JAMES RIVER HEADWATERS WATERSHED

PHASE II
FY 2007

EPA
SECTION 319
PROJECT PROPOSAL

PROJECT NAME: James River Headwaters Watershed Project

LEAD PROJECT SPONSOR: Wells County Soil Conservation District
P.O. Box 7
Fessenden, ND 58438
Phone: 701-547-3622 ext. 5

STATE CONTACT PERSON: Greg Sandness
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STATE: North Dakota **WATERSHED:** James River Headwaters Watershed

HYDROLOGIC UNIT CODE: 10160001-010,-020,-030

HIGH PRIORITY WATERSHED: No

PROJECT TYPE:	**WATER BODY TYPE:**	**NPS CATEGORY:**
Watershed	Rivers / Streams	Agriculture

MAJOR GOALS: The primary goal of the project is to improve the water quality conditions and protect threatened waters within the James River Headwaters and its associated watershed by reducing nutrients and sediments, originating on agricultural land, that could reach the James River. This will be accomplished by providing financial and technical assistance for conservation planning and BMP installation as well as through I/E activities focusing on local NPS issues.

PROJECT DESCRIPTION: Nutrients and sediment, oringinating on agricultural lands, have been identified as the primary NPS pollutants impacting water quality in the James River. To reduce the effects of these pollutants, the Wells County Soil Conservation District will provide financial and technical assistance for farm unit conservation planning and continue their I / E program to place emphasis on NPS pollution issues. Through these efforts the project sponsors plan to 1) heighten local residents awareness of potential NPS impacts in the watershed area, 2) inform landusers of effective methods or technologies for NPS pollution control / prevention, 3) address NPS pollution control measures needed on agricultural lands in the watershed, and 4) document the benefits of applied BMP's and project efforts. The James River Headwaters Watershed is listed in the FY 1999 North Dakota Unified Watershed Assessment as a category I watershed (watersheds in need of restoration) with medium priority. The James River Headwaters Watershed ranked 20th out of 42 category I HUAs with a total score of 90.0 out of a possible 150 points.

FUNDING:

FY 2007 Incremental 319 Funds Requested:	**$ 685,000**
Local / Producer Match:	**$ 456,668**
Other Federal Funds:	**$ 384,000**
Total Project Costs:	**$ 1,525,668**

319 Funded Full Time Personnel: 1

2.0 Statement of Need

2.1 This plan will address water quality in the James River Headwaters Watershed. The James River Headwaters Watershed is listed in the FY 1999 North Dakota Unified Watershed Assessment as a category I watershed (watersheds in need of restoration) with medium priority. The James River Headwaters Watershed ranked 20th out of 42 category I HUAs with a total score of 90.0 out of a possible 150 points.

Based on the State Water Quality Standards (February 1, 1991), the James River has a stream classification of IA. Designated beneficial uses for a Class IA stream are aquatic life, recreation (e.g., boating, swimming), industrial, and agricultural. In addition, the quality of Class IA streams shall be such that they can be used for a municipal water supply after treatment. The James River headwaters are subject to the same physical and chemical criteria as a Class I stream (NDDH, 1998).

The James River reach in the headwaters area is listed in the 2000 North Dakota Water Quality Assessment (305b) report as partially supporting aquatic life. In addition, the *North Dakota 2006 Integrated Report Section 303(d) List of Waters Needing Total Maximum Daily Loads,* lists a 20.47 mile segment of the James River from its confluence with the Big Slough downstream to its confluence with Rocky Run Creek for recreational us impairments caused by pathogens (i.e. total fecal coliform). This 20.47 mile segment assessed unit (AU) is listed as priority 2, which are those AU's that are scheduled for TMDL development in the next 10 years (NDDH, 2006).

2.2 In 1999 and 2000 an assessment project was conducted on the James River Headwaters Watershed project area. In 2004, a comprehensive assessment report was prepared by James Meek with the North Dakota Department of Health titled "Upper James Headwater Watershed Assessment Report". This report contains detailed information and can be found in appendix C.

As stated in the 2004 Assessment Report, aquatic life and recreation are the beneficial uses being impaired.

Aquatic life uses are being impacted by habitat alteration and eutrophication. The primary causes of habitat alteration are; riparian alteration, suspended sediment and sedimentation, and hydrologic alteration. Eutrophication is being caused by excessive nutrient loading.
The primary sources of riparian alteration are:

- Replacement of native vegetation with crops
- Riparian grazing and concentrated animal feeding areas

The primary sources of excessive sediment are:

- Sediment from sheet, rill, gully and wind erosion of cropland
- Streambank erosion caused by vegetation removal
- Streambank erosion caused by livestock trampling

The primary sources of hydrologic alteration are:

- Impoundments (Appendix C, Figure 17)
- Drainage (Appendix A, Figure 3)
- Channelization

The primary sources of nutrients causing eutrophication are:

- Runoff of manure or commercial fertilizer from cropland
- Runoff of manure from pasture and concentrated animal feeding areas
- Runoff of sediment with attached nutrients (phosphorus) from cropland
- Runoff of various organic residues from cropland and pasture
- Direct deposit of manure by livestock

Recreation uses are being impacted by pathogens. The primary sources of pathogens in the threatened reaches are:

- Runoff of manure from cropland and pasture
- Runoff of manure from concentrated animal feeding areas
- Direct deposit of manure by livestock

James River headwaters is a perennial / intermittent river and stream. There are approximately 57 miles of perennial rivers and streams and another 149 miles of intermittent streams. The hydrologic unit code is 10160001- 010,-020,-030. The James River headwaters are a 1^{st} – 4^{th} order stream. Peak flow occurs during spring runoff and also associated with major rainfall events.

2.3 The James River Headwaters Watershed is located in central – east central Wells County, west-central Eddy County, North Dakota. (See Figure 1 in appendix A for map to identify the watershed area).

Water samples were collected during the assessment phase at four sites on the James River during the spring of 1999 and 2000. The Headwaters site (385010), is located 9 miles NW of Fessenden, Fessenden site (385011), 3 mi. N., 2 mi. E. of Fessenden, Munster (385012), 8 mi. W., 3.5 mi. N. of New Rockford and the New Rockford site (358013), 3 mi. E. of New Rockford (see Figure 2 in appendix A for map of sampling sites). Macroinvertibrates samples were collected from four sites (see assessment report appendix C Figure 5).

2.4 James River Headwaters Watershed area encompasses 407,268 acres in Wells and Eddy counties. Approximately 344,559 acres are located in Wells County and 62,709 acres in Eddy County. With the exception of 6440 acres (2760 acres Federal and 3680 acres owned by the State of North Dakota), the remaining acres in the James River Headwaters Watershed are in private ownership. This project will address only the 344,559 acres located in Wells County.

The topography of the James River Headwaters Watershed project area is level to undulating hills with slopes averaging 1 percent to 8 percent. The area adjacent to the James River channel is characterized by rolling hills with slopes of up to 4 percent in the lowland areas to more than 20 percent in the Bremen area. The James River has a drop of less than 3 feet per mile and is entrenched as much as 35 feet in the areas south of Bremen. The elevation of the watershed ranges between 2,000 feet above sea level in the southwestern part of the watershed to 1,425 feet on bottom lands in the northeastern corner where the James River exits the county (Seago 1970).

The predominate soils are black loam to black sandy loams made up of 1) Heimdal-Emrick-Fram association, level to undulating, well drained to moderately well drained, medium-textured soils on glaciofluvial materials, 2) Emrick-Larson association, level to undulating, moderately well drained, medium-textured claypan soils on uplands and 3) Egeland-Embden association, level to undulating, well drained and moderately well drained, moderately coarse textured soils on sandy plains.

The average size per farm unit is 1,500 acres. Most operating units are diversified and raise small grains, row crops and livestock. Most acres are intensively farmed leaving little or no residue over winter. A typical rotation is one year small grain followed by soybeans or dry beans, corn, flax or canola, etc. Grazing practices are typically season long.

The land use in the watershed project area is as follows:

Cropland	- 193,987 acres
Range / Pastureland	- 96,477 acres
CRP	- 28,253 acres
Water area	- 13,782 acres
Urban	- 4,135 acres
Farmsteads, roads, misc.	- 7,925 acres

Local NRCS personnel have estimated that the average annual soil loss of 4 tons per acre watershed wide. Based on the Revised Universal Soil Loss Equation (RUSLE) estimates, the total annual soil loss from water and wind erosion is 1,378,236 tons. At a conservative 5 percent delivery rate, approximately 68,912 tons of soil could reach the James River annually.

Precipitation averages near 17 inches annually. Seventy percent (70%) falls during the growing season, May through September, and about half in the period June through August.

There is one wellhead protection area in the project area, around the wells of the Wells County Rural Water System, located 10 mi west of Fessenden, North Dakota. This water system provides water to 2,087 residents throughout Wells County including the city of Fessenden.

2.5 Agricultural nutrients (nitrogen and phosphorous), total suspended solids and fecal coliform bacteria are the primary pollutants impacting and threatening the beneficial uses and long-term water quality of the James River and downstream waters.

Locally in the headwaters area, beneficial uses being impaired are aquatic life and recreation. On a regional basis, downstream impacts are aquatic life, agriculture, recreation and a potential source of drinking water for the city of Jamestown.

The main sources of pollutants, based on information from the North Dakota Department of Health and data collected by the Wells Co. SCD staff, are poorly managed cropland, degraded riparian areas used by livestock as loafing areas and concentrated livestock feeding areas.

Livestock feeding areas are impacting water quality with nutrients and fecal coliform bacteria. Ninety five concentrated feeding areas have been identified with 28 ranked as priority areas due to proximity to surface waters.

Soil and Water Assessment Tool (SWAT) model was used to estimate total nitrogen loads, total phosphorus loads, and sediment loads for the watershed project area (appendix C, Figure 12, 13, 14). Nitrogen loads ranged from 0.15 – 28.88 lbs/ac, phosphorus loads ranged from 0.04 – 4.24 lbs/ac and sediment loads from 0.004 – 3.20 tons/ac.

The SWAT model also identified reaches of the James River having threatened aquatic life and recreation uses (appendix C, Figure 15).

Priority work areas were determined using SWAT modeling. Work activities will focus on the high and medium priority areas of basins 3 & 4, for best management practice (BMP) implementation. Emphasis will be placed on applying BMP within 1 mile of the river and/or its major tributaries in the priority areas to address sources of stressors threatening aquatic life and recreation uses (appendix C, Figures 19 and 20).

The following are water quality sampling results from year 2000 of the assessment phase. Total nitrogen medians; Headwaters – 1.66 mg/l, Fessenden – 1.81 mg/l, Munster – 1.525 mg/l, New Rockford – 1.485 mg/l. Total phosphorous medians; Headwaters – 0.277 mg/l, Fessenden – 0.147 mg/l, Munster – 0.243 mg/l, New Rockford – 0.201 mg/l. Total suspended solid medians; Headwaters – 2.5 mg/l, Fessenden – 2.5 mg/l, Munster – 2.5 mg/l, New Rockford – 13.5 mg/l. Fecal Coliform colonies; Headwaters – 5, Fessenden – 5, Munster – 40, New Rockford – 20. Concentrations for parameters measured, which include total N, total P, TSS and Fecal Coliform start out high and generally decrease as stream discharge and runoff volume decreased. This trend indicates that the majority of the nutrients entering the James River Headwaters are delivered during spring runoff and storm events. (See appendix B for complete sampling results).

Macroinvertibrates samples were collected from four sites in the project area in 1998. Headwaters site (554009), near Fessenden (554010), Munster site (554011) and near New Rockford (554012) (see appendix C, Figure 5). Site 554009 was classified as having *poor* biotic integrity while the remaining sites were classified as having *fair* biotic integrity. (See assessment report, appendix C section 3.4, pages 8-9 for sampling data).

Aquatic habitat health was assessed in 1998. The four sites sampled for macroinvertebrates were also sampled for aquatic habitat health. The habitat score at site 554011 rated *poor* for habitat health with the remaining sites ranking in the bottom 37th percentile of all samples taken in North Dakota from 1996 through 2000 (See Appendix C, Assessment Report section 3.4, pages 8-9, Table 4).

Hydromodification in the form of surface water drainage is impairing water quality in the watershed. Four legal drains that are located within the James River Headwaters Watershed encompass approximately 58,990 acres, Crystal Lake Drain is 4,090 acres, Wells Drain #1 is 44,160 acres, Heimdal Drain is 3,700 acres and Hamberg-West Norway Drain is 7,040 acres. (See Appendix A, Figure 3 for map of drains). The majority of wetlands located in each of these legal drains are drained to the James River. Runoff from the drainage areas collects to a main channel that then discharges into the James River. These drainage areas are intensively farmed with extensive acres of low residue crops (dry beans, sunflowers, etc.) leaving little or no residue over winter.

Riparian area degradation resulting from overgrazing or crop production was also observed within the watershed. Both of these practices reduce the vegetative buffer strip along portions of the creek. Without this protective vegetation and proper land management strategies along the creek, excessive sediment and nutrient deposition in the creek will continue to degrade water quality in the James River.

Urban runoff from the cities of Fessenden, Hamberg, Bremen and Heimdal may also be a source of pollutants to the James River Headwaters Watershed. Urban runoff water from city streets may consist of quantities of hydrocarbons, sediments, nutrients and pesticides.

The waste water treatment facilities for the city of Fessenden and the Wells County Rural Water System are the only known point sources in the watershed. These systems are under a current NDPDES permit.

3.0 Project Description.

3.1 Project Goals.

Through increased technical and financial assistance and targeted BMP implementation the project will fully restore the aquatic life and recreational uses of the James River Headwaters.

3.2 Objectives and Tasks

Objective 1: Implement the appropriate BMP to achieve and maintain mean annual total nitrogen and phosphorus concentrations of 1.01 mg/L and 0.102 mg/L, respectively and reduce the geometric mean concentrations of fecal coliform bacteria to 200 CFU/100 ml, with less than 10% of samples exceeding 400 CFU/100 ml.

Task 1: Employ a watershed conservationist located in Wells County.
Product: Watershed conservationist
Cost: $321,850

Task 2: Provide technical and financial assistance to agricultural producers to plan, design, and implement BMP's that will improve management on 5100 ac of cropland and 1203 ac of grazing land.
Product: 12 producer contracts
(See BMP budget table for types of BMP to be installed)
Cost: $225,940

Task 3: Provide technical and financial assistance to livestock producers to design and install manure management systems on the 10 highest priority animal feeding operations in the watershed.
Product: 10 manure management systems installed
Cost: $588,327

Task 4: Document acreage and location of planned and installed BMP's to assess progress and target areas for annual work activities and monitor O&M of Section 319 cost-shared practices in accordance with the ND NPS Management Plan.
Product: Database report of acres planned and/or applied and erosion reduction.

Objective 2: Increase the public's awareness of NPS pollution impacts by disseminating information on the project as well as the impacts of NPS pollution to water quality and the associated solutions to the problem. The primary target audience will be landowners/operators within the James River Headwaters project area.

Task 5: Conduct I / E events addressing NPS and water quality issues typically found in the area and coordinate them, when possible, with ongoing state and/or federally sponsored I / E programs.
Product: 2 tours/workshops and 4 information meetings.
Cost: $2,000

Task 6: Prepare newsletter articles and direct mailings to local land users, general public, and media.
Product: 5 newsletters, 10 articles and 10 direct mailings
Cost: $2,250

Task 7: Complete semi-annual, annual and final project reports to update the GRTS. These will be provided to NDDH, EPA, all sponsors and interested individuals.
Product: Published annual / semiannual and 1 final report.

3.3 Milestone Table.
See attached milestone table.

3.4 Permits.
Permits required (404, cultural resource reviews, etc.) to complete the scheduled project activities will be secured. Manure management systems will be submitted for NDDH permit process.

3.5 Appropriateness of the Lead Sponsor.
Wells County Soil Conservation District (SCD), Wells County Water Resource District (WRD), and Wells County Commission are sponsoring the James River Headwaters water quality project. The Wells County SCD will be the lead sponsor. The SCD has staff presence, as well as the presence of Natural Resource Conservation Service (NRCS) personnel.

The SCDs annual and long-range plans, along with the input of the Locally Led Conservation Group, help to prioritize and guide the field service of both staff. The Wells County SCD will be responsible for the O&M and will conduct annual compliance checks of BMP's cost shared with Section 319 funds. The Wells County SCD has legal authorization to employ and receive and expend funds. They have a track record for personnel management and addressing conservation issues for their constituency. An Executive Board of the sponsors will be formed to manage personnel and funding associated with this project and oversees implementation of the scheduled project activities.

4.0 Coordination Plan.

4.1 Cooperating organizations, roles agreements.

1. Wells County Soil Conservation District (SCD) – The SCD is an initiator, supporter of and has endorsed this Section 319 proposal. The SCD will be the lead agency responsible for administration of the Section 319 contract. They will provide clerical assistance, access to equipment and supplies as well as annual financial support ($4,378 /yr). The SCD board will provide for staff time if feasible.

2. Wells County Water Resource District (WRD) – The WRD has endorsed this plan to accelerate technical assistance, in addition the WRD will provide financial support ($10,945 / yr) to ensure all project goals and objectives are achieved.

3. Wells County Commission – The commission has endorsed the water quality project plan and will provide financial support ($10,945/ yr) to ensure all project goals and objectives are achieved.

4. North Dakota Department of Health (NDDH) – The NDDH will oversee Section 319 funding and provide sponsor over sight to ensure proper management and expenditure of Section 319 funding as well as develop the quality assurance project plan (QAPP) for this project. NDDH will provide training for proper water quality sample collection, preservation and transportation, to ensure reliable data is obtained. The NDDH will assist with development and scheduling of a biomonitoring plan.

5. USDA Natural Resources Conservation Service (NRCS) – The NRCS will provide; office space, use of vehicle, computer and copier, technical assistance, if needed, and financial assistance, if funding is available, through the EQIP and WRP programs.

6. North Dakota Cooperative Extension Service (EXT) – Local and State Extension personnel and educational materials will be utilized to compliment the projects' activities. This will include such things as publications and assistance with workshops and information meetings. The specific role of EXT will be dependent on the type of I / E activity being implemented and availability of staff and materials. More specifically, the Extension Nutrient Management Specialist from the Carrington Extension Research Center will be utilized to assist in evaluating and developing manure management systems and also to provide information for manure management workshops and tours of the watershed project.

7. The NPS BMP Engineering Team through the Sheyenne James RC&D Council will be contacted for assistance in designing structural BMP for the watershed project.

8. USDA Farm Service Agency (FSA) – Conservation programs through FSA (i.e. CRP, continuous CRP, or other) will be utilized if available.

4.2 Local Support.

The Wells County SCD, Wells County Water Resource District Board, and Wells County Commission strongly support the development and implementation of a water quality improvement project for the James River Headwaters watershed.

Letters of support and memo's of agreement from the Soil Conservation Districts, County Commissions, Water Resource Districts and NRCS are on file.

