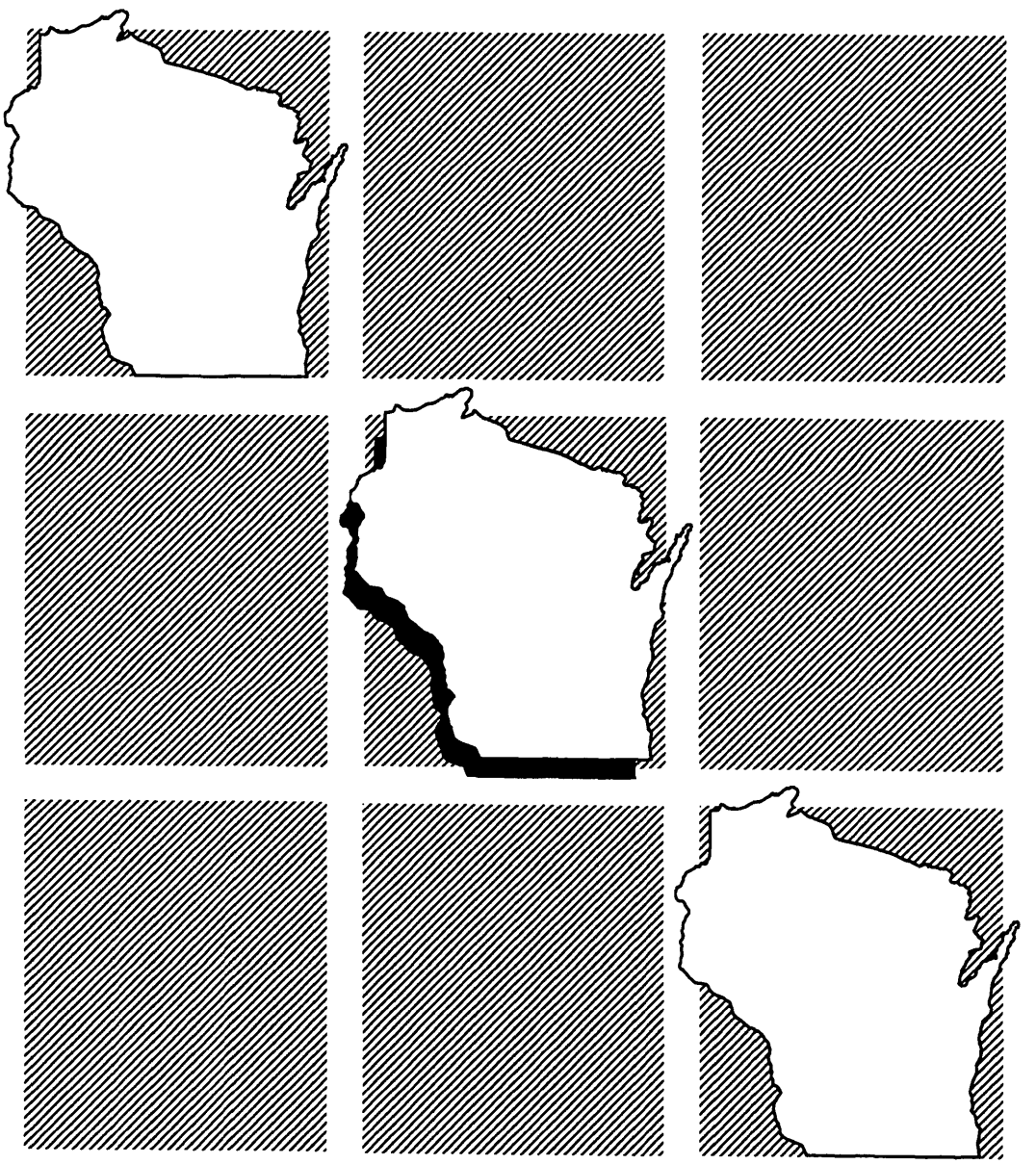
WISCONSIN

A Summary of Cooperative Water-Resources Investigations

U.S. Geological Survey and
Wisconsin Department of Natural Resources



1997

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A SUMMARY OF COOPERATIVE WATER-RESOURCES INVESTIGATIONS

U.S. GEOLOGICAL SURVEY
Water Resources Division
8505 Research Way
Middleton, Wisconsin 53562

and

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
P.O. Box 7921
Madison, Wisconsin 53707

1997

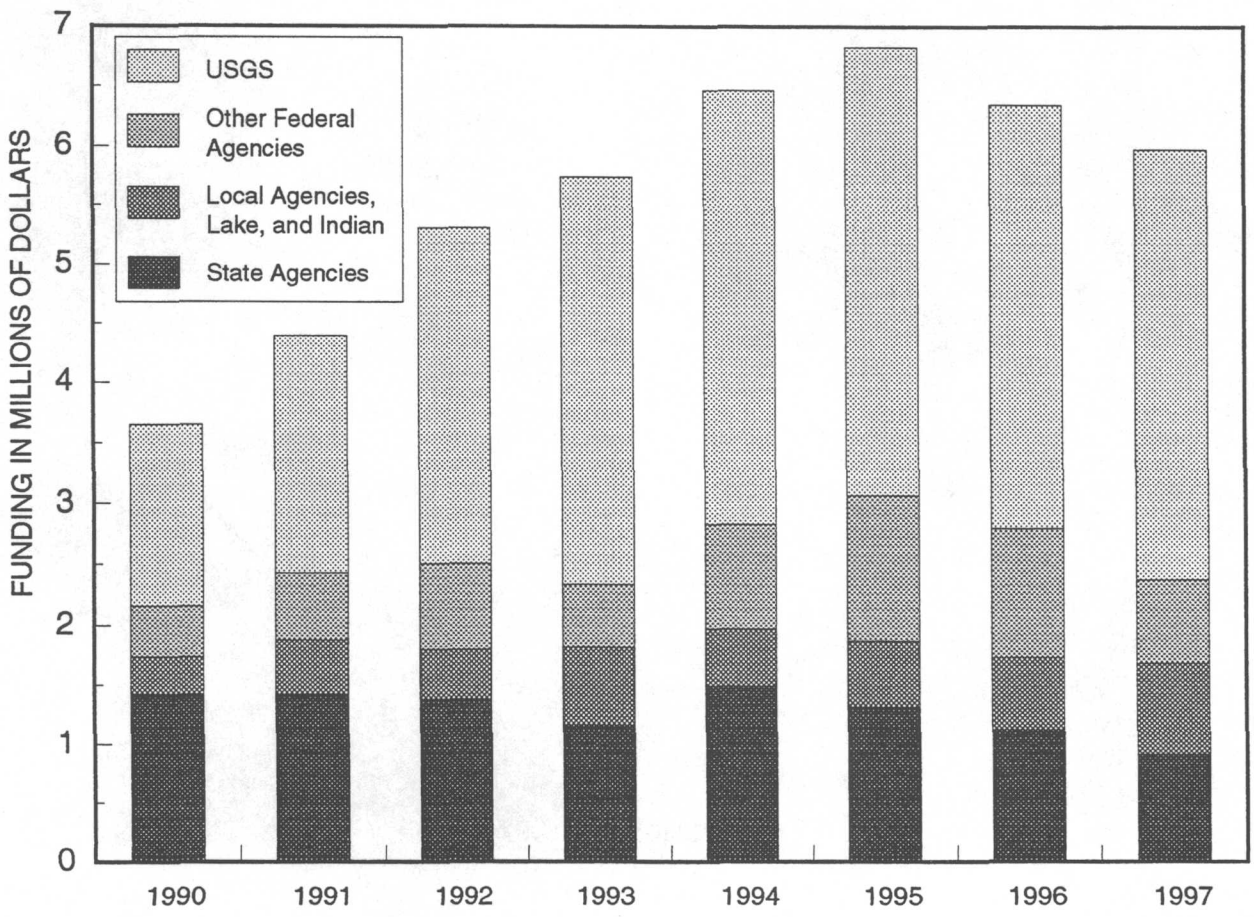
A Summary of Cooperative Water-Resources Investigations U.S. Geological Survey and Wisconsin Department of Natural Resources

1997

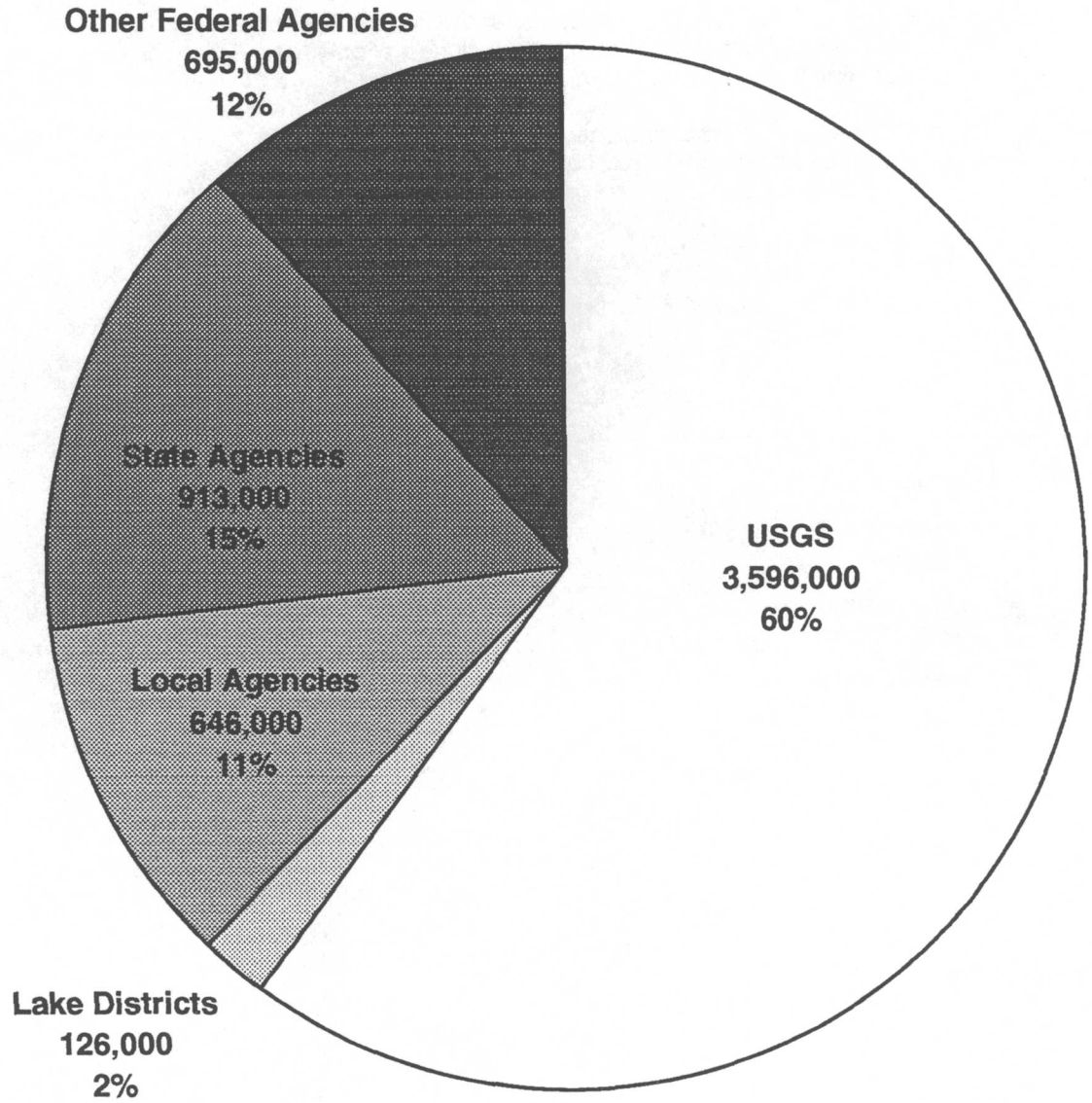
The cooperative program of water-resources investigations between the U.S. Geological Survey and the Wisconsin Department of Natural Resources began as a continuation of cooperative programs with the various State agencies which were merged to form the Wisconsin Department of Natural Resources. These investigations involve various aspects of research, resource evaluations, and water-quantity- and water-quality-monitoring activities.

This is a brief summary report of the activities and plans for the cooperative projects during the July 1996 through June 1997 fiscal year. Each project summary includes a brief description of the objectives, approach, and progress during the 1997 fiscal year, and plans for the 1998 fiscal year.

The appendixes include a detailed listing of proposed stream-monitoring stations for 1998. Also included is the proposed funding summary for the 1997-98 fiscal year.

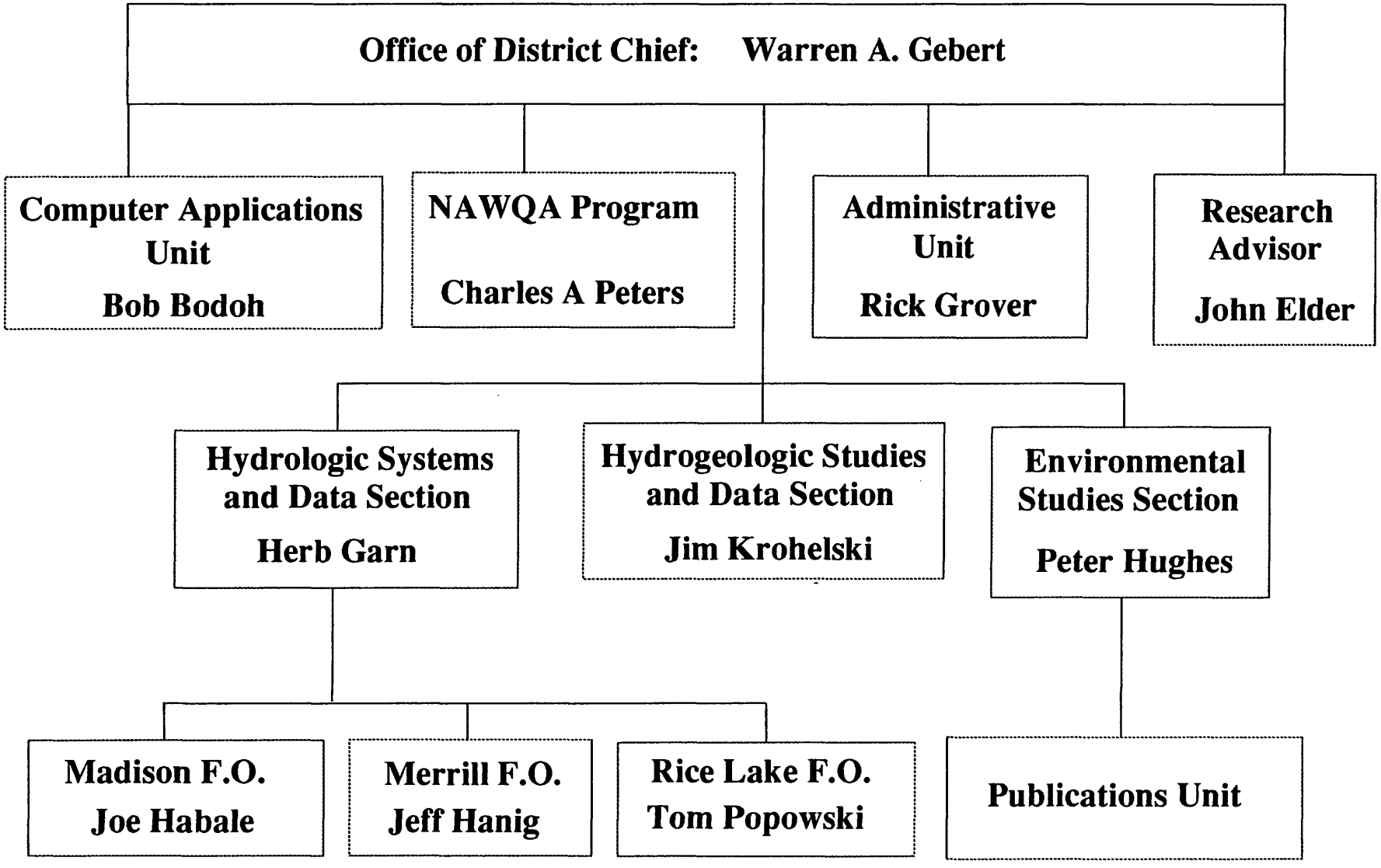


Funding sources for the Wisconsin District program for FY 1997 are shown on the following chart:



Total Funding = 5,976,000

Water Resources Division, Wisconsin District



CONTENTS

COLLECTION OF BASIC RECORDS–SURFACE WATER, WI 001

COOPERATORS:

Wisconsin Department of Natural Resources
U.S. Army Corps of Engineers
Southeastern Wisconsin Regional Planning Commission
Federal (Regular)
Madison Metropolitan Sewerage District
Dane County Department of Public Works
Federal Energy Regulatory Commission Licensees
- Dairyland Power Cooperative
- Niagara of Wisconsin Paper Corporation
- Northern States Power Company
- Wisconsin Electric Power Company
- Wisconsin Power and Light Company
- Wisconsin Public Service Corporation
- Wisconsin Valley Improvement Company

Lac du Flambeau Band of Lake Superior Chippewa
Illinois Department of Transportation
City of Barron
City of Beaver Dam
City of Brookfield
City of Hillsboro
City of Peshtigo
City of River Falls
City of Sparta
City of Thorp
City of Waupun
Village of Wittenberg
Fontana/Walworth Water Pollution Control Commission
Rock County Public Works Department
Menominee Indian Tribe of Wisconsin
Oneida Tribe of Indians of Wisconsin
Stockbridge-Munsee Band of Mohican Indians
Walworth County Metropolitan Sewerage District
Bad River Band of Lake Superior Chippewa Indians

LOCATION:

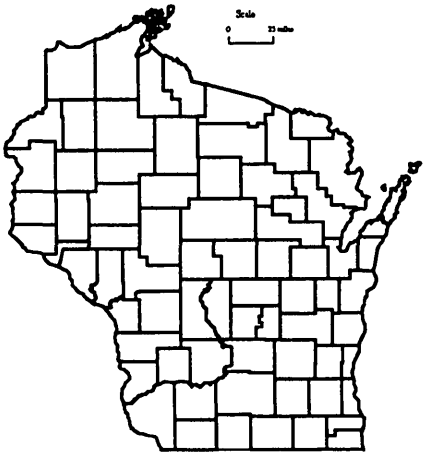
Statewide

PROJECT CHIEF:

Barry K. Holmstrom

PERIOD OF PROJECT:

July 1913-Continuing



PROBLEM: Surface-water information is needed for surveillance, planning, design, hazard warning, operation, and management in water-related fields such as water supply, hydroelectric power, flood control, irrigation, bridge and culvert design, wildlife management, pollution abatement, flood-plain management, and water-resources development. An appropriate data base is necessary to provide this information.

