U.S. Department of the Interior
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Water-Resources-Related Information for the St. Croix Reservation and Vicinity, Wisconsin

Water-Resources Investigations Report 00–4133

Prepared in cooperation with the
St. Croix Chippewa Indians of Wisconsin

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By David A. Saad and Dale M. Robertson

U.S. GEOLOGICAL SURVEY
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Middleton, Wisconsin
2000

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CONVERSION FACTORS AND ABBREVIATED WATER-QUALITY UNITS

Multiply	By	To Obtain
acre	4,047	square meter (m^2)
feet (ft)	0.3048	meter (m)
gallon (gal)	3.785	liter (L)
inch (in)	25.4	millimeter (mm)
cubic inch (in^3)	16.39	cubic centimeter (cm^3)
mile (mi)	1.609	kilometer (km)
pound (lb)	453,600	milligram (mg)
square mile (mi^2)	2.59	square kilometer (km^2)

Temperature, in degrees Celsius (°C) can be converted to degrees Fahrenheit (°F) by use of the following equation:

°F = [1.8(°C)] + 32.

Abbreviated water- and sediment-quality units: Chemical concentrations and water temperature are given in metric units. Chemical concentration is given in milligrams per liter (mg/L), micrograms per liter (µg/L), milligrams per kilogram (mg/kg), or micrograms per kilogram (µg/kg). Milligrams per liter is a unit expressing the concentration of chemical constituents in solution as weight (milligrams) of solute per unit volume (liter) of water. One thousand micrograms per liter is equivalent to one milligram per liter. For concentrations less than 7,000 mg/L, the numerical value is the same as for concentrations in parts per million. Milligrams per kilogram (mg/kg) is a unit expressing the concentration of chemical constituents in solution as weight (milligrams) of solute per unit mass (kilogram) of water. One thousand micrograms per kilogram is equivalent to one milligram per kilogram.

Specific conductance is expressed in microsiemens per centimeter (µS/cm). A microsiemen is the electrical conductivity of water measured between opposite faces of a centimeter cube of aqueous solution at a specified temperature.

Radioactivity is expressed in picocuries per liter (pCi/L). A picocurie is the amount of radioactivity that yields 2.22 radioactive disintegrations per minute.

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Water-Resources-Related Information for the St. Croix Reservation and Vicinity, Wisconsin

By David A. Saad *and* Dale M. Robertson

Abstract

The St. Croix Chippewa Tribe is interested in documenting water-quality conditions in lakes and streams adjacent to their Reservation lands in northwestern Wisconsin and developing management plans to protect these water resources. This report provides the Tribe with a retrospective summary and analysis of available water-resources-related information for their Reservation and vicinity. The study area is divided into four main watersheds: Big Round Lake, Clam River at Clam Lake Outlet, Yellow River at Danbury, and Loon Creek at Danbury. The Clam River Watershed includes the subwatersheds of Bashaw and Sand Lakes. The Yellow River Watershed includes the subwatersheds of Big Sand and Gaslyn Lakes.

In all, 41 surface-water studies or reports that include information relevant to the study area were identified. Most of the surface-water studies were regional or statewide summaries. Fifteen of these studies include lake information and 36 include stream information. Twenty-eight of the studies include water-quality data and 16 include information describing aquatic biology.

Water- and sediment-quality data were obtained for 80 lakes and 23 streams in the study area. Lake information includes data for 101 water-quality characteristics from nearly 4,300 water and sediment analyses of samples collected between 1972 and 1998. Stream information summarized in this report includes data for 135 water-quality characteristics and nearly 4,500 water and sediment analyses of samples collected at 23 sites between 1964 and 1999.

A total of 41 ground-water studies or reports that include information relevant to the study area were identified. Most of the ground-water studies were regional or statewide summaries. Of the 41 studies, 33 include water-quality information, 9 include information regarding water use, and 23 provide descriptions of geology and aquifer characteristics relevant to the study area.

Water-quality information for 773 wells was compiled. Most of the sampled wells were used for drinking water, and most of the drinking-water wells represent domestic supplies. Water-quality data summarized in this report represent 270 characteristics and more than 10,300 analyses of samples collected from drinking-water wells between 1911 and 1999; however, most of the water-quality data were collected after about 1990.

INTRODUCTION

The St. Croix Chippewa Tribe is concerned about the current and future health of lakes and streams adjacent to their Reservation lands in northwestern Wisconsin. The Tribe is interested in documenting historical and current water quality and developing management plans to protect these water resources. To respond to these needs, the Tribe and the U.S. Geological Survey (USGS) entered into a cooperative agreement to provide the Tribe with a retrospective summary and analysis of existing water-resources-related information for their Reservation and vicinity.

Purpose and Scope

The primary purpose of this report is to provide a summary of available water-resources-related information in the vicinity of the St. Croix Reservation lands. A secondary purpose is to analyze available data, where possible, to help identify factors affecting the water resources.

The studies and data included in this report were found in literature and data bases that were readily available through standard literature searches, or from various local, state, and Federal agencies, and academic organizations. Every effort was made to locate all available (and pertinent) water-resources-related information for the study area; however, it is likely that some sources were missed.

Water-resources-related information described in this report has been divided into three categories: (1) surface-water studies and data, (2) ground-water studies and data, and (3) additional data, which includes meteorological and digital thematic data (GIS coverages). Some multidisciplinary studies are included in more than one category.

Description of St. Croix Reservation and Vicinity

The St. Croix Reservation lands, which are spread out over 10 locations in Barron, Burnett, Polk, and Washburn Counties in northwestern Wisconsin (fig. 1), comprise a total of about 3,000 acres. The Tribe is interested in summarizing water-resources-related information for the lakes and streams near 7 of the 10 locations. The lakes of special interest to the Tribe are Bashaw, Big Round, Big Sand, Clam, Gaslyn, and Sand Lakes. The streams of special interest are Loon Creek and the St. Croix and Yellow Rivers upstream from St. Croix Reservation lands near Danbury, Wis.

Water quality in streams and lakes is strongly affected by human activities and natural processes in the surrounding watersheds; therefore, in this report we examine the watersheds of each of the lakes and that of Loon Creek and the Yellow River. The Upper St. Croix River Watershed upstream from Danbury, Wis. is more than twice as large as the area of the other watersheds of interest combined (fig. 1, table 1). In this report, therefore, we focus our efforts on the area near the Reservation rather than on the St. Croix River Watershed upstream from Danbury. The study area is therefore defined as the 707-mi^2 area that includes the watersheds of the six lakes and the watersheds of Loon Creek and the Yellow River upstream from Danbury (fig. 1). Water-quality data collected from the St. Croix River at Danbury (USGS station 05333500, fig. 1) are also summarized in this report, but the environmental characteristics for its watershed are not illustrated and the listed references for the watershed are generally limited to regional studies.

The study area is divided into four main watersheds: (1) Big Round Lake (29.5 mi^2), (2) Clam River at Clam Lake Outlet (298 mi^2), (3) Yellow River at Danbury (323 mi^2), and (4) Loon Creek at Danbury (56 mi^2) (fig. 2, table 1). The Clam River Watershed includes the subwatersheds of Bashaw (29.2 mi^2) and Sand Lakes (16.3 mi^2). The Yellow River Watershed includes the subwatersheds of Big Sand (20.7 mi^2) and Gaslyn Lakes (4.8 mi^2). Watershed boundaries delineated for this study were based on digital coverages of USGS Hydrologic Unit maps (Seaber and others, 1986), U.S. Environmental Protection Agency (USEPA) digital coverages of RF3 files (1999a), and drainage boundaries delineated on 1:24,000-scale USGS topographic quadrangle maps maintained by the USGS office in Middleton, Wis. The environmental characteristics of each watershed are summarized in table 1 and shown in figures 3, 4, and 5.

The dominant land use/land cover of all the watersheds is forest (fig. 3, table 1). The percentage of forest ranges from 36.4 percent in the Bashaw Lake subwatershed to 67.7 percent in the Loon Creek watershed. Other common land-use/land-cover types in the study area are grassland, wetland, agriculture, and open water. Wetlands are fairly evenly distributed over the study area. The percentages of grassland and agricultural land use are generally highest in the southern and central parts of the study area, such as near Bashaw Lake.

The geology underlying the study area consists of Precambrian quartzite, basalt flows (upper volcanic sequence), and sandstone (Oconto Group); Cambrian sandstone; and unconsolidated deposits (referred to as “surficial deposits”) of Quaternary age (fig. 4 and 5, table 1). The Precambrian and Cambrian sandstones are more permeable than other bedrock types, and wells constructed in these areas are more likely to yield water (Young and Hindall, 1973). The Precambrian rocks are of unknown thickness and predominate in the northwest part of the study area. The Cambrian sandstone, which can be several hundred feet thick, overlies the Precambrian rocks in the southeastern part of the study area, generally thickening to the south and east. Most of the watersheds are underlain by a combination of Precambrian and Cambrian rocks; exceptions are the Big Sand and Gaslyn Subwatersheds which are predominantly Precambrian rocks and the Sand Lake Subwatershed which is underlain by Cambrian rocks.

The surficial deposits in the study area are generally 50 to 300 ft thick and mostly pitted outwash (Young and Hindall, 1973) consisting of stratified sand or sand and gravel (fig. 5, table 1). The sand and gravel aquifer is defined by where the surficial deposits are saturated and sufficiently thick and permeable (the situation in most of the study area). Several large areas of peat are

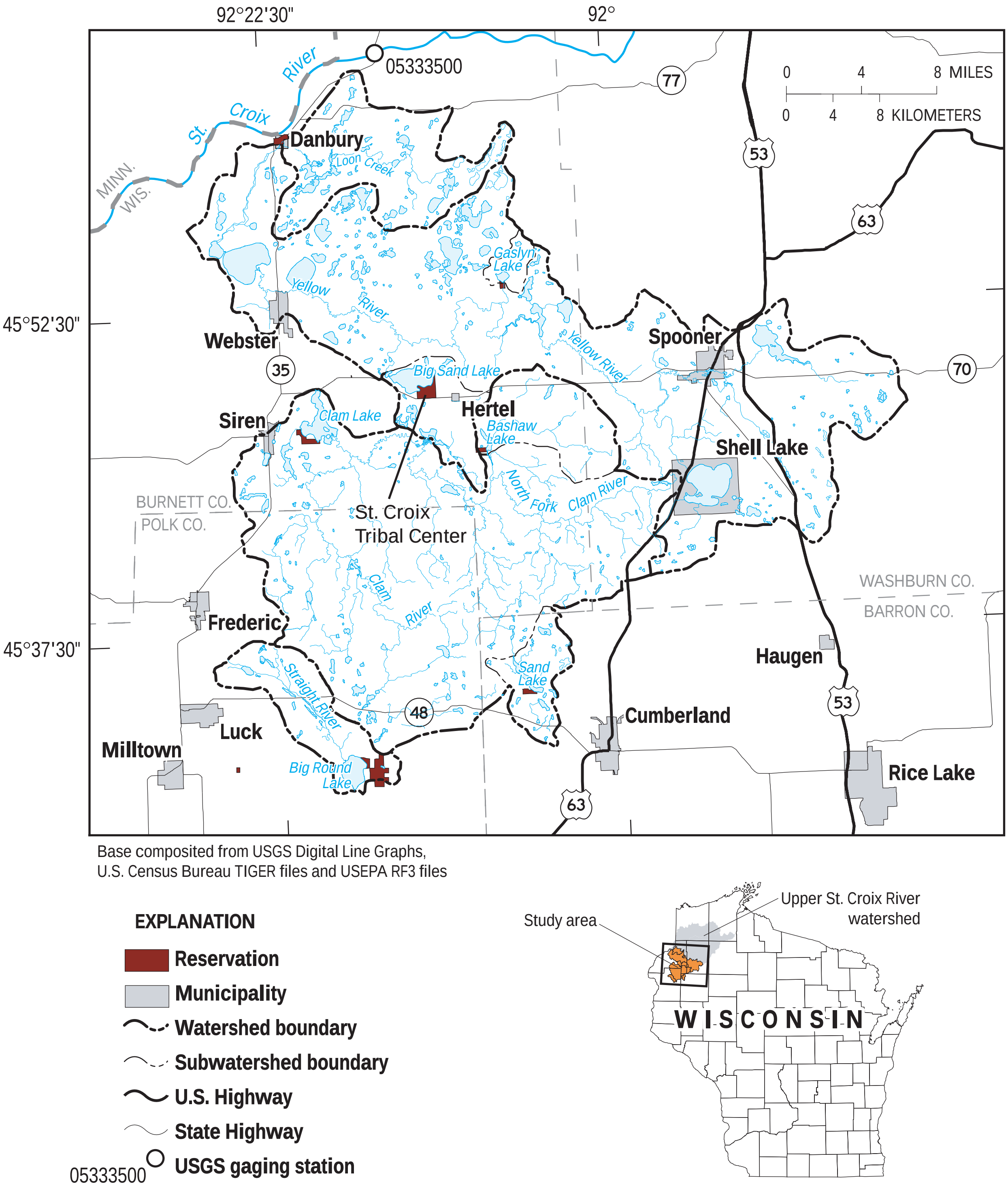


Figure 1. Location of the St. Croix Reservation and study area.

Table 1. Environmental characteristics of selected river and lake watersheds in the vicinity of the St. Croix Reservation, Wisconsin (watershed areas in parentheses)

[mi^2, square miles]

Environmental characteristic	Big Round Lake Watershed (29.5 mi^2)	Clam River Watershed			Loon Creek at Danbury Watershed (56.0 mi^2)	Yellow River Watershed		
		Clam River at Clam Lake outlet (298 mi^2)	Bashaw Lake Subwatershed (29.2 mi^2)	Sand Lake Subwatershed (16.3 mi^2)		Yellow River at Danbury (323 mi^2)	Big Sand Lake Subwatershed (20.7 mi^2)	Gaslyn Lake Subwatershed (4.8 mi^2)
Land use (percentage)								
Urban	0	0.1	0	0	0	0.5	0	0
Agriculture	7.8	8.0	18.9	7.3	0.1	5.6	0.8	0.4
Grassland	23.9	23.5	34.1	17.3	5.2	16.8	11.9	22.1
Forest	46.4	51.6	36.4	55.8	67.7	51.5	53.7	47.4
Open water	9.1	3.2	1.9	7.6	9.2	9.5	15.2	5.5
Wetland	12.4	13.2	7.8	11.4	10.6	14.1	17.5	23.4
Barren	.1	.2	.5	.3	.2	.4	.1	0
Shrubland	.2	.3	.4	0	7.0	1.4	.8	1.2
Bedrock geology[1] (percentage)								
Cambrian sandstone	46.3	65.4	51.8	100	0	42.1	7.5	0
Precambrian sandstone	0	0	0	0	74.6	6.2	0	0
Precambrian quartzite	0	0	0	0	0	0.8	0	0
Precambrian basalt flows	53.8	34.6	48.2	0	25.4	51.0	92.5	100
Surficial deposit type (percentage)								
Sand and gravel	0	30.0	44.9	0	99.6	49.0	78.1	100
Sand	100	63.4	55.1	100	0.4	41.2	0	0
Peat	0	6.6	0	0	0	9.8	21.9	0
Soil characteristics (area-weighted averages)								
Permeability (inches/hour)	5.0	5.0	5.0	3.1	9.7	7.2	8.3	6.6
Organic-matter content (percentage)	4.2	5.3	4.4	4.7	13.0	8.8	4.3	10.4

[1]In parts of the study area underlain by more than one type of bedrock, "bedrock geology" refers to the upper-most unit.

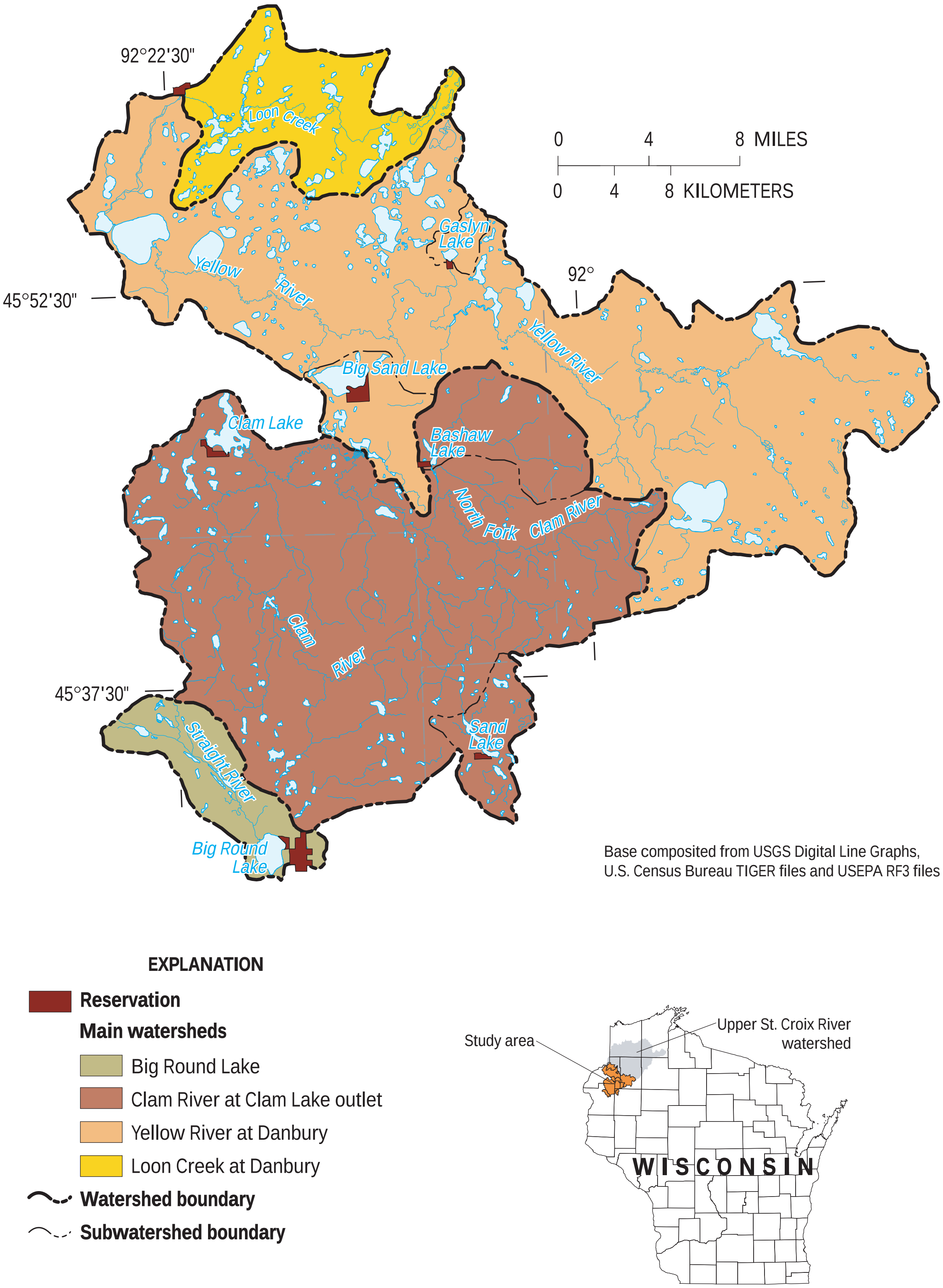


Figure 2. Main watersheds and subwatersheds in the study area.

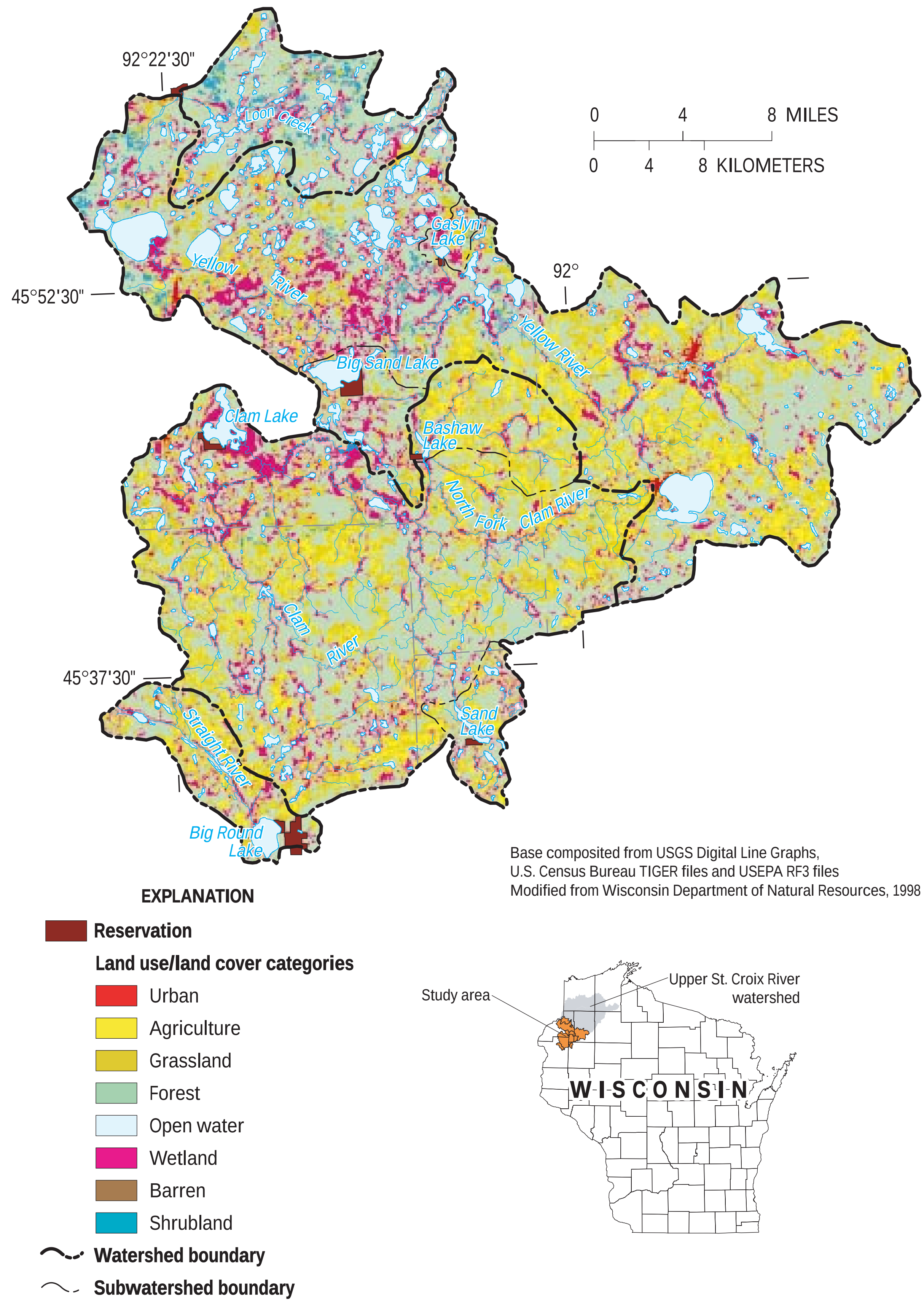


Figure 3. Distribution of land use/land cover in the study area.