4.3 Coordination with other NPS efforts.

The Wells County SCD sponsors annual no-till and residue management demonstrations in the county and in 2006 have initiated a feedlot manure composting demonstration project. They also hold an annual ECO-ED camp for 6th graders in Wells County. These events will be coordinated with the I / E activities supported through the Section 319 project. Networking between the I / E coordinator and project staff will occur, to the benefit of residents and project sponsors.

EQIP funds will be utilized, when available, in the watershed project area to assist in funding BMP's and I / E activities. USDA Farm Service Agency programs (i.e. CRP or others) will be utilized when available.

Funding, should it be available, from other agencies such as; North Dakota Stockmen's Association, North Dakota Dept. of Agriculture Dairy Pollution Prevention Program (DP3), North Dakota Game & Fish Dept., North Dakota Natural Resources Trust, Ducks Unlimited, US Fish & Wildlife Service, etc., will be requested to assist in installing conservation practices.

4.4 Related Activities.

The annual work plans of both the Wells County SCD and NRCS have prioritized activities in the project area.

5.0 Evaluation and Monitoring Plan.

5.1 The quality assurance project plan (QAPP), developed by the North Dakota Department of Health, for the evaluation of the project is provided in Appendix D.

5.3 All water quality data collected will be managed, stored and reported by the North Dakota Department of Health.

5.4 EPA's BASINS modeling software and Soil and Water Assessment Tool (SWAT) model were used to model this watershed project area. BASINS software was developed by EPA to support the development of TMDLs. Developing TMDLs requires a watershed-based approach that integrates both point and non-point sources. BASINS can support this type of source analysis for a variety of pollutants. SWAT was developed to predict the impact of land management practices on water, sediment and agricultural chemical yields in large complex watersheds with varying soils, land use and management conditions over long periods of time.

6.0 Budget.

6.1 The attached budget provides estimated costs per year to complete the water quality project.

Literature Cited

North Dakota Department of Health, September 1998. North Dakota Unified Watershed Assessment FY 1999.

Seago, J. B., M. Robert Wright, C. Howard Wiesner, and Ralph S. E. Smith, 1970. Soil Survey of Wells County, North Dakota.

North Dakota Department of Health, June 2006. North Dakota 2006 303(d) List of Waters Needing Total Maximum Daily Loads. Environmental Health Section, North Dakota Department of Health, Bismarck, ND.

BUDGET TABLE
JAMES RIVER HEADWATERS WATERSHED PROJECT

PART 1: FUNDING SOURCES

		2007	2008	2009	2010	2011	Total
EPA SECTION 319 FUNDS							
FY2007 Funds (FA)		$83,770	$177,962	$236,374	$104,380	$82,514	
Subtotal		**$83,770**	**$177,962**	**$236,374**	**$104,380**	**$82,514**	**$685,000**
OTHER FEDERAL FUNDS							
NDDH	(FA)	$5,000	$5,000	$5,000	$5,000	$5,000	
NRCS	(FA)	$95,500	$68,500	$65,000	$65,000	$65,000 .	
Subtotal		**$100,500**	**$73,500**	**$70,000**	**$70,000**	**$70,000**	**$384,000**
State / Local Match							
Wells Co. SCD	(FA & TA)	$4,140	$4,310	$4,347	$4,510	$4,564	$21,871
Wells Co. WRD	(FA)	$10,324	$10,749	$10,841	$11,249	$11,382	$54,545
Wells Co. Comm.	(FA)	$10,324	$10,749	$10,841	$11,249	$11,382	$54,545
Producers	(FA)	$31,059	$92,834	$131,555	$42,578	$27,681	$325,707
Subtotal		**$55,847**	**$118,642**	**$157,584**	**$69,586**	**$55,009**	**$456,668**
Total Budget		**$240,117**	**$370,104**	**$463,958**	**$243,966**	**$207,523**	**$1,525,668**

NDDH: ND Dept. of Health
SCD: Soil Conservation District
WRD: Water Resource District
NRCS: Natural Resources Conservation Service
Comm: County Commission Board

TA: Technical Assistance
FA: Financial Assistance

JAMES RIVER HEADWATERS WATERSHED PROJECT BUDGET

Part 2: Section 319/Non-Federal Budget	2007	2008	2009	2010	2011	Total Costs	Cash Match	In-Kind Match	319 Funds
Personnel / Support									
Project Coordinator - Salary	$ 37,045	$ 38,145	$ 39,245	$ 40,345	$ 41,445	$ 196,225	$ 78,490		$ 117,735
Project Coordinator - Fringe Benefits	$ 21,250	$ 21,900	$ 22,550	$ 23,200	$ 23,850	$ 112,750	$ 45,100		$ 67,650
Travel	$ 450	$ 450	$ 600	$ 600	$ 700	$ 2,800	$ 1,120		$ 1,680
Training	$ 250	$ 250	$ 250	$ 250	$ 250	$ 1,250	$ 500		$ 750
Telephone	$ 550	$ 550	$ 550	$ 550	$ 550	$ 2,750	$ 1,100		$ 1,650
Postage	$ 625	$ 625	$ 675	$ 675	$ 675	$ 3,275	$ 1,310		$ 1,965
Supplies	$ 1,000	$ 800	$ 500	$ 250	$ 250	$ 2,800	$ 1,120		$ 1,680
Subtotal	**$ 61,170**	**$ 62,720**	**$ 64,370**	**$ 65,870**	**$ 67,720**	**$ 321,850**	**$ 128,740**		**$ 193,110**
Objective 1: Apply Best Mngt Practices*									
BMP's									
Animal Waste Systems	$ 59,333	$ 175,998	$ 234,330	$ 59,333	$ 59,333	$ 588,327	$ 235,331		$ 352,996
Grazing Systems	$ 8,394	$ 17,616	$ 33,332	$ 9,368	$ 4,900	$ 73,610	$ 29,444		$ 44,166
Cropland Management Systems	$ 9,920	$ 38,470	$ 61,225	$ 37,745	$ 4,970	$ 152,330	$ 60,932		$ 91,398
Subtotal	**$ 77,647**	**$ 232,084**	**$ 328,887**	**$ 106,446**	**$ 69,203**	**$ 814,267**	**$ 325,707**		**$ 488,560**
Objective 2: Information / Education									
Tour / Workshop		$ 1,000		$ 1,000		$ 2,000	$ 800		$ 1,200
Newsletter	$ 450	$ 450	$ 450	$ 450	$ 450	$ 2,250	$ 900		$ 1,350
Brouchure / Flyers	$ 350	$ 350	$ 250	$ 200	$ 150	$ 1,300	$ 520		$ 780
Subtotal	**$ 800**	**$ 1,800**	**$ 700**	**$ 1,650**	**$ 600**	**$ 5,550**	**$ 2,220**		**$ 3,330**
Administative									
BMP Management In-kind Match			$ 9,520	$ 26,680	$ 28,560	$ 64,760		$ 64,760	
Clerical	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 5,000		$ 5,000	
Executive Board Meetings	$ 3,500	$ 3,500	$ 3,500	$ 3,500	$ 3,500	$ 17,500		$ 17,500	
Subtotal	**$ 4,500**	**$ 4,500**	**$ 14,020**	**$ 31,180**	**$ 33,060**	**$ 87,260**		**$ 87,260**	
Total 319 / Non-Federal Budget	**$ 144,117**	**$ 301,104**	**$ 407,977**	**$ 205,146**	**$ 170,583**	**$ 1,228,927**	**$ 456,667**	**$ 87,260**	**$ 685,000**

* See BMP budget table for breakdown of BMP costs.

James River Headwaters Watershed
BMP Budget

Cropland Management Syst.	**2007**	**2008**	**2009**	**2010**	**2011**	**Total**
Cons. Tillage 329A 3,920ac @12.00/ac for 2 yrs.	$6,720	$23,520	$36,960	$24,720	$2,160	$94,080
Nutrient Management 4650ac @ 5.00/ac for 2 yrs.	$2,800	$12,200	$17,800	$11,050	$2,650	$46,500
Filter Strips 250ac @ 15.00/ac		$750	$2,625	$375		$3,750
Field Borders 200ac @ 20.00/ac for 2 yrs.	$400	$2,000	$3,840	$1,600	$160	$8,000
Subtotal	**$9,920**	**$38,470**	**$61,225**	**$37,745**	**$4,970**	**$152,330**
Grazing Systems						
Fencing 15840 ft @ .85/ft	$2,244	$3,366	$6,732	$1,122		$13,464
Range Seeding 450ac @ 15.00/ac	$1,250	$1,500	$3,750	$250		$6,750
Pasture and Hayland Planting 300ac @ 15.00/ac		$750	$2,250	$1,500		$4,500
Pipeline 7920 ft@ 3.80/ft	$3,800	$5,700	$11,400	$5,396	$3,800	$30,096
Tank 1100gal @ 1.00/gal	$1,100	$1,100	$1,100	$1,100	$1,100	$5,500
Well 3 ea		$5,200	$8,100			$13,300
Subtotal	**$8,394**	**$17,616**	**$33,332**	**$9,368**	**$4,900**	**$73,610**
Manure Mgmt Syst.						
5 Manure Mgmt Syst.	$58,333	$174,998	$233,330	$58,333	$58,333	$350,000
Waste Utilization 1000ac @ 5.00/ac	$1,000	$1,000	$1,000	$1,000	$1,000	$5,000
Subtotal	**$59,333**	**$175,998**	**$234,330**	**$59,333**	**$59,333**	**$588,327**
Total	**$77,647**	**$232,084**	**$328,887**	**$106,446**	**$69,203**	**$814,267**

All costs are consistent with information in the NPS Program Cost Share Guidelines. BASINS model was used to generate an estimate on the number of acres for BMP's.

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JAMES RIVER HEADWATERS WATERSHED PROJECT
MILESTONE TABLE

Task	Output	Responsibility	Start	End
Objective 1				
Task 1- Employ a project coordinator	Staff presence to provide technical assistance for conservation planning	Project executive board	7/2007	6/2012
Task 2 – Contact producers in project area to provide plan development and follow-up.	12 producer contracts	Project Staff	7/2007	6/2012
Task 3 – Provide technical and financial assistance to livestock producers.	10 manure management systems	Project Staff	7/2007	6/2012
Task 4 – Document installed BMP's to track progress and monitor O&M on cost shared practices.	Data base report on acres planned and / or applied.	Project Staff	7/2007	6/2012
Objective 2				
Task 5 – Conduct I / E events addressing NPS and water quality issues.	2 tours/workshops; 3 information meetings	Project Staff	7/2007	6/2012
Task 6 – Prepare newsletter articles and direct mailings.	5 newsletters, 10 articles, 10 direct mailings.	Project Staff	7/2007	6/2012
Task 7 – Complete semi-annual, annual and final report.	Published semi-annual /annual and final report	Project Staff	10/2007	6/2012

APPENDIX A

FIGURES CITED

Figure 1. James River Headwaters Watershed Project Area - Wells County

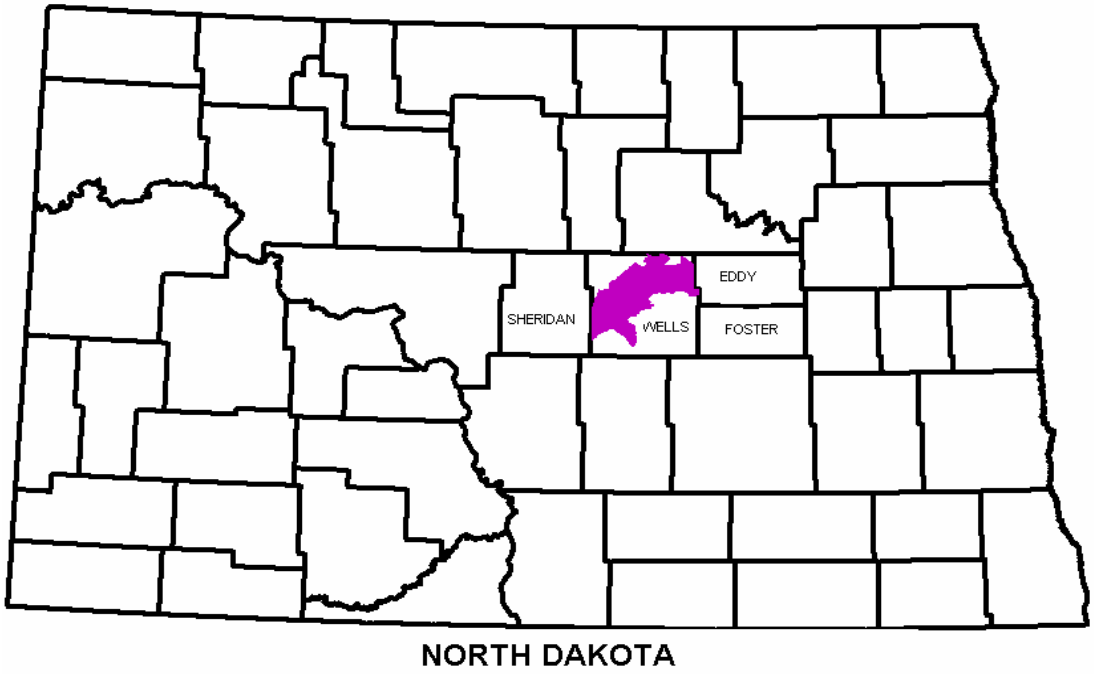


Figure 2. Water Quality Monitoring Sites

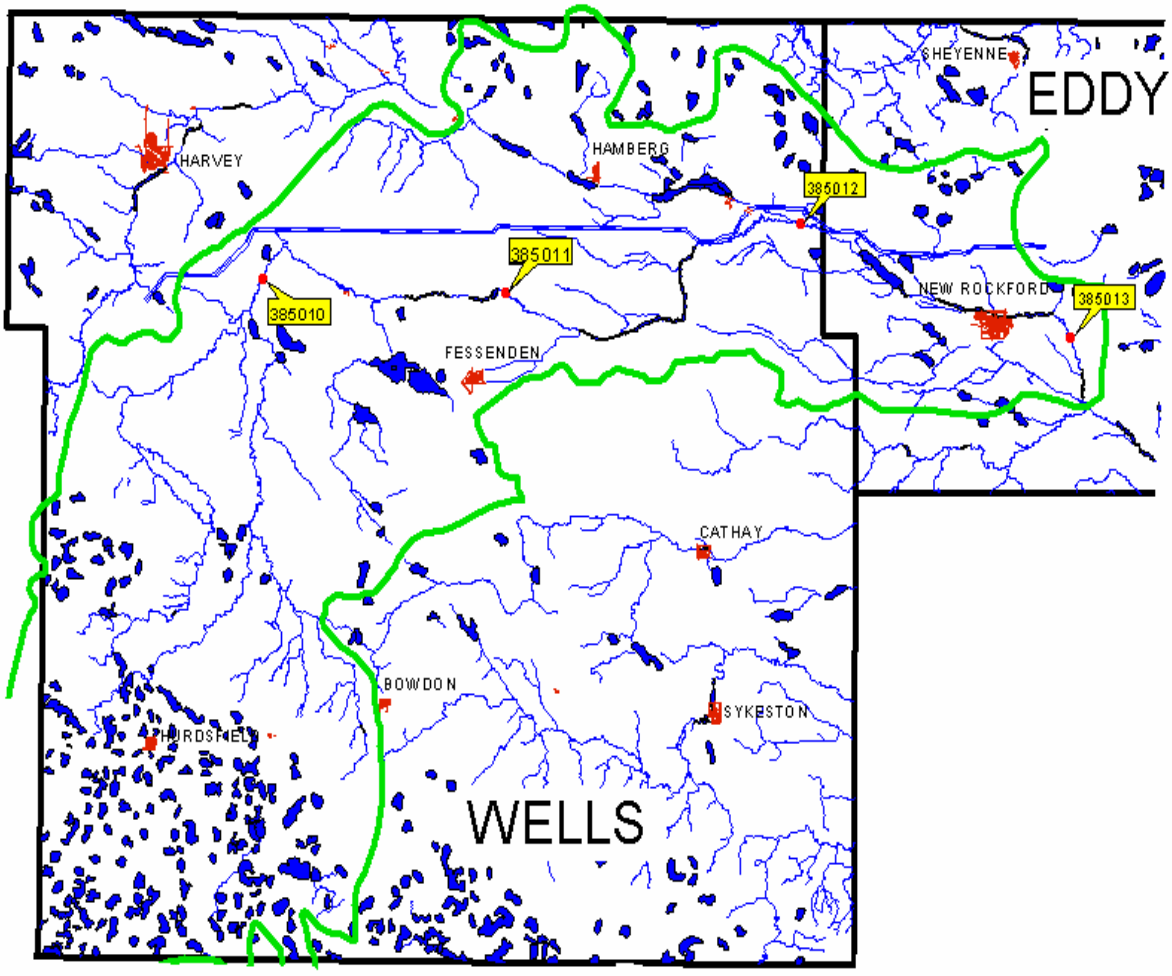
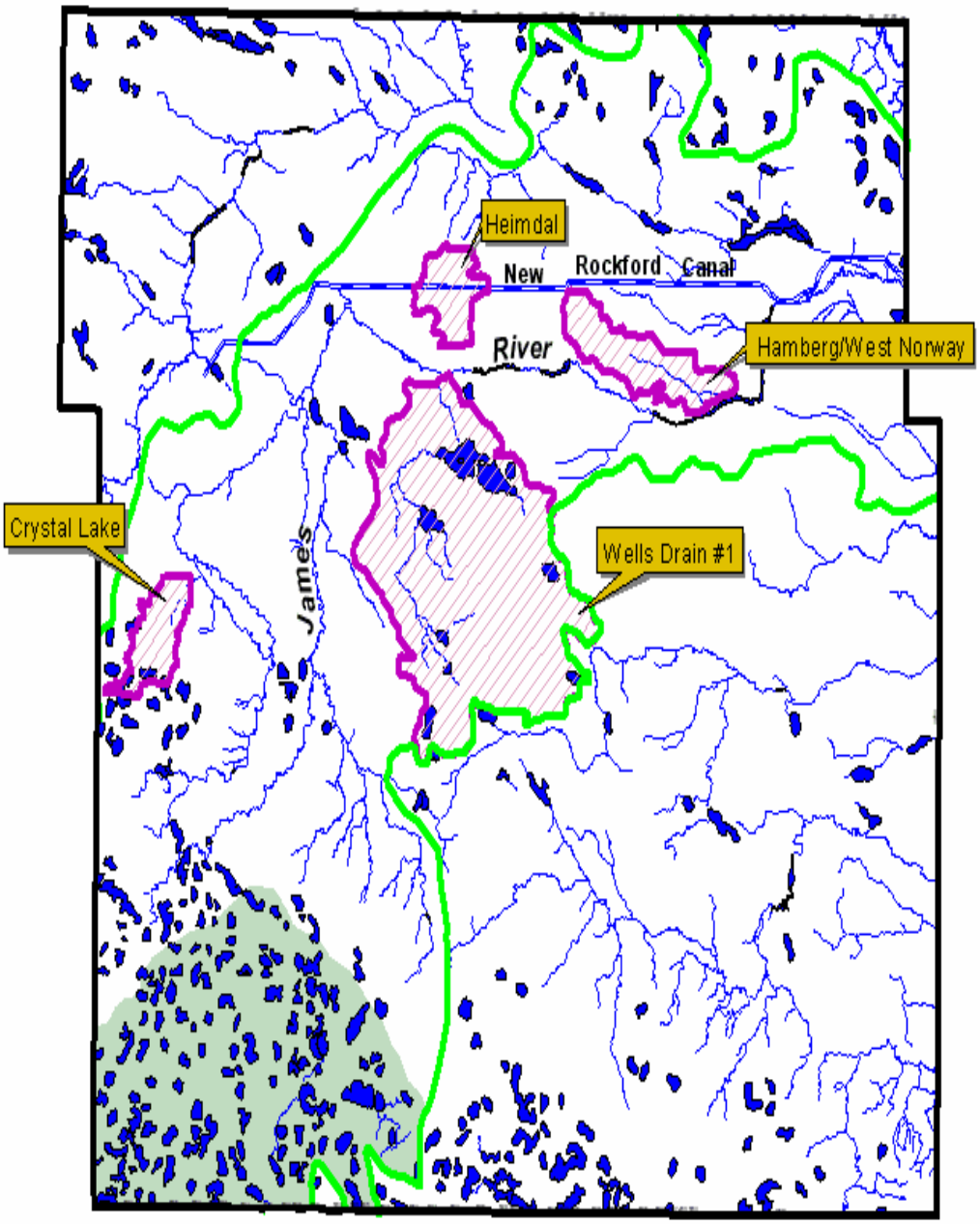