OBJECTIVE: The objectives of this study are to provide continuous discharge records for selected rivers at specific sites to

supply the needs for regulation, analytical studies, definition of statistical properties, trends analysis, determination of the occurrence, and distribution of water in streams for planning. The project is also designed to determine lake levels and to provide discharge for floods, low-flow conditions, and for water-quality investigations. Requests for streamflow data and information relating to streamflow in Wisconsin are answered. Basic data are published annually in the report "Water Resources Data–Wisconsin."

APPROACH: A network of streamflow stations and lake-level stations will be maintained throughout Wisconsin. This includes operating the equipment at the gaging station to record river or lake stage, making periodic discharge measurements at each streamflow station to establish or verify a stage-discharge rating curve, reducing the stage records to instantaneous and daily discharges, compilation of monthly and annual discharges, and preparing data for publication in the annual report "Water Resources Data–Wisconsin".

Requests for streamflow data from other government agencies, consultants, and private parties will be processed.

PROGRESS (July 1996 to June 1997): During the current fiscal year, streamflow data were collected at a total of 92 sites: 27 sites for the Wisconsin Department of Natural Resources (WDNR), 17 sites for the Corps of Engineers, 14 sites for the Southeastern Wisconsin Regional Planning Commission, 6 sites for the Federal program, 3 sites for the Madison Metropolitan Sewerage District, and 1 site each for the Bad River Band of Lake Superior Chippewa Indians, Lac du Flambeau Band of Lake Superior Chippewa, Menominee Indian Tribe of Wisconsin, Oneida Tribe of Indians of Wisconsin, Stockbridge-Munsee Band of Mohican Indians, Illinois Department of Transportation, Rock County, Fontana/ Walworth Water Pollution Control Commission, Dane County Department of Public Works, Walworth County Metropolitan Sewerage District, Federal Energy Commission Licensee, and cities of Barron, Beaver Dam, Brookfield, Hillsboro, Peshtigo, Sparta, Thorp, Waupun, and village of Wittenberg. Streamflow data were also collected at four sites for agencies working jointly with the USGS. Lake-level data were collected at two sites for the Dane County Department of Public Works, at two sites for the Corps of Engineers, at one site for the Rock County Public Works Department, and one site for the WDNR.

A map showing the locations of all continuous-record streamflow-gaging stations in Wisconsin is shown on page 5.

Computation of streamflow and lake-level records for all the network stations for the 1996 water year was completed, stored in our WATSTORE computer data base, and published in the annual report "Water Resources Data–Wisconsin, water year 1996". More than 100 requests for streamflow information were answered.

PLANS (July 1997 to June 1998): Data will be collected at 92 continuous-streamflow stations (see the following list) and lake levels at 6 stations. Streamflow records will be computed and data published for the 1997 water year. Requests for streamflow information will be answered.

Due to budget constraints by the WDNR, operation of the following stations was discontinued as of July 1, 1996.

04071858 Pensaukee River near Pensaukee
04085200 Kewaunee River near Kewaunee
04085281 East Twin River at Mishicot
04085427 Manitowoc River at Manitowoc

Real-time data can be accessed on World-Wide Web at http://wwwdwimdn.er.usgs.gov

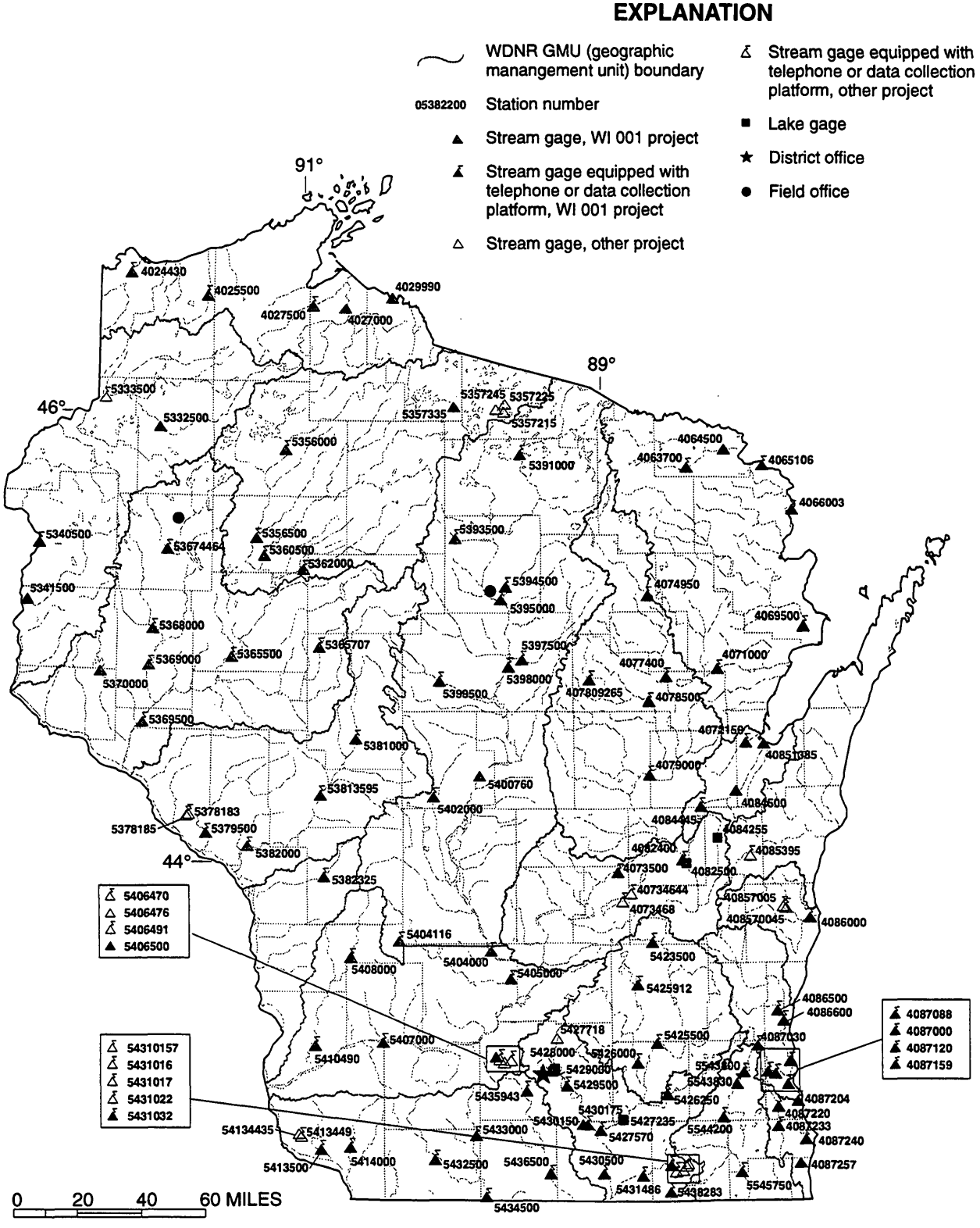
SURFACE-WATER GAGING STATIONS EXPECTED TO BE OPERATED IN 1998 FY

Station number	Name and location	Drainage Area	Period of record (water year)	Cooperator
04024430	Nemadji River - South Superior	420	1974-	WDNR
04025500	Bois Brule River - Brule	118	1943-81, 1984-	Fed.
04027000	Bad River - Odanah	597	1914-22, 1948-	Bad River Band of Lake Superior Chippewa Indians
04027500	White River - Ashland	301	1948-	WDNR
04029990	Montreal River - Saxon Falls	262	1987	WDNR
04063700	Popple River - Fence	139	1964-	Fed.
04064500	Pine River - Pine River Powerplant - Florence	533	1924-76, 1996-	WDNR
04065106	Menominee River - Niagara	2470	1993-	FERC
04066003	Menominee River - Pembine	3140	1950-	WDNR
04069500	Peshtigo River - Peshtigo	1080	1953-	City of Peshtigo
04071000	Oconto River - Gillett	705	1906-09, 1914-	Fed.
04072150	Duck Creek - Howard	108	1988-	Oneida Tribe of Indians of WI
04073500	Fox River - Berlin	1340	1898-	C of E, Detroit
04074950	Wolf River - Langlade	463	1966-79, 1981-	Menominee Indian Tribe of WI
04077400	Wolf River - Shawano	816	1907-09, 1911-	WDNR
04077630	Red River - Morgan	114	1993	Stockbridge-Munsee Band of Mohican Indians
0407809265	Middle Branch Embarrass River - Wittenberg	76.3	1990-	Village of Wittenberg
04079000	Wolf River - New London	2260	1896-	C of E, Detroit
04082400	Fox River - Oshkosh	5310	1991	WDNR
04084445	Fox River - Appleton	5950	1986-	C of E, Detroit
04084500	Fox River - Rapide Croche Dam - Wrightstown	6010	1896-	WDNR
04086000	Sheboygan River - Sheboygan	418	1916-24, 1951-	WDNR
04086500	Cedar Creek - Cedarburg	120	1930-70, 73-81, 1983-87, 1991 -	WDNR
04086600	Milwaukee River - Pioneer Road - Cedarburg	607	1982-	SEWRPC
04087000	Milwaukee River - Milwaukee	696	1914-	SEWRPC
04087030	Menomonee River - Menomonee Falls	34.7	1975-77, 1979-	SEWRPC
04087088	Underwood Creek - Wauwatosa	18.2	1975-	SEWRPC
04087120	Menomonee River - Wauwatosa	123	1962-	SEWRPC
04087160	Kinnickinnic River - Milwaukee	20.4	1976-	SEWRPC
04087204	Oak Creek - South Milwaukee	25	1964-	SEWRPC
04087220	Root River - Franklin	49.2	1964-	SEWRPC
04087233	Root River Canal - Franklin	57	1964-	SEWRPC
04087240	Root River - Racine	190	1963-	SEWRPC
04087257	Pike River - Racine	38.5	1972-	SEWRPC
05332500	Namekagon River - Trego	488	1928-70, 1988	WDNR
05340500	St. Croix River - St. Croix Falls	6240	1902-	WDNR
05341500	Apple River - Somerset	579	1901-70, 1987	WDNR
05356000	Chippewa River - Winter	790	1912-	WDNR
05356500	Chippewa River - Bruce	1650	1914-	WDNR
05357335	Bear River - Manitowish Waters	81.3	1991	Lac du Flambeau Band of Lake Superior Chippewa
05360500	Flambeau River - Bruce	1860	1951-	WDNR, FERC
05362000	Jump River - Sheldon	576	1915-	Fed.
05365500	Chippewa River - Chippewa Falls	5650	1888-1983, 1987	WDNR
05365707	North Fork Eau Claire River - Thorp	51	1986	City of Thorp
053674464	Yellow River - Barron	153	1991	City of Barron
05368000	Hay River - Wheeler	418	1951-	Fed.
05369000	Red Cedar River - Menomonie	1770	1907-08, 1913-	WDNR
05369500	Chippewa River - Durand	9010	1928-	C of E, St. Paul
05370000	Eau Galle River - Spring Valley	64.1	1944-	C of E, St. Paul
05379500	Trempealeau River - Dodge	643	1914-19, 1934	C of E, St. Paul
05382000	Black River - Galesville	2080	1932-	C of E, St. Paul, WDNR
05382325	La Crosse River - Sparta	167	1992-	City of Sparta
05391000	Wisconsin River - Lake Tomahawk	757	1936-	WDNR
05393500	Spirit River - Spirit Falls	81.6	1942-	WDNR
05394500	Prairie River - Merrill	184	1914-31, 1939	WDNR

SURFACE-WATER GAGING STATIONS EXPECTED TO BE OPERATED IN 1998 FY

Station number	Name and location	Drainage Area	Period of record (water year)	Cooperator
05395000	Wisconsin River - Merrill	2760	1903-	WDNR
05397500	Eau Claire River - Kell	375	1914-27, 1939-	WDNR
05398000	Wisconsin River - Rothschild	4020	1945-	WDNR
05399500	Big Eau Pleine River - Stratford	224	1914-26, 1937-	WDNR
05400760	Wisconsin River - Wisconsin Rapids	5420	1914-50, 1958-	WDNR
05402000	Yellow River - Babcock	215	1944-	WDNR
05404000	Wisconsin River - Wisconsin Dells	8090	1935-	WDNR
05404116	S. Br. Baraboo River - Hillsboro	39.1	1988-	City of Hillsboro
05405000	Baraboo River - Baraboo	609	1914-22, 1943-	Fed.
05406500	Black Earth Creek - Black Earth	45.6	1954-	Dane County
05407000	Wisconsin River - Muscoda	10400	1903-04, 1914-	C of E, St. Paul
05408000	Kickapoo River - LaFarge	266	1939-	WI Dept. Tourism
05410490	Kickapoo River - Steuben	687	1933-	C of E, St. Paul
05413500	Grant River - Burton	269	1935-	C of E, R. Island
05414000	Platte River - Rockville	142	1935-	C of E, R. Island
05423500	S. Br. Rock River - Waupun	63.6	1948-69, 1987	City of Waupun
05425500	Rock River - Watertown	969	1931-70, 1977-	C of E, R. Island
05425912	Beaverdam River - Beaver Dam	157	1984-	City of Beaver Dam
05426000	Crawfish River - Milford	762	1931-	Rock County, Jefferson County
05426250	Bark River - Rome	122	1980-	SEWRPC
05427570	Rock River - Indianford	2630	1975-	Rock County
05429500	Yahara River - McFarland	327	1930-	DCDPW
05430150	Badfish Creek - Cooksville	82.6	1977-	MMSD
05430175	Yahara River - Fulton	517	1977	MMSD
05430500	Rock River - Afton	3340	1914-	C of E, R. Island
05431032	Turtle Creek - Delavan	83.3	1996-	WALCOMET
05431486	Turtle Creek - Clinton	199	1939-	C of E, Rock Island, WALCOMET
05432500	Pecatonica River - Darlington	273	1939-	C of E, R. Island
05433000	E. Br. Pecatonica River - Blanchardville	221	1939-1986, 1988	C of E, R. Island
05434500	Pecatonica River - Martintown	1034	1940-	C of E, R. Island
05435943	Badger Mill Creek - Verona	20.3	1997-	MMSD
05436500	Sugar River - Brodhead	523	1914-	C of E, Rock Island
05438283	Piscasaw Creek - Walworth	9.58	1992-	Fontana/Walworth WPCC
05543800	Fox River - Watertown Road - Waukesha	77.4	1993-	City of Brookfield
05543830	Fox River - Waukesha	126	1963-	SEWRPC
05544200	Mukwonago River - Mukwonago	74.1	1973-	SEWRPC
05545750	Fox River - New Munster	811	1940-	IL. DOT
		LAKES		
04082500	Lake Winnebago - Oshkosh	5880	1882-	C of E, Detroit
04084255	Lake Winnebago - Stockbridge	5880	1983-	C of E, Detroit
05404500	Devil's Lake - Baraboo	4.79	1922-30, 1932, 1934-81, 1985-	WDNR
05427235	Lake Koshkonong - Newville	2560	1987	Rock County
05428000	Lake Mendota - Madison	233	1903, 1916-	DCDPW
05429000	Lake Monona - Madison	279	1915-	DCDPW

C of E, Detroit – Corps of Engineers, Detroit, Michigan
C of E, R. Island – Corps of Engineers, Rock Island, Illinois
C of E, St. Paul – Corps of Engineers, St. Paul, Minnesota
DCDPW – Dane County Department of Public Works
Fed. – USGS Federal Program
FERC – Federal Energy Regulatory Commission Licensees
Fontana/Walworth WPCC – Fontana/Walworth Water Pollution Control Commission
IL. DOT – Illinois Department of Transportation
MMSD – Madison Metropolitan Sewerage District
SEWRPC – Southeastern Wisconsin Regional Planning Commission
WALCOMET – Walworth County Metropolitan Sewerage District
WDNR – Wisconsin Department of Natural Resources
WI Dept. Tourism – Wisconsin Department of Tourism



Location of continuous-record data-collection stations.

