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

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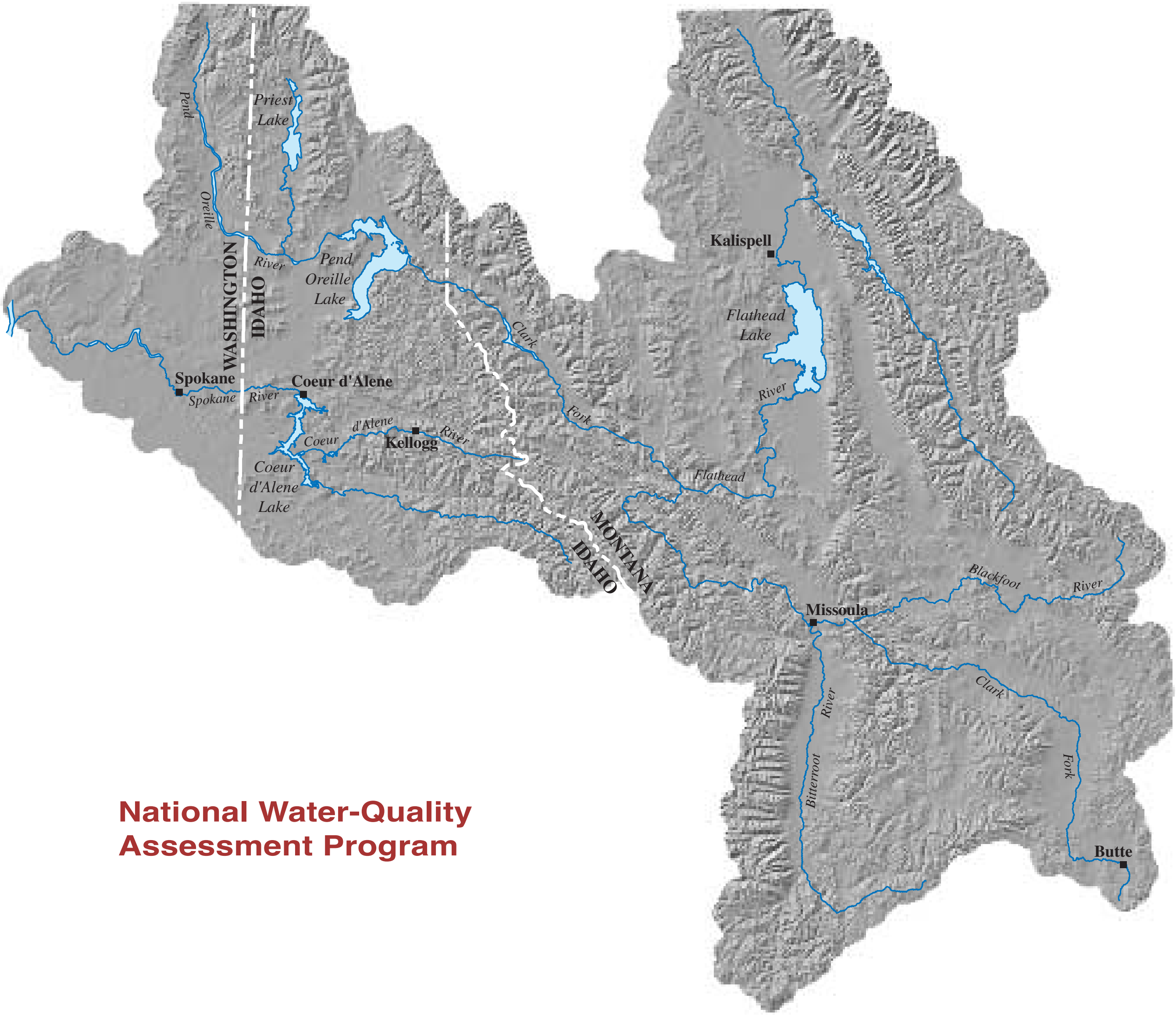
Open-File Report 02–336



National Water-Quality
Assessment Program

USGS
science for a changing world

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

Selected Trace-Element and Synthetic-Organic Compound Data for Streambed Sediment from the Clark Fork-Pend Oreille and Spokane River Basins, Montana, Idaho, and Washington, 1998

***by* Michael A. Beckwith**

Open-File Report 02-336

Helena, Montana
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U.S. Department of the Interior

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Information regarding the National Water-Quality Assessment (NAWQA) Program is available on the Internet via the world wide web using the URL:

http://water.usgs.gov/nawqa

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. 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. 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. 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. 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.

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
Associate Director for Water

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CONVERSION FACTORS, DATUM, ABBREVIATED WATER-QUALITY UNITS, AND ACRONYMS

Multiply	By	To obtain
cubic foot per second (ft^3/s)	0.028317	cubic meter per second
foot (ft)	0.3048	meter (m)
gallon	3.785	liter (L)
gallon	3,785	milliliter
inch (in.)	25.4	millimeter (mm)
inch (in.)	25,400	micrometer (µm)
mile (mi)	1.609	kilometer
part per billion	1	microgram per kilogram (µg/kg)
part per million	1	microgram per gram (µg/g)
square mile (mi^2)	2.59	square kilometer
ton (short)	907.2	kilogram

Temperature can be converted from degrees Celsius (°C) to degrees Fahrenheit (°F) by the equation:

$$°F = 9/5\ (°C) + 32$$

Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29) except as noted in table 1 where some vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88). Horizontal coordinate information is referenced to the North American Datum of 1927 (NAD 27).

Abbreviated units used in this report:

g/kg	grams per kilogram
µg/g	micrograms per gram
µg/kg	micrograms per kilogram
µm	micrometer
mL	milliliter
mm	millimeter

Water-year definition:

A water year is the 12-month period from October 1 through September 30. It is designated by the calendar year in which it ends.

Acronyms used in this report:

p,p’-DDD	1,1-dichloro-2,2-bis(p-chlorophenyl)ethane
p,p’-DDE	1,1-dichloro-2,2-bis(p-chlorophenyl)ethylene
DDT	1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane
MDL	method detection limit
MRL	minimum reporting level
NAWQA	National Water-Quality Assessment
NROK	Northern Rockies Intermontane Basins
NWQL	National Water Quality Laboratory, Denver, Colo.
PCB	polychlorinated biphenyl
RPD	relative percent difference
USGS	U.S. Geological Survey

Selected Trace-Element and Synthetic-Organic Compound Data for Streambed Sediment from the Clark Fork-Pend Oreille and Spokane River Basins, Montana, Idaho, and Washington, 1998

By Michael A. Beckwith

Abstract

Streambed-sediment samples were collected at 22 sites during the summer of 1998 as part of the U.S. Geological Survey National Water-Quality Assessment Program. Sampling sites in the Clark Fork-Pend Oreille and Spokane River basins represented a wide range of environmental conditions including pristine mountain streams and large rivers affected by mining-related and urban activities. Samples were analyzed for 45 inorganic major and trace elements, 109 synthetic organic compounds, and carbon. This report presents the selected results of streambed-sediment sampling from the Clark Fork-Pend Oreille and Spokane River basins in Montana, Idaho, and Washington.