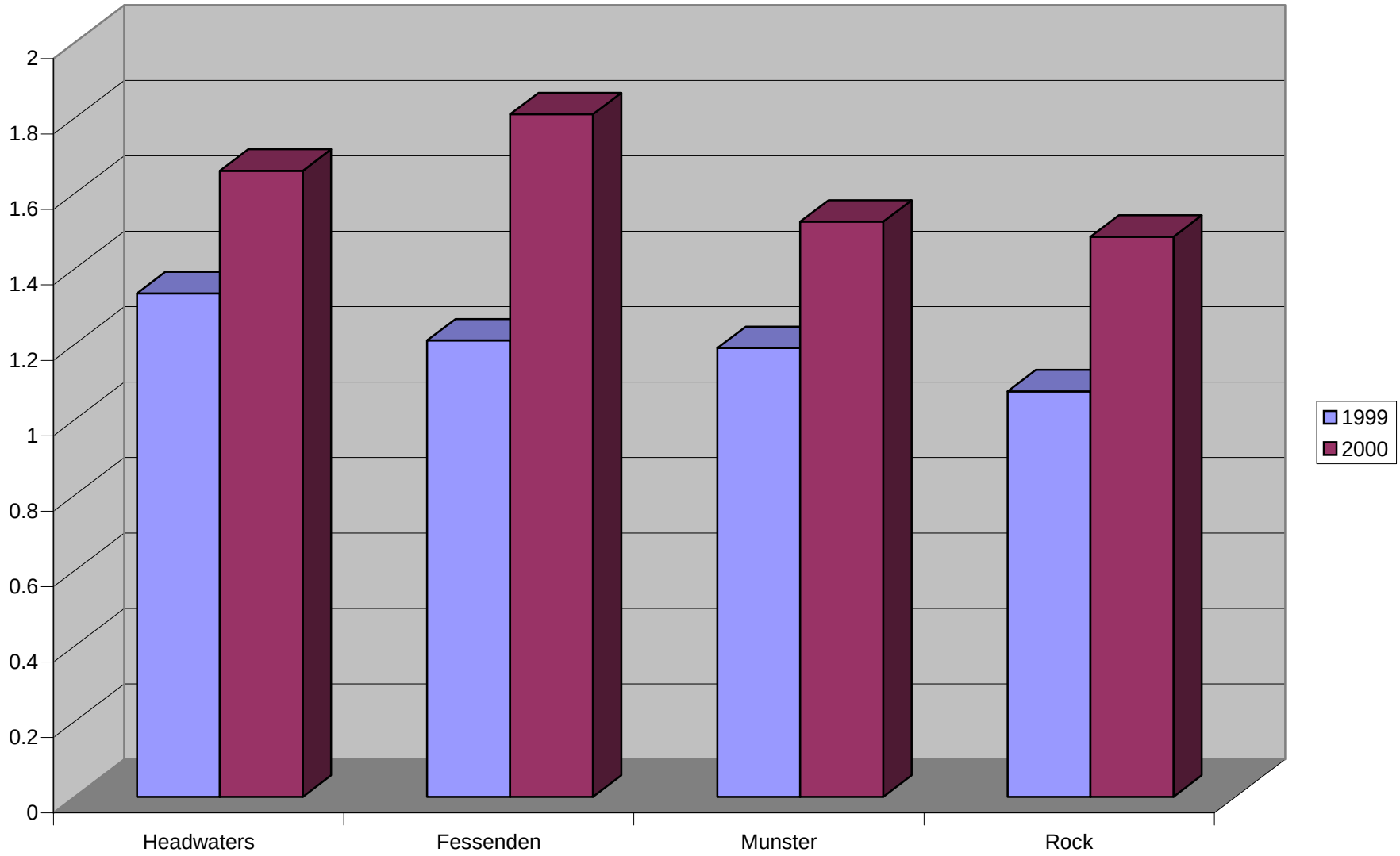
Figure 3. Wells County Drains



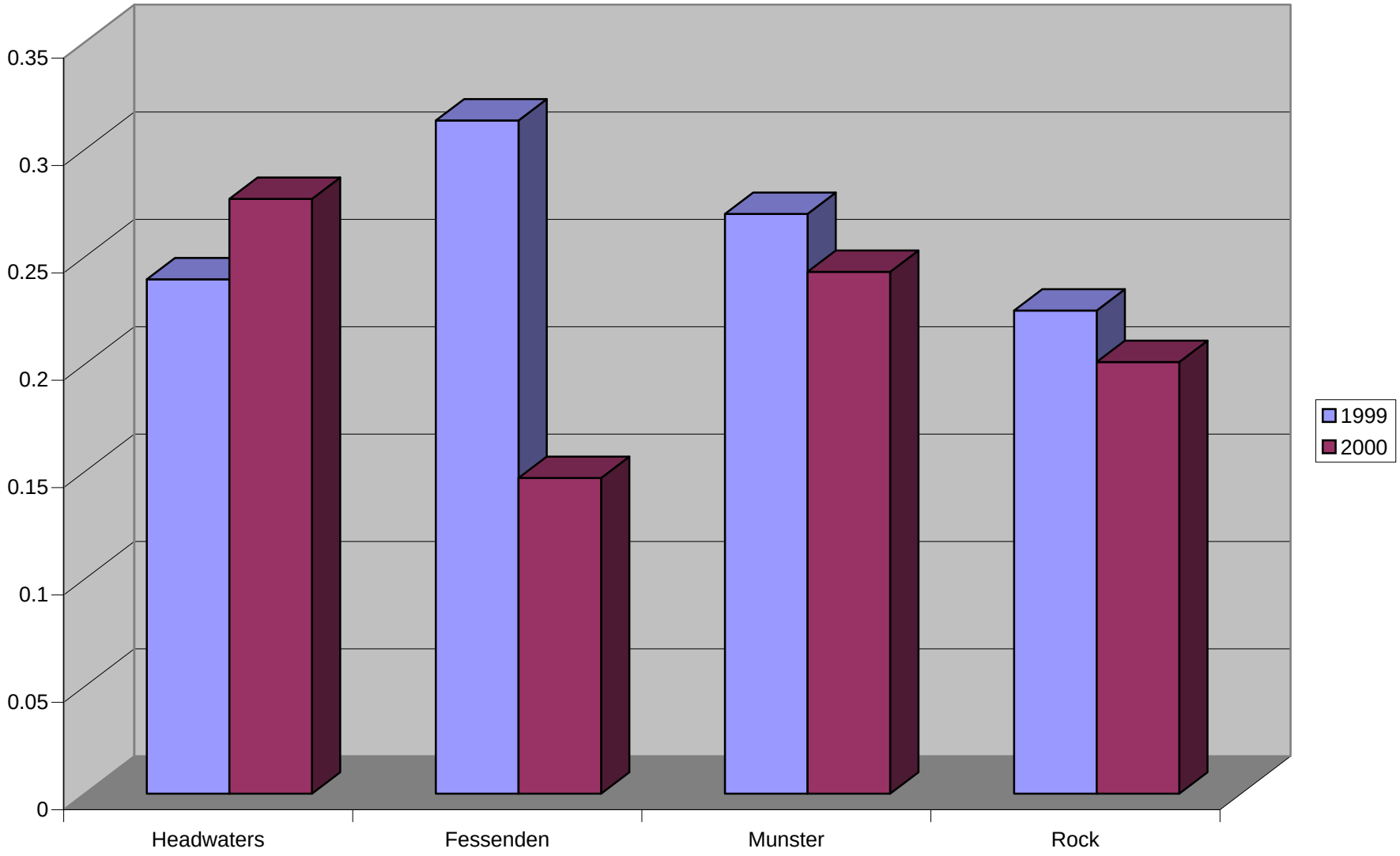
APPENDIX B

1999-2000 SAMPLING DATA

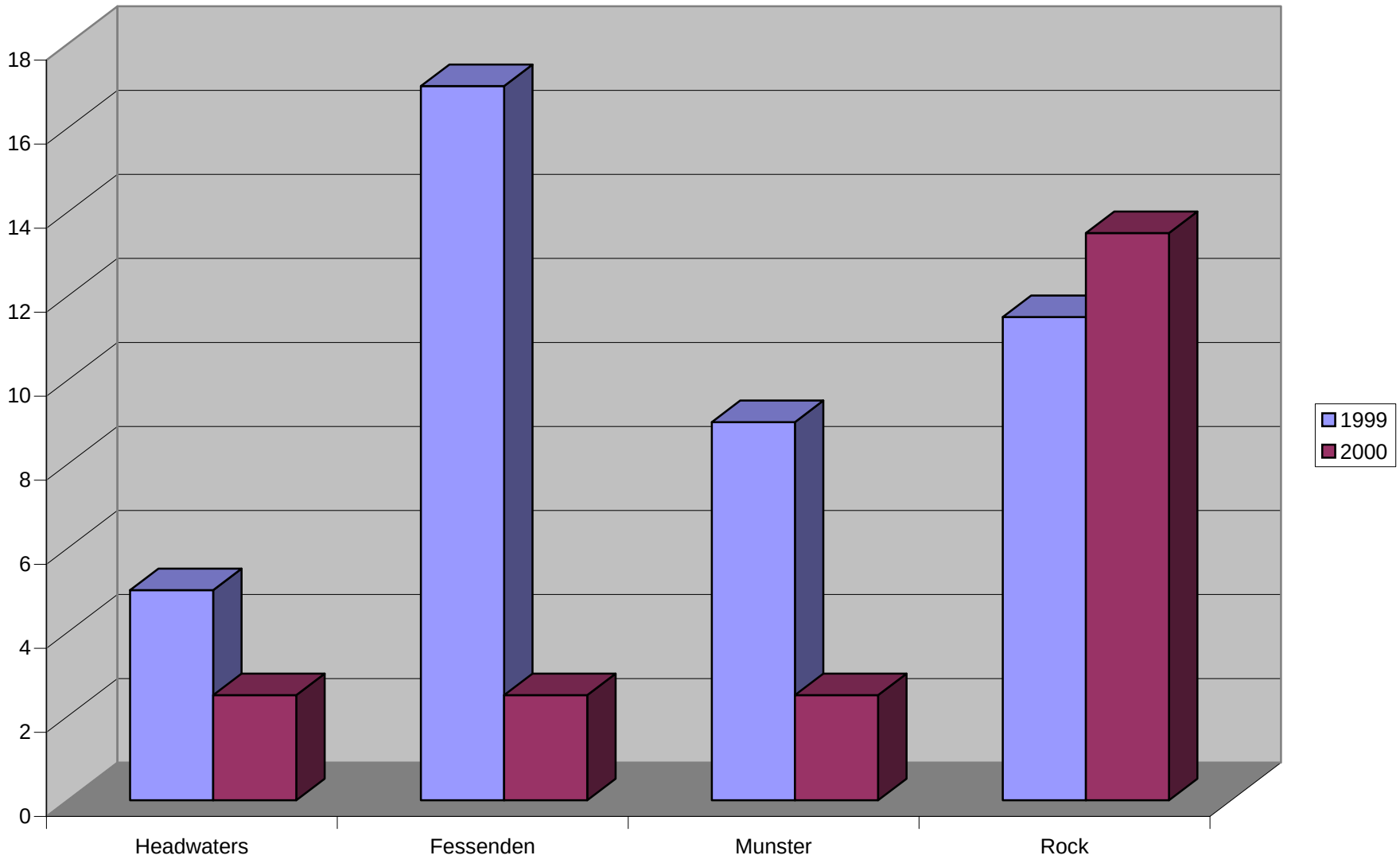
James River Total Nitrogen Median Concentrations



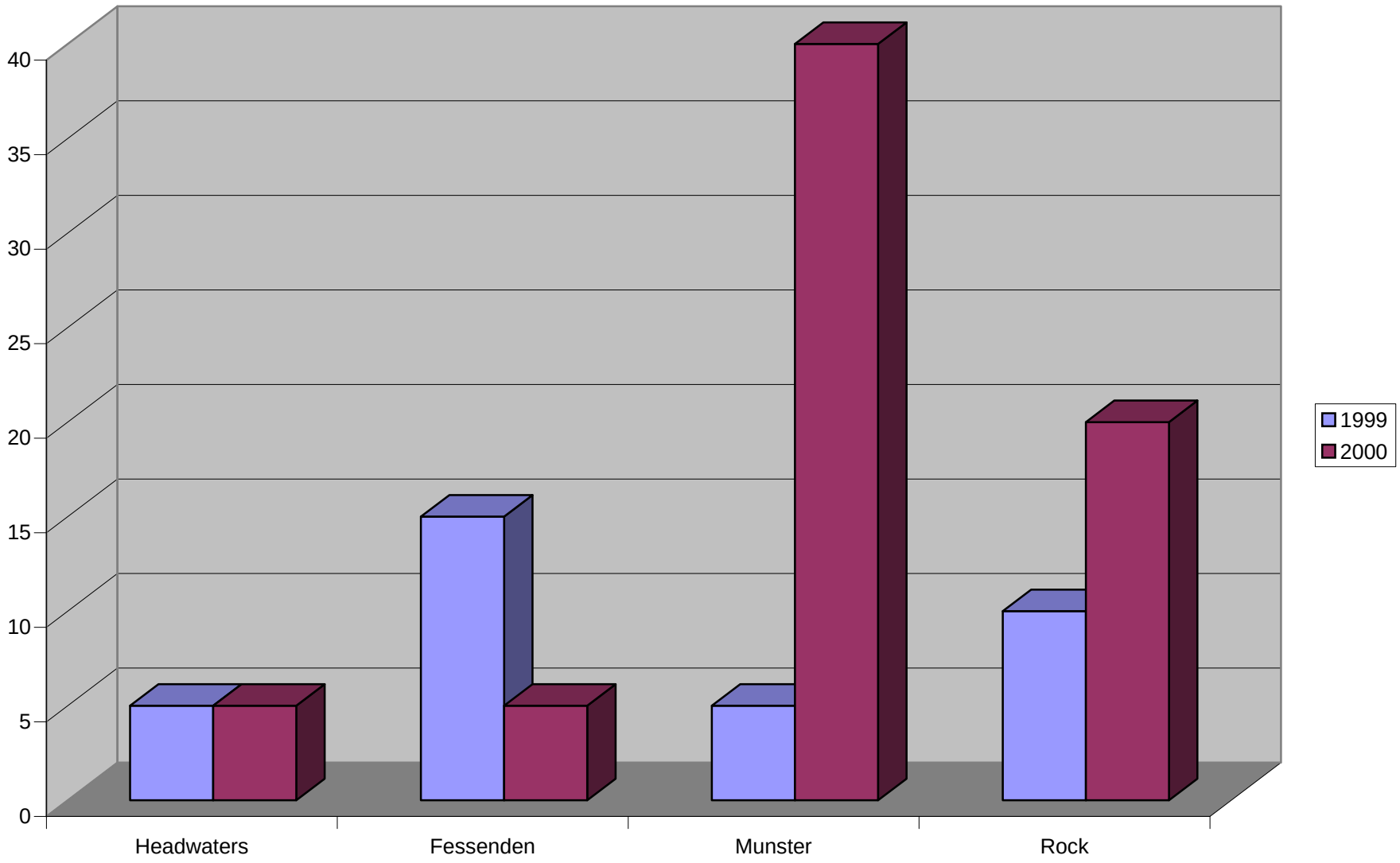
James River Total Phosphorus Median Concentrations