DISCONTINUED SURFACE-WATER DISCHARGE STATIONS

The following continuous-record surface-water discharge stations in Wisconsin have been discontinued. Daily streamflow records were collected and published for the period of record, expressed in water years, shown for each station. Those stations with an asterisk (*) after the station number are currently operated as crest-stage partial-record stations. Some of the discontinued project stations with less than three years of record have not been included. Information regarding these stations may be obtained from the District Office at the address given on the back side of the title page of this report.

Discontinued surface-water discharge stations

Station name	Station number	Drainage area (square miles)	Period of record
STREAMS TRIBUTARY TO LAKE SUPERIOR			
Little Balsam Creek at Patzau, WI	04024314	4.89	1976-78
Little Balsam Creek near Patzau, WI	04024315	5.05	1976-78
Little Balsam Creek Tributary near Patzau, WI	04024318	0.60	1976-78
Little Balsam Creek near Foxboro, WI	04024320	3.27	1977-78
Amnicon River near Poplar (Amnicon Falls), WI	04025000	110	1914-16
Bois Brule (Brule) River near Brule, WI	04026000	160	1914-17
Sioux River near Washburn, WI	04026300*	33.9	1965-66
Pine Creek at Moquah, WI	04026347	6.20	1976-78
Pine Creek Tributary at Moquah, WI	04026348	0.48	1976-78
Pine Creek near Moquah, WI	04026349	19.9	1976-78
North Fish Creek near Moquah, WI	040263491	65.4	1990-91
Bad River near Mellen, WI	04026450*	82.0	1971-75
Bad River at Mellen, WI	04026500	98.3	1948-55
Alder Creek near Upson, WI	04026870	22.2	1972-77
Montreal River near Kimball, WI	04028500	100	1924-26
West Fork Montreal River at Gile, WI	04029000	75.0	1918-26, 1943-47
West Fork Montreal River near Kimball, WI	04029500	86.2	1924-26
STREAMS TRIBUTARY TO LAKE MICHIGAN			
North Branch Pine River at Windsor Dam nr Alvin, WI	04063640*	27.8	1967-68
Pine River near Florence, WI	04064000	510	1914-23
Pine River below Pine River Power Plant near Florence, WI	04064500	533	1924-76
Pike River at Amberg, WI	04066500	255	1914-70
Menominee River near McAllister, WI	04067500	3,930	1945-61, 1979-86, 1988-90, 1993-95
Peshtigo River at High Falls near Crivitz, WI	04068000	537	1912-57
Pensaukee River near Pensaukee, WI	04071858	134	1973-96
Suamico River at Suamico, WI	04072000	60.7	1951-52
Lawrence Creek near Westfield, WI	04072750	13.4	1968-73
Grand River near Kingston, WI	04073050	73.5	1968-75
West Branch White River near Wautoma, WI	04073405	38.9	1964-75
White Creek at Forest Glen Beach near Green Lake, WI	04073462	3.05	1982-88
Swamp Creek above Rice Lake at Mole Lake, WI	04074538	46.3	1977-83, 1985-87
Swamp Creek below Rice Lake at Mole Lake, WI	04074548	56.8	1977-79, 1982-85
Wolf River near White Lake, WI	04075000	485	1935-38
Evergreen Creek near Langlade, WI	04075200*	8.09	1964-73
Wolf River above West Branch Wolf River, WI	04075500	616	1928-62
West Branch Wolf River at Neopit, WI	04076000	93.2	1911-17
West Branch Wolf River near Keshena, WI	04076500	163	1928-32
Little Wolf River near Galloway, WI	04079602	22.6	1974-79
Spaulding Creek near Big Falls, WI	04079700*	5.57	1964-66
Little Wolf River at Royalton, WI	04080000	507	1914-70, 1983-85
Emmons Creek near Rural, WI	04080950	25.1	1977
Storm Sewer to Mirror Lake at Waupaca, WI	04080976	0.04	1971-74
Waupaca River near Waupaca, WI	04081000	265	1916-66, 1983-85
Daggets Creek at Butte Des Morts, WI	04081800	10.6	1977
West Branch Fond du Lac River at Fond du Lac, WI	04083000	83.1	1939-54
East Branch Fond du Lac River near Fond du Lac, WI	04083500	78.4	1939-54
Brothertown Creek at Brothertown, WI	04084200	5.10	1976-77
Kewaunee River near Kewaunee, WI	04085200	127	1964-96
East Twin River at Mishicot, WI	04085281	110	1972-96
Manitowoc River at Manitowoc, WI	04085427	526	1972-96
Onion River at Hingham, WI	04085813	37.2	1979-80
Onion River near Sheboygan Falls, WI	04085845	94.1	1979-82
Milwaukee River at Kewaskum, WI	04086150	138	1968-81
East Branch Milwaukee River near New Fane, WI	04086200	54.1	1968-81

Discontinued surface-water discharge stations

Station name	Station number	Drainage area (square miles)	Period of record
North Branch Milwaukee River near Fillmore, WI	04086340	148	1968-81
Milwaukee River at Waubeka, WI	04086360	432	1968-81, 1994
Mud Lake Outlet near Decker Corner, WI	04086488	7.36	1983-84
Milwaukee River above North Ave Dam at Milwaukee, WI	04087010	702	1982-84
Menomonee River at Germantown, WI	04087018	19.0	1975-77
Jefferson Park Drainageway at Germantown, WI	04087019	1.82	1976-78
Menomonee River at Butler, WI	04087040	60.6	1975-79
Little Menomonee River near Freistadt, WI	04087050*	8.0	1975-79
Noyes Creek at Milwaukee, WI	04087060	1.94	1975-80, 1990
Little Menomonee River at Milwaukee, WI	04087070	19.7	1975-77
Honey Creek at Wauwatosa, WI	04087119	10.3	1975-81
Schoonmaker Creek at Wauwatosa, WI	04087125	1.94	1975-79
Hawley Road Storm Sewer at Milwaukee, WI	04087130	1.83	1975-77
Menomonee River at Milwaukee, WI	04087138	134	1982-84
Kinnickinnic River at Milwaukee, WI	04087160	20.4	1976-83
ST. CROIX RIVER BASIN			
Namekagon River at Trego, WI	05332000	433	1914-27
Loon Creek near Danbury, WI	05335010	17.6	1970-71
Bashaw Brook near Shell Lake, WI	05335380*	26.6	1964-66
Clam River near Webster, WI	05335500	361	1941-42
St. Croix River near Grantsburg, WI	05336000	2,980	1923-70
Wood River near Grantsburg, WI	05339000	185	1939-40
Rice Creek near Balsam Lake, WI	05341375	12.5	1988-89
Balsam Branch at Balsam Lake, WI	05341402	52.8	1988-90
Kinnickinnic River near River Falls, WI	05342000	165	1917-21
CHIPPEWA RIVER BASIN			
West Fork Chippewa River at Lessards, nr Winter, WI	05355500	474	1912-16
Couderay River near Couderay, WI	05356121	169	1981-83
Flambeau River at Flambeau Flowage (Flambeau Reservoir), WI	05357500	622	1927-61
Flambeau River near Butternut, WI	05358000	688	1914-39
Pine Creek near Oxbo, WI	05358300	38.9	1971-75
Flambeau River at Babbs Island near Winter, WI	05358500	967	1929-75
South Fork Flambeau River near Phillips, WI	05359500	609	1929-75
Price Creek near Phillips, WI	05359600*	16.9	1964-66
Flambeau River near (at) Ladysmith, WI	05360000	1,790	1903-06, 1914-61
Chippewa River near Holcombe, WI	05361000	3,720	1944-49
South Fork Jump River near Ogema, WI	05361500	327	1944-54
Chippewa River at Holcombe, WI	05362500	4,680	1943-49
Fisher River at (near) Holcombe, WI	05363000	81.5	1944-45
O'Neil Creek near Chippewa Falls, WI	05363500	78.1	1944-45
Yellow River near Hannibal, WI	05363700	86.7	1962-63
Yellow River at Cadott, WI	05364000*	364	1943-61
Duncan Creek at Bloomer, WI	05364500*	50.3	1944-52
Duncan Creek Tributary near Tilden, WI	05364850	4.17	1987-89
Duncan Creek at Chippewa Falls, WI	05365000	117	1943-55
Eau Claire River near Augusta, WI	05366000	509	1914-26
Bridge Creek at Augusta, WI	05366300	35.0	1980
Eau Claire River near Fall Creek, WI	05366500*	760	1943-55
Chippewa River at (near) Eau Claire, WI	05367000	6,620	1903-09, 1944-54
Red Cedar River near Cameron, WI	05367425	442	1966-70
Red Cedar River near Cameron, WI	05367426	443	1971-73
Red Cedar River near Colfax, WI	05367500	1,100	1914-80, 1989-90
Eau Galle River near Woodville, WI	05369900	39.4	1978-83
Eau Galle River at low water bridge at Spring Valley, WI	05369945	47.9	1982-83, 1986-96
French Creek near Spring Valley, WI	05369955	6.03	1981-83
Lousy Creek near Spring Valley, WI	05369970	5.97	1981-83
Lohn Creek near Spring Valley, WI	05369985	2.53	1981-83
Eau Galle River at Elmwood, WI	05370500	91.6	1943-54
BUFFALO RIVER BASIN			
Buffalo River near Tell, WI	05372000	406	1933-51

Discontinued surface-water discharge stations

Station name	Station number	Drainage area (square miles)	Period of record
TREMPEALEAU RIVER BASIN			
Bruce Valley Creek near Pleasantville, WI	05379288	10.1	1980
Elk Creek near Independence, WI	05379305	108	1980
Trempealeau River at Arcadia, WI	05379400	553	1960-77
Trempealeau River near Trempealeau, WI	05380000	719	1932-34
BLACK RIVER BASIN			
Black River at Medford, WI	05380806	48.1	1984-87
Poplar River near Owen, WI	05380900*	155	1964-66
LA CROSSE RIVER BASIN			
Little LaCrosse River near Leon, WI	05382500	76.9	1934-61, 1979-81
LaCrosse River near West Salem, WI	05383000	396	1914-70
COON CREEK BASIN			
Spring Coulee Creek near Coon Valley, WI	05386490	9.01	1979-81
Coon Creek at Coon Valley, WI	05386500	77.2	1934-40, 1978-81
Coon Creek near Stoddard, WI	05386999	120	1934-40, 1979-81
BAD AXE RIVER BASIN			
North Fork Bad Axe River near Genoa, WI	05387100*	80.8	1964-66
WISCONSIN RIVER BASIN			
Wisconsin River at Conover, WI	05390180	177	1967-71
Pelican River near Rhinelander, WI	05391226	101	1976-79
Wisconsin River at Whirlpool Rapids, near Rhinelander, WI	05392000	1,220	1906-61
Bearskin Creek near Harshaw, WI	05392350*	31.1	1964-66
Tomahawk River near Bradley, WI	05392400	422	1915-27, 1929
Tomahawk River at Bradley, WI	05393000	544	1930-73
New Wood River near Merrill, WI	05394000	82.2	1953-61
Rib River at Rib Falls, WI	05396000	303	1925-57
Little Rib River near Wausau, WI	05396500	79.1	1914-16
East Branch Eau Claire River near Antigo, WI	05397000	81.5	1949-55
Eau Claire River near Antigo, WI	05397110	185	1975-81
Bull Junior Creek (Bull Creek Junior) near Rothschild, WI	05398500	27.4	1944-52
Big Eau Pleine River near Colby, WI	05399000	78.1	1941-54
Hamann Creek near Stratford, WI	05399431	11.3	1977-79
Wisconsin River at Knowlton, WI	05400000	4,530	1921-42
Plover River near Stevens Point, WI	05400500	145	1914-20, 1944-52
Little Plover River near Arnott, WI	05400600	2.24	1959-75
Little Plover River at Plover, WI	05400650	19.0	1959-87
Fourmile Creek near Kellner, WI	05400840	75.0	1964-67
Buena Vista Creek near Kellner, WI	05400853	53.1	1964-67
Tenmile Creek Ditch 5 near Bancroft, WI	05401020	9.73	1964-73
Fourteenmile Creek near New Rome, WI	05401100	91.1	1964-79
Wisconsin River near Necedah, WI	05401500	5,990	1903-14, 1944-50
Big Roche a Cri Creek near Hancock, WI	05401510	9.61	1964-67
Big Roche a Cri Creek near Adams, WI	05401535	52.8	1964-78
Yellow River at Sprague, WI	05402500	392	1927-40
Yellow River at Necedah, WI	05403000	491	1941-57
Lemonweir River at New Lisbon, WI	05403500	507	1944-87, 1994
Hulbert Creek near Wisconsin Dells, WI	05403630*	11.2	1971-77
Dell Creek near Lake Delton, WI	05403700*	44.9	1957-65, 1971-80
Narrows Creek at Loganville, WI	05404200*	40.1	1964-66
Wisconsin River at Prairie du Sac, WI	05406000	9,180	1946-54
Trout Creek at Confluence with Arneson Crk nr Barneveld, WI	05406573	8.37	1976-78
Trout Creek at Twin Parks Dam 8 nr Barneveld, WI	05406574	9.02	1976-79
Trout Creek at County Highway T nr Barneveld, WI	05406575	12.1	1976-78
Trout Creek near Ridgeway, WI	05406577	13.5	1976-79
Knight Hollow Creek near Arena, WI	05406590	7.57	1976-78
Otter Creek near Highland, WI	05406640	16.8	1968-69, 1970-75
Kickapoo River at Ontario, WI	05407500	151	1939, 1973-77
Knapp Creek near Bloomingdale, WI	05408500	8.44	1955-69
West Fork Kickapoo River near Readstown, WI	05409000	106	1939
Kickapoo River at Soldiers Grove, WI	05409500	530	1939
North Fork Nederlo Creek near Gays Mills, WI	05409830	2.21	1968-79
Nederlo Creek near Gays Mills, WI	05409890	9.46	1968-80
Kickapoo River at Gays Mills, WI	05410000	617	1914-34, 1964-77

Discontinued surface-water discharge stations

Station name	Station number	Drainage area (square miles)	Period of record
GRANT RIVER BASIN			
Pigeon Creek near Lancaster, WI	**05413400***	**6.93**	**1964-66**
Rattlesnake Creek near Beetown, WI	05413451	45.2	1990-91
GALENA RIVER BASIN			
Little Platte River near Platteville, WI	05414213	79.7	1987-90
Sinsinawa River near Hazel Green, WI	05414800	24.9	1987-90
Pats Creek near Belmont, WI	05414894	5.42	1981-82
Madden Branch Tributary near Belmont, WI	05414915*	2.83	1981-82
Madden Branch near Meekers Grove, WI	05414920	15.04	1981-82
Galena River at Buncombe, WI	05415000	125	1939-92
APPLE RIVER BASIN			
Apple River near Shullsburg, WI	05418731	9.34	1981-82
ROCK RIVER BASIN			
West Branch Rock River near Waupun, WI	05423000	40.7	1949-70, 1978-81
West Branch Rock River at County Trunk Highway D near Waupun, WI	05423100	43.9	1978-81
East Branch Rock River near Mayville, WI	05424000	179	1949-70
Rock River at Hustisford, WI	05424082	511	1978-85
Johnson Creek near Johnson Creek, WI	05425537	1.13	1978-80
Johnson Creek near Johnson Creek, WI	05425539	13.3	1978-80
Pratt Creek near Juneau, WI	05425928	3.54	1978-80
Rock River at Jefferson, WI	05426031	1,850	1978-94
Whitewater Creek near Whitewater, WI	05426500	11.8	1926-28, 1946-54
Whitewater Creek at Millis Road near Whitewater, WI	05426900	20.6	1978-81
Whitewater Creek at Whitewater, WI	05427000	22.8	1926-28, 1946-54
Koshkonong Creek near Rockdale, WI	05427507	150	1977-82
Token Creek near Madison, WI	05427800*	24.3	1964-66, 1976-81
Sixmile Creek near Waunakee, WI	05427900	41.1	1976-82
Pheasant Branch at Airport Road near Middleton, WI	05427943	9.61	1977-81
South Fork Pheasant Branch at Highway 14 near Middleton, WI	05427945	5.74	1978-81
Pheasant Branch at Century Avenue at Middleton, WI	05427950	20.8	1977-81
Pheasant Branch at mouth at Middleton, WI	05427952	24.5	1978-81
Willow Creek at Madison, WI	05427970	3.15	1974-83
Olbrich Park Storm Ditch at Madison, WI	05428665	2.57	1976-80
Manitou Way Storm Sewer at Madison, WI	05429040	0.23	1971-77
Nakoma Storm Sewer at Madison, WI	05429050	2.30	1972-77
Lake Wingra Outlet at Madison, WI	05429120	6.00	1971-77
Door Creek near Cottage Grove, WI	05429580	15.3	1976-79
Yahara River near Edgerton, WI	05430000	430	1917-18
Oregon Branch at Oregon, WI	05430030	9.93	1979-81
Badfish Creek at County Highway A near Stoughton, WI	05430095	41.9	1956-66, 1986-88
Badfish Creek near Stoughton, WI	05430100	41.3	1956-66
Jackson Creek at Petrie Road near Elkhorn, WI	05431014	8.96	1984-95
Livingston Branch, Pecatonica River near Livingston, WI	05432055	16.4	1987-91
Yellowstone River near Blanchardville, WI	05433500*	28.5	1954-65, 1978-79
Pecatonica River at Dill, WI	05434000	944	1914-19
Steiner Branch near Waldwick, WI	05433510	5.9	1978-79
Skinner Creek at Skinner Hollow Road near Monroe, WI	05434235	32.6	1978-81
Skinner Creek at Klondyke Road near Monroe, WI	05434240	35.0	1978-81
West Branch Sugar River near Mount Vernon, WI	05435980	32.7	1979-80
Mount Vernon Creek near Mount Vernon, WI	05436000	16.4	1954-65, 1976-80
ILLINOIS RIVER BASIN			
White River near Burlington, WI	05545300	110	1964-66, 1973-78

CRANDON GROUND WATER, WI 00201

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Forest County, Wisconsin

PROJECT CHIEF:
James T. Krohelski

PERIOD OF PROJECT:
October 1994-Continuing

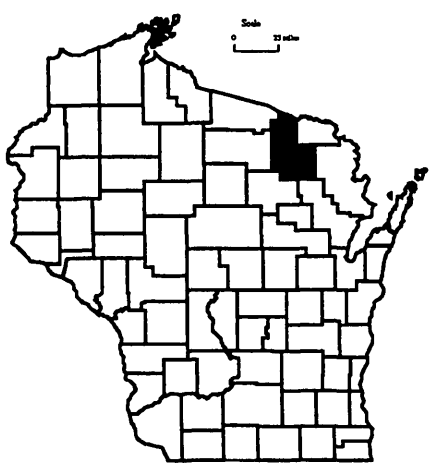
PROBLEM: A large underground zinc-copper mine is being proposed at a site about five miles south of Crandon, Wisconsin, in Forest County. The Wisconsin Department of Natural Resources (WDNR) requested that District staff review the development of a ground-water flow model and associated hydrologic documents as part of a permitting process for the proposed mine.