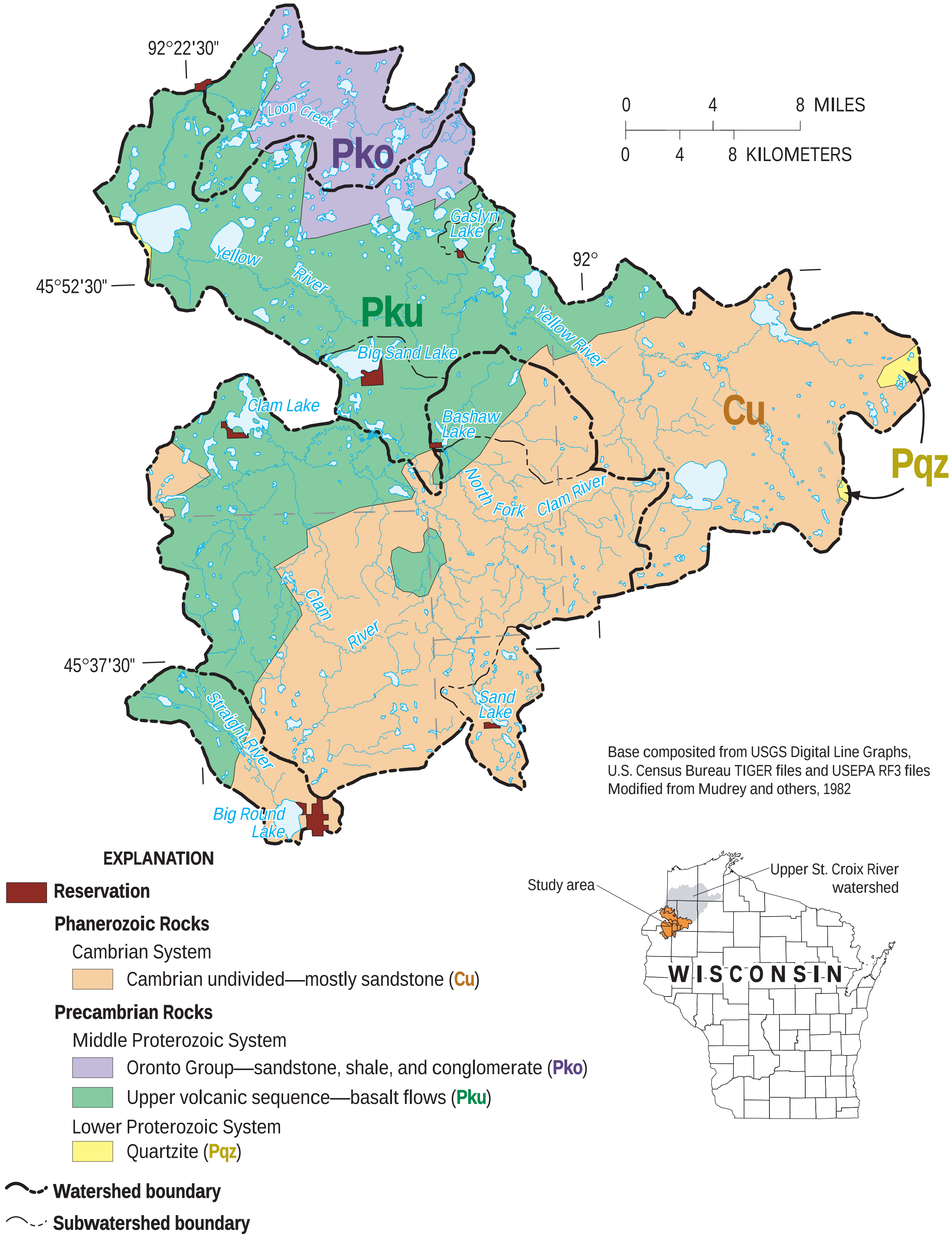
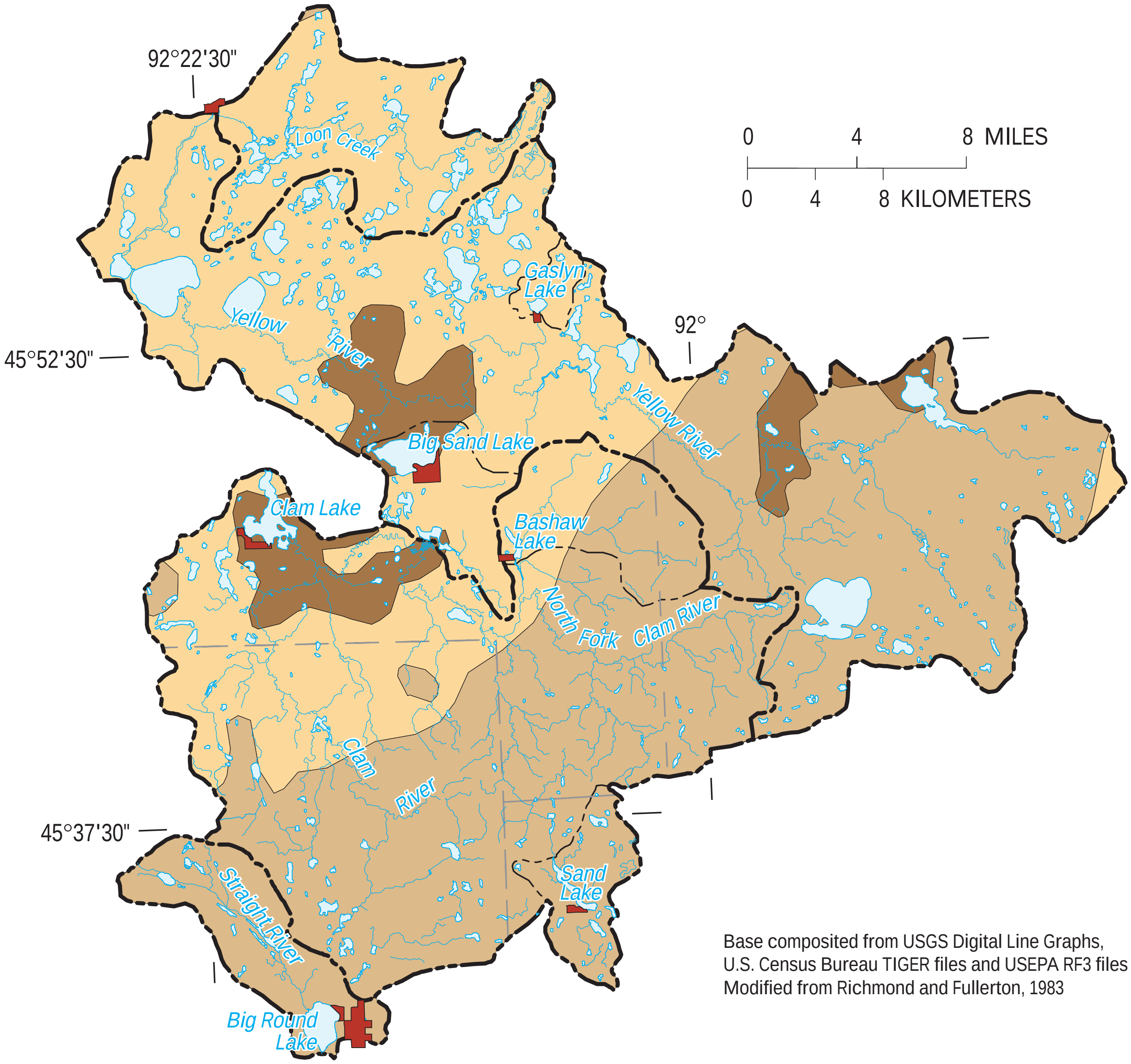


Figure 4. Bedrock geology in the study area.



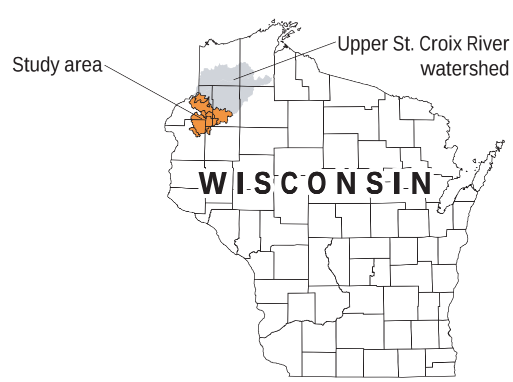


Figure 5. Surficial-deposit types in the study area.

also present in the study area and are generally found in areas of extensive wetlands. Sand and sand and gravel deposits are predominant in all of the watersheds; however, peat is prevalent around Clam and Big Sand Lakes.

Throughout the study area, the top 5 ft of the surficial deposits (referred to as “soils”) can be described as having moderately rapid permeability (water moves downward through the saturated soil at 2 to 6 in/hr) to rapid permeability (6 to 20 in/hr) and generally high (4 to 8 percent) to very high (more than 8 percent) organic-matter content (fig. 6, table 1). Permeability and organic-matter content are generally highest in the northern part of the study area and generally coincide with large areas of peat and wetland areas. The highest permeability and organic matter content are in the Yellow River and Loon Creek Watersheds.

Water use in the Upper St. Croix River Watershed (which includes the study area) is mainly for domestic, irrigation, and agricultural purposes (fig. 1, table 2). The primary source of water for domestic supplies is ground water from the sand and gravel aquifer. Several municipalities in or near the study area also get their water from the sand and gravel aquifer; however, a few municipalities in the southeastern part of the study area get their water from the Cambrian sandstone aquifer where the aquifer is relatively thick. The public-supply wells of the Tribe pump water from the sand and gravel aquifer.

Potential point sources of surface- and ground-water contamination for the study area summarized in this report include landfills and Toxic Release Inventory (TRI) sites as described by the USEPA (1999b). Some common types of TRI sites in the area are gas stations, auto repair shops, farmer cooperatives, schools, and commercial, industrial, and highway department sites. The Yellow River watershed has the most potential point-source sites (17 landfills and 29 TRI sites) in the study area (fig. 7). The landfill sites are evenly spread out over the Yellow River Watershed, but most of the TRI sites are to the east in the vicinity of Spooner, Wis. The Clam River Watershed has 8 landfills and 9 TRI sites. Most of the TRI sites are near Siren, Wis. The Loon Creek Watershed has one landfill and no TRI sites. The Big Round Lake Watershed has no landfills or TRI sites.

SURFACE-WATER STUDIES AND DATA

The surface-water studies and data described here focus on water and sediment chemistry and aquatic biology for the lakes and streams in the study area.

Previous Studies

A total of 41 surface-water studies or reports that include information relevant to the study area were identified (table 3). (Tables 3–10 are located at the back of the report.) Most of the surface-water studies (26 of 41) were regional or statewide summaries. Fifteen of these studies include lake information and 36 include stream information. Twenty-eight of the studies include water-quality data, and 16 include information describing aquatic biology. Most of the more detailed information for the study area is included in local or county-scale studies.

Of the studies described in table 3, several stand out as pertinent sources of information. In particular, county reports by the Wisconsin Conservation Department (WCD), now the the Wisconsin Department of Natural Resources (WDNR) provide useful and detailed information for the lakes and streams in the study area. These reports (Blackman and others, 1966; Sather and Busch, 1976; Sather and Threinen, 1961 and 1964) provide thorough descriptions of lake morphometry, streamflow, water quality, aquatic biology, and general watershed characteristics. They also describe surface-water problems for each county and provide insight into historical water-quality concerns in the study area.

Table 2. Water use, in million gallons per day, in the Upper St. Croix River Watershed, Wisconsin
[Water-use information from Ellefson and others, 1993 and 1997]

Year	Use category						Total	Percent from ground water
	Domestic	Agriculture	Irrigation	Industrial	Commercial	Public		
1990	1.81	3.33	1.14	0.14	0.23	0.32	6.97	73
1995	1.97	0.54	1.55	.25	.37	.27	4.95	99

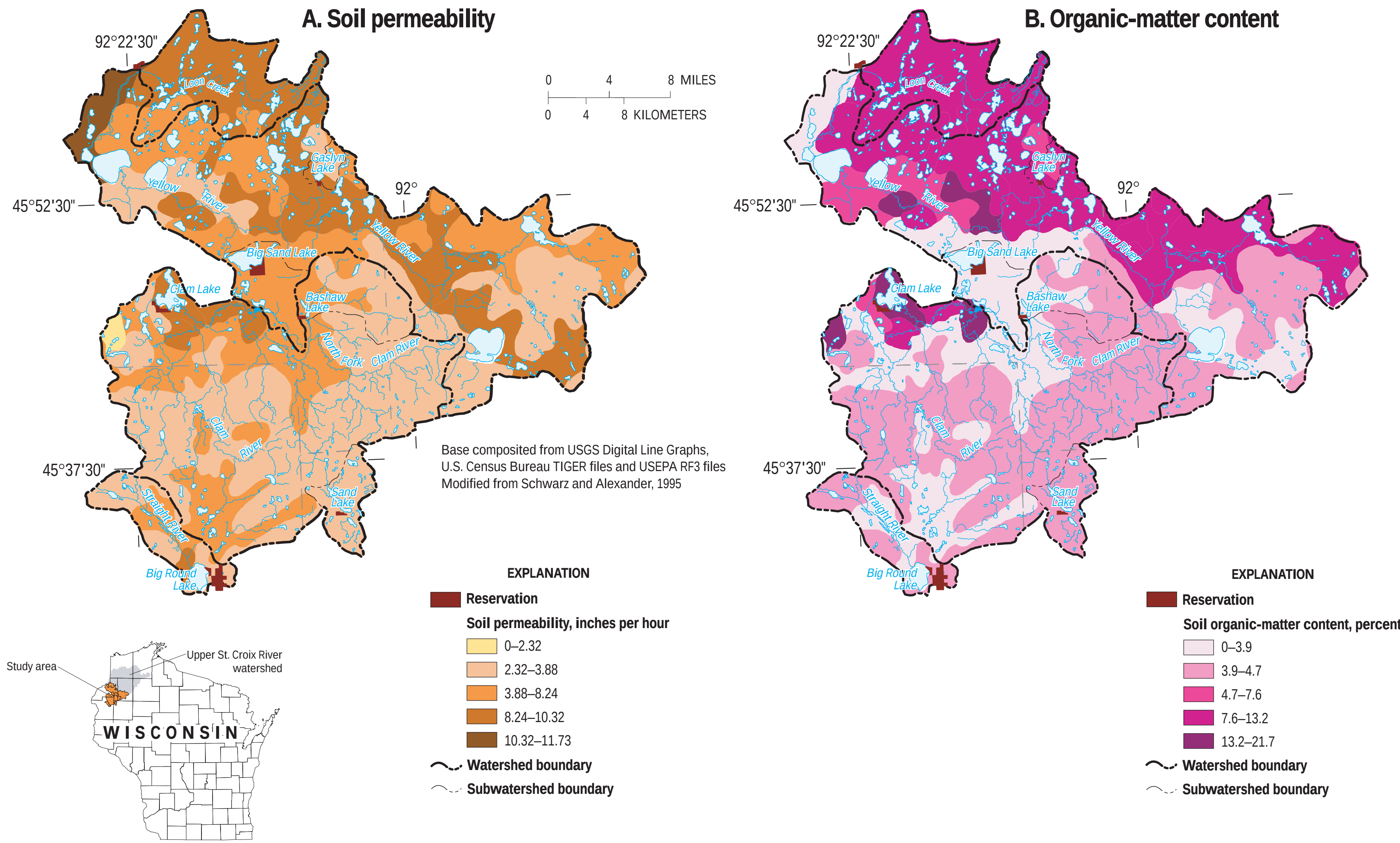


Figure 6. (A) Soil permeability and (B) Organic-matter content in the study area. (Gradations represent quantile distributions and are based on area-weighted averages.)

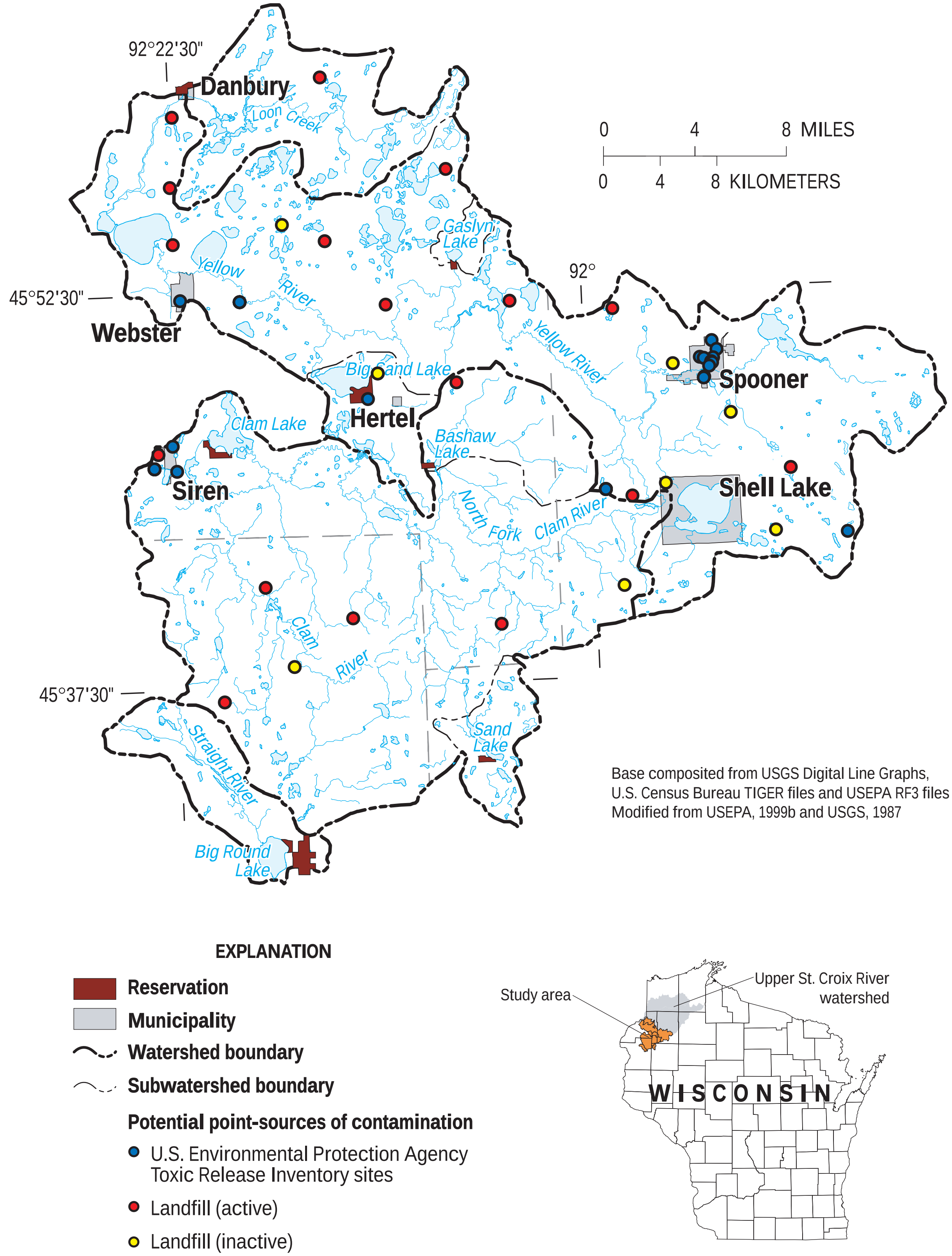


Figure 7. Potential point sources of contamination in the study area.

Available Data

Data were compiled from several data bases in an effort to provide a description of the water-quality and sediment data of lakes and streams in the study area. Only data that were available in digital form or that could be readily compiled are summarized here; however, references to more obscure sources are provided. Water-quality and sediment-quality data were obtained for 80 lakes and 23 streams in the study area (fig. 8) and are summarized in tables 4 and 5, respectively. Data for all of the lakes and 16 of the streams came primarily from the USEPA Storage and Retrieval (STORET) data base. Data for the remaining seven streams came from the U.S. Department of Energy's National Uranium Resources Evaluation (NURE) program data base. Lake data from STORET represent information collected by the USGS, WDNR, and the USEPA. All of the stream data from STORET were collected by the USGS.

Lake Data

Lake information summarized in table 4 represents that for 101 constituents from nearly 4,300 water and sediment analyses from samples collected between 1972 and 1998. The most commonly sampled constituents for lakes were those describing field conditions (temperature, dissolved oxygen, pH, and specific conductance), nutrient concentrations (phosphorus and nitrogen), hardness (alkalinity), and metals that accumulate in the deep part of lakes. For some constituents, these data provide a fairly complete spatial coverage of lake-water and sediment quality in the study area. However, for most measurements, such as transparency (Secchi depth), for which a total of 207 measurements were made, only a few lakes were represented. The temporal representation for almost all lakes was very limited. Only 19 of the 80 lakes were sampled more than once and only Shell Lake near Shell Lake, Wis. had more than 10 years of data. Because long-term data were not available for the lakes of interest, trend analyses for lake data were not done.

Surface-water sources are not used for drinking water in the study area, but drinking-water standards can nevertheless be used as reference points for understanding the quality of water in lakes and streams. Maximum Contaminant Levels (MCL's) and Secondary Maximum Contaminant Levels (SMCL's) have been developed by the USEPA for drinking water for some constituents (U.S. Environmental Protection Agency, 1999c). MCL's are human-health-based standards and SMCL's are for constituents that can affect the esthetic qualities of drinking water. None of the water-quality constituents from lake-water samples exceeded an MCL, and only four constituents exceeded an SMCL: aluminum, iron, manganese, and pH. Aluminum, iron, and manganese exceeded the SMCL's (50, 300, and 50 µg/L, respectively) in many lakes in the study area, including the lakes of interest to the Tribe. Measurements of pH exceeded the SMCL in only one sample from each of four lakes, including Big Round and Big Sand Lakes.

One of the most common ways of describing the water quality of lakes is based on their productivity, also known as trophic status (Lillie and others, 1993). Based on the trophic-status approach, lakes are classified into various categories based on numerical ranges of factors driving or describing their productivity. Such factors include nutrient content (total phosphorus concentration), algal content (surface chlorophyll *a* concentration), transparency (Secchi depth), and dissolved oxygen concentration near the bottom of deeper lakes measured during the summer.

Trophic-status levels have been defined with the following boundaries for total phosphorus, Secchi depth, and chlorophyll *a* (Lillie and others 1993):

Trophic status	Total phosphorus (mg/L)	Chlorophyll *a* (µg/L)	Secchi depth (feet)
Hypereutrophic			
----------	0.061	28.0	3.3
Eutrophic			
----------	0.017	7.4	6.6
Mesotrophic			
----------	0.005	2.0	13.1
Oligotrophic			

Oligotrophic lakes are typically clear, phosphorus concentrations and algal populations are low, and the deep water is likely to contain oxygen throughout the year. Mesotrophic lakes typically have a moderate supply of nutrients, produce moderate algal blooms, and have occasional oxygen depletions at depth. Eutrophic lakes are nutrient rich with relatively severe water-quality problems, such as frequent seasonal algal blooms, poor clarity, and oxygen depletion in lower parts of the lakes. When eutrophic conditions are severe, the lake is considered hypereutrophic.

In the lakes of the study area, average total phosphorus concentrations near the lake surface during the

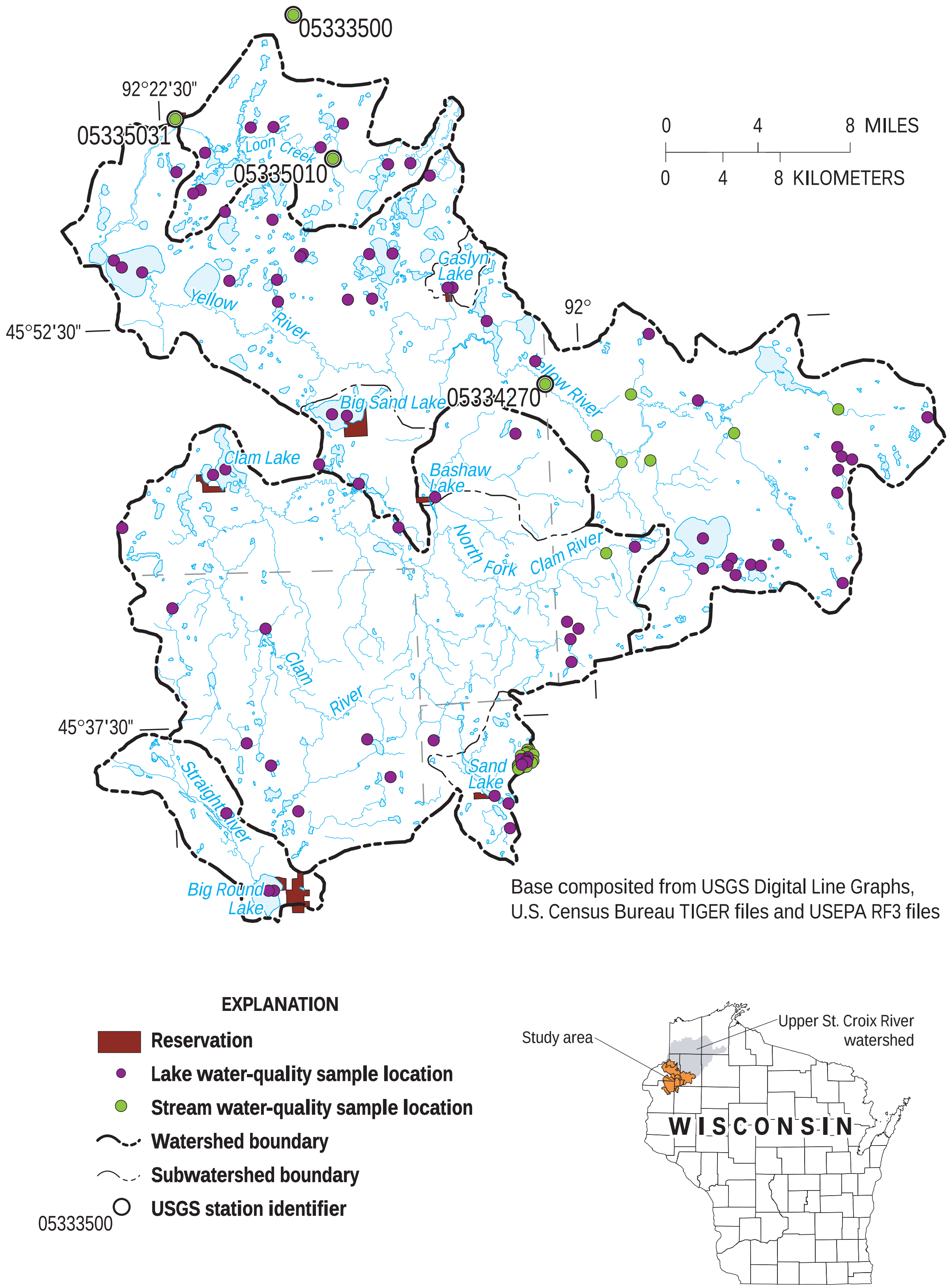


Figure 8. Water-quality sampling locations of streams and lakes in the study area.

summer months (June through August) ranged from 0.01 to 0.15 mg/L, with an average concentration of 0.029 mg/L (fig. 9a, table 6). This concentration would classify the “average” lake in the study area just into the eutrophic category. Average chlorophyll *a* concentrations during the summer months ranged from 1.7 to 32 µg/L, with an average concentration of 9.8 µg/L (fig. 9b). This concentration would also classify the average lake in the study area just into the eutrophic category. Secchi depths measured during summer (based on mean values for only nine lakes) ranged from 2.0 to 14.1 ft, with an average of 7.3 ft. This would classify the average lake into the mesotrophic category. More Secchi depth data are available in early WCD publications (Blackman and others 1966; Sather and Threinen, 1961 and 1964; Sather and Busch, 1976), but only those for the lakes of special interest (Bashaw and Gaslyn Lakes) were added to figure 9c. The individual trophic-status factors generally indicated similar trophic conditions for lakes where more than one factor was measured. The data also indicated that the study area is dominated by mesotrophic to eutrophic lakes. The distribution of various types of lakes, however, is disjointed with only a few clusters of specific types of lakes. A few generalities can be made: (1) the highest density of eutrophic lakes were in the Loon Creek and Clam River Watersheds, and (2) the highest density of mesotrophic lakes and the few oligotrophic lakes were in the headwaters of the Yellow River Watershed.

