREWORD

The U.S. Geological Survey (USGS) is committed to serve the Nation with accurate and timely scientific information that helps enhance and protect the overall quality of life, and facilitates effective management of water, biological, energy, and mineral resources (http://www.usgs.gov/). Information on the quality of the Nation's water resources is of critical interest to the USGS because it is so integrally linked to the long-term availability of water that is clean and safe for drinking and recreation and that is suitable for industry, irrigation, and habitat for fish and wildlife. Escalating population growth and increasing demands for the multiple water uses make water availability, now measured in terms of quantity *and* quality, even more critical to the long-term sustainability of our communities and ecosystems.

The USGS implemented the National Water-Quality Assessment (NAWQA) program to support national, regional, and local information needs and decisions related to water-quality management and policy (http://water.usgs.gov/nawqa). Shaped by and coordinated with ongoing efforts of other Federal, State, and local agencies, the NAWQA program is designed to answer: What is the condition of our Nation's streams and ground water? How are the conditions changing over time? How do natural features and human activities affect the quality of streams and ground water, and where are those effects most pronounced? By combining information on water chemistry, physical characteristics, stream habitat, and aquatic life, the NAWQA program aims to provide science-based insights for current and emerging water issues and priorities. NAWQA results can contribute to informed decisions that result in practical and effective water-resource management and strategies that protect and restore water quality.

Since 1991, the NAWQA program has implemented interdisciplinary assessments in more than 50 of the Nation's most important river basins and aquifers, referred to as Study Units (http://water.usgs.gov/nawqa/ nawqamap.html). Collectively, these Study Units account for more than 60 percent of the overall water use and population served by public water supply, and are representative of the Nation's major hydrologic landscapes, priority ecological resources, and agricultural, urban, and natural sources of contamination.

Each assessment is guided by a nationally consistent study design and methods of sampling and analysis. The assessments thereby build local knowledge about water-quality issues and trends in a particular stream or aquifer while providing an understanding of how and why water quality varies regionally and nationally. The consistent, multi-scale approach helps to determine if certain types of water-quality issues are isolated or pervasive, and allows direct comparisons of how human activities and natural processes affect water quality and ecological health in the Nation's diverse geographic and environmental settings. Comprehensive assessments on pesticides, nutrients, volatile organic compounds, trace metals, and aquatic ecology are developed at the national scale through comparative analysis of the Study-Unit findings (http://water.usgs.gov/nawqa/natsyn.html).

The USGS places high value on the communication and dissemination of credible, timely, and relevant science so that the most recent and available knowledge about water resources can be applied in management and policy decisions. We hope this NAWQA publication will provide you the needed insights and information to meet your needs, and thereby foster increased awareness and involvement in the protection and restoration of our Nation's waters.

The NAWQA program recognizes that a national assessment by a single program cannot address all water- resource issues of interest. External coordination at all levels is critical for a fully integrated understanding of watersheds and for cost-effective management, regulation, and conservation of our Nation's water resources. The program, therefore, depends extensively on the advice, cooperation, and information from other Federal, State, interstate, Tribal, and local agencies, non-government organizations, industry, academia, and other stakeholder groups. The assistance and suggestions of all are greatly appreciated.

Robert M. Hirsch

Robert M. Hirsch
Associate Director for Water

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Conversion Factors, Datums, and Abbreviated Water-Quality Units

Multiply	By	To obtain
acre-foot (acre-ft)	1,233	cubic meter (m^3)
acre-foot per year (acre-ft/yr)	1,233	cubic meter per year (m^3/yr)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
foot (ft)	0.3048	meter (m)
pound per acre per day (lb/acre/d)	0.1836	kilogram per square hectometer per day (kg/hm^2/d)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.590	square kilometer (km^2)
ton per day (ton/d)	0.9072	metric ton per day (mton/d)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F = (1.8 \times °C) + 32.$$

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83). Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88). Altitude, as used in this report, refers to distance above the vertical datum.

Specific conductance is reported in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25°C).

Concentrations of chemical constituents in water are reported either in milligrams per liter (mg/L) or micrograms per liter (µg/L). Concentrations of periphyton chlorophyll *a* are reported in milligrams per square meter (mg/m^2).

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Abstract

Water-quality samples were collected from the Bear River during two base-flow periods in 2001: March 11 to 21, prior to snowmelt runoff, and July 30 to August 9, following snowmelt runoff. The samples were collected from 65 sites along the Bear River and selected tributaries and analyzed for dissolved solids and major ions, suspended sediment, nutrients, pesticides, and periphyton chlorophyll *a*.

On the main stem of the Bear River during March, dissolved-solids concentrations ranged from 116 milligrams per liter (mg/L) near the Utah-Wyoming Stateline to 672 mg/L near Corinne, Utah. During July-August, dissolved-solid concentrations ranged from 117 mg/L near the Utah-Wyoming Stateline to 2,540 mg/L near Corinne and were heavily influenced by outflow from irrigation diversions. High concentrations of dissolved solids near Corinne result largely from inflow of mineralized spring water.

Suspended-sediment concentrations in the Bear River in March ranged from 2 to 98 mg/L and generally decreased below reservoirs. Tributary concentrations were much higher, as high as 861 mg/L in water from Battle Creek. Streams with high sediment concentrations in March included Whiskey Creek, Otter Creek, and the Malad River. Sediment concentrations in tributaries in July-August generally were lower than in March.

The concentrations of most dissolved and suspended forms of nitrogen generally were higher in March than in July-August. Dissolved ammonia concentrations in the Bear River and its tributaries in March ranged from less than 0.021 mg/L to as much as 1.43 mg/L, and dissolved ammonia plus organic nitrogen concentrations ranged from less than 0.1 mg/L to 2.4 mg/L. Spring Creek is the only site where the concentrations of all ammonia species exceeded 1.0 mg/L. In samples collected during March, tributary concentrations of dissolved nitrite plus nitrate ranged from 0.042 mg/L to 5.28 mg/L. In samples collected from tributaries during July-August, concentrations ranged from less than 0.23 mg/L to 3.06 mg/L. Concentrations of nitrite plus nitrate were highest in samples collected from the Whiskey Creek and Spring Creek drainage basins and from main-stem sites below Cutler Reservoir near Collinston (March) and Corinne (July-August).

Concentrations of total phosphorus at main-stem sites were fairly similar during both base-flow periods, ranging from less than 0.02 to 0.49 mg/L during March and less than 0.02 to 0.287 mg/L during July-August. In March, concentrations of total phosphorus in the Bear River generally increased from upstream to downstream. Total phosphorus concentrations in tributaries generally were higher in March than in July-August.

Concentrations of selected pesticides in samples collected from 20 sites in the Bear River basin in either March or July-August were less than 0.1 microgram per liter. Of the 12 pesticides detected, the most frequently detected insecticide was malathion, and prometon and atrazine were the most frequently detected herbicides.

Periphyton samples were collected at 14 sites on the Bear River during August. Chlorophyll *a* concentrations ranged from 21 milligrams per square meter (mg/m^2) to 416 mg/m^2, with highest concentrations occurring below reservoirs. Samples from 8 of the 14 sites had concentrations of chlorophyll *a* that exceeded 100 mg/m^2, indicating that algal abundance at these sites may represent a nuisance condition.

Introduction

The National Water-Quality Assessment (NAWQA) program began full-scale implementation in 1991. The objectives of the NAWQA program are to describe the status of, and trends in, the quality of the Nation's ground-water and surface-water resources, as well as to develop an understanding of the natural and human factors affecting these resources (Gilliom and others, 1995). The Great Salt Lake Basins (GRSL) study unit is 1 of 51 study units that are included in this national program. Water-quality investigations began in the first group of 20 study units in 1991. A second group of 16 study units began investigations in 1994, and a third group of 15 study units, including the GRSL, began in 1997.

Water-quality assessments within the GRSL have included studies by Baskin and others (2002), Gerner (2003), Waddell and Giddings (2003), and Waddell and others (2004). This synoptic study is a component of the NAWQA surface-water study design used to assess the spatial distribution of selected constituent groups along the Bear River and its tributaries over a limited time period. In 2001, water-quality samples were collected at 65 sites (*fig. 1*, *table 1*) on the Bear River and selected tributaries, which were distributed from near the Utah-Wyoming Stateline south of Evanston, Wyoming, downstream to Corinne, Utah. Samples were analyzed for dissolved solids and major ions, suspended sediment, nutrients, pesticides, and periphyton chlorophyll *a* (CHL A).

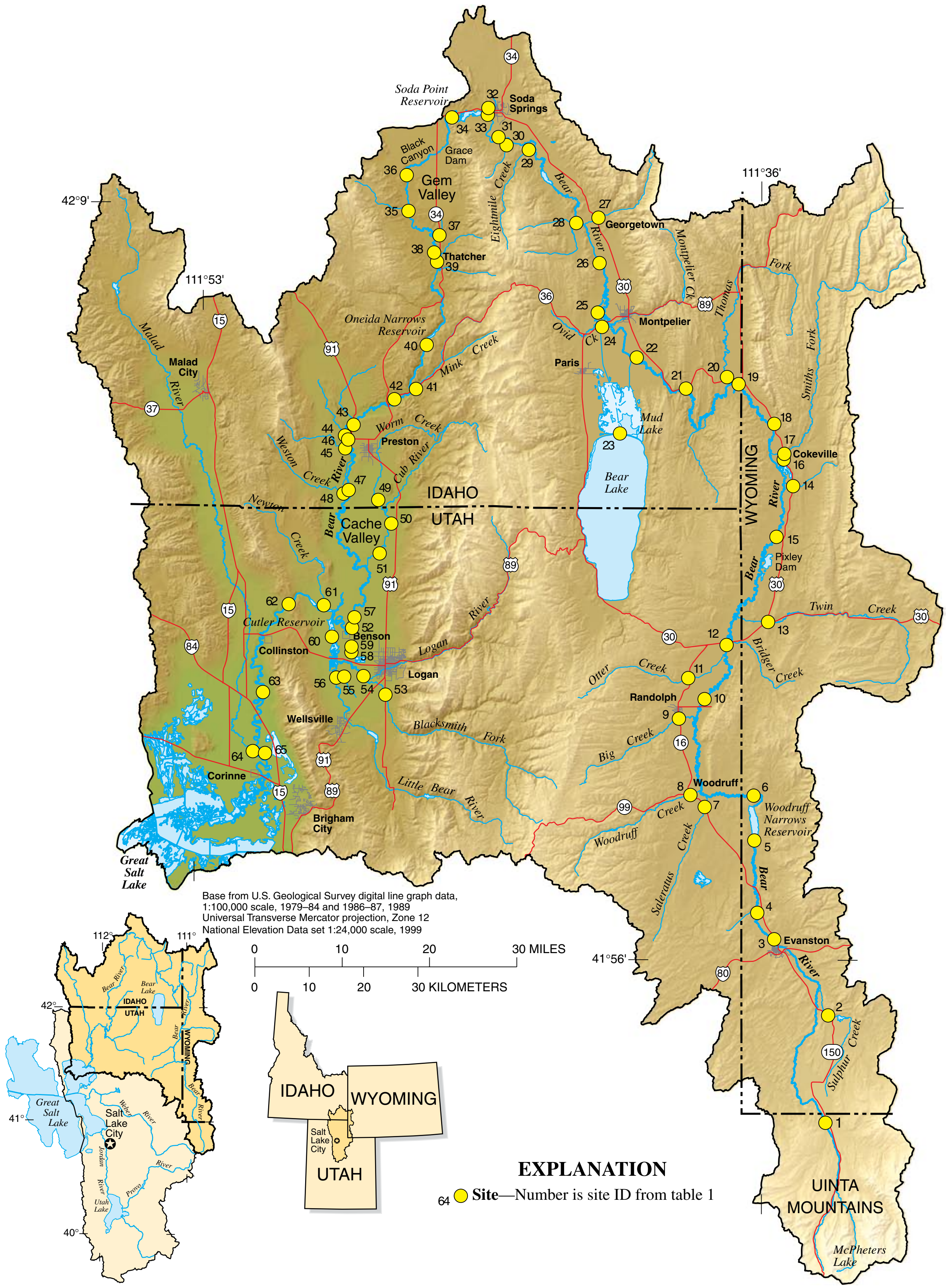

Figure 1. Location of sites sampled in the Bear River basin, Utah, Idaho, and Wyoming, March and July-August 2001.

The Bear River is used extensively for irrigation and power generation and has the potential to provide additional drinking water to the growing population in the GRSL. Many groups, both public and private, are interested in the quality of water in the Bear River. This study was designed to help define the spatial variation in water quality in the Bear River basin during two natural base-flow periods in 2001: in March, prior to snowmelt runoff, and in July-August, following snowmelt runoff. The July-August period coincides with the irrigation season in the Bear River basin. The water quality at base-flow conditions in many segments of the river was affected by releases of stored water and by irrigation withdrawals. This study provides additional information on selected water-quality parameters to assist managers in evaluating the effects of adjoining areas on the quality of water in the Bear River.

Purpose and Scope

This report describes the quality of water in the Bear River and selected tributaries as it relates to dissolved solids and major ions, suspended sediment, nutrients, pesticides, and CHL A during two natural base-flow periods prior to (March) and following (July-August) snowmelt runoff in 2001. Concentrations and loads of dissolved solids, suspended sediment, and nutrients are compared among sites and between the two study periods. Concentrations of nutrients and CHL A are compared to guidelines that indicate the existence of, or potential for, eutrophication.

Data Collection and Analysis

In 2001, samples were collected at 57 sites on the Bear River and selected tributaries from March 11 through 21, and at 63 sites from July 30 through August 9. Limited resources, coupled with the complexity of sampling protocols, necessitated that samples be collected over a period of many days for both of the sampling periods. Site visits generally occurred in an upstream direction. Water samples were collected at each site according to field procedures outlined in Shelton (1994) and Horowitz and others (1994). These samples were processed in the field immediately after collection to reduce the possibility of chemical or biological alteration. Samples were analyzed for major ions, nutrients, and pesticides at either the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL) in Denver, Colorado, or the Utah State Health Laboratory in Salt Lake City, Utah. Algae samples were collected by using methods outlined in Porter and others (1993). These samples were analyzed for CHL A by fluorometry at the USGS Utah Water Science Center laboratory and by high-pressure liquid chromatography (HPLC) at the NWQL. Samples were analyzed for suspended sediment at the Cascades Volcano Observatory Sediment Laboratory in Vancouver, Washington.

In this report, the term "dissolved" refers to that portion of a sample that has passed through a 0.70-micron filter (pesticides only) or a 0.45-micron filter (all other constituents). Dissolved-solids concentrations in this report refer to analyses of sample residue on evaporation at 180 °C. Concentrations of total nitrogen were calculated by adding measured concentrations of total Kjeldahl nitrogen (total ammonia plus organic nitrogen) and total nitrite plus nitrate. Samples collected in March were analyzed for dissolved nitrite plus nitrate at the NWQL, and for total nitrite plus nitrate at the Utah State Health Laboratory. Measured values from sites that had both analyses were used to develop a linear regression model (*fig. 2*) that was used to estimate dissolved nitrite plus nitrate concentration at tributary sites where only total nitrite plus nitrate concentration was measured. On the basis of the regression, about 96 percent of the total nitrogen is dissolved. The estimated values for dissolved nitrite plus nitrate concentration were used in the computation of summary statistics and graphics for the March sampling period at 18 tributary sites.

To compare constituent concentrations among sites, quartiles (25^{th} percentile, 50^{th} percentile or median, and 75^{th} percentile) were calculated for each constituent group. These quartiles were then used to divide the samples into groups: "low" for the group below the 25^{th} percentile, "moderately low" for the group between the 25^{th} percentile and the median (50^{th} percentile), "moderately high" for the group between the median and the 75^{th} percentile, and "high" for the group above the 75^{th} percentile. These groupings are color-coded and graphically illustrated to allow the reader to quickly detect differences in concentrations among sites. This method, however, has limited usefulness for comparing concentrations between sampling periods at individual sites without close inspection of the quartile boundaries for each grouping.

Constituents that are detected at concentrations between the Long-Term Method Detection Level (LT–MDL) and Minimum Reporting Level (MRL) are reported as "estimated."

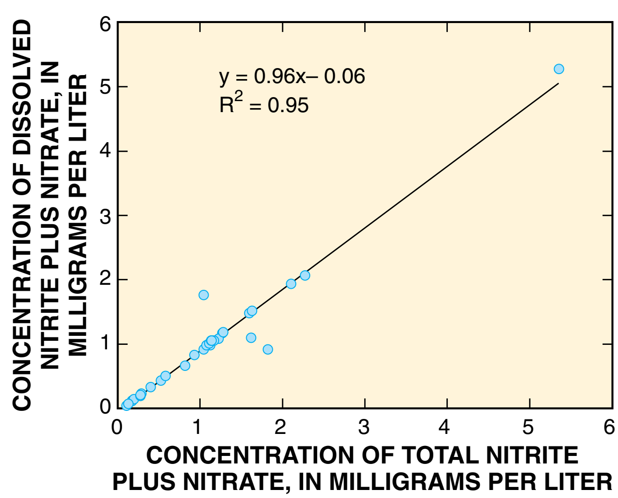

Figure 2. Relation of dissolved to total nitrite plus nitrate (as N) for selected sites in the Bear River basin, March 2001.

The LT-MDL controls false positive errors so that the chance of falsely reporting a concentration at or greater than the LT-MDL for a sample that did not contain the analyte is predicted to be less than or equal to 1 percent. Estimated concentrations are noted with a remark code of "e." These data should be used with the understanding that their uncertainty is greater than that of data reported without the "e" remark code. If an analytical method consistently results in poor recovery or high variability of an analyte, the "e" remark code may be assigned to measured concentrations of that analyte. Concentrations with the "e" remark code were considered as detections in the data analysis and were included in the statistical analysis.

Quality Control

Quality-control samples were collected at select sites to determine if data quality associated with water samples collected for this study is sufficient for water-quality assessments. Three types of quality-control samples were collected and analyzed: (1) field blanks to determine sample bias, (2) replicates to determine sample variability, and (3) field-matrix spikes to test for bias from sample matrix interference.

Nine field blank samples were collected at selected water-quality monitoring sites during this study. Of these, three were analyzed for major ions, five were analyzed for nutrients, and three were analyzed for pesticides. No constituents were detected above the laboratory method reporting limits (MRLs). There were detections of dissolved ammonia and dissolved nitrite plus nitrate that were between the MRL and the method detection limit (MDL). Values between the MRL and MDL are always qualified as estimated; however, the detection of ammonia and dissolved nitrite plus nitrate in concentrations between the MRL and MDL (approximately 0.02 to 0.04 mg/L) indicates the possibility of a small positive bias, and values in this range should be interpreted with caution.

Ten replicate samples were collected at selected water-quality monitoring sites during this study. Of these, three were analyzed for major ions, five were analyzed for nutrients, and two were analyzed for pesticides. For the replicate major-ion samples, the average relative standard deviation (RSD) for all constituents except fluoride was less than 2 percent, which indicates that variability due to sample collection and processing or lab analytical procedures was small. The average RSD among fluoride samples was 14 percent; however, absolute differences between samples were 0.1 mg/L or less. The variability associated with collection, processing, and laboratory analysis of water samples for nutrients was larger in some cases. For example, the average RSD was 20 percent for dissolved phosphorus samples, 8.2 percent for ammonia samples, and 4.7 percent for total phosphorus samples. All of the other nutrient species for which replicate samples were analyzed had RSDs of less than 3 percent. Comparison of results for dissolved phosphorus and ammonia concentrations between sites should be made with caution, particularly when the values are small or of relatively equal magnitude.

Surrogate compounds that were expected to perform similarly to some of the pesticide analytes were added to all of the pesticide samples. Recovery of these surrogates ranged from 72.8 to 134 percent and averaged 99.2 percent, indicating that sample-matrix effects and gross sample-processing errors probably did not affect most analytical results for pesticides. Replicate pesticide samples collected at two sites during August were spiked with known concentrations of specific analytes. These field-matrix-spike samples test for bias from matrix interference and analyte degradation. The recovery of 36 analytes in the two samples ranged from 52 to 189 percent and averaged 114 percent. These data indicate that for the analytes tested, the probability of false negatives is low.

Overall, the data from quality-control samples collected during this study show that for most constituents, bias from sample contamination is minimal or nonexistent, and the sampling and analytical procedures yield reproducible results.

Description of Study Area

The Bear River has the distinction of being the longest river in North America not draining into an ocean. The Bear River begins and ends in Utah; however, it crosses the border of Utah, Idaho, and Wyoming multiple times on its 500-mi journey from its source in the Uinta Mountains of northeastern Utah to its terminus at Great Salt Lake, only about 90 mi apart (*fig. 1*). Beginning about 140,000 years ago, eruption of basaltic lava near Soda Springs, Idaho, blocked the Bear River channel and diverted the river from its northwesterly course into the Snake River drainage and on to the Pacific Ocean, south into the Lake Bonneville part of the Great Basin (Bouchard and others, 1998).

The Bear River discharges, on average, about 1.85 million acre-ft/yr (1931-76) to Great Salt Lake (Waddell and Barton, 1980). For the 2001 water year (October 1, 2000, to September 30, 2001), total discharge of the Bear River at Corrine, Utah, was about 450,000 acre-ft (Herbert and others, 2002). Discharge from the Bear River is about 62 percent of the total average annual runoff of surface water entering Great Salt Lake.

The Bear River is diverted into Bear Lake at Stewart Dam, near Montpelier, Idaho (*fig. 3*). Naturally isolated from each other for thousands of years, a connection between the Bear River and Bear Lake was established during 1911-12 so that the lake could be used as a water-storage reservoir (Utah Power and Light, written commun., 2006). The Rainbow Canal transports water from the diversion into Mud Lake, a shallow lake separated from Bear Lake by a natural dike. This water then can be either diverted into Bear Lake or returned to the Bear River through a canal that connects Mud Lake with the Bear Lake Outlet Canal (*fig. 3*). Water from Bear Lake can be pumped by the Lifton pumping station through the outlet canal and into the Bear River. When full, the surface area of Bear Lake is about 140 mi^2, and the maximum depth exceeds 200 ft. Consequently, Bear Lake is capable of storing about

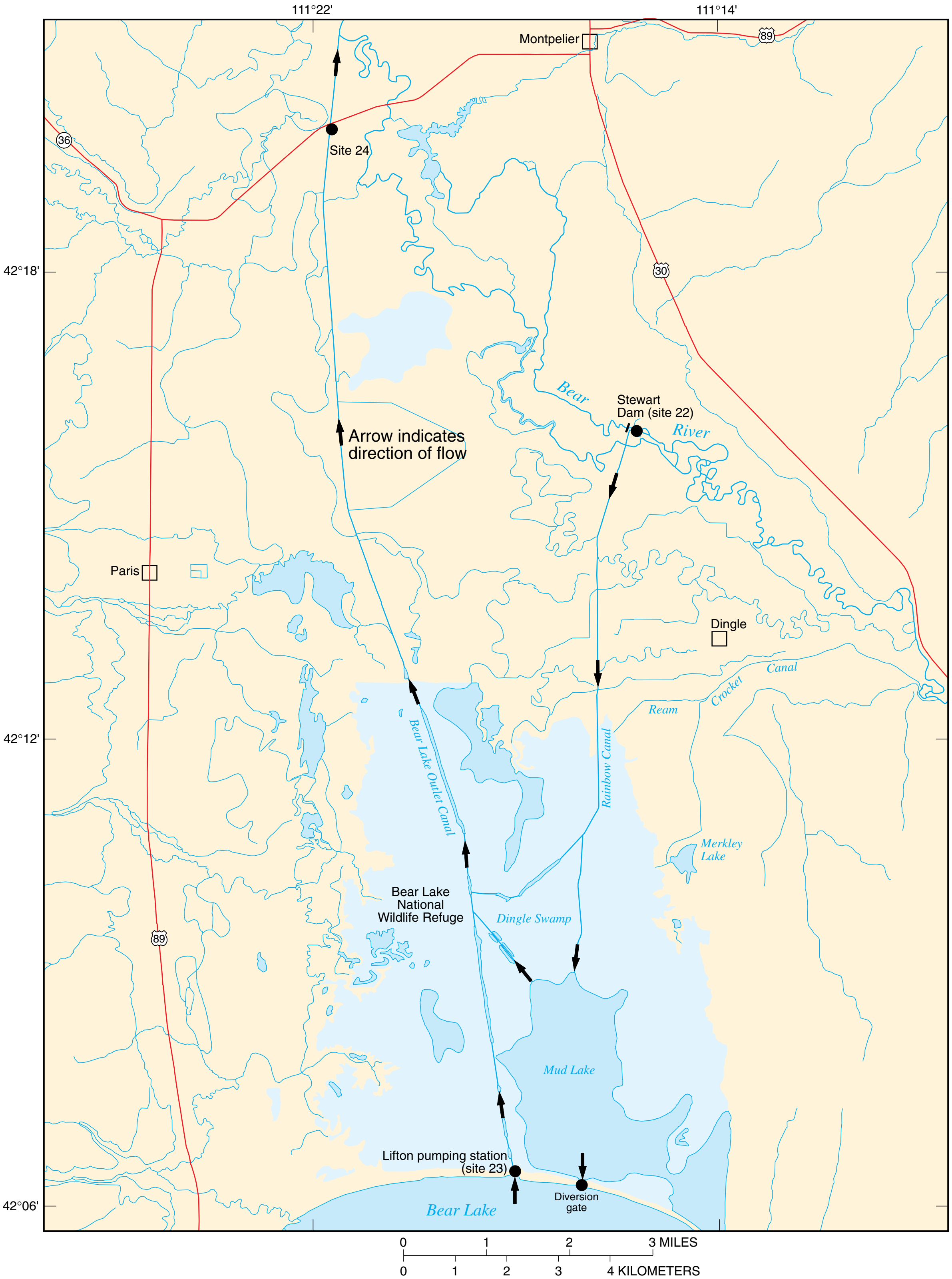

Figure 3. Diversion network for regulation of the Bear River at Bear Lake, Idaho.

1,420,000 acre-ft of water, making it the largest reservoir in the Bear River system. Historically, the level of the lake was maintained by inflow from springs and surface runoff of rain and snow.

During 1995, irrigation for agriculture accounted for an estimated 92 percent of all water use in the Bear River drainage, and public supply accounted for an estimated 4 percent of all water use (Baskin and others, 2002). A network of dams, reservoirs, and diversion structures regulates flow in the Bear River for irrigation and hydroelectric-power generation and modifies the natural hydrologic variability of the river and the physical, chemical, and biological conditions in the river. Flow modification from dams and reservoirs also affects streambank stability and sediment concentration.

Land Use/Cover

Knowledge of land use and land cover can enhance our understanding of natural and anthropogenic factors that influence water quality. Rangeland is the most common land cover upstream from all but two sites on the Bear River and ranges from about 26 to 75 percent of total land cover (*fig. 4* and *table 2*). Forest is the principal land cover (about 45 to 67 percent) upstream from Evanston, Wyoming (*figs. 1* and *4*; *table 2*), but makes up only 14 to 19 percent of the watershed downstream from Randolph, Utah. Concentrations of contaminants in streams generally increase with increasing amounts of agricultural and urban land in a watershed, largely because of increases in the amount of chemicals used and less water being available from undeveloped lands to dilute those chemicals. Agricultural land cover ranges from less than 1 to 18 percent of total land cover (*fig. 4* and *table 2*), with percentages of agricultural land generally increasing with distance downstream from Bear Lake. Extensive agricultural areas exist in Gem Valley, Idaho, and Cache Valley, Utah, and in the valley areas below Cutler Reservoir (*figs. 1* and *4*). Although urban areas cover less than 1 percent of total land cover (*fig. 4*), they can be a major cause of stream impairment (Paul and Meyer, 2001).

Land-use/cover data were derived from the National Land Cover Dataset (NLCD) (Multi-Resolution Land Characteristics Consortium, 1992). This data set provides a consistent land-cover data layer for the conterminous United States, based on 30-meter Landsat thematic map data, and represents conditions in the early to mid-1990s. For this report, the NLCD land-use/-cover classifications were aggregated into eight land classes defined in Anderson and others (1976) as Level I categories.

Water-Quality Issues

Nutrient and sediment loading related to hydrologic modification and agricultural land use are the principal water-quality issues in the Bear River basin. Enrichment of Bear Lake with nutrients and sediment from the Bear River has been an ongoing concern of water managers and water users. Channelization, streamflow modification, and grazing of rangelands contribute to sediment loads in the upper part of the drainage basin. Feedlots, dairy operations, and irrigated crops contribute to nutrient loads in the lower part of the drainage basin. Most tributaries to the Bear River are seasonally diverted for irrigation. Irrigation return flow, with generally higher dissolved-solids concentrations, affects the water quality of the Bear River.

Further insight into problems affecting the quality of streams and reservoirs of the Bear River basin can be obtained from the most recent (2004-05) 303(d) listing of impaired water bodies developed by the States of Utah, Idaho, and Wyoming (Utah Division of Water Quality, 2004; Idaho Department of Environmental Quality, 2005; and Wyoming Department of Environmental Quality, 2004). The Clean Water Act requires that all States develop and update a 303(d) list of water bodies that do not meet their designated beneficial uses and identify the causes of impairment in those water bodies. State 303(d) lists for Utah, Idaho, and Wyoming include 39 stream segments and 7 reservoirs/lakes in the Bear River basin (*table 3*). Most of the affected stream segments are tributaries to the Bear River. High sediment concentrations and excess nutrient loads are the most frequently identified causes of impairment. Water bodies can be removed from the 303(d) list either through evidence that they meet their designated beneficial use or through the development of a plan, detailed in a Total Maximum Daily Load (TMDL) document that addresses the causes of impairment and steps necessary to remove those impairments. Water bodies that have associated TMDLs are listed in *table 4*.

As a basis for evaluating water quality in streams, the Utah Department of Administrative Services and the Idaho and Wyoming Department of Environmental Quality have established contaminant standards and guidelines based on those recommended by the U.S. Environmental Protection Agency (EPA). Both numeric and qualitative criteria are used by these agencies to assess stream trophic conditions. For instance, Utah has identified concentrations of 0.05 mg/L of total phosphorus (as P) and 4.0 mg/L of nitrate (as N) as indicators of excessive nutrients (Utah Division of Administrative Rules, 2005). Idaho stipulates that "Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses," (Idaho Department of Environmental Quality, 2003), and Wyoming stipulates that "Surface waters shall be free from substances and conditions or combinations thereof which are attributable to or influenced by the activities of man, in concentrations which produce undesirable aquatic life" (Wyoming Department of Environmental Quality, 2001).

EPA section 304(a), water-quality criteria for nutrients, provides a starting point for evaluating the effects of high nutrient concentrations on aquatic communities (U.S. Environmental Protection Agency, 2000a). These criteria represent reference conditions, within ecoregions, of surface waters that are minimally impacted by human activities and are protec-

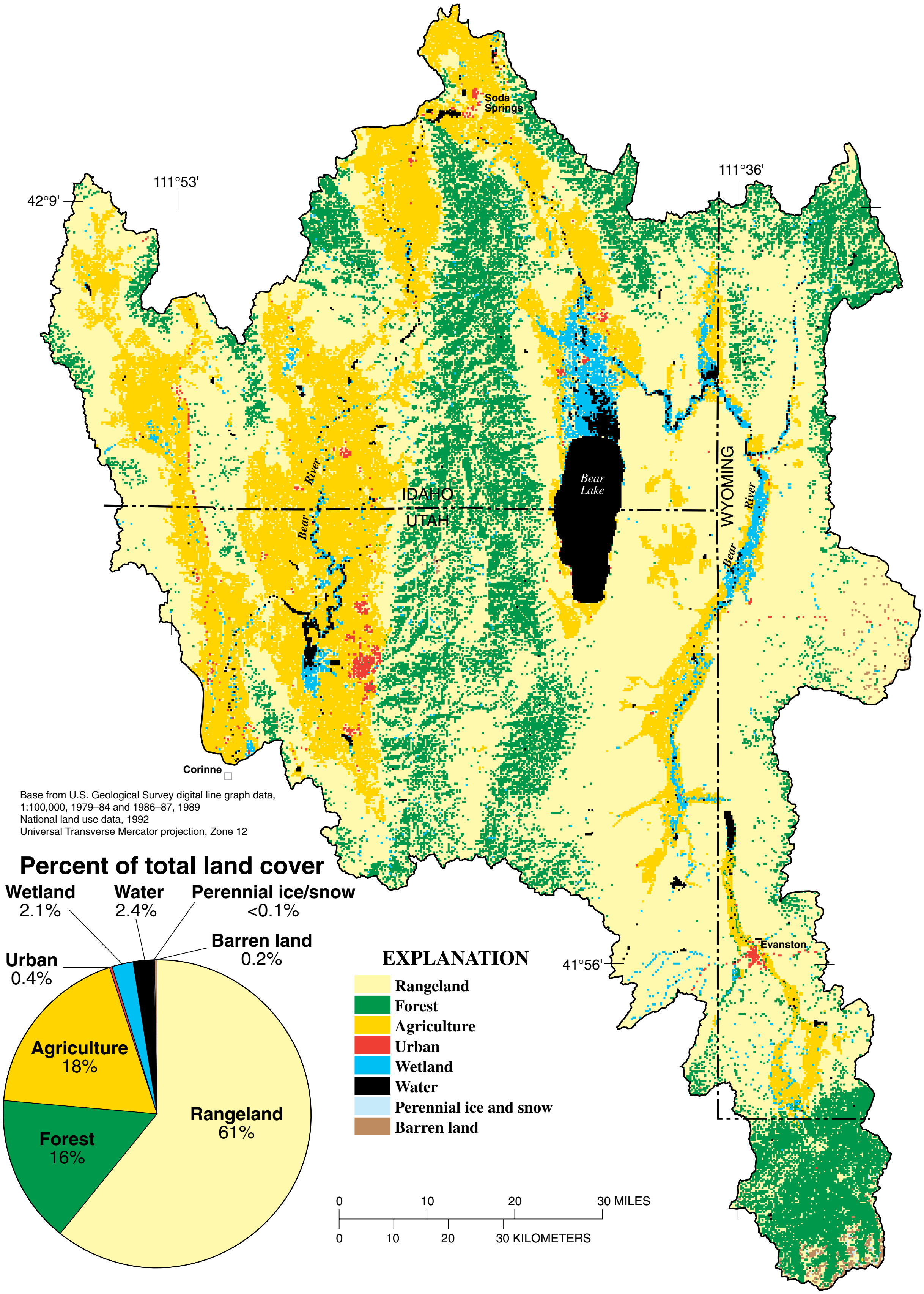

Figure 4. Land use/cover in the Bear River basin upstream from Corinne, Utah.

tive of aquatic life and recreational uses. Reference conditions have been established by the EPA for each ecoregion (U.S. Environmental Protection Agency, 2000b). Nearly all of the sites sampled in this study are in Aggregate Nutrient Ecoregion III, which includes the Central Basin and Range (13), the Wyoming Basin (18), and the Wasatch and Uinta Mountains (19) subecoregions. For Ecoregion III, the following reference conditions have been proposed for establishing nutrient criteria that are protective of designated beneficial uses: 0.025 mg/L of dissolved nitrite plus nitrate, 0.377 mg/L of total nitrogen, 0.022 mg/L of total phosphorus, and 43.9 mg/m^2 of periphyton CHL A (U.S. Environmental Protection Agency, 2000b).