OBJECTIVE: The objective is to review documents related to water resources submitted to WDNR from the Crandon Mining Company (CMC) and their consultants and to make suggestions to WDNR on studies and approaches that will improve the understanding of the hydrology and effects of mining on the water resources in the vicinity of the proposed mine.

APPROACH: The schedule for review of documents will be mutually agreed upon between WDNR and USGS.

PROGRESS (July 1996 to June 1997): (1) The CMC ground-water flow model was delivered in August 1996. An initial review covering starting heads, convergence, and boundary conditions was made and a memo was submitted to WDNR describing the review. (2) The CMC solute transport model was delivered in September 1996. A meeting in which CMC presented the model was held on December 19, 1996. (3) Monitoring of lake stage and shallow ground-water levels adjacent to Little Sand Lake was continued.

PLANS (July 1997 to September 1997): (1) The ground-water flow model and the contaminant transport model reviews will be completed. (2) Additional documents will be reviewed and meetings attended at the request of WDNR. (3) Monitoring of lake stage and shallow ground-water levels adjacent to Little Sand Lake will be continued.



BROWNFIELDS, WI 00203

PROBLEM: The Wisconsin Department of Natural Resources has initiated a land recycling program. This program encourages the redevelopment and return to productive use of urban contaminated properties.

OBJECTIVES: The objective is to give field support to the Wisconsin Department of Natural Resources in determining the extent of contamination of urban contaminated properties.

APROACH: Support will be given by collecting soil and ground-water samples with a Geoprobe and/or analyzing the samples with a field gas chromatograph.

PROGRESS (July 1996 to June 1997): Soil and ground-water samples in the vicinity of several urban contaminated sites were collected and analyzed.

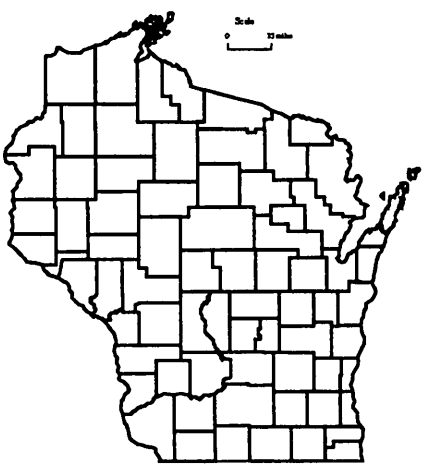
PLANS (July 1997 to June 1998): Support will continue at the request of the Wisconsin Department of Natural Resources.

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Statewide

PROJECT CHIEF:
John F. DeWild

PERIOD OF PROJECT:
May 1996-Continuing



COLLECTION OF BASIC RECORDS–SEDIMENT, WI 004

COOPERATORS:
Wisconsin Department of Natural Resources
U.S. Army Corps of Engineers

LOCATION:
Statewide

PROJECT CHIEF:
William J. Rose

PERIOD OF PROJECT:
March 1968-Continuing

PROBLEM: Water-resources planning and water-quality assessment require a knowledge of the quantity and quality of sediment being transported in rivers and streams in Wisconsin.

OBJECTIVE: This project will provide sediment data for use in specific planning and action programs and will develop a data base for determining trends in sediment discharge and yield. Streams will be characterized according to range of concentration and particle size of suspended sediment.

APPROACH: Sediment-monitoring stations will be operated at selected stream sites throughout the State, including sites of specific interest to cooperating agencies.

The extent of monitoring at a given site will depend on the characteristics of the basin and the needs of the cooperating agency. Some sites will be sampled manually at infrequent intervals; other sites, where flow responds rapidly to precipitation, will be sampled by automatic samplers.

At sites where bedload or unmeasured sediment discharge may be a significant part of the total sediment discharge, suspended- and bed-sediment particle size will be determined from samples collected concurrently with hydraulic data. These data will be used to estimate total sediment discharge using one of several techniques such as the modified Einstein procedure.

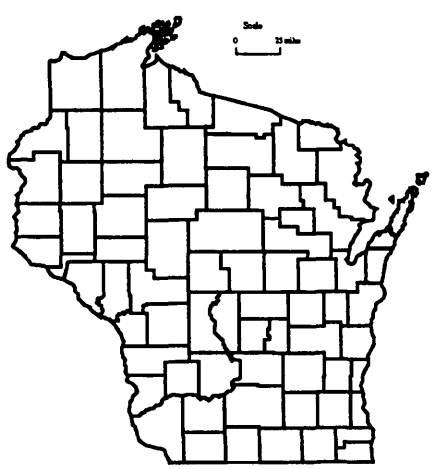
PROGRESS (July 1996 to June 1997): Sediment data have been collected at more than 200 stream sites in Wisconsin since 1968. Most sediment data collection has been in the southern one-third of the State and associated with local special problem studies except for about a five-year period in the early 1970's when there was a Statewide network of sediment monitoring stations. All data have been published annually in the data report, "Water Resources Data–Wisconsin". The 1996 monitoring program is as follows:

CORPS OF ENGINEERS–Suspended sediment was sampled at the Grant River at Burton. Daily loads were determined from these data.

PLANS (July 1997 to June 1998):

CORPS OF ENGINEERS–Operation of the Grant River monitoring station will continue.

Efforts to secure cooperative funding to establish a long-term sediment-monitoring network will continue. About 10 sites areally distributed to sample runoff from the major geographic provinces would provide an adequate network.



REPORTS:

Rose, William J., 1992, Sediment transport, particle sizes, and loads in the lower reaches of the Chippewa, Black, and Wisconsin Rivers in western Wisconsin, U.S. Geological Survey Water-Resources Investigations Report 90-4124, 38 p.

Rose, William J., and Graczyk, David J., 1996, Sediment transport, particle size, and loads in North Fish Creek in Bayfield County, Wisconsin, water years 1990-91, U.S. Geological Survey Water-Resources Investigations Report 95-4222, 18 p.

WISCONSIN WATER-USE DATA FILE, WI 007

PROBLEM: The need for reliable water-use data by State and Federal planning agencies is increasing as the competition for use of the State's water resources increases. Water-use data in a standardized format needs to be available to assist in making decisions on future water use.

OBJECTIVE: The purpose of this project is to collect accurate and complete data on Wisconsin's water use, store data in the State Water-Use Data System (SWUDS), and prepare periodic reports on water use in the State.

APPROACH: Sources of water-use information will be evaluated. The best available data will be entered into SWUDS. Efforts will be made to upgrade the accuracy of the water-use data.

PROGRESS (July 1996 to June 1997): SWUDS was updated with current water-use information. These data included high-capacity well data and information on discharge from sewage-treatment plants in the State. Reformatting programs were written or updated as needed for entering data from other agencies into SWUDS. Data collection was completed for the 1995 water-use publication, "Water use in Wisconsin, 1995".

PLANS (July 1997 to June 1998): Plans include: (1) continue to update and maintain SWUDS with current water-use data, (2) supply water-use data for water-resources studies currently being conducted in the State, and (3) prepare and publish, "Water use in Wisconsin, 1995".

REPORTS:

Ellefson, B.R., Sabin, T.J., Krohelski, J.T., 1993, Water use in Wisconsin, 1990: U.S. Geological Survey Open-File Report 93-118, 1 sheet, scale 1:5,000,000.

Ellefson, B.R., Rury, K.S., and Krohelski, J.T., 1988, Water-use in Wisconsin, 1985: U.S. Geological Survey Open-File Report 87-699, 1 sheet, scale 1:5,000,000.

U.S. Geological Survey, 1990, National Water Summary, 1987–Hydrologic events and water supply and use: U.S. Geological Survey Water-Supply Paper 2350, 553 p.

Krohelski, J.T., Ellefson, B.R., and Storlie, C.A., 1987, Estimated use of ground water for irrigation in Wisconsin, 1984: U.S. Geological Survey Water-Resources Investigations Report 86-4079, 12 p., 1 pl.

Lawrence, C.L., and Ellefson, B.R., 1984, Public-supply pumpage in Wisconsin, by aquifer: U.S. Geological Survey Open-File Report 83-931, 40 p.

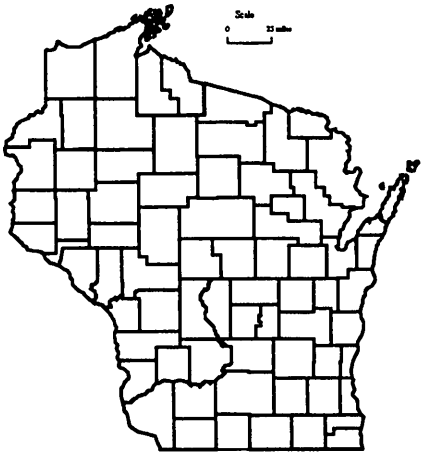
_____, 1982, Water use in Wisconsin, 1979: U.S. Geological Survey Open-File Report 82-444, 98 p.

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Statewide

PROJECT CHIEF:
Bernard R. Ellefson

PERIOD OF PROJECT:
March 1978-Continuing



OCCURRENCE, TRANSPORT, AND SIMULATION OF PCB'S IN THE LOWER FOX RIVER, WI 145

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Lower Fox River, East Central Wisconsin

PROJECT CHIEF:
Jeffrey J. Steuer

PERIOD OF PROJECT:
July 1985 to September 1997

PROBLEM: Polychlorinated biphenyls (PCB's) in the Lower Fox River have been identified and classified as "in-place pollutants" by the Wisconsin Department of Natural Resources (WDNR) due to the high concentrations found in the bottom sediments (up to 250 milligrams per kilogram). These PCB deposits are believed to be a significant source of continuing PCB loading to Green Bay and Lake Michigan. The WDNR is developing a remedial action plan to reduce the PCB presence in the Fox River and Green Bay. Information is needed regarding the location of PCB deposits and transport rate of PCB's within the Fox River to support this remedial action effort.

OBJECTIVE: The objectives of this study are to estimate the total mass of PCB's present in the study reach bottom sediments, compute the total PCB load carried by the river, and simulate present and future PCB transport in the river. The study is being coordinated with and will compliment the U.S. Environmental Protection Agency's mass-balance study of PCB's in Green Bay.

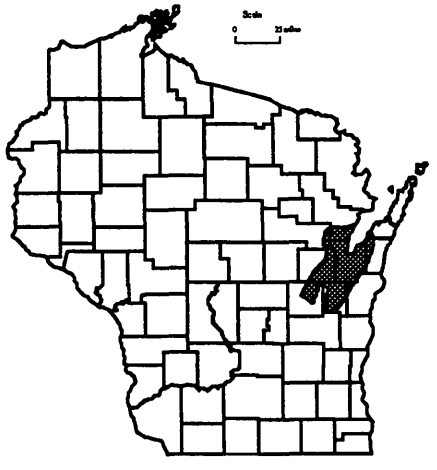
APPROACH: Streamflow-monitoring and automated-suspended-sediment sampling equipment is installed on the Fox River between Neenah/Menasha and DePere. Fox River discharge and suspended-sediment data were collected through September 1990.

Water samples were analyzed to obtain PCB concentrations with congener resolution of hundreths of a nano-gram/liter. Dissolved and particulate PCB concentrations were determined separately so the PCB partition coefficients could be computed. Water samples were also analyzed to determine total and dissolved organic carbon and other parameters. Samples were collected every two weeks, except in winter. Winter sampling was done about once per month.

The total mass of PCB's present in the study reach was estimated by use of an unconsolidated sediment thickness contour map and sediment-core analysis. The sediment cores were divided into several sections by visual inspection and analyzed for PCB concentration. Sediment cores were also analyzed to determine density of the bottom deposits.

The Water Analysis Simulation Program (WASP) model has been used to simulate PCB kinetics and transport. Water-column data collected during the summer and fall of 1992, along with high-flow data collected during the summer of 1993, has been used to validate the transport model.

PROGRESS (July 1996 to June 1997): A fact sheet summarizing the Fox River effort was completed. We assisted the Fish and Wildlife Service in the Natural Resource Damage Assessment process.



PLANS (July 1997 to September 1997): We will continue to assist the Fish and Wildlife Service in the Natural Resource Damage Assessment process.

REPORTS:

Fitzgerald, Sharon and Steuer, Jeffrey, 1996, The Fox River PCB transport study—stepping stone to a healthy Great Lakes ecosystem, USGS Fact Sheet 116-96.

House, Leo B., 1995, Distribution, concentration, and transport of polychlorinated biphenyls in Little Lake Butte des Morts, Fox River, Wisconsin 1987-88, U.S. Geological Survey Open-File Report 93-31.

Velleux, M., Endicott, D., Steuer, Jeffrey J., Jaeger, S., and Patterson, D., 1995, Long-term simulation of PCB export from the Fox River to Green Bay, Journal of Great Lakes Research, International Association for Great Lakes Research, vol. 21, no. 3, 1995, p. 359-372.

Steuer, Jeffrey J., Jaeger, S., and Patterson, D., 1995, A deterministic PCB transport model for the Fox River between Lake Winnebago and the DePere Dam, Wisconsin Department of Natural Resources PUBL WR 389-95.

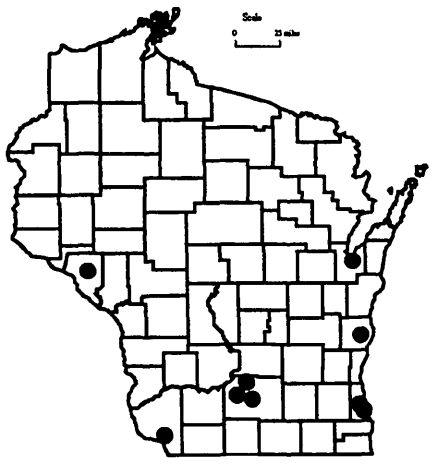
TRENDS IN WATER QUALITY AND STREAM HABITAT FOR PRIORITY WATERSHEDS, WI 17202-17205, 17209-17210, 17213, 17221

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Priority watersheds in Brown, Buffalo, Dane, Grant, Milwaukee and Sheboygan Counties

PROJECT CHIEF:
David J. Graczyk
Steven R. Corsi
David W. Owens

PERIOD OF PROJECT:
October 1990 to September 1997



PROBLEM: An evaluation strategy is needed to assess the effectiveness of nonpoint-source pollution control measures in priority watersheds. Several important processes require research including the role of ground water in nonpoint-source contamination, factors leading to dissolved-oxygen reduction in a stream during runoff events, and the impact of management practices on bedload transport. Several techniques need to be developed and/or refined, such as detecting trends in stream-water chemistry, sampling of fish and fish habitat, relation between fish/fish habitat and changes resulting from watershed management practices, and use of habitat models for determining impact of watershed management on fish populations.

OBJECTIVE: The overall objective of this project is to determine the trends in water quality for 10 sites during and after implementation of improved land-management practices in 7 priority watersheds.

APPROACH: Ten streams were selected in seven different priority watersheds. Continuous-record streamflow, water temperature, and dissolved-oxygen gaging stations were installed at each stream site. Water-quality samples will be collected during events and low flows and analyzed for selected constituents. Land-use inventories will be taken each year to help determine the cause of any changes in water quality.