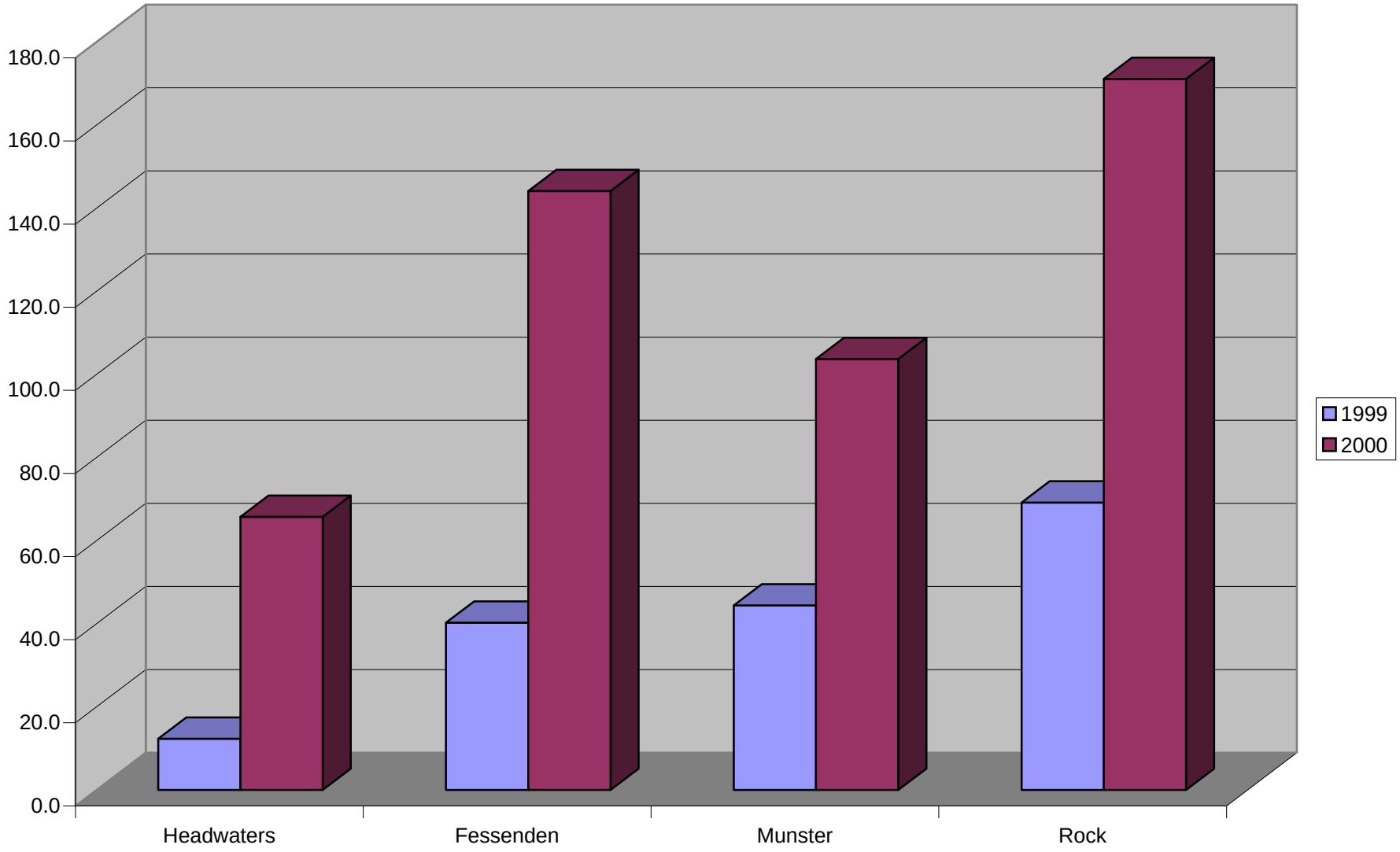
James River TSS Median Concentrations

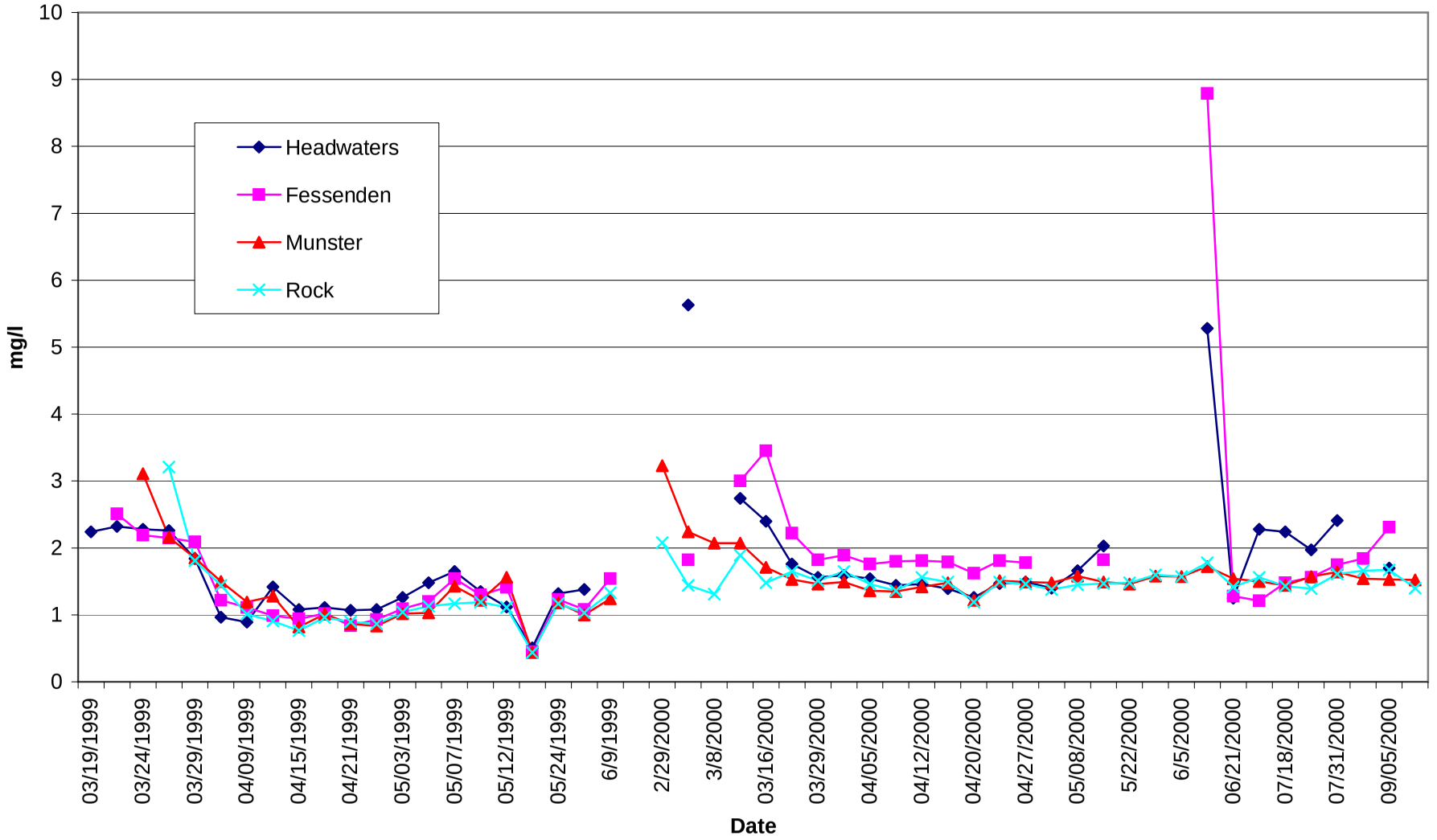


James River Fecal Coliform Bacteria Median Concentrations

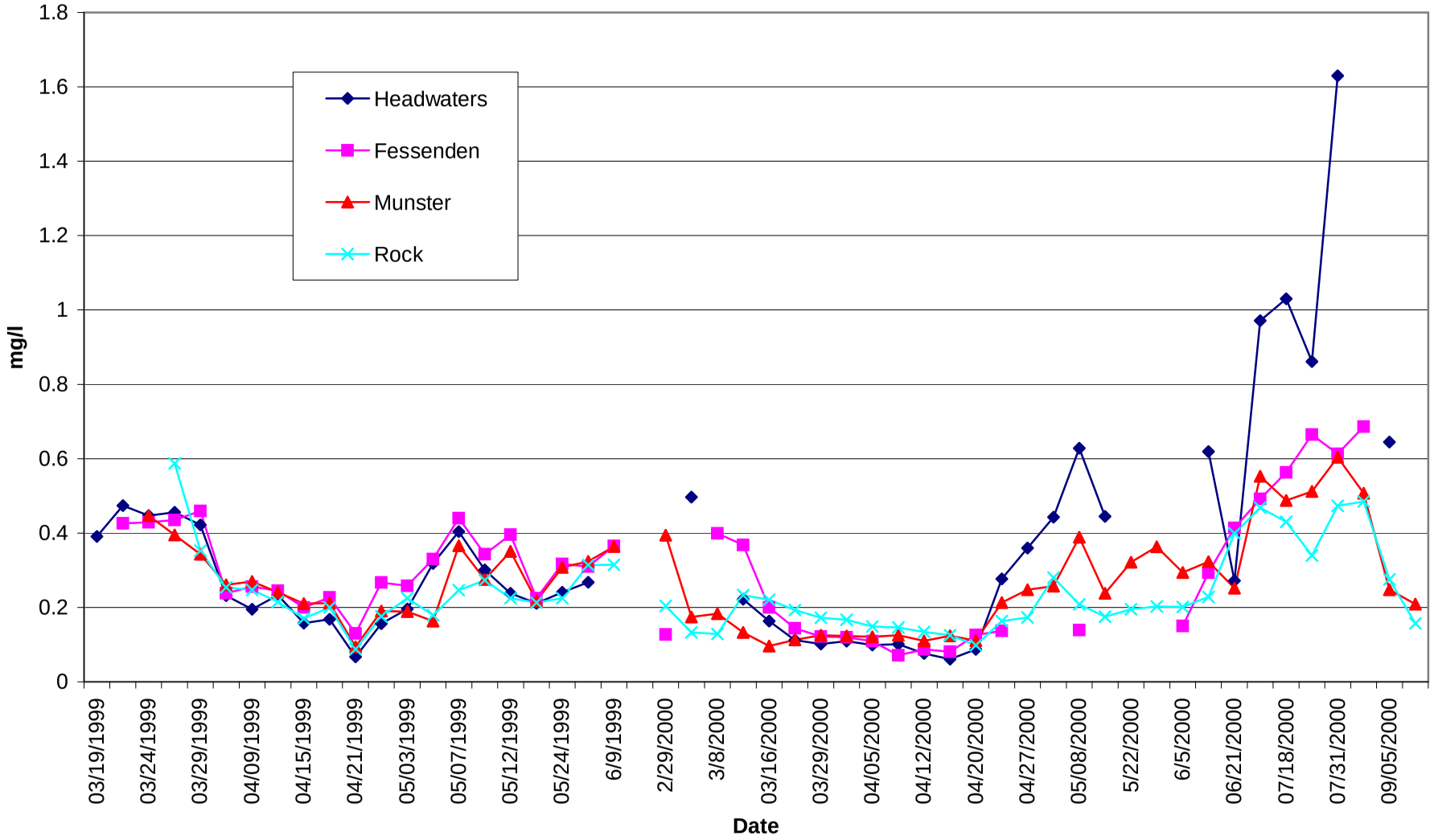


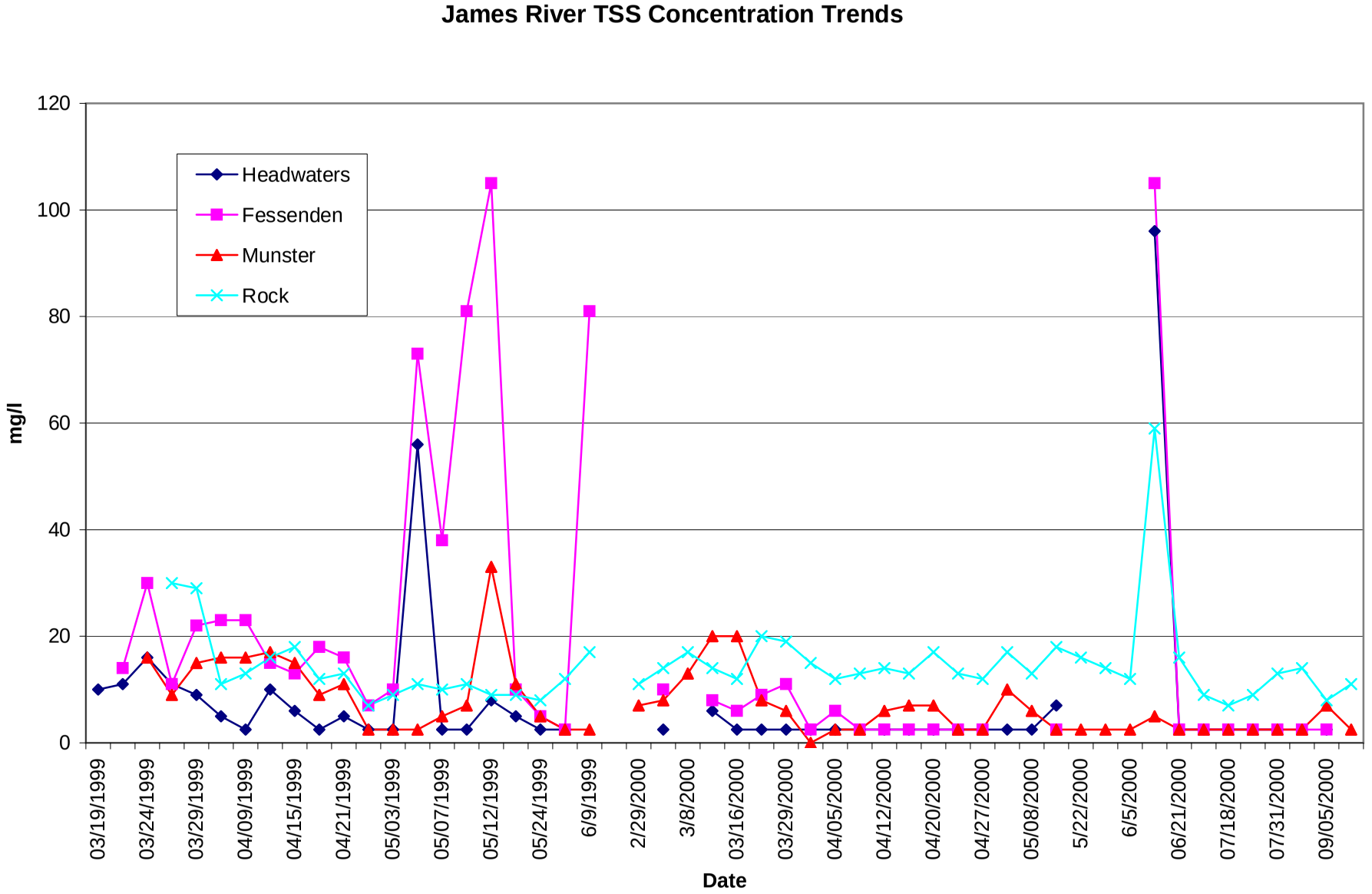
James River Fecal Coliform Bacteria Geometric Means




James River Total Nitrogen Concentration Trends
mg/l
10
9
8
7
6
5
4
3
2
1
0
Headwaters
Fessenden
Munster
Rock
03/19/1999
03/24/1999
03/29/1999
04/09/1999
04/15/1999
04/21/1999
05/03/1999
05/07/1999
05/12/1999
05/24/1999
6/9/1999
2/29/2000
3/8/2000
03/16/2000
03/29/2000
04/05/2000
04/12/2000
04/20/2000
04/27/2000
05/08/2000
5/22/2000
6/5/2000
06/21/2000
07/18/2000
07/31/2000
09/05/2000
Date

James River Total Phosphorus Concentration Trends




James River TSS Concentration Trends
120
100
80
60
40
20
0
mg/l
Headwaters
Fessenden
Munster
Rock
03/19/1999
03/24/1999
03/29/1999
04/09/1999
04/15/1999
04/21/1999
05/03/1999
05/07/1999
05/12/1999
05/24/1999
6/9/1999
2/29/2000
3/8/2000
03/16/2000
03/29/2000
04/05/2000
04/12/2000
04/20/2000
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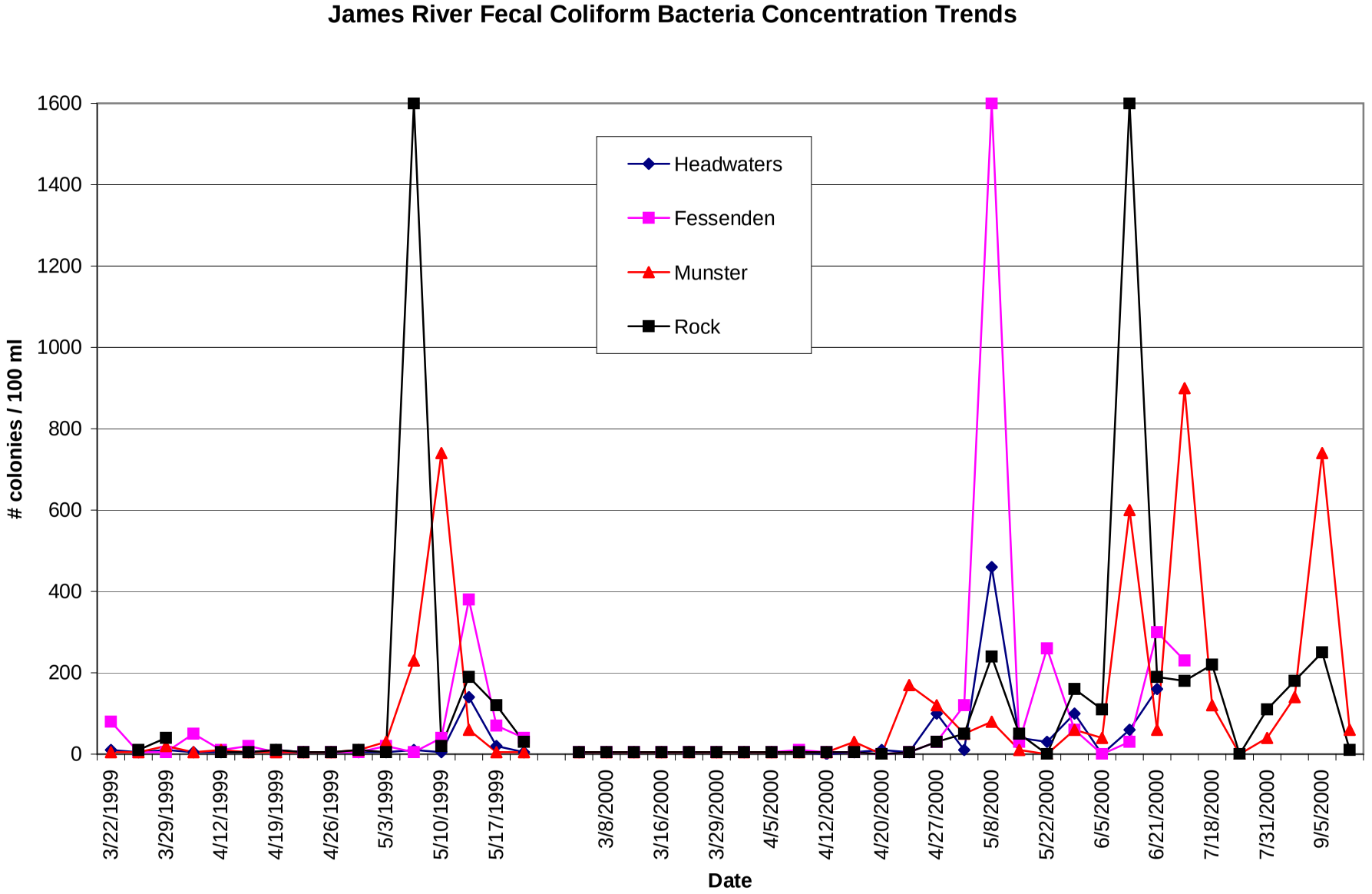
6/5/2000
06/21/2000
07/18/2000
07/31/2000
09/05/2000
Date


James River Fecal Coliform Bacteria Concentration Trends
colonies / 100 ml
1600
1400
1200
1000
800
600
400
200
0
Headwaters
Fessenden
Munster
Rock
3/22/1999
3/29/1999
4/12/1999
4/19/1999
4/26/1999
5/3/1999
5/10/1999
5/17/1999
3/8/2000
3/16/2000
3/29/2000
4/5/2000
4/12/2000
4/20/2000
4/27/2000
5/8/2000
5/22/2000
6/5/2000
6/21/2000
7/18/2000
7/31/2000
9/5/2000
Date

APPENDIX C

UPPER JAMES HEADWATERS WATERSHED ASSESSMENT REPORT 2004

Upper James Headwater (10160001) Watershed Assessment Report

Final, December 2004

Prepared by

James Meek
North Dakota Department of Health
Bismarck, ND
For
Wells County Soil Conservation District
Fessenden, ND

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1.0 Introduction

The primary goal of Upper James Headwater Watershed Assessment Project was to assess the current water quality and beneficial use condition of the James River in the project watershed, and to identify sources or causes of any pollutants which are impairing or threatening to impair beneficial uses. This project was funded by the Section 319 Nonpoint Source Pollution Management Program and sampling was conducted in 1999 and 2000. In addition, the report will set water quality target values, where possible, to reduce non-point source pollution and allow the James River to meet the applicable water quality standards, guidelines, and goals necessary to support its beneficial uses.