Discharge

Ideally, synoptic studies are conducted under steady-state conditions and samples are collected simultaneously along the study reach. The Bear River is highly regulated, however, and difficult to sample under near steady-state conditions. Flow conditions varied considerably between study periods and among sites. Further, variations in water quality at a specific site for a given sampling period can occur with changes in discharge. Large changes in discharge occurred at some sites on the Bear River during the July-August sampling period as compared with the March sampling period (*fig. 5*). As a result, mean daily discharge for the sampling period rather than instantaneous discharge was used to calculate constituent loads for main-stem sites with continuous discharge data. Mean daily discharge for the August 6-8 sampling period was used for sites upstream from Bear Lake and July 30-August 5 for sites downstream from Bear Lake (*fig. 5B*). Instantaneous discharge at sites sampled during this study is listed in *table 5*.

March

Discharge at most sites was less than the historical average for the March 11-21 study period (*fig. 6A*). In the Bear River, discharge ranged from 7 ft^3/s at site 15 to 1,690 ft^3/s at site 65 (fig. 5A). Prior to and during collection of the March samples, warm weather had melted much of the low- and some of the mid-altitude snow cover in the drainage basin below Soda Point Reservoir (site 34). Runoff to the Bear River and its tributaries resulted in increasing discharge toward the end of the sampling period (*fig. 6A*). This effect was particularly evident downstream from Bear Lake where increases in discharge were as much as 50 percent. Many of the Bear River and tributary sites upstream from Bear Lake remained ice covered during March sampling and had substantially less inflow from snowmelt.

During March, about 107 ft^3/s of water was diverted from the Bear River and stored in Mud Lake (Herbert and others, 2002); however, no water was being diverted into or released from Bear Lake (*fig. 5A*). In Gem Valley (*fig. 1*), nearly the entire flow of the Bear River was diverted (by way of penstocks) to the Grace power plant, about 6 mi downstream from the diversion point, and flow in the intervening reach, which includes Black Canyon, consisted mostly of ground-water inflow. A reduction in discharge at site 36 (Bear River at Black Canyon) is evident on many of the figures contained in this report and generally is the result of this diversion.

July-August

Daily discharge at sites on the Bear River was highly regulated during the July 30-August 9 study period (*fig. 6B*). Reservoir releases caused variations in discharge at Bear River sites below Soda Point and Oneida Narrows Reservoirs. Typical fluctuations were as much as 200 ft^3/s or about 20 percent of total flow. The Bear River upstream from Bear Lake generally had below-average daily discharge, ranging from less than 1 ft^3/s at site 5 above Woodruff Narrows Reservoir to about 108 ft^3/s at site 18 (Bear River below Smiths Fork) (*fig. 5B*). Inflow to Mud Lake through the Rainbow Canal was 4.6 ft^3/s (Herbert and others, 2002), while outflow through the Bear Lake Outlet Canal (site 24) averaged 1,280 ft^3/s (*table 5*). Because of the large inflow from Bear Lake, discharge in the Bear River between Bear Lake and Cutler Reservoir was near the historic average (mean daily discharge) during this period (*fig. 6B*). Large diversions into the East and West Hammond canals at Cutler Dam, however, resulted in less-than-average discharge in the Bear River below the reservoir.

Water Quality

The quality of water in Bear River basin streams differed substantially from March to July-August with respect to nitrogen concentration. The median dissolved ammonia concentration in samples from all streams was more than five times higher in samples collected during March (*table 6*) than in samples collected during July-August (*table 7*). Runoff from animal feeding operations in proximity of the streams is a likely source of ammonia. The median concentration of dissolved nitrite plus nitrate was more than 10 times higher and the median concentration of total nitrogen was about 3 times higher in samples collected during March than in samples collected during July-August. Although total phosphorus concentrations at main-stem sites were similar for both sampling periods, the median total phosphorus concentration in tributaries generally was higher in March (0.182 mg/L) than in July-August (0.082 mg/L), possibly from increased sediment in tributaries in March. The maximum concentration of dissolved solids in streams of the Bear River basin was much higher in July-August (2,540 mg/L) than in March (1,080 mg/L); however, the difference in the median concentrations (418 mg/L and 335 mg/L, respectively) was considerably less. The median concentrations of suspended sediment in Bear River basin streams were the same (38 mg/L) for the two periods; however, tributaries had substantially higher concentrations

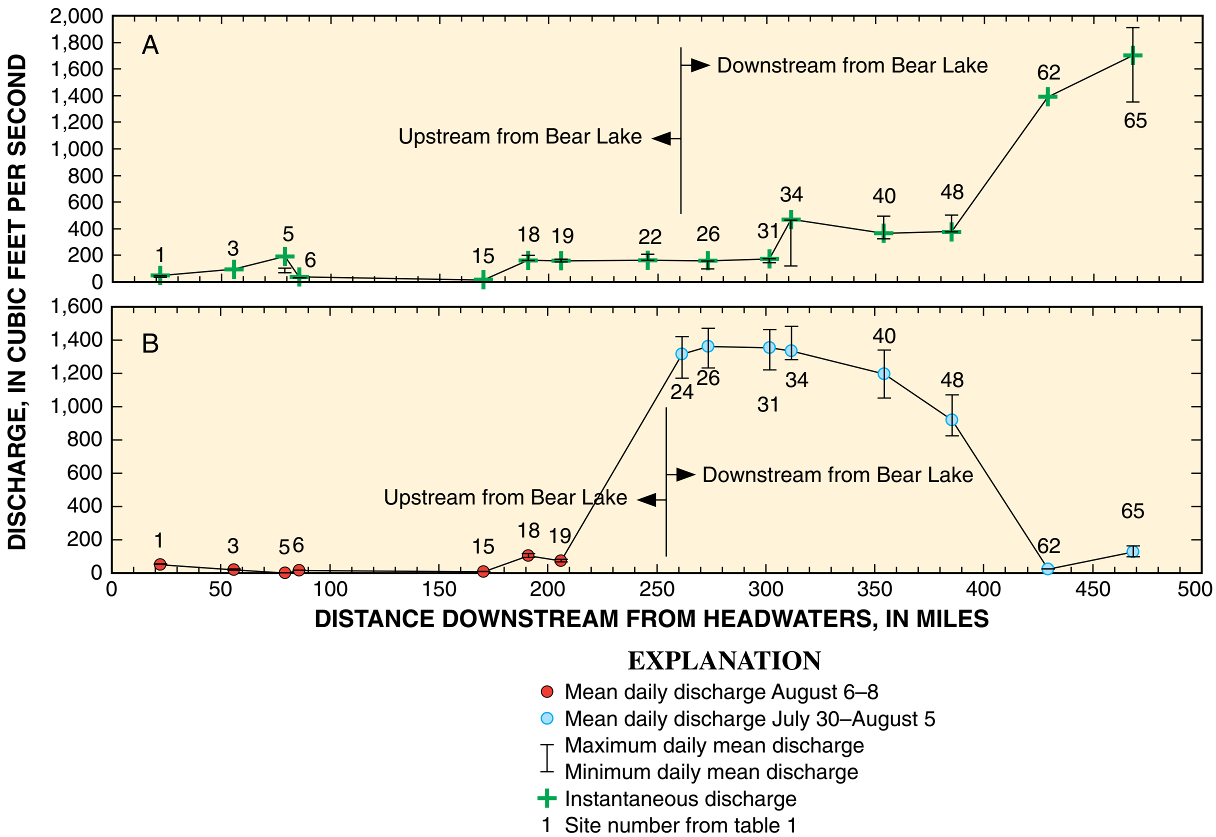

Figure 5. Instantaneous and daily mean discharge at gaged sites on the Bear River, (A) March and (B) July-August 2001.

than main-stem sites in March, while tributaries and main-stem sites had similar concentrations in July-August.

The chemical and sediment load in Bear River basin streams also differed substantially from March to July-August. For instance, the Little Bear River at Benson Marina (site 60) contributed a substantial load of dissolved solids, nutrients, and sediment to the Bear River during March. During July-August, however, discharge was very low and backwater from the Bear River resulted in no detectable flow from the Little Bear River into Cutler Reservoir (and subsequently into the Bear River). Consequently, there was very little contribution of chemical or sediment load to the Bear River from the Little Bear River drainage basin during this time period.

Outflow from point sources, such as wastewater-treatment plants or industrial facilities was not sampled separately, but some stream segments in the Bear River basin are substantially influenced by contaminants from these permitted outflows. Site 58 (*fig. 1*) is on a drainage ditch whose principal source of water is the Logan wastewater-treatment plant; hence, concentrations of dissolved solids and nutrients were substantially elevated at this site. Site 55 (*fig. 1*) is located on Spring Creek, a tributary to the Little Bear River that receives inflow from several facilities that have discharge permits for contaminants.

In addition to providing measurements of constituent concentration, water samples collected at Bear River basin sites were used to calculate constituent yields for some tributary basins (*table 8*). Yields provide a means to compare the relative contribution to stream loads of a parcel of land in a tributary basin. For example, the March suspended-sediment load at site 51 on the Cub River was only slightly higher than that at site 43 on Battle Creek (16.1 and 14.1 tons/d, respectively); however, the yield from the Cub River basin was considerably lower than that from the Battle Creek basin (0.25 and 0.70 lbs/acre/d, respectively) (*table 8*), indicating that the natural and anthropogenic factors contributing to sediment yields in the Battle Creek basin are substantially different from those in the Cub River basin. In addition, sites 37 (Whiskey Creek near Thatcher), 55 (Spring Creek at 600 South), and 58 (Logan waste-water treatment plant ditch) are situated in basins where yields are substantially influenced by point-source contaminants, and constituent yields for these basins are probably biased high relative to other sites.

Dissolved Solids and Major Ions

Variations in the concentration of dissolved solids and major inorganic constituents in water at sites in the Bear River basin generally are associated with differences in basin geology, seasonal snowmelt runoff, Bear Lake outflows and diversions for irrigation, agricultural, and urban inputs, and

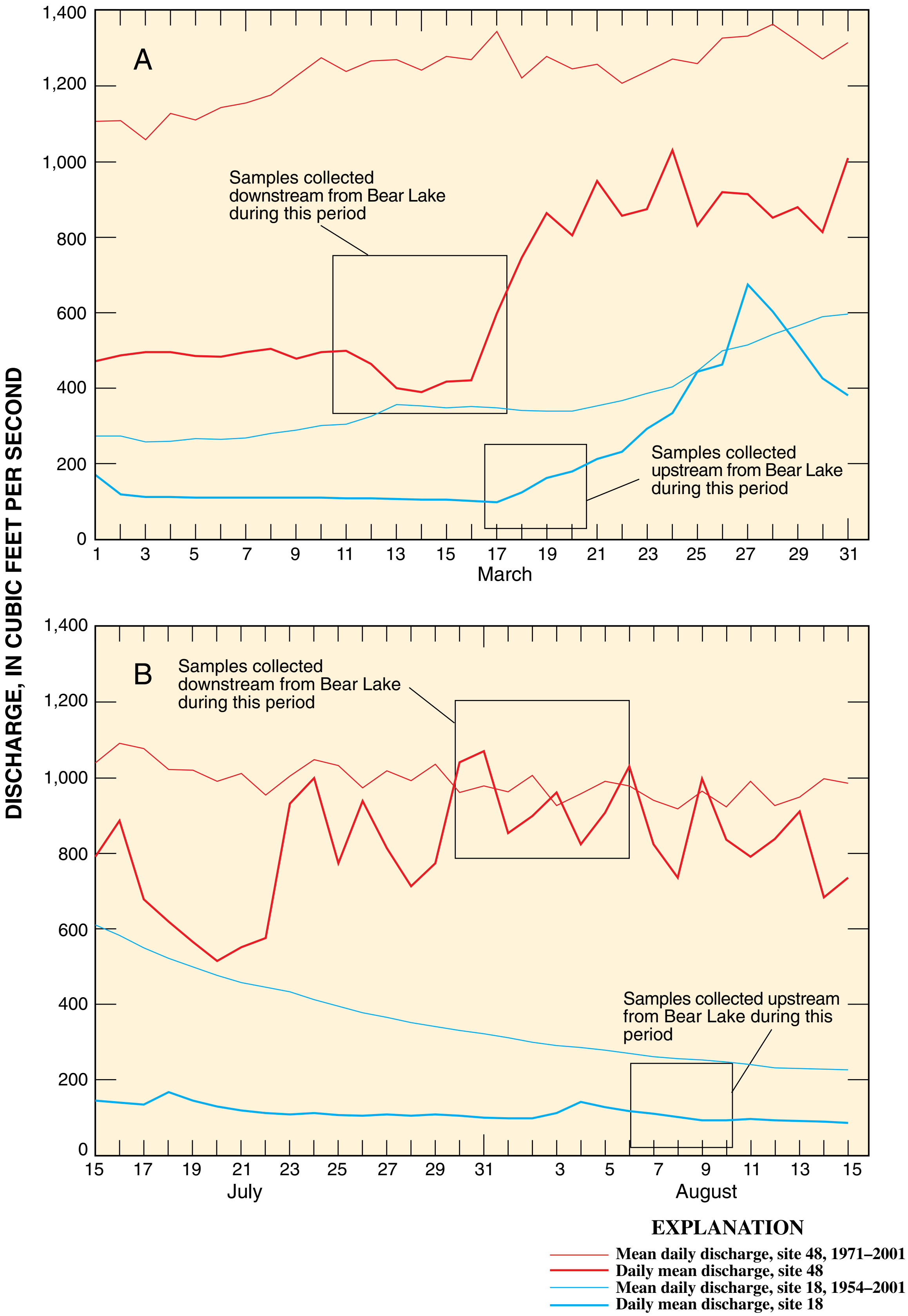

Figure 6. Discharge at Bear River sites 18 and 48, (A) March and (B) July-August 2001.

ground-water discharge. For example, inflow of mineralized water from springs along the Malad River contributes to the high dissolved-solids concentration in the Bear River near Corinne (site 65) (Waddell and Price, 1972). Considerable amounts of dissolved salts also are contributed to the Bear River by mineralized spring water in the Soda Springs and Preston, Idaho areas. The return of water after use for irrigation further contributes to the increase of dissolved solids in the Bear River. Results of chemical analyses for water samples collected during both study periods are listed in *table 9*.

The predominant ions in water samples collected in March from sites upstream from Preston were calcium and bicarbonate (*fig. 7*). Water samples collected from sites adjacent to and downstream from Preston, however, were enriched in sodium and chloride. Water samples collected from sites upstream from Bear Lake during July-August generally were of the calcium bicarbonate type, whereas magnesium and bicarbonate were the predominant ions in water samples collected from sites between Bear Lake and Cutler Reservoir. Calcium carbonate precipitates from water in Bear Lake, and as a result, the magnesium to calcium ratio in water pumped into the Bear River is higher than in the Bear River upstream from Bear Lake. The predominant ions in water samples collected in July-August from sites below Cutler Reservoir were sodium and chloride (*fig. 7*).

March

At sampling sites on the main stem of the Bear River during March, the concentration of dissolved solids ranged from 116 mg/L near the Utah-Wyoming Stateline (site 1) to 672 mg/L near Corinne (site 65) (*fig. 8*). Saleratus Creek (site 7, 760 mg/L) and Twin Creek (site 13, 600 mg/L) had the highest concentrations of dissolved solids in tributary streams upstream from Bear Lake. Relative to other main-stem sites sampled during March, sites upstream from Soda Springs generally had dissolved-solids concentrations less than the median concentration of 335 mg/L for samples collected during March (*fig. 8*).

Main-stem sites downstream from Soda Springs generally had dissolved-solids concentrations that were higher than the median concentration for samples collected during March (*fig. 8*). Soda Creek (site 32, 932 mg/L) and Battle Creek (site 43, 1,080 mg/L) had the highest concentrations of dissolved solids in tributaries downstream from Bear Lake, contributing to an increase in dissolved solids in the Bear River downstream from these confluences. Further, the dissolved-solids load in the Bear River below Soda Point Reservoir (site 34) was about eight times higher than above the reservoir (site 33) (*fig. 9*), principally because of the high concentration of dissolved solids in tributary inflow to the reservoir and increased discharge from reservoir releases. Tributaries above Cutler Reservoir discharged 1,340 tons/d to the Bear River, about 78 percent of the load calculated for the Bear River below Cutler Reservoir, near Collinston, Utah (site 62). Most of the tributary dissolved-solids load was discharged from the Little Bear River (site 60, 950 tons/d) (*fig. 9*). The concentration of dissolved solids (672 mg/L) and the dissolved-solids load (3,060 tons/d) were substantially elevated in the Bear River near Corinne (site 65) relative to upstream main-stem sites.

July-August

During July-August, water-management practices such as irrigation diversions heavily influenced dissolved-solids concentrations at sampling sites on the Bear River. The concentration of dissolved solids ranged from 117 mg/L near the Utah-Wyoming Stateline (site 1) to 2,540 mg/L near Corinne (site 65) (*fig. 10*). The concentration of dissolved solids in tributary streams ranged from 196 mg/L in Stauffer Creek (site 28) to 1,540 mg/L in Soda Creek (site 32). Dissolved-solids concentrations in the Bear River generally were lower upstream from Bear Lake, except at sites 12 (above Bridger Creek) and 15 (below Pixley Dam), where concentrations were greater than 487 mg/L (75th percentile of August samples) (*fig. 10*). Tributaries upstream from sites 12 and 15 had lower dissolved-solids concentrations than the main stem; hence, the increase in concentration at these sites is attributed to unmeasured sources such as irrigation return flow. Inflow from Smiths Fork (site 17) diluted the concentration of dissolved solids in the Bear River downstream from the confluence where concentrations were less than 334 mg/L (*fig. 10*). Dissolved-solids concentrations in the Bear River downstream from Bear Lake were highest at sites in and downstream from Cache Valley.

Inflow to the Bear River from Bear Lake via the Bear Lake Outlet Canal (*fig. 3*) was substantial (about 1,540 ft^3/s) in July-August, and the dissolved-solids load (1,730 ton/d) to the Bear River was the highest of any inflow during this sampling period (*fig. 11*). However, because the concentration of dissolved solids in water released from the lake (site 23, 417 mg/L) was similar to that in the Bear River upstream from the lake (site 21, 387 mg/L), the concentration in the river downstream from Bear Lake was not substantially elevated. The pumpage of large amounts of water from Bear Lake diluted the combined contributions from tributaries and other sources of inflow so that concentrations of dissolved solids remained lower than 550 mg/L downstream to site 52 near Benson, Utah (*fig. 10*).

The dissolved-solids load entering Cutler Reservoir from the Bear River at site 52 near Benson was 1,470 tons/d (*fig. 11*). About 2,390 tons/d were removed from Cutler Reservoir, and of this amount, 2,320 tons discharged to the East and West Hammond Canals and 66 tons released from the dam discharged to the Bear River. No flow was detected entering Cutler Reservoir from the Little Bear River at Benson Marina (site 60), which includes the flow of the Logan River, Blacksmith Fork, Spring Creek (site 55), Hopkins Slough (site 57), and outflow from the Logan wastewater-treatment plant (site 58) (*fig. 10*). The concentration of dissolved solids in the Bear River below Cutler Reservoir, near Collinston (site 62, 980 mg/L), was considerably higher than above the reservoir (site 52, 528 mg/L), largely the result of an increase in sodium and

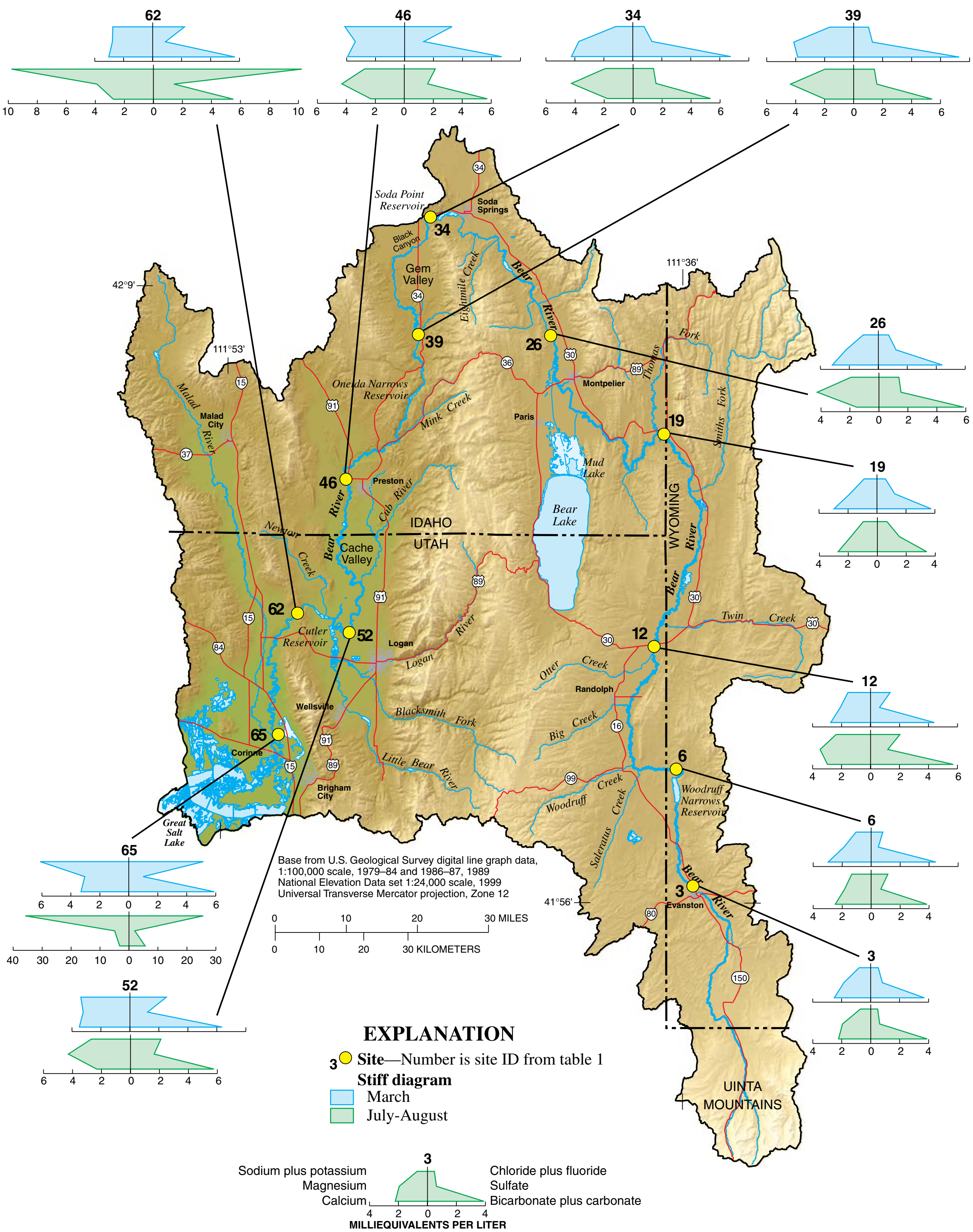

Figure 7. Chemical composition of water samples collected from selected main-stem sites in the Bear River basin, March and July-August 2001.

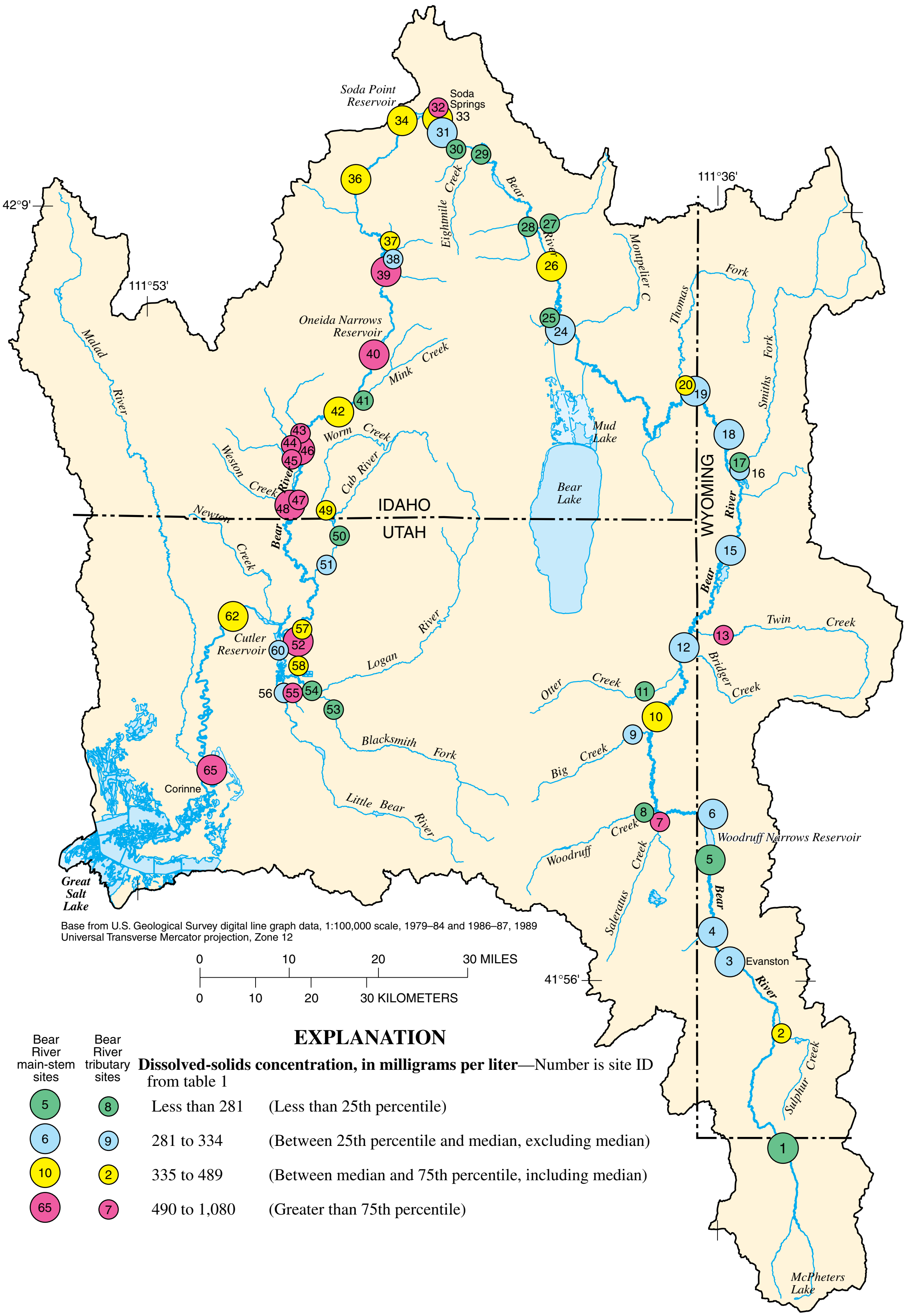

Figure 8. Concentration of dissolved solids in water samples collected from selected sites in the Bear River basin, March 2001.

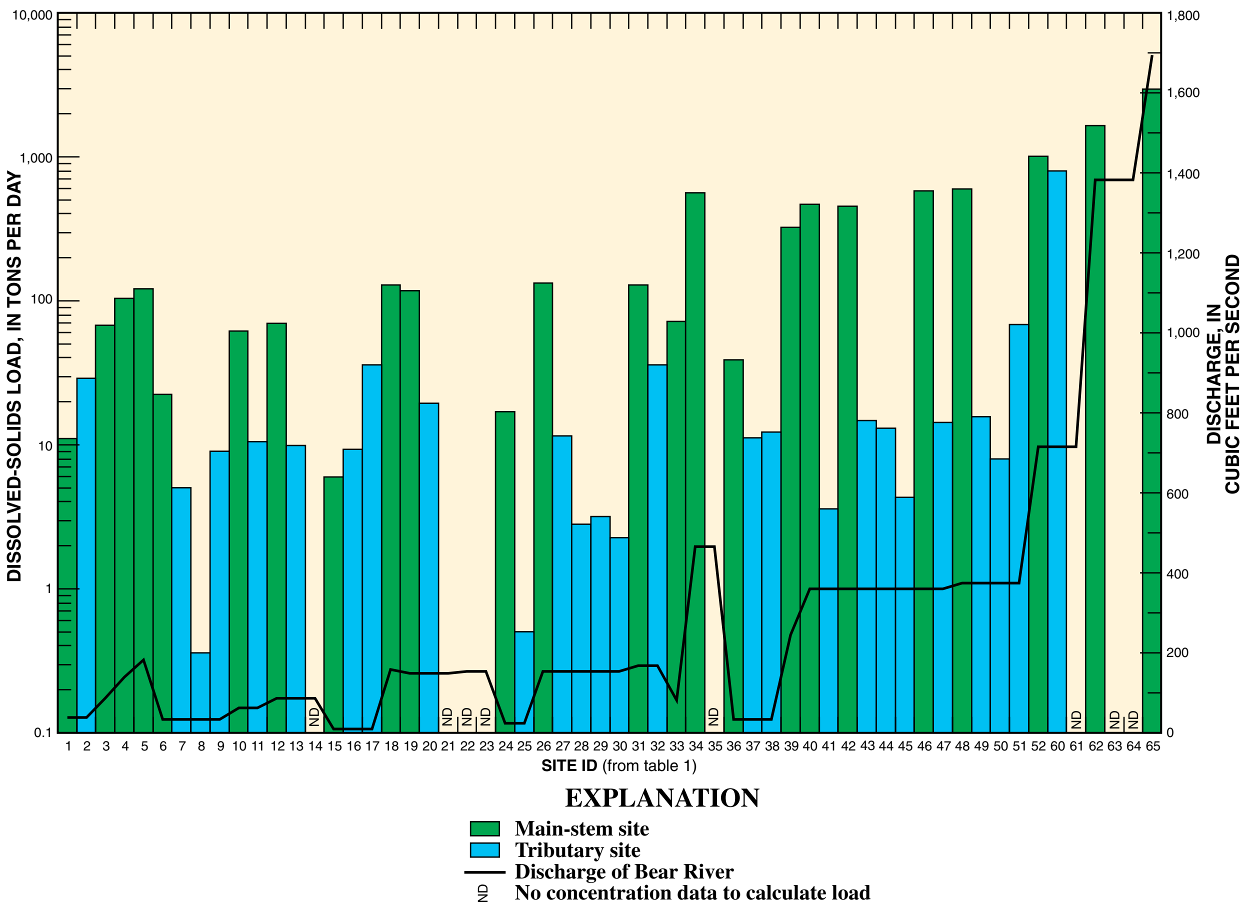

Figure 9. Dissolved-solids load calculated from water samples collected from selected sites in the Bear River basin, March 2001.

chloride (*fig. 7*). In addition, water samples collected from site 62 in March showed a dominance of calcium and bicarbonate. Because most of the water from the reservoir was diverted past site 62 and discharge in the river below the reservoir was low, the increase in dissolved solids probably was caused by ground-water inflow from mineralized springs downstream from the reservoir.

Utah waters protected for agricultural uses, such as irrigation of crops and stock watering, should have a dissolved-solids concentration of less than 1,200 mg/L to meet their beneficial-use designation (Utah Division of Administrative Rules, 2005). The Bear River from Cutler Reservoir to Corinne is designated for the beneficial use of agriculture; however, the concentration of dissolved solids in the Bear River near Corinne (site 65) in July-August was 2,540 mg/L and exceeded the Utah standard for agricultural uses. Some of the tributary streams in the reach between Cutler Reservoir and Corinne, such as the Malad River (site 64) and Salt Creek, which flows into the Bear River about 4 mi upstream from Corrine and originates from Crystal Hot Springs, have naturally high concentrations of dissolved solids. Much of the water for the Malad River during low-flow periods is provided by mineralized hot springs. Waddell and Price (1972) reported concentrations as high as 5,700 mg/L in the Malad River and Mundorff (1970) reported dissolved-solids concentrations as high as 45,500 mg/L in Salt Creek. These inputs have a substantial effect on the concentration of dissolved solids in the Bear River near Corinne, especially during periods of low flow.

Suspended Sediment

Suspended-sediment sources in the Bear River basin include unstable channels, watershed runoff, and stream-bank instability from hydrologic modification. The median concentrations of suspended sediment in Bear River basin streams during the two study periods were compared by using a two-sided Wilcoxon rank-sum test (Ott and Longnecker, 2001, p. 287-299) and determined not to be statistically different (p-value 0.69). Concentrations of suspended sediment above the 75th percentile, however, were much higher in samples collected from tributaries in March than in July-August (*tables 6* and *7*). Concentrations of suspended sediment for water samples collected during both study periods are listed in *table 10*.