PROGRESS (July 1996 to June 1997): Streamflow and water-quality monitoring was continued at six sites in the priority watersheds. Dissolved oxygen was monitored at five sites in the priority watersheds. Data collection was suspended at four sites due to insufficient implementation of best management practices in these four watersheds. All data was summarized and will be published in the report "Water Resources Data–Wisconsin", water year 1996. Water-quality loads were calculated for selected parameters and storm periods for the six sites. Land-use inventories were completed for each basin. Streamflow and water-quality data collection was started at an urban reference site. Data from the urban reference site, which is a rural watershed with little agricultural activity in the basin, will be compared to the highly urbanized watersheds in the Milwaukee area.

PLANS (July 1997 to June 1998): Streamflow, water-quality (for six sites), and dissolved-oxygen (for five sites) monitoring will be continued. Water-quality loads for selected parameters and storm periods will be calculated and compared to data collected in previous years. The data will be analyzed to determine if there are any apparent trends in water quality during implementation of the best management plans. Land-use inventories will be updated for each basin.

REPORTS:

Greb, Steven R., and Graczyk, David J., 1995, Frequency-duration analysis of dissolved-oxygen concentrations in two southwestern Wisconsin streams, Water Resources Bulletin (in press).

Walker, John F., and Graczyk, David J., 1993, Preliminary evaluation of effects of best management practices in the Black Earth Creek, Wisconsin, priority watershed: Water Science Technology, v. 28, no. 3-5, p. 539-548.

Bannerman, R.T., Owens, D.W., Dodds, R.B., and Hornewer, N.J., 1993, Sources of pollutants in Wisconsin stormwater: Water Science Technology, v. 28, no. 3-5, p. 241-259.

BEST MANAGEMENT PRACTICE EVALUATION, WI 17206

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
State of Wisconsin

PROJECT CHIEF:
John F. Walker

PERIOD OF PROJECT:
October 1989 to September 1997

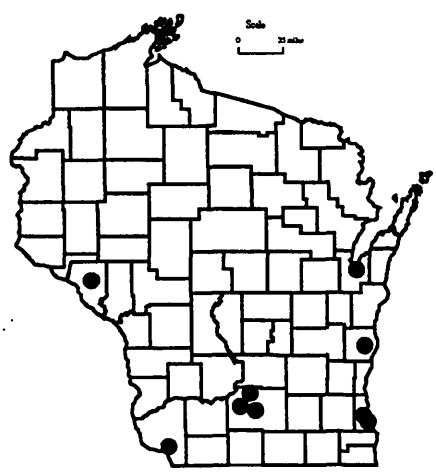
PROBLEM: To date, the effectiveness of best management practices (BMP's) in Wisconsin has not been determined. The natural variability of water-quality data complicates the detection of changes due to BMP implementation. Research is needed to identify techniques for detecting changes due to BMP implementation and applying the techniques to before and after data.

OBJECTIVE: Investigate statistical analysis techniques for assessing trends in water quality due to Best Management Practice (BMP) implementation using data from other states. The ffectiveness of BMP's in two urban basins and seven rural basins in Wisconsin will be determined using the identified statistical techniques.

APPROACH: A comprehensive literature search will be conducted to identify viable statistical analysis techniques and identify needs for method modification or development. Data for several rural and urban basins in other states will be compiled and used to test the selected techniques. Storm loads of total-suspended solids and total phosphorus will be computed and used along with rainfall data and land-use information to assess the effectiveness of the BMP's in several basins in Wisconsin.

PROGRESS (July 1996 to June 1997): Annual progress report describing data collected through water year 1996 was completed and published. Work began on progress report describing data collection through water year 1997. Oracle database design was completed and included all data through water year 1996. Access to database was provided over the world-wide-web through interactive, user-specified data queries. Urban regression analysis was completed and results published in the 1996 annual progress report. Preliminary statistical analysis for sites with transitional BMP-implementation data (Brewery, Garfoot, and Otter Creeks) was performed and published in 1996 annual progress report. Unit-area load analysis was completed.

PLANS (July 1997 to June 1998): Results from unit-area load analysis will be published in a fact sheet. Annual progress report describing data collected through water year 1997 will be completed and published; work on progress report describing data collection through water year 1998 will begin. Work incorporating snowmelt loads into regression analysis will be completed. All data through water year 1997 will be included in Oracle database.



REPORTS:
Walker, J.F., Corsi, S.R., Graczyk, D.J., and Wierl, J.A., 1997, Evaluation of nonpoint-source contamination, Wisconsin: selected data for water year 1996, U.S. Geological Survey Open-File Report (in press).

Owens, D.W., Corsi, S.R., and Rappold, K.F., 1997, Evaluation of nonpoint-source contamination, Wisconsin: selected data for water year 1995, U.S. Geological Survey Open-File Report 96-661A.

Walker, J.F., Graczyk, D.J., Corsi, S.R., Owens, D.W., and Wierl, J.A., 1995, Evaluation of nonpoint-source contamination, Wisconsin: land-use and best management practices inventory, selected streamwater-quality data, urban-watershed quality assurance and quality control, constituent loads in rural streams, and snowmelt-runoff analysis, water year 1994: U.S. Geological Survey Open-File Report 95-320, 21 p.

Corsi, S.R., Walker, J.F., Graczyk, D.J., Greb, S.R., Owens, D.W., and Rappold, K.F., 1995, Evaluation of nonpoint-source contamination, Wisconsin: selected streamwater-quality data, land-use and best-management practices inventory, and quality assurance and quality control, water year 1993: U.S. Geological Survey Open-File Report 94-707, 57 p.

Walker, J.F., 1994, Statistical techniques for assessing water-quality effects of BMPs, ASCE J. of Irrigation and Drainage Engineering, v. 120, no. 2, p. 334-347.

Walker, J.F., 1993, Techniques for detecting effects of urban and rural land-use practices on stream-water chemistry in selected watersheds in Texas, Minnesota, and Illinois: U.S. Geological Survey Open-File Report 93-130, 16 p.

Graczyk, D.J., Walker, J.F., Greb, S.R., Corsi, S.R., Owens, D.W., 1993, Evaluation of nonpoint-source contamination, Wisconsin: Selected data for 1992 water year: U.S. Geological Survey Open-File Report 93-630, 48 p.

LAKE SUPERIOR URBAN STORM-WATER DEMONSTRATION PROJECT, WI 17212

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Eleven cities in Lake Superior Basin (Minnesota, Wisconsin, Michigan)

PROJECT CHIEF:
Jeffrey J. Steuer

PERIOD OF PROJECT:
April 1993 to December 1997

PROBLEM: The Lake Superior Binational Program requires an understanding of the sources and amount of urban storm-water pollution in the Lake Superior Basin.

OBJECTIVE: The objective is to provide water-quality data necessary to construct storm-water management plans as required under the Binational Program. In addition to discharge, these data will include nutrients, metals, polycyclic-aromatic hydrocarbons (PAH's) and eight organic bioaccumulative substances identified by the Binational Program.

APPROACH: One storm sewer in each of two cities (Marquette, Michigan and Superior, Wisconsin) will be intensively monitored (15 events) for precipitation, runoff flow and constituent concentrations. Within the Marquette basin, runoff from nine discrete source areas (streets, parking lots, roof tops, driveways and lawns) will be sampled. These data will be used to calibrate an urban model for the Marquette flume site.

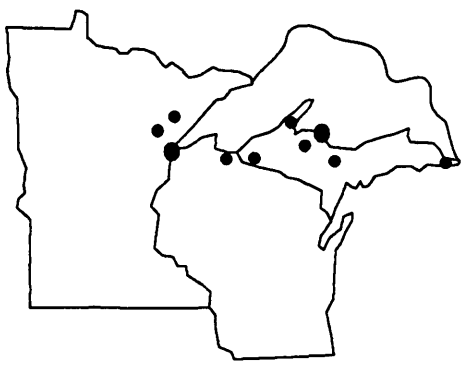
One storm sewer in each of eight smaller municipalities will be monitored over four events for constituent concentrations. Constituent concentrations will be monitored (6 events) at two bulk storage piles in the Duluth/Superior area.

In Duluth, Minnesota, and Superior, Wisconsin, water-quality sites will be installed at an urban undeveloped space, recreational park, golf course, and three gas stations. The concentration and discharge data collected at these sites will be used to further refine the source-area loading model (SLAMM).

PROGRESS (July 1996 to June 1997): Data collection from storm sewers in Marquette, Michigan, Superior, Wisconsin, and the eight smaller municipalities has been completed and the 2,887 samples analyzed. At Superior, Wisconsin, runoff from the Tower Avenue basin (22 acres), as measured during 91 events, was generally 50 percent. At Marquette, Michigan, runoff from the Tower Avenue basin (288 acres), as measured during 65 events, was generally 15 percent. At Marquette and Superior, event loadings for nutrients, metals, and polycyclic-aromatic hydrocarbons (PAH's) have been calculated based upon flume-measured discharge and flow-weighted composite sampling.

Within the Marquette basin, data collection from 8 source areas has been completed, resulting in 3,186 samples being analyzed. Initial assessment of these source-area data indicate that parking lots generate high concentrations of PAH's. Based upon the 1995 monitoring in Superior, the commercial site (Tower Avenue) generated total phosphorus loads (5-30 gm/acre-event), two times greater than the golf course and 40 times greater than the undeveloped site. The golf course and undeveloped sites were removed in September 1996.

PLANS (July 1997 to June 1998): 1996 data for undeveloped and golf course sites will be published in the annual progress report. Source-area journal article will be completed.



REPORTS:

Steuer, J.J., Selbig, W.R., and Hornewer, N.J., 1996, Contaminant concentrations in stormwater from eight Lake Superior basin cities, U.S. Geological Survey Open-File Report 96-122.

Steuer, J., and others, Sources of pollution in an urban basin located in Marquette, Michigan: an examination of concentrations, loads, and data quality (in preparation).

SINGLE SOURCE SITES, WI 17214

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
State of Wisconsin

PROJECT CHIEF:
Todd D. Stuntebeck

PERIOD OF PROJECT:
March 1994-Continuing

PROBLEM: Much work has been done to assess the effectiveness of nonpoint-source pollution-control strategies known as best management practices (BMP's). Most of this work to date has had a basin-wide scope and is focused on evaluating the cumulative effectiveness of several different types of BMP's. Research targeted at evaluating the effectiveness of a single type of BMP would assist resource managers responsible for planning BMP implementation programs.

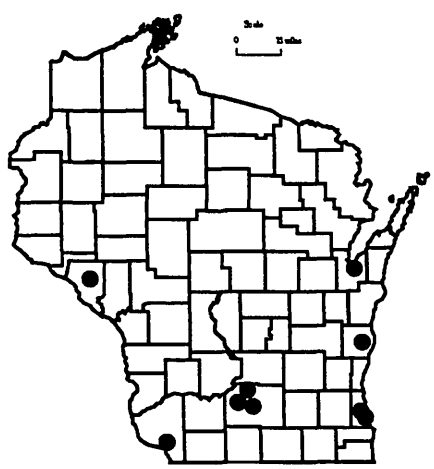
OBJECTIVE: The objective is to determine the significance of a single nonpoint-pollution source and evaluate the effectiveness of BMP's in treating that same source.

APPROACH: Continuously monitor and/or sample streamwater upstream and downstream from a single nonpoint-pollution source before and after implementation of BMP's. Currently, two barnyard-runoff sites are being investigated: Otter Creek in the Sheboygan River Priority Watershed and Halfway Prairie Creek in the Black Earth Creek Priority Watershed. At each site, water-quality samples are collected biweekly and during periods of storm runoff, and stream discharge is monitored continuously.

PROGRESS (July 1996 to June 1997): Samples were collected for 12 runoff periods at Otter Creek and 11 runoff periods at Halfway Prairie Creek before BMP implementation. Since BMP implementation, samples have been collected for seven runoff periods at Otter Creek and eight runoff periods at Halfway Prairie Creek.

Before BMP implementation, downstream loadings of suspended solids, total phosphorus, ammonia nitrogen and biochemical oxygen demand (BOD) exceeded upstream loadings for each barnyard. The barnyard at Otter Creek contributed approximately 55, 40, 30 and 40 percent of the total stream load of suspended solids, total phosphorus, ammonia nitrogen and BOD for the runoff periods monitored; the barnyard at Halfway Prairie Creek contributed approximately 1, 35, 35 and 60 percent, respectively. Assuming that pollutants contributed from upstream sources were not greatly reduced by in-stream transport phenomenon, such as deposition, these barnyards were a significant source of total phosphorus, ammonia nitrogen and BOD within each watershed for the runoff periods monitored. Some seasonality effects were apparent for Otter Creek where, in general, the percent loading attributed to the barnyard was less during spring runoff events. In general, input from the barnyard was also less important during larger runoff events. Data supporting these observations were inconclusive for Halfway Prairie Creek.

Since implementation of barnyard BMP's, data have shown significant reductions in loadings coming from each barnyard. Loadings from Otter Creek have decreased by approximately 85, 95, 90 and 95 percent for suspended solids, total phosphorus, ammonia nitrogen and BOD; loadings at Halfway Prairie Creek have been reduced by 100, 90, 95 and 90 percent, respectively.



PLANS (July 1997 to June 1998): Monitoring streamflow and collection of water-quality data in the post-BMP period at Otter Creek and Halfway Prairie Creek will be continued. Biweekly baseflow samples and samples for five more runoff periods at Otter Creek and Halfway Prairie Creek will be collected. Loads and event-mean concentrations for each constituent will be calculated and statistical analyses to determine the effectiveness of each BMP will be performed. A fact sheet and draft article for publication in journal will be prepared. Results will be presented at various conferences and meetings.

REPORTS:

Stuntebeck, T.D., 1995, Evaluating barnyard best management practices in Wisconsin using upstream-downstream monitoring: U.S. Geological Survey Fact Sheet 221-95, 4 p.

TRIBUTARY PHOSPHORUS LOADING TO LAKE MENDOTA AND EVALUATION OF LOAD DETERMINATION METHODS, WI 17217

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Lake Mendota, Madison, Wisconsin

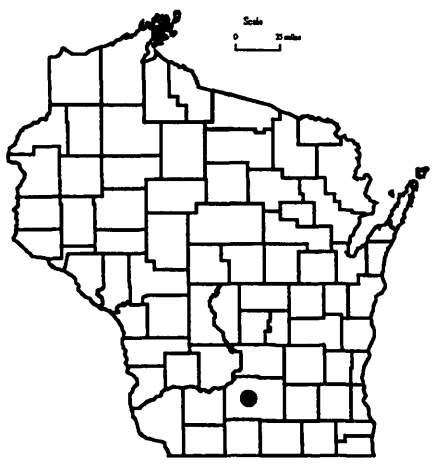
PROJECT CHIEF:
David J. Graczyk

PERIOD OF PROJECT:
October 1994 to June 1996

PROBLEM: Traditionally, monitoring of streamflow and phosphorus loading is done upstream from the lake (sometimes several miles) where the hydraulic gradient is sufficiently steep to employ conventional stream-gaging techniques. These monitoring sites, equipped with automatic samplers, provide data for accurate load determination, but at considerable cost. Usually, the load at the stream's mouth is assumed to be the same as at the monitoring site or adjusted by the ratio of the watershed areas of the two sites. The validity of this assumption is open to question because it is unknown whether the stream reach and watershed between the upstream monitoring site and the lake is a source or a sink for phosphorus. Various data-collection and analysis techniques must be tested to determine the most cost-effective methods for estimating loading at mouths of tributaries to lakes. These methods would then be employed in long-term monitoring on tributaries to selected lakes in priority-watershed projects.

OBJECTIVE: The objectives are to (1) determine the most cost-effective method for estimating total-phosphorus loading at mouths of streams flowing into lakes and (2) determine the annual total-phosphorus loading to Lake Mendota.

APPROACH: Four major tributaries (Yahara River, Pheasant Branch Creek, Sixmile Creek, and Spring Creek) to Lake Mendota will be monitored. These tributaries account for 214 of the 233 square-mile-drainage basin of Lake Mendota. The lower reaches of all these tributaries are low gradient and flow through adjacent wetlands to Lake Mendota. Two of these tributaries, the Yahara River and Pheasant Branch, have continuous-discharge-gaging stations and automatic water-quality samplers upstream of reaches with adjacent wetlands. Water sampling for analysis of total-phosphorus concentration and determination of stream discharge will be done at or very near the mouths of these streams. Annual loads at the four major tributaries will be estimated. The annual loads will be estimated first by using the complete data set of all concentration data. Subsets of the complete data set will be used to estimate annual loads. The annual loads estimated by using the subsets will be compared to the annual loads estimated using the complete data sets in order to determine the minimum sampling intensity that still yields sufficiently accurate load estimates. Pollutant loadings to Lake Mendota will be estimated by summing the loads from the four major tributaries and other sources to Lake Mendota. The other sources include loading from storm sewers, other smaller tributaries, ground-water inflow and direct precipitation to the lake. The loads from these sources will be provided by other agencies, programs and from literature reviews.



PROGRESS (July 1996 to June 1997): A Water-Resources Investigations Report (WRIR) was written and reviewed. The WRIR summarizes all data collected and the various data-collection and analyses techniques used to determine the most cost-effective methods for estimating loads at mouths of tributaries to lakes.