1.1 Environmental Setting

The James Headwater watershed (10160001) is approximately 4592 square kilometers (km^2) in size and extends from the headwaters to the outlet of the Jamestown Reservoir in Stutsman County, ND. The focus of this project or the project watershed, as it will be referenced in the remainder of the document, was an upper portion of the James Headwater watershed that covers 1677 km^2 (Figure 1). The approximate population within the project watershed is 3,300 individuals with population clusters in Fessenden, Manfred, and New Rockford. The watershed contains approximately 91 kilometer (km) of perennial rivers and streams and another 240 km classified as intermittent. According to the North Dakota Agricultural Statistics Service (NASS) 2003 land use data, the dominant landuse in the project watershed is agriculture with 55 percent dedicated to cropland and 40 percent dedicated to pasture and rangeland. The dominant crop types grown in the project watershed are spring wheat and soybean (Figure 2). The project watershed was delineated, using the automatic delineation tool within the BASINS model, into four subbasins based on the location of the sampling sites for this assessment. The subbasins range in size from 605 km^2 to 169 km^2. Some of the area within these subbasins can be classified as non-contributing or closed basins based on 12-digit hydrological units. Approximately, 27 percent of subbasin 1 and 14 percent of subbasin 4 are classified as non- contributing (Figure 1).

The project watershed lies within the Drift Plains (46i), Glacial Outwash (46j), and Missouri Coteau (42a) ecoregions (Figure 3). The geology in the region is one of the defining factors in the ecoregion delineation. The Drift Plains (46i) ecoregion of the Northern Glaciated Plains (46) is characterized by generally flat to occasionally rolling topography with a thick layer of glacial till formed primarily by moving glaciers. The potential natural vegetation for this ecoregion is western wheat grass, big and little bluestem, switch grass, and indian grass. High concentrations of seasonal and temporary wetlands typically exist within this ecoregion. The Glacial Outwash (46j) ecoregion is characterized by flat to slightly rolling topography with ancient channel depressions and lake. The soils in this ecoregion are highly permeable and have low holding capacity. The potential natural vegetation for this ecoregion is little bluestem, needle and thread, blue grama, prairie junegrass with elm, ash, burr oak in the river bottoms. The Missouri Coteau (42a) of the Northwestern Glaciated Plains (42) is located in the upper reaches of the project watershed and is characterized by hummocky, rolling stagnation moraines with numerous pothole wetlands. Integrated drainage networks are typically lacking in this ecoregion and indicate potential non-contributing areas. The potential natural vegetation for this ecoregion is western wheatgrass, bluestem, needle and thread, green needlegrass (Bryce, 1998).

1.2 Applicable Water Quality Standards, Goals, and Guidelines

The James River is assigned aquatic life, recreation, agriculture, and industrial beneficial uses by the *Standards of Water Quality for State of North Dakota* (NDDH, 2001). The focus of this assessment will be on the aquatic life and recreational beneficial use of the James River. The James River is presumed to fully support agricultural and industrial beneficial uses for the purposes of this assessment. The *2004 Section 303(d) List of Waters needing Total Maximum Daily Loads* lists a 20.47 mile segment of the James River from its confluence with the Big Slough downstream to its confluence with Rocky Run for recreational use impairments caused by pathogens (i.e., total fecal coliform) (NDDH, 2004).

For this report, the water quality standards, guidelines and goals relevant to the James River and its beneficial uses involve both narrative and numerical standards set for biological integrity, pathogens, nitrogen, and phosphorus. The state's water quality standards set a narrative biological goal stating, "The biological condition of surface water shall be similar of sites or waterbodies determined by the department to be regional reference sites" (NDDH, 2001). Direct measures of biological community health (i.e., indices of biological integrity), various chemical data (e.g., dissolved oxygen or metals concentrations) or best professional judgment can be used to determine if the river is achieving certain narrative and numerical standards, and the narrative biological goal to fully support aquatic life uses.

In 2004, a macroinvertebrate index of biotic integrity (MIBI) was developed for each ecoregion in North Dakota based on data collected from 1996 to 2000. The scores are rated into "good", "fair", and "poor" biotic integrity categories with each category having a corresponding aquatic use support level. Sites with MIBI scores of 54 or greater are classified as having "good" biological integrity and fully supporting aquatic life uses. Sites with MIBI scores of 21 or below are classified as having "poor" biological integrity and not supporting aquatic life uses. Sites falling between those two categories are classified as having "fair" biotic integrity but due to a lack of statistical significance between this and the other categories, aquatic life use assessments in the "fair" category were not considered to have sufficient data (NDDH, 2004). In these situations, other data such as metal concentrations, dissolved oxygen concentrations, nutrient concentrations, sediment concentrations and habitat assessments are used more significantly in the decision about aquatic life use support.

In the state's water quality standards, the criteria for pathogens is defined at 200 colony forming units (CFU) per 100 milliliters (ml) using fecal coliform bacteria as the indicator organisms (NDDH, 2001). This criterion is only valid during the recreation period of May 1 through September 30. Two separate fecal coliform bacteria criteria are used to determine if the waterbody is classified as fully supporting, fully supporting but threatened or not supporting for recreational uses. The first criterion is that the geometric mean of the samples should not exceed 200 CFU per 100 ml. The second criterion is that not more than 10 percent of the samples should exceed 400 CFU per 100 ml. The waterbody is classified as fully supporting if both criteria are meet, fully supporting but threatened if only the first criteria is met, and not supporting if neither of the criteria are met by the waterbody (NDDH, 1998).

State water quality standards list interim guideline limits for dissolved nitrogen and total phosphorus of 1.0 milligrams per liter (mg/L) and 0.1 mg/L, respectively. The Environmental Protection Agency (EPA) has published nutrient water quality criteria recommendations based on the 25th percentile as a representation of the reference condition for streams in a particular ecoregion. These recommendations are used as a starting point for states in their development of nutrient criteria but they can also be useful in setting water quality goals for this assessment. The recommended total nitrogen and total phosphorus concentrations for the Northern Glaciated Plains ecoregion are 1.01 mg/L and 0.102 mg/L, respectively (U.S. EPA, 2000). However, the unique characteristics of waterbodies can affect the level of nutrients that will result in eutrophication so waterbody-specific limits or goals may be necessary to support the designated beneficial uses.

2.0 Assessment Methods

2.1 Sampling Sites

Sampling locations were selected on the James River in the project watershed for collection of various chemical (e.g. nutrients and suspended solids), physical (e.g. habitat assessments) and biological (e.g. macroinvertebrate community and pathogens) data. Descriptions and locations of sites and parameters sampled are illustrated in Table 1 and Figures 4 and 5.

Table 1. Description and location of sites and parameters sampled during the assessment project

Storet Number	Description	Parameter
385010	James River Headwaters Lat: 47.71126 Long: -99.8217	Water Quality[1]
385011	James River near Fessenden Lat: 47.68781 Long: -99.58079	Water Quality[1]
385012	James River near Munster Lat 47.73457 Long: -99.3185	Water Quality[1]
385013	James River near New Rockford Lat: 47.67299 Long: -99.06319	Water Quality[1]
554009	James River Headwaters Lat: 47.69569 Long: -99.21148	Macroinvertebrate Community Habitat Assessment
554010	James River near Fessenden Lat: 47.73588 Long: -99.36176	Macroinvertebrate Community Habitat Assessment
554011	James River near Munster Lat: 47.68638 Long: -99.57584	Macroinvertebrate Community Habitat Assessment
554012	James River near New Rockford Lat: 47.64615 Long: -99.82942	Macroinvertebrate Community Habitat Assessment

1 – Water Quality includes Nutrients Complete (Total Nitrogen, Total Kjeldahl Nitrogen, Nitrite-Nitrate, Ammonia, and Total Phosphorus), Chlorophyll-a, Dissolved Total Phosphorus, Fecal Coliform Bacteria, and Total Suspended Solids

2.2 Sampling Design

Refer to the James River Sampling Analysis Plan in Appendix B for a complete description of the sampling design for this project.

2.3 Sampling Methods

Refer to Standard Operation Procedures for Field Samplers for a complete description of the sampling methods used for this project (NDDH, 1993).

3.0 Assessment Data

3.1 Hydrology

Monthly precipitation totals from the cooperative weather station in Fessenden, North Dakota for the period of January 1999 to December 2000 were compared to normal monthly precipitation totals to the determine the percent of deviation from the normal for each month (NCDC, 2002). The precipitation totals for nine of the months in 1999 were below normal. The percent deviation from the normal in those months ranged from 7 to 100 percent below normal. The remaining months in 1999 (January, May, and August) were over 50 percent above normal offsetting the below normal months and allowing the annual total for 1999 to finish 5 percent above normal. In 2000, the winter and early spring months (January, February, March, and April) ranged from 35 to 89 percent below normal. The remaining months in 2000, excluding December, ranged from 11 to 260 percent above normal. The annual precipitation total for 2000 was 39 percent above normal (Figure 6).

The mean monthly discharges for 1999 and 2000 at a USGS site near the project watershed (06468170 - James River near Grace City) were compared to the normal mean monthly discharges based on the record from 1969 to 1998. There were periods in both 1999 and 2000 where the mean monthly discharge was considerably above normal. In 1999, this period was in the spring (March, April, and May) where mean monthly discharges were 3 to 5 times above normal. The mean monthly discharges during the rest of 1999 were close to normal. In 2000, the mean monthly discharges in the summer months (June, July, and August) were 10 to 20 times above normal. However, the mean monthly discharges of the spring months (March, April, and May) in 2000 were far below normal (Figure 7). These patterns were consistent with the precipitation patterns seen over the same time periods at Fessenden.

3.2 Total Nitrogen, Total Phosphorus, and Total Suspended Solids

The median total nitrogen (TN) concentrations at the sampling sites were similar and ranged from 1.44 at site 385011 to 1.62 at site 385011. The median total phosphorus (TP) ranged from 0.267 mg/L at site 385011 to 0.208 mg/L at site 385013. The downstream order of the sampling sites was 385010, 385011, 385012, and 385013 and the median TP concentrations appeared to decrease significantly after site 385012. The median total suspended solids concentrations ranged from 2.5 mg/L at site 385010 to 13.0 mg/L at site 385013. The concentration of 2.5 mg/L represents the detection limit for TSS analysis (Table 2).

In addition to median concentrations, the TN, TP, and TSS concentrations at each sampling site were evaluated for any identifiable temporal trends. The sampling sites were similar in any identified trends for TN and TP concentrations. The TN concentrations were highest at the initiation of sampling each year during spring runoff. The concentrations decreased around mid-March and stayed relatively consistent the remainder of the sampling period (Figure 8). The TP concentrations also demonstrated a peak at the initiation of sampling each year during spring runoff followed by a decrease in mid-March. The TP concentrations increased steadily following the decrease for the remainder of the sampling period (Figure 9). There were no identifiable temporal trends in the TSS concentrations (Figure 10).

Table 2. Summary of total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) median concentrations (mg/L) at each site for the 1999-2000 sampling period

Site	TN	TP	TSS
385010	1.49	0.255	2.5
385011	1.62	0.267	9.0
385012	1.49	0.248	6.0
385013	1.44	0.208	13.0

3.3 Pathogens

Site 385013 had the highest geometric mean fecal coliform bacteria (FCB) concentration at 120 CFU per 100 ml while site 385012 had the highest percent of samples over 400 CFU per 100 ml at 19 percent. The geometric mean FCB concentrations ranged from 32 to 86 CFU per 100 ml at the remaining sites. Site 385013 was the only other site where the percent of samples over 400 CFU per 100 ml was greater than or equal to 10 percent (Table 3).

As with TN, TP, and TSS, the FCB concentrations were evaluated for any identifiable temporal trends. In general, the highest FCB concentrations and the most exceedances of 200 CFU per 100 ml at each site occurred during the recreational period (May 1 to September 31). However, several peaks occurred at the sites just prior to the beginning of the recreation period. No other temporal trends were identified in the data (Figure 11). Note: Some of the samples returned results of "too numerous to count" and a value of 1600 CFU per 100 ml was used in these situations. Hence the geometric mean FCB concentrations may be underestimated in some situations.

Table 3. Summary of geometric mean fecal coliform bacteria (FCB) concentrations and the percentage of samples exceeding 400 CFU per 100 ml at each site for samples collected during the recreation period (May 1 – September 30) of 1999 and 2000

Site	Geometric Mean	Percent > 400
385010	32	6
385011	86	7
385012	77	19
385013	120	10

3.4 Macroinvertebrate Index of Biotic Integrity

Macroinvertebrate samples were collected from four sites in the project watershed during the development of the MIBI in 1998 (Figure 5). The macroinvertebrate index of biotic integrity (MIBI) scores ranged from 20 at site 554011 to 38 at site 554009. Based on the classification scheme described in Section 1.2, site 554009 was classified as having "poor" biotic integrity while the remaining sites were classified as having "fair" biotic integrity.

The habitat assessment scores ranged from 94 at site 554010 to 133 at site 554009. Only the habitat score at site 554011 indicated "poor" available habitat. The MIBI scores at all the sites rank in the bottom 37th percentile of all samples taken in North Dakota from 1996 to 2000 (Table 4).

Table 4. Summary of habitats scores, macroinvertebrate index of biotic integrity (MIBI), and the integrity rankings for samples collected at each sampling site

Site	Habitat Score	MIBI Score	Integrity Rating
554009	133	38	Fair
554010	94	30	Fair
554011	99	20	Poor
554012	128	35	Fair

3.5 Land Use

According to the 2003 NASS land use/land cover data, the dominant land uses in the project watershed were pasture/range, spring wheat, and soybean at 28.0, 22.1, and 18.1 percent, respectively (Figure 2). In general, the same land uses dominant overall were dominant in all four subbasins but with different distributions. For example, pasture/range had the highest percent cover in subbasin 1 at 37.0 percent while spring wheat had the highest percent cover in subbasin 3 at 31.6 percent. One exception to this is subbasin 4 which had the highest percent cover of grassland at 18.0 percent (Table 5).

Table 5. Dominant land uses/land covers by percentage for the entire project watershed, delineated subbasins and a riparian buffer around the James River and tributaries.

	Subbasin					
Land Use	**1**	**2**	**3**	**4**	**All**	**Buffer**
Pasture/Range	37.0	21.1	18.2	19.9	28.0	45.7
Spring Wheat	17.6	23.3	31.6	19.5	22.1	20.3
Soybean	14.0	22.0	21.6	23.2	18.1	14.5
Grasslands	6.5	9.0	6.2	18.0	8.2	6.0
Dry Edible Beans	3.9	10.1	10.0	5.8	6.5	4.7
Barley	6.6	8.3	5.2	5.2	6.3	3.8
Water	5.2	2.0	2.1	5.1	4.0	2.1
Sunflower	3.6	1.0	1.0	---	2.1	1.0
Urban	1.0	1.6	1.9	1.0	1.2	1.0
Canola	1.4	1.2	1.2	1.0	1.2	1.0

In addition, the land uses/land covers within an estimated riparian buffer area was examined using a 500-meter buffer around perennial portions of river and a 250-meter buffer around intermittent portions of river. The percent cover of pasture/range in the buffer area at 45.7 percent is higher than the percent cover in the project watershed as a whole or any of the individual subbasins. As with the project watershed and the individual subbasins, spring wheat and soybeans are the other dominant land uses in the buffer area (Table 5).

3.6 Soil & Water Assessment Tool (SWAT) Model

The data presented in this section reflects the use of the Soil & Water Assessment Tool (SWAT) model as a tool to aid identifying potential priority areas. In the model, the project watershed was delineated into 143 subbasins and the average loadings for nutrients and sediment over a ten year period were calculated using simulated weather data. Due to simulated weather data and a lack of river discharge information, the hydrology in the model is not calibrated but the model should still provide acceptable results for comparisons between subbasins. Refer to Soil and Water Assessment Tool User's Manual Version 2000 for more specific information regarding the processes and setup of the model. The total nitrogen, total phosphorus, and sediment loadings from each subbasin are illustrated in Figures 12, 13, and 14. The loadings in the figures for each parameter are in mass per area and divided into four quartiles. This model does not identify areas with definitive or specific land management problems but instead identifies areas that the model indicate are the largest generators of nutrients or sediment and hence the area where best management practices (BMP) may have the largest impact.

4.0 Beneficial Use Assessment

Recreation Use

The focus of this assessment report is on the recreational and aquatic life beneficial uses of the James River in the project watershed. Determining if the James River supports recreational use was a straightforward process based on comparing the North Dakota water quality criteria for the pathogen indicator, fecal coliform bacteria (FCB), to the data collected at each site. Site 385012 and 385013 were classified as fully supporting but threatened based on the FCB geometric mean concentrations and the percent of samples above 400 CFU/100 ml (Table 3). Based on the data at the sampling locations and the 2004 303(d) list, a reach of the James River downstream from the confluence with the Big Slough to the location of site 385013 was identified with threatened recreational uses (Figure 15) (NDDH, 2004).

Aquatic Life Use

Determining if the James River in the project watershed supports aquatic life uses was based primarily on the macroinvertebrate index of biotic integrity (MIBI) scores supported with chemical and physical data. Site 554011 had a "poor" score classified as not supporting aquatic life uses while the other three sites had "fair" scores. A "fair" rating in the MIBI alone does not provide sufficient data to determine aquatic life use support so other data, such as nutrient concentrations, suspended sediment concentrations and habitat assessments, collected during the assessment were used more significantly in the decision about aquatic life use support in those areas with "fair" ratings.

Eutrophication is defined as the increase in primary productivity resulting from excessive nutrient inputs into rivers. The levels of total nitrogen (TN) or total phosphorus (TP) at which rivers are considered eutrophic can be influenced by spatial and temporal variations in a variety of factors and is still an area of significant research. A combination of studies suggests that the TN and TP levels defining the boundary between mesotrophic and eutrophic conditions were 1.5 mg/L and 0.075

mg/L, respectively (U.S. EPA, 2001). The negative impacts from eutrophication could include the reduction of dissolved oxygen due to algal respiration and decomposition by microbial activity and the alteration of the algal community. The alteration of the algal community can lead to a decrease in food resource quality for aquatic insects and fish and an alteration of the aquatic insect and fish communities to include less intolerant species (e.g. D.O. sensitive species). All of the sampling sites had median TP concentrations exceeding the mesotrophic-eutrophic boundary of 0.075 mg/L and the EPA criteria recommendation of 0.102 mg/L for the Northern Glaciated Plains ecoregion. Site 385011 was the only site that had median TN concentrations exceeding the 1.5 mg/L mesotrophic-eutrophic boundary but all of the sites had concentrations exceeding the EPA criteria recommendation of 1.01 mg/L for the Northern Glaciated Plains ecoregion (Table 2). However, it appears that the James River was nitrogen limited for the majority of the sampling season thus nitrogen was the primary control on excessive primary productivity or algae growth so the impact of total phosphorus concentrations on eutrophication and aquatic life uses is uncertain.