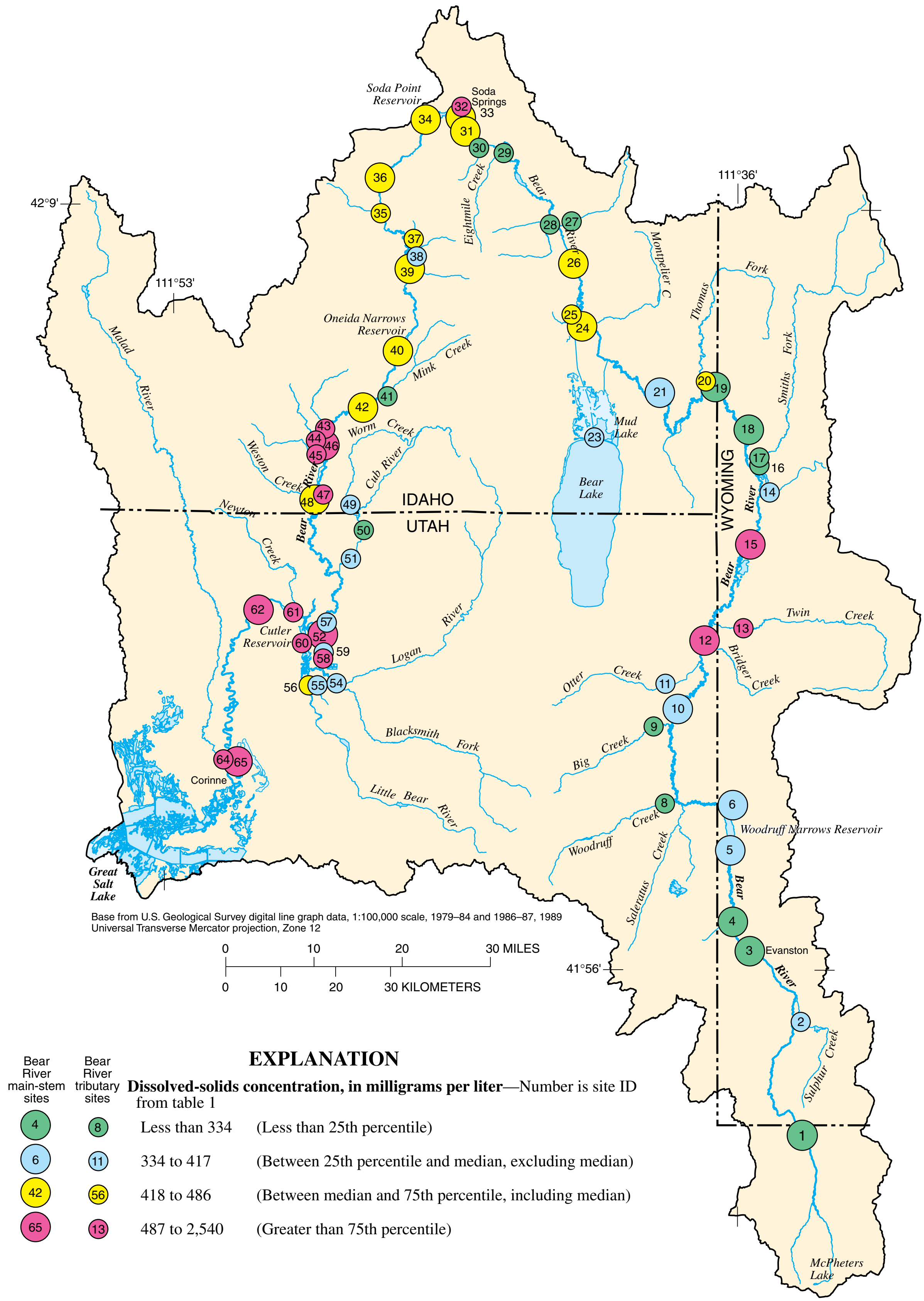

Figure 10. Concentration of dissolved solids in water samples collected from selected sites in the Bear River basin, July-August 2001.

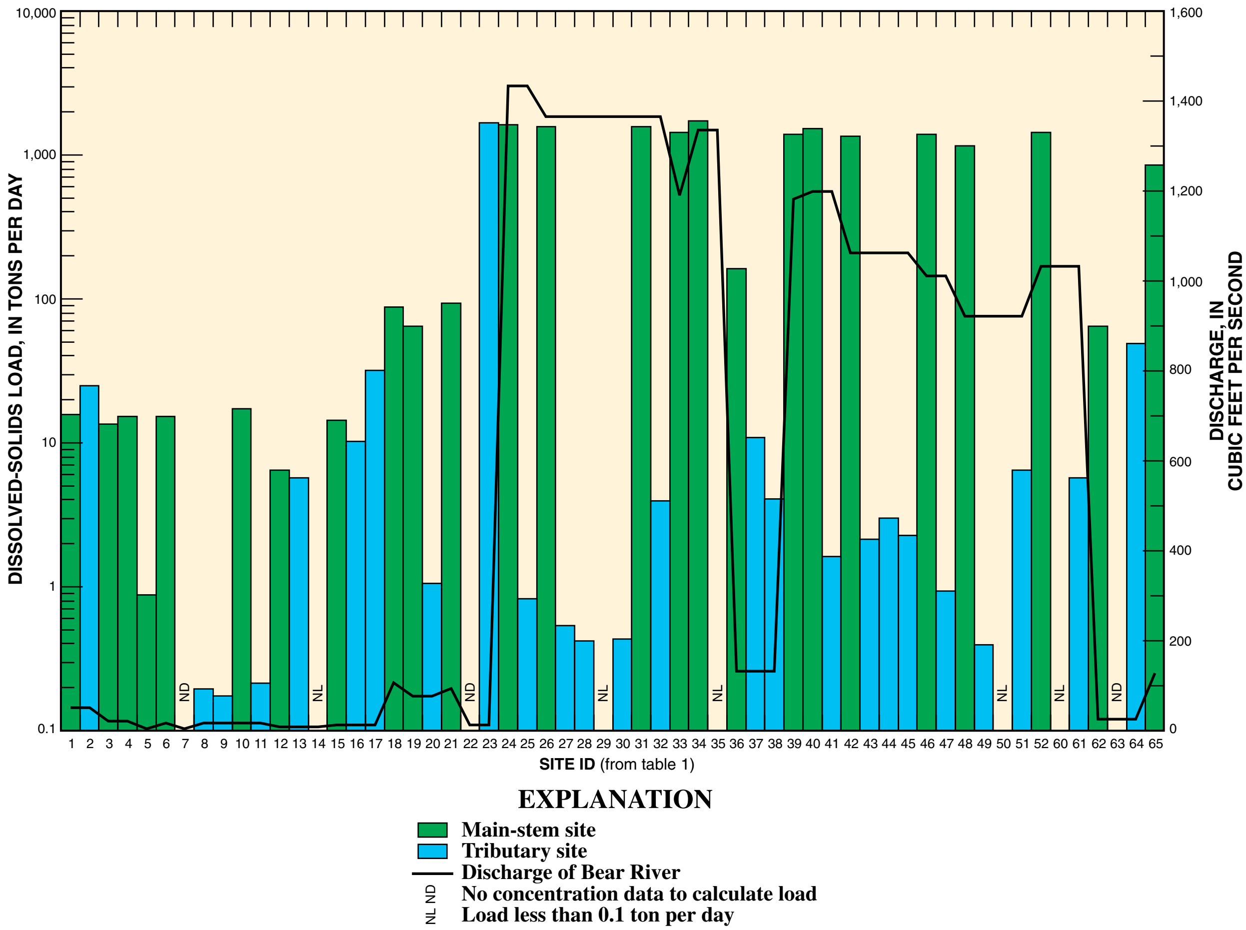

Figure 11. Dissolved-solids load calculated from water samples collected from selected sites in the Bear River basin, July-August 2001.

March

The median concentration of suspended sediment for main-stem sites sampled on the Bear River in March was 28 mg/L (*table 6*) and ranged from 2 mg/L below Woodruff Narrows Reservoir (site 6) to 98 mg/L near Preston (site 46) (*fig. 12*). Tributary concentrations generally were higher than main-stem concentrations, with a median concentration of 48 mg/L. Ten of the 14 samples collected in March with suspended-sediment concentrations greater than the overall 75th percentile (62 mg/L) were from tributary streams (*fig. 12*).

Suspended-sediment concentrations increased from the Utah-Wyoming Stateline (site 1, 3 mg/L) downstream to Bear River above Woodruff Narrows Reservoir (site 5, 90 mg/L). This substantial increase resulted from inputs from Sulphur Creek (site 2, 77 mg/L) and other unmeasured inputs such as that from Yellow Creek (site 4, *fig. 12*). Deposition of sediment in Woodruff Narrows Reservoir, however, resulted in lower concentrations (2 mg/L) downstream at site 6. Concentrations increased downstream to Border, Wyoming (site 19, 61 mg/L) and then decreased downstream again at site 22 at the Stewart Dam diversion into Bear Lake (*fig. 3*). Suspended-sediment concentrations in the Bear River also decreased below Pixley Dam (site 15). The Bear River was entirely diverted into Mud Lake in March with no discharge to the Bear Lake Outlet Canal (*fig. 3*). Consequently, flow in the canal was composed mostly of ground water, resulting in low suspended-sediment concentrations downstream at sites 24 (4 mg/L) and 26 (9 mg/L) (*fig. 12*).

Suspended-sediment concentrations in the Bear River increased in the vicinity of Soda Springs downstream to Oneida Narrows Reservoir, but almost quadrupled from below the reservoir (site 40, 25 mg/L) to near Preston (site 46, 98 mg/L), largely because of substantial contributions of sediment from Battle Creek (site 43), Deep Creek (site 44), and Fivemile Creek (site 45) (*fig. 12*). Suspended-sediment concentrations at sites 43 (861 mg/L) and 44 (395 mg/L) were the first and third highest in the Bear River basin during March. Further, these two tributaries contributed a combined suspended-sediment load of almost 26 tons/d to the Bear River (*fig. 13*), or about 38 percent of the increase in suspended-sediment load between Oneida Narrows Reservoir and Preston. Weston Creek (site 47) and the Cub River (site 51) also contributed substantial amounts of sediment to the Bear

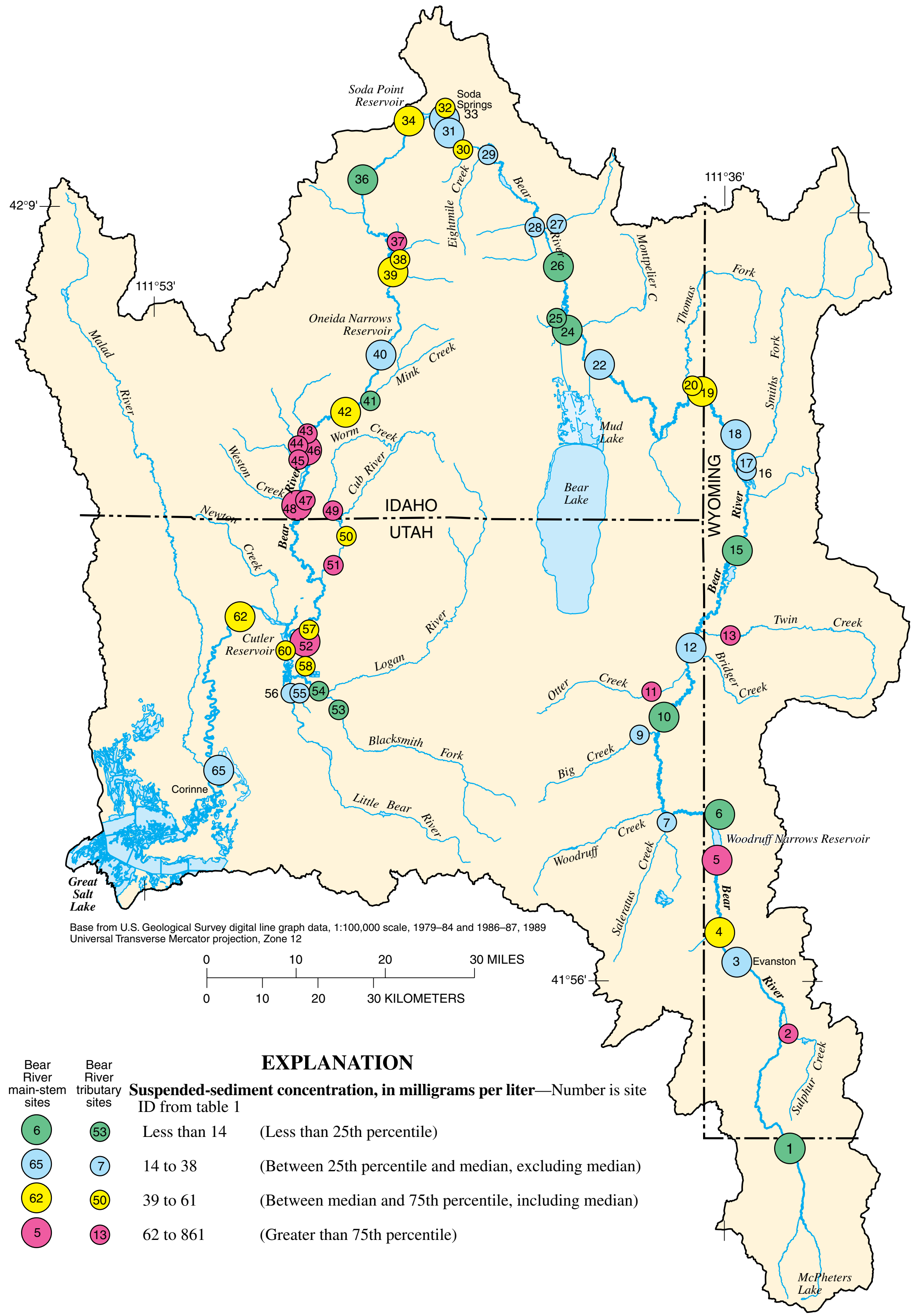

Figure 12. Concentration of suspended sediment in water samples collected from selected sites in the Bear River basin, March 2001.

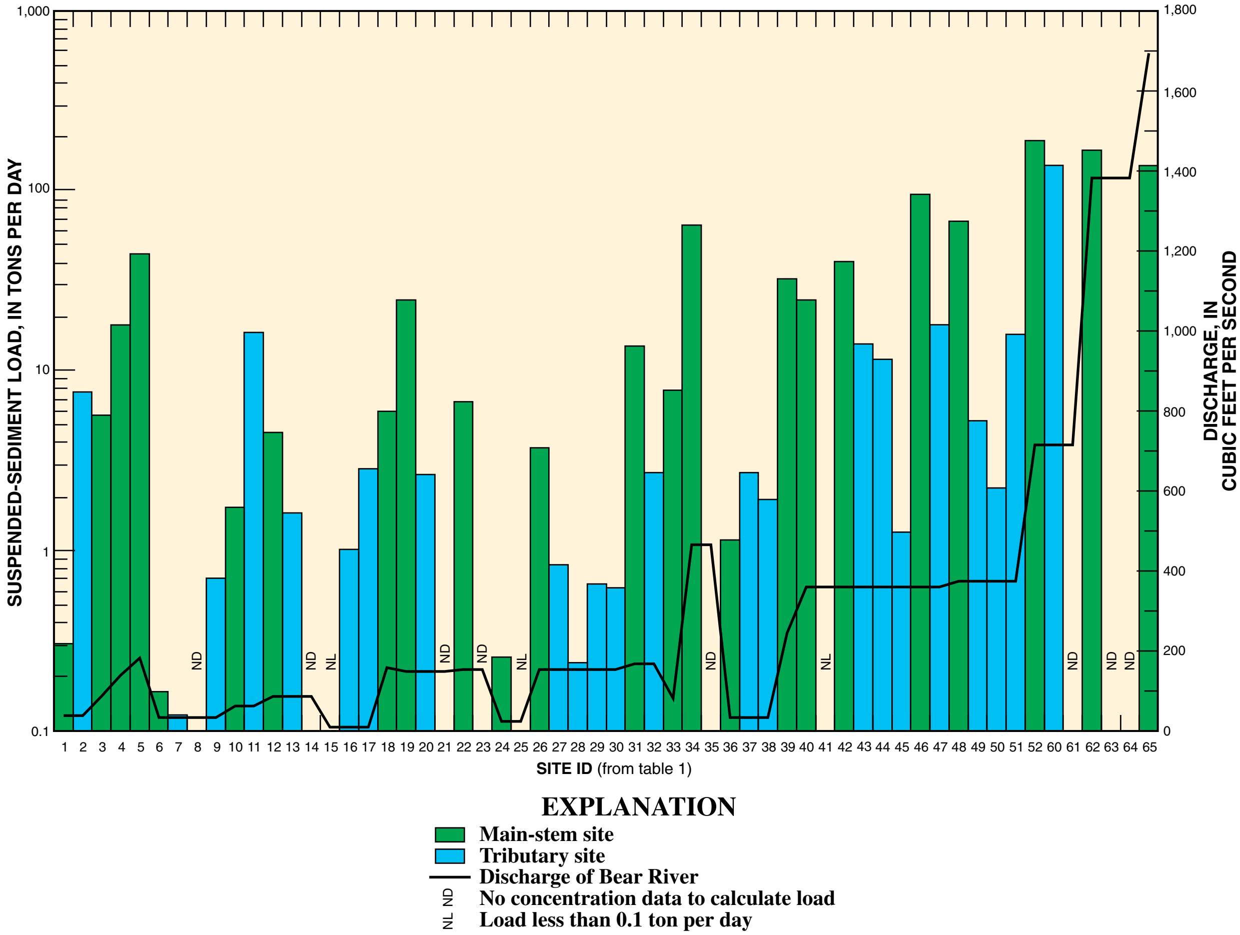

Figure 13. Suspended-sediment load calculated from water samples collected from selected sites in the Bear River basin, March 2001.

River during March, resulting in concentrations greater than the 75th percentile in the main stem downstream to Cutler Reservoir (*fig. 12*). Otter Creek (site 11) and Whiskey Creek (site 37) also had high sediment concentrations in March, which resulted in increased concentrations in the Bear River downstream from their respective confluences.

The Little Bear River and its tributaries were the largest contributors of sediment to the Bear River in March with respect to load (138 tons/d at site 60) (*fig. 13*). Sediment load into Cutler Reservoir from both the Bear and Little Bear Rivers was about 322 tons/d; however, only 163 tons/d discharged from Cutler Reservoir downstream at site 62, near Collinston. A substantial amount of sediment may have been deposited in the reservoir or in the low-gradient reach between the reservoir and site 62.

July-August

The median suspended-sediment concentration for all sites sampled on the Bear River in July-August was 38 mg/L (*table 7*) and ranged from 2 mg/L at Evanston (site 3) to 141 mg/L near Benson (site 52) (*fig. 14*). Tributary concentrations ranged from 3 mg/L in Densmore Creek (site 35) to 179 mg/L in Soda Creek (site 32), with a median concentration of 36 mg/L. Suspended-sediment concentration in Soda Creek increased threefold from the concentration measured at this site in March and was associated with a decrease in discharge from 17 to less than 1 ft^3/s. The concentration below Pixley Dam (site 15) was 84 mg/L, but inflow from Smiths Fork (site 17) had a suspended-sediment concentration of 9 mg/L and reduced concentrations in the Bear River at site 18, below the confluence, to 16 mg/L (*fig. 14*). The concentration of suspended sediment in the Bear River increased from Border, Wyoming (site 19, 16 mg/L) downstream to the Stewart Dam diversion (site 22, 52 mg/L). The suspended-sediment concentration was only 17 mg/L in water discharged from Bear Lake into the Bear Lake Outlet Canal (site 23); however, the concentration increased as flow moved through the canal to site 24 (51 mg/L) and downstream to site 26 (76 mg/L). The increase in concentration along the canal probably is derived in large part from outflow from Mud Lake via Dingle Swamp (*fig. 3*). Because of the large discharge from Bear Lake, suspended-sediment loads were also the highest (176 tons/d at site 24) of any input to the Bear River in the basin (*fig. 15*). Concentrations of suspended sediment in the Bear River decreased below Soda Point, Oneida Narrows, and Cutler Reservoirs

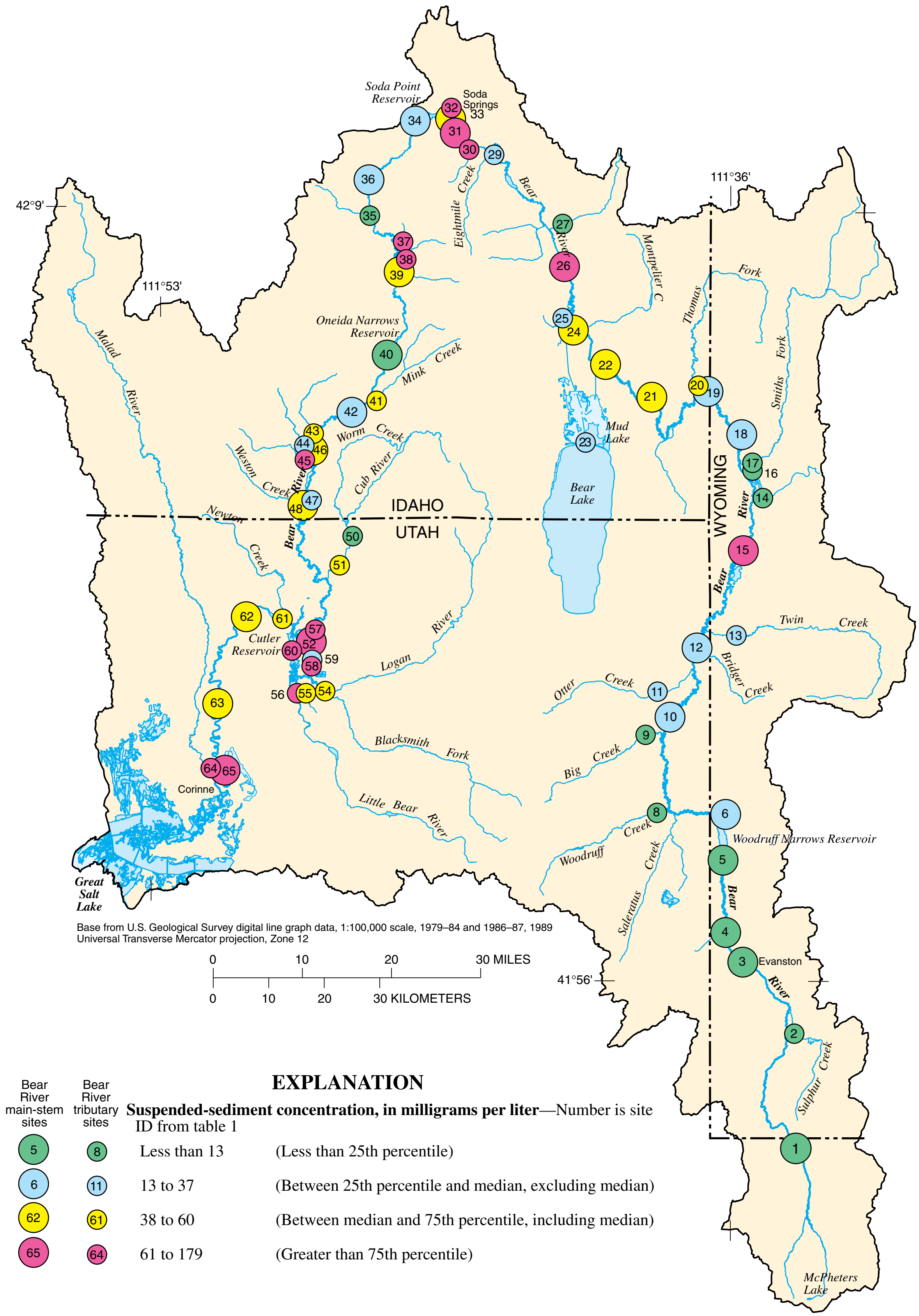

Figure 14. Concentration of suspended sediment in water samples collected from selected sites in the Bear River basin, July-August 2001.

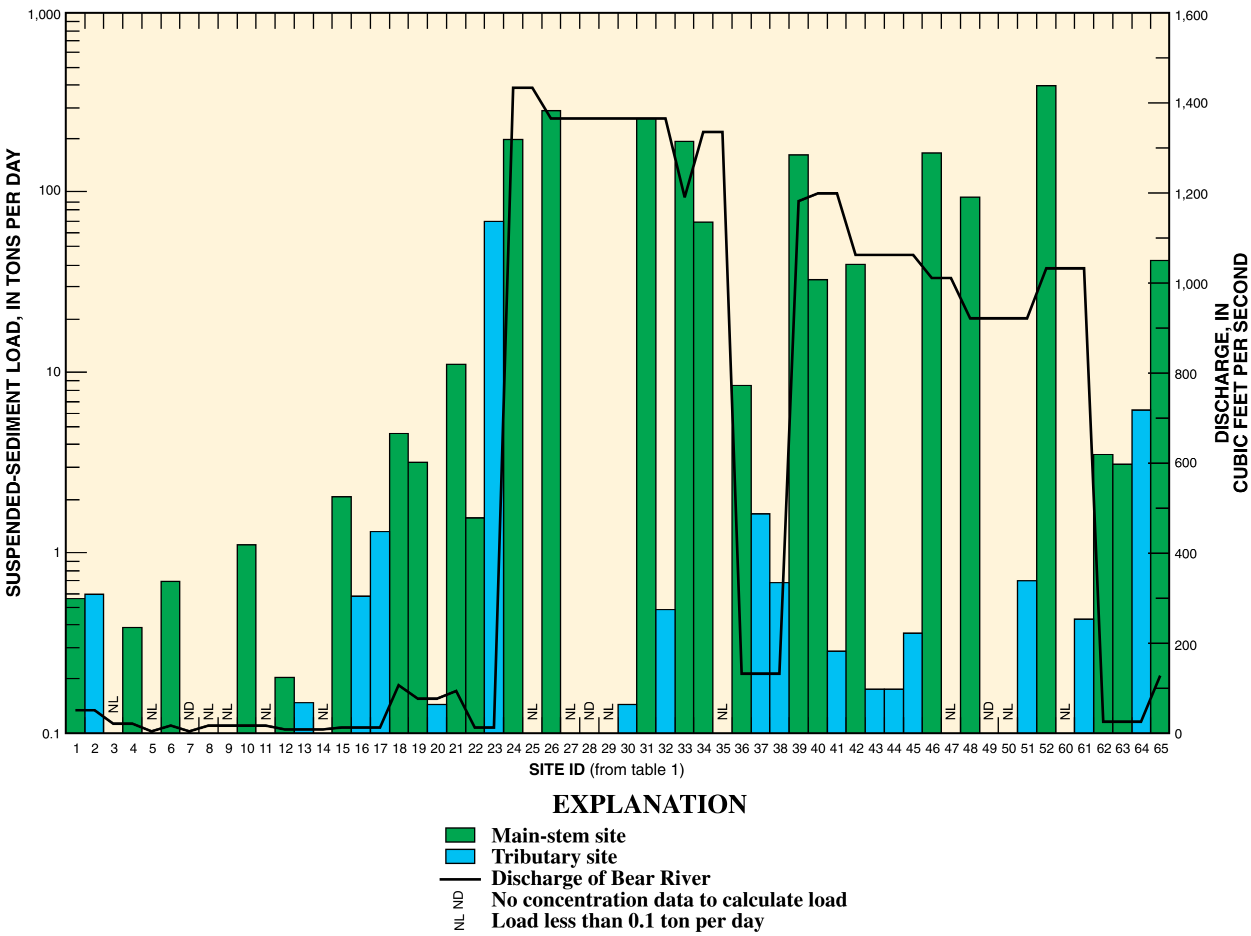

Figure 15. Suspended-sediment load calculated from water samples collected from selected sites in the Bear River basin, July-August 2001.

relative to sites above the reservoirs because of deposition of sediment in the reservoirs.

The suspended-sediment concentration in the Bear River near Benson (site 52, 141 mg/L) was almost four times greater than the concentration upstream at the Idaho-Utah Stateline (site 48, 38 mg/L) (*fig. 14*). The suspended-sediment load also was highest at this site (392 tons/d) (*fig. 15*). Because the maximum concentration of suspended sediment in three tributaries entering this reach was only 41 mg/L (as measured at site 51 on the Cub River), elevated sediment concentrations near site 52 were likely caused by cutting of unstable stream banks resulting from flow modification. The concentration of suspended sediment was 111 mg/L in the Little Bear River at Benson Marina (site 60); however, there was no detectable flow in the river because of backwater from the Bear River. Consequently, there was no measurable contribution of sediment from the Little Bear River to the Bear River during the July-August sampling period.

Other tributaries to the Bear River that resulted in increases in suspended-sediment concentration downstream from their confluences with the river include Whiskey Creek (site 37), Trout Creek (site 38), and the Malad River (site 64). A suspended-sediment concentration of 148 mg/L in the Malad River contributed to an increase of 75 mg/L in the Bear River between site 63 (near Deweyville) and site 65 (near Corinne), just upstream from its junction with Great Salt Lake (*fig. 14*). The suspended-sediment load in the Bear River also increased from 3 to 41 tons/d between sites 63 and 65 (*fig. 15*).

Nutrients

Nutrients, including nitrogen and phosphorus, are essential to the health and function of natural ecosystems (U.S. Geological Survey, 1999). Insufficient amounts of nutrients can lower growth rates of primary producers, such as aquatic vegetation, and limit the diversity and productivity of the ecosystem. Excessive amounts of nutrients can result in public health concerns and a general decline of the aquatic ecosystem health caused by accelerated growth of algae (eutrophication) and the large diurnal changes in dissolved oxygen and pH that sometimes occur. Nutrients occur naturally in streams because of mineral weathering and biological activity in the streambed sediment. Streams may receive additional nutrients from agricultural and urban runoff, atmospheric deposition, and wastewater discharge. Excessive amounts of nutrients have been identified as a source of impairment in many stream segments in the Bear River basin (*table 3*). Concentrations of nutrients in water samples collected during the March and July-August sampling periods are shown in *table 10*.

Nitrogen

Nitrogen species include ammonia, ammonia plus organic nitrogen, and nitrite plus nitrate. Excess concentrations of these constituents commonly are derived from agricultural sources such as fertilizers and feedlots. High nitrogen concentrations in surface water can degrade water quality, resulting in eutrophication and growth of algae, which, in turn, can create hypoxic (low oxygen) conditions that are detrimental to aquatic life (U.S. Geological Survey, 1999). High nitrate concentrations in drinking-water sources also can result in low oxygen levels in infants, causing methemoglobinemia or blue-baby syndrome (Eldridge, 2002). High levels of nitrite and organic nitrogen often are indicators of pollution caused by sewage or other organic waste. In oxygenated (non-polluted) waters, concentrations of nitrite are typically two orders of magnitude lower than nitrate concentrations.

March

Dissolved ammonia concentrations in the Bear River in March ranged from less than 0.021 mg/L (as N) at several sites to 0.473 mg/L near Corinne (site 65) (*table 10*), with a median concentration of 0.153 mg/L (*table 6*). Tributary concentrations also ranged from less than 0.021 mg/L at several sites to 1.43 mg/L in Spring Creek (site 55) with a median concentration of 0.149 mg/L. Ammonia toxicity relative to aquatic organisms is dependent on pH and water temperature. Ammonia concentrations in water samples collected from the Bear River basin in March generally were much lower than national water-quality guidelines; however, the concentration in Spring Creek exceeded the EPA chronic criterion of 1.09 mg/L (U.S. Environmental Protection Agency, 1999). Ammonia is known to be a problem contaminant in Spring Creek and the Utah Division of Water Quality has prepared a TMDL document addressing the problem (PSOMAS and Cirrus Ecological Solutions, written commun., 2002).

Dissolved ammonia plus organic nitrogen concentrations in Bear River basin streams in March ranged from less than 0.1 mg/L near the Utah-Wyoming Stateline (site 1) to 2.4 mg/L in Spring Creek (site 55) (table 10). Spring Creek is the only site where concentrations of all ammonia species exceeded 1.0 mg/L, which likely results from agricultural practices (fertilizers) and livestock grazing in this part of the basin. The highest concentrations of ammonia plus organic nitrogen were measured in tributaries in the lower part of the basin below Oneida Narrows Reservoir.

Dissolved nitrite plus nitrate concentrations in the Bear River in March ranged from 0.044 mg/L (estimated) at site 12 (above Bridger Creek) to 1.76 mg/L near Collinston (site 62) (*fig. 16*), with a median concentration of 0.429 mg/L (*table 6*). Tributary concentrations ranged from 0.042 mg/L (estimated) at Smiths Fork (site 17) to 5.28 mg/L in Spring Creek (site 55), with a median concentration of 0.666 mg/L. Dissolved nitrite plus nitrate concentrations in Worm Creek (site 49) were the second highest (4.57 mg/L, estimated) in the Bear River basin. The nitrate concentration in the water sample from Spring Creek was the only value that exceeded the Utah pollution indicant value of 4.0 mg/L (Utah Division of Administrative Rules, 2005). Nitrogen sources in the Spring Creek basin include animal waste, septic systems, and industrial discharge (PSOMAS and Cirrus Ecological Solutions, written commun., 2002).

Concentrations of dissolved nitrite plus nitrate measured and estimated in water samples from 12 of 13 sites upstream from Soda Springs (site 33) were less than the median concentration of 0.526 mg/L for all sites (*fig. 16*). The only exception was the sample from Thomas Fork (site 20), which had a concentration of 1.17 mg/L. Concentrations in water samples from sites downstream from Soda Springs were greater than the median concentration, except for samples from the Logan River (site 54) and Blacksmith Fork (site 53). Higher nitrite plus nitrate concentrations in water samples from sites downstream from Soda Springs probably are caused by larger amounts of agricultural and urban inputs to the river in the segment between Soda Springs and Great Salt Lake. Also, as a result of warmer air temperatures, more snowmelt runoff occurred downstream from Soda Springs (the March average daily air temperature at Logan, Utah, was more than 11 degrees warmer than the average daily air temperature at Randolph, Utah), which resulted in transport of larger amounts of nitrite plus nitrate from these areas. An increase in discharge of the Bear River from 370 ft^3/s at the Idaho-Utah Stateline (site 48) to 1,380 ft^3/s at site 62, near Collinston, also resulted in an increase in the nitrite plus nitrate load in the Bear River from 1.06 to 6.53 tons/d, respectively (*fig. 17*).