PLANS (July 1997 to September 1997): The WRIR will be printed and distributed.

ASSESSMENT OF THE WATER QUALITY, HYDROLOGY, AND BIOLOGY OF GENEVA LAKE, WI 17314

PROBLEM: Because of increased urban development and recreational use, concerns have arisen over the potential decline in the water quality of Geneva Lake. The public perception is that the water quality of Geneva Lake is declining; however, little direct evidence is available to support or deny the perceptions. To reduce the impact on the lake, efforts are being made to decrease the point and nonpoint-source pollution to the lake. However, more water-quality and biological information are needed to determine which pollution prevention strategies will be most cost effective.

OBJECTIVE: The objectives of this project are to (1) document the water-quality and planktonic populations in the lake, (2) estimate phosphorus and sediment loading to the lake, (3) determine the historical water quality of the lake by examining the lake's sediments, and (4) construct hydrologic and phosphorus budgets for the lake.

APPROACH: Phosphorus and streamflow will be monitored at two locations upstream of Geneva Lake and at the outlet from which loads of phosphorus to and from the lake will be estimated. Nutrient concentrations, dissolved oxygen, water temperature, pH, specific conductance, and phytoplankton and zooplankton populations will be monitored monthly at five locations within the lake during the first year of the study. Sampling locations and frequency will be modified in future years of the study. Nutrient and phosphorus budgets will be constructed for the lake using a dynamic simulation model. Sediment cores will be collected and analyzed to estimate sedimentation rates and the historical water quality of the lake.

PROGRESS (July 1996 to June 1997): Sampling sites were chosen for lake and stream sampling. Lake sampling began shortly after ice out in 1997. Sediment cores were collected.

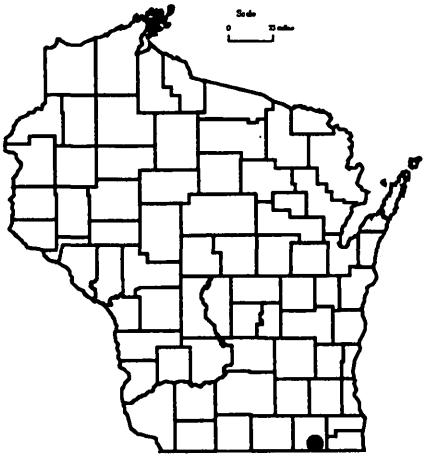
PLANS (July 1997 to June 1998): Lake sampling will continue throughout this period at five locations. After ice-out in 1998, lake sampling will be done at three locations on a biweekly sampling interval. Stream sampling sites will be installed in late summer of 1997. Streamflow and phosphorus samples will be collected monthly and during high flow events at the two inflow sites and approximately bimonthly at the outlet. Preliminary water and phosphorus budgets will be constructed. Sediment data will be analyzed.

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Walworth County, southeast Wisconsin

PROJECT CHIEF:
Dale M. Robertson
William J. Rose
Sharon A. Fitzgerald

PERIOD OF PROJECT:
March 1997 to September 2000



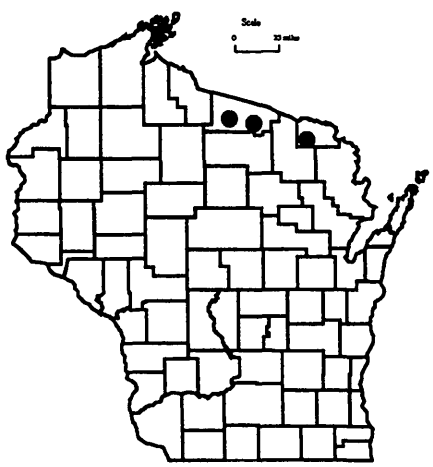
MERCURY CYCLING IN LAKES, WI 18001

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Florence and Vilas Counties, northern Wisconsin

PROJECT CHIEF:
William J. Rose

PERIOD OF PROJECT:
March 1987 to September 1996



ACIDIC LAKES

PROBLEM: Acid deposition has damaged lakes in Canada and in the northeastern United States. The pH of precipitation in northern Wisconsin averages 4.6 to 4.7, and Wisconsin has more susceptible lakes than any state east of the Mississippi. Many of these lakes are seepage lakes, whose chemistry is closely associated with precipitation chemistry. Previous studies addressing hydrologic and chemical budgets in northern Wisconsin have concentrated on lakes with alkalinities greater than 20 µeq/L; however, to truly address the potential effects of acid deposition on sensitive lake ecosystems, it is necessary to study lakes with alkalinities less than 20 µeq/L.

OBJECTIVE: Objectives are to determine the hydrologic and chemical budgets for Honeysuckle, Max, and Morgan Lakes in northern Wisconsin to provide information about mechanisms of acid loadings to these lakes, investigate differences between bog lakes and clear-water lakes, evaluate the feasibility of, and develop an approach for, pumping ground water in an acid lake to raise its pH and alkalinity, and continue limited hydrologic monitoring at Vandercook Lake, which has a data base going back to October 1980.

APPROACH: Lake inflows from precipitation and ground-water discharge, and lake outflows from evaporation and ground-water recharge will be quantified. Alkalinity, pH, major cations and anions, nutrients, and mercury plus other trace elements in selected flow paths will be quantified. The lakes will be evaluated for their potential for acidification.

The ground-water-pumping study will be done at Max Lake where a well will be installed to draw water from the lower part of the sand and gravel aquifer adjacent to the lake. The chemical quality and quantity of pumped water will be monitored as well as the effects of the pumping on the lake.

PROGRESS (July 1996 to June 1997): Most monitoring emphasis was at Max Lake; lake stage and a single recorder-equipped well were monitored at Morgan Lake; and lake stage, precipitation, and the ground-water-well network were monitored at Vandercook Lake. Monitoring at Max Lake was discontinued November 22, 1996.

Ground water was pumped into Max Lake to raise and maintain its pH to 7.0. Ground water was pumped from May 16 to November 16 at a 20 gallons-per-minute pumping rate.

PLANS (July 1997 to June 1998): Routine data collection will continue at Vandercook and Morgan Lakes. Instrumentation will be removed from Max Lake.

REPORTS:

Webster, Katherine E., Kratz, Timothy K., Bowser, Carl J., Magnuson, John J., and Rose, William J., The influence of landscape position on lake chemical responses to drought in northern Wisconsin, USA: Limnology and Oceanography, v. 41, no. 5, p. 977-984.

HYDROLOGIC CONSIDERATIONS ASSOCIATED WITH THE ARTIFICIAL ACIDIFICATION OF LITTLE ROCK LAKE IN VILAS COUNTY, WI

PROBLEM: A multi-agency group will study biological chemical responses to artificial acidification of one basin of two-basin Little Rock Lake by artificially lowering the pH incrementally over an 8-year period. The basins will be separated by a barrier; one basin will be acidified, the other will function as a control. A detailed understanding of the lake hydrology is needed by the group to (1) determine which of the basins to acidify, (2) estimate the amount of acid required to achieve a given pH level, (3) characterize the lake hydrologically to increase the transfer value of the study's results to other lakes, (4) monitor the effects of the acidification on the local ground water, and (5) provide basic hydrologic information on lake hydrology that would be input to any acidification models that may be tested.

OBJECTIVE: The goals of this project are to determine monthly water budgets for each basin (the control and acidified basins) of Little Rock Lake, define ground-water-flow paths, and monitor ground-water quality.

APPROACH: Inflow to the lake from precipitation, overland flow, and ground-water discharge, and outflow from the lake from evaporation and ground-water recharge will be determined. Ground-water gradients determined from a piezometer network will be evaluated to define flow paths of ground water discharging to and recharging from the lake. Ground water discharging to and recharging from the lake will be sampled from piezometers situated in the appropriate flow paths. Concentrations of major chemical constituents, including hydrogen ion and alkalinity, nutrients, and trace elements, including aluminum and lead, will be determined. Monthly water budgets will be calculated.

PROGRESS (July 1996 to September 1996): Routine hydrologic monitoring continued through September 30, 1996. Data were published in the Wisconsin District's annual lake data report. The project is completed.

PLANS: Instrumentation will be removed.

REPORTS:

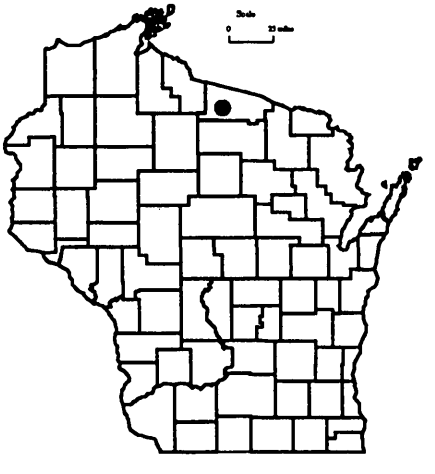
Rose, William J., 1993, Hydrology of Little Rock Lake in Vilas County, north-central Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 93-4139, 22 p.

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Vilas County, northern Wisconsin

PROJECT CHIEF:
William J. Rose

PERIOD OF PROJECT:
March 1987 to September 1997



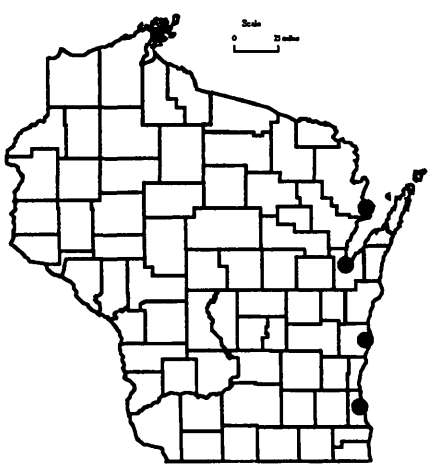
LAKE MICHIGAN TRIBUTARY LOADING, WI 183

COOPERATORS:
Environmental Protection Agency
Wisconsin Department of Natural Resources

LOCATION:
Cities of Marinette, Green Bay, Milwaukee and Sheboygan

PROJECT CHIEF:
David W. Hall

PERIOD OF PROJECT:
July 1992 to September 1997



PROBLEM: Concern about the potential negative health and biologic effects of toxic chemicals and heavy metals being transported into Lake Michigan has increased with growing evidence of links between the presence of these contaminants and carcinogens in fish, genetic defects in fish-eating birds, and reproductive disorders in biota. Adequate management of chemical loads requires that the total contribution of contaminants from atmospheric, ground water, and tributary rivers be quantified.

OBJECTIVE: Objectives of this project are to build a streamflow and water-quality data base for 11 Lake Michigan tributaries in the states of Wisconsin, Michigan, and Indiana to act as a baseline for evaluation of future remediation activities; estimate loads of PCB's, transnonachlor, atrazine, trace metals, nutrients, and suspended solids to Lake Michigan; compare loads between tributaries to target basins of major concern; identify contaminants of greatest concern; and describe the mobility of contaminants.

APPROACH: The Wisconsin District will install acoustic-velocity-metering (AVM) stations at the mouths of the four Wisconsin tributaries, including the Milwaukee, Sheboygan, Fox, and Menominee Rivers to provide real-time flow and water-quality data. Field sampling will be scheduled to obtain approximately 75 percent of the samples during non-baseflow periods. Composited samples for analyses of congener-specific PCB's and pesticides will be field filtered and processed through XAD-2 resin columns. Composited samples for analyses of particulate and dissolved trace metals will be obtained using clean sampling protocols. Data will be entered into the WATSTORE and ADAPS data bases.

PROGRESS (July 1996 to June 1997): Sample collection was completed for all of the 11 stations in October 1995. A total of 401 samples was collected from the 11 tributaries to Lake Michigan for analysis of congener-specific PCB's, 14 pesticides and pesticide degradation products, trace metals, nutrients, and major ions. Mean daily discharges measured at the eight acoustic-velocity meter equipped sites and three standard stage-discharge equipped sites have been computed. Preliminary, and when possible, final data analyses are in progress. A journal article discussing preliminary PCB results from the first samples analyzed by the Wisconsin State Lab of Hygiene is in draft form. An Open-File USGS report of cross-sectional field data collected from six stations across each tributary, including dissolved oxygen, conductance, temperature and pH data, is also in draft form.

PLANS (July 1997 to June 1998): After organics data have undergone Environmental Protection Agency (EPA) QA/QC checks, journal articles will be written to present project results, including discussions of factors affecting contaminant concentrations and quantification of contaminant loads. Project data will be formatted and electronically transmitted for storage in the EPA ORACLE database, prior to EPA use of the data in the Lake Michigan Mass Balance Model. The project will be extended through 1998 to allow additional time for lab work, database construction, and estimation of tributary contaminant loads.

LAKE SUPERIOR TRIBUTARY LOADING, WI 18302

PROBLEM: Concern about the potential negative health and biologic effects of toxic chemicals and heavy metals being transported into Lake Superior has increased with growing evidence of links between the presence of these contaminants and carcinogens in fish, genetic defects in fish-eating birds and reproductive disorders in biota. Adequate management of chemical loads requires that the total contribution of contaminants from atmospheric, ground water, and tributary rivers be quantified.

OBJECTIVE: Objectives of this project are to build a streamflow and water-quality data base for two Lake Superior tributaries to act as a baseline for evaluation of future remediation activities, estimate loads of targeted contaminants to Lake Superior, compare loads between tributaries to target basins of major concern, identify contaminants of greatest concern, and describe the mobility of contaminants.

APPROACH: The Wisconsin and Minnesota Districts will install acoustic-velocity-metering (AVM) stations at the two St. Louis River harbor exits to Lake Superior and instrument the Nemadji River for water-quality sampling. The AVM sites will be calibrated using Doppler discharge measurements. Infiltrex automated organic samplers will be installed to obtain flow-composited samples for organic analyses. Data will be entered into the WATSTORE and ADAPS data bases.

PROGRESS (July 1996 to June 1997): Gaging station operations were continued for the year. Several PCB samples were taken during this period using the Infiltrex samplers controlled by the flow-proportional sampling program. AVM data from the sites were calibrated with Doppler measurements to estimate discharge. Discharge data for Duluth and Superior AVM sites and the Nemadji River were published in the report, "Water Resources Data–Wisconsin, water year 1996".

PLANS (July 1997 to June 1998): The gaging stations will be operated through September 1997. Operation beyond September 1997 will depend on finding alternative funding sources. Flow data will be finalized and published in the report, "Water Resources Data–Wisconsin, water year 1997".

COOPERATORS:

U.S. Environmental Protection Agency
Wisconsin Department of Natural Resources
Minnesota Pollution Control Agency

LOCATION:

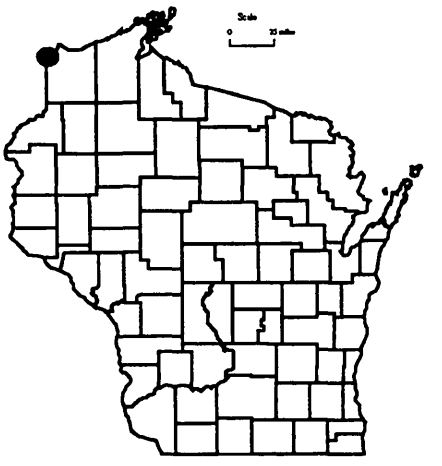
Cities of Duluth, Minnesota and Superior, Wisconsin

PROJECT CHIEF:

Peter E. Hughes

PERIOD OF PROJECT:

July 1993 to September 1997



DANE COUNTY REGIONAL HYDROLOGIC STUDY, WI 189

COOPERATORS:
City of Middleton
Dane County Regional Planning Commission
Madison Metropolitan Sewerage District
Wisconsin Department of Natural Resources
Wisconsin Geological and Natural History Survey

LOCATION:
Dane County and parts of surrounding counties

PROJECT CHIEF:
James T. Krohelski

PERIOD OF PROJECT:
October 1992 to September 1996

PROBLEM: Officials at all levels of government are concerned about the effects of increasing urban growth and development on the surface- and ground-water resources in Dane County. The relation between surface water and ground water must be understood to allow for increased ground-water withdrawals while protecting the quality and quantity of surface-water resources in the county. A comprehensive study that combines existing water data with new data is needed to provide government and planning agencies with a tool to aid in managing the water resources of the Dane County area.

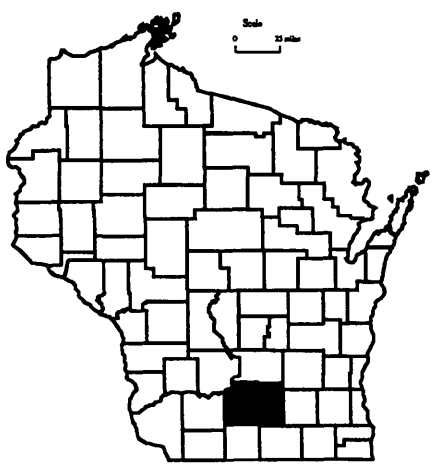
OBJECTIVES: The objective is to provide a better understanding of the regional ground-water system in relation to surface water and to provide a tool (ground-water flow model) that will be useful in water-resource management decision making on a continuing basis.

APPROACH: The study is divided into three phases: (1) establish conceptual framework of the ground-water system and data base, (2) develop and calibrate three-dimentional ground-water flow model, and (3) determine how land-use and management strategies effect water resources.