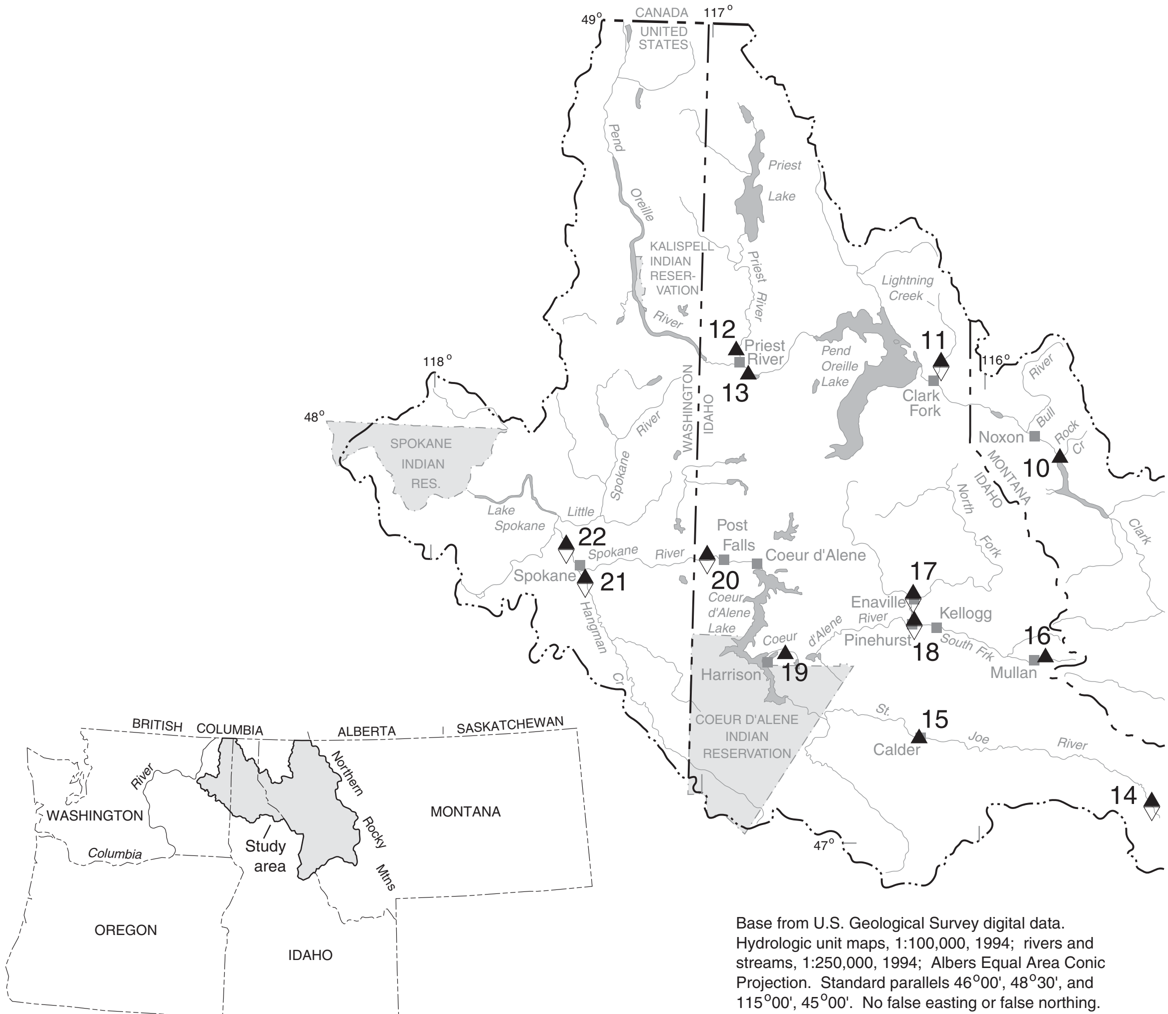
Trace-element concentrations in streambed sediment determined from this study were compared to median trace-element concentrations for streambed-sediment data collected from streams across the Nation during 1992-96. Generally, concentrations of arsenic, cadmium, copper, lead, mercury, and zinc were higher or similar to the national median concentration of these same trace elements. Concentrations of chromium, nickel, and selenium in streambed sediment of the study area generally were lower than the national median concentration.

Most of the analytical results for synthetic organic compounds were reported as either estimated or non-detected values. Phthalates and polycyclic aromatic hydrocarbons were the most frequently detected classes of synthetic organic compounds in streambed sediment. Organochlorine pesticide residues were detected at two sites. Polychlorinated biphenyls were detected at one site.

INTRODUCTION

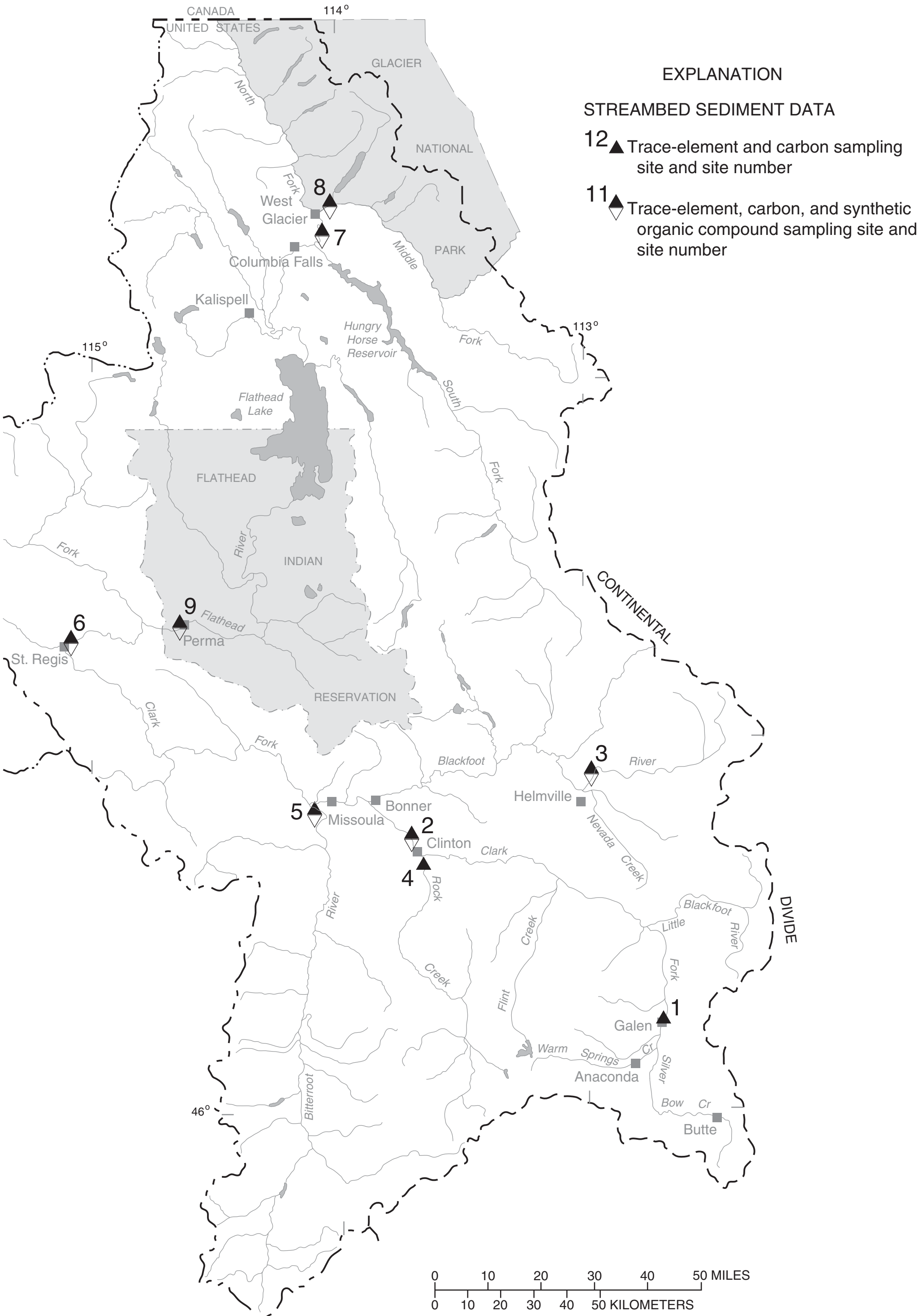
In 1991, the U.S. Geological Survey (USGS) began full-scale implementation of the National Water-Quality Assessment (NAWQA) Program. The program goals are to characterize water-quality conditions and trends in the Nation's surface- and ground-water resources and the natural and human factors affecting those conditions. These goals are accomplished by collecting biological, physical, and chemical data at sites that represent a broad distribution of diverse environmental influences thought to control water quality in major river basins of the United States. The design of the program enables integration of the information into a nationally consistent database for comparison of water-quality data over time and over a large range of geographic and hydrologic conditions. The general concepts for full-scale implementation of the NAWQA Program are outlined in a report by Hirsch and others (1988).

The Northern Rockies Intermontane Basins (NROK) study area in western Montana, northern Idaho, and eastern Washington (fig. 1) was one of the study areas selected for assessment as part of the NAWQA Program. The NROK study area was selected to represent several important river basins and aquifer systems in the northern part of the intermountain west. Study activities in the NROK area began in late 1996. One part of the NROK assessment was to examine the occurrence and distribution of trace elements and synthetic organic compounds in streambed sediment collected from streams in the basins. Streambed sediment provides habitat for many aquatic organisms and can act as the primary exposure pathway for contaminants in aquatic ecosystems. Streambed sediment also integrates the transport of contaminants with time, and may indicate their long-term presence and transport in the aquatic environment better than water samples periodically collected from the stream. Trace elements in aquatic systems may be attributed to natural geologic sources or to past and present land use. Although trace elements originate from natural sources, human activities such as mining, agriculture, and urbanization can affect their concentration and distribution. In contrast, synthetic organic compounds are solely the product of human activities.



Base from U.S. Geological Survey digital data. Hydrologic unit maps, 1:100,000, 1994; rivers and streams, 1:250,000, 1994; Albers Equal Area Conic Projection. Standard parallels 46°00', 48°30', and 115°00', 45°00'. No false easting or false northing. North American Datum 1927 (NAD 27)

Figure 1. Location of the Northern Rockies Intermontane Basins study area, sampling sites, Indian Reservations,



and Glacier National Park, Montana, Idaho, and Washington.