The hardness of the water of a lake (described by the alkalinity—the amount of available carbonates, bicarbonates, and hydroxides in the water) has been used as an indicator of the productivity of fish in lakes (Moyle, 1949). Lakes with alkalinity less than 20 mg/L are considered to have very soft water and have a low productivity of fish. Lakes with alkalinity from 20 to 40 mg/L are considered soft-water lakes and generally have low to medium fish productivity. Lakes with alkalinity from 40 to 80 mg/L are medium- to hard-water lakes and generally have medium to high fish productivity. Lakes with alkalinity greater than 80 mg/L are hard-water lakes and generally have high fish productivity.

On the basis of compiled alkalinity data and the detailed alkalinity maps produced by the WCD (Blackman and others, 1966; Sather and Threinen, 1961 and 1964; Sather and Busch, 1976), several generalities can be made about the hardness and fish productivity of lakes in the study area (figure 9d). Most of the drainage lakes (lakes with outflows) that intersect the main rivers in the basin have hard or moderately hard water. Most of the small seepage lakes (lakes without in-flowing and out-flowing streams) have soft to very soft water (Blackman and others, 1966; Sather and Threinen, 1961 and 1964; Sather and Busch, 1976). This distribution is not very well demonstrated by the subset of lakes shown in figure 9d. (For the lakes of primary interest without alkalinity data, data from the earlier WCD publications were added to figure 9d.) Most of the small, soft-water, seepage lakes had little additional data and are not shown in figure 9d. In general, the lakes with high total phosphorus and chlorophyll *a* concentrations and shallow Secchi depths had high alkalinities suggesting high fish productivity; however, several exceptions were found where lakes indicated to have low productivity on the basis of alkalinity actually had high nutrient and chlorophyll *a* concentrations.

Water from the lakes of primary interest to the Tribe (Bashaw, Big Round, Big Sand, Clam, Gaslyn, and Sand Lakes) were sampled several times for a wide range of constituents by the USGS between August 1984 and August 1986 (Krabbenhoft and Krohelski, 1992) and by either the WDNR or USEPA in subsequent years. Sediment samples from three of the lakes (Bashaw, Clam, and Gaslyn Lakes) also were collected by the USGS and analyzed for nutrient concentrations. These data are described later in this report for each lake individually.

Stream Data

Stream information summarized in table 5 represents that for 135 constituents and nearly 4,500 water and sediment analyses from samples collected at 23 sites between 1964 and 1999 (fig. 8). These data, however, do not represent the quality of water and sediment in streams throughout the entire study area. Most of the sampling locations were in the Clam River Watershed, specifically the Sand Lake Subwatershed. No stream data were available for the watersheds of Bashaw, Big Round, Big Sand, and Gaslyn Lakes, and very little stream data were available for most of the Clam and Yellow River Watersheds. Most of the stream data (78 percent of all analyses) summarized in table 5 were collected by the USGS from the St. Croix River at Danbury (USGS station 05333500) from 1964 through 1999. Most of the data collected are from after 1994 when this station started to be sampled as part of the USGS National Water-Quality Assessment (NAWQA) program (Stark and others, 1999). Another 14 percent of all analyses were collected by the USGS from the Yellow River at Danbury (USGS station 05335031) between 1975 and 1998. Data from 12 of the 23 streams summarized in table 5 represent information collected from 12 small inlets to Kirby Lake in the Sand Lake Subwatershed in Barron County. These data were collected as part of a study of Kirby Lake done by the USGS during 1995 and 1996 (Rose and Robertson, 1998) and include only total phosphorus information. Data from the remaining nine streams represent a small number of analyses on samples collected from the Yellow River Watershed (seven sites), Loon Creek Watershed (one site), and Clam River Watershed (one site). One sample from the St. Croix River near Danbury, collected in July 1995 as part of NAWQA, included measurements of 20 trace-metal constituents in water and 38 trace-metal constituents and 106 organic compounds in the bed-sediment material. These trace-metal and organic compound data were not included in table 5; however, a list of measured constituents is included in Stark and others (1999). Most of the trace-metal and organic-compound data indicated that concentrations were less than the detection limits of the analyses.

Other than the wide suite of constituents measured at the St. Croix River at Danbury, most of the water-quality data were collected to describe the alkalinity or hardness of the water and the nutrient concentrations in the water. The only constituent that has been sampled over all areas is alkalinity. On the basis of maps displaying the distribution of alkalinity produced by the WCD (Blackman and others, 1966; Sather and Threinen, 1961 and 1964; Sather and Busch, 1976), one generality can be made: alkalinity of most streams in the Clam River Watershed were in the hard-water range (greater than 90 mg/L), whereas alkalinities in most of the other study-area streams were in the medium- to hard-water range (40 to 90 mg/L). Total phosphorus concentrations in the few streams that were sampled were generally less than 0.1 mg/L, except in the tributaries to Kirby Lake, where concentrations were as high as 0.17 mg/L.

Three of the stream water-quality constituents listed in table 5 exceeded a drinking-water MCL: beryllium, lead, and fecal coliform. The MCL for beryllium (4.0 μg/L) was exceeded in one sample from the Yellow River near Spooner, Wis. (USGS station 05334270). The MCL for lead (15 μg/L) was exceeded several times in samples collected from the St. Croix River near Danbury. The MCL for fecal coliform is zero, yet fecal coliform bacteria were detected in many water samples from the St. Croix and Yellow Rivers near Danbury. The SMCL's for color and iron were exceeded several times in samples from the St. Croix and Yellow Rivers. Additionally, the SMCL for manganese was exceeded in one water sample from the St. Croix River near Danbury.

Sediment-quality samples were collected from seven stream locations in the study area as part of the NURE program. Six of the locations were in the headwaters of the Yellow River Watershed and one was near the headwaters of the Clam River Watershed. The constituents analyzed in stream-sediment samples were primarily trace metals.

Currently, no sediment-quality criteria exist for the protection of benthic organisms (Scudder and others, 1997). However, several sets of sediment contaminant screening values are available to assess potential adverse effects on benthic species (U.S. Environmental Protection Agency, 1997). One set of screening values for bulk sediment samples was developed by Ingersoll and others (1996). This set of guidelines includes two Sediment Effect Concentrations (SEC) called the Effect Range Low (ERL) and the Effect Range Median (ERM). The ERL is the concentration below which effects are rarely observed or predicted among sensitive life stages and (or) species of biota (Long and Morgan, 1990; Ingersoll and others, 1996). The ERM is the concentration above which effects are frequently or always observed among most species of biota. None of the constituents measured in sediment samples collected in the study area exceeded an ERM; however, three constituents exceeded an ERL. Chromium exceeded the ERL (41 mg/kg, dry weight) at all seven sample locations. The ERL's for copper and nickel (39 and 24 mg/kg, dry weight, respectively) were exceeded at two locations in the Yellow River Watershed.

Aquatic-Biology Data

The WDNR and other agencies have collected aquatic-biology data for much of Wisconsin, including the study area. However, because aquatic-biology information is in numerous data bases and in various file formats the data are not readily available and therefore not summarized in this report. Information describing aquatic-biology, associated metadata, and contacts, for data collected in Wisconsin, is currently being compiled by the WDNR (2000a). Some aquatic-biology information from miscellaneous printed sources is included in the descriptions of the sites of primary interest and also included in the references described in table 3.

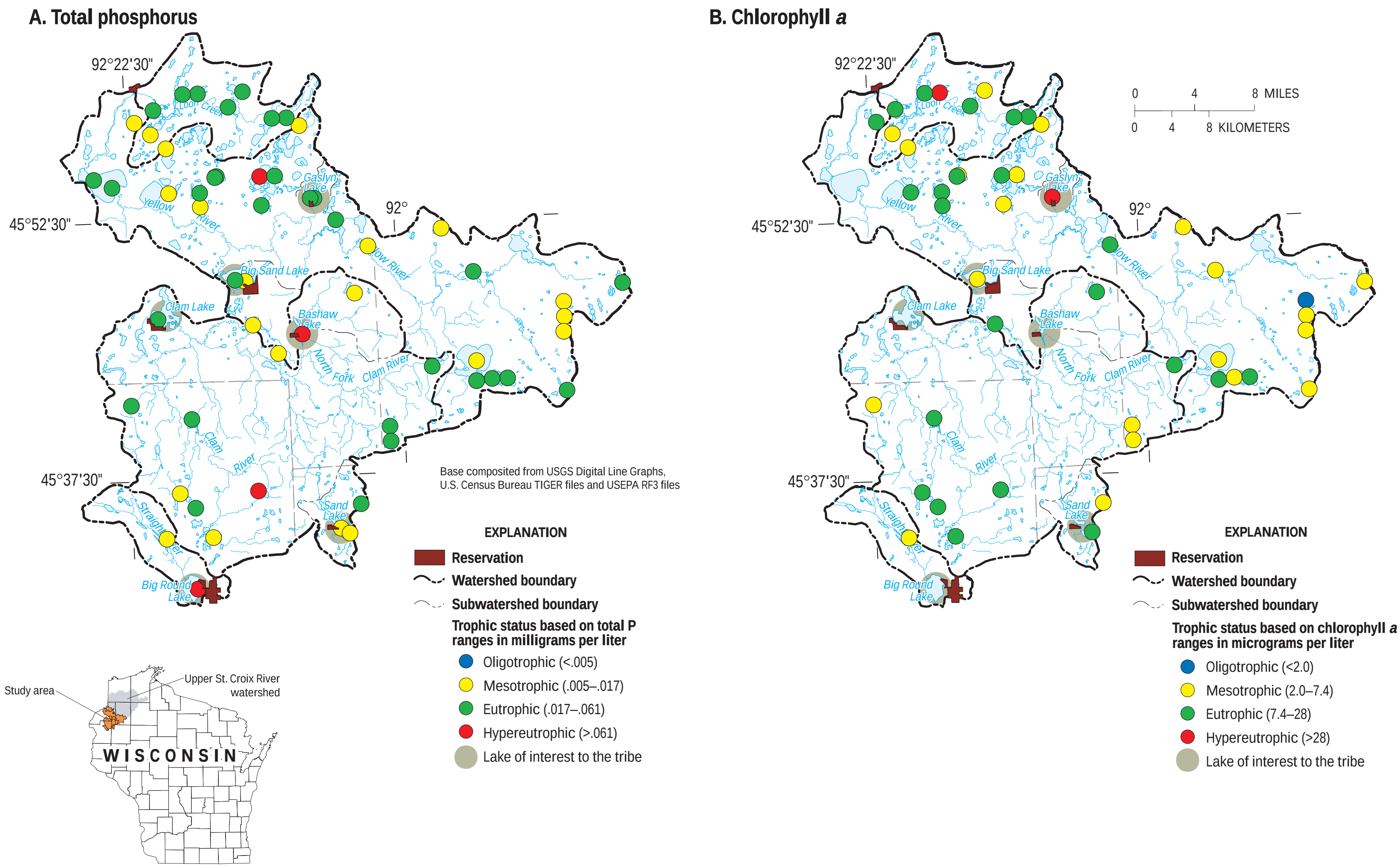


Figure 9. Trophic status of lakes in the study area based on (A) total phosphorus, (B) chlorophyll *a*, (C) Secchi depth averages for June, July, and August, and fish productivity based on (D) alkalinity. (Phosphorus and chlorophyll averages are based on samples collected within 3 feet of lake surface.)

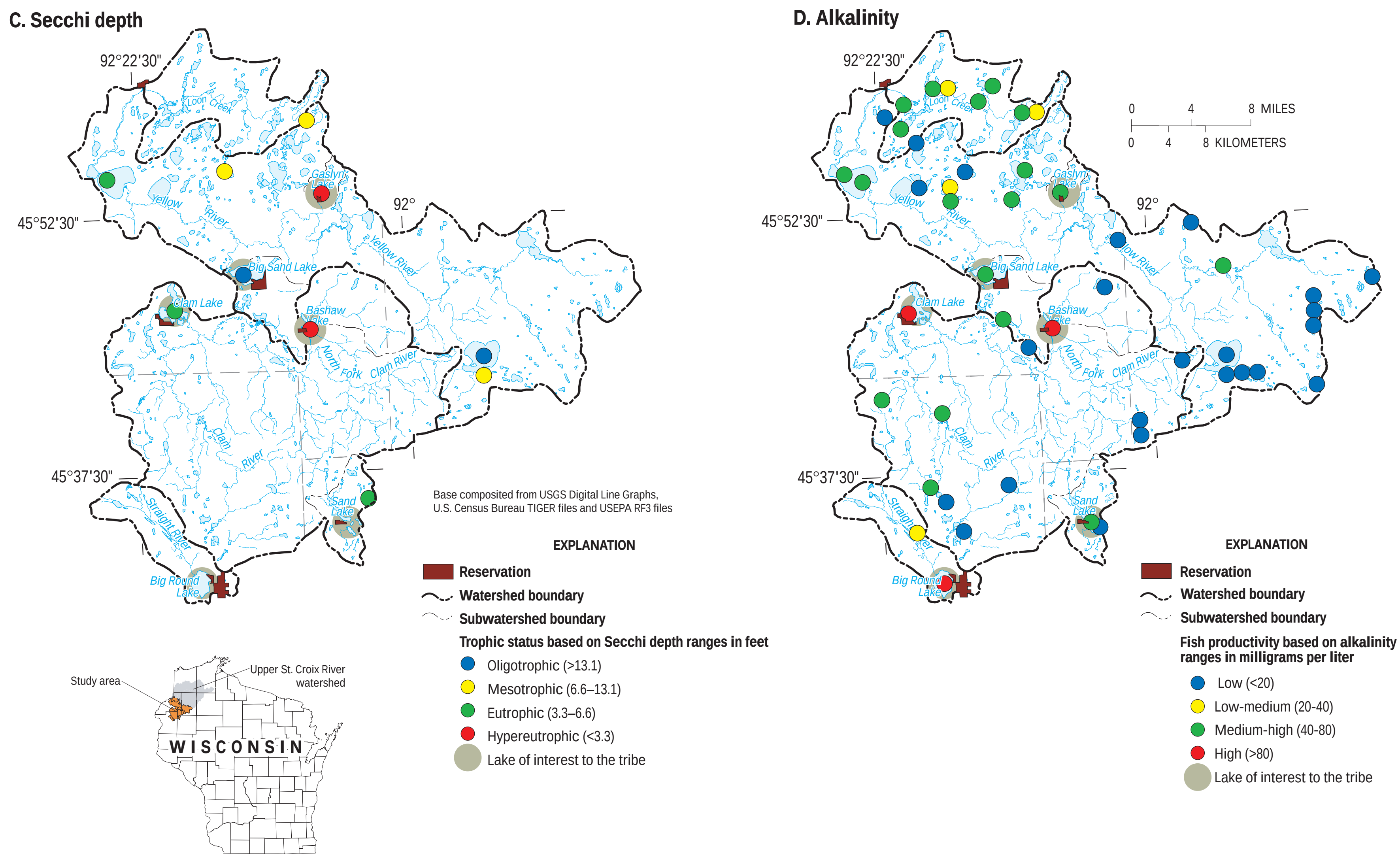


Figure 9. Trophic status of lakes in the study area based on (A) total phosphorus, (B) chlorophyll *a*, (C) Secchi depth averages for June, July, and August, and fish productivity based on (D) alkalinity.—Continued

Additionally, some relevant fish-consumption advisory information is described below.

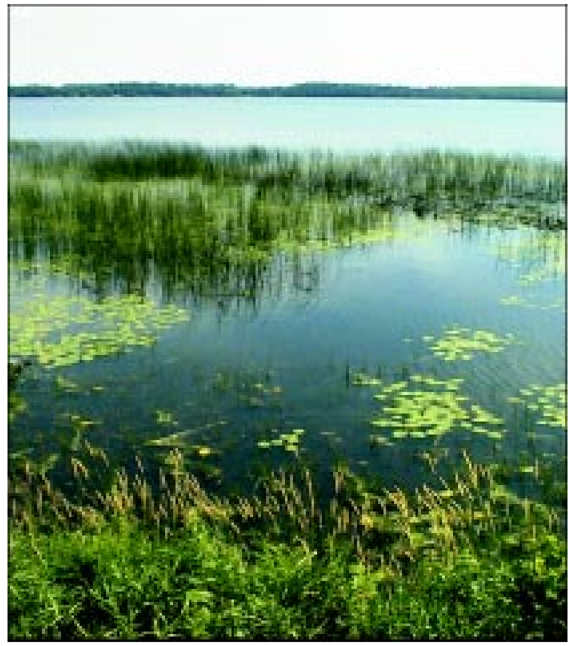
Consumption advisories concerning mercury levels in fish have been published by the WDNR (1995). The advisory information includes several of the lakes of interest to the Tribe. Additional mercury information for walleyes in lakes harvested by the Tribe has been summarized by the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) and was found on the World Wide Web at URL http://www.glifwc.org/.

Description of Selected Lakes and Streams and Their Watersheds

In this section, we provide a brief description of the physical, chemical, and biological characteristics of the primary lakes and streams; environmental characteristics; and potential point sources of contamination in the watersheds. Most of the water-quality data available for each site are summarized in tables 7 and 8. Lakes and streams are described in order from south to north.

Big Round Lake

Big Round Lake is a drainage lake in Polk County in Township (T.) 35 N., Range (R.) 16 W., section (sec.) 13. The lake has a surface area of 1,015 acres and a shoreline length of 5.35 mi. Maximum depth of the lake is 17 ft and mean depth is 10 ft (Wisconsin Department of Natural Resources, 1995). Big Round Lake has a total watershed area of 29.5 mi^2, with a direct drainage of 4.1 mi^2. The watershed, drained primarily by the Straight River, is largely forested (46.4 percent); about 8 percent of the watershed is agricultural. All surficial deposits in the watershed are classified as sand and have an average soil permeability of 5.0 in/hr. No potential point sources of contamination were identified in the watershed. The Straight River is the inlet and outlet of the lake. Information for Big Round Lake, summarized in table 7, represents data from several water samples and physical measurements made by the USGS and the USEPA from 1984 to 1986. Surface-water-quality data were available for only one other lake (Dahl Lake) and no streams in the Big Round Lake Watershed.



Big Round Lake

Big Round Lake is a hypereutrophic, hard-water lake. Average total phosphorus concentration was 0.13 mg/L, and average hardness was 87 mg/L (table 7). The lake has one of the highest phosphorus concentrations in the study area. Average specific conductance of the lake was about 219 µS/cm, and average pH was 9.0. The lake only weakly stratifies in the summer, but dissolved oxygen can be depleted in the deepest areas of the lake. One or more fish species were tested for mercury levels, and no consumption advisory was posted (Wisconsin Department of Natural Resources, 1995).

In 1961, fish present in the lake included northern pike, walleye, largemouth bass, bluegill, black crappie, perch, pumpkinseed, and bullhead (Sather and Threinen, 1961). Nesting waterfowl included mallard, blue-wing teal, green-wing teal, and ring-neck duck. Extensive use was made of the lake by migratory waterfowl. Ranging in importance from most to least were coot, diving ducks (redhead and canvasback), puddle ducks, Canada goose, and whistling swan.

Sand Lake

Sand Lake is a drainage lake in Barron County (T. 36 N., R. 14 W., sec. 21) in the Clam River Watershed. The lake has a surface area of 322 acres, a length of 2.35 mi, a maximum width of 0.31 mi, and shoreline length of 5.96 miles. The maximum depth of the lake is 57 ft and mean depth is 28 ft (Wisconsin Department of Natural Resources, 1995). The lake has a 5-ft control structure maintaining the lake level. Sand Lake has a total subwatershed area of 16.3 mi^2, with a direct drainage of 3.1 mi^2. Only two small tributaries enter the lake from Kidney and Little Sand Lakes. Sand Creek is the outlet of the lake. The subwatershed is heavily forested (55.8 percent); about 7 percent is agricultural. All surficial deposits in the subwatershed are classified as sand and have an average soil permeability of 3.1 in/hr. No potential point sources of contamination were identified in its subwatershed. Information for Sand Lake, summarized in table 7, mainly represents two samples collected by the USGS in 1984 and 1985. The single alkalinity value was collected by the WCD in the 1960's (Sather and Threinen, 1964). Surface-water-quality data were also available for Cranberry, Kidney, and Kirby Lakes in the Sand Lake Subwatershed, as well as the 12 inlets to Kirby Lake.

Sand Lake

Sand Lake is a clear, moderately hard-water lake, with an alkalinity of 75 mg/L (table 7). Only two total phosphorus concentrations were available for the lake: one during August 1984, which was less than the detection limit of the analysis of 0.01 mg/L, and the other during September 1985, which was 0.04 mg/L. These concentrations would classify the lake as oligotrophic during 1984 and eutrophic during 1985. Average specific conductance of the lake was 188 μS/cm, and average pH was 8.7. The lake strongly stratifies during summer, with a late summer thermocline depth of about 28 feet and bottom temperature near 6^{o}C. Dissolved oxygen concentrations were lowest just below the thermocline, where they reached about 2 mg/L. (Concentrations were about 4 mg/L near the bottom of the lake.)

In 1964, Sand Lake's fish population consisted of northern pike, walleye, largemouth bass, perch, bluegill, black crappie, smallmouth bass, and bullhead (Sather and Threinen, 1964). The lakeshore vegetation was mainly upland hardwoods, with a few scattered white pine. A 27-acre marshy wetland adjoining the lake provided habitat for muskrat, nesting puddle ducks, merganser, coot, and loon. A few Canada geese also used the lake during migratory season.

Bashaw Lake

Bashaw Lake is a drainage lake in Burnett County (T. 38 N., R. 14 W. sec. 17, 18, and 19) in the Clam River Watershed. The lake has a surface area of 171 acres, a length of 1.31 mi, a maximum width of 0.43 mi, and a shoreline length of 3.25 mi. The maximum depth of the lake is 16 ft and mean depth is 7 ft (Wisconsin Department of Natural Resources, 1995). Bashaw Lake has a total subwatershed area of 29.2 mi^2, with a direct drainage of 2.4 mi^2. Most of the subwatershed drains into the lake through Bashaw Brook. Water leaves the lake through Bashaw Outlet. The Bashaw Lake Subwatershed consists primarily of a combination of forest (36.4 percent), grassland (34.1 percent), agriculture (18.9 percent), and wetland (7.8 percent). The Bashaw Lake Subwatershed contains the highest percentage of agricultural land use compared to the other watersheds or subwatersheds of interest. The surficial deposits in the subwatershed are classified as a combination of sand and sand and gravel deposits, and have an average soil permeability of 5.0 in/hr. One potential point source of contamination (an active landfill) was identified in the subwatershed. The information summarized in table 7 mainly represents three water samples collected by the USGS between 1984 and 1986. The Secchi depth and alkalinity data were collected by the WCD in the 1960's (Blackman and others, 1966). Additional surface-water-quality data were available for only one other lake (Poquettes Lake) and no streams in the Bashaw Lake Subwatershed.

Bashaw Lake

Bashaw Lake is a turbid, hypereutrophic, hard-water lake. Average total phosphorus concentration was 0.09 mg/L, and alkalinity was 84 mg/L (table 7). The lake had one of the highest total phosphorus concentrations in the study area. The only Secchi depth measured in the lake was 3 ft, measured in July 1964 (Blackman and others, 1966). Average specific conductance of the lake was 205 μS/cm, and average pH was 7.9. The lake stratified only weakly during the summer it was examined and had relatively high dissolved-oxygen concentrations from the surface to the bottom of the lake.

In 1964, the fish population in the lake was composed mostly of northern pike, largemouth bass, bluegill, and black crappie (Blackman and others, 1966). Pumpkinseed, bullhead, and white sucker were also present. Lakeshore vegetation was mainly upland hardwoods with a few scattered pines and small areas of tamarack and tag alder swamp. A margin of dense aquatic vegetation surrounded the entire lakeshore, the main species being wild rice, cattail, pondweed species, coontail, and water milfoil. All but 20 percent of the littoral region of the lake had a sand bottom. The extensive beds of wild rice and cattails along with approximately 57 acres of adjoining wetlands offered excellent habitat for nesting mallard, blue-winged teal, ring-necked ducks, wood duck, and occasionally hooded merganser. The lake also received moderate use by migratory ducks, puddle ducks, and coot. Muskrat presence was significant.