July-August

Dissolved ammonia concentrations in the Bear River in July-August ranged from less than 0.021 mg/L at several sites to 0.198 mg/L below Woodruff Narrows Reservoir (site 6) (*table 10*). Tributary concentrations ranged from less than 0.021 mg/L at many sites to 0.061 mg/L in Spring Creek (site 55). Ammonia concentrations in water samples from the Bear River basin in July-August were much lower than national water-quality guidelines, with a median concentration of 0.024 mg/L (estimated) (*table 7*).

Dissolved ammonia plus organic nitrogen concentrations in Bear River basin streams in July-August were lower than those measured in March, ranging from less than 0.1 mg/L in Trout Creek at Thatcher (site 38) to 0.89 mg/L in the Bear River below Woodruff Narrows Reservoir (site 6) (*table 10*). Median concentrations of ammonia plus organic nitrogen were substantially greater (as much as one order of magnitude) than dissolved ammonia for samples collected during March and

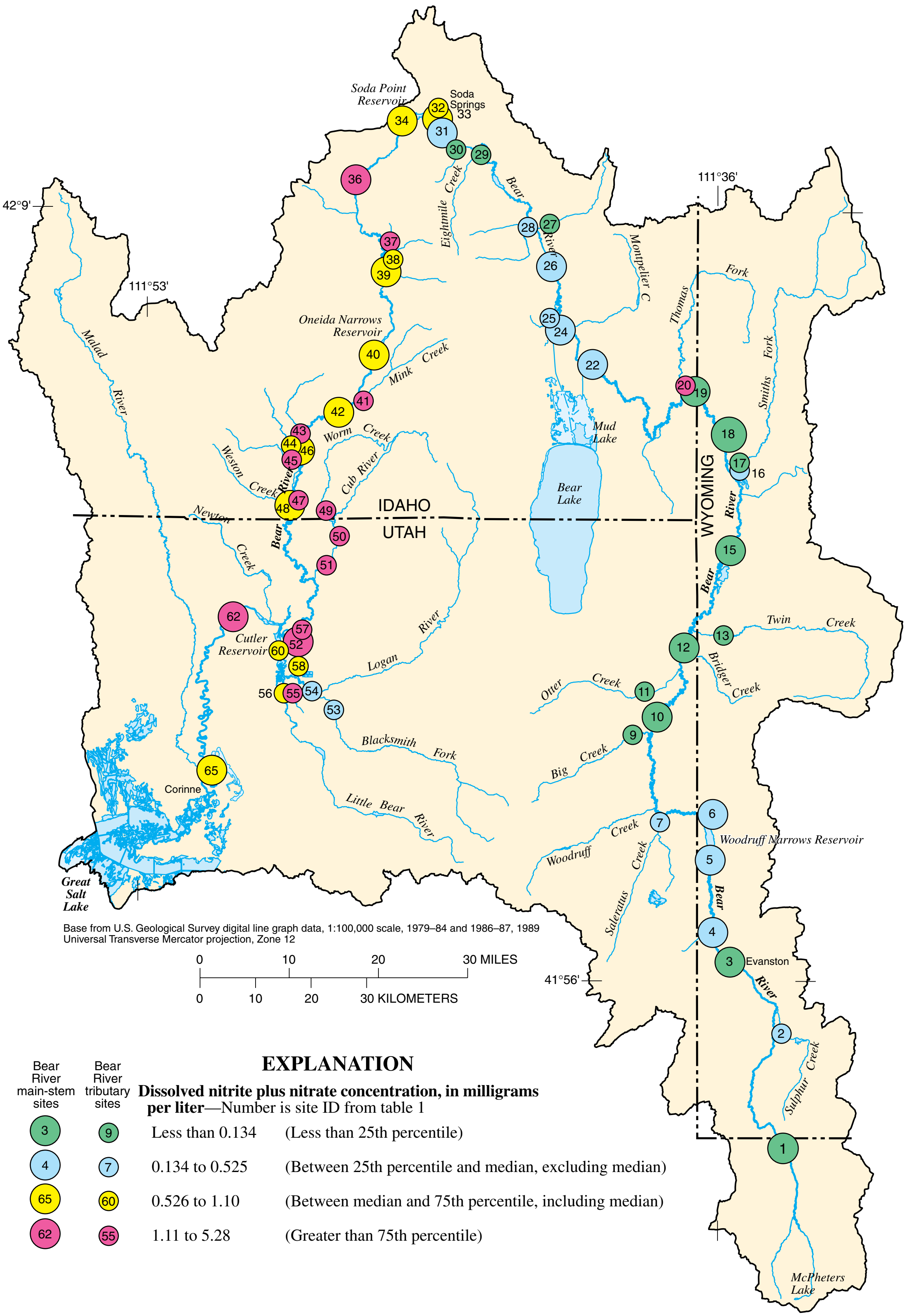

Figure 16. Concentration of dissolved nitrite plus nitrate in water samples collected from selected sites in the Bear River basin, March 2001.

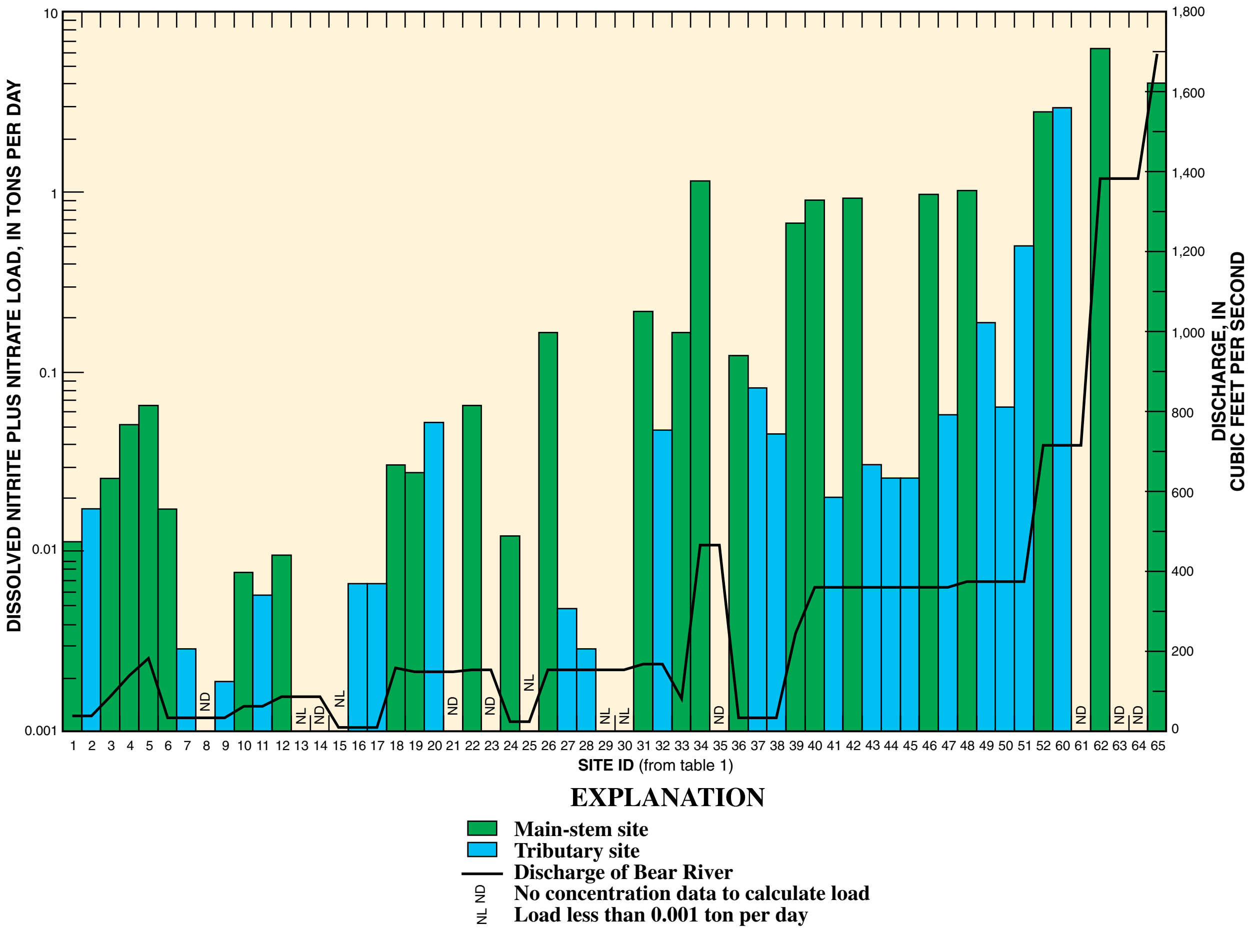

Figure 17. Dissolved nitrite plus nitrate load calculated from water samples collected from selected sites in the Bear River basin, March 2001.

July-August, indicating that most of the nitrogen is present as organic nitrogen. Concentrations of dissolved ammonia and ammonia plus organic nitrogen in the Bear River and particularly in tributaries typically were higher in March than in August, probably as a result of increased runoff from agricultural areas.

Dissolved nitrite plus nitrate concentrations in the Bear River in July-August ranged from 0.023 mg/L (estimated) at Border, Wyoming (site 19) to 0.69 mg/L near Corinne (site 65) (*fig. 18*), with a median concentration of 0.05 mg/L (*table 7*). Tributary concentrations ranged from less than 0.023 mg/L at many sites to 3.06 mg/L in Whiskey Creek (site 37), with a median concentration of 0.032 mg/L. The median nitrite plus nitrate concentration in water samples collected from all sites in July-August (0.041 mg/L) was less than one-tenth of the median for all March water samples (0.525 mg/L), a result, in part, of increased uptake of nitrogen by aquatic plants and less surface runoff containing animal waste during the late summer.

As with the March distribution, water samples collected from most sites upstream from Soda Springs generally contained nitrite plus nitrate concentrations lower than the median (*fig. 18*). Water samples collected from sites downstream from Soda Springs generally contained concentrations of nitrite plus nitrate higher than the median (*fig. 18*). Most of the water samples containing nitrite plus nitrate concentrations higher than 0.22 mg/L (75th percentile) were collected from tributary streams.

Ground-water inflow to Black Canyon (*fig. 1*, site 36) contains a large amount of nutrients. Most of the flow of the Bear River upstream from site 36 is diverted past Black Canyon through a large diversion pipe. Daily discharge at the upstream end of Black Canyon and downstream from the diversion at Grace Dam (*fig. 1*) was about 100 ft^3/s (Herbert and others, 2002) and 130 ft^3/s (*table 5*) at site 36 just upstream from Grace power plant at the lower end of the canyon. The increase in discharge of 30 ft^3/s resulted from local ground-water inflow to the river in Black Canyon. The concentration of dissolved nitrite plus nitrate at the head of the canyon was assumed to be the same as at site 34, below Soda Point Reservoir (0.052 mg/L), and the measured concentration at the lower end of the canyon at site 36 was 0.282 mg/L. By using the flows and concentration at the head and lower end of Black Canyon, the average concentration of nitrite plus nitrate

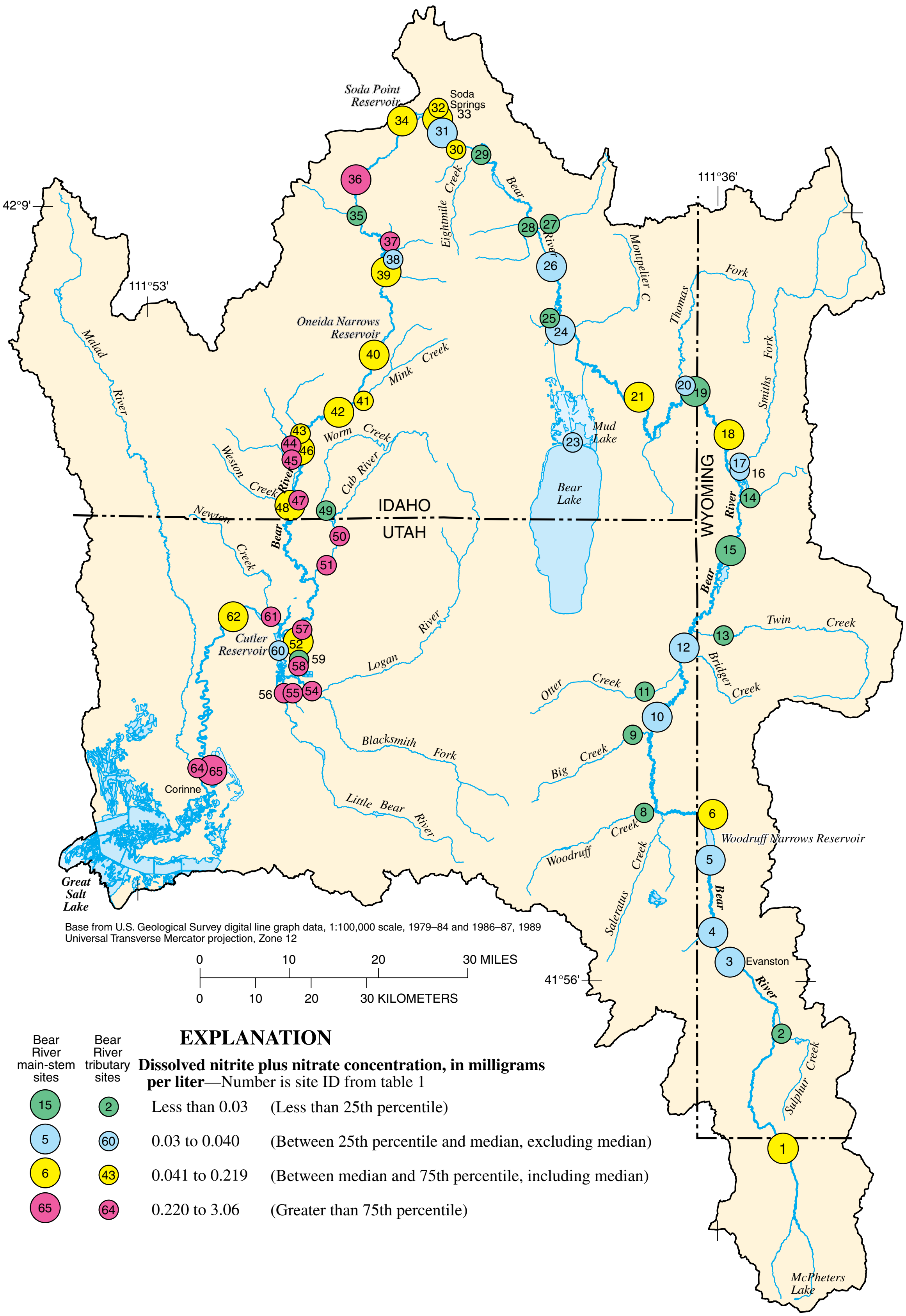

Figure 18. Concentration of dissolved nitrite plus nitrate in water samples collected from selected sites in the Bear River basin, July-August 2001.

in ground-water inflow to the canyon was estimated to be 1 mg/L.

The dissolved nitrite plus nitrate concentration more than doubled (as did the loads) from site 34 at Alexander (0.052 mg/L) to site 39 near Thatcher (0.111 mg/L) (*fig. 19*), probably because of ground-water inflow downstream from Grace Dam *(fig. 18)*. Water applied for irrigation in Gem Valley (*fig. 1*) readily infiltrates down to and through the highly permeable basalts in this area, bringing dissolved nitrite plus nitrate to the river. The largest nitrate loads to the Bear River were contributed by outflow from Bear Lake (site 23), Whiskey Creek (site 37), and from the Malad River (site 64) (*fig. 19*). A high nitrite plus nitrate concentration (1.34 mg/L) in inflow from the Malad River contributed to a two-order-of-magnitude increase in load between sites 62 (Collinston) and 65 (Corinne) on the Bear River.

Phosphorus

Phosphorus is a major cellular building component of plants and animals. It is used for adenosine triphosphate (ATP) formation, phospholipid production, and DNA synthesis. Because plants readily take up the soluble form of phosphorus (orthophosphate), unless additional phosphorus is introduced to an aquatic system from anthropogenic sources, it is typically in short supply and can be a limiting nutrient. Unlike nitrogen, phosphorus does not form any toxic byproducts as it cycles through the ecosystem.

The reference conditions for total phosphorus for level III subecoregions 13, 18, and 19 in the Bear River basin are 0.029, 0.022, and 0.010 mg/L (based on the 25th percentile), respectively (U.S. Environmental Protection Agency, 2000b). Forty-nine of the 57 sites sampled had a total phosphorus concentration exceeding these reference conditions in either March or July-August. The Bear River near the Utah-Wyoming Stateline (site 1) was the only site where total phosphorus concentrations in water samples collected in both March and July-August were less than the reference condition of 0.022 mg/L for Aggregate Nutrient Ecoregion III streams.

March

During March, concentrations of total phosphorus in the Bear River ranged from less than 0.004 mg/L near the Utah-Wyoming Stateline (site 1) to 0.49 mg/L near Collinston (site

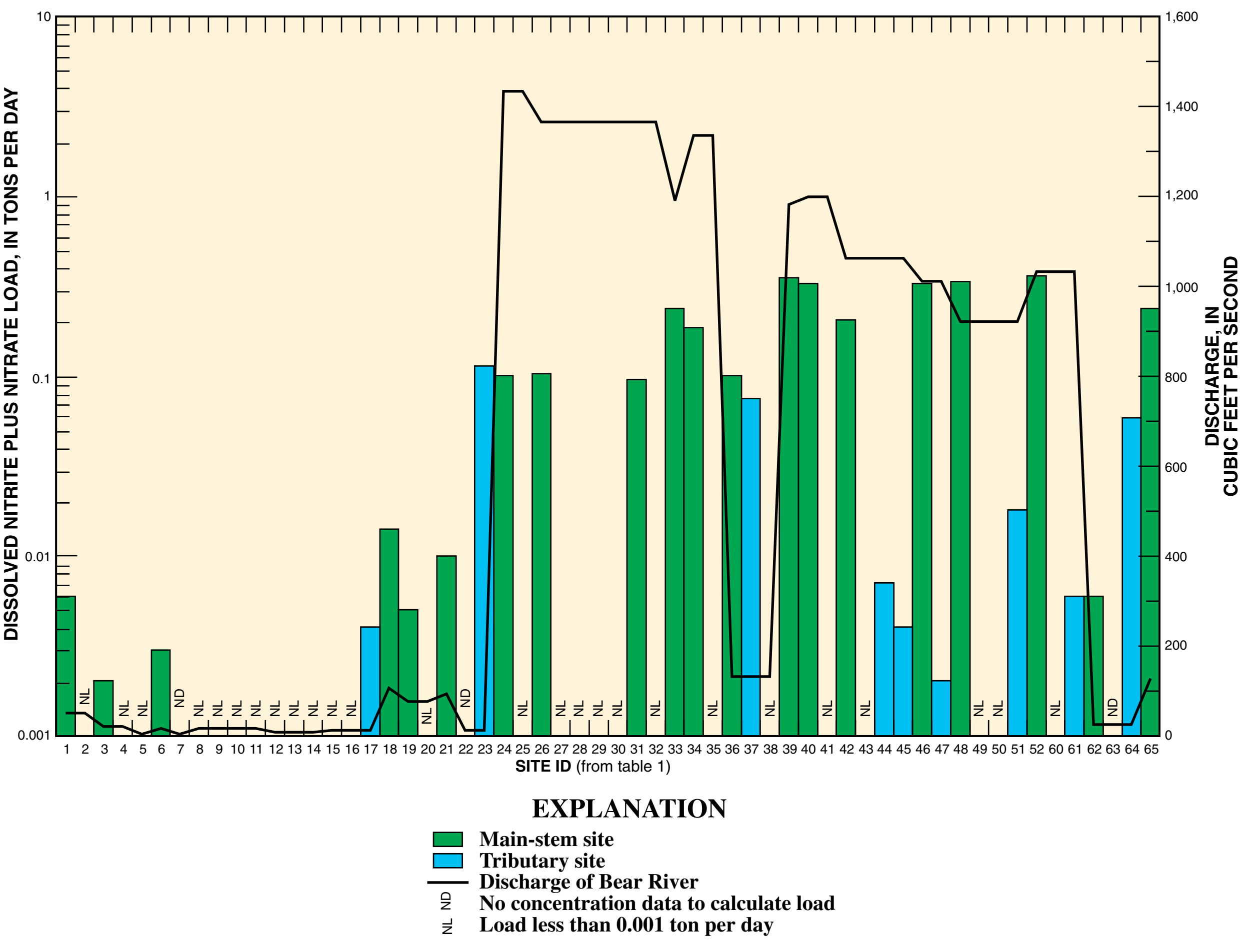

Figure 19. Dissolved nitrite plus nitrate load calculated from water samples collected from selected sites in the Bear River basin, July-August 2001.

62) (*fig. 20*). Total phosphorus concentrations in tributary streams ranged from less than 0.02 mg/L in Ovid Creek (site 25) and Blacksmith Fork (site 53) to 2.4 mg/L in the Logan wastewater-treatment plant ditch (site 58).

Concentrations of total phosphorus in the Bear River generally increased from upstream to downstream (*fig. 20*). Sites upstream from Preston (site 46) generally had lower total phosphorus concentrations (less than 0.073 mg/L); sites downstream from Preston had higher concentrations (0.073 to 0.49 mg/L). Tributaries contributed substantial amounts of total phosphorus to the Bear River. The total phosphorus concentration was less than 0.004 mg/L in the Bear River near the Utah-Wyoming Stateline (site 1); however, inputs from Sulphur Creek (site 2, 0.441 mg/L) and possibly Yellow Creek (site 4, 0.167 mg/L) contributed to the increase to 0.273 mg/L in the Bear River above Woodruff Narrows Reservoir (site 5) (*fig. 20*). The total phosphorus concentration below the reservoir (site 6, 0.05 mg/L) was much lower, likely resulting from deposition of phosphorus in the reservoir, probably in association with suspended sediment. Inputs from site 7 (Saleratus Creek, 0.317 mg/L) and site 8 (Genes (Woodruff) Creek, 0.347 mg/L) likely increased total phosphorus concentration in the main stem downstream from these confluences. Smiths Fork (site 17) contributed a substantial amount of flow to the Bear River but had a relatively dilute total phosphorus concentration (0.028 mg/L). The concentration of total phosphorus remained low in the Bear River downstream to Soda Point Reservoir (site 33, 0.035 mg/L).

Most sampled tributaries below Soda Point Reservoir contributed to increasing total phosphorus concentrations in the Bear River (*fig. 20*). Many sampled tributaries downstream from Preston and all Bear River sites downstream from the Idaho-Utah Stateline exceeded 0.273 mg/L (the 75th percentile) total phosphorus. The highest total phosphorus concentration (1.27 mg/L) in March was in Spring Creek (site 55). The largest tributary load (1.3 tons/d) was from the Little Bear River at Benson Marina (site 60) (*fig. 21*), which also includes substantial loads from Spring Creek and the Logan wastewater-treatment plant (site 58). Outflow from the treatment plant contributed 2.4 mg/L total phosphorus to the Little Bear River. Inflow from the Little Bear River into Cutler Reservoir at site 60 (0.45 mg/L) increased the total phosphorus concentration in the Bear River from 0.29 mg/L at site 52 (near Benson) to 0.49 mg/L at site 62 (near Collinston). Total phosphorus concentration in the Cub River (site 51, 0.394 mg/L) also contributed to an increase in concentration and load in the Bear River between sites 48 and 52 (*fig. 21*). The concentration of total phosphorus in the Bear River near Corinne (site 65) decreased to 0.289 mg/L, but was still greater than the 75th percentile.

July-August

Total phosphorus concentrations in the Bear River in July-August ranged from 0.005 mg/L near the Utah-Wyoming Stateline (site 1) to 0.287 mg/L near Corinne (site 65) (*fig. 22*). Total phosphorus in water samples from tributary streams ranged from less than 0.02 mg/L in Twin Creek (site 13) to 2.3 mg/L in the Logan wastewater-treatment plant ditch (site 58).

Concentrations of total phosphorus generally were less than 0.067 mg/L (median) in water samples collected from sites upstream from Bear Lake (*fig. 22*), except at site 6, Bear River below Woodruff Narrows Reservoir (0.198 mg/L) and site 15, Bear River below Pixley Dam (0.107 mg/L). Because of the low level of Woodruff Narrows Reservoir in July-August, conditions may have been conducive for resuspension of phosphorus in reservoir sediments into the water column through wind action or downcutting.

Total phosphorus loads in the Bear River increased substantially downstream from Bear Lake (*fig. 23*). The concentration of total phosphorus in the water sample collected from the Bear Lake outflow (site 23) was very low (0.014 mg/L); however, the concentration near the end of the Bear Lake Outlet Canal (site 24, *fig. 3*) was nearly five times higher (0.067 mg/L), resulting in a load of about 0.26 tons/d to the Bear River (*fig. 23*). Most of the additional phosphorus was in the particulate form and may have been bound to sediment or contained in algae in Mud Lake (*fig. 3*), which then was transported into the outlet canal. Concentrations of total phosphorus generally were between 0.029 mg/L and 0.110 mg/L in water samples collected from sites downstream from Bear Lake (*fig. 22*). Total phosphorus concentrations increased downstream from Preston (site 46), where concentrations at most sites exceeded 0.110 mg/L. Inflow from the Cub River and its tributaries also contributed to an increase in total phosphorus in the Bear River between sites 48 and 52 (*fig. 22*). Tributary streams generally contributed considerably less phosphorus to the Bear River in July-August than in March.

Pesticides

Water samples collected from selected sites in the Bear River basin were analyzed for pesticides (herbicides, insecticides, and degradates). Pesticide samples were collected at 5 sites in March and 15 sites during July-August. Samples collected from all sites were analyzed for 47 pesticides, 8 of which were detected, and samples collected at 9 sites in July-August were analyzed for an additional 61 pesticides, 4 of which were detected (*tables 11* and *12*). Pesticides were detected at all the sites, either in March or July-August, and all detections were less than 0.1 µg/L (*table 11*). Eighty-five percent of the samples had at least one pesticide detected and 70 percent had more than one detected. Concentrations of pesticides in samples collected during both study periods are shown in *table 12*.

Malathion, an organophosphate used to control mosquitoes, lawn and garden pests, and livestock pests, was the insecticide detected most frequently *(table 11*). Prometon, a persistent broad-spectrum herbicide used for bare-ground weed control around buildings, along fences and roadways, and in other non-crop areas, was the herbicide detected most frequently. Atrazine, a herbicide that selectively controls

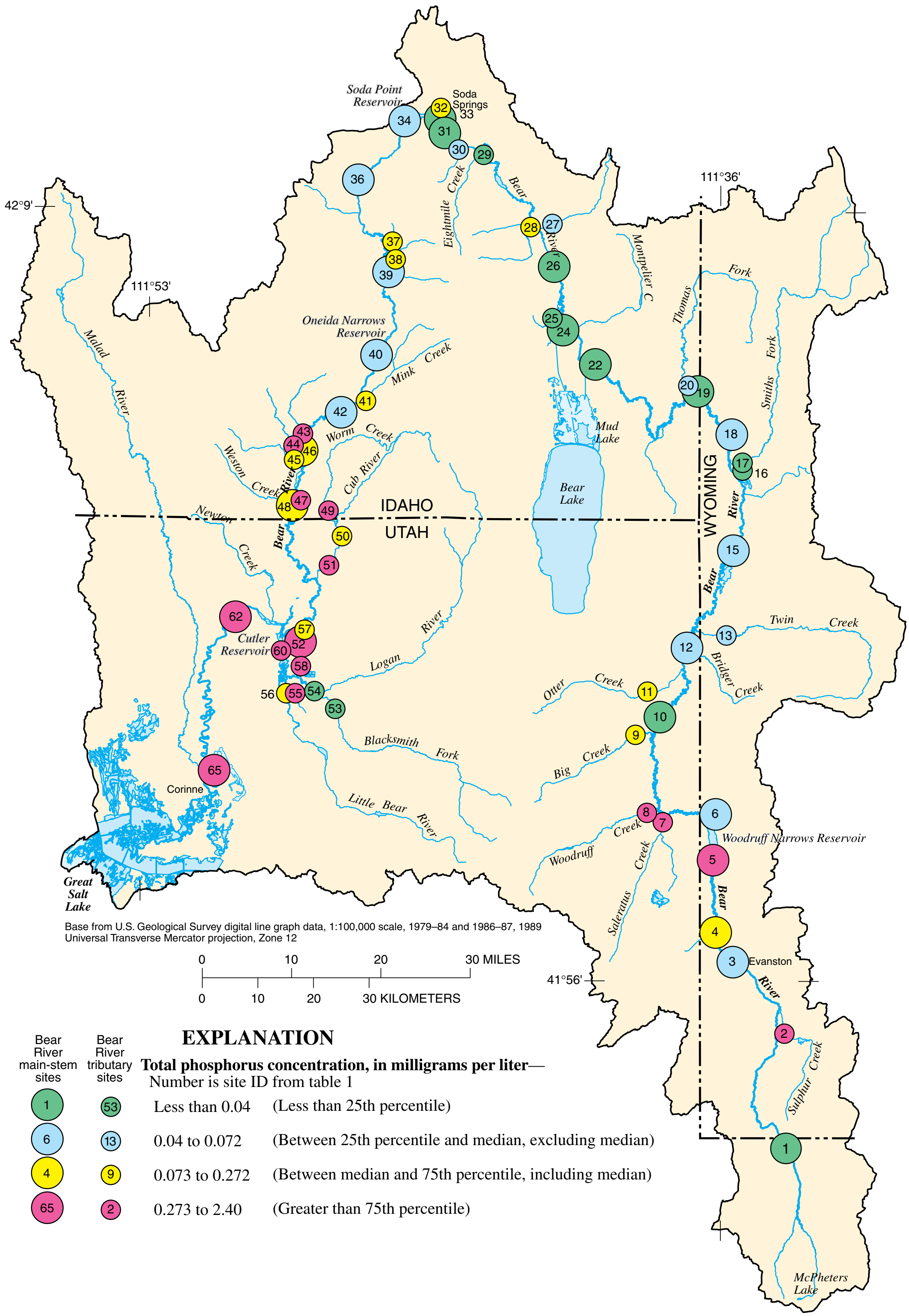

Figure 20. Concentration of total phosphorus in water samples collected from selected sites in the Bear River basin, March 2001.

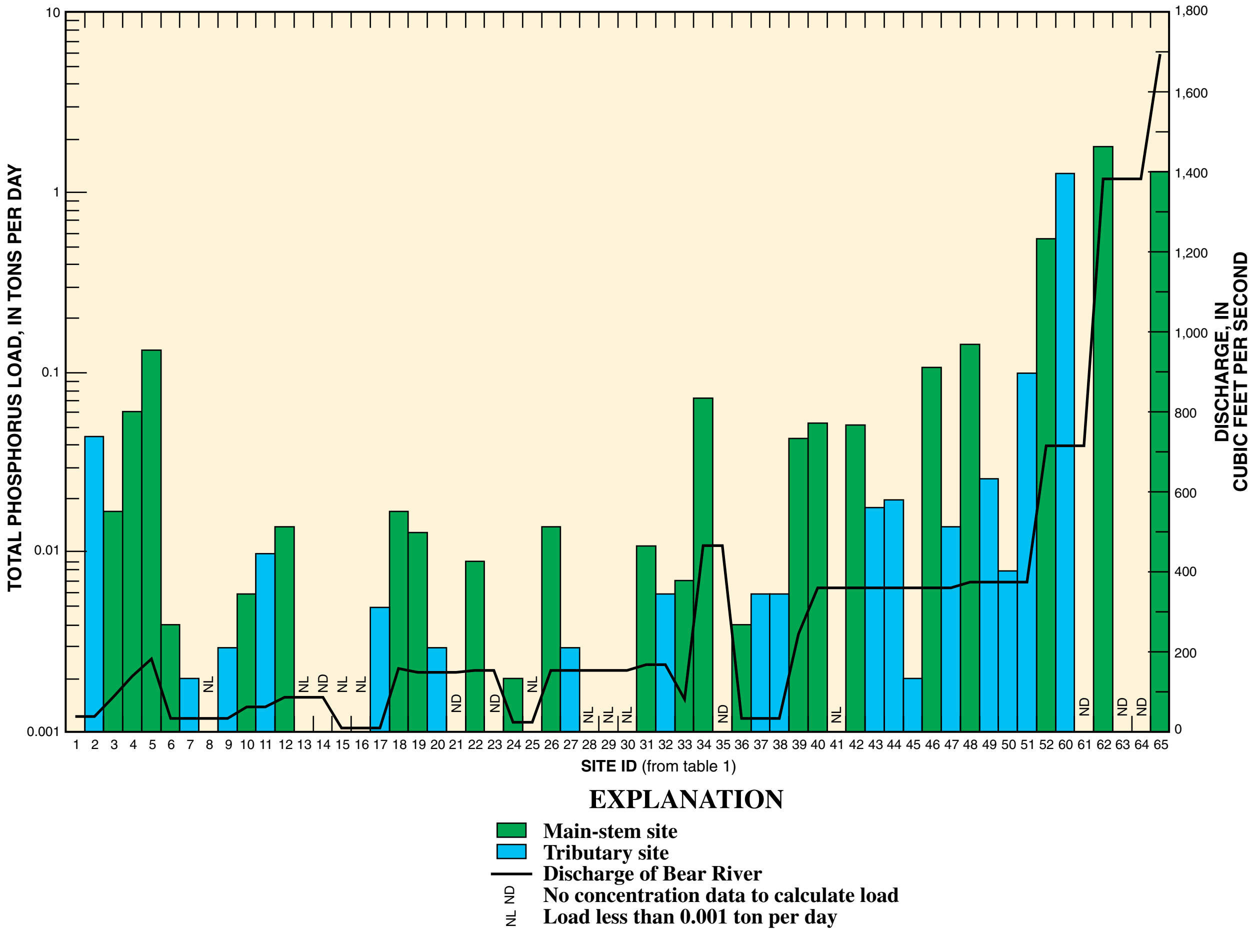

Figure 21. Total phosphorus load calculated from water samples collected from selected sites in the Bear River basin, March 2001.

broadleaf weeds without injury to the target crop, was the pesticide detected in the highest concentration (0.096 µg/L, estimated).