PROGRESS (July 1996 to June 1997): A report describing phase 2 of the Dane County Hydrologic Study, a calibrated three-dimensional flow model, was completed and approved for publication. Simulations incorporating potential land-use and management strategies were run and the results given to the Dane County Regional Planning Commission.

PLANS: Project is complete except for publication of the report.

REPORTS: Krohelski, J.T., Bradbury, K.R., Hunt, R.J., and Swanson, S.K., 1997, Numerical simulation of ground-water flow in Dane County, Wisconsin: Wisconsin Geological and Natural History Survey Informational Circular (in press).



DANE COUNTY SURFACE WATER MODEL, WI 18901

PROBLEM: Officials at all levels of government are concerned about the effects of increasing urban growth and development on the surface- and ground-water resources in Dane County. The relation between surface water and ground water must be understood to allow for increased ground-water withdrawals while protecting the quality and quantity of surface-water resources in the county. A comprehensive study that combines existing water data with new data is needed to provide government and planning agencies with a tool to aid in managing the water resources of the Dane County area.

OBJECTIVES: Evaluate alternative operation plans for the lake system (Lakes Mendota, Monona, and Waubesa) in order to sustain downstream flows and provide adequate lake levels for recreation.

APPROACH: The model used in preparing the report, "Hydrologic effects of proposed changes in management practices, Winnebago Pool, Wisconsin" by William R. Krug (1981), will be used as a basis for developing a model for the Madison area lakes. This is a daily reservoir storage routing model used to simulate lake stage and outflow given the dam operating rules for the reservoir.

Net inflow to be used in the model will be computed from the measured outflow, observed changes in lake stages, and the record of past diversions. Outflow has been measured since September 1930 on the Yahara River near McFarland, Wisconsin. Daily lake stage for most periods of the same years has been measured on Lakes Monona and Mendota. Records of sewage diversion are available from the Madison Metropolitan Sewerage District.

The model will be used to evaluate the effects of various possible alternatives including various levels of minimum outflow requirements.

PROGRESS (July 1996 to June 1997): The model has been completed and used to simulate minimum outflows of 8.5, 10, 30, and 36 cubic feet per second. The model demonstrates that these levels of outflow can be maintained without reducing the levels of the lakes below levels observed in the recent past and without causing higher lake levels than have been observed.

PLANS: The final report will be reviewed and published.

COOPERATORS:

City of Middleton
Dane County Regional Planning Commission
Madison Metropolitan Sewerage District
Wisconsin Department of Natural Resources
Wisconsin Geological and Natural History Survey

LOCATION:

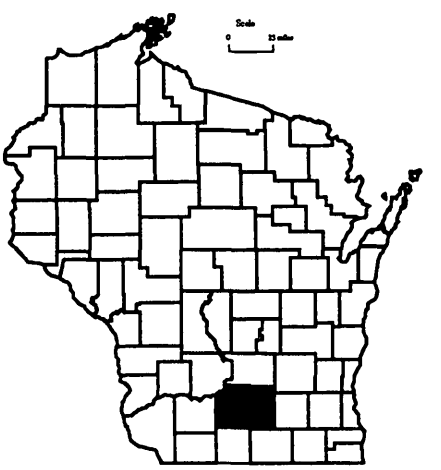
Dane County, Wisconsin

PROJECT CHIEF:

William R. Krug

PERIOD OF PROJECT:

October 1995 to December 1996



TRANSPORT AND BIOGEOCHEMICAL CYCLING OF PCB'S IN THE MILWAUKEE RIVER - THE IMPORTANCE OF ALGAL DYNAMICS, WI 19100, 19101

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Milwaukee County, eastern Wisconsin

PROJECT CHIEF:
Jeffrey J. Steuer

PERIOD OF PROJECT:
February 1993 to September 1997

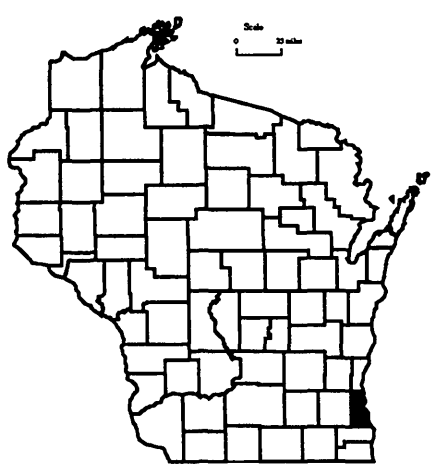
PROBLEM: The Milwaukee Harbor is identified as an area of concern by the International Joint Commission because it is highly contaminated by toxic synthetic organic chemicals and trace metals. A plan is being developed to restore and revive the surface waters of this area, but little is known about the upstream transport of contaminated in-place sediments. Knowledge of the processes that control cycling and transport of polychlorinated biphenyls (PCB's) is essential to the remediation effort. Algal incorporation of PCB's may be a quantitatively important process in this transport.

OBJECTIVE: The objective is to determine the link between algal dynamics and PCB transport by characterizing total suspended solids (TSS) in the river as biogenic (algal) and detrital components, determining PCB, organic carbon and lipid concentrations of each fraction, and evaluating the link between algal uptake of PCB's and concentration of PCB's in TSS and resuspendable surficial bottom sediments. Milwaukee River PCB loading will be determined at Estabrook Park, Thiensville, and Pioneer Road. PCB loading will also be determined on Cedar Creek, a tributary entering upstream of Pioneer Road. This monitoring will assist in evaluating the effectiveness of the Ruck Pond remediation. Due to high bottom sediment and fish PCB concentrations, a fourth site has been selected on the South Branch of the Manitowoc River at Hayton.

APPROACH: The three Milwaukee River sites, one Cedar Creek site, and one Manitowoc River site will be monitored for two years during event and base-flow conditions. Automated water-quality samplers will be used to obtain daily total suspended solids (TSS) samples; more intensive samples will be obtained on the rising hydrograph limb. Between June 1993 and June 1995, 26 manual organic samples (80 liters) will be collected at the Milwaukee sites and 18 samples will be collected at the Hayton site. Measured water-column characteristics include PCB (dissolved and particulate), TSS, VSS, particulate and dissolved organic carbon, chlorophyll *a*, sand/silt split and chloride.

Water column and bed algae will be seasonally collected and a biomass determined. Dominant algal species will be laboratory cultured and PCB uptake subsequently measured. These data will be used to calculate the algal and detrital PCB fractions.

Seasonal samples will also be collected from the surficial sediment layer at each of the four sites. Total organic carbon, congener-specific PCB, porosity, particle density, bulk density, and chlorophyll *a* will be determined during each of the four seasons.



PROGRESS (June 1996 to July 1997): The data-collection effort is complete. Water-column PCB concentrations on the Milwaukee River ranged from 3 to 168 ng/L resulting in transported PCB loads of 4 to 261 grams per day. Hayton system water-column PCB concentrations range from 38 to 564 ng/L, producing transported PCB loads of 4 to 136 grams per day. The algal identification effort and laboratory PCB uptake experiments are complete.

PLANS (July 1997 to September 1997): A report detailing the PCB loading, partitioning, algal PCB uptake and suspended-solids classification will be published.

REPORTS:

Swackhamer, Deborah, and others, 1996, PCB concentrations in algae from the Milwaukee and Manitowoc Rivers, Wisconsin

Fitzgerald, Sharon and Steuer, Jeffrey, 1996, The Fox River PCB transport study–stepping stone to a healthy Great Lakes ecosystem, U.S. Geological Survey Fact Sheet 116-96.

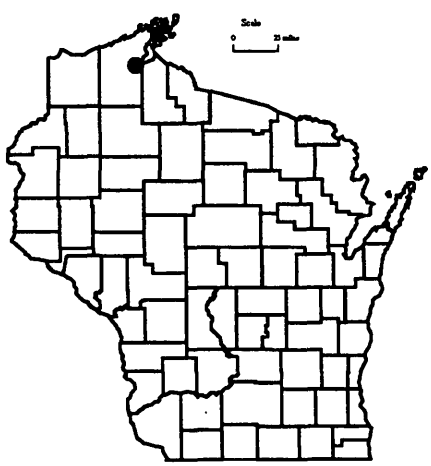
NORTH FISH CREEK SEDIMENT, WI 193

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
East-central Bayfield County near Ashland, Wisconsin

PROJECT CHIEF:
Faith Fitzpatrick

PERIOD OF PROJECT:
June 1994 to September 1997



PROBLEM: North Fish Creek has been identified as having an excessive sediment load that is causing major sedimentation problems in its lower reaches and in Chequamegon Bay. The sediment may be limiting spawning habitat for steelhead, coho salmon, and trout, and also may be impacting important wetland aquatic habitat in the coastal wetland located at the mouth of Fish Creek.

OBJECTIVES: The objectives of this study are to (1) identify sedimentation rates in the floodplain and channel prior to European settlement, (2) identify variations in historical sedimentation rates, (3) identify extrinsic and intrinsic factors leading to destabilization of the fluvial system, and (4) identify the effects of variations in storm runoff on channel hydraulic processes of sediment erosion, transport, and deposition.

APPROACH: Cores of channel, floodplain, and back-water sediment will be examined and dated using indirect and radiometric techniques. Channel geometry of relict cutoff meanders will be compared to channel geometry of the active channel along several reaches of the stream characterized by erosional, transitional, and depositional processes. Historical records such as Government Land Office Surveys, bridge designs, maps, aerial photographs, and field notes will be used to supplement field data. Rates of bluff retreat will be quantified using aerial photographs from 1938, 1950, and 1990.

PROGRESS (July 1996 to June 1997): Analyses of sediment and organic samples from floodplain cores continues. Approximately 25 samples have been analyzed for radiocarbon to quantify long-term sedimentation rates. Macrofossil samples are being examined for long-term change in vegetation. Analyses of change in low magnitude, high-frequency floods is complete. Analysis of rates of bluff retreat is complete. Particle-size analysis of channel and floodplain sediment is complete. Analyses of the effects of headwater detention basins on main-stem bluff erosion continues.

Preliminary results of analyses of relict cutoff meanders suggest that, in the upper part of North Fish Creek, the size of the bank-full flood has doubled in the last 50 years and parts of the channel have eroded up to 3 meters over that same time period. The channel capacity in the upper part has increased substantially, which causes less flooding upstream but more flooding and sedimentation downstream as flood water is routed downstream quicker than 50 years ago. Near the mouth, an average of 1 meter of sediment has accumulated in the channel and near-channel floodplain over the last 50 years. The main channel is seeking alternative routes through Fish Creek Slough as the accumulation of sediment in and near the channel raises the local water table above that in the surrounding slough. This results in a water surface slope away from the main channel and causes the channel to shift away from its present position toward areas of lower elevation.

PLANS (July 1997 to June 1998): Data analyses will be completed, model of effects of detention basin storage on sediment transport will be completed, and report and dissertation will be completed.

REPORTS:

Fitzpatrick, F.A., and Knox, J.C., Effects of Long-Term Land-Use Changes on Flooding and Sedimentation, North Fish Creek, Wisconsin: U.S. Geological Survey Water Resources Investigations Report (in preparation).

Fitzpatrick, F.A., Effects of Changes in Vegetation, Climate, and Isostatic Rebound on Sedimentation and Hydrology of a Northern Wisconsin Stream, Ph.D. dissertation, University of Wisconsin-Madison (in preparation).

OPTIMUM MANAGEMENT OF GROUND-WATER RESOURCES IN THE LOWER FOX RIVER VALLEY, WI 198

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Lower Fox River Valley (Green Bay Metropolitan and Fox Cities area)

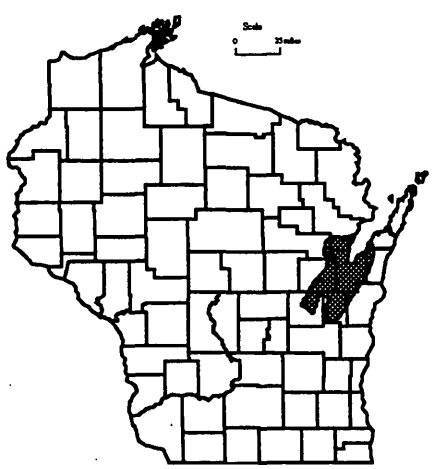
PROJECT CHIEF:
John F. Walker

PERIOD OF PROJECT:
October 1995 to September 1997

PROBLEM: Recent water-level measurements indicate that the cones of depression from two pumping centers, the Green Bay Metropolitan area and the Fox Cities area, have merged so that pumping in one area effects the other area. Water-use projections, used in a previously developed ground-water-flow model, indicate water levels near the center of the cone of depression at Green Bay will decline more than 250 feet below the top of the sandstone aquifer by the year 2015 and leave about 330 feet of saturated aquifer thickness. This would result in increased pumpage costs and a reduction in the amount of water that can be pumped from the sandstone aquifer. In response to the concern over declining water levels in the aquifer, proposals to build a pipeline to Lake Michigan have been discussed.

OBJECTIVE: The objective of this study is to determine whether ground water, under managed pumping conditions, is an alternative to Lake Michigan water for future water supply in the Lower Fox River Valley. An optimization model will be used to determine ground-water-management plans so that water yields are maximized, while water-level declines in the sandstone aquifer are constrained to remain within reasonable ranges.

APPROACH: A three-dimensional regional ground-water-flow model encompassing the entire Lower Fox River Valley was developed as part of an ongoing ground-water study. The flow model will provide the head response resulting from various management solutions. The goal of the optimization modeling will be to maximize well yield while maintaining reasonable water levels in the aquifer. Optimization modeling will be applied to several management scenarios, addressing relevant issues and questions concerning ground-water resources of the Lower Fox River Valley. Potential issues include ground-water availability in the sandstone aquifer, well placement and pumping strategies, quality of the water supply, and relation between ground and surface water.



PROGRESS (July 1996 to June 1997): Two sets of preliminary optimization scenarios were developed and solved using optimization techniques. The first set of scenarios optimized well rates in Brown County. The second set of scenarios optimized well rates in the Fox Cities area. The preliminary results were presented to planning agencies in Brown County and the Fox Cities area, respectively, as a demonstration of the potential use of optimization techniques. Based upon suggestions from the planning agencies, a final set of scenarios was developed and solved.

PLANS (July 1997 to June 1998): The results from the final optimization scenarios will be presented in a USGS Water-Resources Investigations Report.

EVALUATION OF THE EFFECTIVENESS OF VEGETATED FILTER STRIPS AS A MEANS OF REDUCING THE TRANSPORT OF NUTRIENTS AND SUSPENDED SEDIMENT IN AGRICULTURAL AREAS, WI 199

PROBLEM: Vegetated filter strips, also referred to as grass filter strips, have been used as a Best Management Practice (BMP) to reduce the loss of sediment and nutrients from agricultural land to adjacent streams. The extent of the reduction in sediment and nutrient transport associated with the installation of vegetated filter strips in areas is not well known, especially the extent of the reduction in areas with specific types of surficial deposits. Therefore, it is difficult to model and quantify the changes in water quality associated with installing vegetated filter strips.

OBJECTIVE: The objective of this project is to determine how vegetated filter strips affect the transport of nutrients and suspended sediment to streams in an area with extensive agriculture on clayey surficial deposits.

APPROACH: A paired-basin approach will be used to determine how vegetated filter strips reduce the loss of nutrients and suspended sediment from the watershed and how this reduction affects the water quality of the adjacent streams. Two similar basins will be chosen near Green Bay, Wisconsin. Each basin will be equipped with a station that will continuously measure streamflow and precipitation and also have a stage-activated, automatic ISCO sampler to collect storm-runoff samples. (An upstream-downstream approach will also be considered.) Daily nutrient and suspended sediment loads at each site will then be computed throughout the study using the integration method described by Porterfield (1972). For the first two years after installing the stations, no changes in land-use practice will occur in either basin–vegetated filter strips will not be installed. These data will be used to compare the sites during the pre-filter strip conditions. After this period, one basin, chosen as the reference basin, will continue to have minimal changes in land use allowed, while the other basin will have vegetated filter strips installed throughout. These data will be used to determine whether the relation between the amount of nutrients and suspended sediment transported during storm events has changed between the two basins and the quantitative affects of applying this BMP.

PROGRESS (October 1996 to June 1997): General areas have been chosen for the two basins.

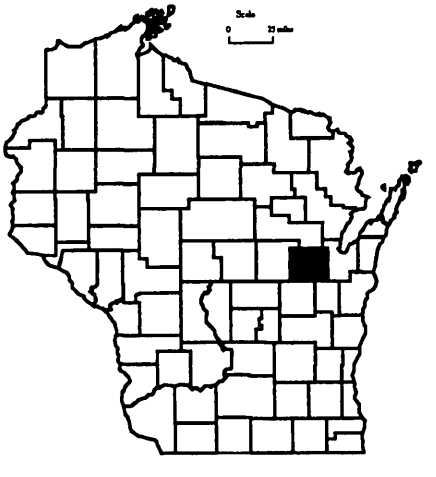
PLANS (July 1997 to June 1998): Agreements with specific farmers will be made on whether to install filter strips or to maintain their agricultural practices as at the present. Sampling stations will be installed in both basins. Daily and monthly total phosphorus and suspended sediment loads will be computed.