Clam Lake

Clam Lake, also referred to as Upper Clam Lake, is a drainage lake in Burnett County (T. 38 N., R. 16 W., sec. 2, 3, 10, and 11) in the Clam River Watershed near where the river leaves the study area. The lake has a surface area of 1,207 acres, a length of 2.62 mi, a maximum width of 1.81 mi, and a shoreline length of 12.3 mi. The maximum depth of the lake is 11 ft and mean depth is 5 ft (Wisconsin Department of Natural Resources, 1995). A water-control structure on Lower Clam Lake, immediately downstream of Clam Lake, maintains the lake level. Clam Lake has a total watershed area of 298 mi^2, with a direct drainage of 7.3 mi^2. Most of the watershed drains into the lake through the Clam River. The watershed of the lake is primarily forested (51.6 percent); about 8 percent is agricultural. The dominant surficial deposits in the watershed are classified as a combination of sand (63 percent) and sand and gravel (30 percent) deposits; the remaining 7 percent of the area is peat deposits. Average soil permeability is 5.0 in/hr. Several potential point sources of contamination were identified in the watershed: industry, the high school, and the highway department, and several active and inactive landfills throughout the watershed. The information summarized in table 7 represents three water samples and four physical measurements collected by the USGS between 1984 and 1986. Surface-water-quality data were compiled for approximately 25 other lakes in the Clam River Watershed (including Bashaw and Sand Lake Subwatersheds) and 13 streams. Of the 13 streams, 12 represent the Kirby Lake inlets; the other stream sample was collected near the headwaters of the Clam River as part of the NURE program.

Clam Lake

Clam Lake is a turbid, eutrophic to hypereutrophic, hard-water lake, with a hardness of 99 mg/L (table 7). Total phosphorus concentrations ranged from 0.02 to 0.1 mg/L, averaging 0.05 mg/L. Average summer Secchi depth was 4.3 ft. The average specific conductance of the lake was about 214 µS/cm and average pH was 8.2. The lake weakly stratified during the summer it was examined and had relatively high dissolved oxygen concentrations from the surface to the bottom of the lake.

In 1965, the most common fish species were northern pike, walleye, largemouth bass, bluegill, perch, black crappie, and pumpkinseed (Blackman and others, 1966). Bullhead, white sucker, bowfin, rock sturgeon, and forage minnows were also present. The 370 acres of adjoining wetlands and extensive beds of wild rice provided habitat for muskrat, nesting puddle ducks, and ring-necked duck. Diving ducks and coot, sometimes as many as 10,000 of each, used the lake during the fall migrations. There was also heavy use by migrant puddle ducks and goose.

Big Sand Lake

Big Sand Lake is seepage lake in Burnett County (T. 38 and 39 N., R. 15 W., several sections) in the Yellow River Watershed. The lake has a surface area of 1,400 acres, a length of 2.75 mi, a maximum width of 1.35 mi, and a shoreline length of 7.6 mi. Maximum depth of the lake is 55 ft, although the mean depth is only 9 ft (Wisconsin Department of Natural Resources, 1995). Big Sand Lake has a total subwatershed area of 20.7 mi^2, with a direct drainage area of 4.7 mi^2. Water leaves the lake through Sand Creek, which then flows into the Yellow River. The Big Sand Lake Subwatershed consists primarily of forested areas (53.7 percent); agriculture and urban areas are only a small percent of the land use in the subwatershed. However, the urban area around the Tribal Center (fig. 1) and the nearby community of Hertel is growing (Aaron Colson, St. Croix Tribe, written commun., May 2000). The surficial deposits in the subwatershed are classified largely as sand and gravel (78 percent); however, much of the area immediately around the lake has peat deposits. Average soil permeability in the subwatershed is 8.3 in/hr. Potential point sources of contamination identified in the subwatershed include the St. Croix Tribal center and one inactive landfill (fig. 7). The information for Big Sand Lake, summarized in table 7, represents several water samples collected by the USGS and WDNR between 1979 and 1985. The single Secchi depth value was collected by the WCD in the 1960's (Blackman and others, 1966). Surface-water-quality data were available for two other lakes (Bass and Pokegama Lakes) but for no streams in the subwatershed.

Big Sand Lake

Big Sand Lake is a clear, mesotrophic to eutrophic, medium- to hard-water lake. Average total phosphorus concentration was 0.02 mg/L, and average alkalinity was 42 mg/L (table 7). The only Secchi depth measured in the lake was 14 ft, measured in May 1965 (Blackman and others, 1966). Average specific conductance of the lake was about 111 µS/cm, and average pH was 8.5. Measurements indicated that the lake was only weakly stratified during summer and that dissolved oxygen concentrations were relatively high down to a depth of 10 ft; however, the lake has areas much deeper than that, and such areas may stratify and have low concentrations of dissolved oxygen. One or more fish species were tested for mercury levels and no consumption advisory was posted (Wisconsin Department of Natural Resources, 1995).

In 1965, the main fish species present were northern pike, walleye, largemouth bass, bluegill, black crappie, and pumpkinseed (Blackman and others, 1966). Muskellunge, smallmouth bass, rock bass, bullhead, perch, white sucker, and bowfin were also present. Migratory waterfowl use was very high with large concentrations of puddle ducks, diving ducks, coot and goose at times. Big Sand Lake was also used by nesting mallard, blue-winged teal, ring-necked ducks, wood duck, and loon.

Gaslyn Lake

Gaslyn Lake is a drainage lake in Burnett County (T. 39 and 40 N., R. 14 W., sec. 4, 5, 32, and 33) in the Yellow River Watershed. The lake has a surface area of 164 acres, a length of 0.78 mi, a maximum width of 0.58 mi, and a shoreline length of 2.24 mi. Maximum depth of the lake is 12 ft and mean depth is 6 ft (Wisconsin Department of Natural Resources, 1995). Gaslyn Lake has a total subwatershed area of 4.8 mi^2, with a direct drainage area of 3.5 mi^2. Most of the subwatershed drains directly into the lake; however, there is a small inlet stream in the northwest corner of the lake. Water leaves the lake through a small outlet on the south end of the lake that then flows into the Yellow River. The Gaslyn Lake Subwatershed consists largely of forested areas (47.4 percent); almost no agriculture or urban areas are in the subwatershed. All surficial deposits in the subwatershed are classified as sand and gravel, with an average soil permeability of 6.6 in/hr. No potential point sources of contamination were identified in the subwatershed. The information for Gaslyn Lake, summarized in table 7, represents several samples collected by the USGS and WDNR between 1979 and 1986. The single value for Secchi depth was collected by the WDNR in the 1960's (Blackman and others, 1966). No other surface-water-quality data were compiled for this subwatershed.

Gaslyn Lake

Gaslyn Lake is a turbid, eutrophic, medium- to hard-water lake. Average total phosphorus concentration was 0.03 mg/L, and alkalinity was 75 mg/L (table 7). The only Secchi depth measured in the lake was 2 ft, measured in August 1965 (Blackman and others, 1966). Average specific conductance of the lake was about 157 µS/cm, and average pH was 7.1. The lake stratifies weakly in the summer, but dissolved oxygen can be depleted in the deepest areas of the lake. Occasionally, dissolved oxygen concentrations become very low in the winter and result in fishkills.

In 1964, the primary fish species present were northern pike, largemouth bass, perch, bluegill, pumkinseed, bullhead, white sucker, and forage minnows (Blackman and others, 1966). Sixty percent of the surrounding lakeshore was tamarack, tag alder, and fresh meadow wetlands, which were used by muskrat, nesting puddle ducks, ring-necked ducks, and loon. The littoral zone had extensive wild rice beds which were used by large numbers of migratory diving ducks, puddle ducks, and coot.

Yellow River

The Yellow River (fig. 1) originates in Washburn County, then flows across Burnett County before emptying into the St. Croix River at Danbury (T. 39 N., R. 14 W., sec. 25 to T. 40 N., R. 16 W., sec. 31). The river has a total length of 38 mi, an average width of 60 ft, and average depth of 1.5 ft (Blackman and others, 1966). The river has an average gradient of 5 ft/mi. The total drainage area of the Yellow River at Danbury is 323 mi^2 and includes the subwatersheds of Big Sand and Gaslyn Lakes. The watershed of the river consists of forested areas (51.5 percent), grassland (16.8 percent), and wetlands (14.1 percent). Agricultural areas represent 5.6 percent of the watershed. The largest urban area in the basin is Spooner, Wis. The surficial deposits in the watershed are classified as a mix of sand and gravel (49 percent), sand (41 percent), and peat (10 percent) deposits. Most of the peat deposits are around Big Sand Lake. The average soil permeability of the basin is 7.2 in/hr. Several potential point sources of contamination were identified in the watershed: various types near Spooner and Webster, a commercial source just west of Webster, and many active and inactive landfills throughout the watershed.

Most of the water-quality data for the Yellow River, summarized in table 8, were collected by the USGS at station 05335031 (fig. 8) near Danbury, Wis. from October 1975 through September 1998. One additional location on the Yellow River (USGS station 05334270 near Spooner, Wis., fig. 8) was sampled by the USGS once during 1986. Surface-water samples, not summarized in table 8, were also collected at six locations in the headwaters of the Yellow River in September 1977 as part of the NURE program. These samples were analyzed mainly for trace metals. Additionally, water-quality data were compiled for approximately 40 lakes in the watershed.

Yellow River

The Yellow River is generally a clear, medium- to hard-water river. Alkalinity and specific conductance of the river appear to decrease as the water moves downstream. Hardness of the river measured during the single sampling at Spooner was 97 mg/L, and specific conductance was 200 μS/cm; at Danbury, average alkalinity was 76 mg/L and average specific conductance was 157 μS/cm (table 8). Average pH of the Yellow River was about 8. Average total phosphorus concentration at Danbury was 0.06 mg/L, of which about half was in dissolved forms. Average total nitrogen concentration was 0.76 mg/L, of which 70 percent was in organic forms. Suspended sediment concentrations in the river were very low, averaging 4.2 mg/L.

In 1965, the fish population was made up of a variety of species with northern pike, largemouth bass, bluegill, pumpkinseed, white sucker, redhorse, and common shiner being the most common (Blackman and others, 1966). Muskellunge, walleye, perch, smallmouth bass, black crappie, rock bass, bullhead, hog sucker, carp, and numerous minnows and darters also were present. There are several feeder streams on the river; however, Black Creek and Spring Creek were the only ones that contained trout. Muskrat were common along with nesting mallard, black duck, blue-winged teal, wood duck, and hooded merganser. Large numbers of puddle ducks along with diving ducks, coot, and goose also used the river during migration periods.

Loon Creek

Loon Creek is in Burnett County (T. 40 N., R. 15 W. , sec. 2 to T. 41 N., R. 16 W., sec. 27) and originates as the intermittent outlet of Loon Lake. As it flows toward its outlet into the Yellow River, it passes through Eagle, Briggs, Loon, Gull, Falk, and Minerva Lakes. Loon Creek enters into the Yellow River just upstream from where the Yellow River enters the St. Croix River at Danbury. Loon Creek has a total length of 10 mi, an average width of 27 ft, and an average depth of 1.5 ft (Blackman and others, 1966). Average gradient is 19 ft/mi. The total drainage area of Loon Creek is 56 mi^2. The watershed of the river consists primarily of forested areas (67.7 percent) and wetlands (10.6 percent). Almost no agricultural or urban areas are present in the watershed. The surficial deposits in the watershed are mostly sand and gravel deposits and the average soil permeability is 9.7 in/hr. Only one potential point source of contamination, an active landfill, was identified in the watershed.

Loon Creek

Loon Creek is generally a clear, warm, medium- to hard-water river. Only one water-quality sample, collected by the USGS (station 05335010, fig. 8) in October 1970, was analyzed (results are summarized in table 8). Alkalinity of the river was 60 mg/L, and specific conductance was 130 µS/cm. The pH of Loon Creek was 7.2, and the total phosphorus concentration was 0.02 mg/L. No suspended sediment data were available. Additional water-quality data were compiled for nine lakes in the watershed.

In 1965, a wide variety of fish were present, the most common being perch, bluegill, rock bass, white sucker, common shiner, creek chub, and longnose dace (Blackman and others, 1966). Northern pike, walleye, largemouth bass, smallmouth bass, bullhead, redhorse, hog sucker, mudminnow, and johnny darter also were present. Muskrat and beaver were common and the 504 acres of adjoining wetlands were used by nesting mallard, blue-winged teal, wood duck, and merganser. Numerous migrating puddle ducks also used the creek.

St. Croix River

The St. Croix River (fig. 1) originates in Upper St. Croix Lake in Douglas County and Upper Eau Claire Lake in Bayfield County, then flows south until it reaches the Mississippi River. Before reaching Danbury, the river flows through St. Croix Flowage and merges with the Namekagon and Totagatic Rivers (both originating in Douglas County). The average discharge of the river from 1914 through 1998 was 1,320 ft^3/s (Holmstrom and others, 1998). Streamflow is measured by the USGS at Danbury (station 05333500, fig. 8), and daily data are available from 1914 to the present. The total drainage area of the St. Croix River at Danbury is 1,580 mi^2. The watershed of the river primarily consists of forested areas (64 percent) and wetlands (17 percent). Only 0.8 percent of the basin is agricultural and 0.1 percent is urban (several small towns). The surficial deposits in the watershed are mostly sand (43 percent) and sand and gravel (54 percent) deposits. All the rivers draining the study area eventually flow into the St. Croix River.

All the information for the St. Croix River, summarized in table 8, represent data collected by the USGS at station 05333500 from 1964 to 1999. The river has been extensively sampled from June 1995 to the present by the NAWQA program (Stark and others, 1999). This program maintains continual discharge measurements and samples the river approximately monthly plus during about five high-flow events each year. Each water sample is analyzed for a wide suite of constituents, which are listed in Stark and others (1999).

St. Croix River

The St. Croix River at Danbury is a light-brown color, medium- to hard-water river. Average alkalinity of the St. Croix River at Danbury was 54 mg/L, and average specific conductance was 124 µS/cm (table 8). Average pH of the river was about 7.5. Average total phosphorus concentration at Danbury was 0.02 mg/L, of which more than 60 percent was in dissolved forms. Average total nitrogen concentration was 0.52 mg/L, of which about 70 percent was in organic forms. Suspended sediment concentrations in the river were quite low, averaging 10 mg/L.

In 1965, the Burnett County portion of the river was managed for smallmouth bass, muskellunge, channel catfish, and rock or lake sturgeon (Blackman and others, 1966). The most abundant fish were redhorse. Midway in the scale of comparative abundance were smallmouth bass, channel catfish, muskellunge, walleye, rock sturgeon, northern pike, bullhead, yellow perch, bluegill, hog sucker, and white sucker. Least in numbers were largemouth bass, rock bass, black crappie, blue sucker, quillback, carp, bowfin, and burbot. There was also a wide variety of minnows and darters, which included the bluntnose minnow, common shiner, golden shiner, creek chub, spotfin darter, and gilt darter.

In 1996, fish-community sampling was done on the St. Croix River near Danbury as part of the NAWQA program. Twenty-eight species of fish were identified during this effort (Goldstein and others, 1999). The only abundant species (greater than 20 percent of the number of fish collected) identified was the common shiner. Common species (5 to 20 percent of the number of fish collected) identified include northern hogsucker, golden redhorse, shorthead redhorse, horny head chub, smallmouth bass, and gilt darter. Rare species (less than 5 percent of the number of fish collected) included chestnut lamprey, southern brook lamprey, white sucker, silver redhorse, river redhorse, largescale stoneroller, bigmouth shiner, spotfin shiner, sand shiner, bluntnose minnow, longnose dace, stonecat, central mudminnow, northern pike, burbot, rock bass, bluegill, yellow perch, logperch, blackside darter, and walleye.

In 1965, the river was an overwintering area for a variety of waterfowl and provided habitat for muskrat, beaver, nesting mallard, black duck, blue-winged teal, wood duck, and merganser (Blackman and others, 1966). Migratory puddle ducks, diving ducks, coot, and Canada goose also used the river and its large areas of adjoining wetlands.

GROUND-WATER STUDIES AND DATA

The ground-water studies examined for this report included any investigation that contained descriptions of the physical or chemical characteristics of ground water or characteristics of aquifers in the study area.

Previous Studies

A total of 41 ground-water studies or reports that include information relevant to the study area were identified (table 9). Most of the ground-water studies (27 of 41) were regional or statewide summaries. Thirty-three of the studies include water-quality information, 9 include information regarding water use, and 23 provide descriptions of geology and aquifer characteristics relevant to the study area.

Many of the reports described in table 9 may provide useful information to the Tribe regarding groundwater resources for the Reservation and vicinity. In general, the county-scale studies by the Wisconsin Geological and Natural History Survey (Bridson, 1997a and 1997b; Zaporozec, 1987) provide the most detailed description of geology, aquifer characteristics, water quality, and potential sources of contamination in the study area. The report by Horsley and Witten, Inc. (1999) provides a comprehensive summary of the water quality of the public-supply wells of the Reservation. Additionally, the report by Young and Hindall (1973) provides a thorough description of the physical setting, hydrogeology, and ground-water/surface-water relation in the study area.

Available Data

Ground-water data were compiled from several data bases in an effort to provide a description of the quality of the resources in the study area. Data were obtained from the WDNR Groundwater Retrieval Network (GRN) data base, the USEPA STORET data base, the NURE data base, and a data base maintained by the Wisconsin Department of Agriculture, Trade, and Consumer Protection (DATCP). Water-quality information for 773 wells was compiled (fig. 10). Most of the wells (674 of 773) were from the GRN data base, 54 wells were from the STORET data base, 31 wells were unique to the DATCP data base, and 14 wells were from the NURE data base. All the wells from the STORET data base were sampled by the USGS. Most of the sampled wells (731 of 773) were used for drinking water, and most of the drinking-water wells (628 of 731) represent domestic supplies. A summary of water-quality characteristics measured in samples from drinking-water wells is given in table 10.

Ground-water information, summarized in table 10, represents 270 water-quality characteristics and more than 10,300 analyses from samples collected from drinking-water wells between 1911 and 1999 and obtained from the data bases described previously; however, most of the ground-water quality data were collected after about 1990. The characteristics summarized in table 10 include major ions, nutrients, organics, radionuclides, trace metals, microbes, and field measurements. The distribution of drinking-water wells with water-quality data covers much of the study area (figure 10); however, many of the characteristics listed in table 10 were collected from only a few wells and probably do not provide a representative description for the entire study area. Also, the number of measurements for each characteristics may include more than one measurement collected at a single well.

For some of the water-quality characteristics listed in table 10, MCL’s or SMCL’s have been established (U.S. Environmental Protection Agency, 1999c). Six of the constituents listed in table 10 equaled or exceeded an MCL in at least one sample: copper, lead, nitrate, tetrachloroethylene, 1,2-dichloroethane, and 1,1-dichloroethylene. Copper and lead can enter water supplies from

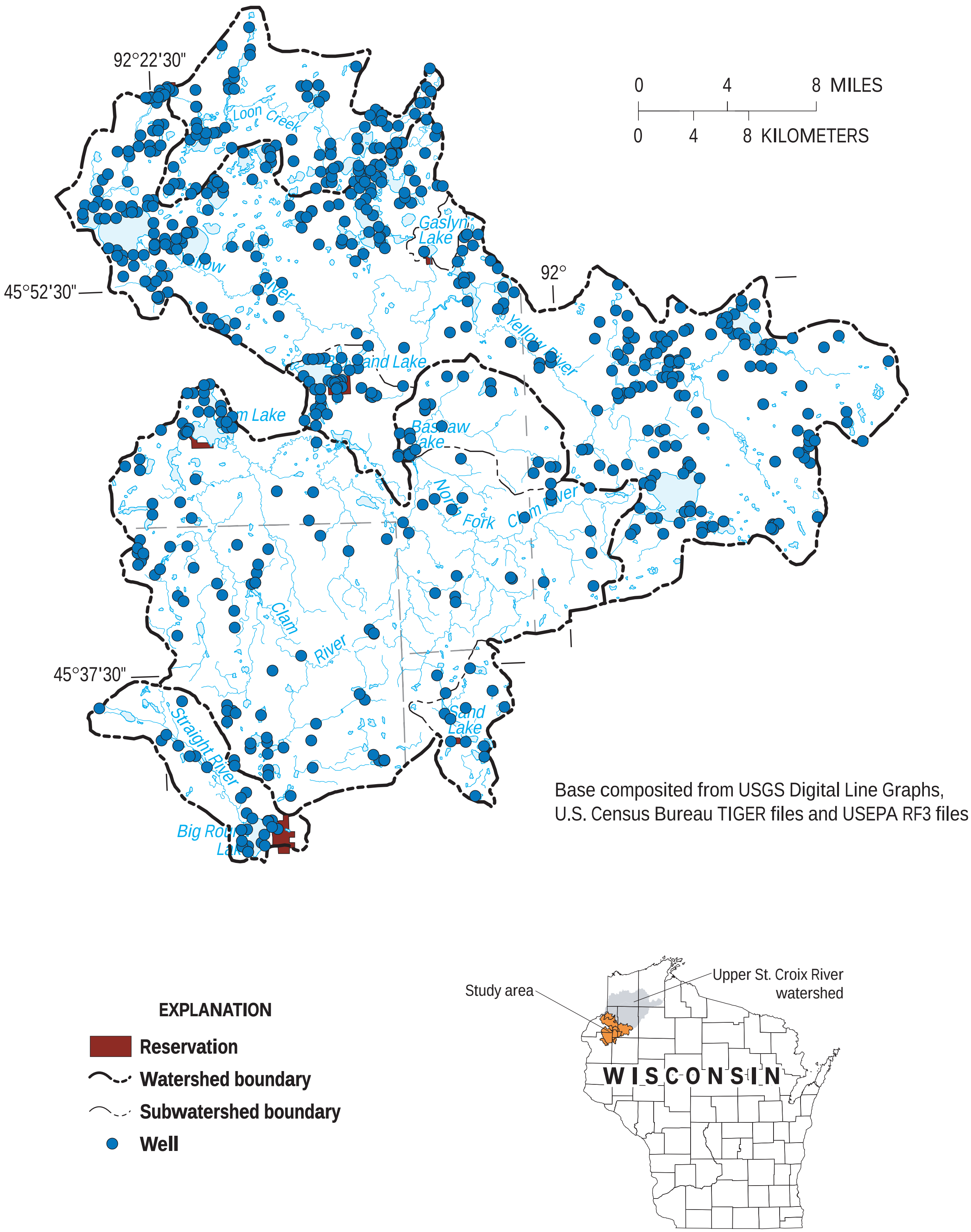


Figure 10. Location of drinking-water wells in the study area for which water-quality data are available.

natural sources or as a result of corroded plumbing system materials (U.S. Environmental Protection Agency, 1999c). Nitrate can also occur naturally; however, elevated concentrations can be the result of fertilizer use, leaching of septic tanks, or sewage (U.S. Environmental Protection Agency, 1999c). Tetrachloroethylene, 1,2-dichloroethane, and 1,1-dichloroethylene are organic chemicals used for industrial manufacturing or cleaning purposes (U.S. Environmental Protection Agency, 1999c). Most of the constituents that exceeded an MCL were detected at high concentrations in only one or two wells. Only nitrate and lead were found in high concentrations in more than two wells. Constituents that exceeded an SMCL include iron and manganese, which were found in high concentrations in 12 and 21 wells, respectively.

Distribution of total nitrite plus nitrate (commonly referred to as nitrate), one of the most commonly analyzed constituents in ground-water samples, is shown in fig. 11. In all, 362 nitrate analyses from 154 drinking-water wells were obtained (fig. 11, table 10). Wells that had been sampled for nitrate were distributed over the entire study area; however, most of those wells were sampled only once or twice. Samples from five wells had concentrations greater than the 10 mg/L MCL.

In addition to the information from the data bases described previously, a summary of all water-quality data specific to the St. Croix tribal water-supply systems was compiled by Horsley and Witten, Inc. (1999). Summaries of water quality and concerns were provided for four Tribal communities that have public-supply wells: Danbury, Hertel (near Big Sand Lake), Maple Plain (adjacent to Sand Lake), and Round Lake (adjacent to Big Round Lake). Only two constituents in ground-water analyses for the public-supply wells exceeded an MCL. Copper and lead concentrations in water samples collected from Maple Plain and Hertel wells exceeded the MCL's (1,300 and 5.0 µg/L, respectively). The high concentrations were attributed to the materials in the water-distribution system. Several constituents, though not necessarily exceeding an MCL, were listed as "water-quality concerns" for each community: nitrate and VOC's for the Danbury community; copper, lead, nitrate, VOC's, and thallium for the Hertel communities; copper, lead, nitrate, VOC's, and radionuclides for the Maple Plain community; and copper and lead for the Round Lake community.

ADDITIONAL DATA

Additional data that may be useful for understanding and evaluating the water resources of the St. Croix Reservation and vicinity include meteorological data and digital thematic data.