This report presents selected results of sampling for trace elements and synthetic organic compounds in streambed sediment from the Clark Fork-Pend Oreille and Spokane River basins in Montana, Idaho, and Washington. Streambed-sediment samples were collected at 22 sites (fig. 1, table 1) during the summer of 1998. Concentrations of trace elements and carbon were determined for samples from all 22 sites and synthetic organic compounds were determined for samples from 14 of those sites. Sampling sites were selected to represent a wide range of environmental conditions.

Description of Study Area

The NROK study area (fig. 1) covers about 31,500 mi^2 of Montana (68 percent of the study area), Idaho (21 percent), and Washington (11 percent). A small part of the study area lies within the Walla Walla Plateau section of the Columbia Plateaus physiographic province, whereas most of the study area lies within the Northern Rocky Mountains physiographic province. The study area is characterized by a complex geologic history that involves multiple episodes of sedimentation, igneous activity, uplift, and erosion mostly

Table 1. Streambed sediment sampling sites in the Northern Rockies Intermontane Basins study area

Site number (fig. 1)	Site name	USGS station number	Latitude	Longitude	Drainage area (in square miles upstream from gaging station)	Altitude[1] (in feet above sea level)
	Clark Fork-Pend Oreille River Basin					
1	Clark Fork near Galen, Montana	12323800	46°12’30"	112°45’59"	572	4,749
2	Clark Fork at Turah Bridge, near Bonner, Montana	12334550	46°49’34"	113°48’48"	3,641	3,320
3	Blackfoot River above Nevada Creek, near Helmville, Montana	12335100	46°55’09"	113°00’52"	494	4,280
4	Rock Creek near Clinton, Montana	12334510	46°43’21"	113°40’56"	885	3,519
5	Bitterroot River near Missoula, Montana	12352500	46°49’55"	114°03’11"	2,814	3,110
6	Clark Fork at St. Regis, Montana	12354500	47°18’07"	115°05’11"	10,709	2,600
7	North Fork Flathead River near Columbia Falls, Montana	12355500	48°29’44"	114°07’36"	1,548	3,146
8	Middle Fork Flathead River near West Glacier, Montana	12358500	48°29’43"	114°00’33"	1,128	3,129
9	Flathead River at Perma, Montana	12388700	47°22’03"	114°35’03"	8,795	2,469
10	Rock Creek near Noxon, Montana	12391420	47°58’28"	115°43’41"	32	2,326[2]
11	Lightning Creek at Clark Fork, Idaho	12392155	48°09’04"	116°10’56"	115	2,094[2]
12	Priest River near Priest River, Idaho	12395000	48°12’31"	116°54’49"	902	2,090
13	Pend Oreille River above Priest River, Idaho	12395200	48°10’16"	116°52’15"	24,200	2,001
	Spokane River Basin					
14	St. Joe River at Red Ives Ranger Station, Idaho	12413875	47°03’22"	115°21’08"	106	3,710
15	St. Joe River at Calder, Idaho	12414500	47°16’29"	116°11’17"	1,030	2,172
16	South Fork Coeur d’Alene River at Shoshone Park, near Mullan, Idaho	12413027	47°27’53"	115°43’31"	7	3,599
17	North Fork Coeur d’Alene River at Enaville, Idaho	12413000	47°34’08"	116°15’06"	895	2,100[2]
18	South Fork Coeur d’Alene River near Pinehurst, Idaho	12413470	47°33’06"	116°14’13"	299	2,190
19	Coeur d’Alene River near Harrison, Idaho	12413860	47°28’43"	116°43’56"	1,475	2,100
20	Spokane River near Post Falls, Idaho	12419000	47°42’11"	116°58’37"	3,840	2,126
21	Hangman Creek at Spokane, Washington	12424000	47°39’10"	117°26’55"	689	1,716
22	Spokane River at Seven Mile Bridge, near Spokane, Washington	12424500	47°44’25"	117°31’10"	5,020	1,631

[1]Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29).
[2]Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88).

by fluvial and glacial processes. Approximately 56 percent of the land in the study area is publicly owned (primarily within State and National forest lands, Glacier National Park, and federally-designated wilderness areas). About 37 percent of the study area is privately owned and about 7 percent is within the Coeur d'Alene, Flathead, Kalispell, and Spokane Indian Reservations (Maret and Dutton, 1999).

The climate of the study area is affected by both maritime and continental air masses. Precipitation ranges from approximately 100 in. per year in the mountains of northwestern Montana and northern Idaho, to less than 15 in. per year in the drier intermontane valleys. Most of the annual precipitation falls between late autumn and spring, much of it as snow. Large snowpacks release water as snowmelt runoff, which occurs primarily from April to July. Historical flooding in the study area typically has been a result of weather systems from the Pacific Ocean bringing warm air and rain that melt accumulated snowpack at low- to mid-altitudes in winter and spring.

Two major rivers drain the NROK study area: the Clark Fork-Pend Oreille and the Spokane (fig. 1). The headwaters of the Clark Fork begin along the Continental Divide near Butte, Mont., and the river flows northwest more than 350 mi to Pend Oreille Lake in Idaho. The Flathead River is the largest tributary to the Clark Fork, draining much of northwestern Montana and a small part of British Columbia, Canada; its three major forks join near the south entrance to Glacier National Park and flow into Flathead Lake. The Flathead River joins the Clark Fork about 76 mi downstream from Flathead Lake, approximately doubling the streamflow of the Clark Fork. The Clark Fork terminates at its inflow (or inlet) to Pend Oreille Lake and the Pend Oreille River begins at the outlet of Pend Oreille Lake. The Pend Oreille River flows through northeastern Washington before joining the Columbia River in British Columbia, Canada. At the international border, the entire Clark Fork-Pend Oreille River basin drains an area of about 25,200 mi^2 (about 79 percent of the study area) with an annual mean discharge of 26,790 ft^3/s (Wiggins and others, 1999).

The Spokane River basin covers approximately 6,600 mi^2 or about 21 percent of the study area. The Spokane River begins in northern Idaho at the outlet of Coeur d'Alene Lake which has two primary inflows, the Coeur d'Alene and St. Joe Rivers. Flowing through the City of Spokane, Wash., the Spokane River has an annual mean discharge of about 6,760 ft^3/s (Wiggins and others, 1999). Downstream from Lake Spokane (a reservoir created in the early 1900s and locally known as Long Lake), the Spokane River enters the Columbia River in eastern Washington.

About 1,600 active and inactive hard-rock mines of various sizes are located in the Clark Fork-Pend Oreille and Spokane River basins (Maret and Dutton, 1999). Ore bodies located in the upper Clark Fork basin near Butte, Mont., and in the South Fork Coeur d'Alene River valley in Idaho produced large amounts of copper, lead, silver, and zinc, primarily from the 1880s through the 1980s. Metal extraction also yielded large volumes of metal-rich wastes, or tailings, which were deposited directly into or near these streams and their tributaries. These tailings typically were enriched in arsenic, cadmium, copper, lead, mercury, and zinc. Elevated concentrations of trace elements in streambed sediment at sites in the Clark Fork-Pend Oreille and Spokane River basins are well documented (Johns and Moore, 1987; Horowitz and others, 1993, 1995a, 1995b; Bortleson and others, 1994; Phillips and Lipton, 1995; Hornberger and others, 1997; Woods and Beckwith, 1997; and Grosbois and others, 2001).

Andrews (1987) estimated that 100 million tons of tailings were discharged to streams in the headwaters of the Clark Fork near Butte, Mont., during the period 1880 to 1982. As a result, metal enrichment of the streambed sediment of the Clark Fork has been reported as far as 150 mi downstream from Butte (Moore and Luoma, 1990). Silver Bow Creek and the Clark Fork downstream from Butte to the confluence with the Blackfoot River compose one of the largest Superfund areas in the Nation.

Long (1998) estimated that mines and mills in the Coeur d'Alene mining district in Idaho generated 109 million tons of tailings, of which about 56 million tons entered the South Fork Coeur d'Alene River or its tributaries. A 21-mi^2 area surrounding Kellogg, Idaho, also is one of the largest Superfund sites in the Nation. Tailings discharged to the South Fork Coeur d'Alene River have been transported downstream and deposited along the mainstem Coeur d'Alene River channel and flood plain and in Coeur d'Alene Lake. Metal-enriched sediments transported through Coeur d'Alene Lake have been deposited in the bed and banks of the Spokane River as far downstream as the Columbia River in Washington (Bortleson and others, 1994).

Methods

Twenty-two streambed-sediment sampling sites were selected (table 1) using recommended NAWQA Program guidelines (Gilliom and others, 1995). Major ions, trace elements, and carbon were determined for samples from all 22 sites; synthetic organic compounds also were determined for samples from 14 of those sites. The selected sites include those where fish tissue and water-quality sampling was conducted as part of the NROK study, as well as additional sites to achieve greater spatial distribution and to assess specific environmental conditions. The sites sampled represent a wide range of environmental settings and degrees of human impact, including pristine mountain streams and streams affected by mining-related and urban activities.