In addition to nutrients, total suspended solids (TSS) concentrations can have an impact on aquatic life uses in streams. TSS is the amount of both mineral and organic solids suspended in water, and is often used as a surrogate measure for suspended sediments. North Dakota, along with most other states, do not have TSS criteria designed to protect aquatic life use. The development of criteria is a complex process influenced by numerous spatial and methodological variations and is the subject of current research. The negative effects of TSS on aquatic life are dependent on the concentration and the duration of the exposure. Long durations of high concentrations of TSS can negatively impact the reproduction, feeding, and movement of fish and aquatic insect communities. One study proposed that the level of risk to the fish community from suspended sediment concentration be based on a level above the background concentration. Less than 25 mg/L above the background level would represent a very low risk, 25-100 mg/L above the background would represent low risk, 100-200 mg/L above the background would represent a moderate risk, 200-400 mg/L above background would represent a high risk, and greater than 400 mg/L above the background would represent an unacceptable risk (DFO, 2000). Using existing literature, the European Inland Fisheries Advisory Commission developed a the following criteria: (1) less than 25 mg/L of suspended solids had no harmful effect on fisheries, (2) 25-80 mg/L could maintain moderate fisheries, (3) 80-400 mg/L was unlikely to support good freshwater fisheries, and (4) greater than 400 mg/L was likely to support only poor fisheries (DFO, 2000). South Dakota has set a standard for TSS at a 30-day average of 90 mg/L and a daily maximum of 158 mg/L for permanent warm-water fisheries. In addition, suspended solids can eventually settle and cause sedimentation problems like the filling of interstitial space and the smothering of benthic organisms. Excluding site 385011, none of the sites demonstrated consistent exposure to TSS concentrations above 30 mg/L, which may negatively affect aquatic life (Figure 10). Approximately 14 percent of the samples collected at site 385011 had TSS concentrations above 30 mg/L. The assessment data collected for TSS can also be compared to criteria from other states within the same ecoregions, such as South Dakota. The 30-day average did not exceeded 90 mg/L at any of the sites and there were no exceedances of the 158 mg/L daily maximum standard.

Based on the currently available data, a reach of the James River from the confluence with the Big Slough upstream about two miles past site 385010 was identified with threatened aquatic life uses (Figure 15). The reach identified as having aquatic life use impairments was selected primarily to encompass all of the sites where biological, physical, and chemical data indicated impairment. The

reach selected contains the sites with the lowest MIBI and habitat scores and the highest nutrient and suspended solids concentrations. Due to relatively inconsistent TSS concentrations among the sites in the selected reach and the presence of a "fair" rated MIBI site, the aquatic life uses were designated as only threatened instead of not supported.

5.0 Stressors and Sources

Stressors are any physical, chemical, or biological factors that can cause an adverse response in the designated uses. Sources are points, areas, or activities that initiate the stressors on designated uses. Stressors and their typical sources for recreational uses and aquatic life uses impairment will be discussed in this section (EPA, 2000).

Recreational Uses

1. Pathogens – disease-causing microorganisms can infect humans through skin contact or the ingestion of contaminated fish, shellfish, or water. The primary sources of pathogens in the threatened reaches are:
    - Runoff of manure from cropland and pasture
    - Runoff of manure from concentrated animal feeding areas
    - Direct deposit of manure by livestock

Note: The discharge monitoring report data for 1999-2000 from the New Rockford, Fessenden, Central Plains Water District, and Hurdsfield wastewater treatment plants were analyzed to determine the potential of the wastewater treatment plants as sources pathogens (Figure 16). Only the largest New Rockford facility had data for ammonia and fecal coliform bacteria concentrations. Considering the limited days of discharge (14 in 1999 and 41 in 2000) and the typically low concentrations, it is unlikely that the wastewater treatment facilities are significant sources of pathogens.

Aquatic Life Uses

1. Habitat Alteration

    a. Riparian Alteration – Removal of riparian vegetation can decrease bank stability, alter flow characteristics, decrease nutrient and sediment uptake, increase stream temperature, and decrease woody debris which reduces available substrate and changes the energy source from outside to inside the channel. The primary sources of riparian alteration are:
        - Replacement of native vegetation with crops
        - Riparian grazing and concentrated animal feeding areas
        - Replacement of native vegetation with impervious surfaces and lawns

    b. Suspended sediment and sedimentation – Some level of suspended sediment in rivers is natural and is necessary to maintain natural river channel stability. Excess suspended sediment, when deposited, reduces interstitial spaces and can smother benthic organisms. Excessive suspended sediment can also negatively impact the feeding and motility of aquatic organisms. The primary sources of excessive sediment are:

- Sediment from sheet, rill, gully and wind erosion of cropland
- Streambank erosion caused to vegetation removal
- Streambank erosion caused by livestock trampling

c. Hydrologic Alteration – Altering the flow in the river channel through the addition, subtraction, or artificial control of water can have negative effects on the optimal habitats for aquatic life. For example, impoundments increase sedimentation and algal growth on the upstream side by reducing stream velocity to pool-like conditions and erosion on the downstream side. Large impoundments can cause incision of the river by creating longer abnormal periods of high flows with decreased sediment loads. Incision reduces available substrate through scouring and can lead to the detachment of the river from the floodplain. The primary sources of hydrologic alteration are:
   - Impoundments (Figure 17)
   - Drainage
   - Channelization

2. Eutrophication – Excessive algal respiration and decomposition by microbial activity can reduce the dissolved oxygen. Even if excessive algal growth is insufficient to reduce dissolved oxygen, it can impact the aquatic community by decreasing the quality of food resources for aquatic insects and fish and increasing tolerant species. The primary sources of nutrients causing eutrophication are:
   - Runoff of manure or commercial fertilizer from cropland.
   - Runoff of manure from pasture and concentrated animal feeding areas.
   - Runoff of sediment with attached nutrients (phosphorus) from cropland.
   - Runoff of various organic residues from cropland and pasture.
   - Direct deposit of manure by livestock.

6.0 Water Quality Target Values

Aquatic Life Use

Water quality targets necessary to maintain and restore beneficial uses were chosen using a combination of literature sources, numerical and narrative water quality standards and best professional judgment. The targets chosen for aquatic life use were based on the macroinvertebrate IBI (MIBI) score, total suspended solids (TSS) concentrations, total nitrogen (TN) concentrations, and total phosphorus (TP) concentrations (Table 6). The MIBI score selected as a target value should indicate good biological integrity necessary to fully support aquatic life use (Table 6). In this case, the target value was set at the good biological integrity classification rather than a numerical value because of the continued development of the MIBI. Currently, a score of approximately 54 or greater indicates a "good" biological integrity condition and translates into a classification of supporting aquatic life. However, further development of the MIBI might alter that number slightly so it is best to use a narrative classification of good, which will not change, as a target. The TN and TP concentration targets were based on the EPA nutrient criteria recommendations for the Northern Glaciated Plains ecoregion (46) (U.S. EPA, 2000). The TSS concentration target was based on the literature discussed in Section 4.0, assessment data, and best

professional judgment. All of the water quality targets for aquatic life uses should be considered long-term (5 years plus) in nature and open to future alterations depending on new data or criteria.

Table 6. Summary of water quality target values chosen for beneficial use restoration

Beneficial Uses	Indicator	Target Value
Aquatic Life	Macroinvertebrate Index of Biotic Integrity Rating	Good
Aquatic Life	Total Suspended Solids Concentration (mg/L)	30
Aquatic Life	Total Nitrogen Concentration (mg/L)	1.01
Aquatic Life	Total Phosphorus Concentration (mg/L)	0.102
Recreation[1]	Geometric Mean Fecal Coliform Bacteria (CFU/100ml)	200
Recreation[1]	Percent of Fecal Coliform Bacteria Samples > 400 CFU/100ml	10%

1 – Target values limited to samples taken during the recreational period (May 1 – September 31).

The percent load reductions needed to meet the water quality targets for TN, TP, and TSS were calculated using load duration curves (LDC) (Table 7) (Appendix C). The discharge records needed for the LDC calculations were estimated using records from the USGS site 06468170 (James River near Grace City) and allocating discharge among subbasins depending on basin size. The load reductions were determined by identifying samples exceeding the criteria LDC, developing a linear regression model of those samples, and calculating the average reduction needed to reduce the linear regression model to the criteria LDC. Each subbasin load reduction was corrected for any upstream load reductions so that the percentages in Table 7 are isolated and individual to each subbasin.

Table 7. Percent total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) load reductions by subbasin needed to meet the water quality targets

	Subbasin			
	1	**2**	**3**	**4**
TN	47	44	38	0
TP	72	50	58	40
TSS	0	59	0	0
Outlet	385010	385011	385012	385013

Recreation Use

The targets chosen for recreational uses were based on fecal coliform bacteria. The numerical standard in the North Dakota water quality standards and the decision criteria for assessing waters listed in the 303(d) TMDL list set the target values for the geometric mean fecal coliform bacteria concentration at 200 CFU/100ml and the percentage of samples above 400 CFU/100ml at 10 percent (Table 6).

7.0 Priority Areas

Areas of the project watershed were assigned priority rankings for best management practice (BMP) implementation based on all the available assessment data and best professional judgment. A

subbasin rating system based on the total nitrogen (TN), total phosphorus (TP), and sediment loads modeled by Soil and Water Assessment Tool (SWAT) was created to aid in assigning priority rankings. The subbasin rating system is determined by averaging the percentile rank of the TN, TP, and sediment loads where zero identifies the subbasin with the lowest load (Figure 18). High, medium, low, and no were the four priority rankings used for this assessment report. High priority areas are locations where the applications of BMPs to sources of stressors are likely to be the most effective in achieving the water quality targets and restoring threatened designated uses. No priority areas are locations where the application of BMPs is likely to have no effect and in this case represents non- contributing areas. In general, the effectiveness of BMP implementation within each priority ranking is likely to decrease the farther the implementation location is from a stream or river drainage network so riparian areas are a priority over non-riparian areas within each priority ranking. Due to differences in the location of threatened reaches and sources of stressors for aquatic life uses and recreation uses, priority ranking assignments were done separately for the two uses. The priority rankings for aquatic life uses and recreation uses are illustrated in Figures 19 and 20. The priority rankings should not definitively replace in-field judgment on the most effective location for BMP implementation but act as a guide for locations to focus on at least initially.

8.0 Literature Cited

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Appendix A
Figures Cited in Report

Figure 1. Subbasins and non-contributing areas in the project watershed

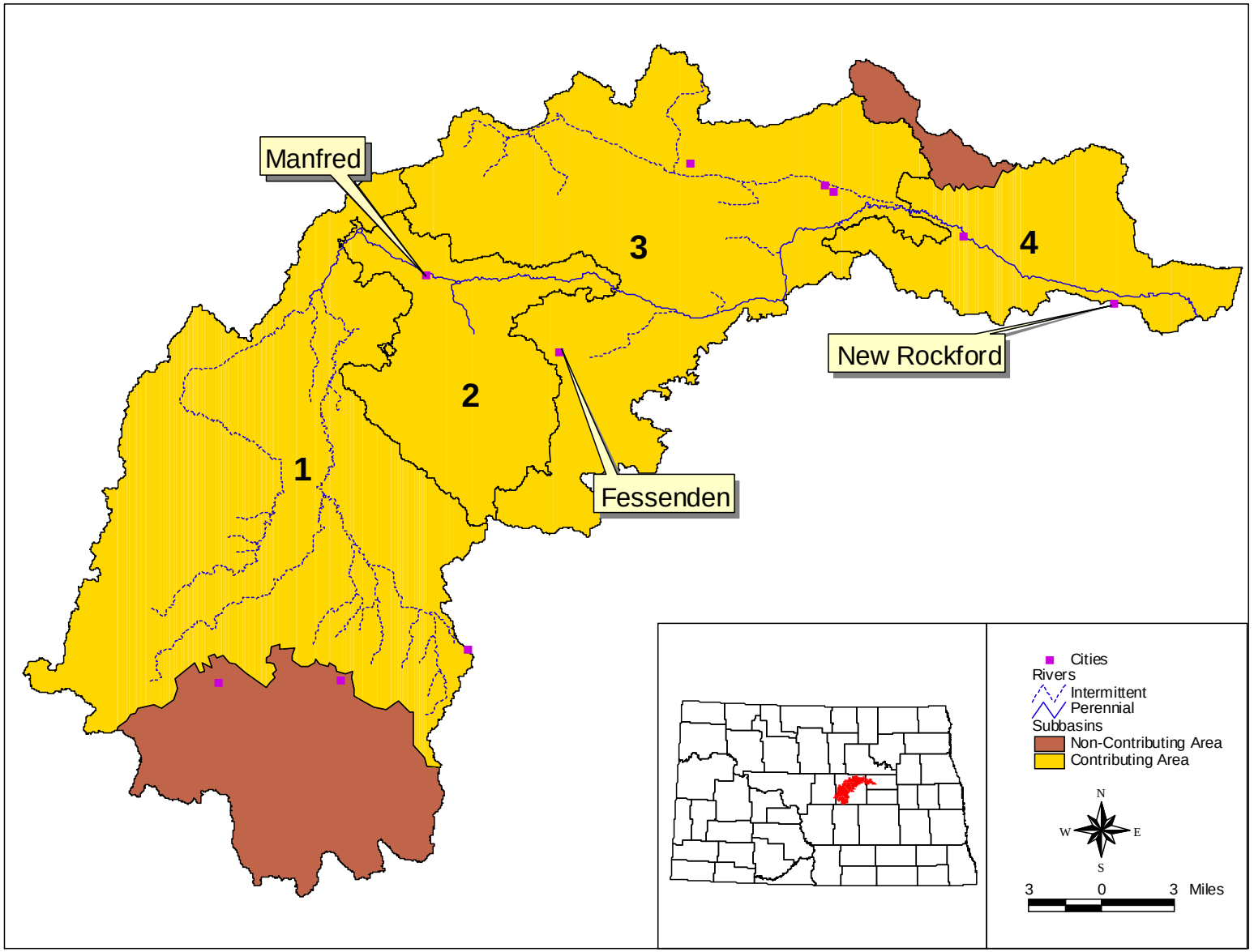


Figure 2. North Dakota Agricultural Statistics Service (NASS) 2003 Land Use/Land Cover for the project watershed