Meteorological data are collected at several weather stations in and around the study area. Recent and historical data for these weather stations are available on the World Wide Web. Recent climatic data for active weather stations are available from the National Climatic Data Center Web site at URL http://www.ncdc.noaa.gov/. Historical climatic data for three weather stations near the study area are available from the Midwest Regional Climate Center at URL http://mcc.sws.uiuc.edu/. Historical data include information from station 471923 near Cumberland, Wis., station 471978 near Danbury, Wis., and station 478027 at the Spooner Experimental Farm near Spooner, Wis. Data collected at the stations include temperature and precipitation and date back to 1894 for the Spooner Experimental Farm. The average annual temperature for these stations range from 41 to 43°F and the average annual precipitation ranges from 29 to 33 in/yr.

Digital thematic data, referred to as Geographic Information Systems (GIS) spatial coverages, contain important information to help understand the effects of natural and anthropogenic factors on water resources as well as provide the ability to model, analyze, and display thematic information. GIS coverages are available at many scales, from neighborhoods to nations. The quality of data can vary from coarse data to very detailed, point-specific data. Many GIS coverages are available to the general public at no cost; however, others may be available for a fee or even restricted to a specific set of users. GIS themes may include infrastructure, such as roads, railroads, sewer lines, and municipal boundaries; environmental data such as geology, surficial deposits, land use, and contaminant point sources; and many other types of information. GIS coverages are available from a variety of sources including, but not limited to, the WDNR, USGS, USEPA, county Land Conservation Districts, universities, municipal governments, and other county and federal government agencies. Some of the coverages available from the WDNR are described by Laedlein (1993). The USGS Web site with downloadable GIS coverages can be found at the URL http://water.usgs.gov/public/GIS/.

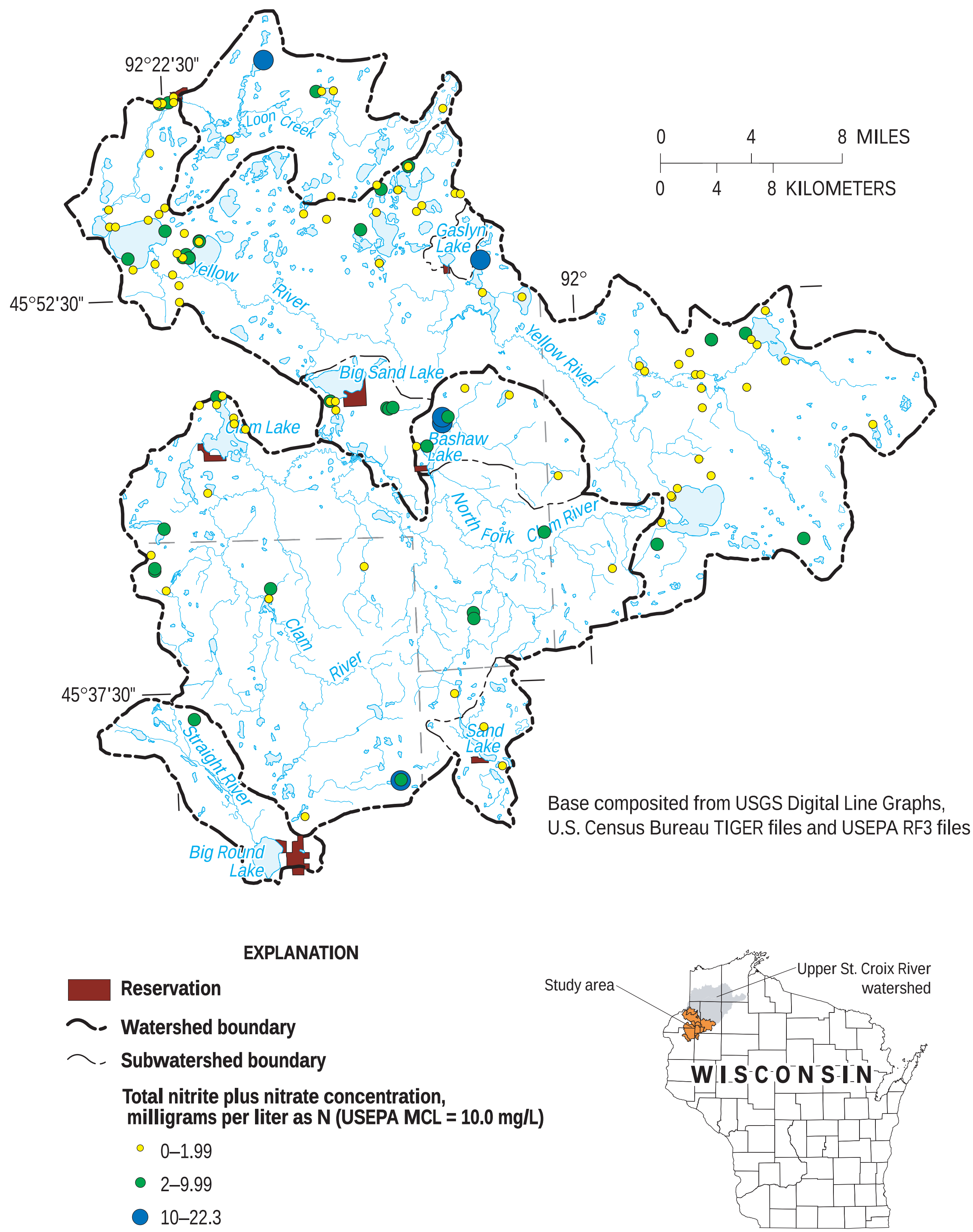


Figure 11. Total nitrite plus nitrate concentrations in drinking-water wells from the St. Croix Reservation and vicinity. (Concentrations represent maximum values where more than one sample was collected for a well.)

SUMMARY

The St. Croix Chippewa Tribe is interested in documenting water-quality conditions in lakes and streams adjacent to their Reservation lands in northwestern Wisconsin and developing management plans to protect these water resources. This report provides the Tribe with a retrospective summary and analysis of available water-resources-related information for their Reservation and vicinity.

The lakes of special interest to the Tribe include Bashaw, Big Round, Big Sand, Clam, Gaslyn, and Sand Lakes. The streams of interest include Loon Creek and the St. Croix and Yellow Rivers upstream from St. Croix Reservation lands near Danbury, Wis. The study area described in this report includes all of the watersheds containing these lakes and streams except the St. Croix River Watershed, which is more than two times as large as the area of the other watersheds of interest, combined. The study area is divided into four main watersheds: Big Round Lake, Clam River at Clam Lake Outlet, Yellow River at Danbury, and Loon Creek at Danbury. The Clam River Watershed includes the subwatersheds of Bashaw and Sand Lakes. The Yellow River Watershed includes the subwatersheds of Big Sand and Gaslyn Lakes.

In all, 41 surface-water studies or reports that include information relevant to the study area were identified. Most of the surface-water studies were regional or statewide summaries. Fifteen of these studies include lake information, and 36 include stream information. Twenty-eight of the studies include water-quality data, and 16 include information describing aquatic biology.

Water-quality and sediment-quality data were obtained for 80 lakes and 23 streams in the study area. Lake information includes data for 101 water-quality characteristics from nearly 4,300 water and sediment analyses of samples collected between 1972 and 1998. The most common characteristics measured for lakes were those describing field conditions (temperature, dissolved oxygen, pH, and specific conductance), nutrient concentrations (phosphorus and nitrogen), hardness (alkalinity), and metals that accumulate in the deep part of lakes. For some characteristics, these data provide a fairly complete spatial coverage of water and sediment quality for lakes in the study area; however, for many measurements, such as transparency (Secchi depth), only a few lakes were sampled. The temporal representation for almost all lakes was very limited. Only 19 of the 80 lakes were sampled more than once. Water from the lakes of primary interest to the Tribe (Bashaw, Big Round, Big Sand, Clam, Gaslyn, and Sand Lakes) were sampled a few times for a wide range of characteristics by the USGS between August 1984 and August 1986 and by either the WDNR or USEPA in subsequent years. Sediment samples from three of the lakes (Bashaw, Clam, and Gaslyn Lakes) were also collected by the USGS and analyzed for nutrient concentrations.

The study area is dominated by mesotrophic to eutrophic lakes. The highest density of eutrophic lakes were in the Loon Creek and Clam River Watersheds; the highest density of mesotrophic lakes and the few oligotrophic lakes were located in the headwaters of the Yellow River Watershed. Most of the drainage lakes that intersect the main rivers in the basin have hard or moderately hard water, and most of the small seepage lakes have soft to very soft water.

Stream information summarized in this report includes data for 135 water-quality characteristics and nearly 4,500 water and sediment analyses from samples collected at 23 sites between 1964 and 1999. These data, however, do not represent the quality of water and sediment in streams throughout the entire study area. Most of the sampling locations were in the Clam River Watershed, specifically the Sand Lake Subwatershed. No stream data were available for the watersheds of Bashaw, Big Round, Big Sand, and Gaslyn Lakes, and very little stream data for most of the Clam River and Yellow River Watersheds. Seventy-eight percent of all analyses were done by the USGS on samples collected from the St. Croix River at Danbury between 1964 and 1999, but mostly after 1994 when it was sampled as part of the USGS NAWQA program. Another 14 percent of all analyses were done by the USGS on samples collected from the Yellow River at Danbury between 1975 and 1998. Data from 12 of the 23 streams summarized represent information collected from 12 small inlets to Kirby Lake in the Sand Lake Subwatershed in Barron County. For the remaining nine sites (seven sites in the Yellow River Watershed, one site in the Loon Creek Watershed, and one site in the Clam River Watershed) limited data were available from only a few analyses.

Other than the wide suite of constituents measured at the St. Croix River at Danbury, most of the water-quality data were collected to describe alkalinity and nutrient concentrations. The only characteristic that was sampled over the entire area was alkalinity. In general, most streams in the Clam River Watershed were hard-water streams with alkalinities greater than 90 mg/L,

whereas most of the other streams in the study area had medium to hard water with alkalinities between 40 and 90 mg/L. Total phosphorus concentrations in the few streams that were sampled were generally less than 0.1 mg/L, except in the tributaries to Kirby Lake, which were as high as 0.17 mg/L.

A total of 41 ground-water studies or reports that include information relevant to the study area were identified. Most of the ground-water studies were regional or statewide summaries. Of the 41 studies, 33 include water-quality information, 9 include information regarding water use, and 23 provide descriptions of geology and aquifer characteristics relevant to the study area.

Water-quality information for 773 wells was compiled. Most of the sampled wells were used for drinking water, and most of the drinking-water wells represent domestic supplies.

Water-quality data summarized in this report represents 270 characteristics and more than 10,300 analyses of samples collected from drinking-water wells between 1911 and 1999; however, most of the ground-water-quality data were collected after about 1990. Constituents analyzed for in ground-water samples included major ions, nutrients, organics, radionuclides, trace metals, and microbes, in addition to field measurements. The distribution of drinking-water wells with water-quality data covers much of the study area; however, many of the measurements were collected from only a few wells and probably do not provide a complete description for the entire study area.

On the basis of data summarized in this report, six constituents for which ground-water samples were analyzed equaled or exceeded a USEPA MCL in at least one sample: copper, lead, nitrate, tetrachloroethylene, 1,2-dichloroethane, and 1,1-dichloroethylene. Most of these constituents exceeded an MCL in water samples from one or two wells. Only nitrate and lead were found in concentrations above the MCL in more than two wells. Iron and manganese exceeded a Secondary MCL in 12 and 21 wells, respectively.

Historical data summarized in this report were collected by several agencies using a variety of methods and covering a range of different time periods. Based on this information, the trends in and status of the water quality in the lakes and streams of interest to the Tribe can be only described generally. An accurate description of water-quality status and trends at a particular lake or stream would require a consistent and long-term, data-collection effort.

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Tables 3–10

Table 3. Characteristics and description of surface-water studies, St. Croix Reservation and vicinity, Wisconsin

[X, study includes description of these characteristics relevant to the Reservation and vicinity]

Literature citation	Characteristics									Description
	Lake information	Stream information	Aquatic biology	Water quality	Stream discharge	Sediment/sed. quality	Modeling/runoff calculations	Habitat	Other	
Andrews and others (1995)		X		X						Regional summary of volatile organic compounds in the Upper Mississippi River Basin. Contains data and maps on land use, landfills, volatile organic compounds, and surface-water contamination. The St. Croix River near Danbury, Wis. contained low levels of volatile organics.
Andrews and others (1996)		X	X					X		Regional study of the Upper Mississippi River Basin. General details given on aquatic biology and ecology collections. This report lists many references for the Upper Mississippi River Basin, which includes the St. Croix Reservation.
Archer and others (1995)	X	X	X	X						Statewide summary of *Cryptosporidium* and *Giardia* occurrence, concentrations, and distributions in Wisconsin.
Blackman and others (1966)	X	X	X	X	X			X		Local study of the surface-water resources of Burnett County. Includes most of the central and western part of the study area. Report includes detailed physical, chemical, and biologic characteristics for all of the lakes and streams in the county. Also includes descriptions of surface-water problems in the county.
Burnett County Soil and Water Conservation District, Wisconsin (1974)		X						X		Local summary of Burnett County surface water. Contains information on bank erosion and the importance of snags to rivers. This reference identifies the locations of unstable slopes on several rivers and their associated lakes; one river, the Clam, is in the vicinity of the St. Croix Reservation.
Burnett (1982)		X					X			Statewide summary of flood-plain zoning, costs, and regulations. Also includes information on insurance, grants, and hazard programs for Wisconsin floods. Zoning and cost issues may pertain to the reservation area.
Christopherson and others (1988)		X					X			Statewide summary of legal aspects of surface-water management. Includes details on zoning, flood-plain management, flood delineations, jurisdictions, and a shoreland-wetland floodplain compliance checklist. This reference pertains to the area including and surrounding the St. Croix Reservation.
Engel and Nichols (1991)	X		X	X		X				Local study of Rice Lake which is adjacent to the study area in Polk County. Contains data on macrophytes and other biomass, water budgets, fish, turbidity, land cover, and bed-sediment chemistry.
Fallon and others (1997)		X		X						Regional summary of the Upper Mississippi River Basin. Pesticide measurements taken in streams are listed by county, including the counties containing the St. Croix Reservation. Includes maps of atrazine, MCPA, carbofuran and aldicarb pesticide concentrations.

Table 3. Characteristics and description of surface-water studies, St. Croix Reservation and vicinity, Wisconsin—Continued

Literature citation	Characteristics: Lake information	Stream information	Aquatic biology	Water quality	Stream discharge	Sediment/sed. quality	Modeling/runoff calculations	Habitat	Other	Description
Field (1978)		X			X					Statewide summary of low-flow characteristics of streams protected under the Watershed Protection and Flood Prevention Act of 1954 (Public Law 566).
Gebert and Holmstrom (1974)		X			X					Statewide summary of low-flow characteristics of Wisconsin streams at sewage-treatment plants.
Goldstein and others (1999)		X	X						X	Regional summary of the Upper Mississippi River Basin in Wisconsin and Minnesota focusing on the relation between fish communities and land use. Includes fish species and abundancy data for the St. Croix River near Danbury, Wis.
Graczyk (1986)		X	X	X	X	X				Regional water-quality summary for the St. Croix River Valley. Includes classifications of streams based on physical and chemical properties. Measurements given for dissolved oxygen, acidity, temperature, suspended sediment, major inorganic constituents, nutrients, trace metals, bacteria, pesticides, discharge, and sediment loads and yields. Four stations are on or immediately adjacent to the St. Croix Reservation.
Holmstrom (1979)		X			X					Statewide summary of low-flow characteristics of streams at sewage-treatment and industrial plants in Wisconsin.
Holmstrom (1980)		X			X	X				Regional study of the St. Croix River Basin. Contains mostly information on surface-water flow. Has data on low flow, including graphs of discharge. Several sites analyzed are in the vicinity of the St. Croix Reservation.
Holmstrom and others (1990–99)		X		X	X					Statewide summaries of streamflow and water-quality data for USGS-monitored sites in Wisconsin for water years 1989 through 1999.
Krabbenhoft and Krohelski (1992)	X			X		X	X			Local summary of the water quality, lake sediment, and lake-level fluctuations for St. Croix Reservation. Includes data on dissolved oxygen and acidity for Bashaw, Big Round, Big Sand, Clam, Gaslyn, and Sand Lakes. Report includes tables listing physical and chemical properties of each lake. Water-quality measurements include hardness, dissolved calcium, magnesium, nitrogen, phosphorus, arsenic, iron, lead, mercury, selenium, and zinc.
Kroening (1996)		X		X						Regional study of the Upper Mississippi River Basin in Wisconsin and Minnesota. Contains data on nitrogen and phosphorus quantities. The St. Croix River near Danbury, Wis., had low levels of phosphorus and nitrate.

Table 3. Characteristics and description of surface-water studies, St. Croix Reservation and vicinity, Wisconsin—Continued

Literature citation	Characteristics									Description
	Lake information	Stream information	Aquatic biology	Water quality	Stream discharge	Sediment/sed. quality	Modeling/runoff calculations	Habitat	Other	
Kroening (1998)		X		X						Regional study of the Upper Mississippi River Basin in Wisconsin and Minnesota. Nutrient sources are detailed, and phosphorus and nitrogen amounts are cited by location, including sites in the St. Croix River Basin.
Muldoon and others (1990)	X			X						Regional study focused on natural occurence of phosphorus in geologic materials and in ground water and possible effects on lake water quality. Includes information for several of the lakes of interest to the Tribe.
Patterson (1990)		X		X	X					Local study of the Crex Meadows Wildlife Area, which is in the vicinity of the St. Croix Reservation. Primarily a resource for ground-water information, however it contains discharge measurements for the St. Croix River at Danbury, Wis.
Rose (1993)	X	X		X			X	X	X	Local study of Balsam Lake in Northwestern Wisconsin. Water budgets with inflow and outflow measurements are charted. Lake storage and evaporation measurements are given. Other properties measured include phosphorus concentrations and trophic state indices. This area is adjacent to the Big Round Lake Watershed in Polk County.
Rose and Robertson (1998)	X	X	X	X	X		X	X		Local study of Kirby Lake in Barron County. Water budgets of the lake are given in terms of lake stage, precipitation, and inflows. Acidity, specific conductance, total phosphorus, dissolved oxygen, concentrations of surface chlorophyll *a*, and trophic-state indices have been measured. Kirby Lake is in the Sand Lake Subwatershed of the study area.
Sather and Busch (1976)	X	X	X	X	X			X		Local study of the surface-water resources of Washburn County. Includes the eastern part of the study area, in particular the headwaters of the Yellow River. Report includes detailed physical, chemical, and biologic characteristics for all of the lakes and streams in the county. Also includes descriptions of surface-water problems in the county.
Sather and Threinen (1961)	X	X	X	X	X			X		Local study of the surface-water resources of Polk County. Includes the southern part of the study area, in particular Big Round Lake and parts of the Clam River Watershed. Report includes detailed physical, chemical, and biologic characteristics for all of the lakes and streams in the county. Also includes descriptions of surface-water problems in the county.
Sather and Threinen (1964)	X	X	X	X	X			X		Local study of the surface-water resources of Barron County. Includes the southeastern part of the study area, in particular part of the Sand Lake watershed. Report includes detailed physical, chemical, and biologic characteristics for all of the lakes and streams in the county. Also includes descriptions of surface-water problems in the county.

Table 3. Characteristics and description of surface-water studies, St. Croix Reservation and vicinity, Wisconsin—Continued

Literature citation	Characteristics: Lake information	Stream information	Aquatic biology	Water quality	Stream discharge	Sediment/sed. quality	Modeling/runoff calculations	Habitat	Other	Description
Stark and others (1996)		X	X		X					Regional summary of Upper Mississippi River Basin. Includes some streamflow and aquatic species information; however, only limited information available for the study area.
Stark and others (1999)		X	X	X		X				Regional summary of the Upper Mississippi River Basin. Includes general information on land use, aquatic biology, and streambed sediment and focuses on water-quality in agricultural and urban areas. Contains a list of what studies were done on streams, including several in the vicinity of the St. Croix Reservation.
U.S. Environmental Protection Agency (1992)		X		X				X		Statewide documentation of risk evaluation of the environmental problems faced by tribes in Wisconsin. Water-resources-related problems described in the report and relevant to the Reservation include industrial, municipal, and nonpoint-source discharge; drinking-water and ground-water contamination; physical degradation of aquatic habitat; unintended releases of toxic substances; and pesticides.
West Central Wisconsin Regional Planning Commission (1976)		X		X						Local water and sewer plan for Polk County. Includes land-use, climate, and soil survey information. Details are given for water and sewers for Clam Fall, Wis., which is in the southern part of the study area.
Wisconsin Department of Natural Resources (1972)		X	X	X						Regional study of pollution in the St. Croix River Basin. Contains a biological survey, acidity, dissolved oxygen, and temperature measurements for water near waste sites. Yellow River is a case study in this report.
Wisconsin Department of Natural Resources (1975)		X	X	X	X					Regional study of the St. Croix River Basin. Focuses on water-quality including measurements of dissolved oxygen, biochemical oxygen demand, bacteria concentrations, suspended and dissolved solids, and nutrients. Also has discharge measurements from municipal and industrial sites. Includes sites in the vicinity of the St. Croix Reservation.
Wisconsin Department of Natural Resources (1979)	X	X	X					X		Regional study of the St. Croix River Basin. Not much detailed information, but has thorough summary of organic matter and oxygen demands in the lakes and streams in the vicinity of the St. Croix Reservation.
Wisconsin Department of Natural Resources (1982)		X		X					X	Regional study of pollution in the St. Croix River Basin. Concentrates on point and nonpoint sources of pollution, wastewater treatment, and cost estimates for meeting future wastewater needs. Costs may be relevant to the St. Croix Reservation.

Table 3. Characteristics and description of surface-water studies, St. Croix Reservation and vicinity, Wisconsin—Continued

Literature citation	Characteristics									Description
	Lake information	Stream information	Aquatic biology	Water quality	Stream discharge	Sediment/sed. quality	Modeling/runoff calculations	Habitat	Other	
Wisconsin Department of Natural Resources (1984)		X		X					X	Regional study of the St. Croix River Basin. Lists water-quality problems including point and nonpoint sources of pollution. Contains recommendations to establish watershed management programs. These water-management programs would include the area in the vicinity of the St. Croix Reservation.
Wisconsin Department of Natural Resources (1995)	X		X							Statewide summary of Wisconsin lakes. Includes information for the lakes in the study. Details include: lake area, maximum depth, mean depth, public access, lake map type, and fish species present. Also lists fish advisory ratings for mercury.
Wisconsin Heritage Areas Program (1978)		X						X	X	Local study of Burnett County that includes much of the study area. Includes township and range location of streams and qualitative descriptions of surrounding biology.
Wisconsin Nonpoint Source Water Pollution Abatement Program (1993a)	X	X		X					X	Local study of the Yellow River Watershed in Barron County, neighboring and partially including the St. Croix Indian Reservation. Survey of watershed includes land use management, agricultural practices, pollution sources, and water-quality properties such as common ions. May be useful for establishing a water management plan in the vicinity of the St. Croix Reservation.
Wisconsin Nonpoint Source Water Pollution Abatement Program (1993b)	X	X		X					X	Local study of the Yellow River Watershed in Barron County neighboring and partially including the St. Croix Indian Reservation. Project summary focuses on the cost aspects of the first volume (1993).
Wisconsin Nonpoint Source Water Pollution Abatement Program (1995)				X					X	Local study of the Balsam Branch Watershed and its streams, lakes, and wetlands. Contains data on water-quality, including common ions. This area is adjacent to the Big Round Lake Watershed in Polk County. Contains extensive data on point and nonpoint sources of pollution. Costs of implementing pollution-management programs are discussed.
Young and Hindall (1973)	X	X		X	X		X			Regional summary of the water resources of the St. Croix River Basin. Includes a wide variety of surface- and ground-water information relevent to the study area and a detailed description of the physical setting. Includes streamflow and water quality for some of the streams in the study area.