Aquatic-life guidelines have been established for 7 of the 12 pesticides detected (*table 11*). The Canadian Council of Ministers of the Environment (2001) and U.S. Environmental Protection Agency (2002, 2004) established these guidelines as maximum levels that should not be exceeded if aquatic life is to be protected. The concentrations measured in water samples from the Bear River basin were less than the stated guidelines, indicating that there was not a threat to aquatic life in the Bear River during both study periods. The consequences to aquatic life from the presence of mixtures of these pesticides, however, are not known. The EPA has established human-health standards for 9 of the 12 pesticides detected (*table 11*). None of the pesticide concentrations in water samples from Bear River basin sites exceeded these guidelines, and all but atrazine were at least two orders of magnitude less than human-health standards.

Periphyton Chlorophyll *a*

Periphyton (algae attached to an aquatic substrate) samples were collected at 14 sites on the Bear River during August by scraping rocks, snags, or coarse sediments. These samples were then analyzed for CHL A, which is the most common photosynthetic pigment in the sample and commonly is used to compare the abundance of algae among sites. CHL A concentrations ranged from 21 mg/m^2 at site 1 (Bear River near Utah-Wyoming Stateline) to 416 mg/m^2 at site 40 (Bear River below Oneida Narrows Reservoir) (*table 13*). Algal levels in the Bear River ranged from those that presumably would be present under natural conditions to those indicative of eutrophication. Factors that may affect river algal levels include scouring, shading, grazing, toxic chemicals, and available nutrients.

Concentrations of CHL A below the 25th percentile (low concentrations) and above the 75th percentile (high concentrations) in periphyton samples throughout the Bear River basin (*fig. 24*) indicate that algal communities are probably responding to a complex mix of local conditions, including light and nutrient availability, substrate, and discharge. No spatial

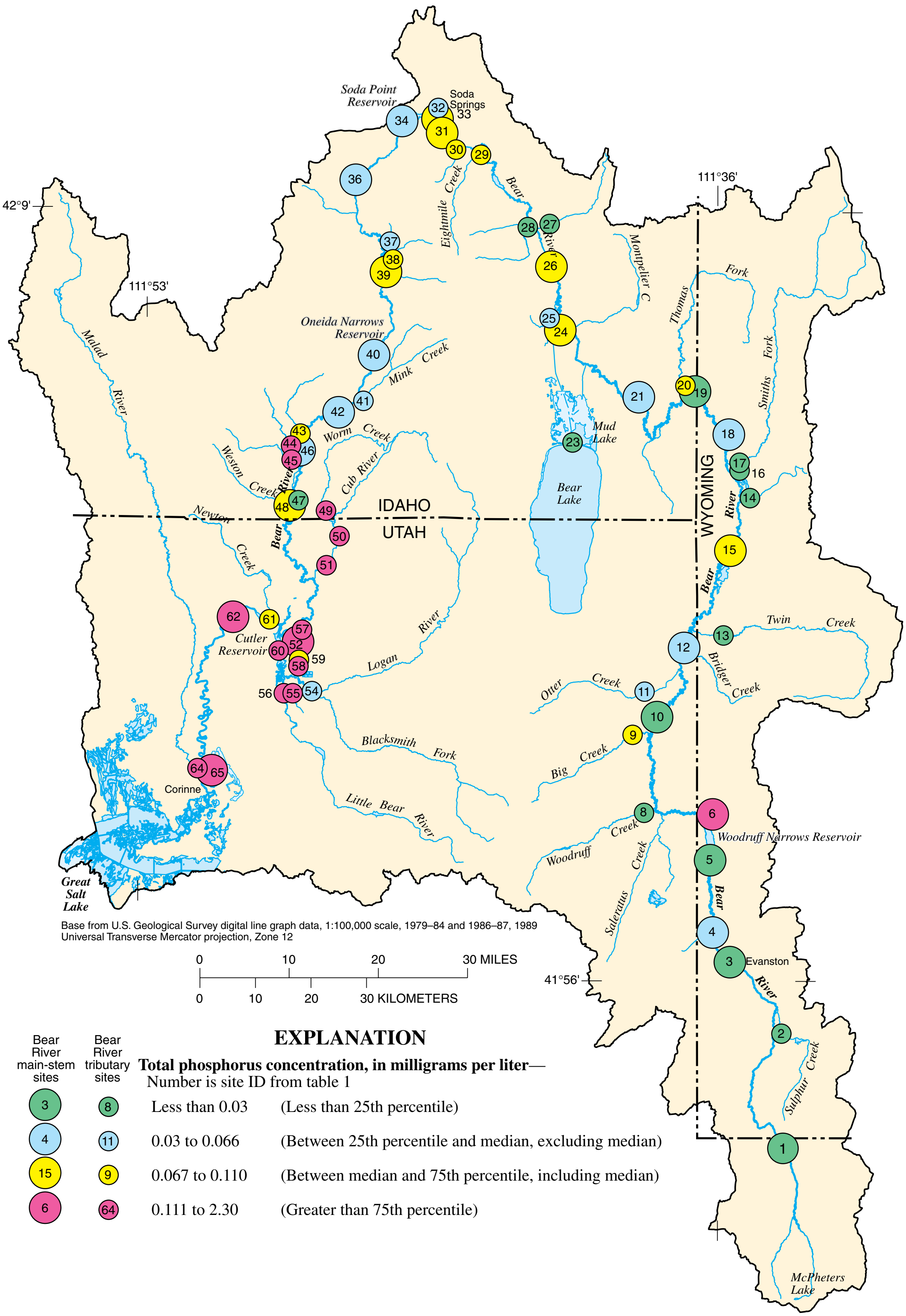

Figure 22. Concentration of total phosphorus in water samples collected from selected sites in the Bear River basin, July-August 2001.

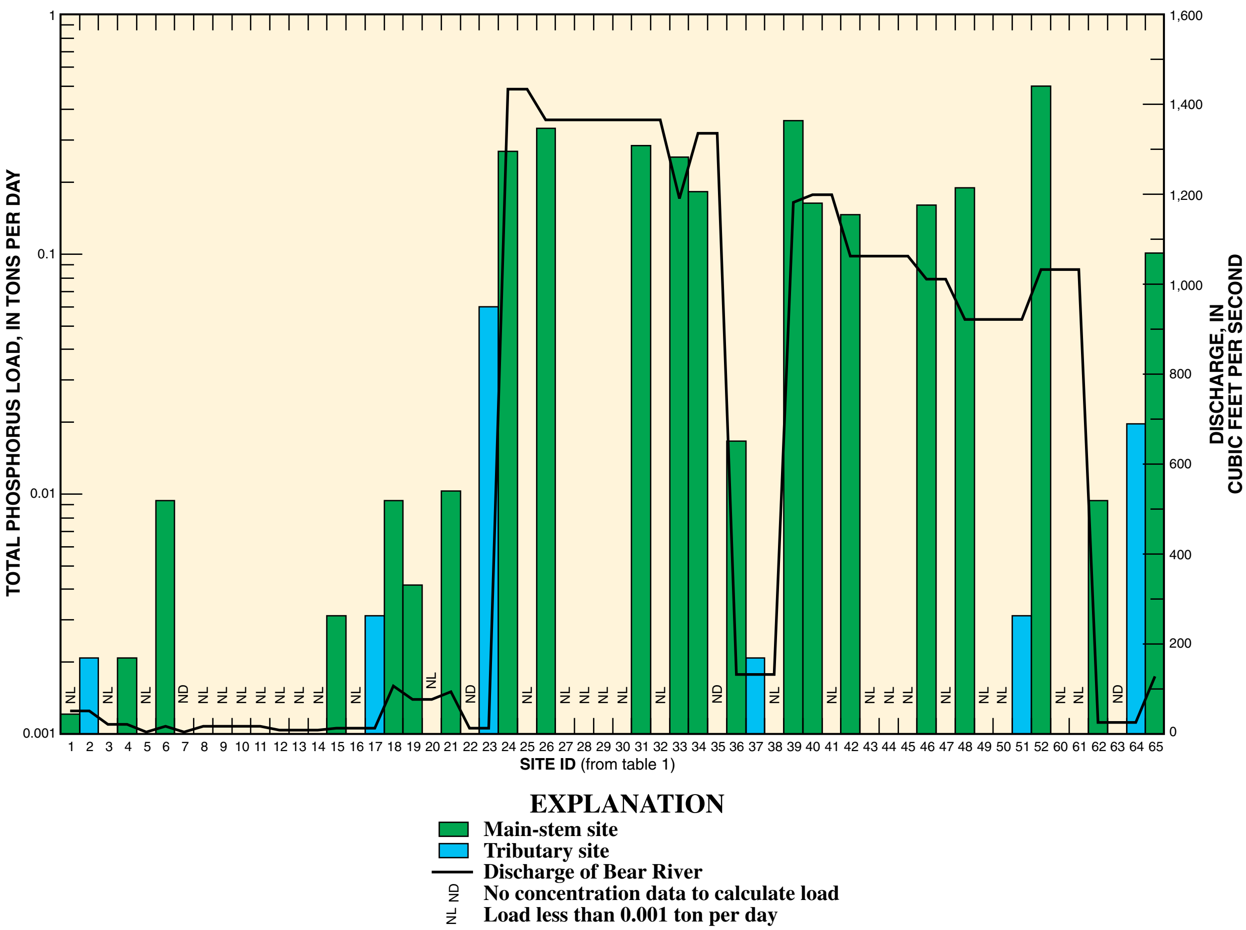

Figure 23. Total phosphorus load calculated from water samples collected from selected sites in the Bear River basin, July-August 2001.

pattern (for example, upstream to downstream) was evident on the basis of general deterioration or improvement in causal factors. CHL A concentrations in the Bear River generally were highest (above the 75th percentile) below reservoirs but also were high (290 mg/m^2) at site 18, below the Smiths Fork confluence (*fig. 24*).

A periphyton CHL A concentration of about 44 mg/m^2 is one estimate of the background condition for streams in Aggregate Nutrient Ecoregion III (U.S. Environmental Protection Agency, 2000b). Four sites in the Bear River basin had concentrations of CHL A of less than 45 mg/m^2, indicating that these sites had an abundance of algae consistent with natural conditions. Samples from 8 of the 14 sites where periphyton was collected had concentrations of CHL A that exceeded 100 mg/m^2 (*table 13*). Concentrations of CHL A between 100 and 200 mg/m^2 may be indicative of nuisance algal conditions (U.S. Environmental Protection Agency, 2000a). Algae at these sites may contribute to large nighttime decreases in dissolved-oxygen concentration, clogged filters or intakes, or degraded recreational or aesthetic uses.

Summary and Conclusions

This study was implemented to help provide a spatial snapshot of selected water-quality parameters in the Bear River basin during two base-flow periods in 2001: in March, prior to snowmelt runoff and in July-August, following snowmelt runoff. This second period coincides with the irrigation season in the Bear River basin, and flows in many segments of the river are augmented by releases of stored water or reduced by irrigation withdrawals, both of which affect the water quality of streams in the drainage basin. Water-quality samples were collected at 65 sites on the Bear River and selected tributaries from near the Utah-Wyoming Stateline south of Evanston, Wyoming, downstream to Corinne, Utah, near the outflow to Great Salt Lake. Samples were analyzed for dissolved solids and major ions, suspended sediment, nutrients, pesticides, and periphyton chlorophyll *a*.

On the main stem of the Bear River during March, concentrations of dissolved solids ranged from 116 mg/L near the Utah-Wyoming Stateline to 672 mg/L near Corinne. Dissolved-solids concentrations in the Bear River downstream

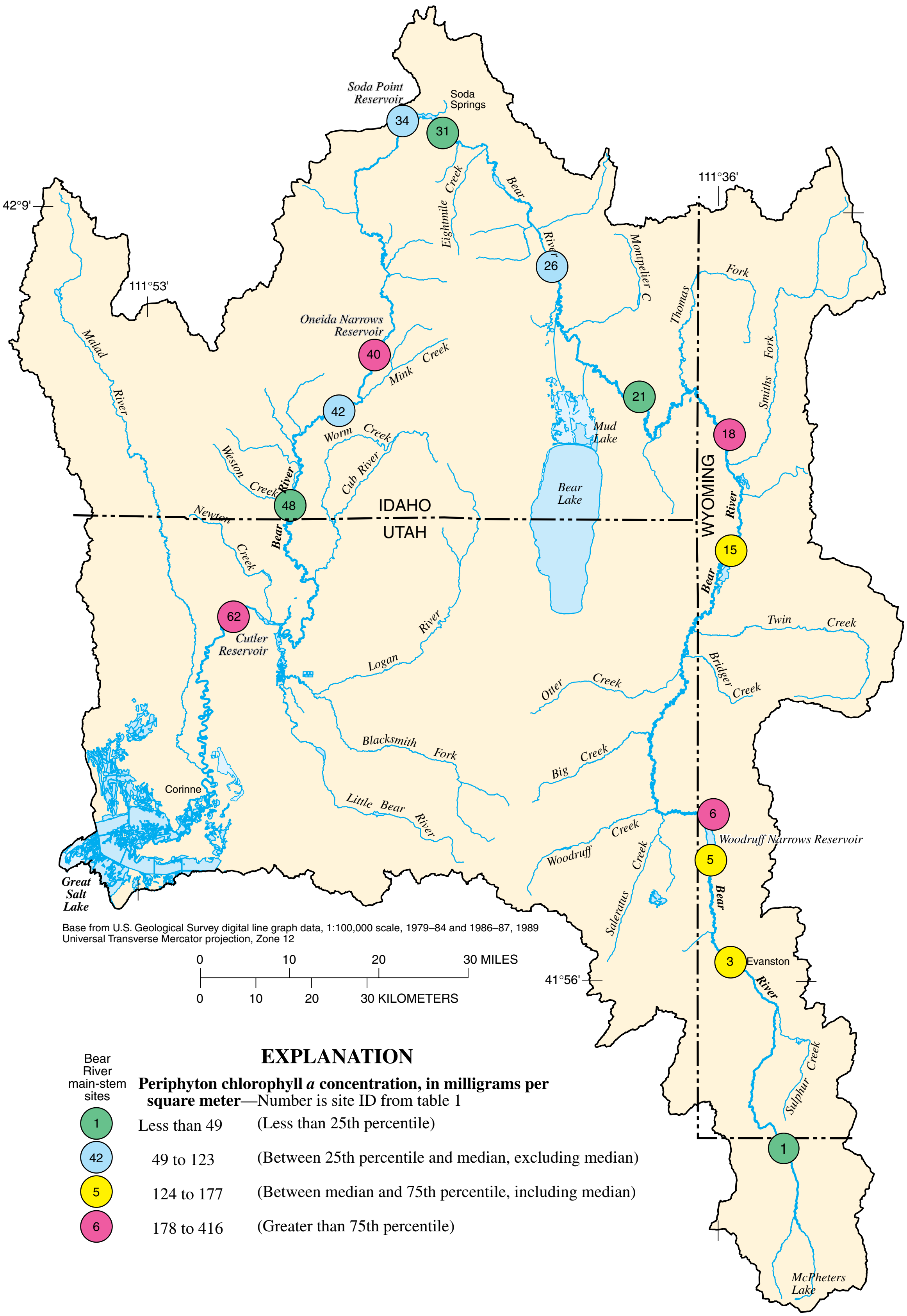

Figure 24. Concentration of chlorophyll *a* in periphyton (algae) samples collected from selected sites in the Bear River basin, August 2001.

from Soda Springs, Idaho, generally were higher than in the river upstream from this area. During July-August, concentrations of dissolved solids ranged from 117 mg/L near the Utah-Wyoming Stateline to 2,540 mg/L near Corinne and were heavily influenced by outflow from irrigation diversions. High concentrations of dissolved solids and loads in the Bear River below Cutler Reservoir result largely from inflow of mineralized ground water and in the vicinity of Corinne were high enough to exceed the Utah standard for agriculture during the July-August sampling period.

Suspended-sediment concentrations in the Bear River in March ranged from 2 mg/L below Woodruff Narrows Reservoir to 98 mg/L near Preston, Idaho, with a median concentration of 28 mg/L. Tributary concentrations generally were higher, as much as 861 mg/L in water from Battle Creek. The largest suspended-sediment loads to the Bear River in March were contributed by the Little Bear River, and the largest loads to the river in July-August were contributed by the Bear Lake Outlet Canal. Sediment concentrations in sampled tributary basins in July-August generally were lower than in March. Streams with sediment concentrations high enough to increase concentrations in the main stem downstream from their confluences included Whiskey Creek, Otter Creek, Trout Creek, and the Malad River. Suspended-sediment concentrations in the Bear River generally decrease below reservoirs.

Dissolved ammonia concentrations in the Bear River and its tributaries in March ranged from less than 0.021 mg/L to as much as 1.43 mg/L. The dissolved ammonia concentration in Spring Creek exceeded the EPA chronic criterion of 1.09 mg/L and the dissolved ammonia plus organic nitrogen concentration in the creek was 2.4 mg/L. Spring Creek is the only site where concentrations of all ammonia species exceeded 1.0 mg/L. Dissolved ammonia and ammonia plus organic nitrogen concentrations in the Bear River basin in July-August were considerably lower than in March.

The concentrations of most dissolved and suspended forms of nitrogen generally were higher in March than in July-August. The median nitrite plus nitrate concentration in water samples collected from all sites in July-August (0.041 mg/L) was less than one-tenth of the median for all March water samples (0.526 mg/L). In samples collected during March, tributary concentrations of dissolved nitrite plus nitrate ranged from 0.042 mg/L (estimated) to 5.28 mg/L. In samples collected during July-August from tributaries, concentrations ranged from less than 0.023 mg/L to 3.06 mg/L. Concentrations of nitrite plus nitrate were highest in the Whiskey Creek and Spring Creek drainage basins and at main-stem sites below Cutler Reservoir near Collinston (March) and Corinne (July-August).

Concentrations of total phosphorus at main-stem sites were fairly similar during both base-flow periods, ranging from less than 0.02 to 0.49 mg/L during March and less than 0.02 to 0.287 mg/L during July-August. In March, concentrations of total phosphorus in the Bear River generally increased from upstream to downstream. Total phosphorus concentrations in tributaries generally were higher in March than in July-August. During July-August, inflow from the Bear Lake Outlet Canal substantially increased total phosphorus loads in the Bear River downstream from Bear Lake.

Pesticides were detected at 20 sites sampled either in March or July-August, but concentrations were less than 0.1 μg/L. The most frequently detected insecticide was malathion, and prometon and atrazine were the most frequently detected herbicides. Concentrations of the 12 pesticides detected did not exceed established aquatic-life guidelines and were not a threat to aquatic life in the Bear River during the study periods. In addition, pesticide concentrations in water samples collected from Bear River basin sites were at least two orders of magnitude less than EPA established human-health standards.

Periphyton samples were collected at 14 sites on the Bear River during August. Chlorophyll *a* concentrations ranged from 21 mg/m^2 near the Utah-Wyoming Stateline to 416 mg/m^2 in the Bear River below Oneida Narrows Reservoir, with the highest concentrations occurring below reservoirs. Samples from 8 of the 14 sites had concentrations of chlorophyll *a* that exceeded 100 mg/m^2, indicating that algal abundance at these sites may represent a nuisance condition.

Additional basin-wide synoptic studies in the Bear River basin, particularly during peak periods of snowmelt runoff, would help to give a more complete picture of water quality in the basin. These studies provide valuable data that allow managers to evaluate the effects of adjoining management areas on areas they are responsible for, as well as the effects of their decisions on adjoining areas.

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Tables

Table 1. Location of sites sampled on the Bear River and its tributaries, March and July-August 2001

[**Site designation:** UT, Utah; ID, Idaho; WY, Wyoming; **Site type:** MS, main stem; T, tributary; Latitude and Longitude: dd, degrees; mm, minutes; ss, seconds; River miles: Miles downstream from headwaters at McPheters Lake; —, not applicable]

Site number (fig. 1)	Site designation	U.S. Geological Survey streamflow-gaging station number	Site type	Latitude (ddmmss)	Longitude (dddmmss)	River miles
1	Bear River near Utah-Wyoming Stateline	10011500	MS	405755	1105110	22.2
2	Sulphur Creek at mouth, near Evanston, WY	410934110511501	T	410934	1105115	—
3	Bear River at Evanston, WY	10016900	MS	411613	1105747	56.2
4	Bear River below Yellow Creek, near Evanston, WY	411851111004001	MS	411851	1110040	61.9
5	Bear River above reservoir, near Woodruff, UT	10020100	MS	412604	1110101	79.6
6	Bear River below reservoir, near Woodruff, UT	10020300	MS	413020	1110050	86.1
7	Saleratus Creek near Woodruff, UT	413010111072701	T	413010	1110727	—
8	Genes (Woodruff) Creek at Woodruff, UT	413127111092001	T	413127	1110920	—
9	Big Creek at Highway 89, near Randolph, UT	413916111110501	T	413916	1111105	—
10	Bear River at Randolph, UT	414009111082101	MS	414009	1110821	127.7
11	Otter Creek near Randolph, UT	414317111093201	T	414317	1110932	—
12	Bear River above Bridger Creek, near Leefe, WY	414637111042501	MS	414637	1110425	144.6
13	Twin Creek at Highway 89, near Leefe, WY	414841110592201	T	414841	1105922	—
14	Sublette Creek at Highway 30, near Cokeville, WY	420227110555301	T	420227	1105553	—
15	Bear River below Pixley Dam, near Cokeville, WY	10028500	MS	415620	1105905	170.7
16	Spring Creek at Cokeville, WY	420506110570801	T	420506	1105708	—
17	Smiths Fork at Highway 30, near Cokeville, WY	420540110570301	T	420540	1105703	—
18	Bear River below Smiths Fork, near Cokeville, WY	10038000	MS	420736	1105821	191.9
19	Bear River at Border, WY	10039500	MS	421240	1110311	206.0
20	Thomas Fork at mouth, near Border, WY	421249111042001	T	421249	1110420	—
21	Bear River at Harer, ID	10044000	MS	421150	1111005	232.6
22	Bear River near Dingle, ID	421457111162201	MS	421457	1111622	246.1
23	Bear Lake at Lifton, near St. Charles, ID	10055500	T	420716	1111852	—
24	Bear Lake Outlet Canal near Montpelier, ID	421819111213301	MS[1]	421819	1112133	261.5
25	Ovid Creek near Ovid, ID	421943111220601	T	421943	1112206	—
26	Bear River at Pescadero, ID	10068500	MS	422406	1112122	273.5
27	Georgetown Creek at Georgetown, ID	422843111221601	T	422843	1112216	—
28	Stauffer Creek near Georgetown, ID	422835111243801	T	422835	1112438	—
29	Eightmile Creek at Eightmile Road, near Soda Springs, ID	423545111311301	T	423545	1113113	—
30	Bailey Creek near Soda Springs, ID	423621111343001	T	423621	1113430	—
31	Bear River at Soda Springs, ID	10075000	MS	423650	1113458	301.7
32	Soda Creek at mouth, at Soda Springs, ID	423922111370401	T	423922	1113704	—
33	Bear River above Soda Point Reservoir, at Soda Springs, ID	423859111365901	MS	423859	1113659	307.2
34	Bear River at Alexander, ID	10079500	MS	423842	1114151	311.9
35	Densmore Creek at mouth, near Thatcher, ID	422943111473901	T	422943	1114739	—
36	Bear River at Black Canyon, near Turner, ID	423215111474501	MS	423215	1114745	323.8
37	Whiskey Creek at Highway 34, near Thatcher, ID	422714111431501	T	422714	1114315	—
38	Trout Creek at Thatcher, ID	422428111433201	T	422428	1114332	—
39	Bear River near Thatcher, ID	422430111435901	MS	422430	1114359	339.9
40	Bear River below Oneida Narrows Reservoir, near Oneida, ID	421519111452101	MS	421519	1114521	354.4
41	Mink Creek at mouth, near Preston, ID	421138111463501	T	421138	1114635	—
42	Bear River at Highway 30, near Riverdale, ID	420959111495301	MS	420959	1114953	364.4
43	Battle Creek near Preston, ID	420821111544401	T	420821	1115444	—
44	Deep Creek at mouth, near Preston, ID	420716111555201	T	420716	1115552	—
45	Fivemile Creek near Preston, ID	420600111554901	T	420600	1115549	—

Table 1. Location of sites sampled on the Bear River and its tributaries, March and July-August 2001—Continued

Site number (fig. 1)	Site designation	U.S. Geological Survey streamflow-gaging station number	Site type	Latitude (ddmmss)	Longitude (dddmmss)	River miles
46	Bear River near Preston, ID	420549111545901	MS	420549	1115459	376.3
47	Weston Creek at mouth, near Weston, ID	420129111555901	T	420129	1115559	—
48	Bear River at Idaho-Utah Stateline	10092700	MS	420047	1115514	385.4
49	Worm Creek at 800 E., near Franklin, ID	420050111512601	T	420050	1115126	—
50	Spring Creek near Cove, UT	415834111485901	T	415834	1114859	—
51	Cub River near Richmond, UT	10102200	T	415637	1115014	—
52	Bear River near Benson, UT	414804111543401	MS	414804	1115434	415.9
53	Blacksmith Fork at 2900 S., near Millville, UT	414048111495101	T	414048	1114951	—
54	Logan River below Blacksmith Fork, near Logan, UT	10115200	T	414315	1115308	—
55	Spring Creek at 600 S., near Logan, UT	414314111553801	T	414314	1115538	—
56	Little Bear River at 600 S., near Mendon, UT	414308111564101	T	414308	1115641	—
57	Hopkins Slough near Benson, UT	414805111533001	T	414805	1115330	—
58	Logan wastewater-treatment plant ditch near Logan, UT	414541111544201	T	414541	1115442	—
59	Swift Slough at 1300 E., near Logan, UT	414615111544301	T	414615	1115443	—
60	Little Bear River at 3000 N., at Benson Marina, UT	414712111571901	T	414712	1115719	—
61	Newton Creek at mouth, near Newton, UT	415020111582701	T	415020	1115827	—
62	Bear River near Collinston, UT	10118000	MS	415003	1120316	429.5
63	Bear River at U-30 crossing, near Deweyville, UT	414255112065901	MS	414255	1120659	444.8
64	Malad River south of Bear River City, UT	413537112074301	T	413537	1120743	—
65	Bear River near Corinne, UT	10126000	MS	413435	1120600	468.6

[1]Bear Lake Outlet Canal considered main-stem site because Bear River is diverted from main channel upstream from confluence of outlet canal with main channel.

Table 2. Drainage area and land use/cover in the Bear River basin above sites sampled on the Bear River, March and July-August 2001

[**Site designation**: UT, Utah; ID, Idaho; WY, Wyoming; <, less than]

Site number (fig. 1)	Site designation	Drainage area (square miles)	Land use/cover by basin (percent)								Irrigated land (acres)
			Rangeland	Forest	Agriculture	Urban	Wetland	Open water	Perennial ice/snow	Barren land	
1	Bear River near Utah-Wyoming Stateline	172	26	67	<0.1	<0.1	<0.1	0.2	0.7	5.4	30
3	Bear River at Evanston, WY	442	43	45	8.9	.2	.9	.3	.3	2.2	29,370
4	Bear River below Yellow Creek, near Evanston, WY	696	58	32	6.2	.4	1.2	.3	.2	1.4	35,528
5	Bear River above reservoir, near Woodruff, UT	754	60	30	6.7	.4	1.1	.3	.2	1.3	40,900
6	Bear River below reservoir, near Woodruff, UT	787	61	29	6.5	.4	1.1	.7	.2	1.2	41,573
10	Bear River at Randolph, UT	1,381	71	19	7.0	.2	1.3	.6	.1	.7	62,762
12	Bear River above Bridger Creek, near Leefe, WY	1,515	71	18	8.2	.2	1.5	.6	<.1	.6	79,698
15	Bear River below Pixley Dam, near Cokeville, WY	2,013	75	14	7.5	.2	1.6	.5	<.1	.7	88,525
18	Bear River below Smiths Fork, near Cokeville, WY	2,444	75	15	6.8	.2	1.9	.5	<.1	.6	104,223
19	Bear River at Border, WY	2,478	75	15	6.9	.2	2.0	.5	<.1	.5	107,940
21	Bear River at Harer, ID	2,828	75	15	7.0	.2	2.2	.6	<.1	.5	132,788
22	Bear River near Dingle, ID	2,861	75	15	7.2	.2	2.2	.6	<.1	.5	134,871
26	Bear River at Pescadero, ID	3,699	70	15	8.3	.2	3.0	3.9	<.1	.4	201,053
31	Bear River at Soda Springs, ID	3,967	68	16	9.2	.2	2.9	3.6	<.1	.3	212,105
33	Bear River above Soda Point Reservoir, at Soda Springs, ID	4,029	67	16	9.7	.2	2.8	3.6	<.1	.3	213,339
34	Bear River at Alexander, ID	4,089	67	16	10	.2	2.8	3.6	<.1	.3	215,660
36	Bear River at Black Canyon, near Turner, ID	4,114	67	16	11	.2	2.8	3.6	<.1	.3	220,421
39	Bear River near Thatcher, ID	4,257	66	16	12	.2	2.7	3.5	<.1	.3	252,038
40	Bear River below Oneida Reservoir, near Oneida, ID	4,454	65	16	12	.2	2.7	3.3	<.1	.3	261,445
42	Bear River at Highway 30, near Riverdale, ID	4,543	65	17	12	.2	2.6	3.3	<.1	.3	265,092
46	Bear River near Preston, ID	4,775	64	16	14	.2	2.5	3.1	<.1	.3	290,815
48	Bear River at Idaho-Utah Stateline	4,881	64	16	15	.2	2.5	3.1	<.1	.3	305,416
52	Bear River near Benson UT	5,218	62	16	16	.2	2.5	3.0	<.1	.3	373,935
62	Bear River near Collinston, UT	6,266	61	17	17	.4	2.3	2.6	<.1	.2	450,992
63	Bear River at U-30 crossing, near Deweyville, UT	6,304	61	17	17	.4	2.3	2.6	<.1	.2	456,061
65	Bear River near Corinne, UT	7,065	61	16	18	.4	2.1	2.4	<.1	.2	552,762

Table 3. List of impaired water bodies in the Bear River basin, 2004–05

[**HUC,** Hydrologic Unit Code; Data from Utah Division of Water Quality (2004); Wyoming Department of Environmental Quality (2004); Idaho Department of Environmental Quality (2005)]

Site	Description	HUC	State	Impairment
Bear River	From Woodruff Creek to Utah/Wyoming border	16010101	Utah	Dissolved oxygen
Bear River	From Utah/Wyoming border to Woodruff Creek	16010101	Utah	Dissolved oxygen
Saleratus Creek	From headwaters to confluence with Woodruff Creek	16010101	Utah	Dissolved oxygen
Newton Reservoir	—	16010202	Utah	Dissolved oxygen, total phosphorus
Cutler Reservoir	—	16010202	Utah	Dissolved oxygen, total phosphorus
Tony Grove Lake	—	16010203	Utah	Dissolved oxygen, total phosphorus, pH
Porcupine Reservoir	—	16010203	Utah	Temperature
Mantua Reservoir	—	16010204	Utah	Temperature
Bridger Creek	From Utah Stateline upstream	16010101	Wyoming	Habitat degradation
Bear River	From Sulphur Creek to Woodruff Narrows Reservoir	16010101	Wyoming	Sediment
Dry Creek	Headwaters to Thomas Fork	16010102	Idaho	Nutrients, sediment
Thomas Fork	Idaho/Wyoming border to Bear River	16010102	Idaho	Nutrients, sediment
Preuss Creek	Source to Thomas Fork	16010102	Idaho	Sediment, habitat degradation
Bear River	Idaho/Wyoming border to Wardboro	16010102	Idaho	Unknown[1]
Bear River	Wardboro to Alexander Reservoir	16010101	Idaho	Nutrients, sediment
Co-op Creek	Source to Stauffer Creek	16010201	Idaho	Nutrients, sediment
Pearl Creek	North Fork to Bear River	16010201	Idaho	Nutrients, sediment
Alexander Reservoir	—	16010201	Idaho	Sediment
Meadow Creek	Headwaters to North Creek	16010201	Idaho	Sediment, unknown metals
Ovid Creek	Confluence of North and Mill Creeks to Bear River	16010201	Idaho	Sediment
Snowslide Canyon	Source to Montpelier Creek	16010201	Idaho	Sediment
St. Charles Creek	Source to refuge	16010201	Idaho	Nutrients, sediment
North Creek	Below Mill Hollow to Ovid Creek	16010201	Idaho	Unknown[1]
Battle Creek	Source to Bear River	16010202	Idaho	Nutrients, sediment
Cub River	Sugar Creek to Idaho/Utah border	16010202	Idaho	Nutrients, sediment, flow alteration
Densmore Creek	Source to Bear River	16010202	Idaho	Nutrients, sediment
Weston Creek	Source to Bear River	16010202	Idaho	Nutrients, sediment, flow alteration
Whiskey Creek	Source to Bear River	16010202	Idaho	Nutrients, sediment
Williams Creek	Right Fork to Bear River	16010202	Idaho	Nutrients, sediment
Cottonwood Creek	Tributary 6.4 kilometers upstream to Bear River	16010202	Idaho	Sediment
Oneida Narrows Reservoir	—	16010202	Idaho	Sediment
Strawberry Creek	Source to Mink Creek	16010202	Idaho	Unknown[1]
Maple Creek	Left Fork to Cub River	16010202	Idaho	Bacteria, Unknown[1]
Fivemile Creek	Source to Bear River	16010202	Idaho	Unknown[1]
Bear River	Oneida Narrows Reservoir dam to Idaho/Utah border	16010202	Idaho	Nutrients, sediment, flow alteration
Worm Creek	Glendale Reservoir to Idaho/Utah border	16010202	Idaho	Unknown[1]
Elkhorn Creek	Source to Little Malad River	16010202	Idaho	Unknown[1]
Bear River	Cove powerplant to Oneida Dam	16010202	Idaho	Nutrients, sediment, flow alteration
Deep Creek	Oxford Slough to Bear River	16010204	Idaho	Unknown[1]
Samaria Creek	Source to Malad River	16010204	Idaho	Nutrients, sediment
Devil Creek	Devil Creek Reservoir dam to Malad River	16010204	Idaho	Nutrients, sediment
Malad River	Source to Pleasant View	16010204	Idaho	Sediment
Wright Creek	Source to Daniels Reservoir	16010204	Idaho	Sediment
Dairy Creek	Source to Wright Creek	16010204	Idaho	Unknown[1]
Little Malad River	Headwaters to Malad River	16010204	Idaho	Sediment
Deep Creek	Headwaters to mouth	16010204	Idaho	Unknown[1]

[1]Unknown: Site added in 1998; data not sufficient for load analysis (additional sites and/or more sampling events needed); nutrient and sediment impairments identified; possible pollutant sources include agriculture, livestock grazing, and streambank erosion.