Streambed-sediment samples were collected using the procedures described by Shelton and Capel (1994). A representative sample was obtained by collecting the upper inch of fine-grained streambed sediment from 5 to 10 depositional zones along a 300- to 600-ft stream reach. Depositional zones commonly are located in shallow pools and back eddies, behind boulders, and along the banks of low-velocity stream reaches. Samples were collected with a plastic spoon and composited in a glass vessel until approximately 1 to 2 liters of sediment had been obtained. Samples for major and trace-element analysis were wet sieved, using stream water, through a 63-µm mesh nylon sieve into 500-mL plastic containers for shipment to the laboratory. Samples for synthetic organic compound analysis were wet sieved through a 2-mm mesh stainless-steel sieve into pre-cleaned 1-L glass jars. All samples were placed on ice immediately after sieving and shipped in coolers by express carrier to the USGS National Water Quality Laboratory (NWQL) in Denver, Colo. Precautions taken to minimize sample contamination included wearing vinyl gloves, covering the glass collection vessel, sieving inside a mobile laboratory, and following rigorous cleaning and sampling methods as specified by NAWQA Program protocols (Shelton and Capel, 1994).

Streambed-sediment samples were analyzed for 45 inorganic constituents consisting of major and trace elements, carbon, and 109 synthetic organic compounds (tables 2 and 3, back of the report). Samples for major and trace-element analysis were digested at the laboratory using a mixture of hydrochloric, nitric, perchloric, and hydrofluoric acids. The resultant solution was evaporated to dryness, the remaining solid material reconstituted with 5-percent nitric acid, and filtered. The extracts were analyzed for major and trace elements by inductively coupled plasma-atomic emission spectrometry as described by Arbogast (1990, 1996), Fishman (1993), and Sanzolone (1999). Following solvent extraction, samples for analysis of synthetic organic compounds were analyzed by dual capillary-column gas chromatography with electron-capture detection as described by Foreman and others (1995) and Furlong and others (1996).

Recently, the USGS NWQL developed a convention for reporting the presence of substances at low concentrations (Childress and others, 1999). These estimated values (indicated by a remark code “e” in this report) are smaller than a minimum amount reliably reported by a given analytical method (the minimum reporting level or MRL), but larger than the method detection limit (MDL) which was established to keep the possible occurrence of false negative or false positive error to 1 percent or less. The remark code “e” also is used to indicate quantitative uncertainty intermittently introduced by chemical interference or variable recovery efficiency (Furlong and others, 1996). Estimated values indicate that substances have been identified (detected), but the reported concentration has more uncertainty than concentrations that are reported (concentrations higher than the MRL) without the “e” remark code.

TRACE ELEMENTS IN STREAMBED SEDIMENT

Trace elements (metals and metalloids) occur naturally in rivers and streams from the weathering of rocks and mineral soils, but also can be introduced by human activities such as mining and processing of metal ores, manufacturing and other industries, and the production and consumption of fossil fuels. Several trace elements are of environmental concern because of their toxicity to both aquatic and terrestrial biota. Some trace elements can accumulate or concentrate (biomagnify) in higher levels of the food chain. Elements of particular environmental concern include arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc. Results of analyses of these trace elements in streambed sediment are presented in table 4 (back of report). For each of these nine trace elements of environmental concern, a minimum, maximum, and median concentration was calculated from all the analytical results. These values are presented in table 5 (back of the report) along with median concentration values for streambed-sediment data collected as part of the NAWQA Program from streams across the Nation during 1992-96 (Rice, 1999). To increase the likelihood of detecting trace elements and allowing data among sites to be compared, the silt and clay fraction (<63 µm) of streambed sediment was collected for this study, as well as for those samples collected from 1992-96 for the NAWQA Program. Streambed-sediment data collected for this study and from 1992-96 represent ambient concentrations that result from a combination of natural processes and human-caused activity (Rice, 1999).

Arsenic concentrations in streambed sediment of the Northern Rockies Intermontane Basins study area ranged from 2.6 to 190 µg/g (table 4). In the Clark Fork-Pend Oreille River basin, most arsenic concentrations in streambed sediment were relatively low (fig. 2) and were near the national median value of 6.3 µg/g (table 5) for arsenic concentrations in streambed-sediment samples collected in 1992-96 as part of the national NAWQA Program (Rice, 1999). However, along the Clark Fork, arsenic concentrations at three sites ranged from 22 to 180 µg/g (sites 1, 2, and 6) and were much higher than the national median value. In the Spokane River basin, some arsenic concentrations were near the national median value but about one-half of the arsenic concentrations (14 to 190 µg/g at sites 16, 17, 18, 19, and 20) were much higher than the national median value.

Cadmium concentrations in streambed sediment ranged from <0.10 to 28 µg/g. In the Clark Fork-Pend Oreille basin, 8 of 13 streambed-sediment samples contained cadmium concentrations that were less than the national median value of 0.40 µg/g. However, five samples contained cadmium concentrations that were higher than the national median value and concentrations at three sites equaled or exceeded 1 µg/g (sites 1, 2, and 6). In the Spokane River basin, almost all cadmium concentrations were higher than the national median value. The three highest values (fig. 2) ranged from 24 to 28 µg/g (sites 18, 19, and 20).

Chromium concentrations in streambed sediment of the study area ranged from 33 to 65 µg/g (table 4). In the Clark Fork-Pend Oreille basin, only one sample collected in the Clark Fork near Galen (site 1) contained a chromium concentration that exceeded the national median value of 64 µg/g (table 5). In the Spokane River basin, all chromium concentrations were lower than the national median value.

Copper concentrations in streambed sediment ranged from 18 to 1,200 µg/g. In the Clark Fork-Pend Oreille basin, many copper concentrations were near the national median value of 27 µg/g; copper concentrations at six sites were higher than the national median value. Copper concentrations at three sites along the Clark Fork ranged from 140 to 1,200 µg/g (sites 1, 2, and 6) and were much higher than the national median value. Similarly, in the Spokane River basin, many copper concentrations were near the national median value; the three highest values (fig. 2) ranged from 62 to 140 µg/g (sites 18, 19, and 20).

Lead concentrations in streambed sediment of the study area ranged from 12 to 6,600 µg/g (table 4). In the Clark Fork-Pend Oreille basin, 6 of 13 lead concentrations exceeded the national median value of 27 µg/g (table 5). At sites 1 and 2, along the Clark Fork, lead concentrations were 200 and 120 µg/g, respectively. In the Spokane River basin, most lead concentrations in streambed sediment were higher than the national median value. The largest lead concentrations in the Spokane River basin (fig. 2) ranged from 1,600 to 6,660 µg/g (sites 18, 19, and 20).

Mercury concentrations in streambed sediment ranged from <0.02 to 4.5 µg/g. In the Clark Fork-Pend Oreille basin, most mercury concentrations were near or less than the national median value of 0.06 µg/g. However, along the Clark Fork, three mercury concentrations ranged from 0.33 to 1.1 µg/g (sites 1, 2, and 6). In the Spokane River basin, 5 of 9 mercury concentrations exceeded the national median value. The three highest values in the Spokane River basin (fig. 2) ranged from 0.71 to 4.5 µg/g (sites 18, 19, and 20).

Nickel concentrations in streambed sediment ranged from 12 to 29 µg/g (table 4). In the Clark Fork-Pend Oreille basin, all nickel concentrations were lower than the national median value of 27 µg/g (table 5); the highest nickel concentration was about 24 µg/g at site 1. In the Spokane River basin, only one nickel concentration (29 µg/g at site 20) exceeded the national median value.

Selenium concentrations in streambed sediment of the study area ranged from <0.10 to 0.92 µg/g. In the Clark Fork-Pend Oreille basin, only one selenium concentration exceeded the national median value of 0.70 µg/g. In the Spokane River basin, all selenium concentrations were lower than the national median value.