Table 4. Summary of selected water-quality and sediment-quality characteristics for samples from lakes from the St. Croix Reservation and vicinity, Wisconsin

[N, number; Min, minimum value; Max, maximum value; <DL, less than the detection limit; °C, degrees Celsius; FTU, formazin turbidity unit; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µeq/L, microequivalents per liter; mg/kg, milligrams per kilogram; µg/L, micrograms per liter; NTU, nephelometric turbidity units]

Parameter code	Characteristic	N	Min	Max
00010	Water temperature, field, °C	317	0	56
00074	Light transmission, 1 meter, percent	10	70	94
00076	Turbidity, Hach, FTU	89	0.5	20
00078	Transparency, Secchi disk, meters	71	.55	20
00080	Color, platinum cobalt scale	37	5	130
00095	Specific conductance, µS/cm at 25°C	271	12.7	250
00154	Sulfate, total, mg/L as S	14	.27	4.3
00300	Oxygen, dissolved, mg/L	353	<DL	13.9
00400	pH, field	277	5.2	9.4
00403	pH, whole water, lab	117	5.9	9.6
00409	Alkalinity, total, gran titration, µeq/L	14	27	1,900
00410	Alkalinity, total, mg/L as $CaCO_3$	107	2.0	91
00417	Alkalinity, fixed endpoint, lab, mg/L	1	7.0	7.0
00496	Loss on ignition, bottom material, mg/kg	8	7,600	630,000
00500	Residue, total, mg/L	16	12	38
00505	Residue, total volatile, mg/L	20	10	18
00515	Residue, total, filtered, dried at 105°C, mg/L	1	28	28
00530	Residue, total, nonfiltered, mg/L	29	2	12
00600	Nitrogen, total, mg/L as N	64	.2	2.9
00605	Nitrogen, organic, mg/L as N	70	.15	1.8
00608	Nitrogen, ammonia, dissolved, mg/L as N	102	<DL	1.4
00610	Nitrogen, ammonia, total, mg/L as N	30	<DL	0.52
00611	Nitrogen, ammonia, bottom material, mg/kg as N	12	8	380
00613	Nitrogen, nitrite, dissolved, mg/L as N	65	<DL	.04
00615	Nitrogen, nitrite, total, mg/L as N	11	<DL	<DL
00618	Nitrogen, nitrate, dissolved, mg/L as N	65	<DL	.68
00623	Nitrogen, kjeldahl, dissolved, mg/L	3	.2	.6
00624	Nitrogen, kjeldahl, suspended, mg/L as N	3	.2	.5
00625	Nitrogen, kjeldahl, total, mg/L as N	37	<DL	2.7
00626	Nitrogen, ammonia plus organic, bottom material, mg/kg as N	12	<DL	93,000
00630	Nitrogen, nitrite plus nitrate, total, mg/L as N	28	<DL	.1
00631	Nitrogen, nitrite plus nitrate, dissolved, mg/L as N	40	<DL	.13
00633	Nitrogen, nitrite plus nitrate, bottom material, mg/kg as N	12	<DL	280
00662	Phosphorus, total recoverable, µg/L as P	14	16	100
00665	Phosphorus, total, mg/L as P	267	<DL	.26
00666	Phosphorus, dissolved, mg/L as P	31	<DL	.6
00668	Phosphorus, bottom material, mg/kg as P	12	17	2,400

Table 4. Summary of selected water-quality and sediment-quality characteristics for samples from lakes from the St. Croix Reservation and vicinity, Wisconsin—Continued

Parameter code	Characteristic	N	Min	Max
00671	Phosphorus, dissolved orthophosphate, mg/L as P	97	<DL	.06
00681	Carbon, organic, dissolved, mg/L as C	14	4.1	15
00691	Carbon, inorganic, dissolved mg/L as C	14	.53	22
00900	Hardness, total, mg/L as $CaCO_3$	9	12	100
00910	Calcium, mg/L as $CaCO_3$	14	.76	24
00915	Calcium, dissolved, mg/L as Ca	14	9.6	26
00916	Calcium, total, mg/L as Ca	89	1	23
00918	Calcium, total recoverable, mg/L as Ca	2	3.4	3.4
00921	Magnesium, total recoverable, mg/L as Mg	2	1.1	1.1
00923	Sodium, total recoverable, mg/L as Na	2	1.2	1.4
00925	Magnesium, dissolved, mg/L as Mg	28	.42	9.3
00927	Magnesium, total, mg/L as Mg	88	<DL	10
00929	Sodium, total, mg/L as Na	89	.9	12
00930	Sodium, dissolved, mg/L as Na	28	.17	3.9
00931	Sodium adsorption ratio	4	.1	.1
00932	Sodium, percent	4	6	7
00935	Potassium, dissolved, mg/L as K	28	.2	5
00937	Potassium, total, mg/L as K	86	.5	5.1
00940	Chloride, dissolved, mg/L as Cl	102	.9	13
00941	Chloride, total, mg/L as Cl	14	.2	6.5
00945	Sulfate, dissolved, mg/L as SO_4	36	2.0	8.5
00950	Fluoride, dissolved, mg/L as F	28	<DL	.1
00955	Silica, dissolved, mg/L as SiO_2	30	.09	26
00980	Iron, total recoverable, µg/L as Fe	2	.12	.12
01002	Arsenic, total, µg/L as As	11	<DL	<DL
01005	Barium, dissolved, µg/L as Ba	7	18	62
01007	Barium, total, µg/L as Ba	11	<DL	<DL
01010	Beryllium, dissolved, µg/L as Be	7	<DL	<DL
01012	Beryllium, total, µg/L as Be	11	<DL	<DL
01027	Cadmium, total, µg/L as Cd	11	<DL	<DL
01034	Chromium, total, µg/L as Cr	11	2	10
01037	Cobalt, total, µg/L as Co	11	<DL	<DL
01042	Copper, total, µg/L as Cu	11	2	6
01044	Iron, suspended, µg/L as Fe	6	100	710
01045	Iron, total, µg/L as Fe	20	.06	1,700
01046	Iron, dissolved, mg/L as Fe	14	3	960
01051	Lead, total, µg/L as Pb	11	<DL	<DL
01054	Manganese, suspended, µg/L as Mn	4	40	180
01055	Manganese, total, µg/L as Mn	100	.06	2,200
01056	Manganese, dissolved, µg/L as Mn	28	<DL	260

Table 4. Summary of selected water-quality and sediment-quality characteristics for samples from lakes from the St. Croix Reservation and vicinity, Wisconsin—Continued

Parameter code	Characteristic	N	Min	Max
01062	Molybdenum, total, µg/L as Mo	11	<DL	4
01065	Nickel, dissolved, µg/L as Ni	7	1	80
01067	Nickel, total, µg/L as Ni	11	3	25
01077	Silver, total, µg/L as Ag	11	<DL	<DL
01080	Strontium, dissolved, µg/L as Sr	11	24	49
01092	Zinc, total, µg/L as Zn	13	8	30
01095	Antimony, dissolved, µg/L as Sb	7	<DL	<DL
01105	Aluminum, total, µg/L as Al	25	10	170
01123	Manganese, total recoverable, µg/L as Mn	2	17	18
01147	Selenium, total, µg/L as Se	11	<DL	<DL
32210	Chlorophyll *a*, µg/L, trichromatic uncorrected	131	.09	32
32217	Chlorophyll *a*, µg/L, fluorometric uncorrected	6	3.9	35
49701	Transparency, Secchi disk, feet	136	3	24
50245	Potassium, total recoverable, mg/L	2	1.3	1.5
70300	Dissolved residue, mg/L at 180°C	14	54	130
70301	Dissolved solids, sum, mg/L	4	98	120
70507	Orthophosphorus, total, mg/L as P	14	<DL	.05
71846	Ammonia, dissolved, mg/L	4	.03	.04
71851	Nitrate, dissolved, mg/L as NO_3	14	<DL	.82
71885	Iron, µg/L as Fe	14	20	960
71886	Phosphorus, total, mg/L as PO_4	7	.06	.31
71900	Mercury, total, µg/L as Hg	11	<DL	.5
74010	Iron, total, mg/L as Fe	83	<DL	15
82079	Turbidity, lab, NTU	14	.5	5

Table 5. Summary of selected water-quality and sediment-quality characteristics and flow data for samples from streams from the St. Croix Reservation and vicinity, Wisconsin

[N, number; Min, minimum value; Max, maximum value; <DL, less than the detection limit; °C, degrees Celsius; ft^3/s, cubic feet per second; JTU, Jackson turbidity unit; FTU, formazin turbidity unit; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; mg/kg, milligrams per kilogram; µg/L, micrograms per liter; µg/kg, micrograms per kilogram; µm, micrometer; MF, membrane filter; mL, milliliter; mm, millimeter; pCi/L, picocuries per liter]

Parameter code	Characteristic	N	Min	Max
00010	Water temperature, field, °C	219	0	26
00060	Streamflow, ft^3/s	32	1,030	6,190
00061	Streamflow, instantaneous, ft^3/s	200	0	6,670
00070	Turbidity, JTU	11	1	5
00076	Turbidity, Hach, FTU	9	0	5
00080	Color, platinum cobalt scale	23	5	110
00095	Specific conductance, µS/cm at 25°C	209	50	230
00300	Oxygen, dissolved, mg/L	103	6	15
00400	pH, field	116	6	8.6
00403	pH, whole water, lab	69	7	8.2
00405	Carbon dioxide, mg/L	93	<DL	82
00410	Alkalinity, total, mg/L as $CaCO_3$	40	21	190
00440	Bicarbonate, mg/L as HCO_3	21	26	110
00445	Carbonate, mg/L as CO_3	19	<DL	<DL
00452	Carbonate, field, mg/L as CO_3	24	<DL	81
00453	Bicarbonate, field, mg/L as HCO_3	53	22	91
00600	Nitrogen, total, mg/L	84	<DL	1.9
00605	Nitrogen, organic, mg/L as N	74	<DL	1.7
00608	Nitrogen, ammonia, dissolved, mg/L as N	60	<DL	0.11
00610	Nitrogen, ammonia, total, mg/L as N	46	<DL	.11
00613	Nitrogen, nitrite, dissolved, mg/L as N	59	<DL	.03
00615	Nitrogen, nitrite, total, mg/L as N	46	<DL	.06
00620	Nitrogen, nitrate, total, mg/L as N	33	<DL	.43
00623	Nitrogen, kjeldahl, dissolved, mg/L	59	<DL	.62
00625	Nitrogen, kjeldahl, total, mg/L as N	106	<DL	1.8
00630	Nitrogen, nitrite plus nitrate, total, mg/L as N	46	<DL	.44
00631	Nitrogen, nitrite plus nitrate, dissolved, mg/L as N	60	<DL	.36
00650	Phosphate, total, mg/L as PO_4	2	<DL	.09
00665	Phosphorus, total, mg/L as P	149	<DL	.39
00666	Phosphorus, dissolved, mg/L as P	100	<DL	.08
00668	Phosphorus, bottom material, mg/kg dry weight	7	330	780
00671	Phosphorus, dissolved orthophosphate, mg/L as P	60	<DL	.03
00680	Carbon, organic, total, mg/L as C	32	2	39
00681	Carbon, organic, dissolved, mg/L as C	54	3	20
00689	Carbon, organic, suspended, mg/L as C	54	<DL	2.2
00720	Cyanide, total, mg/L as Cn	8	<DL	<DL
00900	Hardness, total, mg/L as $CaCO_3$	88	27	98

Table 5. Summary of selected water-quality and sediment-quality characteristics and flow data for samples from streams from the St. Croix Reservation and vicinity, Wisconsin—Continued

Parameter code	Characteristic	N	Min	Max
00902	Hardness, noncarbonate, mg/L as $CaCO_3$	25	<DL	13
00915	Calcium, dissolved, mg/L as Ca	87	7	25
00916	Calcium, total, mg/L as Ca	7	9	30
00917	Calcium, bottom material, mg/kg dry weight	7	0.78	2.2
00924	Magnesium, bottom material, mg/kg dry weight	7	.55	1.6
00925	Magnesium, dissolved, mg/L as Mg	87	1.0	8.5
00927	Magnesium, total, mg/L as Mg	7	3.3	12
00929	Sodium, total, mg/L as Na	7	2.1	4.7
00930	Sodium, dissolved, mg/L as Na	86	1	3.9
00931	Sodium adsorption ratio	86	0	.2
00932	Sodium, percent	86	5.0	11
00934	Potassium, bottom material, mg/kg dry weight	7	.45	.96
00935	Potassium, dissolved, mg/L as K	86	<DL	1.3
00937	Potassium, total, mg/L as K	1	1	1
00938	Potassium, bottom material, mg/kg dry weight	7	1.3	1.8
00940	Chloride, dissolved, mg/L as Cl	106	<DL	7.8
00945	Sulfate, dissolved, mg/L as SO_4	89	1	10
00946	Sulfate, mg/L as SO_4	7	<DL	7
00950	Fluoride, dissolved, mg/L as F	87	<DL	.3
00955	Silica, dissolved, mg/L as SiO_2	86	8	17
00956	Silica, total, mg/L as SiO_2	1	.006	.006
01002	Arsenic, total, µg/L as As	17	<DL	2.0
01003	Arsenic, bottom material, mg/kg dry weight	7	.80	1.9
01007	Barium, total, µg/L as Ba	12	3	200
01008	Barium, bottom material, mg/kg dry weight	7	330	580
01012	Beryllium, total, µg/L as Be	9	<DL	10
01013	Beryllium, bottom material, mg/kg dry weight	7	<DL	1
01018	Iron, bottom material, mg/kg dry weight	7	1.8	3.9
01022	Boron, total, µg/L as B	15	<DL	60
01023	Boron, bottom material, mg/kg dry weight	7	<DL	14
01027	Cadmium, total, µg/L as Cd	17	<DL	3
01029	Chromium, bottom material, mg/kg dry weight	7	40	70
01034	Chromium, total, µg/L as Cr	17	1	20
01037	Cobalt, total, µg/L as Co	17	<DL	2.0
01038	Cobalt, bottom material, mg/kg dry weight	7	13	25
01042	Copper, total, µg/L as Cu	16	<DL	24
01043	Copper, bottom material, mg/kg dry weight	7	6	51
01044	Iron, suspended, µg/L as Fe	1	80	80
01045	Iron, total, µg/L as Fe	16	<DL	810
01046	Iron, dissolved, mg/L as Fe	68	40	791

Table 5. Summary of selected water-quality and sediment-quality characteristics and flow data for samples from streams from the St. Croix Reservation and vicinity, Wisconsin—Continued

Parameter code	Characteristic	N	Min	Max
01051	Lead, total, µg/L as Pb	10	<DL	24
01053	Manganese, bottom material, mg/kg dry weight	7	310	840
01054	Manganese, suspended, µg/L as Mn	1	3	3
01055	Manganese, total, µg/L as Mn	17	<DL	100
01056	Manganese, dissolved, µg/L as Mn	68	7	37
01059	Thallium, total µg/L as Tl	7	<DL	<DL
01062	Molybdenum, total µg/L as Mo	8	<DL	8
01063	Molybdenum, bottom material, mg/kg dry weight	7	<DL	<DL
01067	Nickel, total, µg/L as Ni	17	<DL	16
01077	Silver, total, µg/L as Ag	16	<DL	<DL
01078	Silver, bottom material, mg/kg dry weight	7	<DL	<DL
01080	Strontium, dissolved, µg/L as Sr	1	43	43
01082	Strontium, total, µg/L as Sr	1	29	29
01083	Strontium, bottom material, mg/kg dry weight	7	85	190
01087	Vanadium, total, µg/L as V	7	<DL	<DL
01088	Vanadium, sediment, mg/kg dry weight	7	69	130
01092	Zinc, total, µg/L as Zn	17	<DL	45
01093	Zinc, bottom material, mg/kg dry weight	7	38	87
01105	Aluminum, total, µg/L as Al	8	<DL	37
01132	Lithium, total, µg/L as Li	7	<DL	4
01133	Lithium, bottom material, mg/kg dry weight	7	6	13
01147	Selenium, total, µg/L as Se	17	<DL	.2
01148	Selenium, bottom material, mg/kg dry weight	7	<DL	1.7
01162	Zirconium, total, µg/L as Zr	7	<DL	<DL
01163	Zirconium, bottom material, mg/kg dry weight	7	70	70
01183	Niobium, sediment, mg/kg dry weight	7	4	14
01189	Scandium, total, µg/L as Sc	7	<DL	<DL
01203	Yttrium, total, µg/L as Y	7	<DL	1
01239	Niobium, total, µg/L as Nb	7	<DL	7
04132	Nickel, sediment, mg/kg dry weight	7	12	38
22608	Uranium, sediment, mg/kg dry weight	7	.68	3.9
22706	Uranium, total, µg/L as U	7	.02	.39
31616	Fecal coliform, MF M-FC broth, colonies/100 mL	26	1	56
31625	Fecal coliform, MF M-FC agar, 0.7 µm, colonies/100 mL	38	<DL	600
31673	Fecal streptococci, MF KF agar, colonies/100 mL	38	3	3,500
31679	Fecal streptococci, MF M-Ent agar, colonies/100 mL	7	5	1,000
34480	Thallium, sediment, mg/kg dry weight	7	2,700	7,800
39086	Alkalinity, total filtered, incremental, mg/L as $CaCO_3$	53	18	74
45514	Yttrium, sediment, mg/kg dry weight	7	12	20
70300	Dissolved residue, mg/L at 180°C	88	34	130

Table 5. Summary of selected water-quality and sediment-quality characteristics and flow data for samples from streams from the St. Croix Reservation and vicinity, Wisconsin—Continued

Parameter code	Characteristic	N	Min	Max
70301	Dissolved solids, sum, mg/L	85	42	120
70302	Dissolved solids, tons per day	83	63	1,300
70303	Dissolved solids, tons per acre-ft	85	<DL	.15
70331	Suspended sediment, percent <0.062 mm	70	4	100
70507	Phosphorus, total orthophosphate, mg/L as P	1	.02	.02
71845	Ammonia, total, mg/L	43	<DL	.14
71846	Ammonia, dissolved, mg/L	29	.03	.08
71851	Nitrate, dissolved, mg/L as NO_3	13	<DL	.9
71883	Manganese, elemental, µg/L as Mn	1	100	100
71885	Iron, µg/L	2	270	350
71886	Phosphorus, total, mg/L as PO_4	27	<DL	.21
71887	Nitrogen, total, mg/L as NO_3	42	<DL	8.5
71900	Mercury, total, µg/L as Hg	10	<DL	1
80154	Suspended sediment, mg/L	107	1	94
80155	Suspended sediment, discharge, tons per day	106	.88	740
81726	Scandium, sediment, mg/kg dry weight	7	330	780
82313	Thallium, bottom material, µg/kg dry weight	7	.004	.007
82364	Thorium, total, µg/L as Th	7	<DL	<DL
82068	Potassium-40, dissolved, pCi/L as K-40	3	<DL	1

Table 6. Summary of selected water-quality data collected during June through August (unless specified) for samples from lakes from the St. Croix Reservation and vicinity, Wisconsin

[mg/L, milligrams per liter; mg/L, micrograms per liter; N, number; ---, no data]

Lake	Total phosphorus, mg/L		Chlorophyll *a*, μg/L		Secchi depth, feet	
	N	mean	N	mean	N	mean
Lakes of special interest						
Big Round Lake	1	0.15	---	---	---	---
Clam Lake	2	.03	---	---	4	4.3
Bashaw Lake	2	.09	---	---	1	3.0
Sand Lake	1	.01				
Big Sand Lake	2	.02	1	7.4	1	[1]14.1
Gaslyn Lake	3	.03	1	30	1	2.0
Other lakes						
Austin Lake	1	.02	1	11	---	---
Baker Lake	1	.02	1	3.9	---	---
Bass Lake (eastern Polk County)	1	.01	1	13	---	---
Bass Lake (southeast Burnett County)	1	.01	---	---	---	---
Bass Lake (eastern Burnett County)	1	.01	1	7.9	---	---
Big Ripley Lake	1	.02	1	7.5	---	---
Burlingame Lake	1	.04	1	10	---	---
Clam Falls Flowage	1	.03	1	18	---	---
Conners Lake	1	.01	1	18	---	---
Crystal Lake	1	.03	1	1.3	---	---
Dahl Lake	1	.02	1	4.5	---	---
Deep Lake	1	.02	1	2.7	---	---
Eagle Lake	1	.04	1	16	---	---
Fish Lake (west basin)	3	.01	3	3.1	7	12.5
Goose Lake	1	.01	1	3.5	---	---
Green Lake	1	.13	1	11	---	---
Hanscom Lake	1	.02	1	7.8	---	---
Hayden Lake	1	.01	1	12	---	---
Johnson Lake	1	.01	1	6.8	---	---
Kidney Lake	1	.02	1	8.9	---	---
Kirby Lake	2	.03	2	5.5	1	5.6
Knapp Lake	1	.04	1	5.3	---	---
Larson Lake	1	.07	1	28	---	---
Leach Lake	1	.02	1	5.7	---	---
Little Long Lake (Burnett County)	1	.01	1	12	---	---
Long Lake (Washburn County)	1	.05	1	17	---	---
Little Pine Lake	1	.03	1	18	---	---
Little Ripley Lake	1	.02	2	6.3	---	---
Loon Lake	1	.02	1	13	---	---
Love Lake	1	.02	1	7.1	---	---

Table 6. Summary of selected water-quality data collected during June through August (unless specified) for samples from lakes from the St. Croix Reservation and vicinity, Wisconsin—Continued

Lake	Total phosphorus, mg/L		Chlorophyll *a*, µg/L		Secchi depth, feet	
	N	mean	N	mean	N	mean
Mallard Lake	1	.02	1	5.4	---	---
McKenzie Lake	1	.01	1	14	---	---
Minerva Lake	1	.03	1	16	---	---
North Lake	1	.03	1	15	---	---
Oak Lake	1	.01	1	1.7	---	---
Offers Lake	1	.02	1	5.3	---	---
Pavlas Lake	1	.03	1	6.3	---	---
Point Lake	3	.03	3	4.8	16	6.6
Pokegama Lake	1	.01	1	12	---	---
Rice Lake	2	.05	---	---	---	---
Ripley Lake	1	.01	1	2.5	---	---
Sand Lake (Burnett County)	1	.04	1	4.8	---	---
Shell Lake	36	.01	36	5.7	91	13.1
Stone Lake	1	.03	1	32	---	---
Twenty Six Lake	1	.03	1	6.9	---	---
Yellow Lake	4	.05	---	---	7	4.3
Yellow River Flowage	1	.04	1	5.9	---	---

[1] Secchi depth measured May 1965.