Table 4. Water bodies in the Bear River basin with associated Total Maximum Daily Load (TMDL) documents

Site	State	Impairment	TMDL Established
Middle Bear River	Utah	Total phosphorus	1997
Cutler Reservoir	Utah	Ammonia	1998
Yellow Creek	Wyoming	Ammonia Fecal-coliform bacteria Total residual chlorine	1999
Central Bear River	Wyoming	Fecal-coliform bacteria Total residual chlorine	1999
Lower Bear River	Utah	Total phosphorus	2002
Little Bear River	Utah	Total phosphorus Hydrologic modification	2000
Mantua Reservoir	Utah	Total phosphorus Dissolved oxygen pH	2000
Spring Creek	Utah	Total phosphorus Dissolved oxygen Ammonia Fecal-coliform bacteria	2002
Hyrum Reservoir	Utah	Total phosphorus Dissolved oxygen Fecal-coliform bacteria	2002

Table 5. Discharge, dissolved-oxygen concentration, and physical properties for water samples collected from selected sites on the Bear River and its tributaries, March and July-August 2001

[**Site designation:** UT, Utah; ID, Idaho; WY, Wyoming; **Site type:** MS, main stem; T, tributary; ft^3/s, cubic feet per second; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; ºC, degrees Celsius; —, no data]

Site number (fig. 1)	Site designation	Site type	Date	Time	Discharge, instantaneous (ft^3/s)	Dissolved oxygen (mg/L)	Dissolved oxygen (percent saturation)	pH, field (standard units)	Specific conductance, lab (µS/cm)	Specific conductance, field (µS/cm)	Temperature (°C)
1	Bear River near Utah-Wyoming Stateline	MS	03-20-01	1030	37	10.5	104	8.4	—	210	2.4
			08-09-01	1100	52	7.7	104	8.5	—	183	16.1
2	Sulphur Creek at mouth, near Evanston, WY	T	03-20-01	1300	6.8	10.0	92	8.2	—	554	1.0
			08-09-01	0850	28	7.7	101	8.4	—	498	16.5
3	Bear River at Evanston, WY	MS	03-21-01	0950	86	11.0	99	8.3	—	474	.6
			08-09-01	0900	19	8.6	112	8.3	—	458	16.6
4	Bear River below Yellow Creek, near Evanston, WY	MS	03-21-01	0920	135	10.6	94	8.1	—	505	.5
			08-09-01	1140	20	8.6	127	8.3	—	490	19.0
5	Bear River above reservoir, near Woodruff, UT	MS	03-20-01	1610	181	9.9	85	8.3	—	416	.1
			08-08-01	1430	.52	11.8	177	8.8	—	635	23.9
6	Bear River below reservoir, near Woodruff, UT	MS	03-20-01	1000	29	8.9	80	8.0	—	539	1.7
			08-08-01	1100	22	5.2	76	8.5	—	538	21.8
7	Saleratus Creek near Woodruff, UT	T	03-19-01	1520	2.9	7.5	65	8.2	—	1,150	.3
8	Genes (Woodruff) Creek at Woodruff, UT	T	03-19-01	1640	.70	9.8	84	8.3	—	404	.2
			08-08-01	1410	.24	7.1	104	8.4	475	—	22.7
9	Big Creek at Highway 89, near Randolph, UT	T	03-19-01	1350	13	10.2	92	8.4	—	560	1.9
			08-07-01	1520	.19	11.9	180	9.7	—	417	25.3
10	Bear River at Randolph, UT	MS	03-19-01	1350	58	11.0	117	8.3	—	777	8.2
			08-08-01	1140	17	8.3	116	8.1	—	643	21.0
11	Otter Creek near Randolph, UT	T	03-19-01	1530	19	8.9	87	8.4	—	448	4.2
			08-08-01	0930	.23	7.3	94	8.2	—	514	17.0
12	Bear River above Bridger Creek, near Leefe, WY	MS	03-19-01	1140	83	10.2	87	8.2	—	593	.1
			08-07-01	1230	5.0	9.4	141	8.2	—	830	24.9
13	Twin Creek at Highway 89, near Leefe, WY	T	03-18-01	1450	7.3	9.0	87	8.5	—	967	4.4
			08-07-01	0950	4.2	9.6	128	8.5	—	783	18.0
14	Sublette Creek at Highway 30, near Cokeville, WY	T	08-07-01	0820	.04	5.8	73	8.0	—	562	16.0
15	Bear River below Pixley Dam, near Cokeville, WY	MS	03-18-01	1400	7.0	11.5	100	8.3	—	589	.7
			08-06-01	1600	13	4.6	77	8.4	—	943	24.0
16	Spring Creek at Cokeville, WY	T	03-19-01	1020	14	10.9	105	8.3	—	498	4.3
			08-07-01	1540	18	9.4	135	8.6	—	376	22.4
17	Smiths Fork at Highway 30, near Cokeville, WY	T	03-18-01	1300	63	11.6	116	8.8	—	439	5.8
			08-07-01	1350	56	9.8	140	8.6	—	363	21.7
18	Bear River below Smiths Fork, near Cokeville, WY	MS	03-18-01	1000	156	11.5	101	8.3	—	539	1.3
			08-07-01	0940	108	7.7	101	8.2	—	500	18.3
19	Bear River at Border, WY	MS	03-18-01	1040	147	11.2	96	8.3	—	529	.4
			08-06-01	1410	77	9.4	133	8.3	—	530	22.2
20	Thomas Fork at mouth, near Border, WY	T	03-17-01	1440	17.5	11.8	122	8.1	—	860	7.2
			08-06-01	1200	.91	6.2	83	8.1	—	738	20.0
21	Bear River at Harer, ID	MS	08-06-01	1000	92	7.5	105	8.3	—	637	22.5
22	Bear River near Dingle, ID		03-17-01	1150	153	10.8	93	8.1	—	569	.7
		MS	08-06-01	1000	11	5.8	83	8.0	—	637	18.8

Table 5. Discharge, dissolved-oxygen concentration, and physical properties for water samples collected from selected sites on the Bear River and its tributaries, March and July-August 2001—Continued

Site number (fig. 1)	Site designation	Site type	Date	Time	Discharge, instantaneous (ft^3/s)	Dissolved oxygen (mg/L)	Dissolved oxygen (percent saturation)	pH, field (standard units)	Specific conductance, lab (µS/cm)	Specific conductance, field (µS/cm)	Temperature (°C)
23	Bear Lake at Lifton, near St. Charles, ID	T	08-05-01	0930	1,540	6.8	90	8.5	—	600	21.5
24	Bear Lake Outlet Canal near Montpelier, ID	MS[2]	03-17-01	1140	23	7.8	68	7.8	—	515	.5
			08-05-01	1400	1,280	6.9	98	8.5	—	724	22.9
25	Ovid Creek near Ovid, ID	T	03-17-01	0850	1.1	12.6	109	8.4	—	359	.3
			08-05-01	1510	.74	5.7	80	8.2	724	—	23.5
26	Bear River at Pescadero, ID	MS	03-17-01	0930	150	10.1	86	8.0	—	595	.2
			08-05-01	0930	1,300	6.7	93	8.4	—	722	21
27	Georgetown Creek at Georgetown, ID	T	03-16-01	1530	22	10.1	104	8.6	—	393	7.1
			08-05-01	1300	.81	9.5	112	8.6	407	—	21.2
28	Stauffer Creek near Georgetown, ID	T	03-16-01	1410	6.3	9.6	89	7.7	—	330	3.0
			08-05-01	1350	.81	11.8	160	8.2	345	—	26.2
29	Eightmile Creek at Eightmile Road, near Soda Springs, ID	T	03-16-01	1250	7.5	11.4	105	8.3	—	332	2.5
			08-04-01	1410	.13	8.0	108	8.0	—	423	22.5
30	Bailey Creek near Soda Springs, ID	T	03-16-01	1340	4.5	9.9	97	8.1	—	399	4.9
			08-04-01	1300	.53	10.9	132	8.2	508	—	17.0
31	Bear River at Soda Springs, ID	MS	03-16-01	1200	165	11.1	91	8.3	—	525	.6
			08-04-01	1640	1,150	8.5	124	8.6	—	727	23.5
32	Soda Creek at mouth, at Soda Springs, ID	T	03-16-01	1050	17	10.1	100	7.6	—	1,470	5.9
			08-04-01	1040	.97	5.5	64	6.9	2,050	—	15.1
33	Bear River above Soda Point Reservoir, at Soda Springs, ID	MS	03-16-01	0940	78	10.1	94	8.0	—	607	.7
			08-04-01	1220	1,190	8.3	111	8.6	—	727	21.3
34	Bear River at Alexander, ID	MS	03-16-01	0930	[1]461	9.8	92	7.3	—	790	2.8
			08-04-01	1000	[1]1,200	6.9	90	8.3	—	759	20.1
35	Densmore Creek at mouth, near Thatcher, ID	T	08-04-01	0910	.01	7.5	91	8.0	794	—	17.5
36	Bear River at Black Canyon, near Turner, ID	MS	03-15-01	1520	32	12.7	134	9.0	—	792	9.4
			08-03-01	1500	130	9.0	115	8.6	748	—	20.0
37	Whiskey Creek at Highway 34, near Thatcher, ID	T	03-15-01	1300	11	9.9	115	8.6	—	726	13.8
			08-03-01	1300	9.0	10.7	121	8.0	756	—	16.2
38	Trout Creek at Thatcher, ID	T	03-15-01	0930	16	12.4	102	8.3	—	562	.3
			08-03-01	1630	4.1	9.4	131	8.4	—	679	22.8
39	Bear River near Thatcher, ID	MS	03-15-01	1110	244	11.6	107	8.4	—	843	4.6
			08-03-01	1340	1,180	7.0	92	8.2	—	767	20.5
40	Bear River below Oneida Narrows Reservoir, near Oneida, ID	MS	03-15-01	1130	[1]356	12.4	117	8.2	—	883	5.4
			08-03-01	0930	[1]1,180	8.9	116	8.0	798	—	20.7
41	Mink Creek at mouth, near Preston, ID	T	03-14-01	1600	6.7	11.9	117	8.9	—	405	6.9
			08-02-01	1330	2.3	11.2	146	8.5	457	—	21.8
42	Bear River at Highway 30, near Riverdale, ID	MS	03-14-01	1340	357	11.2	107	8.4	—	885	6.1
			08-03-01	1010	1,060	8.4	109	8.3	—	800	20.3
43	Battle Creek near Preston, ID	T	03-14-01	1020	6.1	11.6	97	8.5	—	1,780	1.5
			08-02-01	1140	1.5	8.2	102	8.1	896	—	18.3
44	Deep Creek at mouth, near Preston, ID	T	03-14-01	1530	11	11.1	109	8.2	—	868	6.9
			08-01-01	1500	2.1	8.0	105	8.2	799	—	20.8
45	Fivemile Creek near Preston, ID	T	03-14-01	1400	3.7	10.9	108	8.2	—	810	7.9
			08-01-01	1300	1.6	6.5	78	8.0	905	—	16.2

Table 5. Discharge, dissolved-oxygen concentration, and physical properties for water samples collected from selected sites on the Bear River and its tributaries, March and July-August 2001—Continued

Site number (fig. 1)	Site designation	Site type	Date	Time	Discharge, instantaneous (ft³/s)	Dissolved oxygen (mg/L)	Dissolved oxygen (percent saturation)	pH, field (standard units)	Specific conductance, lab (µS/cm)	Specific conductance, field (µS/cm)	Temperature (°C)
46	Bear River near Preston, ID	MS	03-14-01	1240	356	11.8	109	8.2	—	1,060	5.3
			08-02-01	0750	1,010	6.2	77	8.1	896	—	18.2
47	Weston Creek at mouth, near Weston, ID	T	03-14-01	1010	8.8	12.0	107	8.1	—	1,140	3.8
			08-01-01	1120	.45	12.5	144	8.0	—	1,230	16.6
48	Bear River at Idaho-Utah Stateline	MS	03-13-01	1430	370	10.9	105	8.3	—	1,050	6.7
			08-02-01	1500	903	8.4	111	8.3	—	889	21.2
49	Worm Creek at 800 E., near Franklin, ID	T	03-13-01	1630	16	9.9	100	8.3	—	832	7.9
			08-01-01	1000	.36	5.7	63	8.0	745	—	16.0
50	Spring Creek near Cove, UT	T	03-13-01	1200	14	12.4	118	8.1	—	418	6.6
			08-01-01	0850	.12	3.1	36	7.6	555	—	15.8
51	Cub River near Richmond, UT	T	03-13-01	0940	95	11.4	101	8.2	—	568	3.9
			08-02-01	1040	6.7	9.2	114	8.2	—	618	18.3
52	Bear River near Benson UT	MS	03-13-01	1410	712	10	95	8.4	—	1,020	6.1
			08-01-01	1620	1,030	7.2	95	8.0	—	895	21.6
53	Blacksmith Fork at 2900 S., near Millville, UT	T	03-12-01	1640	72	11	91	8.3	—	420	7.1
54	Logan River below Blacksmith Fork, near Logan, UT	T	03-12-01	0910	204	9.8	91	8.2	—	456	4.9
			07-31-01	1330	3.0	8.2	106	7.8	586	—	20.2
55	Spring Creek at 600 S., near Logan, UT	T	03-12-01	1140	101	8.8	80	8.1	—	843	4.7
			07-31-01	1210	—	—	—	—	644	—	—
56	Little Bear River at 600 S., near Mendon, UT	T	03-12-01	1440	102	9.5	86	8.2	—	590	4.1
			07-31-01	0930	14	6.1	76	8.0	—	705	18.8
57	Hopkins Slough near Benson, UT	T	03-12-01	1700	20	9.3	91	8.2	—	831	7.3
			07-31-01	1120	1.7	9.3	108	7.9	619	—	16.0
58	Logan wastewater-treatment plant ditch near Logan, UT	T	03-11-01	1800	62	10	90	8.0	—	736	4.0
			07-31-01	0830	6.5	6.9	88	7.7	902	—	20.7
59	Swift Slough at 1300 E., near Logan UT	T	07-31-01	0920	.7	8	92	7.9	583	—	16.5
60	Little Bear River at 3000 N., at Benson Marina, UT	T	03-13-01	1040	1,070	8.1	75	8.2	—	610	5.3
			08-01-01	1130	0	6.5	90	8.4	—	850	24.0
61	Newton Creek at mouth, near Newton, UT	T	07-31-01	1500	4.1	8.6	119	8.4	—	888	23.6
62	Bear River near Collinston, UT	MS	03-11-01	1530	[1]1,380	10.5	98	8.2	—	844	5.3
			07-30-01	1430	17	8.4	116	8.3	—	1,750	23.4
63	Bear River at U-30 crossing, near Deweyville, UT	MS	07-30-01	1550	25	7.9	110	8.3	—	1,500	24.4
64	Malad River south of Bear River City, UT	T	07-30-01	1410	16	12.4	178	8.4	—	2,150	25.3
65	Bear River near Corinne, UT	MS	03-12-01	1100	1,690	—	—	8.5	—	1,200	6.5
			07-30-01	1150	230	9.9	136	8.3	—	4,860	23.4

[1]Daily mean discharge.

[2]Bear Lake Outlet Canal considered main-stem site because Bear River is diverted from main channel upstream from confluence of outlet canal with main channel.

Table 6. Statistical summary of discharge, and concentrations of dissolved solids, suspended sediment, and nutrients for water samples collected from streams in the Bear River basin, March 2001

[ft^3/s, cubic feet per second; mg/L, milligrams per liter; <, less than; e, estimated; —, not calculated]

Sites	Number of sites	Minimum	Percentile			Maximum	Mean	Standard deviation
			25th	50th (median)	75th			
Discharge (ft^3/s)								
All	57	0.7	13	37	153	1,690	167	325
Main stem	25	7	78	153	356	1,690	298	410
Tributary	32	.7	7.1	15	43	1,070	64	189
Dissolved solids (mg/L)								
All	56	116	281	335	490	1,080	401	185
Main stem	24	116	302	349	494	672	401	136
Tributary	32	188	246	329	490	1,080	401	217
Suspended sediment (mg/L)								
All	55	2	14	38	62	861	79	158
Main stem	24	2	12	28	49	98	35	30
Tributary	31	5	18	48	80	861	114	205
Dissolved ammonia (mg/L)								
All	37	<.021	.024e	.149	.206	1.43	—	—
Main stem	24	<.021	.050	.153	.200	.473	—	—
Tributary	13	<.021	.022e	.149	.510	1.43	—	—
Dissolved nitrite plus nitrate (mg/L)								
All	56	.042e	.135	.526	1.11	5.28	.915	1.10
Main stem	25	.044	.122	.429	1.01	1.76	.600	.543
Tributary	31	.042e	.165	.666	1.86	5.28	1.17	1.36
Total nitrogen (mg/L)								
All	33	.262	.701	1.5	1.77	8.09	1.71	1.51
Main stem	21	.325	.701	1.41	1.65	2.82	1.29	.764
Tributary	12	.262	1.18	1.75	3.39	8.09	2.43	2.16
Total phosphorus (mg/L)								
All	57	<.02	.040	.073	.273	2.4	—	—
Main stem	25	<.02	.036	.053	.112	.49	—	—
Tributary	32	<.02	.051	.182	.406	2.4	—	—

Table 7. Statistical summary of discharge, and concentrations of dissolved solids, suspended sediment, and nutrients for water samples collected from streams in the Bear River basin, July-August 2001

[ft^3/s, cubic feet per second; mg/L, milligrams per liter; <, less than; e, estimated; —, not calculated]

Sites	Number of sites	Minimum	Percentile			Maximum	Mean	Standard deviation
			25th	50th (median)	75th			
Discharge (ft^3/s)								
All	62	0	0.8	10	88	1,540	243	464
Main stem	27	.5	19.5	108	1,105	1,300	493	549
Tributary	35	0	.4	1.5	5.4	1,540	49	260
Dissolved solids (mg/L)								
All	60	117	334	418	487	2,540	478	349
Main stem	25	117	379	443	485	2,540	525	447
Tributary	35	196	317	373	490	1,540	443	260
Suspended sediment (mg/L)								
All	61	2	13	38	61	179	45	40
Main stem	27	2	15	38	56	141	41	35
Tributary	34	3	12	36	69	179	48	43
Dissolved ammonia (mg/L)								
All	38	<.021	<.021	.024e	.029e	.198	—	—
Main stem	24	<.021	<.021	.023e	.026e	.198	—	—
Tributary	14	<.021	<.021	.025e	.030e	.061	—	—
Dissolved nitrite plus nitrate (mg/L)								
All	61	<.023	.025e	.041	.22	3.06	—	—
Main stem	25	.023e	.026e	.05	.1	.69	.09	.14
Tributary	36	<.023	<.023	.032	.578	3.06	—	—
Total nitrogen (mg/L)								
All	38	.107	.402	.543	.675	1.85	.604	.379
Main stem	24	.211	.475	.543	.616	1.08	.543	.189
Tributary	14	.107	.241	.537	1.12	1.85	.710	.572
Total phosphorus (mg/L)								
All	60	<.02	.030	.067	.111	2.30	—	—
Main stem	25	<.02	.040	.054	.087	.287	—	—
Tributary	35	<.02	.026	.082	.173	2.30	—	—

Table 8. Yield of nutrients, dissolved solids, and suspended sediment from Bear River tributary basins, March and July-August 2001

[**Site designation:** UT, Utah; WY, Wyoming; ID, Idaho; lbs/acre/day, pounds per acre per day;—, not calculated; <, less than]

Site number (fig. 1)	Site designation	Subbasin area (acres)	March lbs/acre/day x 10^4			
			Dissolved ammonia	Nitrite plus nitrate	Total nitrogen	Total phosphorus
2	Sulphur Creek at mouth, near Evanston, WY	49,856	—	1.3	—	3.2
7	Saleratus Creek near Woodruff, UT	138,240	—	.4	—	.4
8	Genes (Woodruff) Creek at Woodruff, UT	78,080	—	—	—	.2
9	Big Creek at Highway 89, near Randolph, UT	45,760	—	.9	—	1.1
11	Otter Creek near Randolph, UT	24,384	—	4.6	—	8.2
13	Twin Creek at Highway 89, near Leefe, WY	163,840	—	.2	—	.2
14	Sublette Creek at Highway 30, near Cokeville, WY	19,712	—	—	—	—
16	Spring Creek at Cokeville, WY	178,560	<.1	.8	1.8	.1
17	Smiths Fork at Highway 30, near Cokeville, WY	175,360	.4	.8	5.1	.5
20	Thomas Fork at mouth, near Border, WY	149,760	.2	7.4	8.8	.3
25	Ovid Creek near Ovid, ID	69,120	—	.1	—	<.1
27	Georgetown Creek at Georgetown, ID	22,464	—	4.8	—	2.3
28	Stauffer Creek near Georgetown, ID	22,592	—	2.8	—	1.1
29	Eightmile Creek at Eightmile Road, near Soda Springs, ID	22,528	—	1.1	—	.5
30	Bailey Creek near Soda Springs, ID	4,352	—	6.6	—	2.3
32	Soda Creek at mouth, at Soda Springs, ID	32,192	4.2	30	—	3.6
35	Densmore Creek at Mouth, near Thatcher, ID	11,072	—	—	—	—
37	Whiskey Creek at Highway 34, near Thatcher, ID	2,944	—	570	—	38
38	Trout Creek at Thatcher, ID	31,168	3.0	30	48	3.6
41	Mink Creek at mouth, near Preston, ID	40,512	.2	11	16	.7
43	Battle Creek near Preston, ID	40,512	1.4	16	29	9.0
44	Deep Creek at mouth, near Preston, ID	86,400	3.5	6.3	23	4.6
45	Fivemile Creek near Preston, ID	10,432	—	53	—	4.2
47	Weston Creek at mouth, near Weston, ID	46,912	—	25	—	6.2
49	Worm Creek at 800 E., near Franklin, ID	29,504	—	130	—	17
50	Spring Creek near Cove, UT	11,648	—	110	—	14
51	Cub River near Richmond, UT	128,000	27	82	160	16
53	Blacksmith Fork at 2900 S., near Millville, UT	180,480	—	3.6	—	.2
54	Logan River below Blacksmith Fork, near Logan, UT	338,560	.7	11	17	.8
55	Spring Creek at 600 S., near Logan, UT	15,680	500	1,800	2,800	441
56	Little Bear at 600 S., near Mendon, UT	167,680	8.1	22	54	5.7
57	Hopkins Slough near Benson, UT	13,120	7.7	220	—	19
58	Logan wastewater-treatment plant ditch near Logan, UT	1,600	160	1,100	—	5,000
59	Swift Slough at 1300 E., near Logan UT	22,912	—	—	—	—
60	Little Bear River at 3000 N., at Benson Marina, UT	583,040	54	100	250	45
61	Newton Creek at mouth, near Newton, UT	38,592	—	—	—	—
64	Malad River south of Bear River City, UT	453,760	—	—	—	—

Table 8. Yield of nutrients, dissolved solids, and suspended sediment from Bear River tributary basins, March and July-August 2001—Continued

Site number (fig. 1)	March		July-August					
	lbs/acre/day x 10^2		lbs/acre/day x 10^4				lbs/acre/day x 10^2	
	Dissolved solids	Suspended sediment	Dissolved ammonia	Nitrite plus nitrate	Total nitrogen	Total phos-phorus	Dissolved solids	Suspended sediment
2	25	6	—	0.3	—	0.8	100	2.4
7	9	<1	—	—	—	—	—	—
8	1	—	—	<.1	—	<.1	.5	<.1
9	47	3	—	<.1	—	<.1	.6	<.1
11	100	130	—	<.1	—	<.1	1.8	.1
13	14	2	—	<.1	—	<.1	7.1	.2
14	—	—	—	<.1	—	<.1	.4	<.1
16	13	1	.2	.1	1.2	<.1	12	.6
17	50	3	.6	.4	3.2	.3	37	1.6
20	31	4	<.1	<.1	.2	<.1	1.5	.2
25	2	<1	—	<.1	—	<.1	2.4	<.1
27	120	7	—	<.1	—	<.1	4.9	.1
28	30	2	—	<.1	—	<.1	3.8	—
29	34	6	—	<.1	—	<.1	.8	<.1
30	120	28	—	1.4	—	.7	20	6.4
32	260	17	<.1	.1	.3	<.1	25	2.9
35	—	—	—	<.1	—	—	.2	<.1
37	910	180	—	500	—	11	770	110
38	93	12	.3	.2	.8	.7	26	4.6
41	21	<1	.1	.1	1.2	.2	8.2	1.5
43	88	70	<.1	.2	1.0	.2	11	.9
44	36	27	<.1	1.5	2.1	.2	7.0	.4
45	99	24	—	7.1	—	1.8	44	7.3
47	73	77	—	.8	—	<.1	4.0	.2
49	130	36	—	<.1	—	.3	2.7	—
50	160	38	—	.2	—	.1	1.8	<.1
51	130	25	.1	2.8	5.2	.4	10	1.2
53	53	2.8	—	—	—	—	—	—
54	80	2.6	<.1	.1	.3	<.1	1.6	.3
55	1,700	100	—	—	—	—	—	—
56	110	8.2	.2	2.6	5.9	.9	19	3.7
57	350	37	—	12	—	1.9	24	7.1
58	7,800	1,150	—	210	—	500	1,100	200
59	—	—	—	<.1	—	.1	5.9	.5
60	513	48	—	—	—	—	—	—
61	—	—	—	2.9	—	.6	30	2.3
64	—	—	—	2.5	—	.8	22	2.8

Table 9. Results of chemical analyses for water samples collected from selected sites on the Bear River and its tributaries, March and July-August 2001

[**Site designation:**UT, Utah; ID, Idaho; WY, Wyoming; **Site type:** MS, main stem; T, tributary; mg/L, milligrams per liter; °C, degrees Celsius; µg/L, micrograms per liter; u, analyzed by Utah Health Laboratory;—, no data; <, less than; e, estimated]

Site number (fig. 1)	Site designation	Site type	Date	Time	Alkalinity (mg/L as $CaCO_3$)	Bicarbonate (mg/L as HCO_3)	Carbonate (mg/L as CO_3)	Calcium, dissolved (mg/L as Ca)	Chloride, dissolved (mg/L as Cl)
1	Bear River near Utah-Wyoming Stateline	MS	03-20-01	1030	104 u	—	—	29 u	—
			08-09-01	1100	97	117	—	28	1.1
2	Sulphur Creek at mouth, near Evanston, WY	T	03-20-01	1300	244 u	—	—	61 u	15 u
			08-09-01	0850	216 u	264 u	—	53 u	13 u
3	Bear River at Evanston, WY	MS	03-21-01	0950	185 u	—	—	50 u	18 u
			08-09-01	0900	194	232	3	44	16
4	Bear River below Yellow Creek, near Evanston, WY	MS	03-21-01	0920	184 u	—	—	48 u	28 u
			08-09-01	1140	202	246	—	46	24
5	Bear River above reservoir, near Woodruff, UT	MS	03-20-01	1610	163 u	—	—	39 u	22 u
			08-08-01	1430	188	195	17	29	68
6	Bear River below reservoir, near Woodruff, UT	MS	03-20-01	1000	223 u	—	—	60 u	28 u
			08-08-01	1100	193	219	8	50	40
7	Saleratus Creek near Woodruff, UT	T	03-19-01	1520	120 u	—	—	65 u	81 u
8	Genes (Woodruff) Creek at Woodruff, UT	T	03-19-01	1640	169 u	—	—	48 u	—
			08-08-01	1410	223 u	272 u	—	55 u	18 u
9	Big Creek at Highway 89, near Randolph, UT	T	03-19-01	1350	200 u	—	—	53 u	47 u
			08-07-01	1520	101 u	123 u	—	18 u	61 u
10	Bear River at Randolph, UT	MS	03-19-01	1350	235 u	—	—	60 u	85 u
			08-08-01	1140	263	326	—	63	38
11	Otter Creek near Randolph, UT	T	03-19-01	1530	207 u	—	—	52 u	17 u
			08-08-01	0930	259 u	316 u	—	51 u	14 u
12	Bear River above Bridger Creek, near Leefe, WY	MS	03-19-01	1140	220 u	—	—	55 u	48 u
			08-07-01	1230	283	348	—	60	72
13	Twin Creek at Highway 89, near Leefe, WY	T	03-18-01	1450	208 u	—	—	86 u	41 u
			08-07-01	0950	117 u	142 u	—	54 u	—
14	Sublette Creek at Highway 30, near Cokeville, WY	T	08-07-01	0820	200 u	244 u	—	55 u	19 u
15	Bear River below Pixley Dam, near Cokeville, WY	MS	03-18-01	1400	223 u	—	—	57 u	38 u
			08-06-01	1600	250	292	4	69	78
16	Spring Creek at Cokeville, WY	T	03-19-01	1020	172 u	—	—	68 u	7.3 u
			08-07-01	1540	125	137	8	48	5.9
17	Smiths Fork at Highway 30, near Cokeville, WY	T	03-18-01	1300	146 u	—	—	60 u	6.7 u
			08-07-01	1350	126	143	5	45	5.4
18	Bear River below Smiths Fork, near Cokeville, WY	MS	03-18-01	1000	196	228	5	58	19
			08-07-01	0940	172	210	—	55	20
19	Bear River at Border, WY	MS	03-18-01	1040	187 u	—	—	60 u	20 u
			08-06-01	1410	171	202	3	54	23
20	Thomas Fork at mouth, near Border, WY	T	03-17-01	1440	235 u	—	—	72 u	108 u
			08-06-01	1200	170	208	—	43	111
21	Bear River at Harer, ID	MS	08-06-01	1000	191	234	—	56	35
23	Bear Lake at Lifton, near St. Charles, ID	T	08-05-01	0930	242	274	10	28	46
24	Bear Lake Outlet Canal near Montpelier, ID	MS[1]	03-17-01	1140	205 u	—	—	55 u	22 u
			08-05-01	1400	257	298	8	30	48
25	Ovid Creek near Ovid, ID	T	03-17-01	0850	171 u	—	—	48 u	10 u
			08-05-01	1510	233 u	284 u	—	36 u	56 u

Table 9. Results of chemical analyses for water samples collected from selected sites on the Bear River and its tributaries, March and July-August 2001—Continued

Site number (fig. 1)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, residue at 180 °C, dissolved (mg/L)	Hardness, total (mg/L as $CaCO_3$)	Magnesium, dissolved (mg/L as Mg)	Manganese, dissolved (µg/L as Mn)	Potassium, dissolved (mg/L as K)	Sodium, dissolved (mg/L as Na)	Sulfate, dissolved (mg/L as SO_4)	Iron, dissolved (µg/L as Fe)
1	—	—	116 u	—	8.7 u	—	—	2.2 u	—	—
	<.2	3.5	117	101	7.7	3.3	.5	1.8	3.3	<30
2	—	—	346 u	—	23 u	308u	11 u	18 u	31 u	—
	—	—	334 u	—	29 u	—	3 u	15 u	38 u	—
3	—	—	302 u	—	22 u	53 u	3.5 u	16 u	39 u	—
	.2	5.5	281	208	24	27	2.5	15	30	30 e
4	—	—	300 u	—	24 u	72 u	5.1 u	21 u	34 u	—
	.2	4.7	287	220	26	29	2.7	19	28	40 e
5	—	—	258 u	—	20 u	97 u	6.6 u	18 u	22 u	—
	.3	8.4	379	218	35	18	5.8	45	46	20 e
6	—	—	300 u	—	23 u	97 u	2.3 u	24 u	24 u	—
	.2 e	11	336	216	22	332	3.1	29	32	10
7	—	—	760 u	—	61 u	87 u	17 u	74 u	346 u	—
8	—	—	228 u	—	15 u	19 u	5.4 u	12 u	24 u	—
	—	—	310 u	—	24 u	—	1.8 u	16 u	21 u	—
9	—	—	304 u	—	22 u	11u	2.7 u	32 u	23 u	—
	—	—	256 u	—	23 u	—	3 u	41 u	36 u	—
10	—	—	406 u	—	27 u	158 u	2.6 u	57 u	38 u	—
	.1 e	13	382	282	31	119	2.3	30	34	50 e
11	—	—	246 u	—	21 u	16 u	4.7 u	11 u	—	—
	—	—	354 u	—	37 u	—	2.4 u	11 u	—	—
12	—	—	328 u	—	25 u	105 u	3.6 u	34 u	30 u	—
	.2	10	492	323	42	60	3.2	53	57	—
13	—	—	600 u	—	42 u	20 u	3.5 u	64 u	195 u	—
	—	—	512 u	—	41 u	—	4 u	54 u	261 u	—
14	—	—	368 u	—	30 u	—	2.5 u	23 u	76 u	—
15	—	—	334 u	—	29 u	67 u	2.9 u	31 u	36 u	—
	.3	15	616	381	50	28	4.4	71	116	10 e
16	—	—	298 u	—	20 u	24 u	1.3 u	9.4 u	83 u	—
	.2 e	5.9	214	179	15	9.1	.7	6.5	61	—
17	—	—	256 u	—	16 u	25 u	—	8.6 u	64 u	—
	.1 e	4.6	214	167	13	12	.7	5.7	55	—
18	.2	7.0	322	227	20	30	1.6	17	60	<10
	.2 e	7.1	320	225	21	29	1.4	19	69	10 e
19	—	—	304 u	—	23 u	24 u	1.8 u	19 u	59 u	—
	.2	7.6	333	226	22	21	1.8	21	73	10 e
20	—	—	488 u	—	26 u	27 u	1.4 u	76 u	54 u	—
	.1 e	7.1	443	217	26	36	1.5	72	59	10 e
21	.2	8.9	387	251	27	5.6	1.8	33	85	<10
23	.2	11	417	281	51	<3.0	4.9	39	70	<10
24	—	—	288 u	—	26 u	21 u	2.1 u	19 u	32 u	—
	.2	11	434	285	51	3.0	4.7	41	73	<10
25	—	—	204 u	—	13 u	8.1 u	2.8 u	8.1 u	—	—
	—	—	420 u	—	47 u	—	6.3 u	60 u	57 u	—