EXPLANATION

CLARK FORK-PEND OREILLE RIVER BASIN

1. Clark Fork near Galen, Montana
2. Clark Fork at Turah Bridge, near Bonner, Montana
3. Blackfoot River above Nevada Creek, near Helmville, Montana
4. Rock Creek near Clinton, Montana
5. Bitterroot River near Missoula, Montana
6. Clark Fork at St. Regis, Montana
7. North Fork Flathead River near Columbia Falls, Montana
8. Middle Fork Flathead River near West Glacier, Montana
9. Flathead River at Perma, Montana
10. Rock Creek near Noxon, Montana
11. Lightning Creek at Clark Fork, Idaho
12. Priest River near Priest River, Idaho
13. Pend Oreille River above Priest River, Idaho

SPOKANE RIVER BASIN

14. St. Joe River at Red Ives Ranger Station, Idaho
15. St. Joe River at Calder, Idaho
16. South Fork Coeur d'Alene River at Shoshone Park, near Mullan, Idaho
17. North Fork Coeur d'Alene River at Enaville, Idaho
18. South Fork Coeur d'Alene River near Pinehurst, Idaho
19. Coeur d'Alene River near Harrison, Idaho
20. Spokane River near Post Falls, Idaho
21. Hangman Creek at Spokane, Washington
22. Spokane River at Seven Mile Bridge, near Spokane, Washington

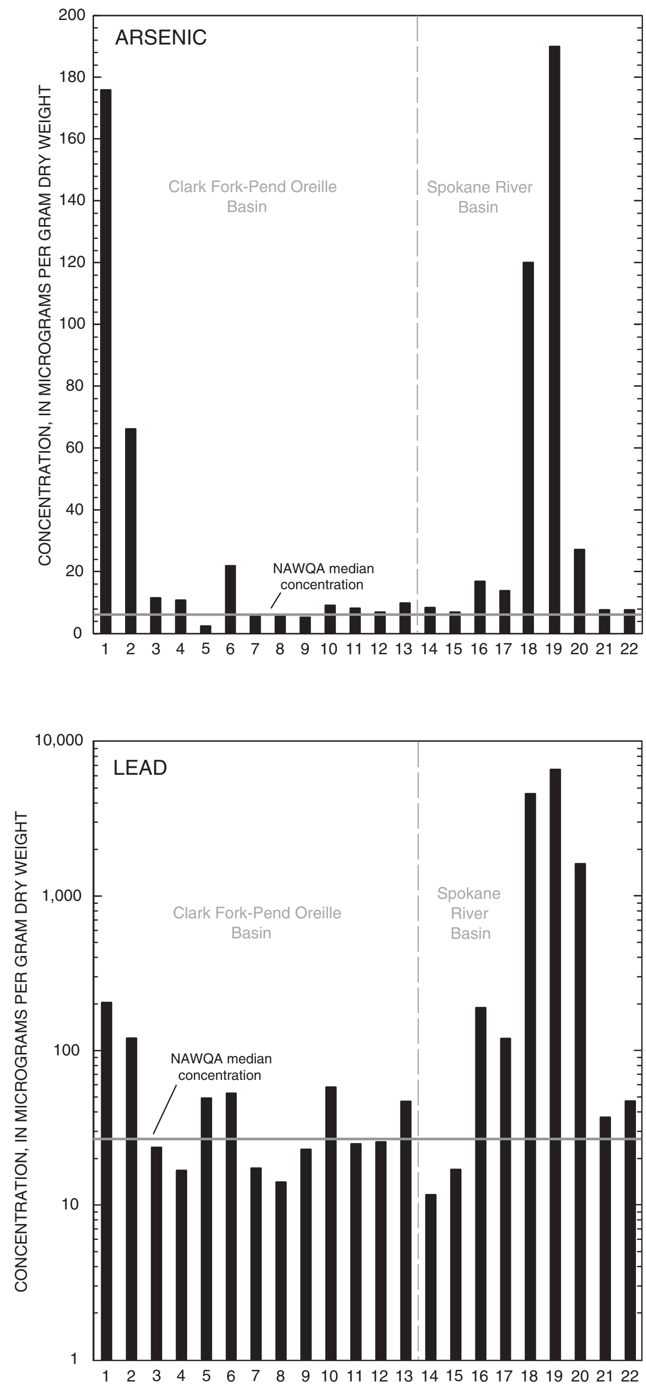


Figure 2. Concentrations of selected trace elements in streambed sediment from stream sites in the Northern Rockies Intermontane Basins study area, 1998. Solid line shows the National Water-Quality Assessment (NAWQA) Program median concentrations in streambed sediment from across the Nation, 1992-96 (Rice, 1999).

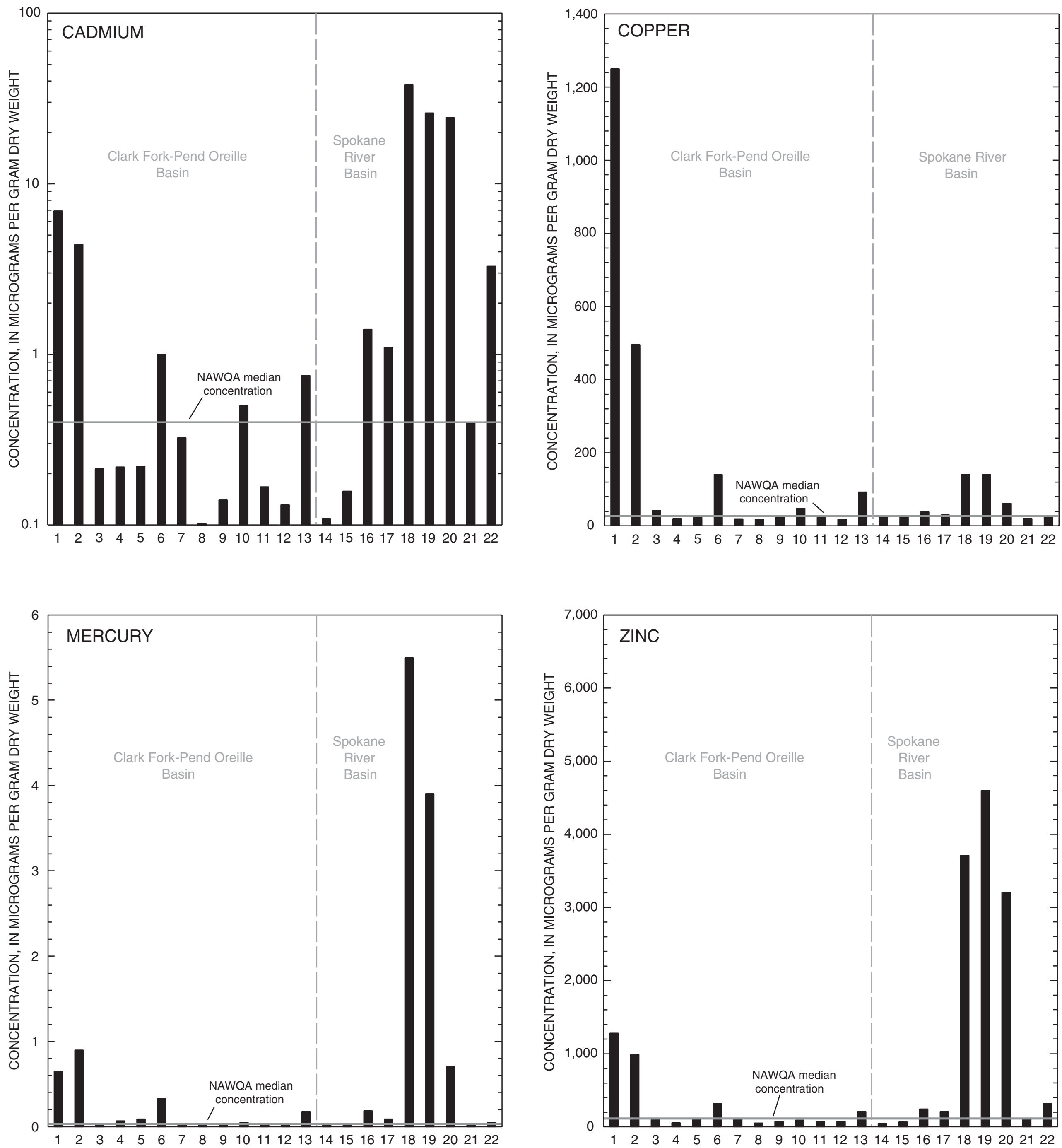


Figure 2. Concentrations of selected trace elements in streambed sediment from stream sites in the Northern Rockies Intermontane Basins study area, 1998. Solid line shows the National Water-Quality Assessment (NAWQA) Program median concentrations in streambed sediment from across the Nation, 1992-96 (Rice, 1999) (Continued).

Zinc concentrations in streambed sediment ranged from 47 to 4,600 µg/g (table 4). In the Clark Fork-Pend Oreille basin, most zinc concentrations were near or slightly lower than the national median value of 110 µg/g (table 5). Along the Clark Fork, two zinc concentrations were 1,300 and 1,000 µg/g (sites 1 and 2). In the Spokane River basin, 6 of 9 zinc concentrations exceeded the national median value. The three highest values in the Spokane River basin (fig. 2) ranged from 3,200 to 4,600 µg/g (sites 18, 19, and 20).

In general, sites 1 and 2 in the Clark Fork-Pend Oreille basin and sites 18, 19, and 20 in the Spokane River basin had the largest concentrations of trace elements in streambed sediment samples. At these five sites, the concentrations of most of the trace elements analyzed for this study exceeded the median concentrations determined from streambed sediment samples collected in 1992-96 as part of the national NAWQA Program (Rice, 1999). At the other 17 sites sampled in the NROK, concentrations of trace elements in streambed sediment were generally near or less than the national median concentration. Concentrations of arsenic, cadmium, copper, lead, mercury, and zinc in streambed-sediment samples from the NROK generally were higher or similar to the national median, whereas concentrations of chromium, nickel, and selenium generally were lower.