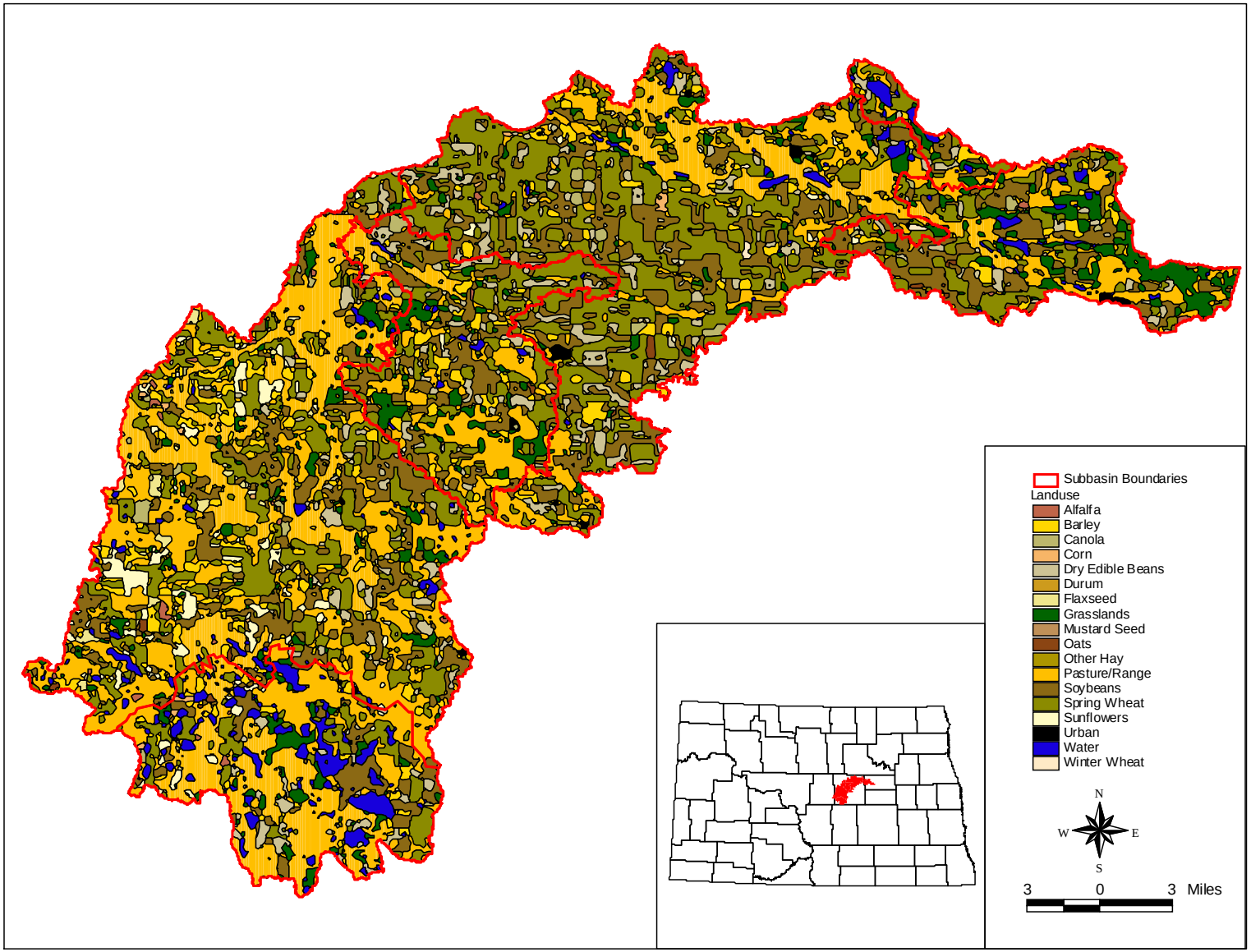


Figure 3. Level IV ecoregions in the project watershed

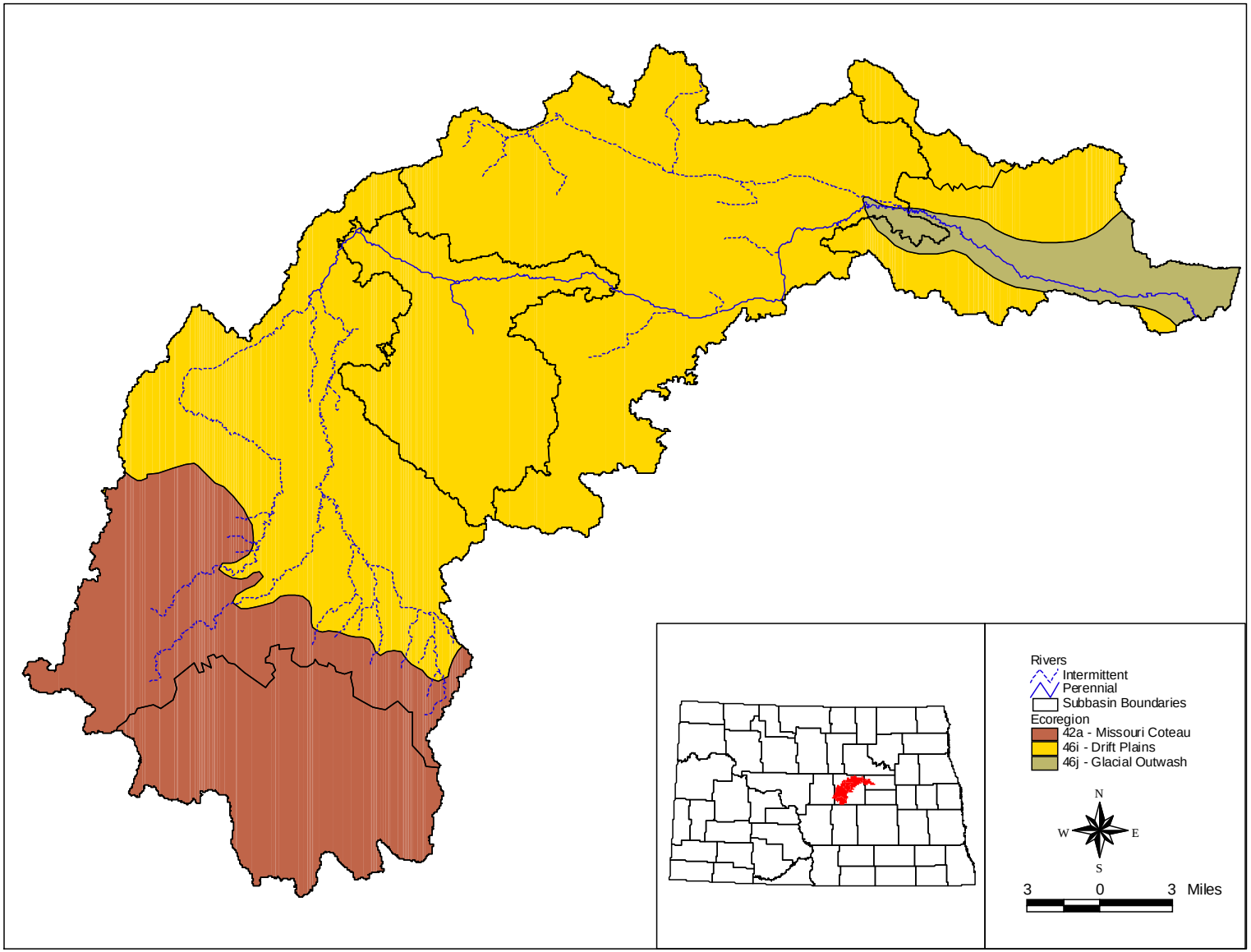


Figure 4. Location of sites in the project watershed samples for water quality in 1999 and 2000

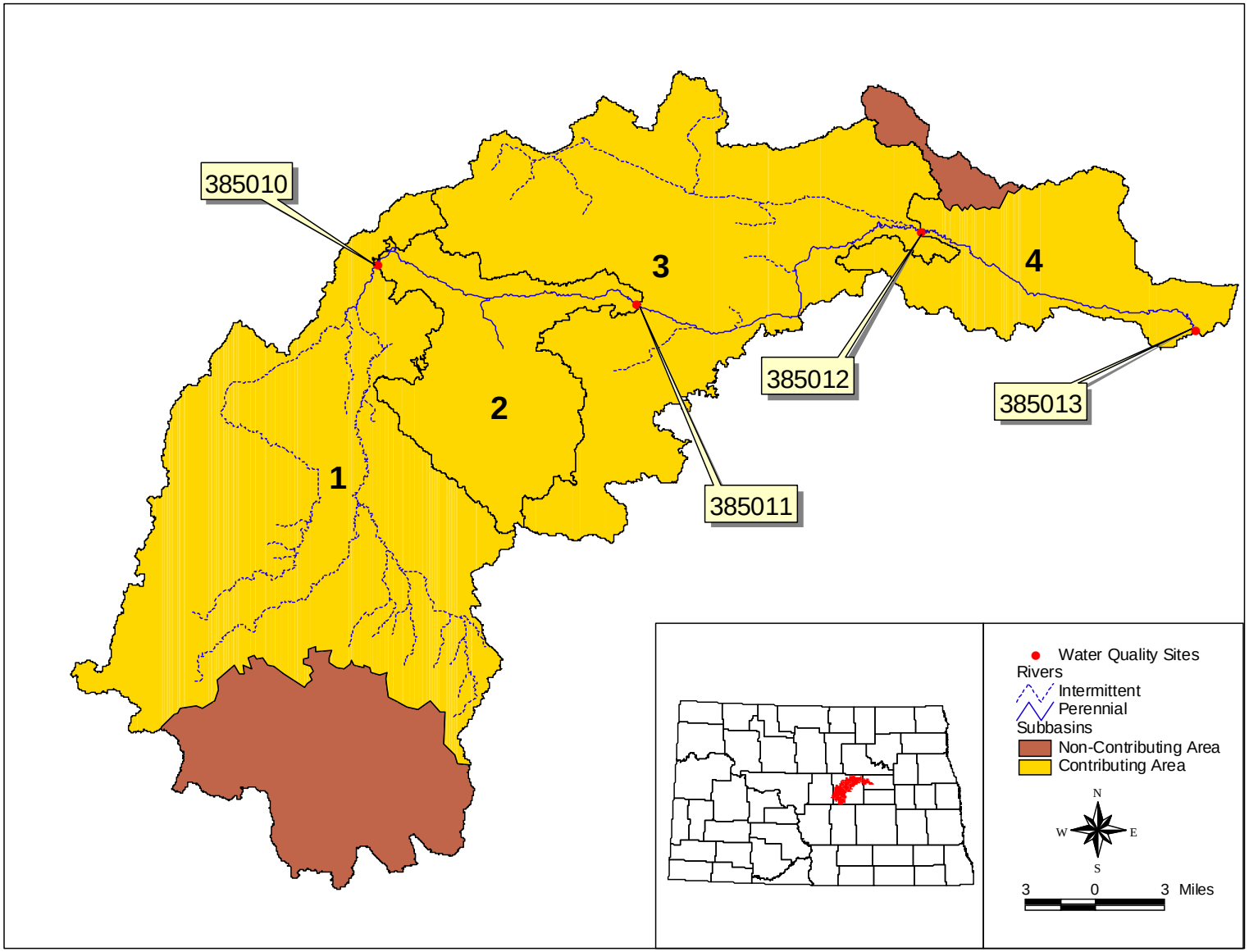


Figure 5. Location of sites in the project watershed sampled for macroinvertebrates in 1996

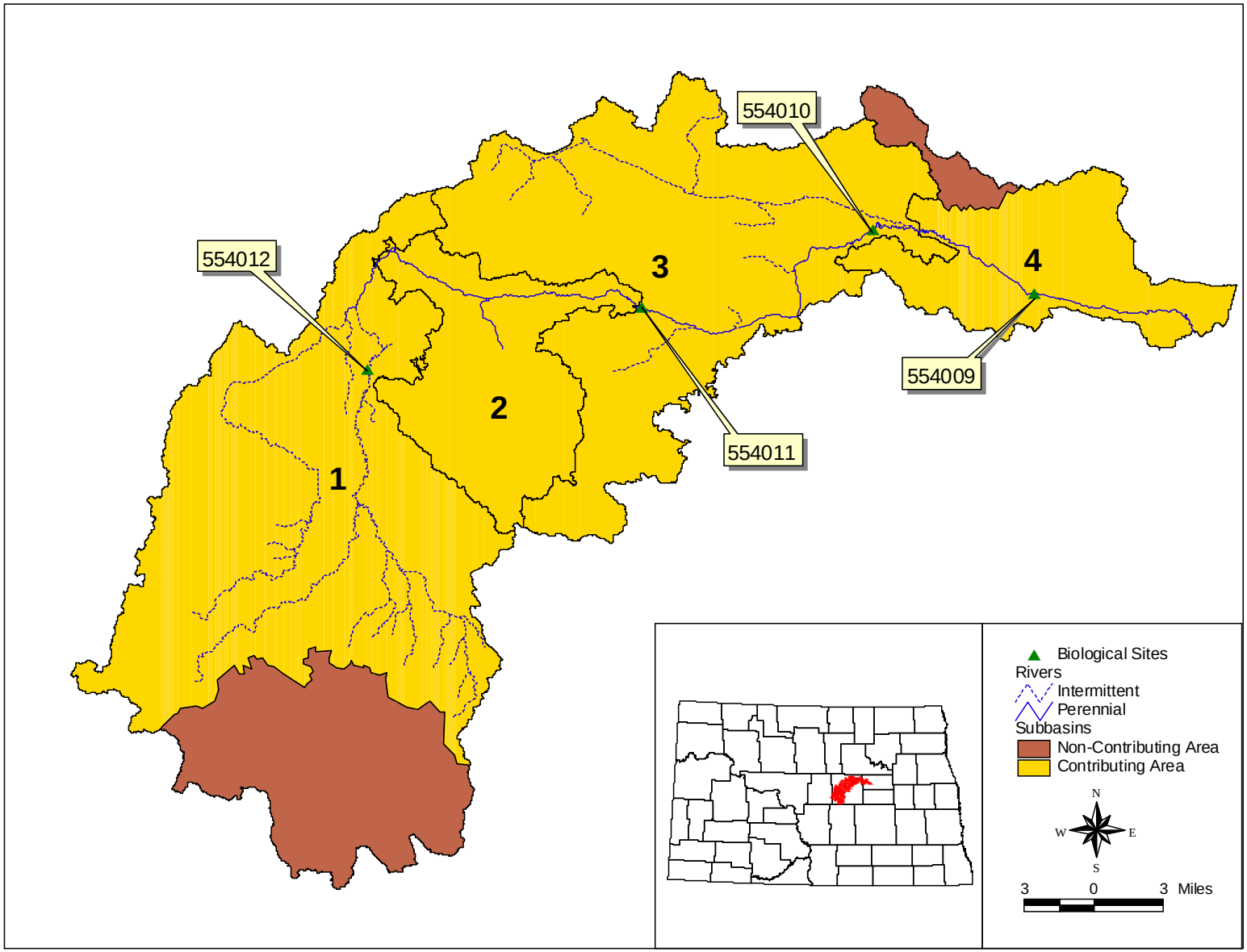


Figure 6. Percent deviation of monthly and annual precipitation totals from normal totals at the cooperative weather station in Fessenden, ND for 1999 and 2000 (normal based on records from 1971-2000)

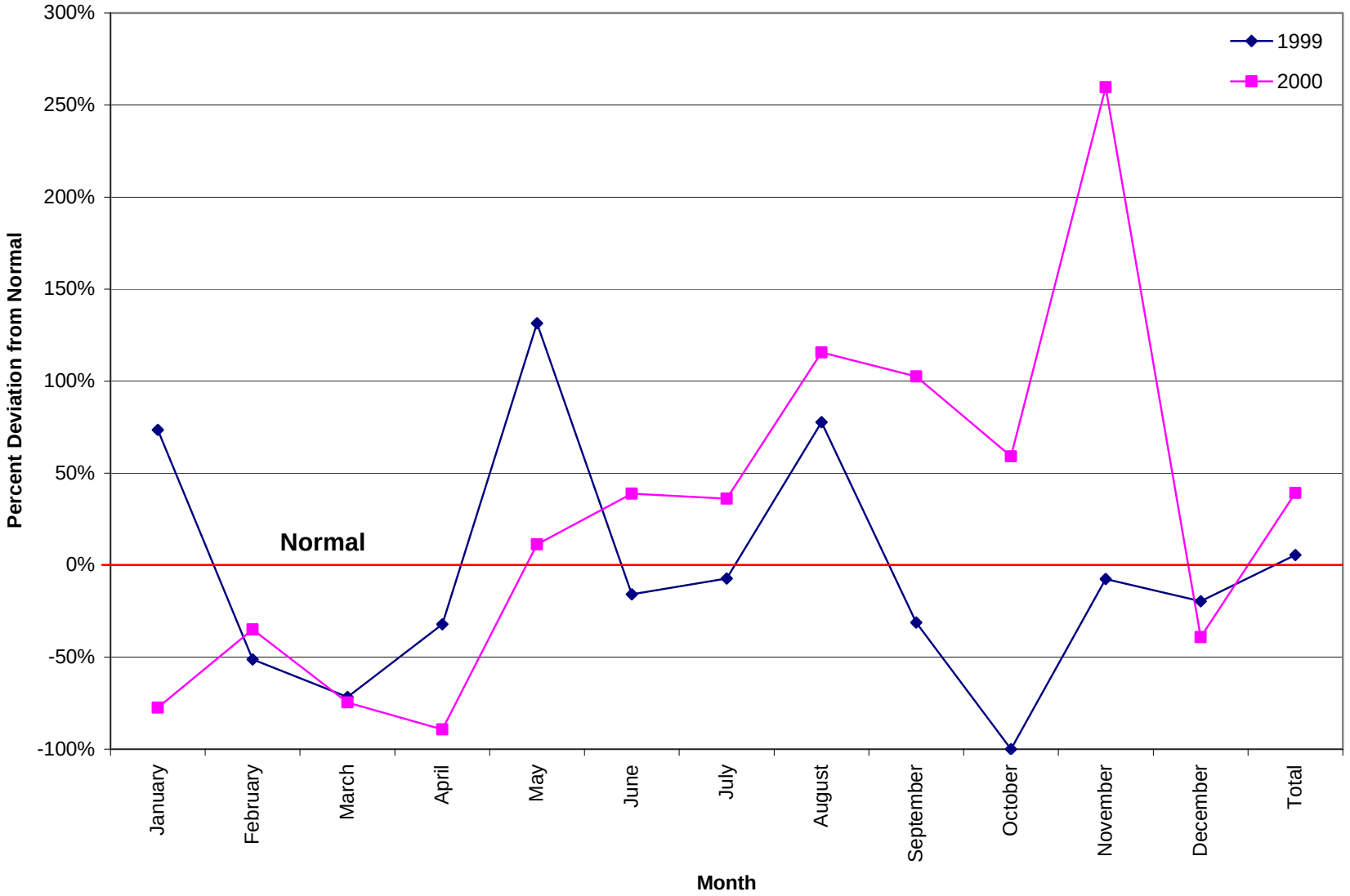


Figure 7. Mean monthly discharge for 1999, 2000, and the period of 1969 to 1998 at USGS site 06468170 James River near Grace City

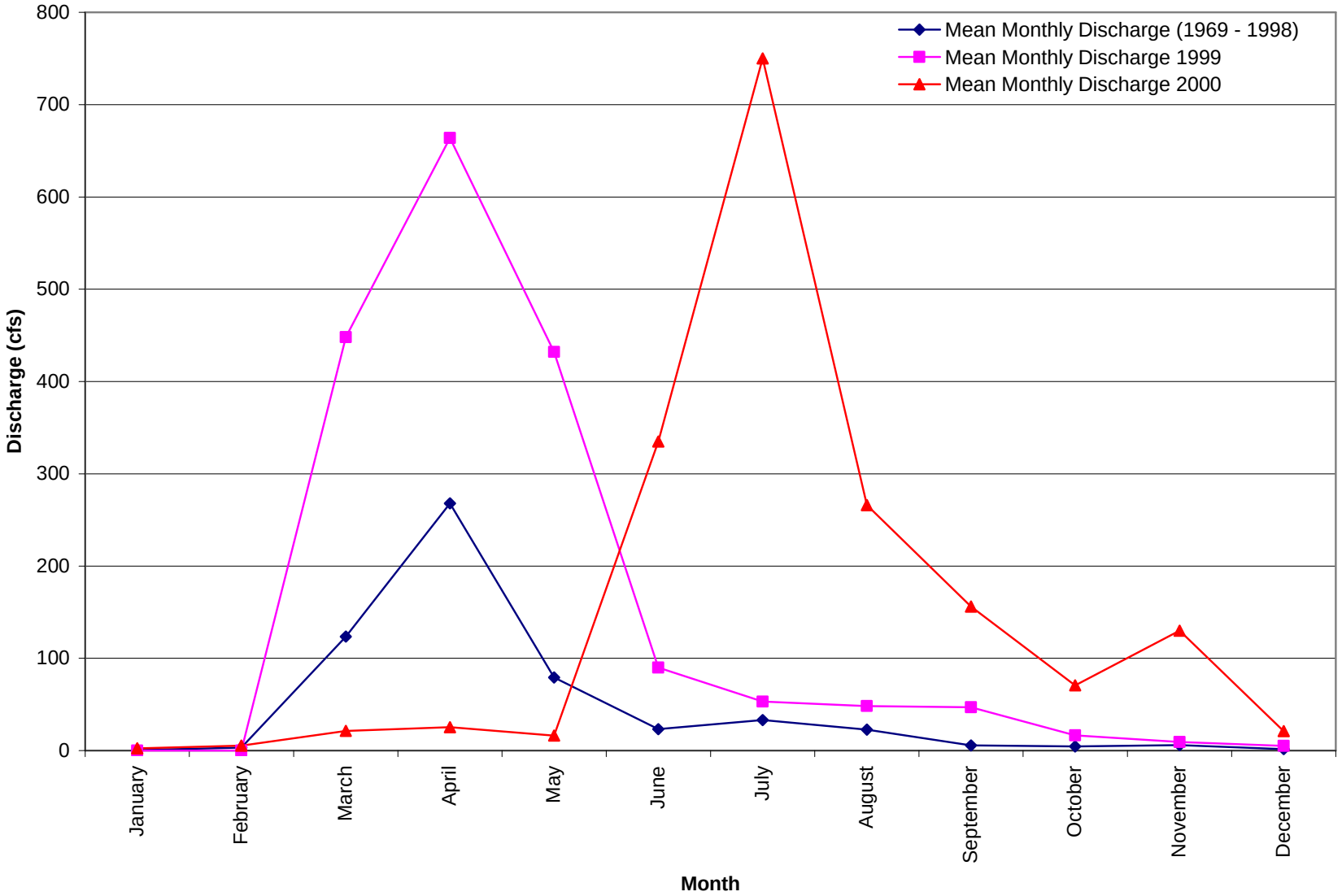


Figure 8. Total nitrogen concentrations at the water quality sampling sites for 1999 – 2000