COOPERATOR:
Wisconsin Department of Natural Resources
Fox-Wolf Basin 2000

LOCATION:
Outagamie County, northeast Wisconsin

PROJECT CHIEF:
Dale M. Robertson

PERIOD OF PROJECT:
October 1996 to September 2001



EFFECTS OF CRANBERRY BOG OPERATIONS ON THE HYDROLOGY AND WATER QUALITY OF A STREAM IN WEST-CENTRAL WISCONSIN, WI 201

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Near Tomah, Wisconsin

PROJECT CHIEF:
David J. Graczyk

PERIOD OF PROJECT:
July 1996 to June 1997

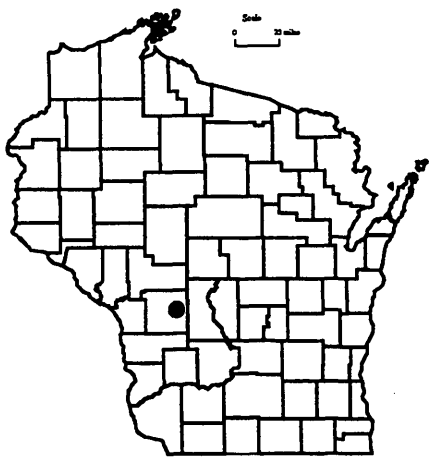
PROBLEM: The impacts of cranberry operations on wetlands and receiving waters has not been thoroughly assessed. Concern with both upland and wetland cranberry operations is based on a number of factors: (1) a number of beds are located directly in converted wetlands or in proximity to natural wetlands; (2) as with any agricultural operation, fertilizers and pesticides are used; and (3) cranberry operations commonly divert large amounts of water to beds from nearby streams and from the beds to nearby streams. This discharge water may transport excess nutrients and/or pesticides from the beds as well as alter the flow and thermal regimes of source and receiving waters.

This study is designed to identify and quantify potential water quality, habitat and biological impacts associated with the flow and temperature alterations from cranberry operations and to better define large scale impacts of cranberry operations. Baseline data will be collected on flow, water temperature, water quality and biological communities.

OBJECTIVE: The objectives of the study will be to determine the hydrology, streamflow and water-quality characteristics of a stream with cranberry operations in its headwaters, a stream with a recreational reservoir in its headwaters, and a non-impacted stream that is hydrologically similar to the other two watersheds.

APPROACH: Three streams will be monitored in Jackson and Monroe Counties, Wisconsin. One stream will have a cranberry operation in its headwaters, one stream will have a recreational reservoir in its headwaters and a third stream will be a non-impacted stream without cranberry operations or recreational reservoirs in its headwaters. Data collection will begin July 1, 1996, and continue until June 30, 1997.

Continuous streamflow, water temperature and rainfall will be monitored at all three streams. At the cranberry bog stream, dissolved oxygen, air temperature and solar radiation will be monitored. An automatic sampler will be installed at the cranberry stream site. Samples will be collected during periods of overland runoff from rainfall and/or snowmelt. Also, samples will be collected when cranberry beds are being drained during normal operation of cranberry bogs. Water samples will be collected biweekly for nine months and monthly for the remaining three months. Streamflow will be measured and water-quality samples will be collected monthly at one site above the cranberry operation, one site above the recreational reservoir and one site in the headwaters of the non-impacted stream.



PROGRESS (July 1996 to June 1997): Continuous streamflow, water temperature and precipitation data were collected at three sites. Additional data was collected at Clear Creek which included dissolved oxygen, air temperature, and solar radiation. Biweekly water samples were collected at the three sites. These samples were analyzed for pH, ammonia nitrogen, total phosphorus and suspended solids. Water samples were also collected biweekly at three sites which are upstream of the three continuous stream gages. Water samples were collected monthly at two streams which are tributary to the cranberry bog. Runoff samples were collected at the Clear Creek gage which is the outlet of the cranberry bog. These samples will be analyzed for acute toxicity using microtox, and using *Hyalella azteca* (indigenous to the stream) and *Ceriodaphnia Dubia* as indicator species. All data was summarized and will be published in the report "Water Resources Data–Wisconsin", water year 1996.

PLANS (July 1997 to June 1998): Streamflow, water temperature and precipitation data collection will continue until October 1, 1997. Water-quality sampling will be discontinued in July 1997. All data collected in water year 1997 will be summarized and published in "Water Resources Data–Wisconsin", water year 1997.

Completed Projects

The following is a list of completed projects with reports that are in various stages of preparation.

WI093	Geology, ground-water flow, and dissolved-solids concentrations along hydrogeologic sections through Wisconsin's aquifers
WI171	Application of habitat-suitability index models to assess effects of fine-grained sediment on brook trout and brown trout habitat
WI17211	Estimating stormwater contributions to contaminant concentrations in urban streams
WI18003	Methylmercury dynamics in littoral zone sediments of a seepage lake
WI190	Microbial enhancement of PCB congener mobility at the sediment/water interface in the lower Fox River, Wisconsin

APPENDIX A

STREAM-GAGING STATIONS PROPOSED FOR 1998 FISCAL YEAR

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Statewide

PROJECT CHIEF:
Barry K. Holmstrom

PERIOD OF PROJECT:
July 1913-Continuing

PROBLEM: Surface-water information is needed for surveillance, planning, design, hazard warning, operation, and management in water-related fields such as water supply, hydroelectric power, flood control, irrigation, bridge and culvert design, wildlife management, pollution abatement, flood-plain management, and water-resources development. An appropriate data base is necessary to provide this information.

OBJECTIVE: The objectives of this project are to provide continuous-discharge records for selected rivers at specific sites to supply the need for regulation, analytical studies, definition of statistical properties, trends analysis, and determination of the occurrence and distribution of water in streams for planning. The project is also designed to determine lake levels and to provide discharge for flood and low-flow conditions and for water-quality investigations. Requests for streamflow data and information relating to streamflow in Wisconsin are answered. Basic data are published annually in the report "Water Resources Data–Wisconsin".

APPROACH: A network of streamflow-gaging stations and lake-level stations will be maintained throughout Wisconsin. This includes operating the equipment at the gaging station to record river or lake stage, making periodic discharge measurements at each streamflow station to establish or verify a stage-discharge rating curve, reducing the periodic stage readings to instantaneous and daily discharges, compilation of monthly and annual discharges, and preparing data for publication in the annual report, "Water Resources Data–Wisconsin".

Requests for streamflow data from other government agencies, consultants, and private parties will be processed.

PROGRESS (July 1996 to June 1997): Twenty-six continuous-record gaging stations were operated in cooperation with the Wisconsin Department of Natural Resources (WDNR) during the 1997 fiscal year. Data were analyzed and published for one station that was partially funded by the U.S. Army Corps of Engineers and one by a FERC licensee. Partial-record data were collected and published at six stations. More than 100 requests for streamflow data were answered; WDNR, other State, Federal, and county agencies, consultants, municipalities, and the general public requested data. Streamflow records for the 1996 water year were published in the annual report, "Water Resources Data–Wisconsin, water year 1996.

PLANS (July 1997 to June 1998): Streamflow records for the 1997 water year will be computed and published in the annual report, "Water Resources Data–Wisconsin, water year 1997." Continuous streamflow data will be collected at seven gaging stations. Partial records will be collected and published at one station. Partial funding may also be provided for one station. Stage and precipitation data will be collected at one lake station. Requests for streamflow information will be answered.

PROPOSED PROGRAM FOR THE PERIOD 7/1/97-6/30/98

USGS Gaging Stations
Wisconsin Department of Natural Resources

STREAMFLOW FOR HYDROPOWER DATA

		Record began (water year)
04027500	1/ White River near Ashland	1948
04029990	1/ Montreal River at Saxon Falls	1987
04064500	2/ Pine River below Pine River powerplant near Florence	1924-76, 1996
04066003	2/ Menominee River near Pembine	1950
04077400	3/ Wolf River near Shawano	1907-09, 1911
05332500	1/ Namekagon River near Trego	1928-70, 1987
05340500	1/ St. Croix River at St. Croix Falls	1902
05341500	1/ Apple River near Somerset	1901-70, 1987
05356000	1/ Chippewa River at Bishops Bridge near Winter	1912
05356500	1/ Chippewa River near Bruce	1914
05360500	1/ Flambeau River near Bruce	1951
05365500	1/ Chippewa River at Chippewa Falls	1888-1983, 1987
05369000	1/ Red Cedar River at Menomonie	1913
05391000	4/ Wisconsin River near Lake Tomahawk	1936
05393500	4/ Spirit River at Spirit Falls	1942
05394500	4/ Prairie River near Merrill	1914-31, 1939
05395000	4/ Wisconsin River at Merrill	1903
05397500	4/ Eau Claire River near Kelly	1914-27, 1939
05398000	4/ Wisconsin River at Rothschild	1945
05399500	4/ Big Eau Pleine River near Stratford	1914
05400760	4/ Wisconsin River at Wisconsin Rapids	1914
05402000	4/ Yellow River at Babcock	1944
05404000	4/ Wisconsin River near Wisconsin Dells	1935

1/ WDNR cooperates with Northern States Power Company
2/ WDNR cooperates with Wisconsin Electric Power Company
3/ WDNR cooperates with Wisconsin Power and Light Company
4/ WDNR cooperates with Wisconsin Valley Improvement Company

Wisconsin Electric Power Company (WEPCO) funds two stations at a cost of $8,900. Complete records are collected at nine stations and partial records at one station for the Wisconsin Valley Improvement Company (WVIC); total cost of the WVIC program is $42,290. Partial records are collected at some of the Northern States Power Company stations; total cost of Northern States Power Company program is $34,600. Wisconsin Power and Light Company funds one station at a cost of $4,450.

CONTINUOUS-RECORD MONITORING–RIVERS

	Cost
04024430 Nemadji River near South Superior	$ 4,450
04067500 Menominee River near McAllister	4,850
04085200 Kewaunee River near Kewaunee	5,990*
04085427 Manitowoc River at Manitowoc	4,910*
04086000 Sheboygan River at Sheboygan	8,800
04086500 Cedar Creek near Cedarburg	4,450
TOTAL	$33,450

*Funding uncertain.

DEVIL'S LAKE NEAR BARABOO

05404500	Devil's Lake near Baraboo (stage-precipitation data)	1,750

FOX RIVER AT OSHKOSH

04082400	Fox River at Oshkosh (WDNR cooperates with Mercury Marine)	5,660

FOX RIVER AT RAPIDE CROCHE DAM NEAR WRIGHTSTOWN

04084500	Fox River at Rapide Croche Dam near Wrightstown (WDNR cooperates with Appleton Papers)	1,850

ANALYZE AND PUBLISH DATA FOR STATIONS PARTIALLY FUNDED BY U.S. ARMY CORPS OF ENGINEERS

05382000	Black River near Galesville	1,150
	TOTAL	$10,410

APPENDIX B

FUNDING SUMMARY PROPOSED FOR GENERAL COOPERATIVE PROGRAM WITH WISCONSIN DEPARTMENT OF NATURAL RESOURCES 1998 FISCAL YEAR

	Actual 96-97 DNR Share	Proposed 97-98 DNR Share	Total	Remarks
Streamflow for Hydropower Data (WI 00-001) Holmstrom/Addis	92,690	101,640	203,280	DNR receives 53,690 from WVIC, 8,900 from WEPCO, 34,600 from NSP, and 4,450 from WP&L.
Corps of Engineers shortfall-Galesville (WI 00-001) Holmstrom/Larry Lester	1,100	1,150	2,300	
Wrightstown Gage (LFRDA) (WI00-001) Holmstrom/Patterson	1,800	1,850	3,700	DNR receives funds from LFRDA.
Fox River at Oshkosh (AVM) (WI 00-001) Holmstrom/Rasman, Weisensel	5,500	5,660	11,320	DNR receives funds from Mercury Marine.
Cedar Creek nr Cedarburg (WI 00-001) Holmstrom/Patterson	4,350	4,450	8,900	
Devils Lake (WI 00-001) Holmstrom/Lathrop	3,900	1,750	3,500	
Nemadji River near Superior (WI00-001) Holmstrom/Prey)	4,350	4,450	8,900	
Sheboygan River near Sheboygan (WI00-001) Holmstrom/Patterson	4,350	4,450	8,900	For period 10/1/97-9/30/98.
Kewaunee River at Kewaunee (WI00-001) Holmstrom/Patterson	0	7,100	14,200	For period 10/1/97-9/30/98.
Manitowoc River at Manitowoc (WI00-001) Holmstrom/Patterson	0	6,015	12,030	For period 10/1/97-9/30/98.
Rock River at Jefferson (WI00-001) Holmstrom/Patterson	0	6,815	13,630	
LaCrosse River at West Salem (WI00-001) Holmstrom/Patterson	0	9,300	18,600	
Menominee River at McAllister (WI00-001) Holmstrom/Patterson	0	4,850	9,700	For period 10/1/97-9/30/98.
Oconto River at Oconto (WI00-001) Holmstrom/Patterson	0	9,300	18,600	For period 10/1/97-9/30/98.
Crandon (WI 00-201) Krohelski/Tans	80,000	100,000	100,000	

	Actual 96-97 DNR Share	Proposed 97-98 DNR Share	Total	Remarks
Water-Use Data (WI 78-007) Ellefson/Baker	75,000	75,000	150,000	75,000 direct state services.
Lower Fox PCB Transport Model (WI 86-145) Steuer/Baker, Patterson	2,500	0	0	
Nonpoint Trends (WI 91-172) Hughes/Bannerman				
17202 - Bower/Otter	33,000	17,000	34,000	
17205 - Black Earth	30,000	25,000	50,000	
17206 - Evaluation BMP	47,000	38,000	76,000	
17209 - Fixed Interval	13,200	0	0	
17210 - Lincoln Creek	21,500	13,500	27,000	
17212 - Lake Superior	14,907	0	0	
17213 - GIS Data Base	48,500	60,000	120,000	
17214 - Lake Evaluation Gage	60,000	50,000	100,000	
17219 - SLAMM	5,000	0	0	
17221 - Urban Reference Site	17,600	9,000	18,000	
17222 - Distribution of Loading		7,200	14,400	
17223 - Mutli-Stream Exp. Design		23,000	46,000	
17224 - Monroe Street		7,300	14,600	
17225 - Siphon Samplers		16,000	32,000	
17227 - Gutter Flow		20,000	40,000	
17228 - C/E Urban BMP		11,000	22,000	
Little Rock Lake (WI 92-18001) Rose/Knauer, Webster	5,300	4,300	8,600	
Lake Michigan Mass Balance (WI 183) Hughes/Patterson		22,500	45,000	
Milwaukee River PCBs (WI 191) Steuer/Patterson	5,000	0	0	
Hayton Mill Pond (WI 19101) Steuer/Patterson	4,500	5,000	10,000	
North Fish Creek Sediment (WI 94-193) Fitzpatrick/Swanson	36,000	0	0	
Lower Fox Optimization (WI 95-198) Conlon/Krill	34,375	0	0	
Brownfields Assessment Sites (WI00-00203) Krohelski/Parker	1,000	10,000	20,000	
Cranberry Bog (WI96-201) Graczyk/Epping, Greb	29,500	0	0	

WISCONSIN DISTRICT PUBLICATIONS

The reports listed below are a partial list of reports prepared by the Wisconsin District in cooperation with other agencies since 1948. The list contains reports that are relevant and contribute significantly to understanding the hydrology of Wisconsin's water resources.

The reports published in a U.S. Geological Survey series are for sale by the U.S. Geological Survey, Box 25425, Federal Center, Denver, CO 80225. Prepayment is required. Remittance should be sent by check or money order payable to the U.S. Geological Survey. Prices can be obtained by writing to the above address or by calling (303) 236-7476. Copies of reports published by the University of Wisconsin, Geological and Natural History Survey, can be obtained from their office at 3817 Mineral Point Road, Madison, WI 53705.

WATER-SUPPLY PAPERS

Kammerer, P.A., Jr., and Krug, W.R., 1993, Wisconsin stream water quality, in U.S. Geological Survey, National water summary 1990–91—Hydrologic events and stream water quality: U.S. Geological Survey Water-Supply Paper 2400, p. 561–568.

Melcher, N.B., and Walker, J.F., 1992, Evaluation of selected methods for determining streamflow during periods of ice effect: U.S. Geological Survey Water-Supply Paper 2378, 47 p.

U.S. Geological Survey, 1991, National water summary 1988-89—Hydrologic Events and Floods and Droughts: U.S. Geological Survey Water-Supply Paper 2375, 591 p.

U.S. Geological Survey, 1990, National water summary 1987—Hydrologic events and water supply and use: U.S. Geological Survey Water-Supply Paper 2350, 553 p.

_____,1988, National water summary 1986—Hydrologic events, selected water-quality trends, and ground-water quality: U.S. Geological Survey Water-Supply Paper 2325, 569 p.

_____1986, National water summary 1985—Hydrologic events and surface-water resources: U.S. Geological Survey Water-Supply Paper 2300, 506 p.

_____1985, National water summary 1984—Hydrologic events, selected water-quality trends, and ground-water resources: U.S. Geological Survey Water-Supply Paper 2275, 467 p.

_____1984, National water summary 1983—Hydrologic events and issues: U.S. Geological Survey Water-Supply Paper 2250, 243 p.

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