Table 7. Summary of selected water-quality characteristics for samples from the lakes of interest for the St. Croix Reservation and vicinity, Wisconsin

[N, number; ---, no data; <DL, less than the detection limit; °C, degrees Celsius; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; mg/kg, milligrams per kilogram; µg/L, micrograms per liter; NTU, nephelometric turbidity unit]

Parameter code	Characteristic	Bashaw Lake		Big Round Lake		Big Sand Lake		Clam Lake		Gaslyn Lake		Sand Lake	
		N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean
00010	Water temperature, field, °C	3	20	3	16	2	22	3	20	3	21	2	21
00076	Turbidity, Hach, FTU	---	---	---	---	2	2.3	---	---	1	7.8	---	---
00078	Transparency, Secchi disk, meters	1	0.9	1	2	1	4.3	4	1.3	1	0.6	---	---
00080	Color, platinum cobalt scale	---	---	1	13	---	---	---	---	---	---	---	---
00095	Specific conductance, µS/cm at 25°C	3	205	3	219	4	111	3	214	4	157	2	188
00154	Sulfate, total, mg/L as S	---	---	1	4.3	---	---	---	---	---	---	---	---
00300	Oxygen, dissolved, mg/L	3	6.9	2	8.3	3	5.8	3	8.6	4	7.1	2	9.1
00400	pH, field	3	7.9	2	9	2	8.5	3	8.2	2	7.1	2	8.7
00403	pH, whole water, lab	2	7.8	3	8.1	4	7.7	2	8.4	3	7.5	2	8.3
00409	Alkalinity, total, gran titration, µeq/L	---	---	1	1,900	---	---	---	---	---	---	---	---
00410	Alkalinity, total, mg/L as $CaCO_3$	1	84	---	---	2	42	---	---	1	75	1	75
00496	Loss on ignition, bottom material, mg/kg	2	420,000	---	---	---	---	2	480,000	2	460,000	---	---
00530	Residue, total, nonfiltered, mg/L	1	7	1	12	1	2	1	6	1	7	1	3
00600	Nitrogen, total, mg/L as N	---	---	---	---	2	.78	---	---	1	1.4	---	---
00605	Nitrogen, organic, mg/L as N	2	1.2	---	---	2	.44	2	.78	2	.81	---	---
00608	Nitrogen, ammonia, dissolved, mg/L as N	3	.05	2	0.09	4	.15	3	.03	4	.10	2	<DL
00610	Nitrogen, ammonia, total, mg/L as N	2	.08	1	.25	1	<DL	2	.03	2	.02	1	<DL
00611	Nitrogen, ammonia, bottom material, mg/kg as N	3	200	---	---	---	---	3	130	3	300	---	---
00613	Nitrogen, nitrite, dissolved, mg/L as N	---	---	---	---	2	.01	---	---	1	.01	---	---
00615	Nitrogen, nitrite, total, mg/L as N	2	<DL	1	<DL	1	<DL	2	<DL	2	<DL	1	<DL
00618	Nitrogen, nitrate, dissolved, mg/L as N	---	---	---	---	2	.07	---	---	1	.29	---	---
00623	Nitrogen, kjeldahl, dissolved, mg/L	---	---	1	.3	1	.6	---	---	---	---	1	.2
00624	Nitrogen, kjeldahl, suspended, mg/L as N	---	---	1	.50	1	.2	---	---	---	---	1	.2
00625	Nitrogen, kjeldahl, total, mg/L as N	2	1.3	2	1.8	2	.8	3	.8	2	1.1	2	.65
00626	Nitrogen, ammonia plus organic, bottom material, mg/kg as N	3	36,000	---	---	---	---	3	45,000	3	42,000	---	---
00630	Nitrogen, nitrite plus nitrate, total, mg/L as N	2	<DL	1	<DL	1	<DL	2	<DL	2	<DL	1	<DL
00631	Nitrogen, nitrite plus nitrate, dissolved, mg/L as N	3	.11	2	<DL	2	<DL	3	<DL	3	2.23	2	<DL
00633	Nitrogen, nitrite plus nitrate, bottom material, mg/kg as N	3	83	---	---	---	---	3	89	3	98	---	---
00662	Phosphorus, total recoverable, µg/L as P	---	---	1	27	---	---	---	---	---	---	---	---
00665	Phosphorus, total, mg/L as P	2	.09	2	.13	4	.02	3	.05	3	.03	2	.03
00666	Phosphorus, dissolved, mg/L as P	3	.02	2	.03	2	.04	3	.03	3	.02	2	.03

Table 7. Summary of selected water-quality characteristics for samples from the lakes of interest for the St. Croix Reservation and vicinity, Wisconsin—Continued

Parameter code	Characteristic	Bashaw Lake		Big Round Lake		Big Sand Lake		Clam Lake		Gaslyn Lake		Sand Lake	
		N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean
00668	Phosphorus, bottom material, mg/kg as P	3	660	---	---	---	---	3	650	3	1,200	---	---
00671	Phosphorus, dissolved orthophosphate, mg/L as P	3	<DL	2	<DL	3	.01	3	<DL	4	.01	2	<DL
00681	Carbon, organic, dissolved, mg/L as C	---	---	1	4.1	---	---	---	---	---	---	---	---
00691	Carbon, inorganic, dissolved mg/L as C	---	---	1	22	---	---	---	---	---	---	---	---
00900	Hardness, total, mg/L as $CaCO_3$	3	93	2	87	---	---	3	99	3	66	---	---
00910	Calcium, mg/L as $CaCO_3$	---	---	1	23	---	---	---	---	---	---	---	---
00915	Calcium, dissolved, mg/L as Ca	3	24	2	21	2	9.7	3	26	3	18	2	22
00916	Calcium, total, mg/L as Ca	---	---	---	---	2	8.5	---	---	1	19	---	---
00925	Magnesium, dissolved, mg/L as Mg	3	8	3	8.4	2	3.4	3	9	3	4.9	2	7
00927	Magnesium, total, mg/L as Mg	---	---	---	---	2	3	---	---	1	5	---	---
00929	Sodium, total, mg/L as Na	---	---	---	---	2	5	---	---	1	2	---	---
00930	Sodium, dissolved, mg/L as Na	3	2.8	3	2.7	2	1.8	3	2.9	3	2.3	2	2.5
00931	Sodium adsorption ratio	1	.1	---	---	---	---	1	.1	1	.1	---	---
00932	Sodium, percent	1	6	---	---	---	---	1	6	1	7	---	---
00935	Potassium, dissolved, mg/L as K	3	.93	3	.85	2	.4	3	.7	3	.67	2	.95
00937	Potassium, total, mg/L as K	---	---	---	---	2	.55	---	---	1	1.1	---	---
00940	Chloride, dissolved, mg/L as Cl	3	2.8	2	3	4	1.3	3	2.1	4	1.6	2	1.6
00941	Chloride, total, mg/L as Cl	---	---	1	2.8	---	---	---	---	---	---	---	---
00945	Sulfate, dissolved, mg/L as SO_4	3	5.8	2	3.8	2	3.1	3	4.7	3	5.3	2	4.5
00950	Fluoride, dissolved, mg/L as F	3	.1	3	.09	2	.1	3	.1	3	<DL	2	<DL
00955	Silica, dissolved, mg/L as SiO_2	3	14	3	22	2	2	3	16	3	17	2	9.8
01002	Arsenic, total, µg/L as As	2	<DL	1	<DL	1	<DL	2	<DL	2	<DL	1	<DL
01005	Barium, dissolved, µg/L as Ba	1	23	1	25	1	25	1	28	1	62	1	21
01007	Barium, total, µg/L as Ba	2	<DL	1	<DL	1	<DL	2	<DL	2	<DL	1	<DL
01010	Beryllium, dissolved, µg/L as Be	1	<DL	1	<DL	1	<DL	1	<DL	1	<DL	1	<DL
01012	Beryllium, total, µg/L as Be	2	<DL	1	<DL	1	<DL	2	<DL	2	<DL	1	<DL
01027	Cadmium, total, µg/L as Cd	2	<DL	1	<DL	1	<DL	2	<DL	2	<DL	1	<DL
01034	Chromium, total, µg/L as Cr	2	6.5	1	2	1	4	2	2.5	2	4	1	4
01037	Cobalt, total, µg/L as Co	2	<DL	1	<DL	1	<DL	2	<DL	2	<DL	1	<DL
01042	Copper, total, µg/L as Cu	2	2.5	1	5	1	3	2	5	2	4	1	2
01044	Iron, suspended, µg/L as Fe	2	250	1	100	1	170	2	290	2	1,000	---	---
01045	Iron, total, µg/L as Fe	3	500	2	300	2	280	3	440	3	1,900	2	140
01046	Iron, dissolved, µg/L as Fe	3	88	2	17	2	49	3	130	3	950	2	4.5

Table 7. Summary of selected water-quality characteristics for samples from the lakes of interest for the St. Croix Reservation and vicinity, Wisconsin—Continued

Parameter code	Characteristic	Bashaw Lake		Big Round Lake		Big Sand Lake		Clam Lake		Gaslyn Lake		Sand Lake	
		N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean
01051	Lead, total, µg/L as Pb	2	<DL	1	<DL	1	<DL	2	<DL	2	<DL	1	<DL
01054	Manganese, suspended, µg/L as Mn	1	40	---	---	---	---	1	50	1	180	---	---
01055	Manganese, total, µg/L as Mn	2	80	1	160	3	83	2	55	3	200	1	30
01056	Manganese, dissolved, µg/L as Mn	3	23	3	11	2	3.5	3	14	3	120	2	<DL
01062	Molybdenum, total, µg/L as Mo	2	2	1	<DL	1	<DL	2	1	2	1.5	1	3
01065	Nickel, dissolved, µg/L as Ni	1	1	1	1	1	1	1	2	1	80	1	1
01067	Nickel, total, µg/L as Ni	2	9	1	4	1	5	2	8.5	2	19	1	4
01077	Silver, total, µg/L as Ag	2	<DL	1	<DL	1	<DL	2	<DL	2	<DL	1	<DL
01080	Strontium, dissolved, µg/L as Sr	2	42	1	39	1	24	2	48	2	40	1	34
01092	Zinc, total, µg/L as Zn	2	20	1	10	1	10	2	20	2	30	1	10
01095	Antimony, dissolved, µg/L as Sb	1	<DL	1	<DL	1	<DL	1	<DL	1	<DL	1	<DL
01105	Aluminum, total, µg/L as Al	2	20	2	25	1	110	2	20	2	40	1	50
01147	Selenium, total, µg/L as Se	2	<DL	1	<DL	1	<DL	2	<DL	2	<DL	1	<DL
32210	Chlorophyll *a*, µg/L, trichromatic uncorrected	---	---	---	---	2	7.37	---	---	1	30	---	---
70300	Dissolved residue, mg/L at 180°C	3	120	2	120	2	55	3	130	3	110	2	95
70301	Dissolved solids, sum, mg/L	1	120	---	---	---	---	1	120	1	98	---	---
70507	Orthophosphorus, total, mg/L as P	2	.03	2	.04	2	.02	2	.02	2	.03	2	<DL
71846	Ammonia, dissolved, mg/L	1	.03	---	---	---	---	1	.03	1	.03	1	.12
71851	Nitrate, dissolved, mg/L as NO_3	---	---	1	.82	---	---	---	---	---	---	---	---
71885	Iron, µg/L as Fe	---	---	1	20	---	---	---	---	---	---	---	---
71886	Phosphorus, total, mg/L as PO_4	1	.31	1	.31	1	.15	1	.06	1	.06	---	---
71900	Mercury, total, µg/L as Hg	2	.15	1	.2	1	<DL	2	.2	2	.3	1	.1
74010	Iron, total, mg/L as Fe	---	---	---	---	2	1.5	---	---	1	.25	---	---
82079	Turbidity, lab, NTU	---	---	1	1.5	---	---	---	---	---	---	---	---

Table 8. Summary of selected water-quality characteristics for samples from the steams of interest for the St. Croix Reservation and vicinity, Wisconsin

[N, number; ---, no data; <DL, less than the detection limit; °C, degrees Celsius; ft^3/s, cubic feet per second; JTU, Jackson turbidity unit; FTU, formazin turbidity unit; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; MF, membrane filter; mL, milliliter; mm, millimeter; pCi/L, picocuries per liter]

Parameter code	Characteristic	St. Croix River near Danbury, Wis. (USGS station 05333500)		Loon Creek near Danbury, Wis. (USGS station 05335010)		Yellow River near Danbury, Wis. (USGS station 05335031)		Yellow River near Spooner, Wis. (USGS station 05334270)	
		N	Mean	N	Mean	N	Mean	N	Mean
00010	Water temperature, field, °C	189	9.3	1	8	21	12.6	1	15.2
00060	Streamflow, ft^3/s	32	1,620	---	---	---	---	---	---
00061	Streamflow, instantaneous, ft^3/s	178	1,700	---	---	22	363	---	---
00070	Turbidity, JTU	11	2.1	---	---	---	---	---	---
00076	Turbidity, Hach, FTU	9	2.1	---	---	---	---	---	---
00080	Color, platinum cobalt scale	22	34	1	30	---	---	---	---
00095	Specific conductance, µS/cm at 25°C	185	124	1	130	22	157	1	200
00300	Oxygen, dissolved, mg/L	80	10.5	---	---	20	10.3	1	10
00400	pH, field	87	7.5	1	7.2	21	7.9	1	8.2
00403	pH, whole water, lab	65	7.6	---	---	3	7.7	1	8.2
00405	Carbon dioxide, mg/L	77	7.2	---	---	16	2.1	---	---
00410	Alkalinity, total, mg/L as $CaCO_3$	21	54	1	60	11	76	---	---
00440	Bicarbonate, mg/L as HCO_3	14	67	1	73	6	95	---	---
00445	Carbonate, mg/L as CO_3	13	0	1	0	5	0	---	---
00452	Carbonate, field, mg/L as CO_3	24	3.4	---	---	---	---	---	---
00453	Bicarbonate, field, mg/L as HCO_3	53	62	---	---	---	---	---	---
00600	Nitrogen, total, mg/L as N	62	.52	---	---	21	.76	1	.4
00605	Nitrogen, organic, mg/L as N	53	.36	---	---	20	.55	1	.18
00608	Nitrogen, ammonia, dissolved, mg/L as N	55	.03	---	---	4	.06	1	.02
00610	Nitrogen, ammonia, total, mg/L as N	28	.04	---	---	17	.05	1	.02
00613	Nitrogen, nitrite, dissolved, mg/L as N	55	.01	---	---	4	.02	---	---
00615	Nitrogen, nitrite, total, mg/L as N	28	.01	---	---	17	.01	1	<DL
00620	Nitrogen, nitrate, total, mg/L as N	20	.11	---	---	13	.15	---	---
00623	Nitrogen, kjeldahl, dissolved, mg/L	55	.28	---	---	4	.38	---	---
00625	Nitrogen, kjeldahl, total, mg/L as N	84	.38	---	---	21	.59	1	.2
00630	Nitrogen, nitrite plus nitrate, total, mg/L as N	28	.12	---	---	17	.16	1	.2
00631	Nitrogen, nitrite plus nitrate, dissolved, mg/L as N	55	.11	---	---	4	.23	1	.16
00650	Phosphate, total, mg/L as PO_4	1	.09	---	---	1	.09	---	---
00665	Phosphorus, total, mg/L as P	84	.02	---	---	22	.06	1	.02

Table 8. Summary of selected water-quality characteristics for samples from the steams of interest for the St. Croix Reservation and vicinity, Wisconsin—Continued

Parameter code	Characteristic	St. Croix River near Danbury, Wis. (USGS station 05333500)		Loon Creek near Danbury, Wis. (USGS station 05335010)		Yellow River near Danbury, Wis. (USGS station 05335031)		Yellow River near Spooner, Wis. (USGS station 05334270)	
		N	Mean	N	Mean	N	Mean	N	Mean
00666	Phosphorus, dissolved, mg/L as P	81	.02	---	---	18	.02	1	.02
00671	Phosphorus, dissolved orthophosphate, mg/L as P	55	.01	---	---	4	.02	1	.02
00680	Carbon, organic, total, mg/L as C	16	8.8	---	---	16	6.1	---	---
00681	Carbon, organic, dissolved, mg/L as C	54	7	---	---	---	---	---	---
00689	Carbon, organic, suspended, mg/L as C	54	.46	---	---	---	---	---	---
00720	Cyanide, total, mg/L as Cn	8	.004	---	---	---	---	---	---
00900	Hardness, total, mg/L as $CaCO_3$	86	57	1	67	---	---	1	97
00902	Hardness, noncarbonate, mg/L as $CaCO_3$	24	4.2	1	7	---	---	---	---
00915	Calcium, dissolved, mg/L as Ca	85	16	1	19	---	---	1	25
00925	Magnesium, dissolved, mg/L as Mg	85	4.3	1	4.7	---	---	1	8.5
00930	Sodium, dissolved, mg/L as Na	84	2.3	1	1.8	---	---	1	3.9
00931	Sodium adsorption ratio	84	.11	1	.1	---	---	1	.2
00932	Sodium, percent	84	8	1	5	---	---	1	8
00935	Potassium, dissolved, mg/L as K	84	.62	1	.6	---	---	1	.7
00940	Chloride, dissolved, mg/L as Cl	87	2.2	1	1	17	2.1	1	4.5
00945	Sulfate, dissolved, mg/L as SO_4	87	3.9	1	7.6	---	---	1	7.1
00950	Fluoride, dissolved, mg/L as F	85	.1	1	.1	---	---	1	.1
00955	Silica, dissolved, mg/L as SiO_2	84	12	1	16	---	---	1	16
01002	Arsenic, total, µg/L as As	9	1.2	---	---	---	---	1	<DL
01007	Barium, total, µg/L as Ba	4	88	---	---	---	---	1	200
01012	Beryllium, total, µg/L as Be	1	<DL	---	---	---	---	1	<DL
01022	Boron, total, µg/L as B	8	27	---	---	---	---	---	---
01027	Cadmium, total, µg/L as Cd	9	1.4	---	---	---	---	1	<DL
01034	Chromium, total, µg/L as Cr	9	17	---	---	---	---	1	1
01037	Cobalt, total, µg/L as Co	9	1.1	---	---	---	---	1	<DL
01042	Copper, total, µg/L as Cu	8	4.9	---	---	---	---	1	3
01044	Iron, suspended, µg/L as Fe	---	---	---	---	---	---	1	80
01045	Iron, total, µg/L as Fe	8	380	---	---	---	---	1	190
01046	Iron, dissolved, µg/L as Fe	67	240	---	---	---	---	1	110
01051	Lead, total, µg/L as Pb	9	9.3	---	---	---	---	1	<DL
01054	Manganese, suspended, µg/L as Mn	---	---	---	---	---	---	1	3

Table 8. Summary of selected water-quality characteristics for samples from the steams of interest for the St. Croix Reservation and vicinity, Wisconsin—Continued

Parameter code	Characteristic	St. Croix River near Danbury, Wis. (USGS station 05333500)		Loon Creek near Danbury, Wis. (USGS station 05335010)		Yellow River near Danbury, Wis. (USGS station 05335031)		Yellow River near Spooner, Wis. (USGS station 05334270)	
		N	Mean	N	Mean	N	Mean	N	Mean
01055	Manganese, total, µg/L as Mn	9	38	---	---	---	---	1	10
01056	Manganese, dissolved, µg/L as Mn	67	14	---	---	---	---	1	7
01062	Molybdenum, total, µg/L as Mo	---	---	---	---	---	---	1	<DL
01067	Nickel, total, µg/L as Ni	9	4.7	---	---	---	---	1	3
01077	Silver, total, µg/L as Ag	8	.38	---	---	---	---	1	<DL
01080	Strontium, dissolved, µg/L as Sr	---	---	---	---	---	---	1	43
01092	Zinc, total, µg/L as Zn	9	16	---	---	---	---	1	20
01105	Aluminum, total, µg/L as Al	---	---	---	---	---	---	1	<DL
01147	Selenium, total, µg/L as Se	9	.9	---	---	---	---	1	<DL
31616	Fecal coliform, MF M-FC broth, colonies/100 mL	4	8	---	---	22	21	---	---
31625	Fecal coliform, MF M-FC agar, 0.7 mm, colonies/100 mL	24	35	---	---	14	28	---	---
31673	Fecal streptococci, MF KF agar, colonies/100 mL	24	180	---	---	14	1,080	---	---
31679	Fecal streptococci, MF M-Ent agar, colonies/100 mL	4	57	---	---	3	360	---	---
39086	Alkalinity, total filtered, incremental, mg/L as $CaCO_3$	53	51	---	---	---	---	---	---
70300	Dissolved residue, mg/L at 180°C	86	86	1	91	---	---	1	130
70301	Dissolved solids, sum, mg/L	83	73	1	87	---	---	1	120
70302	Dissolved solids, tons per day	83	370	---	---	---	---	---	---
70303	Dissolved solids, tons per acre-ft	84	.12	1	.12	---	---	---	---
70331	Suspended sediment, percent <0.062 mm	50	67	---	---	20	64	---	---
70507	Orthophosphorus, total, mg/L as P	---	---	---	---	---	---	1	.02
71845	Ammonia, total, mg/L	26	.05	---	---	17	.06	---	---
71846	Ammonia, dissolved, mg/L	28	.04	---	---	---	---	1	.03
71851	Nitrate, dissolved, mg/L as NO_3	12	.57	1	.7	---	---	---	---
71883	Manganese, elemental, µg/L as Mn	---	---	1	100	---	---	---	---
71885	Iron, µg/L as Fe	1	270	1	350	---	---	---	---
71886	Phosphorus, total, mg/L as PO_4	14	.09	1	.05	11	.13	1	.06
71887	Nitrogen, total, mg/L as NO_3	24	2.4	---	---	17	3.4	1	1.8
71900	Mercury, total, µg/L as Hg	9	.44	---	---	---	---	1	<DL
80154	Suspended sediment, mg/L	85	10	---	---	22	4.2	---	---
80155	Suspended sediment, discharge, tons per day	84	61	---	---	22	4.2	---	---
82068	Potassium-40, dissolved, pCi/L as K-40	3	.7	---	---	---	---	---	---

Table 9. Characteristics and description of ground-water studies, St. Croix Reservation and vicinity, Wisconsin
[X, study includes description of these characteristics relevant to Reservation and vicinity]

Literature citation	Characteristics						Description
	Water quality	Water use	Geology/aquifer characteristics	Flow direction	Modeling	Other	
Andrews and others (1995)	X			X		X	Regional study of the Upper Mississippi River Valley area. Shows the relationship between ground water and human factors including land use, population distributions, landfill locations, and volatile organic-compound (VOC) release areas. Includes a map of the St. Croix River Basin that shows low levels of trihalomethane and VOCs for areas in the vicinity of the Reservation.
Andrews and others (1996)	X		X				Regional study of the Upper Mississippi River Valley area. Contains general information on surficial and bedrock geology, and water-quality for the study area. Report includes many references relevant to the study area.
Bell and Hindall (1975)	X	X	X	X			Local study of Rice Lake - Eau Claire area. Rice Lake, Menominee and Cameron aquifers studied in terms of thickness, transmissivity, water yielding capability, water-flow direction, water quality, and lithology. Soil conditions and water availability discussed in terms of their agricultural implications. The Rice Lake subarea is adjacent to the eastern edge of the Sand Lake Watershed and reaches of the Yellow River appear in geology and soil maps.
Bridson (1997a)	X						Local study of ground-water quality for Burnett County, which includes part of the study area. Report includes maps of nitrate, chloride, alkalinity, ferrous iron concentrations, hardness, and electrical conductivity measurements from numerous wells.
Bridson (1997b)	X						Local study of ground-water quality for Polk County, which includes part of the study area. Report includes maps of nitrate, chloride, alkalinity, ferrous iron concentrations, hardness, and electrical conductivity measurements from numerous wells.
DeWild and Krohelski (1995)	X						Regional study summarizing 29 ground-water samples and 29 soil-gas samples collected and analyzed for radon-222 from Reservations in Wisconsin. At two sites on St. Croix Reservation, ground-water concentrations of radon range from 440 to 530 pCi/L and soil-gas concentrations range from 240 to 1,390 pCi/L.
Engel and Nichols (1991)						X	Local study of the Rice Lake system. Relates ground-water flow to surface-water flow with seasonal water budgets. Biomass analysis has been conducted around the lake with an explanation of the limits to growth. This area is adjacent to the St. Croix Reservation in Polk County, and may be useful as examples of biota growth in the surrounding area.
Erickson and Cotter (1983)						X	Statewide summary of trends in ground-water levels in Wisconsin. Includes information from several wells in the study area.
Fallon and others (1997)	X		X		X		Regional study of pesticides in streams, streambed sediment, and ground water of the Upper Mississippi River Basin. Ground-water parts of the report focus on physical geology of the aquifers with connections to surface-water contamination from pesticides.

Table 9. Characteristics and description of ground-water studies, St. Croix Reservation and vicinity, Wisconsin—Continued

Literature citation	Characteristics: Water quality	Water use	Geology/aquifer characteristics	Flow direction	Modeling	Other	Description
Hanson (1998)	X		X		X		Regional study of the Upper Mississippi River Basin and its susceptibility to contamination of groundwater. Water-quality data includes pesticide and nitrate. Focuses on links between land use and water quality. Shows that the St. Croix Reservation and vicinity has a relatively high susceptibility to ground-water contamination.
Holmstrom and others (1990–99)	X		X				Statewide summaries of water levels and water-quality for USGS-monitored ground-water sites in Wisconsin for water years 1989 through 1998.
Horsley and Witten, Inc. (1999)	X	X	X	X	X		Local study of the St. Croix Reservation. Includes descriptions of hydrogeologic setting and a summary of water quality for the public-supply wells of the Reservation. Also includes well-head delineations for the public-supply wells.
Johnson (1986)			X				Local study of the Pleistocene geology of Barron County. Includes a glacial history of the area. Geomorphic feature overview includes the locations of glacial deposits and ice margins. Drill-hole logs provide information on strata and soil types. Drill holes 26, 27, and 31 are just out-side of the Sand Lake Watershed.
Johnson and others (1999)			X			X	Regional study of Glacial Lake Lind deposits in northwestern Wisconsin. Includes details on red clay deposits and other stratigraphic layers in the vicinity of the St. Croix Reservation.
Kammerer (1981)	X		X		X		Statewide summary of ground-water-quality data from the USGS WATSTORE data base. Major aquifer systems are evaluated in terms of the concentrations of inorganic and trace constituents in water samples. Includes only general information for the study area.
Kammerer (1984)	X		X		X		Statewide summary of water-quality data from the USGS WATSTORE data base by aquifer and ground-water province. Constituents include major ions, dissolved solids, iron, manganese, and nitrate. Also contains information from wells in the vicinity of the reservation, along with several maps showing potential sources of ground-water contamination.
Kammerer (1995)	X		X	X	X		Statewide summary of shallow ground-water flow and quality data from the USGS WATSTORE data base, presented as contoured concentration maps. Constituents include major ions, dis-solved solids, sulfide, fluoride, iron, manganese, and nitrate. Includes information from wells in the vicinity of the Reservation.
Kammerer and others (1998)	X		X	X			Statewide summary of geology, ground-water flow, and dissolved solids concentrations along hydrogeologic sections through Wisconsin aquifers. Two of the sections cross the study area.
Krabbenhoft and Krohelski (1992)	X						Local summary of the water quality, lake sediment, and lake-level fluctuations for the St. Croix Reservation. Ground-water-quality measurements include hardness, dissolved calcium, mag-nesium, nitrogen, phosphorus, arsenic, iron, lead, mercury, selenium, and zinc.
Mudrey and Bradbury (1992)	X						Statewide summary of trace-constituent data in ground water that was collected as part of the U.S. Department of Energy NURE program. Includes 14 wells near the Reservation. Report summarizes statistics and maps for 34 trace constituents and field measurements of pH, dis-solved oxygen, alkalinity, and specific conductance.
Muldoon and Dahl (1998)			X				Local study of Burnett County water-table elevations. Map includes much of the study area.