To characterize within-site variability of trace-element and carbon concentrations, triplicate samples were collected at two sites (table 6, back of the report): the Clark Fork at Turah Bridge, near Bonner, Mont. (site 2), and the South Fork Coeur d'Alene River near Pinehurst, Idaho (site 18) (fig. 1). Each of these triplicate samples was collected from separate stream reaches and processed and analyzed independently. The triplicate analyses indicate some variability in trace-element concentrations in streambed-sediment samples (table 6). The variability might result from where samples were collected. Relative percent differences (RPD) ranged from 0.0 percent for lead to 110 percent for cadmium; the median RPD for all samples at both sites was 29 percent.

SYNTHETIC ORGANIC COMPOUNDS IN STREAMBED SEDIMENT

Most of the analytical results from the 14 sites sampled for synthetic organic compounds in the NROK study area were reported as either estimated or non-detected values (table 7, back of the report). Phthalates and polycyclic aromatic hydrocarbons were the most frequently detected classes of synthetic organic compounds in streambed sediment. Some form of phthalates was detected at every site (table 7). Phthalates commonly are used in the manufacture of many kinds of plastics; the plastic spoons and filter apparatus used in sampling and sieving may have contributed to the frequent detection of phthalates.

Organochlorine pesticide residues were detected in streambed sediment at two sites (sites 21 and 22) in the NROK study area. Although banned from use in the United States since the early 1970s, DDT and its degradation products p,p'-DDD and p,p'-DDE can persist in the environment. The concentration of p,p'-DDE in streambed sediment of Hangman Creek (site 21) upstream from its confluence with the Spokane River near downtown Spokane, Wash., was 1.4 µg/kg. Both p,p'-DDD and p,p'-DDE were detected in samples collected from the Spokane River at Seven Mile Bridge (site 22) downstream from the City of Spokane, Wash. (table 7).

Polychlorinated biphenyls (PCBs) were detected in streambed-sediment samples from the South Fork Coeur d'Alene River near Pinehurst (site 18) at an estimated concentration of 26 µg/kg (table 7), or about one-half the laboratory MRL. However, PCBs were not detected in streambed sediment at any of the other sample sites, including the Spokane River at Seven Mile Bridge (site 22) downstream from the Spokane, Wash., urban area and municipal treatment plant.

To characterize with-in site variability of synthetic organic compounds and carbon concentrations, triplicate samples were collected at two sites (table 8, back of the report): the Clark Fork at Turah Bridge, near Bonner, Mont. (site 2), and the Spokane River at Seven Mile Bridge, near Spokane, Wash. (site 22). In general, triplicate samples collected at sites 2 and 22 confirmed the presence or absence of synthetic organic compounds (table 8). However, some synthetic organic compounds were detected in only one or two of the triplicate samples. The triplicate analyses indicate some variability in synthetic-organic compound concentrations in streambed-sediment samples that might result from the spatial variability in the stream reach where the samples were collected.

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DATA

Table 2. Inorganic constituents and carbon content analyzed in streambed sediment in the Northern Rockies Intermontane Basins study area

[Minimum reporting levels in micrograms per gram, dry weight, unless noted otherwise. Samples were wet sieved in the field through a 63-micrometer mesh nylon sieve. Abbreviation: MRL, minimum reporting level]

Constituent	MRL	Constituent	MRL
Aluminum	0.005 percent	Neodymium	1
Antimony	.1	Nickel	2
Arsenic	.1	Niobium	4
Barium	1	Phosphorus	.005 percent
Beryllium	.1	Potassium	.005 percent
Bismuth	1	Scandium	2
Cadmium	.1	Selenium	.1
Calcium	.005	Silver	.1
Cerium	1	Sodium	.005 percent
Chromium	1	Strontium	2
Cobalt	1	Sulfur	.05
Copper	1	Tantalum	1
Europium	1	Thallium	1
Gallium	1	Thorium	1
Gold	1	Tin	1
Holmium	1	Titanium	.005 percent
Iron	.005 percent	Uranium	.1
Lanthanum	1	Vanadium	2
Lead	1	Ytterbium	1
Lithium	1	Yttrium	1
Magnesium	.005 percent	Zinc	2
Manganese	4	Carbon, inorganic	.01 percent
Mercury	.2	Carbon, organic	.01 percent
Molybdenum	.5	Carbon, total	.01 percent

Table 3. Carbon and synthetic organic compounds analyzed in streambed sediment in the Northern Rockies Intermontane Basins study area

[Minimum reporting levels are in micrograms per kilogram or grams per kilogram dry weight. Samples were wet sieved in the field through a 2-millimeter stainless-steel sieve. Abbreviations: CAS, Chemical Abstract Service; g/kg, grams per kilogram; MRL, minimum reporting level. Symbol: --, not available]

Compound name	CAS number	MRL	Compound name	CAS number	MRL
Carbon, inorganic	--	0.2 (g/kg)	4-Chloro-3-methylphenol	59-50-7	50
Carbon, organic	--	.2 (g/kg)	4-Chlorophenyl phenyl ether	7005-72-3	50
Carbon, total	--	.1 (g/kg)	4H-Cyclopenta[def]phenanthrene	203-64-5	50
1,2,4-Trichlorobenzene	120-82-1	50	4-Nitrophenol	100-02-7	--
1,2-Dichlorobenzene	95-50-1	50	Acenaphthene	83-32-9	50
1,2-Dimethylnaphthalene	573-98-8	50	Acenaphthylene	208-96-8	50
1,3-Dichlorobenzene	541-73-1	50	Acridine	260-94-6	50
1,4-Dichlorobenzene	106-46-7	50	Aldrin	309-00-2	1
1,6-Dimethylnaphthalene	575-43-9	50	alpha-Endosulfan	959-98-8	1
1-Methyl-9H-fluorene	1730-37-6	50	alpha-HCH	319-84-6	1
1-Methylphenanthrene	832-69-9	50	Anthracene	120-12-7	50
1-Methylpyrene	2381-21-7	50	Anthraquinone	84-65-1	50
2,2'-Biquinoline	119-91-5	50	Azobenzene	103-33-3	50
2,3,5,6-Tetramethylphenol	527-35-5	50	Benz[a]anthracene	56-55-3	50
2,3,6-Trimethylnaphthalene	829-26-5	50	Benzo[a]pyrene	50-32-8	50
2,4,6-Trichlorophenol	88-06-2	--	Benzo[b]fluoranthene	205-99-2	50
2,4,6-Trimethylphenol	527-60-6	--	Benzo[c]cinnoline	230-17-1	50
2,4-Dichlorophenol	120-83-2	--	Benzo[ghi]perylene	191-24-2	50
2,4-Dinitrophenol	51-28-5	--	Benzo[k]fluoranthene	207-08-9	50
2,4-Dinitrotoluene	121-14-2	50	beta-HCH	319-85-7	1
2,6-Dimethylnaphthalene	581-42-0	50	bis(2-Chloroethoxy)methane	111-91-1	50
2,6-Dinitrotoluene	606-20-2	50	bis(2-Chloroethyl) ether	111-44-4	50
2-Chloronaphthalene	91-58-7	50	Bis(2-chloroisopropyl) ether	108-60-1	--
2-Chlorophenol	95-57-8	50	Bis(2-ethylhexyl) phthalate	117-81-7	50
2-Ethylnaphthalene	939-27-5	50	Butylbenzyl phthalate	85-68-7	50
2-Methylanthracene	613-12-7	50	C8-Alkylphenol	--	50
2-Nitrophenol	88-75-5	--	Carbazole	86-74-8	50
3,5-Dimethylphenol	108-68-9	50	Chloroneb	2675-77-6	5
4,6-Dinitro-2-methylphenol	534-52-1	--	Chrysene	218-01-9	50
4-Bromophenylphenyl ether	101-55-3	50	cis-Chlordane	5103-71-9	1

Table 3. Carbon and synthetic organic compounds analyzed in streambed sediment in the Northern Rockies Intermontane Basins study area (Continued)