Table 9. Results of chemical analyses for water samples collected from selected sites on the Bear River and its tributaries, March and July-August 2001—Continued

Site number (fig. 1)	Site designation	Site type	Date	Time	Alkalinity (mg/L as $CaCO_3$)	Bicarbonate (mg/L as HCO_3)	Carbonate (mg/L as CO_3)	Calcium, dissolved (mg/L as Ca)	Chloride, dissolved (mg/L as Cl)
26	Bear River at Pescadero, ID	MS	03-17-01	0930	221 u	—	—	64 u	24 u
			08-05-01	0930	249	345	6	31	48
27	Georgetown Creek at Georgetown, ID	T	03-16-01	1530	175 u	—	—	59 u	—
			08-05-01	1300	130 u	159 u	—	61 u	—
28	Stauffer Creek near Georgetown, ID	T	03-16-01	1410	152 u	—	—	40 u	8.5 u
			08-05-01	1350	171 u	208 u	—	44 u	4.6 u
29	Eightmile Creek at Eightmile Road, near Soda Springs, ID	T	03-16-01	1250	172 u	—	—	53 u	5.5 u
			08-04-01	1410	215 u	262 u	—	71 u	6.6 u
30	Bailey Creek near Soda Springs, ID	T	03-16-01	1340	207 u	—	—	56 u	4.5 u
			08-04-01	1300	233 u	284 u	—	72 u	17 u
31	Bear River at Soda Springs, ID	MS	03-16-01	1200	200 u	—	—	61 u	16 u
			08-04-01	1640	253	286	11	32	48
32	Soda Creek at mouth, at Soda Springs, ID	T	03-16-01	1050	676 u	—	—	133 u	71
			08-04-01	1040	932	1,140	—	289	24
33	Bear River above Soda Point Reservoir, at Soda Springs, ID	MS	03-16-01	0940	235 u	—	—	69 u	20 u
			08-04-01	1220	262	292	14	34	49
34	Bear River at Alexander, ID	MS	03-16-01	0930	338 u	—	—	85 u	27 u
			08-04-01	1000	268	318	4	36	50
35	Densmore Creek at mouth, near Thatcher, ID	T	08-04-01	0910	339 u	414 u	—	47 u	48 u
36	Bear River at Black Canyon, near Turner, ID	MS	03-15-01	1520	280 u	—	—	54 u	42 u
			08-03-01	1500	264	318	2	42	49
37	Whiskey Creek at Highway 34, near Thatcher, ID	T	03-15-01	1300	287 u	—	—	68 u	39 u
			08-03-01	1300	279 u	340 u	—	73 u	46 u
38	Trout Creek at Thatcher, ID	T	03-15-01	0930	261 u	—	—	71 u	13 u
			08-03-01	1630	263	313	4	61	32
39	Bear River near Thatcher, ID	MS	03-15-01	1110	364 u	—	—	77 u	36 u
			08-03-01	1340	270	330	—	40	50
40	Bear River below Oneida Narrows Reservoir, near Oneida, ID	MS	03-15-01	1130	339 u	—	—	80 u	46 u
			08-03-01	0930	285	347	—	43	52
41	Mink Creek at mouth, near Preston, ID	T	03-14-01	1600	185 u	—	—	51 u	11 u
			08-02-01	1330	241	294	—	59	13
42	Bear River at Highway 30, near Riverdale, ID	MS	03-14-01	1340	318 u	—	—	80 u	42 u
			08-03-01	1010	286	349	—	43	52
43	Battle Creek near Preston, ID	T	03-14-01	1020	320 u	—	—	78 u	267 u
			08-02-01	1140	300	366	—	49	78
44	Deep Creek at mouth, near Preston, ID	T	03-14-01	1530	266 u	—	—	63 u	95 u
			08-01-01	1500	303	370	—	46	75
45	Fivemile Creek near Preston, ID	T	03-14-01	1400	344 u	—	—	83 u	47 u
			08-01-01	1300	349 u	426 u	—	88 u	53 u
46	Bear River near Preston, ID	MS	03-14-01	1240	335 u	—	—	79 u	116
			08-02-01	0750	286	349	—	46	76
47	Weston Creek at mouth, near Weston, ID	T	03-14-01	1010	284 u	—	—	92 u	121 u
			08-01-01	1120	331 u	404 u	—	72 u	133 u
48	Bear River at Idaho-Utah Stateline	MS	03-13-01	1430	333 u	—	—	78 u	114 u
			08-02-01	1500	290	353	—	56	64
49	Worm Creek at 800 E., near Franklin, ID	T	03-13-01	1630	315 u	—	—	60 u	31 u
			08-01-01	1000	328 u	400 u	—	56 u	34 u

Table 9. Results of chemical analyses for water samples collected from selected sites on the Bear River and its tributaries, March and July-August 2001—Continued

Site number (fig. 1)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, residue at 180 °C, dissolved (mg/L)	Hardness, total (mg/L as $CaCO_3$)	Magnesium, dissolved (mg/L as Mg)	Manganese, dissolved (µg/L as Mn)	Potassium, dissolved (mg/L as K)	Sodium, dissolved (mg/L as Na)	Sulfate, dissolved (mg/L as SO_4)	Iron, dissolved (µg/L as Fe)
26	—	—	346 u	—	27 u	20 u	2.2 u	23 u	59 u	—
	.2	11	436	290	52	<3.0	4.6	41	73	<10
27	—	—	230 u	—	17 u	—	—	2.4 u	36 u	—
	—	—	252 u	—	19 u	—	—	3.9 u	80 u	—
28	—	—	198 u	—	14.u	79 u	5.3 u	6.7 u	—	—
	—	—	196 u	—	20 u	—	2.1 u	6.6 u	—	—
29	—	—	188 u	—	11 u	12 u	1.4 u	4.4 u	—	—
	—	—	260 u	—	15 u	—	3.4 u	8.2 u	—	—
30	—	—	222 u	—	19 u	—	1.1 u	3.8 u	—	—
	—	—	310 u	—	26 u	—	2.4u	9.9 u	—	—
31	—	—	300 u	—	24 u	8.8 u	2.2 u	15 u	72 u	—
	.2	10	443	293	52	<3.0	4.9	42	74	10 e
32	—	—	932 u	—	102 u	164 u	11 u	58 u	112 u	—
	.6	49	1,540	1,280	135	229	19	28	391	330 e
33	—	—	352 u	—	29 u	6.8 u	2.8 u	20 u	—	—
	.2	11	463	298	52	3	5.0	43	74	10 e
34	—	—	476 u	—	45 u	35 u	4.2 u	24 u	63 u	—
	.2	11	485	302	52	3.9	5.0	41	76	10
35	—	—	468 u	—	59 u	—	6.2 u	47 u	76 u	—
36	—	—	466 u	—	53 u	—	5.9 u	39 u	66 u	—
	.2	14	474	321	52	3.9	5.4	42	75	10 e
37	—	—	450 u	—	41 u	5.5 u	4.5 u	34 u	58 u	—
	—	—	466 u	—	45 u	—	4.5 u	36 u	63 u	—
38	—	—	336 u	—	27 u	18 u	3.0 u	14 u	25 u	—
	.1 e	11	373	302	36	27	3.4	28	67	—
39	—	—	516 u	—	50 u	26 u	6.2 u	34 u	62 u	—
	.2	12	443	318	53	2.3 e	5.2	42	77	<10
40	—	—	512 u	—	44 u	30 u	8.5 u	42 u	69 u	—
	.2	12	485	317	51	3e	5.9	46	77	<10
41	—	—	240 u	—	17 u	7.4 u	3.8 u	12 u	—	—
	.2	22	268	232	21	7.2	4.8	15	7.7	—
42	—	—	488 u	—	42 u	—	7.8 u	40 u	69 u	—
	.2	11	483	316	51	4.6	6.0	46	77	10 e
43	—	—	1,080 u	—	55 u	114 u	12 u	227 u	230 u	—
	.3	18	535	315	47	54	8.1	66	73	<10
44	—	—	522 u	—	30 u	55 u	11 u	78 u	55 u	—
	.3	12	535	329	52	5.9	8.2	59	76	10 e
45	—	—	520 u	—	35 u	76 u	9.2 u	53 u	47 u	—
	—	—	536 u	—	39 u	—	11 u	59 u	50 u	—
46	—	—	622 u	—	41 u	38 u	14 u	86 u	64 u	—
	.2	12	525	332	52	6.6	8.2	58	77	<10
47	—	—	718 u	—	46 u	46 u	13 u	82 u	—	—
	—	—	782 u	—	61 u	—	15 u	110 u	148 u	—
48	—	—	628 u	—	42 u	49 u	15 u	91 u	—	—
	.4	26	484	276	33	23	10	64	38	—
49	—	—	438 u	—	39 u	66 u	13 u	38 u	24 u	—
	—	—	414 u	—	46 u	—	19 u	44 u	20 u	—

Table 9. Results of chemical analyses for water samples collected from selected sites on the Bear River and its tributaries, March and July-August 2001—Continued

Site number (fig. 1)	Site designation	Site type	Date	Time	Alkalinity (mg/L as $CaCO_3$)	Bicar-bonate (mg/L as HCO_3)	Carbon-ate (mg/L as CO_3)	Calcium, dissolved (mg/L as Ca)	Chloride, dissolved (mg/L as Cl)
50	Spring Creek near Cove, UT	T	03-13-01	1200	189 u	—	—	43 u	16 u
			08-01-01	0850	262 u	320 u	—	53 u	14 u
51	Cub River near Richmond, UT	T	03-13-01	0940	243 u	—	—	52 u	24 u
			08-02-01	1040	259	306	—	50	39
52	Bear River near Benson, UT	MS	03-13-01	1410	318 u	—	—	70 u	89 u
			08-01-01	1620	288	351	—	47	74
53	Blacksmith Fork at 2900 S., near Millville, UT	T	03-12-01	1640	194 u	—	—	56 u	8.5 u
54	Logan River below Blacksmith Fork, near Logan, UT	T	03-12-01	0910	225 u	—	—	57 u	8.8 u
			07-31-01	1330	272	332	—	68	21
55	Spring Creek at 600 S., near Logan, UT	T	03-12-01	1140	295 u	—	—	62 u	60 u
			07-31-01	1210	249 u	304 u	—	64	24
56	Little Bear River at 600 S., near Mendon, UT	T	03-12-01	1440	266 u	—	—	58 u	29 u
			07-31-01	0930	288	351	—	75	51
57	Hopkins Slough near Benson, UT	T	03-12-01	1700	312 u	—	—	47 u	40 u
			07-31-01	1120	253 u	308 u	—	48 u	29 u
58	Logan wastewater-treatment plant ditch near Logan, UT	T	03-11-01	1800	251 u	—	—	40 u	54 u
			07-31-01	0830	271 u	330 u	—	70 u	86 u
59	Swift Slough at 1300 E., near Logan, UT	T	07-31-01	0920	259 u	316 u	—	53 u	29 u
60	Little Bear River at 3000 N., at Benson Marina, UT	T	03-13-01	1040	236 u	—	—	52 u	32 u
			08-01-01	1130	292	331	12	54	72
61	Newton Creek at mouth, near Newton, UT	T	07-31-01	1500	279 u	340 u	—	57 u	—
62	Bear River near Collinston, UT	MS	03-11-01	1530	284 u	—	—	61 u	78 u
			07-30-01	1430	275	336	—	55	362
64	Malad River south of Bear River City, UT	T	07-30-01	1410	358 u	436 u	—	54 u	269 u
65	Bear River near Corinne, UT	MS	03-12-01	1100	295 u	—	—	66 u	182 u
			07-30-01	1150	279 u	340 u	—	65 u	909 u

[1]Bear Lake Outlet Canal considered main-stem site because Bear River is diverted from main channel upstream from confluence of outlet canal with main channel.

Table 9. Results of chemical analyses for water samples collected from selected sites on the Bear River and its tributaries, March and July-August 2001—Continued

Site number (fig. 1)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, residue at 180 °C, dissolved (mg/L)	Hardness, total (mg/L as $CaCO_3$)	Magnesium, dissolved (mg/L as Mg)	Manganese, dissolved (µg/L as Mn)	Potassium, dissolved (mg/L as K)	Sodium, dissolved (mg/L as Na)	Sulfate, dissolved (mg/L as SO_4)	Iron, dissolved (µg/L as Fe)
50	—	—	254 u	—	21 u	38 u	4.0 u	15 u	—	—
	—	—	324 u	—	31 u	—	4.0 u	30 u	—	—
51	—	—	324 u	—	26 u	55 u	9.3 u	28 u	21 u	—
	.1 e	9.3	363	247	30	25	5.6	32	26	<10
52	—	—	542 u	—	39 u	32 u	12 u	71 u	59 u	—
	.3	13	528	331	52	3.6	7.9	58	78	<10
53	—	—	246 u	—	23 u	—	—	5.6 u	—	—
54	—	—	246 u	—	23 u	6.7 u	1.2 u	6.5 u	—	—
	.1 e	9.4	336	289	29	38	3.6	13	14	30 e
55	—	—	494 u	—	45 u	45 u	14 u	42 u	49 u	—
	.2	12	387	298	34	19	5.4	20	46	10 e
56	—	—	328 u	—	28 u	66 u	7.8 u	21 u	—	—
	.2	23	418	304	28	26	7.5	29	14	10 e
57	—	—	422 u	—	43 u	15 u	11 u	43 u	—	—
	—	—	346 u	—	34 u	24 u	7.6 u	35 u	—	—
58	—	—	374 u	—	24 u	40 u	12 u	58 u	29 u	—
	—	—	524 u	—	34 u	40 u	11 u	70 u	36 u	—
59	—	—	356 u	—	31 u	7.9 u	7.7 u	30 u	21 u	—
60	—	—	330 u	244 u	28 u	23 u	6.6 u	26 u	24 u	—
	.3	17	518	323	46	<3.0	8.2	57	61	<10
61	—	—	530 u	—	55 u	33 u	9.0 u	60 u	79 u	—
62	—	—	462 u	—	34 u	11 u	9.6 u	57 u	42 u	—
	.3	15	980	333	47	4.6	13	217	68	10 e
64	—	—	1,160 u	—	60 u	8.6u	26	285 u	118 u	—
65	—	—	672 u	—	3.1 u	—	15 u	132 u	48 u	—
	—	—	2,540 u	—	60 u	—	47 u	795 u	96 u	—

Table 10. Results of nutrient and sediment analyses for water samples collected from selected sites on the Bear River and its tributaries, March and July-August 2001

[**Site designation:** UT, Utah; ID, Idaho; WY, Wyoming; **Site type:** MS, main stem; T, tributary; mg/L, milligrams per liter; NTU, nephelometric turbidity units; %, percent; mm, millimeter; <, less than; >, greater than;—, no data; e, estimated; u, analyzed by Utah Health Laboratory; c, calculated from total NO_2+NO_3 concentration (fig. 2)]

Site number (fig. 1)	Site designation	Site type	Date	Time	Nitrogen, ammonia, dissolved (mg/L as N)	Nitrogen, ammonia plus organic nitrogen, dissolved (mg/L as N)	Nitrogen, ammonia plus organic nitrogen, total (mg/L as N)
1	Bear River near Utah-Wyoming Stateline	MS	03-20-01	1030	<0.041	<0.1	0.07 e
			08-09-01	1100	<.04	.14	.17
2	Sulphur Creek at mouth, near Evanston, WY	T	03-20-01	1300	—	—	—
			08-09-01	0850	—	—	—
3	Bear River at Evanston, WY	MS	03-21-01	0950	.162	.56	.74
			08-09-01	0900	.024 e	.41	.47
4	Bear River below Yellow Creek, near Evanston, WY	MS	03-21-01	0920	—	—	—
			08-09-01	1140	.022 e	.44	.51
5	Bear River above reservoir, near Woodruff, UT	MS	03-20-01	1610	.312	1.2	1.5
			08-08-01	1430	.021 e	.52	.6
6	Bear River below reservoir, near Woodruff, UT	MS	03-20-01	1000	.066	.27	.33
			08-08-01	1100	.198	.89	1
7	Saleratus Creek near Woodruff, UT	T	03-19-01	1520	—	—	—
8	Genes (Woodruff) Creek at Woodruff, UT	T	03-19-01	1640	—	—	—
			08-08-01	1410	—	—	—
9	Big Creek at Highway 89, near Randolph, UT	T	03-19-01	1350	—	—	—
			08-07-01	1520	—	—	—
10	Bear River at Randolph, UT	MS	03-19-01	1350	<.041	.28	.35
			08-08-01	1140	.025 e	.15	.2
11	Otter Creek near Randolph, UT	T	03-19-01	1530	—	—	—
			08-08-01	0930	—	—	—
12	Bear River above Bridger Creek, near Leefe, WY	MS	03-19-01	1140	.167	.63	.8
			08-07-01	1230	.031 e	.33	.54
13	Twin Creek at Highway 89, near Leefe, WY	T	03-18-01	1450	—	—	—
			08-07-01	0950	—	—	—
14	Sublette Creek at Highway 30, near Cokeville, WY	T	08-07-01	0820	—	—	—
15	Bear River below Pixley Dam, near Cokeville, WY	MS	03-18-01	1400	.058	.35	.45
			08-06-01	1600	.034 e	.36	.7
16	Spring Creek at Cokeville, WY	T	03-19-01	1020	<.041	.13	.23
			08-07-01	1540	.03 e	.11	.2
17	Smiths Fork at Highway 30, near Cokeville, WY	T	03-18-01	1300	<.041	.1 e	.22
			08-07-01	1350	.032 e	.09 e	.16
18	Bear River below Smiths Fork, near Cokeville, WY	MS	03-18-01	1000	<.041	.15	.25
			08-07-01	0940	.024 e	.2	.3
19	Bear River at Border, WY	MS	03-18-01	1040	<.041	.14	.26
			08-06-01	1410	.034 e	.18	.22
20	Thomas Fork at mouth, near Border, WY	T	03-17-01	1440	.025 e	.16	.24
			08-06-01	1200	.023 e	.31	.65
21	Bear River at Harer, ID	MS	08-06-01	1000	<.04	.23	.38
22	Bear River near Dingle, ID	MS	03-17-01	1150	<.041	.1 e	.19
			08-06-01	1000	—	—	—
23	Bear Lake at Lifton, near St. Charles, ID	T	08-05-01	0930	<.04	.21	.26
24	Bear Lake Outlet Canal near Montpelier, ID	MS[1]	03-17-01	1140	.144	.4	.49
			08-05-01	1400	<.04	.25	.44

Table 10. Results of nutrient and sediment analyses for water samples collected from selected sites on the Bear River and its tributaries, March and July-August 2001—Continued

Site number (fig. 1)	Nitrogen, NO_2 plus NO_3, dissolved (mg/L as N)	Nitrogen, NO_2 plus NO_3, total (mg/L as N)	Nitrogen, nitrite, dissolved (mg/L as N)	Phosphorus, dissolved (mg/L as P)	Ortho phosphorus, dissolved (mg/L as P)	Phosphorus, total (mg/L as P)	Turbidity (NTU)	Suspended sediment, (% finer than 0.062 mm)	Suspended sediment (mg/L)	Total suspended solids (mg/L)
1	0.122	0.17 u	<0.006	<0.006	<0.018	<.004	1.1	—	3	<4 u
	.041 e	—	<.006	<.006	<.02	.005	.8	79	4	—
2	.18 c	.25 u	—	—	—	.441 u	32	—	77	78 u
	<.01 u	—	—	.02 u	—	.026 u	5	72	8	5.3 u
3	.116	.17 u	.005 e	.019	<.018	.072	18	—	24	24 u
	.039 e	—	<.006	.005 e	<.02	.01	1.4	—	2	—
4	.15 c	.22 u	—	—	—	.167 u	47	—	48	50 u
	.026 e	—	<.006	.025	.017 e	.04	2.6	—	7	—
5	.139	.20 u	.009	.109	.08	.273	72	—	90	86 u
	.031 e	—	<.006	.025	.014 e	.018	1.4	—	2	<4 u
6	.227	.29 u	.003 e	.035	.025	.05	3.4	—	2	<4 u
	.075	—	.029	.153	.132	.198	15	—	15	11 u
7	.39 c	.47 u	—	—	—	.317 u	7.4	—	14	12 u
8	—	<.10 u	—	—	—	.347 u	2.1	—	—	<4 u
	<.01 u	—	—	<.02 u	—	<.02 u	1.8	59	8	5.2 u
9	.06 c	.13 u	—	—	—	.073 u	7.5	—	20	16 u
	<.01 u	—	—	.075 u	—	.098 u	4.7	71	11	15 u
10	.05	<.10 u	.003 e	.009	<.018	.036	5.5	—	11	8 u
	.026 e	—	<.006	.01	<.02	.019	—	61	24	—
11	.11 c	.18 u	—	—	—	.195 u	35	—	318	93 u
	<.01 u	—	—	<.02 u	—	.033 u	1.8	88	26	<4 u
12	.044 e	<.10 u	.003 e	.014	<.018	.061	14	—	20	21 u
	.026 e	—	—	.02 u	<.02	.054	7.7	97	15	25 u
13	.07 c	.14 u	—	—	—	.068 u	42	—	83	50 u
	<.01 u	—	—	.02 u	—	<.02 u	2.3	55	13	<4 u
14	<.01 u	—	—	<.02 u	—	.023 u	1.4	56	9	6 u
15	.046 e	.11 u	.003 e	.014	<.018	.041	6.6	—	5	7.2 u
	.024 e	—	.003 e	.024	.012 e	.107	36	88	84	19 u
16	.195	.27 u	.003 e	.006	<.018	.031	6.6	—	27	10 u
	.025 e	—	.003 e	.006 e	<.02	.018	1.7	—	12	7.2 u
17	.042 e	<.10 u	<.006	.004 e	<.018	.028	4.5	—	17	12 u
	.026 e	—	<.006	.003 e	<.02	.018	2.5	71	9	8.4 u
18	.075	.13 u	<.006	.006	<.018	.04	8.6	—	14	13 u
	.05	—	.003 e	.01	<.02	.031	11	—	16	<4 u
19	.073	.13 u	.003 e	.008	<.018	.032	9.7	—	61	13 u
	.023 e	—	<.006	.004 e	<.02	.02	1.9	—	16	7.6 u
20	1.17	1.27 u	.013	.004 e	<.018	.054	14	—	56	29 u
	.034 e	—	.005 e	.007	<.02	.085	38	93	56	51 u
21	.041 e	—	<.006	.005 e	<.02	.042	1.8	—	45	31 u
22	.164	—	.003 e	.004 e	<.018	.022	4.8	—	16	—
	—	—	—	—	—	—	3.2	84	52	—
23	.027 e	—	<.006	<.006	<.02	.014	4.4	94	17	—
24	.207	.27 u	.005 e	.016	.009 e	.036	3.1	—	4	<4 u
	.026 e	—	<.006	.004 e	<.02	.067	4.7	—	51	8 u

Table 10. Results of nutrient and sediment analyses for water samples collected from selected sites on the Bear River and its tributaries, March and July-August 2001—Continued

Site number (fig. 1)	Site designation	Site type	Date	Time	Nitrogen, ammonia, dissolved (mg/L as N)	Nitrogen, ammonia plus organic nitrogen, dissolved (mg/L as N)	Nitrogen, ammonia plus organic nitrogen, total (mg/L as N)
25	Ovid Creek near Ovid, ID	T	03-17-01	0850	—	—	—
			08-05-01	1510	—	—	—
26	Bear River at Pescadero, ID	MS	03-17-01	930	.09	.32	.39
			08-05-01	930	<.04	.27	.45
27	Georgetown Creek at Georgetown, ID	T	03-16-01	1530	—	—	—
			08-05-01	1300	—	—	—
28	Stauffer Creek near Georgetown, ID	T	03-16-01	1410	—	—	—
			08-05-01	1350	—	—	—
29	Eightmile Creek at Eightmile Road, near Soda Springs, ID	T	03-16-01	1250	—	—	—
			08-04-01	1410	—	—	—
30	Bailey Creek near Soda Springs, ID	T	03-16-01	1340	—	—	—
			08-04-01	1300	—	—	—
31	Bear River at Soda Springs, ID	MS	03-16-01	1200	.024 e	.23	.3
			08-04-01	1640	.024 e	.27	.52
32	Soda Creek at mouth, at Soda Springs, ID	T	03-16-01	1050	.149	.21	—
			08-04-01	1040	.029 e	.13	.16
33	Bear River above Soda Point Reservoir, at Soda Springs, ID	MS	03-16-01	0940	.174	.38	.51
			08-04-01	1220	.026 e	.28	.49
34	Bear River at Alexander, ID	MS	03-16-01	0930	.203	.35	.53
			08-04-01	1000	.043	.37	.43
35	Densmore Creek at mouth, near Thatcher, ID	T	08-04-01	0910	—	—	—
36	Bear River at Black Canyon, near Turner, ID	MS	03-15-01	1520	.169	.16	.17
			08-03-01	1500	.022 e	.29	.37
37	Whiskey Creek at Highway 34, near Thatcher, ID	T	03-15-01	1300	—	—	—
			08-03-01	1300	—	—	—
38	Trout Creek at Thatcher, ID	T	03-15-01	0930	.108	.43	.64
			08-03-01	1630	<.04	<.1	<.08
39	Bear River near Thatcher, ID	MS	03-15-01	1110	.111	.29	.37
			08-03-01	1340	<.04	.3	.5
40	Bear River below Oneida Narrows Reservoir, near Oneida, ID	MS	03-15-01	1130	.191	.44	.53
			08-03-01	0930	<.04	.3	.46
41	Mink Creek at mouth, near Preston, ID	T	03-14-01	1600	.022 e	.35	.59
			08-02-01	1330	<.04	.36	.35
42	Bear River at Highway 30, near Riverdale, ID	MS	03-14-01	1340	.097	.23	.4
			08-03-01	1010	.026	.32	.45
43	Battle Creek near Preston, ID	T	03-14-01	1020	.168	.73	1.7
			08-02-01	1140	<.04	.35	.39
44	Deep Creek at mouth, near Preston, ID	T	03-14-01	1530	.51	1	2.4
			08-01-01	1500	.026	.36	.44
45	Fivemile Creek near Preston, ID	T	03-14-01	1400	—	—	—
			08-01-01	1300	—	—	—
46	Bear River near Preston, ID	MS	03-14-01	1240	.199	.42	.59
			08-02-01	0750	<.04	.34	.42
47	Weston Creek at mouth, near Weston, ID	T	03-14-01	1010	—	—	—
			08-01-01	1120	—	—	—

Table 10. Results of nutrient and sediment analyses for water samples collected from selected sites on the Bear River and its tributaries, March and July-August 2001—Continued

Site number (fig. 1)	Nitrogen, NO_2 plus NO_3, dissolved (mg/L as N)	Nitrogen, NO_2 plus NO_3, total (mg/L as N)	Nitrogen, nitrite, dissolved (mg/L as N)	Phosphorus, dissolved (mg/L as P)	Ortho phosphorus, dissolved (mg/L as P)	Phosphorus, total (mg/L as P)	Turbidity (NTU)	Suspended sediment, (% finer than 0.062 mm)	Suspended sediment (mg/L)	Total suspended solids (mg/L)
25	.16 c	0.23 u	—	—	—	<0.02 u	1.6	—	5	<4 u
	<.01 u	—	—	<.02 u	—	.061 u	4.7	80	13	6 u
26	.429	.52 u	.004 e	.01	<.018	.035	4.2	—	9	8 u
	.028 e	—	<.006	< .007	<.02	.087	29	—	76	8 u
27	.09 c	.16 u	—	—	—	.043 u	.4	—	14	<4 u
	<.01 u	—	—	<.02 u	—	.022 u	1.1	52	7	<4 u
28	.19 c	.26 u	—	—	—	.076 u	6.8	—	14	11 u
	<.01 u	—	—	<.02 u	—	.026 u	4.5	—	—	4 u
29	.06 c	.13 u	—	—	—	.027 u	3.2	—	32	4 u
	<.01 u	—	—	.042 u	—	.074 u	3	80	22	4 u
30	.12 c	.19 u	—	—	—	.041 u	8	—	51	22 u
	.22 u	—	—	.034 u	—	.109 u	8.9	82	98	10 u
31	.511	.58 u	.006	.009	<.018	.024	1.6	—	30	4.8 u
	.026 e	—	<.006	.006	<.02	.074	24	—	70	8 u
32	1.06	1.15 u	.009	.037	.029	.128 u	1.7	—	60	6.8 u
	.041 e	—	<.006	.014	.009 e	.034	3	30	179	<4 u
33	.833	.93 u	.016	.018	.014 e	.035	2	—	36	<4 u
	.073	—	<.006	.007	<.02	.076	30	—	59	4 u
34	.983	1.12 u	.012	.015	.014 e	.059	9	—	51	12 u
	.052	—	<.006	.014	<.02	.049	15	—	19	<4 u
35	<.01 u	—	—	.024 u	—	—	.9	56	3	<4 u
36	1.48	1.60 u	.013	.047	.064	.051	.6	—	13	<4 u
	.282	—	.007	.029	.021	.045	2.3	63	24	<4 u
37	2.84 c	3.02 u	—	—	—	.19 u	12	—	91	66 u
	3.06 u	—	—	.035 u	—	.065 u	1.2	31	70	<4 u
38	1.09	1.62 u	.013	.073	.032	.131	15	—	45	24 u
	.027 e	—	<.006	<.006	<.02	.099 u	12	—	65	8 u
39	1.08	1.23 u	.011	.038	.033	.065	5.7	—	48	9.2 u
	.111	—	.005 e	.021	.01 e	.108	17	—	50	<4 u
40	.978	1.08 u	.016	.03	.024	.055	3.6	—	25	<4 u
	.1	—	.006	.026	.015 e	.049	8.1	94	10	<4 u
41	1.18	1.28 u	.017	.046	.033	.082	4.9	—	5	<4 u
	.046 e	—	.013	.053	.041	.066	2.2	48	49	<4 u
42	1.01	1.11 u	.015	.028	.018	.053	2.7	—	41	8.4 u
	.072	—	.003 e	.022	<.02	.049	6.5	—	14	<4 u
43	1.94	2.10 u	.029	.126	.104	1.11	>1,000	—	861	880 u
	.107	—	.013	.039	.028	.089	16	95	44	<4 u
44	.917	1.82 u	.024	.141	.12	.677	300	—	395	396 u
	1.18	—	.04	.066	.051	.115	8.7	61	31	<4 u
45	2.76 c	2.94 u	—	—	—	.219 u	50	—	127	99 u
	.86 u	—	—	.135 u	—	.214 u	16	54	88	8 u
46	1.05	1.13 u	.016	.039	.029	.112	30	—	98	49 u
	.119	—	.017	.028	.016 e	.057	4.5	53	61	<4 u
47	2.52 c	2.69 u	—	—	—	.608 u	770	—	765	804 u
	1.51 u	—	—	<.02 u	—	.02 u	3.2	72	31	16 u

Table 10. Results of nutrient and sediment analyses for water samples collected from selected sites on the Bear River and its tributaries, March and July-August 2001—Continued

Site number (fig. 1)	Site designation	Site type	Date	Time	Nitrogen, ammonia, dissolved (mg/L as N)	Nitrogen, ammonia plus organic nitrogen, dissolved (mg/L as N)	Nitrogen, ammonia plus organic nitrogen, total (mg/L as N)
48	Bear River at Idaho-Utah Stateline	MS	03-13-01	1430	0.212	0.52	0.71
			08-02-01	1500	<.04	.37	.46
49	Worm Creek at 800 E., near Franklin, ID	T	03-13-01	1630	—	—	—
			08-01-01	1000	—	—	—
50	Spring Creek near Cove, UT	T	03-13-01	1200	—	—	—
			08-01-01	0850	—	—	—
51	Cub River near Richmond, UT	T	03-13-01	0940	.679	1.4	1.9
			08-02-01	1040	<.04	.42	.85
52	Bear River near Benson UT	MS	03-13-01	1410	.424	.84	1.3
			08-01-01	1620	<.04	.31	.71
53	Blacksmith Fork at 2900 S., near Millville, UT	T	03-12-01	1640	—	—	—
54	Logan River below Blacksmith Fork, near Logan, UT	T	03-12-01	0910	.022 e	.1 e	.2
			07-31-01	1330	.027 e	.27	.34
55	Spring Creek at 600 S., near Logan, UT	T	03-12-01	1140	1.43	2.4	2.8
			07-31-01	1210	.061	.42	.65
56	Little Bear River at 600 S., near Mendon, UT	T	03-12-01	1440	.247	.71	.98
			07-31-01	0930	.054	.46	.74
57	Hopkins Slough near Benson, UT	T	03-12-01	1700	—	—	—
			07-31-01	1120	—	—	—
58	Logan wastewater-treatment plant ditch near Logan, UT	T	03-11-01	1800	—	—	—
			07-31-01	0830	—	—	—
59	Swift Slough at 1300 E., near Logan, UT	T	07-31-01	0920	—	—	—
60	Little Bear River at 3000 N., at Benson Marina, UT	T	03-13-01	1040	.548	1.1	1.5
			08-01-01	1130	<.04	.47	.72
61	Newton Creek at mouth, near Newton, UT	T	07-31-01	1500	—	—	—
62	Bear River near Collinston, UT	MS	03-11-01	1530	.206	.65	1.1
			07-30-01	1430	.024 e	.39	.6
63	Bear River at U-30 crossing, near Deweyville, UT	MS	07-30-01	1550	—	—	—
64	Malad River south of Bear River City, UT	T	07-30-01	1410	—	—	—
65	Bear River near Corinne, UT	MS	03-12-01	1100	.473	.89	1.5
			07-30-01	1150	—	—	—

[1]Bear Lake Outlet Canal considered main-stem site because Bear River is diverted from main channel upstream from confluence of outlet canal with main channel.