Table 9. Characteristics and description of ground-water studies, St. Croix Reservation and vicinity, Wisconsin—Continued

Literature citation	Characteristics						Description
	Water quality	Water use	Geology/aquifer characteristics	Flow direction	Modeling	Other	
Muldoon and others (1990)	X		X				Regional study focused on natural occurrence of phosphorus in geologic materials and in ground water and possible effects on lake water quality. Includes information for several of the lakes of interest to the Tribe.
Olcott (1992)	X	X	X	X			Regional summary of aquifer systems in Iowa, Michigan, Minnesota, and Wisconsin. Includes maps of geology, aquifers, aquifer characteristics, water quality, and water use. Maps show considerable detail in the vicinity of the study area for some information.
Patterson and Zaporozec (1987)						X	Statewide analysis of water-level fluctuations in Wisconsin wells. Includes several wells in the study area.
Rose (1993)	X		X	X			Local study of Balsam Lake in northwestern Wisconsin. Ground-water quality and hydraulic gradient were analyzed from 11 piezometers placed in ground-water seepage-emergence areas. Balsam Lake is adjacent to the Big Round Lake watershed in Polk County. Report may be useful as an example of how to monitor water quality in a similar geologic setting.
Schmidt and Kessler (1987)			X		X		Statewide map of ground-water-contamination susceptibility in Wisconsin. Information used to make the final map is also presented, including depth to bedrock, bedrock type, depth to water table and soil-characteristic maps. Shows considerable detail for the study area, which is moderately to highly susceptible to ground-water contamination.
Siegel and others (1995)	X		X				Regional study including Polk County that examines seasonal changes in pore-water chemistry of peatlands. Examines the downward hydraulic conductivity of pore waters into mineral-rich soil. Deals with water table influence on the specific conductance and acidity of peat. The peatlands detailed in this article are in the vicinity of the St. Croix Reservation.
Stark and others (1996)	X		X				Regional summary of water quality for the Upper Mississippi River Basin in Minnesota and Wisconsin. Ground-water data includes physical and chemical measurements from major aquifers. Report provides general water-quality information for the study area.
Stark and others (1999)	X		X				Regional study of water quality for the Upper Mississippi River Basin in Minnesota and Wisconsin. Contains general information on ground-water quality, bedrock geology, and land use for the study area.
U.S. Environmental Protection Agency (1992)	X	X			X		Statewide documentation of risk evaluation for the environmental problems faced by Tribes in Wisconsin. Water-resources-related problems are described in the report and are relevant to the Reservation, including industrial, municipal, and nonpoint-source discharges; drinking water and ground-water contamination; physical degradation of aquatic habitat; unintended releases of toxic substances; and pesticides.
Warzecha and others (1995)	X						Statistically designed statewide survey of 538 wells in Wisconsin. Includes wells in the vicinity of the Reservation. Most of the wells near the Reservation are below standards for the measured constituents, which include nitrate, sulfate, atrazine, arsenic, radon, and bacteria.

Table 9. Characteristics and description of ground-water studies, St. Croix Reservation and vicinity, Wisconsin—Continued

Literature citation	Characteristics						Description
	Water quality	Water use	Geology/aquifer characteristics	Flow direction	Modeling	Other	
Wisconsin Department of Natural Resources (1972)						X	Regional study of water-quality standards in the St. Croix River Valley. Proposes pollution-control requirements. Has little quantitative data, but provides general environmental description of the study area.
Wisconsin Department of Natural Resources (1975)	X	X					Regional study of the water quality in the St. Croix River Basin. Provides information for wells in and around the St. Croix Reservation.
Wisconsin Department of Natural Resources (1982)	X	X				X	Regional study of St. Croix River Basin that focuses on the treatment of wastewater. Describes point and nonpoint sources of pollutions. Regulatory actions are listed along with potential costs of implementation. Could be a relevant source of information for costs of implementing regulations in the vicinity of the reservation.
Wisconsin Department of Natural Resources (1984)	X	X					Regional study of the St. Croix River Basin focusing on point and nonpoint sources of pollution. Pollution sources are identified as the causes of water-quality problems. Watersheds in the study area are identified for future monitoring.
Wisconsin Nonpoint Source Water Pollution Abatement Program (1993a)	X	X					Local study of the Yellow River Watershed in Barron County in the vicinity of the St. Croix Reservation. Survey of watershed includes land-use management, agricultural practices, point and nonpoint pollution, water-supply locations, and water-quality characteristics including common ions. Provides goals for future land-use practices that may be relevant to the St. Croix Tribe.
Wisconsin Nonpoint Source Water Pollution Abatement Program (1993b)	X	X					Local study of the Yellow River Watershed in Barron County in the vicinity of the St. Croix Reservation. This report focuses on the cost aspects of the study.
Wisconsin Nonpoint Source Water Pollution Abatement Program (1995)	X					X	Local study of the Balsam Branch watershed which is adjacent to the Big Round Lake Watershed. Survey of watershed includes point and nonpoint pollution sources, water-supply locations, and water-quality characteristics such as common ions. Lists goals for future land use practices that may be relevant to the St. Croix Tribe.
Young and Hindall (1973)	X	X	X	X			Regional summary of the water resources of the St. Croix River Basin. Includes a wide variety of surface- and ground-water information relevent to the study area and a detailed description of the physical setting. Ground-water information includes geology, aquifer characteristics, well yields, and water quality.
Zaporozec (1986)	X		X	X			Local study of Barron County ground-water quality, which includes part of the Sand Lake Watershed. Water-quality measurements are summarized by town by means of contour maps. Report also includes descriptions of geology and ground-water availability.
Zaporozec (1987)	X		X			X	Local atlas of ground-water resources and geology of Barron County. Includes maps of geology, soils, ground-water levels, water quality, and potential sources of ground-water pollution. This county study includes part of the Sand Lake Watershed in the southeast part of the study area.

Table 10. Summary of selected water-quality characteristics for samples from drinking-water wells, St. Croix Reservation and vicinity, Wisconsin

[N, number of samples; Min, minimum value; Max, maximum value; <DL, less than detection limit; °C, degrees Celsius; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; MPN, most probable number; MUG, 4-methylumbelliferyl-D-galactopyranoside; ONPG, ortho-nitrophenyl-*B*-galactoside]

Parameter code	Characteristic	N	Min	Max
00010	Water temperature, field, °C	92	6	52
00080	Color, platinum cobalt scale	16	0	5
00095	Specific conductance, µS/cm at 25°C	62	31	620
00300	Oxygen, dissolved, mg/L	11	1.7	10.1
00400	pH, field	72	6	8.4
00403	pH, lab	42	6.5	8.3
00410	Alkalinity, total, mg/L as $CaCO_3$	67	31	220
00405	Carbon dioxide, mg/L as CO_2	2	5.7	8.8
00440	Bicarbonate, mg/L as HCO_3	27	23	250
00445	Carbonate, mg/L as CO_3	24	<DL	2
00500	Residue, total, mg/L	10	110	300
00607	Nitrogen, organic, dissolved, mg/L as N	5	<DL	.03
00608	Nitrogen, ammonia, dissolved, mg/L as N	7	<DL	.18
00613	Nitrogen, nitrite, dissolved, mg/L as N	40	<DL	.49
00615	Nitrogen, nitrite, total, mg/L as N	61	<DL	.8
00618	Nitrogen, nitrate, dissolved, mg/L as N	77	<DL	8.4
00620	Nitrogen, nitrate, total, mg/L as N	56	<DL	9.2
00623	Nitrogen, kjeldahl, dissolved, mg/L as N	5	<DL	<DL
00630	Nitrogen, nitrite plus nitrate, total, mg/L as N	362	<DL	22
00631	Nitrogen, nitrite plus nitrate, dissolved, mg/L as N	48	<DL	6.6
00660	Phosphorus, dissolved orthophosphate, mg/L as PO_4	3	.06	.13
00681	Carbon, organic, dissolved, mg/L as C	18	<DL	6.9
00720	Cyanide, total, mg/L	29	<DL	<DL
00900	Hardness, total, mg/L as $CaCO_3$	56	28	200
00902	Hardness, noncarbonate, mg/L as $CaCO_3$	42	<DL	91
00915	Calcium, dissolved, mg/L	56	6.5	59
00916	Calcium, total, mg/L as Ca	26	9.1	75
00925	Magnesium, dissolved, mg/L as Mg	55	2.9	20
00927	Magnesium, total, mg/L as Mg	27	<DL	22
00929	Sodium, total, mg/L as Na	38	2	27
00930	Sodium, dissolved, mg/L as Na	20	2	49
00931	Sodium adsorption ratio	9	.1	.7
00932	Sodium, percent	9	3	23
00935	Potassium, dissolved, mg/L as K	11	.5	2
00937	Potassium, total, mg/L as K	4	.3	1.2
00940	Chloride, dissolved, mg/L as Cl	65	<DL	73
00945	Sulfate, dissolved, mg/L as SO_4	69	<DL	55
00946	Sulfate, total, mg/L as SO_4	15	<DL	8
00950	Fluoride, dissolved, mg/L as F	47	<DL	1
00951	Fluoride, total, mg/L as F	22	<DL	1.1
00955	Silica, dissolved, mg/L	11	14	31
00956	Silica, total, mg/L	4	13	15
01000	Arsenic, dissolved, µg/L as As	5	<DL	2

Table 10. Summary of selected water-quality characteristics for samples from drinking-water wells, St. Croix Reservation and vicinity, Wisconsin—Continued

Parameter code	Characteristic	N	Min	Max
01002	Arsenic, total, µg/L	25	<DL	14
01007	Barium, total, µg/L as Ba	44	<DL	190
01012	Beryllium, total, µg/L	25	<DL	1
01020	Boron, dissolved, mg/L as B	5	<DL	110
01022	Boron, total, mg/L as B	14	<DL	32
01025	Cadmium, dissolved, µg/L as Cd	14	<DL	3
01027	Cadmium, total, µg/L	32	<DL	2
01030	Chromium, dissolved, µg/L as Cr	2	<DL	<DL
01034	Chromium, total, µg/L	55	<DL	20
01035	Cobalt, dissolved, µg/L as Co	5	<DL	<DL
01037	Cobalt, total, µg/L as Co	14	<DL	13
01040	Copper, dissolved, µg/L as Cu	5	<DL	<DL
01042	Copper, total, µg/L	46	<DL	1,500
01044	Iron, suspended, µg/L	4	140	640
01045	Iron, total, µg/L	43	<DL	3,900
01046	Iron, dissolved, mg/L as Fe	9	<DL	9,400
01049	Lead, dissolved, µg/L as Pb	5	<DL	6
01051	Lead, total, µg/L as Pb	34	<DL	27
01055	Manganese, total, µg/L as Mn	52	<DL	2,700
01056	Manganese, dissolved, µg/L as Mn	9	<DL	540
01059	Thallium, total, µg/L as Tl	24	<DL	<DL
01062	Molybdenum, total, µg/L as Mo	14	<DL	7
01067	Nickel, total, µg/L as Ni	25	<DL	4
01075	Silver, dissolved, µg/L as Ag	5	<DL	<DL
01077	Silver, total, µg/L as Ag	18	<DL	2
01082	Strontium, total, µg/L as Sr	4	19	44
01087	Vanadium, total, µg/L as V	14	<DL	<DL
01090	Zinc, dissolved, µg/L as Zn	5	20	3,200
01092	Zinc, total, µg/L as Zn	43	<DL	4,400
01097	Antimony, total, µg/L as Sb	11	<DL	<DL
01105	Aluminum, total, µg/L as Al	16	<DL	<DL
01132	Lithium, total, µg/L as Li	14	<DL	6
01145	Selenium, dissolved, µg/L as Se	5	<DL	<DL
01147	Selenium, total, µg/L as Se	58	<DL	10
01162	Zirconium, total, µg/L as Zr	14	<DL	<DL
01189	Scandium, total, µg/L as Sc	14	<DL	<DL
01203	Yttrium, total, µg/L as Y	14	<DL	1
01239	Niobium, total, µg/L as Nb	14	<DL	4
11501	Radium 228, total, pCi/L as radium 228	1	4.3	4.3
22705	Uranium, total, µg/L	14	<DL	.73
31508	Coliform, total, 5 tube MPN	198	0	5
31855	Bacteria, sulfate reducing	1	<DL	<DL
32101	Bromodichloromethane, total, µg/L	118	<DL	<DL
32102	Carbon tetrachloride, total, µg/L	120	<DL	<DL

Table 10. Summary of selected water-quality characteristics for samples from drinking-water wells, St. Croix Reservation and vicinity, Wisconsin—Continued

Parameter code	Characteristic	N	Min	Max
32104	Bromoform, total, µg/L	118	<DL	<DL
32105	Dibromochloromethane, total, µg/L	119	<DL	<DL
32106	Chloroform, total, µg/L	118	<DL	2.7
32730	Phenols, total, µg/L	5	<DL	3
34010	Toluene, total, µg/L	120	<DL	4.3
34030	Benzene, total, µg/L	117	<DL	2.3
34200	Acenaphthylene, total, µg/L	4	<DL	<DL
34205	Acenaphthene, total, µg/L	4	<DL	<DL
34210	Acrolein, total, µg/L	14	<DL	<DL
34215	Acrylonitrile, total, µg/L	14	<DL	<DL
34220	Anthracene, total, µg/L	4	<DL	<DL
34225	Asbestos, fibrous, total, µg/L	1	<DL	<DL
34230	Benzo[*b*]fluoranthene, total, µg/L	4	<DL	<DL
34242	Benzo[*k*]fluoranthene, total, µg/L	4	<DL	<DL
34247	Benzo[*a*]pyrene, total, µg/L	7	<DL	<DL
34259	Benzene hexachloride, delta, total, µg/L	1	<DL	<DL
34301	Chlorobenzene, total, µg/L	120	<DL	<DL
34311	Chloroethane, total, µg/L	115	<DL	<DL
34320	Chrysene, total, µg/L	4	<DL	<DL
34351	Endosulfan sulfate, total, µg/L	1	<DL	<DL
34356	Endosulfan, beta, total, µg/L	1	<DL	<DL
34361	Endosulfan, alpha, total, µg/L	1	<DL	<DL
34371	Ethylbenzene, total, µg/L	120	<DL	.43
34376	Fluoranthene, total, µg/L	4	<DL	<DL
34381	Fluorene, total, µg/L	4	<DL	<DL
34386	Hexachlorocyclopentadiene, total, µg/L	12	<DL	<DL
34391	Hexachlorobutadiene, total, µg/L	42	<DL	<DL
34396	Hexachloroethane, total, µg/L	22	<DL	<DL
34403	Indeno[1,2,3-*cd*]pyrene, total, µg/L	4	<DL	<DL
34413	Bromomethane, total, µg/L	118	<DL	<DL
34418	Chloromethane, total, µg/L	49	<DL	.11
34423	Dichloromethane, total, µg/L	106	<DL	32
34461	Phenanthrene, total, µg/L	4	<DL	<DL
34469	Pyrene, total, µg/L	4	<DL	.03
34475	Tetrachloroethylene, total, µg/L	124	<DL	58
34488	Trichlorofluoromethane, total, µg/L	89	<DL	240
34496	1,1-Dichloroethane, total, µg/L	118	<DL	2.4
34501	1,1-Dichloroethylene, total, µg/L	120	<DL	8.6
34506	1,1,1-Trichloroethane, total, µg/	120	<DL	55
34511	1,1,2-Trichloroethane, total, µg/L	120	<DL	<DL
34516	1,1,2,2-Tetrachloroethane, total, µg/L	118	<DL	<DL
34521	Benzo[*g*,*h*,*i*]perlyene, total, µg/L	4	<DL	.03
34526	Benzo[*a*]anthracene, total, µg/L	4	<DL	<DL
34531	1,2-Dichloroethane, total, µg/L	125	<DL	120
34536	1,2-Dichlorobenzene, total, µg/L	120	<DL	<DL
34541	1,2-Dichloropropane, total, µg/L	76	<DL	<DL

Table 10. Summary of selected water-quality characteristics for samples from drinking-water wells, St. Croix Reservation and vicinity, Wisconsin—Continued

Parameter code	Characteristic	N	Min	Max
34546	1,2-Dichloroethylene, total, µg/L	120	<DL	<DL
34551	1,2,4-Trichlorobenzene, total, µg/L	104	<DL	<DL
34556	Dibenzo[*a,h*]anthracene, total, µg/L	4	<DL	<DL
34566	1,3-Dichlorobenzene, total, µg/L	120	<DL	<DL
34571	1,4-Dichlorobenzene, total, µg/L	120	<DL	<DL
34576	2-Chloroethyl vinyl ether, total, µg/L	69	<DL	<DL
34668	Dichlorodifluoromethane, total, µg/L	20	<DL	<DL
34670	Polychorinated biphenyl 1260, total, µg/L	1	<DL	<DL
34671	Polychorinated biphenyl 1016, total, µg/L	1	<DL	<DL
34680	Aldrin, µg/L	11	<DL	<DL
34688	Hexachlorobenzene, µg/L	12	<DL	<DL
34696	Naphthalene, total, µg/L	46	<DL	<DL
34699	*trans*-1,3-Dichloropropene, total, µg/L	75	<DL	<DL
34704	*cis*-1,3-Dichloropropene, total, µg/L	75	<DL	<DL
34670	Methylene blue active substances, mg/L	9	<DL	<DL
38432	Dalapon, µg/L	12	<DL	<DL
38437	1,2-Dibromo-3-chloropropane, total, µg/L	56	<DL	<DL
38692	*Leptothrix*, count per mL	3	<DL	<DL
38694	*Gallionella*, count per mL	3	<DL	<DL
38695	*Crenothrix*, count per mL	3	<DL	4,400
38865	Oxamyl, µg/L	12	<DL	<DL
38926	Endothall, µg/L	9	<DL	<DL
39032	Pentachlorophenol, total, µg/L	12	<DL	<DL
39033	Atrazine, µg/L	12	<DL	<DL
39051	Methomyl, µg/L	11	<DL	<DL
39053	Aldicarb, µg/L	11	<DL	<DL
39055	Simazine, µg/L	12	<DL	<DL
39175	Vinyl chloride, total, µg/L	120	<DL	<DL
39180	Trichloroethylene, total, µg/L	121	<DL	2.3
39300	*p,p’* DDT, total, µg/L	1	<DL	<DL
39310	*p,p’* DDD, total, µg/L	1	<DL	<DL
39320	*p,p’* DDE, total, µg/L	1	<DL	<DL
39337	alpha-BHC, total, µg/L	4	<DL	<DL
39338	beta-BHC, total, µg/L	1	<DL	<DL
39340	BHC Gamma (Lindane), µg/L	13	<DL	<DL
39348	alpha-Chlordane, µg/L	12	<DL	<DL
39350	Chlordane, µg/L	12	<DL	<DL
39356	Dual, µg/L	11	<DL	.1
39380	Dieldrin, µg/L	12	<DL	<DL
39390	Endrin, µg/L	13	<DL	<DL
39400	Toxaphene, µg/L	13	<DL	<DL
39410	Heptachlor, µg/L	13	<DL	<DL
39420	Heptachlor epoxide, µg/L	13	<DL	<DL
39480	Methoxychlor, µg/L	13	<DL	<DL
39488	PCB-1221, total, µg/L	1	<DL	<DL
39492	PCB-1232, total, µg/L	1	<DL	<DL

Table 10. Summary of selected water-quality characteristics for samples from drinking-water wells, St. Croix Reservation and vicinity, Wisconsin—Continued

Parameter code	Characteristic	N	Min	Max
39496	PCB-1242, total, µg/L	1	<DL	<DL
39500	PCB-1248, total, µg/L	1	<DL	<DL
39504	PCB-1254, total, µg/L	1	<DL	<DL
39515	PCB, total, µg/L	12	<DL	<DL
39516	PCB congeners, total in water, µg/L	2	<DL	<DL
39720	Picloram, µg/L	12	<DL	<DL
39730	2, 4-D, µg/L	12	<DL	<DL
39760	Silvex, total, µg/L	12	<DL	<DL
39810	gamma-Chlordane, µg/L	12	<DL	<DL
39941	Glyphosate, µg/L	9	<DL	<DL
46317	Alachlor, µg/L	12	<DL	<DL
46369	Ethylene dibromide, µg/L	2	<DL	<DL
46492	Triazine screen, µg/L	19	<DL	<DL
70300	Dissolved residue, mg/L at 180°C	56	64	370
70301	Dissolved solids, sum, mg/L	21	57	260
71846	Ammonia, dissolved, mg/L as ammonia	5	<DL	.1
71851	Nitrate, dissolved, mg/L as nitrate	23	.2	37
71855	Nitrite, total, mg/L as nitrite	6	.01	.66
71856	Nitrite, dissolved, mg/L as nitrite	5	<DL	.1
71875	Hydrogen sulfide, mg/L as H_2S	6	<DL	<DL
71883	Manganese, elemental, µg/L	22	<DL	360
71885	Iron, µg/L	22	<DL	1,100
71900	Mercury, total, µg/L	46	<DL	.5
74010	Iron, total, mg/L as Fe	16	<DL	14
77041	Carbon disulfide, µg/L	69	<DL	<DL
77057	Vinyl acetate, µg/L	22	<DL	<DL
77093	*cis*-1,2-Dichloroethylene, total, µg/L	106	<DL	<DL
77103	2-Hexanone, µg/L	22	<DL	<DL
77117	Isopropyl ether, µg/L	22	<DL	<DL
77128	Styrene, total, µg/L	120	<DL	<DL
77135	*o*-Xylene, µg/L	41	<DL	.65
77161	1,2-Dichloropropene, µg/L	44	<DL	<DL
77168	1,1-Dichloropropene, µg/L	104	<DL	<DL
77170	2,2-Dichloropropane, µg/L	104	<DL	<DL
77173	1,3-Dichloropropane, µg/L	104	<DL	<DL
77189	Butyl acetate, µg/L	14	<DL	<DL
77222	1,2,4-Trimethylbenzene, total, µg/L	41	<DL	<DL
77223	Isopropylbenzene, total, µg/L	56	<DL	<DL
77224	*n*-Propylbenzene, µg/L	39	<DL	4
77226	1,3,5-Trimethylbenzene, total, µg/L	42	<DL	3.6
77272	1-Chloro-3-Methylbenzene, total, µg/L	7	<DL	<DL
77275	*o*-Chlorotoluene, µg/L	117	<DL	<DL
77277	*p*-Chlorotoluene, µg/L	115	<DL	<DL
77297	Bromochloromethane, µg/L	39	<DL	<DL
77342	*n*-Butylbenzene, µg/L	39	<DL	<DL
77350	*sec*-Butylbenzene, µg/L	39	<DL	<DL

Table 10. Summary of selected water-quality characteristics for samples from drinking-water wells, St. Croix Reservation and vicinity, Wisconsin—Continued

Parameter code	Characteristic	N	Min	Max
77353	*tert*-Butylbenzene, µg/L	39	<DL	<DL
77356	*p*-Isopropyltoluene, µg/L	42	<DL	<DL
77424	Iodomethane, µg/L	22	<DL	<DL
77443	1,2,3-Trichloropropane, total, µg/L	104	<DL	<DL
77562	1,1,1,2-Tetrachloroethane, total, µg/L	118	<DL	<DL
77596	Dibromomethane, µg/L	104	<DL	<DL
77613	1,2,3-Trichlorobenzene, µg/L	39	<DL	<DL
77651	1,2-Dibromoethane (EDB), total, µg/L	74	<DL	<DL
77700	Carbaryl, µg/L	11	<DL	<DL
77860	Butachlor, µg/L	11	<DL	<DL
77903	*bis*-2-Ethylhexyl adipate, total, µg/L	3	<DL	<DL
78008	Endrin ketone, µg/L	3	<DL	<DL
78032	Methyl *tert*-butyl ether (MTBE), total, µg/L	39	<DL	<DL
78109	Allyl chloride, µg/L	22	<DL	<DL
78133	Methyl isobutyl ketone, µg/L	23	<DL	<DL
78885	Diquat, µg/L	9	<DL	<DL
78922	*trans*-Nonachlor, µg/L	1	<DL	<DL
78923	*cis*-Nonachlor, µg/L	1	<DL	<DL
79724	Xylene, total, µg/L	49	<DL	2.3
81287	Dinoseb, µg/L	12	<DL	<DL
81405	Carbofuran, µg/L	12	<DL	<DL
81408	Metribuzin, µg/L	7	<DL	<DL
81551	Xylene, total, µg/L	47	<DL	<DL
81552	Acetone, µg/L	23	<DL	<DL
81555	Bromobenzene, total, µg/L	118	<DL	<DL
81575	Dichloroiodomethane, µg/L	14	<DL	<DL
81577	Diisopropyl ether, µg/L	1	<DL	<DL
81595	Methyl ethyl ketone, µg/L	69	<DL	<DL
81597	Methyl methacrylate, µg/L	22	<DL	<DL
81607	Tetrahydrofuran, µg/L	69	<DL	<DL
81611	Trichlortrifluoroethane, total, µg/L	70	<DL	95
82052	Dicamba, total, µg/L	11	<DL	<DL
82080	Trihalomethane, total, µg/L	73	<DL	2.7
82303	Radon-222, total, pCi/L	11	73	530
82365	Thorium, dissolved, µg/L as Th	14	<DL	15
82576	Aldicarb sulfoxide, µg/L	11	<DL	<DL
82587	Aldicarb sulfone, µg/L	11	<DL	<DL
85795	Xylene *m*/*p*, total, µg/L	41	<DL	1.6
99060	Coliform, total, ONPG, colonies/100 mL	357	<DL	1
99069	*E. coli*, MUG, colonies/100 mL	23	<DL	1
99129	ONPG tubes positive	6	0	0
99130	MUG tubes positive	6	0	0
99131	Coliform, total, 10 tube MMO-MUG MPN index/100 mL	6	<DL	<DL
99132	*E. coli*, 10 tube MMO-MUG MPN index/100 mL	6	<DL	<DL