Compound name	CAS number	MRL	Compound name	CAS number	MRL
cis-Nonachlor	5103-73-1	1	Nitrobenzene	98-95-3	50
cis-Permethrin	54774-45-7	5	N-nitrosodi-n-propylamine	621-64-7	50
Dacthal	1861-32-1	5	N-nitrosodiphenylamine	86-30-6	50
Dibenz[a,h]anthracene	53-70-3	50	o,p'-DDD	53-19-0	1
Dibenzothiophene	132-65-0	50	o,p'-DDE	3424-82-6	1
Dieldrin	60-57-1	1	o,p'-DDT	789-02-6	2
Diethyl phthalate	84-66-2	50	o,p'-Methoxychlor	30667-99-3	5
Dimethyl phthalate	131-11-3	50	Oxychlordane	27304-13-8	1
Di-n-butyl phthalate	84-74-2	50	p-Cresol	106-44-5	50
Di-n-octyl phthalate	117-84-0	50	Pentachloroanisole	1825-21-4	1
Endrin	72-20-8	2	Pentachloronitrobenzene	82-68-8	50
Fluoranthene	206-44-0	50	Pentachlorophenol	87-86-5	--
Fluorene	86-73-7	50	Phenanthrene	85-01-8	50
Heptachlor	76-44-8	1	Phenanthridine	229-87-8	50
Heptachlor epoxide	1024-57-3	1	Phenol	108-95-2	50
Hexachlorobenzene	118-74-1	1	Polychlorinated biphenyls	1336-36-3	50
Hexachlorobutadiene	87-68-3	--	p,p'-DDD	72-54-8	1
Hexachlorocyclopentadiene	77-47-4	--	p,p'-DDE	72-55-9	1
Hexachloroethane	67-72-1	--	p,p'-DDT	50-29-3	2
Indeno[1,2,3-cd]pyrene	193-39-5	50	p,p'-Methoxychlor	72-43-5	5
Isodrin	465-73-6	1	Pyrene	129-00-0	50
Isophorone	78-59-1	50	Quinoline	91-22-5	50
Isoquinoline	119-65-3	50	Toxaphene	8001-35-2	200
Lindane	58-89-9	1	trans-Chlordane	5103-74-2	1
Mirex	2385-85-5	1	trans-Nonachlor	39765-80-5	1
Naphthalene	91-20-3	50	trans-Permethrin	51877-74-8	5

Table 4. Concentrations of selected trace elements and carbon in streambed sediment in the Northern Rockies Intermontane Basins study area, 1998

[Concentrations are reported in micrograms per gram, dry weight, for trace elements and percent dry weight for carbon. Samples were wet sieved in the field through a 63-micrometer nylon-mesh sieve. Symbols: <, less than minimum reporting level]

Site number (fig. 1)	Site name	Arsenic	Cad-mium	Chro-mium
	Clark Fork-Pend Oreille River Basin			
1	Clark Fork near Galen, Montana	180	6.9	65
2	Clark Fork at Turah Bridge, near Bonner, Montana	66	4.2	57
3	Blackfoot River above Nevada Creek, near Helmville, Montana	12	.21	61
4	Rock Creek near Clinton, Montana	11	.22	45
5	Bitterroot River near Missoula, Montana	2.6	.22	40
6	Clark Fork at St. Regis, Montana	22	1.0	48
7	North Fork Flathead River near Columbia Falls, Montana	6.1	.32	44
8	Middle Fork Flathead River near West Glacier, Montana	5.6	<.10	35
9	Flathead River at Perma, Montana	5.4	.14	48
10	Rock Creek near Noxon, Montana	9.2	.50	36
11	Lightning Creek at Clark Fork, Idaho	8.3	.17	33
12	Priest River near Priest River, Idaho	7.0	.13	40
13	Pend Oreille River above Priest River, Idaho	10	.75	56
	Spokane River Basin			
14	St. Joe River at Red Ives Ranger Station, Idaho	8.5	.10	44
15	St. Joe River at Calder, Idaho	7.0	.16	40
16	South Fork Coeur d'Alene River at Shoshone Park, near Mullan, Idaho	17	1.4	43
17	North Fork Coeur d'Alene River at Enaville, Idaho	14	1.1	43
18	South Fork Coeur d'Alene River near Pinehurst, Idaho	120	28	36
19	Coeur d'Alene River near Harrison, Idaho	190	26	38
20	Spokane River near Post Falls, Idaho	27	24	44
21	Hangman Creek at Spokane, Washington	7.8	.40	48
22	Spokane River at Seven Mile Bridge, near Spokane, Washington	7.8	3.3	38

Table 4. Concentrations of selected trace elements and carbon in streambed sediment in the Northern Rockies Intermontane Basins study area, 1998 (Continued)

Copper	Lead	Mercury	Nickel	Selenium	Zinc	Carbon, inorganic (percent)	Carbon, organic (percent)	Carbon, total (percent)	Site number (fig. 1)
Clark Fork-Pend Oreille River Basin									
1,200	200	0.65	24	0.92	1,300	0.42	3.0	3.4	1
490	120	1.1	21	.54	1,000	.17	2.6	2.7	2
42	24	.03	20	.23	96	.56	1.4	1.9	3
20	17	.07	15	.47	54	.02	3.9	4.0	4
26	49	.09	12	.29	94	.01	2.9	2.9	5
140	53	.33	17	.36	320	.06	2.5	2.6	6
19	17	.04	18	.33	110	1.2	1.1	2.4	7
18	14	.03	14	.15	50	.86	.67	1.5	8
25	23	.03	19	.19	74	.17	1.4	1.5	9
48	58	.05	16	.34	92	.02	3.0	3.1	10
26	25	<.02	14	.15	79	.01	1.2	1.2	11
19	26	.02	15	<.10	75	.02	.88	.90	12
93	47	.18	23	.38	210	.06	1.8	1.9	13
Spokane River Basin									
24	12	.02	19	.24	47	.02	2.7	2.7	14
26	17	.04	18	.24	65	.02	2.4	2.4	15
38	190	.19	18	.44	260	.03	4.9	5.0	16
30	120	.09	19	.25	210	.01	2.1	2.1	17
140	4,400	4.5	19	.32	3,700	.47	1.4	1.9	18
140	6,600	3.9	22	.28	4,600	1.3	1.3	2.6	19
62	1,600	.71	29	.54	3,200	.02	3.7	3.7	20
20	37	.02	21	.16	100	.06	1.4	1.5	21
26	47	.05	17	.20	320	.02	1.4	1.4	22

Table 5. Statistical summary of concentrations of selected trace elements and carbon in streambed sediment of the Northern Rockies Intermontane Basins study area, and comparison with median concentrations from the National Water-Quality Assessment Program

[Concentrations are reported in micrograms per gram, dry weight, for trace elements and percent dry weight for carbon. Abbreviation: NAWQA, National Water-Quality Assessment Program. Symbol: <, less than minimum reporting level; --, no value reported]

Constituent	Northern Rockies Intermontane Basins			Median concen-tration, NAWQA Program[1]
	Mini-mum	Maxi-mum	Median	
Arsenic	2.6	190	9.6	6.3
Cadmium	<.10	28	.45	.40
Chromium	33	65	44	64
Copper	18	1,200	28	27
Lead	12	6,600	47	27
Mercury	<.02	4.5	.06	.06
Nickel	12	29	19	27
Selenium	<.10	.92	.28	.70
Zinc	47	4,600	100	110
Carbon, inorganic (percent)	.01	1.3	.06	--
Carbon, organic (percent)	.67	4.9	2.0	2.8
Carbon, total (percent)	.9	5.0	2.4	--

[1]Data from 1992-96 (Rice, 1999).

Table 6. Concentrations of selected trace elements and carbon in triplicate samples of streambed sediment collected at two sites in the Northern Rockies Intermontane Basins study area, 1998

[Concentrations are reported in micrograms per gram, dry weight, for trace elements and percent dry weight for carbon. Samples were wet sieved in the field through a 63-micrometer mesh nylon sieve. Data from sample 1 at each site are reported in table 4. Abbreviations: RPD, relative percent difference]

Constituent	Clark Fork at Turah Bridge, near Bonner, Montana (site 2)					South Fork Coeur d Alene River near Pinehurst, Idaho (site 18)				
	Concentration					Concentration				
	Sample 1	Sample 2	Sample 3	Mean	RPD[1]	Sample 1	Sample 2	Sample 3	Mean	RPD[1]
Arsenic	66	75	63	68	18	120	140	120	130	15
Cadmium	4.2	4.8	4.2	4.4	14	28	43	83	51	110
Chromium	57	60	66	61	15	36	42	42	40	15
Copper	490	570	500	520	15	140	190	210	180	39
Lead	120	120	120	120	0.0	4,400	6,300	9,100	6,600	71
Mercury	1.1	.80	.90	.93	32	4.5	5.9	6.2	5.5	31
Nickel	21	23	21	22	9.0	19	22	25	22	27
Selenium	.54	.78	.44	.59	58	.32	.43	.54	.43	51
Zinc	1,000	1,200	1,000	1,100	18	3,700	4,700	10,000	6,100	100
Carbon, inorganic (percent)	.17	.20	.14	.17	35	.47	.43	.30	.40	42
Carbon, organic (percent)	2.6	2.4	2.0	2.3	26	1.4	1.7	2.3	1.8	50
Carbon, total (percent)	2.7	2.2	2.6	2.5	20	1.9	2.1	2.6	2.2	32

[1]The relative percent difference is the difference of the highest and lowest concentration divided by the mean of the concentrations. These values show how concentrations can widely vary at each site.