Table 10. Results of nutrient and sediment analyses for water samples collected from selected sites on the Bear River and its tributaries, March and July-August 2001—Continued

Site number (fig. 1)	Nitrogen, NO_2 plus NO_3, dissolved (mg/L as N)	Nitrogen, NO_2 plus NO_3, total (mg/L as N)	Nitrogen, nitrite, dissolved (mg/L as N)	Phosphorus, dissolved (mg/L as P)	Ortho phosphorus, dissolved (mg/L as P)	Phosphorus, total (mg/L as P)	Turbidity (NTU)	Suspended sediment, (% finer than 0.062 mm)	Suspended sediment (mg/L)	Total suspended solids (mg/L)
48	1.06	1.17 u	0.018	0.054	0.043	0.143	34	—	66	62 u
	.136	—	.013	.028	.011 e	.074	10	—	38	<4 u
49	4.57 c	4.82 u	—	—	—	.593 u	70	—	122	111 u
	<.01 u	—	—	.293 u	—	.387 u	29	—	—	25 u
50	1.78 c	1.92 u	—	—	—	.214 u	34	—	59	41 u
	.42 u	—	—	—	—	.25 u	6.4	77	11	5.2 u
51	2.06	2.28 u	.036	.216	.215	.394	43	—	63	58 u
	.998	—	.043	.017	<.02	.142	12	—	41	4 u
52	1.51	1.63 u	.033	.12	.103	.29	71	—	96	108 u
	.129	—	.009	.027	.01 e	.175	69	—	141	151 u
53	.17 c	.24 u	—	—	—	<.02 u	1.3	—	13	5.6 u
54	.326	.40 u	.005 e	.008	<.018	.023	.6	—	8	6 u
	.237	—	.016	.017	<.02	.041	2.5	65	53	6 u
55	5.28	5.35 u	.094	1.12	1.06	1.27	15	—	30	28 u
	.595	—	.021	.233	.211	.345	39	—	61	58 u
56	.666	.82 u	.015	.113	.09	.174	10	—	25	25 u
	.573	—	.016	.088	.067	.204	42	—	83	61 u
57	2.73 c	2.91 u	—	—	—	.235 u	24	—	45	43 u
	1.71 u	—	—	.085 u	—	.266 u	65	99	101	94 u
58	.54 c	.63 u	—	—	—	2.4 u	24	—	55	70 u
	.97 u	—	—	2.5	—	2.3 u	8.6	48	93	8 u
59	<.01 u	—	—	.049 u	—	.082 u	16	98	31	24 u
60	1.06	1.14 u	.025	.314	.277	.45	41	—	48	54 u
	.029 e	—	<.006	.12	.092	.35	96	—	111	101 u
61	.51 u	—	—	.038 u	—	.097 u	20	—	40	31 u
62	1.76	1.04 u	.022	.077	.062	.49	45	—	44	47 u
	.082	—	<.006	.042	.03	.137	35	—	52	34 u
63	—	—	—	—	—	—	21	98	46	—
64	1.34 u	—	—	.185 u	—	.432 u	85	99	148	153 u
65	.918	1.04 u	.026	.13	.109	.289	52	—	30	99 u
	.69 u	—	—	<.02 u	—	.287 u	140	99	121	121 u

Table 11. Pesticides detected in water samples collected from selected sites in the Bear River basin, March and July-August 2001

[µg/L, micrograms per liter; —, no data; e, estimated]

Pesticide	Type	Number of samples	Number of detections	Minimum reporting level (µg/L)	Maximum concentration (µg/L)	Benchmarks	
						Aquatic life (µg/L)	Human health (µg/L)
2,4-D	Herbicide	9	3	0.21	0.03 e	—	[1]70
Atrazine	Herbicide	20	11	.007	.096e	[2]1.8	[1]3
Bentazon	Herbicide	9	4	.011	.01e	—	[1]200
Metolachlor	Herbicide	20	1	.013	.006e	[2]7.8	[1]100
Picloram	Herbicide	9	1	.019	.09	[2]29	[1]500
Prometon	Herbicide	20	13	.015	.008e	—	[1]100
Tebuthiuron	Herbicide	20	8	.016	.023e	[2]1.6	[1]500
Azinphos-methyl	Insecticide	20	1	.050	.009e	[3].01	—
Chlorpyrifos	Insecticide	20	1	.005	.004e	[3].041	[1]20
Malathion	Insecticide	20	5	.027	.006e	[3].1	[1]100
2-Hydroxyatrazine	Degradate	9	2	.008	.031e	—	—
Deethylatrazine	Degradate	20	9	.006	.015e	—	—

[1] U.S. Environmental Protection Agency, 2004.

[2] Canadian Government Aquatic-Life Guidelines (Canadian Council of Ministers of the Environment, 2001).

[3] U.S. Environmental Protection Agency, 2002.

Table 12. Results of pesticide analyses of water samples collected from selected sites on the Bear River and its tributaries, March and July-August 2001

[UT, Utah; ID, Idaho; WY, Wyoming; concentration reported in micrograms per liter;<, less than; e, estimated;—, not analyzed]

Pesticide	Use	Class	Reporting level	Bear River at Evanston, WY (site 3)	Bear River at Evanston, WY (site 3)	Bear River below Yellow Creek, near Evanston, WY (site 4)	Bear River below Reservoir, near Woodruff, UT (site 6)	Bear River below Smiths Fork, near Cokeville, WY (site 18)	Bear River below Smiths Fork, near Cokeville, WY (site 18)	Bear River at Harer, ID (site 21)
				03-21-01	08-09-01	08-09-01	08-08-01	03-18-01	08-07-01	08-06-01
2,6-Diethylaniline	Degradate	aniline	0.002	<.002	<0.002	<0.002	<0.002	<0.002	<0.002	<.002
Acetochlor	Herbicide	acetanilide	.004	<.004	<.004	<.004	<.004	<.004	<.004	<.004
Alachlor	Herbicide	acetanilide	.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002
alpha-HCH	Insecticide	organochlorine	.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005
Atrazine	Herbicide	triazine	.007	<.007	<.007	<.007	<.007	<.007	<.007	<.007
Azinphos-methyl	Insecticide	organothiophosphate	.050	<.05	<.05	<.05	<.05	<.050	<.050	<.05
Benfluralin	Herbicide	dinitroaniline	.010	<.01	<.01	<.01	<.01	<.010	<.010	<.01
Butylate	Herbicide	thiocarbamate	.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002
Carbaryl	Insecticide	carbamate	.041	<.041	<.041	<.041	<.041	<.041	<.041	<.041
Carbofuran	Insecticide	carbamate	.020	<.02	<.02	<.02	<.02	<.020	<.020	<.02
Chlorpyrifos	Insecticide	organothiophosphate	.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005
Cyanazine	Herbicide	triazine	.018	<.018	<.018	<.018	<.018	<.018	<.018	<.018
Dacthal	Herbicide	chlorobenzoic acid ester	.003	<.003	<.003	<.003	<.003	<.003	<.003	<.003
Deethylatrazine	Degradate	triazine	.006	<.006	<.006	<.006	<.006	<.006	<.006	<.006
Diazinon	Insecticide	organothiophosphate	.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005
Dieldrin	Insecticide	organochlorine	.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005
Disulfoton	Insecticide	organothiophosphate	.021	<.021	<.021	<.021	<.021	<.021	<.021	<.021
EPTC	Herbicide	thiocarbamate	.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002
Ethalfluralin	Herbicide	dinitroaniline	.009	<.009	<.009	<.009	<.009	<.009	<.009	<.009
Ethoprop	Insecticide	organothiophosphate	.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005
Fonofos	Insecticide	organothiophosphate	.003	<.003	<.003	<.003	<.003	<.003	<.003	<.003
gamma-HCH	Insecticide	organochlorine	.004	<.004	<.004	<.004	<.004	<.004	<.004	<.004
Linuron	Herbicide	urea	.035	<.035	<.035	<.035	<.035	<.035	<.035	<.035
Malathion	Insecticide	organothiophosphate	.027	<.027	<.027	<.027	<.027	<.027	[1].006 e	[1].002 e
Methyl parathion	Insecticide	organothiophosphate	.006	<.006	<.006	<.006	<.006	<.006	<.006	<.006
Metolachlor	Herbicide	acetanilide	.013	<.013	<.013	<.013	<.013	<.013	<.013	<.013
Metribuzin	Herbicide	triazine	.006	<.006	<.006	<.006	<.006	<.006	<.006	<.006
Molinate	Herbicide	thiocarbamate	.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002
Napropamide	Herbicide	amide	.007	<.007	<.007	<.007	<.007	<.007	<.007	<.007
p,p'-DDE	Degradate	organochlorine	.003	<.003	<.003	<.003	<.003	<.003	<.003	<.003
Parathion	Insecticide	organothiophosphate	.007	<.007	<.007	<.007	<.007	<.007	<.007	<.007
Pebulate	Herbicide	thiocarbamate	.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002
Pendimethalin	Herbicide	dinitroaniline	.010	<.01	<.01	<.01	<.01	<.010	<.01	<.01
cis-Permethrin	Insecticide	pyrethroid	.006	<.006	<.006	<.006	<.006	<.006	<.006	<.006
Phorate	Insecticide	organothiophosphate	.011	<.011	<.011	<.011	<.011	<.011	<.011	<.011
Prometon	Herbicide	triazine	.015	<.015	[1] .005 e	[1].006 e	<.015	<.015	[1].002 e	[1].002 e
Pronamide	Herbicide	amide	.004	<.004	<.004	<.004	<.004	<.004	<.004	<.004
Propachlor	Herbicide	acetanilide	.010	<.010	<.010	<.010	<.010	<.010	<.010	<.010
Propanil	Herbicide	amide	.011	<.011	<.011	<.011	<.011	<.011	<.011	<.011
Propargite	Acaricide	sulfite ester	.023	<.023	<.023	<.023	<.023	<.023	<.023	<.023
Simazine	Herbicide	triazine	.011	<.011	<.011	<.011	<.011	<.011	<.011	<.011
Tebuthiuron	Herbicide	urea	.016	<.016	.019 e	.023 e	.006 e	<.016	<.016	<.016
Terbacil	Herbicide	uracil	.034	<.034	<.034	<.034	<.034	<.034	<.034	<.034
Terbufos	Insecticide	organothiophosphate	.017	<.017	<.017	<.017	<.017	<.017	<.017	<.017
Thiobencarb	Herbicide	thiocarbamate	.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005
Triallate	Herbicide	thiocarbamate	.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002
Trifluralin	Herbicide	dinitroaniline	.009	<.009	<.009	<.009	<.009	<.009	<.009	<.009
2,4-D methyl ester	Herbicide	chlorophenoxy acid ester	.009	—	<.009	—	—	—	<.009	<.009
2,4-D	Herbicide	chlorophenoxy acid	.021	—	.03	—	—	—	<.02	<.02
2,4-DB	Herbicide	chlorophenoxy acid	.016	—	<.02	—	—	—	<.008	<.02
2-Hydroxyatrazine	Degradate	triazine	.008	—	<.008	—	—	—	<.008	<.008
3-Hydroxycarbofuran	Degradate	carbamate	.006	—	<.01	—	—	—	.01	<.01
3-Ketocarbofuran	Degradate	carbamate	1.5	—	<1.50	—	—	—	<1.50	<1.50
3-(4-chlorophenyl)-1- methyl urea	Degradate	phenyl urea	.024	—	<.024	—	—	—	<.024	<.024

Table 12. Results of pesticide analyses of water samples collected from selected sites on the Bear River and its tributaries, March and July-August 2001—Continued

Pesticide	Bear River at Pescadero, ID (site 26)	Bear River at Pescadero, ID (site 26)	Bear River at Soda Springs, ID (site 31)	Bear River at Alexander, ID (site 34)	Bear River near Thatcher, ID (site 39)	Bear River at Hwy 30, near Riverdale, ID (site 42)	Bear River at ID-UT Stateline (site 48)	Bear River at ID-UT Stateline (site 48)	Cub River near Richmond, UT (site 51)	Cub River near Richmond, UT (site 51)	Bear River near Benson, UT (site 52)	Little Bear River at 3000 N., at Benson Marina, UT (site 60)	Bear River near Collinston, UT (site 62)
	03-17-01	08-05-01	08-04-01	08-04-01	08-03-01	08-03-01	03-13-01	08-02-01	03-13-01	08-02-01	08-01-01	08-01-01	07-30-01
2,6-Diethylaniline	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Acetochlor	<.004	<.004	<.004	<.004	<.004	<.004	<.004	<.004	<.004	<.004	<.004	<.004	<.004
Alachlor	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002
alpha-HCH	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005
Atrazine	<.007	.008 e	.008	.008	.008	.008	.006 e	.004 e	.029	<.007	.003 e	.096 e	.014 e
Azinphos-methyl	<.05	<.05	<.05	<.05	<.05	[1].009 e	<.05	<.05	<.05	<.05	<.05	<.05	<.05
Benfluralin	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Butylate	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002
Carbaryl	<.041	<.041	<.041	<.041	<.041	<.041	<.041	<.041	<.041	<.041	<.041	<.041	<.041
Carbofuran	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
Chlorpyrifos	[1] .004 e	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005
Cyanazine	<.018	<.018	<.018	<.018	<.018	<.018	<.018	<.018	<.018	<.018	<.018	<.018	<.018
Dacthal	<.003	<.003	<.003	<.003	<.003	<.003	<.003	<.003	<.003	<.003	<.003	<.003	<.003
Deethylatrazine	<.006	.001 e	.001 e	.002 e	.002 e	.002 e	<.006	<.006	.015 e	.007 e	<.006	.009 e	.005 e
Diazinon	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005
Dieldrin	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005
Disulfoton	<.021	<.021	<.021	<.021	<.021	<.021	<.021	<.021	<.021	<.021	<.021	<.021	<.021
EPTC	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002
Ethalfluralin	<.009	<.009	<.009	<.009	<.009	<.009	<.009	<.009	<.009	<.009	<.009	<.009	<.009
Ethoprop	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005
Fonofos	<.003	<.003	<.003	<.003	<.003	<.003	<.003	<.003	<.003	<.003	<.003	<.003	<.003
gamma-HCH	<.004	<.004	<.004	<.004	<.004	<.004	<.004	<.004	<.004	<.004	<.004	<.004	<.004
Linuron	<.035	<.035	<.035	<.035	<.035	<.035	<.035	<.035	<.035	<.035	<.035	<.035	<.035
Malathion	<.027	[1] .004 e	<.027	[1] .004 e	[1] .004 e	<.027	<.027	<.027	<.027	<.027	<.027	<.027	<.027
Methyl parathion	<.006	<.006	<.006	<.006	<.006	<.006	<.006	<.006	<.006	<.006	<.006	<.006	<.006
Metolachlor	<.013	<.013	<.013	<.013	<.013	<.013	<.013	<.013	[1].006 e	<.013	<.013	<.013	<.013
Metribuzin	<.006	<.006	<.006	<.006	<.006	<.006	<.006	<.006	<.006	<.006	<.006	<.006	<.006
Molinate	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002
Napropamide	<.007	<.007	<.007	<.007	<.007	<.007	<.007	<.007	<.007	<.007	<.007	<.007	<.007
p,p'-DDE	<.003	<.003	<.003	<.003	<.003	<.003	<.003	<.003	<.003	<.003	<.003	<.003	<.003
Parathion	<.007	<.007	<.007	<.007	<.007	<.007	<.007	<.007	<.007	<.007	<.007	<.007	<.007
Pebulate	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002
Pendimethalin	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
cis-Permethrin	<.006	<.006	<.006	<.006	<.006	<.006	<.006	<.006	<.006	<.006	<.006	<.006	<.006
Phorate	<.011	<.011	<.011	<.011	<.011	<.011	<.011	<.011	<.011	<.011	<.011	<.011	<.011
Prometon	<.015	[1] .005 e	[1] .006 e	[1] .005 e	[1] .005 e	[1].005 e	<.015	[1] .008 e	<.015	<.015	[1] .005 e	[1].007 e	[1] .006 e
Pronamide	<.004	<.004	<.004	<.004	<.004	<.004	<.004	<.004	<.004	<.004	<.004	<.004	<.004
Propachlor	<.010	<.010	<.010	<.010	<.010	<.010	<.010	<.010	<.010	<.010	<.010	<.010	<.010
Propanil	<.011	<.011	<.011	<.011	<.011	<.011	<.011	<.011	<.011	<.011	<.011	<.011	<.011
Propargite	<.023	<.023	<.023	<.023	<.023	<.023	<.023	<.023	<.023	<.023	<.023	<.023	<.023
Simazine	<.011	<.011	<.011	<.011	<.011	<.011	<.011	<.011	<.011	<.011	<.011	<.011	<.011
Tebuthiuron	<.016	.003 e	.003 e	.003 e	.003 e	.003 e	<.016	<.016	<.016	<.016	<.016	<.016	<.016
Terbacil	<.034	<.034	<.034	<.034	<.034	<.034	<.034	<.034	<.034	<.034	<.034	<.034	<.034
Terbufos	<.017	<.017	<.017	<.017	<.017	<.017	<.017	<.017	<.017	<.017	<.017	<.017	<.017
Thiobencarb	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005
Triallate	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002
Trifluralin	<.009	<.009	<.009	<.009	<.009	<.009	<.009	<.009	<.009	<.009	<.009	<.009	<.009
2,4-D methyl ester	—	<.009	—	—	—	—	—	<.009	—	<.009	<.009	<.009	<.009
2,4-D	—	<.02	—	—	—	—	—	.01 e	—	<.02	<.02	<.02	.02 e
2,4-DB	—	<.02	—	—	—	—	—	<.02	—	<.02	<.02	<.02	<.02
2-Hydroxyatrazine	—	<.008	—	—	—	—	—	<.008	—	<.008	<.008	.031 e	.009 e
3-Hydroxycarbofuran	—	<.01	—	—	—	—	—	<.01	—	<.01	<.01	<.01	<.01
3-Ketocarbofuran	—	<1.50	—	—	—	—	—	<1.50	—	<1.50	<1.50	<1.50	<1.50
3-(4-chlorophenyl)-1-methyl urea	—	<.024	—	—	—	—	—	<.024	—	<.024	<.024	<.024	<.024

Table 12. Results of pesticide analyses of water samples collected from selected sites on the Bear River and its tributaries, March and July-August 2001—Continued

Pesticide	Use	Class	Reporting level	Bear River at Evanston, WY (site 3)	Bear River at Evanston, WY (site 3)	Bear River below Yellow Creek, near Evanston, WY (site 4)	Bear River below Reservoir, near Woodruff, UT (site 6)	Bear River below Smiths Fork, near Cokeville, WY (site 18)	Bear River below Smiths Fork, near Cokeville, WY (site 18)	Bear River at Harer, ID (site 21)
				03-21-01	08-09-01	08-09-01	08-08-01	03-18-01	08-07-01	08-06-01
Acifluorfen	Herbicide	benzoic acid	.007	—	<.01	—	—	—	<.01	<.01
Aldicarb sulfone	Degradate	sulfone	.02	—	<.02	—	—	—	<.02	<.02
Aldicarb sulfoxide	Degradate	sulfoxide	.008	—	<.01	—	—	—	<.01	<.01
Aldicarb	Insecticide	carbamate	.04	—	<.04	—	—	—	<.04	<.04
Bendiocarb	Insecticide	carbamate	.025	—	<.025	—	—	—	<.025	<.025
Benomyl	Fungicide	carbamate	.004	—	<.004	—	—	—	<.004	<.004
Bensulfuron-methyl	Herbicide	sulfonylurea	.015	—	<.016	—	—	—	<.016	<.016
Bentazon	Herbicide	N heterocycle	.011	—	<.01	—	—	—	<.01	<.01
Bromacil	Herbicide	uracil	.033	—	<.03	—	—	—	<.03	<.03
Bromoxynil	Herbicide	phenol	.017	—	<.02	—	—	—	<.02	<.02
Carbaryl	Insecticide	carbamate	.028	—	<.03	—	—	—	<.03	<.03
Carbofuran	Insecticide	carbamate	.006	—	<.01	—	—	—	<.01	<.01
Chloramben methyl ester	Herbicide	chlorobenzoic acid ester	.018	—	<.02	—	—	—	<.02	<.02
Chlorimuron ethyl	Herbicide	sulfonylurea	.01	—	<.010	—	—	—	<.010	<.010
Chlorothalonil	Fungicide	organochlorine	.035	—	<.04	—	—	—	<.04	<.04
Clopyralid	Herbicide	picolinic acid	.013	—	<.01	—	—	—	<.01	<.01
Cycloate	Herbicide	thiocarbamate	.013	—	<.01	—	—	—	<.01	<.01
Dacthal monoacid	Degradate	chlorobenzoic acid ester	.011	—	<.01	—	—	—	<.01	<.01
Deethylatrazine	Degradate	triazine	.028	—	<.01	—	—	—	<.01	<.01
Deisopropylatrazine	Degradate	triazine	.044	—	<.04	—	—	—	<.04	<.04
Dicamba	Herbicide	chlorobenzoic acid	.012	—	<.01	—	—	—	<.01	<.01
Dichlorprop	Herbicide	chlorophenoxy acid	.013	—	<.01	—	—	—	<.01	<.01
Dinoseb	Herbicide	nitrophenol	.012	—	<.01	—	—	—	<.01	<.01
Diphenamid	Herbicide	amide	.026	—	<.03	—	—	—	<.03	<.03
Diuron	Herbicide	urea	.015	—	<.01	—	—	—	<.01	<.01
Fenuron	Herbicide	urea	.031	—	<.03	—	—	—	<.03	<.03
Flumetsulam	Herbicide	sulfonamide	.011	—	<.011	—	—	—	<.011	<.011
Fluometuron	Herbicide	urea	.031	—	<.03	—	—	—	<.03	<.03
Imazaquin	Herbicide	imidazolinone	.016	—	<.016	—	—	—	<.016	<.016
Imazethapyr	Herbicide	imidazolinone	.017	—	<.017	—	—	—	<.017	<.017
Imidacloprid	Insecticide	N heterocycle	.007	—	<.007	—	—	—	<.007	<.007
Linuron	Herbicide	urea	.014	—	<.01	—	—	—	<.01	<.01
MCPA	Herbicide	chlorophenoxy acid	.016	—	<.02	—	—	—	<.02	<.02
MCPB	Herbicide	chlorophenoxy acid	.015	—	<.01	—	—	—	<.01	<.01
Metalaxyl	Fungicide	amino acid derivative	.02	—	<.02	—	—	—	<.02	<.02
Methiocarb	Insecticide	carbamate	.008	—	<.01	—	—	—	<.01	<.01
Methomyl-oxime	Degradate	oxime	.011	—	<.011	—	—	—	<.011	<.011
Methomyl	Insecticide	carbamate	.004	—	<.004	—	—	—	<.004	<.004
Metsulfuron methyl	Herbicide	sulfonylurea	.025	—	<.033	—	—	—	<.025	<.025
Neburon	Herbicide	urea	.012	—	<.01	—	—	—	<.01	<.01
Nicosulfuron	Herbicide	sulfonylurea	.013	—	<.013	—	—	—	<.013	<.013
Norflurazon	Herbicide	amine	.016	—	<.02	—	—	—	<.02	<.02
Oryzalin	Herbicide	dinitroaniline	.017	—	<.02	—	—	—	<.02	<.02
Oxamyl oxime	Degradate	oxime	.013	—	<.013	—	—	—	<.013	<.013
Oxamyl	Insecticide	carbamate	.012	—	<.01	—	—	—	<.01	<.01
Picloram	Herbicide	amine	.019	—	<.02	—	—	—	.09	<.02
Propham	Herbicide	carbamate	.01	—	<.01	—	—	—	<.01	<.01
Propiconazole	Fungicide	triazole	.021	—	<.021	—	—	—	<.021	<.021
Propoxur	Insecticide	carbamate	.008	—	<.01	—	—	—	<.01	<.01
Siduron	Herbicide	urea	.016	—	<.017	—	—	—	<.017	<.017
Sulfometuron methyl	Herbicide	sulfonylurea	.009	—	<.009	—	—	—	<.009	<.009
Terbacil	Herbicide	uracil	.01	—	<.01	—	—	—	<.01	<.01
Tribenuron-methyl	Herbicide	sulfonylurea	.009	—	<.01	—	—	—	<.01	<.01
Triclopyr	Herbicide	organochlorine	.022	—	<.02	—	—	—	<.02	<.02

[1]Estimated value below long-term method detection level or one-half laboratory reporting level.

Table 12. Results of pesticide analyses of water samples collected from selected sites on the Bear River and its tributaries, March and July-August 2001—Continued

Pesticide	Bear River at Pescadero, ID (site 26)	Bear River at Pescadero, ID (site 26)	Bear River at Soda Springs, ID (site 31)	Bear River at Alexander, ID (site 34)	Bear River near Thatcher, ID (site 39)	Bear River at Hwy 30, near River-dale, ID (site 42)	Bear River at ID-UT Stateline (site 48)	Bear River at ID-UT Stateline (site 48)	Cub River near Richmond, UT (site 51)	Cub River near Richmond, UT (site 51)	Bear River near Benson, UT (site 52)	Little Bear River at 3000 N., at Benson Marina, UT (site 60)	Bear River near Collinston, UT (site 62)
	03-17-01	08-05-01	08-04-01	08-04-01	08-03-01	08-03-01	03-13-01	08-02-01	03-13-01	08-02-01	08-01-01	08-01-01	07-30-01
Acifluorfen	—	<.01	—	—	—	—	—	<.01	—	<.01	<.01	<.01	<.01
Aldicarb sulfone	—	<.02	—	—	—	—	—	<.02	—	<.02	<.02	<.02	<.02
Aldicarb sulfoxide	—	<.01	—	—	—	—	—	<.01	—	<.01	<.01	<.01	<.01
Aldicarb	—	<.04	—	—	—	—	—	<.04	—	<.04	<.04	<.04	<.04
Bendiocarb	—	<.025	—	—	—	—	—	<.025	—	<.025	<.025	<.025	<.025
Benomyl	—	<.004	—	—	—	—	—	<.004	—	<.004	<.004	<.004	<.004
Bensulfuron-methyl	—	—	—	—	—	—	—	—	—	—	—	—	—
Bentazon	—	<.01	—	—	—	—	—	.01 e	—	[1].004e	.01 e	.01e	<.01
Bromacil	—	<.03	—	—	—	—	—	<.03	—	<.03	<.03	<.03	<.03
Bromoxynil	—	<.02	—	—	—	—	—	<.02	—	<.02	<.02	<.02	<.02
Carbaryl	—	<.03	—	—	—	—	—	<.03	—	<.03	<.03	<.03	<.03
Carbofuran	—	<.01	—	—	—	—	—	<.01	—	<.01	<.01	<.01	<.01
Chloramben methyl ester	—	<.02	—	—	—	—	—	<.02	—	<.02	<.02	<.02	<.02
Chlorimuron ethyl	—	<.010	—	—	—	—	—	<.010	—	<.010	<.010	<.010	<.010
Chlorothalonil	—	<.04	—	—	—	—	—	<.04	—	<.04	<.04	<.04	<.04
Clopyralid	—	<.01	—	—	—	—	—	<.01	—	<.01	<.01	<.01	<.01
Cycloate	—	<.01	—	—	—	—	—	<.01	—	<.01	<.01	<.01	<.01
Dacthal monoacid	—	<.01	—	—	—	—	—	<.01	—	<.01	<.01	<.01	<.01
Deethylatrazine	—	<.01	—	—	—	—	—	<.01	—	<.01	<.01	<.01	<.01
Deisopropylatrazine	—	<.04	—	—	—	—	—	<.04	—	<.04	<.04	<.04	<.04
Dicamba	—	<.01	—	—	—	—	—	<.01	—	<.01	<.01	<.01	<.01
Dichlorprop	—	<.01	—	—	—	—	—	<.01	—	<.01	<.01	<.01	<.01
Dinoseb	—	<.0007	—	—	—	—	—	<.01	—	<.01	<.01	<.01	<.01
Diphenamid	—	<.03	—	—	—	—	—	<.03	—	<.03	<.03	<.03	<.03
Diuron	—	<.01	—	—	—	—	—	<.01	—	<.01	<.01	<.01	<.01
Fenuron	—	<.03	—	—	—	—	—	<.03	—	<.03	<.03	<.03	<.03
Flumetsulam	—	<.011	—	—	—	—	—	<.011	—	<.011	<.011	<.011	<.011
Fluometuron	—	<.03	—	—	—	—	—	<.03	—	<.03	<.03	<.03	<.03
Imazaquin	—	<.016	—	—	—	—	—	<.016	—	<.016	<.016	<.016	<.016
Imazethapyr	—	<.017	—	—	—	—	—	<.017	—	<.017	<.017	<.017	<.017
Imidacloprid	—	<.007	—	—	—	—	—	<.007	—	<.007	<.007	<.007	<.007
Linuron	—	<.01	—	—	—	—	—	<.01	—	<.01	<.01	<.01	<.01
MCPA	—	<.02	—	—	—	—	—	<.02	—	<.02	<.02	<.02	<.02
MCPB	—	<.01	—	—	—	—	—	<.01	—	<.01	<.01	<.01	<.01
Metalaxyl	—	<.02	—	—	—	—	—	<.02	—	<.02	<.02	<.02	<.02
Methiocarb	—	<.01	—	—	—	—	—	<.01	—	<.01	<.01	<.01	<.01
Methomyl-oxime	—	<.011	—	—	—	—	—	<.011	—	<.011	<.011	<.011	<.011
Methomyl	—	<.004	—	—	—	—	—	<.004	—	<.004	<.004	<.004	<.004
Metsulfuron methyl	—	<.025	—	—	—	—	—	<.025	—	<.025	<.025	<.025	<.025
Neburon	—	<.01	—	—	—	—	—	<.01	—	<.01	<.01	<.01	<.01
Nicosulfuron	—	<.013	—	—	—	—	—	<.013	—	<.013	<.013	<.013	<.013
Norflurazon	—	<.02	—	—	—	—	—	<.02	—	<.02	<.02	<.02	<.02
Oryzalin	—	<.02	—	—	—	—	—	<.02	—	<.02	<.02	<.02	<.02
Oxamyl oxime	—	<.013	—	—	—	—	—	<.013	—	<.013	<.013	<.013	<.013
Oxamyl	—	<.01	—	—	—	—	—	<.01	—	<.01	<.01	<.01	<.01
Picloram	—	<.02	—	—	—	—	—	<.02	—	<.02	<.02	<.02	<.02
Propham	—	<.01	—	—	—	—	—	<.01	—	<.01	<.01	<.01	<.01
Propiconazole	—	<.021	—	—	—	—	—	<.021	—	<.021	<.021	<.021	<.002
Propoxur	—	<.01	—	—	—	—	—	<.01	—	<.01	<.01	<.01	<.01
Siduron	—	<.017	—	—	—	—	—	<.017	—	<.017	<.017	<.017	<.017
Sulfometuron methyl	—	<.009	—	—	—	—	—	<.009	—	<.009	<.009	<.009	<.009
Terbacil	—	<.01	—	—	—	—	—	<.01	—	<.01	<.01	<.01	<.01
Tribenuron-methyl	—	<.01	—	—	—	—	—	<.01	—	<.01	<.01	<.01	<.01
Triclopyr	—	<.02	—	—	—	—	—	<.02	—	<.02	<.02	<.02	<.02

Table 13. Concentration of chlorophyll a in periphyton (algae) samples collected from selected sites in the Bear River basin, August 2001

[**Site designation:** UT, Utah; WY, Wyoming; ID, Idaho]

Site number (fig. 1)	Site designation	Date	Time	Chlorophyll *a* (milligrams per square meter)
1	Bear River near Utah-Wyoming Stateline	08/20/01	1300	21
3	Bear River at Evanston, WY	08/20/01	1630	126
5	Bear River above reservoir, near Woodruff, UT	08/22/01	1000	169
6	Bear River below reservoir, near Woodruff, UT	08/21/01	1130	181
15	Bear River below Pixley Dam, near Cokeville, WY	08/23/01	0900	144
18	Bear River below Smiths Fork, near Cokeville, WY	08/23/01	1300	290
21	Bear River at Harer, ID	08/22/01	1400	29
26	Bear River at Pescadero, ID	08/13/01	1500	66
31	Bear River at Soda Springs, ID	08/14/01	1100	44
34	Bear River at Alexander, ID	08/14/01	1430	75
40	Bear River below Oneida Narrows Reservoir, near Oneida, ID	08/15/01	1300	416
42	Bear River at Highway 30, near Riverdale, ID	08/15/01	0900	122
48	Bear River at Idaho-Utah Stateline	08/16/01	0900	44
62	Bear River near Collinston, UT	08/16/01	1400	196

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