Table 7. Concentrations of synthetic organic compounds and carbon detected in streambed sediment in the Northern Rockies Intermontane Basins study area, 1998

[Compounds listed in Table 3 but not detected are not shown here. Minimum reporting levels for each constituent are presented in table 3. Concentrations reported in micrograms per kilogram or grams per kilogram, dry weight. Samples were wet sieved in the field through a 2-millimeter stainless-steel sieve. Abbreviations: CAS, Chemical Abstract Service; e, estimated; g/kg, grams per kilogram; --, not detected]

Site number	Site name	Compound name and CAS number				
		1-Methylphenanthrene 832-69-9	1-Methylpyrene 2381-21-7	2-2 -Biquinoline 119-91-5	2,6-Dimethylnaphthalene 581-42-0	2-Ethylnaphthalene 939-27-5
2	Clark Fork at Turah Bridge, near Bonner, Montana	--	--	--	--	--
3	Blackfoot River above Nevada Creek, near Helmville, Montana	--	--	--	--	--
5	Bitterroot River near Missoula, Montana	--	--	--	--	--
6	Clark Fork at St. Regis, Montana	--	--	--	--	--
7	North Fork Flathead River near Columbia Falls, Montana	--	--	--	--	e1.8
8	Middle Fork Flathead River near West Glacier, Montana	--	--	--	--	--
9	Flathead River at Perma, Montana	--	--	--	--	--
11	Lightning Creek at Clark Fork, Idaho	--	--	--	--	--
14	St. Joe River at Red Ives Ranger Station, Idaho	--	--	--	--	--
17	North Fork Coeur d'Alene River at Enaville, Idaho	--	--	--	--	--
18	South Fork Coeur d'Alene River near Pinehurst, Idaho	--	--	--	94	--
20	Spokane River near Post Falls, Idaho	--	--	--	--	--
21	Hangman Creek at Spokane, Washington	--	--	--	e8.8	--
22	Spokane River at Seven Mile Bridge, near Spokane, Washington	--	e11	e33	--	--

Table 7. Concentrations of synthetic organic compounds and carbon detected in streambed sediment in the Northern Rockies Intermontane Basins study area, 1998 (Continued)

Site number	Compound name and CAS number							
	Acenaphthylene 208-96-8	**Anthracene 120-12-7**	**Benz[a]anthracene 56-55-3**	**Benzo[a]pyrene 50-32-8**	**Benzo[b]fluoranthene 205-99-2**	**Benzo[ghi]perylene 191-24-2**	**Benzo[k]fluoranthene 207-08-9**	**bis(2-ethylhexyl) phthalate 117-81-7**
2	--	--	--	--	--	--	--	--
3	--	--	--	--	--	--	--	e29
5	--	--	e14	--	e22	e24	e22	e32
6	--	--	--	--	--	--	--	e33
7	--	--	--	--	--	--	--	e48
8	--	--	--	--	--	--	--	e25
9	--	--	--	--	--	--	--	--
11	--	--	--	--	--	--	--	e23
14	--	--	--	--	--	--	--	e15
17	--	--	--	--	--	--	--	e40
18	--	--	e13	--	--	--	--	120
20	--	--	e9.8	e15	e20	e13	e19	e36
21	--	--	--	--	--	--	--	60
22	--	e6.6	e17	e24	--	--	--	e45

Table 7. Concentrations of synthetic organic compounds and carbon detected in streambed sediment in the Northern Rockies Intermontane Basins study area, 1998 (Continued)

Site number	Compound name and CAS number							
	Butylbenzyl phthalate 85-68-7	**Chrysene 218-01-9**	**Diethyl phthalate 84-66-2**	**Di-n-butyl phthalate 84-74-2**	**Fluoranthene 206-44-0**	**Indeno[1,2,3-cd]pyrene 193-39-5**	**Naphthalene 91-20-3**	**p-Cresol 106-44-5**
2	--	e20	--	e36	e25	--	--	680
3	e20	--	--	e41	--	--	--	e31
5	e20	e9.3	--	e42	e7.2	e24	--	e47
6	--	--	--	--	e13	--	--	1,100
7	e23	--	--	e43	--	--	--	190
8	--	--	--	e42	e11	--	--	87
9	--	--	--	e30	--	--	--	120
11	e20	--	--	e30	--	e5.9	--	--
14	--	--	e1.1	e47	--	--	--	200
17	e16	--	--	e39	e15	--	--	100
18	e28	e6.9	e35	e56	--	--	--	88
20	e30	e5.1	--	e33	e33	e11	e6.9	--
21	e20	--	e12	e42	--	--	--	84
22	e18	e17	--	e28	e39	--	e7.1	160

Table 7. Concentrations of synthetic organic compounds and carbon detected in streambed sediment in the Northern Rockies Intermontane Basins study area, 1998 (Continued)

Site number	Compound name and CAS number								
	Phenanthrene 85-01-8	**Phenol 108-95-2**	**Polychlorinated biphenyls 1336-36-3**	**p,p -DDD 72-54-8**	**p,p -DDE 72-55-9**	**Pyrene 129-00-0**	**Carbon, inorganic (g/kg)**	**Carbon, organic (g/kg)**	**Carbon, total (g/kg)**
2	--	51	--	--	--	e27	1.0	32	33
3	--	--	--	--	--	--	3.4	11	14
5	--	e9.0	--	--	--	e9.2	.10	11	11
6	--	72	--	--	--	--	.60	19	20
7	--	--	--	--	--	--	6.7	11	18
8	--	--	--	--	--	--	5.4	4.6	10
9	--	e11	--	--	--	--	2.3	4.7	7.0
11	--	--	--	--	--	--	.10	3.1	3.1
14	--	e9.1	--	--	--	--	.10	7.6	7.6
17	--	e7.8	--	--	--	e3.9	.10	15	15
18	e6.4	e22	e26	--	--	e14	.40	15	15
20	e9.0	--	--	--	--	e20	.10	9.2	9.2
21	--	e16	--	--	1.4	--	.40	15	15
22	e15	--	--	1.2	2.9	e30	.30	8.7	9.0

Table 8. Concentrations of carbon and synthetic organic compounds detected in triplicate samples of streambed sediment collected at two sites in the Northern Rockies Intermontane Basins study area, 1998

[Concentrations are reported in micrograms per kilogram or grams per kilogram, dry weight. Samples were wet-sieved in the field through a 2-millimeter mesh stainless-steel screen. Data from sample 1 at each site are reported in table 7. Abbreviations: e, estimated; g/kg, gram per kilogram. Symbols: <, less than minimum reporting level; --, not detected]

Constituent	Clark Fork at Turah Bridge, near Bonner, Montana (site 2)			Spokane River at Seven Mile Bridge, near Spokane, Washington (site 22)		
	Concentration			Concentration		
	Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
Carbon, inorganic (g/kg)	1.0	0.40	1.2	0.30	<0.10	<0.10
Carbon, organic (g/kg)	32	24	22	8.7	13	14
Carbon, total (g/kg)	33	24	23	9.0	13	14
1-Methylphenanthrene	--	--	--	--	--	e.43
1-Methylpyrene	--	--	--	e11	--	--
2,2'-Biquinoline	--	--	--	e33	--	--
2,6-Dimethylnaphthalene	--	--	e32	--	--	e31
Acenaphthylene	--	--	--	--	--	e17
Anthracene	--	--	--	e6.6	e14	e25
Benz[a]anthracene	--	--	--	e17	e26	96
Benzo[a]pyrene	--	--	--	e24	e30	99
Benzo[b]fluoranthene	--	--	--	--	--	68
Benzo[ghi]perylene	--	e9.6	--	--	--	52
Benzo[k]fluoranthene	--	--	--	--	--	56
bis(2-ethylhexyl) phthalate	--	--	--	e45	72	e49
Butylbenzyl phthalate	--	--	--	e18	e26.5	--
Chrysene	e20	--	--	e17	e25	86
Di-n-butyl phthalate	e36	e27	e35	e28	e41	e27
Fluoranthene	e25	e19	e24	e39	53	130
Indeno[1,2,3-cd]pyrene	--	--	--	--	--	51
Naphthalene	--	--	--	e7	e15	e20
p-Cresol	680	540	78	160	120	270
Phenanthrene	--	--	e6.4	e15	e27	e27
Phenol	51	e50	--	--	--	e38
p,p'-DDD	--	--	--	1.2	1.8	1.4
p,p'-DDE	--	--	--	2.9	4.5	4.0
Pyrene	e27	e7.2	e10	e30	e46	160

[1]Data from sample 1 at each site are reported in table 7.