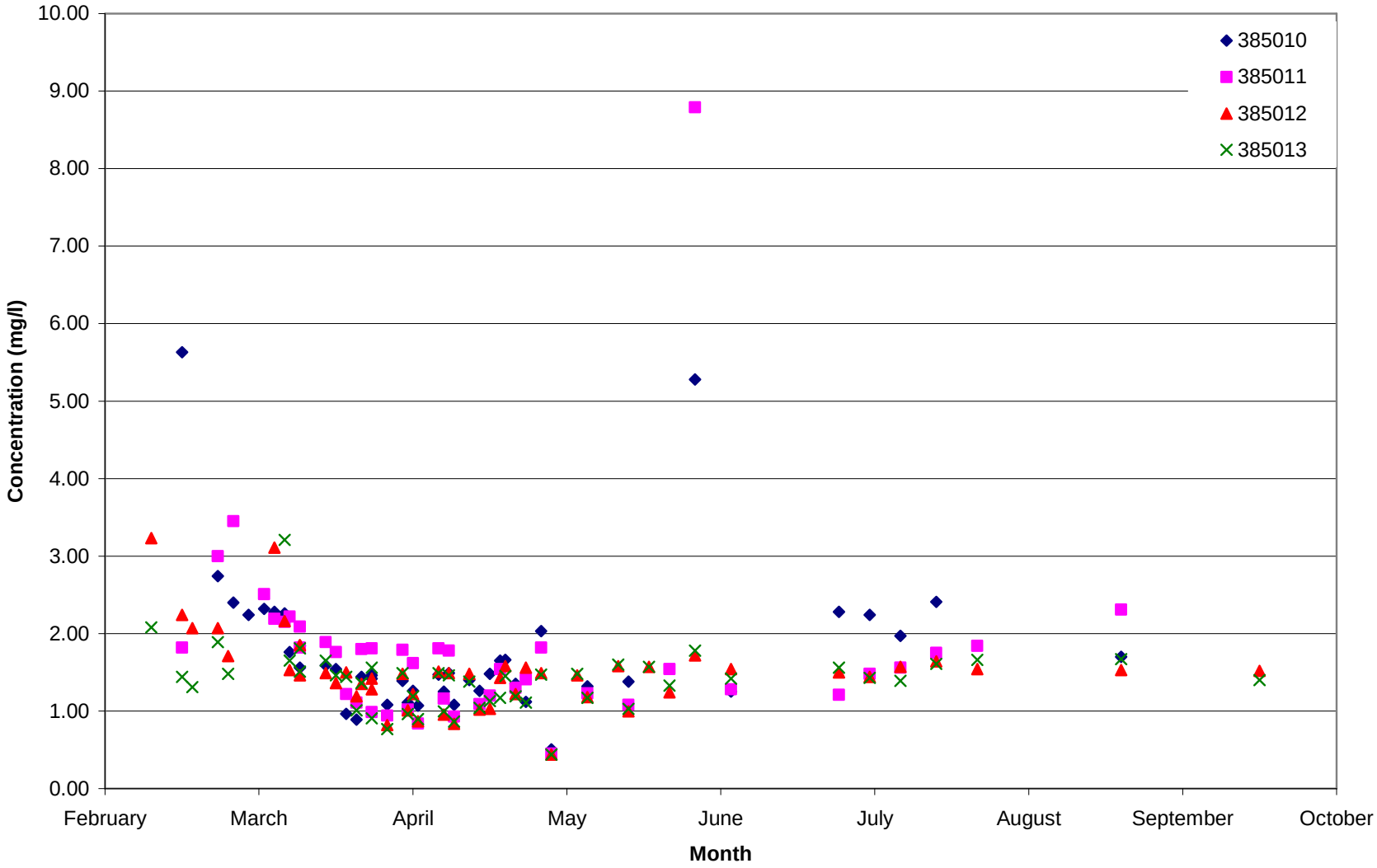


Figure 9. Total phosphorus concentrations at the water quality sampling sites for 1999 – 2000

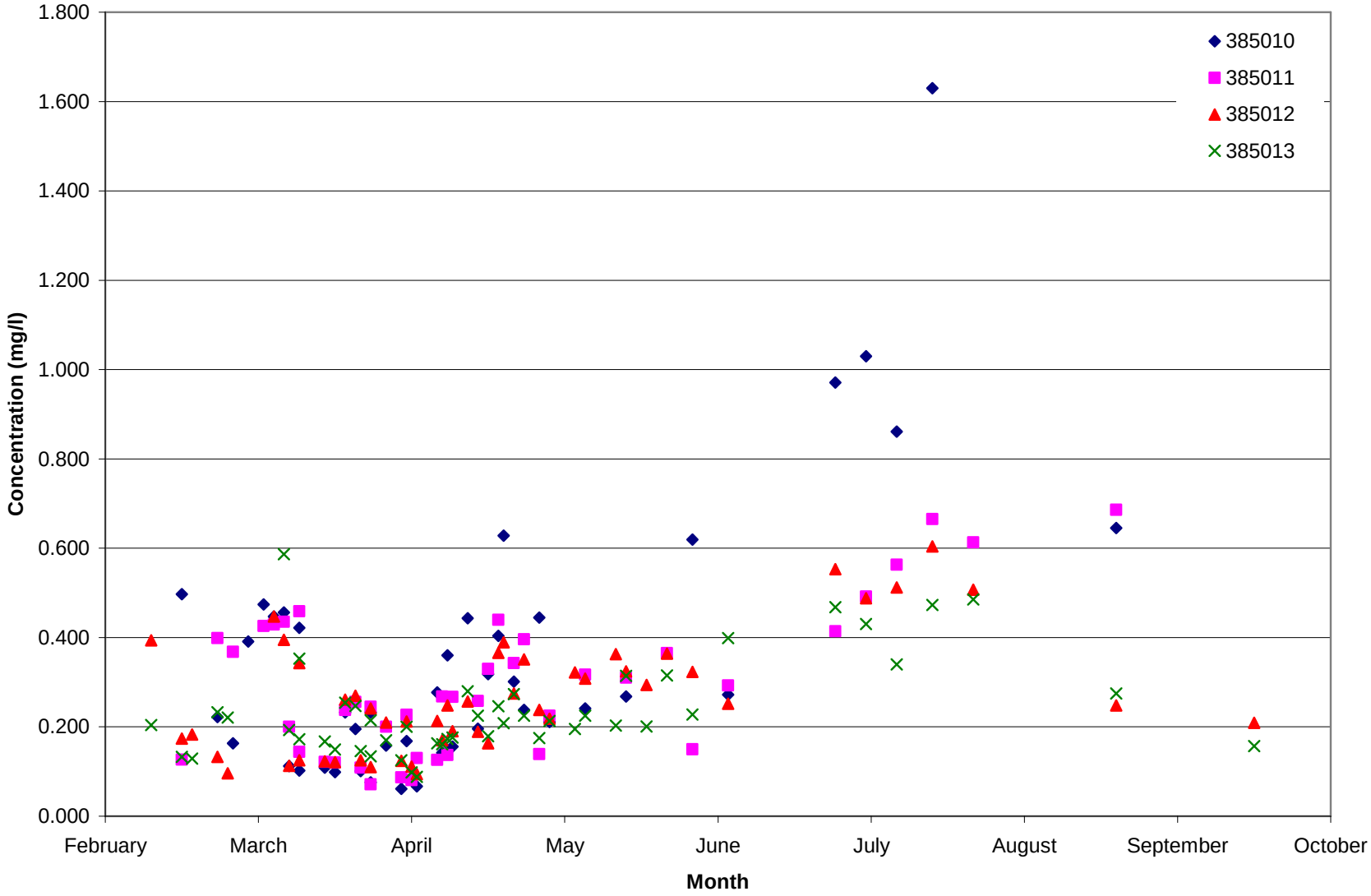


Figure 10. Total suspended solids concentrations at the water quality sampling sites for 1999 – 2000

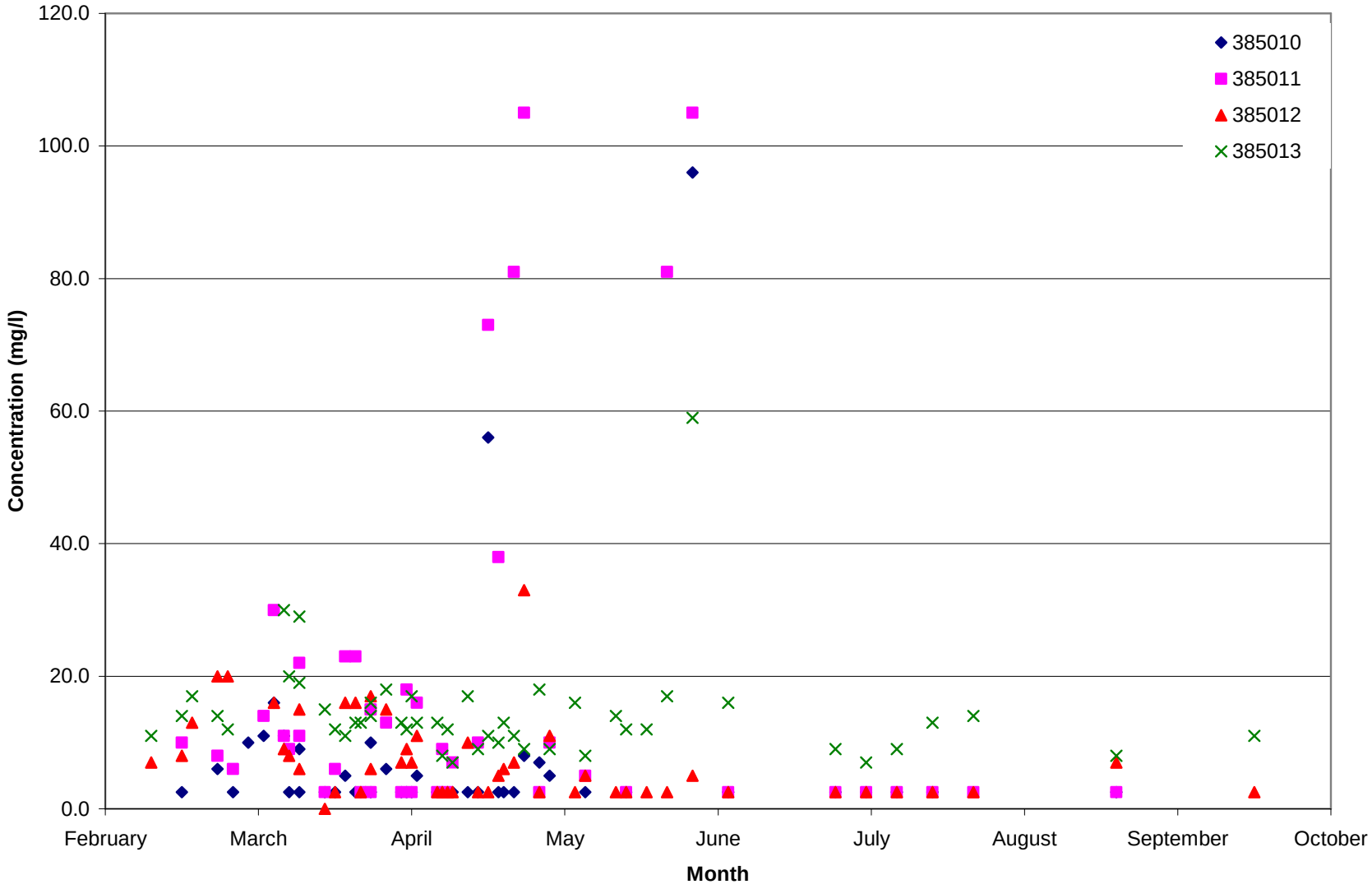


Figure 11. Fecal coliform bacteria concentrations at the water quality sampling sites for 1999 – 2000

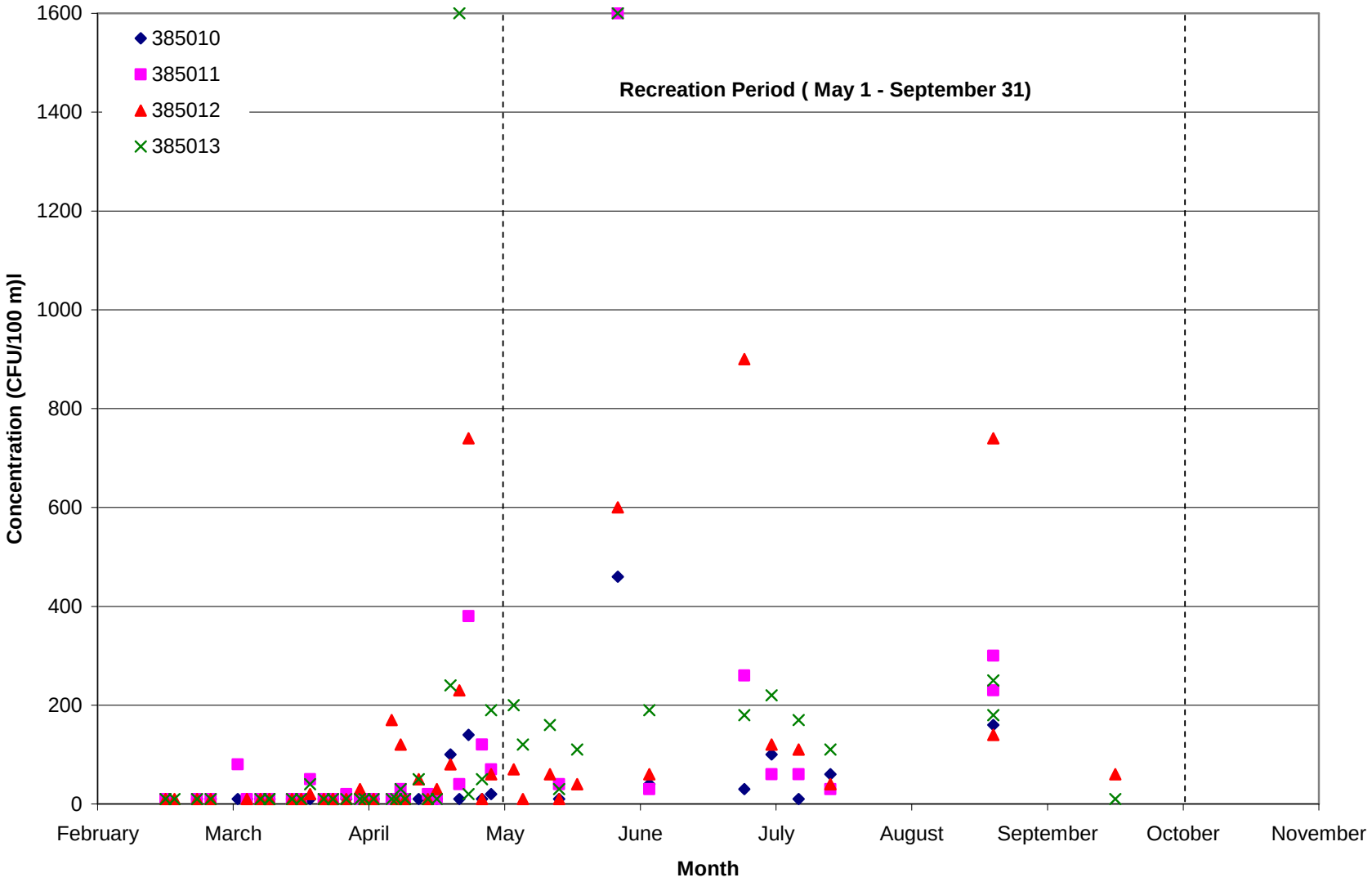


Figure 12. Soil and Water Assessment Tool (SWAT) modeled total nitrogen loads by subbasin for the project watershed

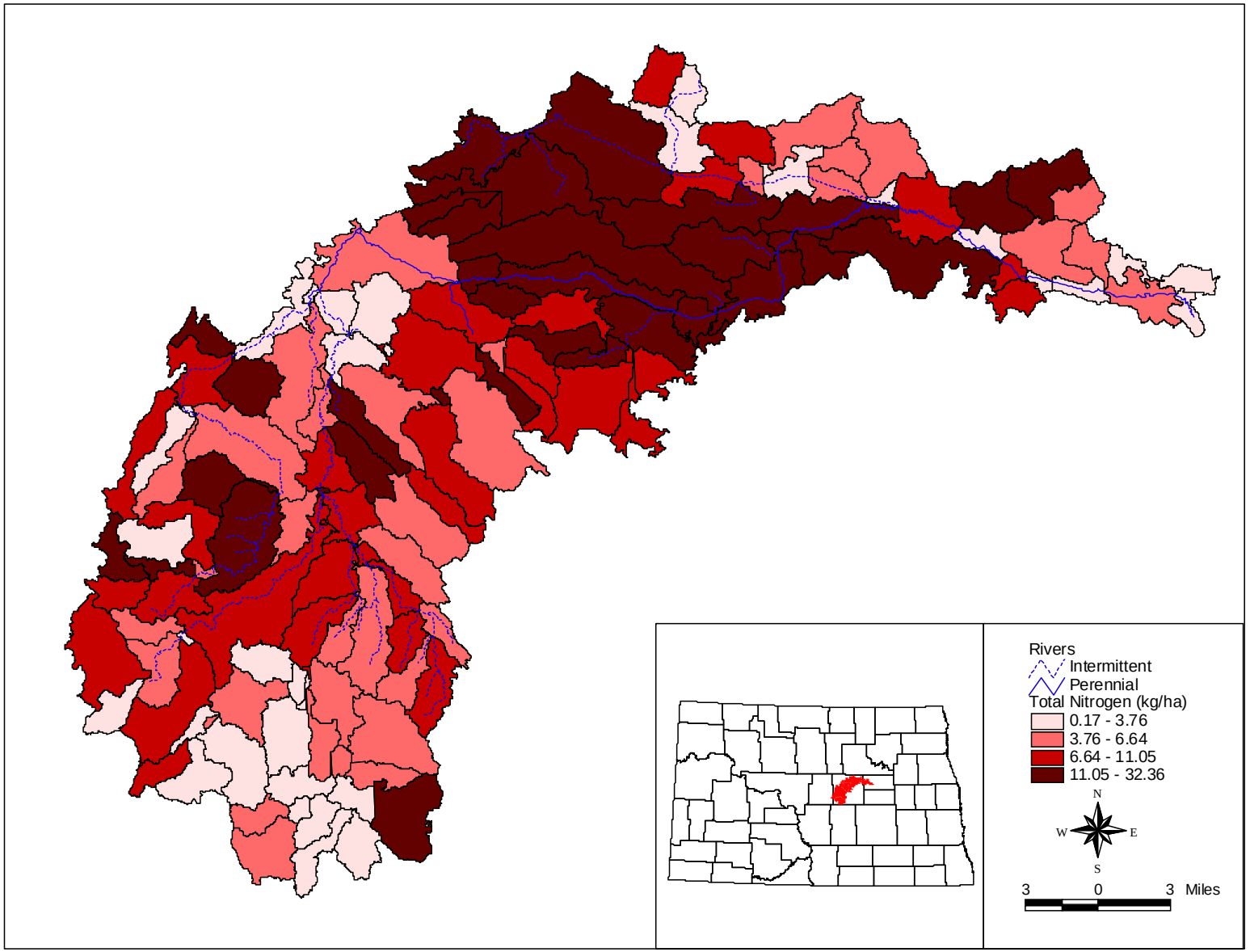


Figure 13. Soil and Water Assessment Tool (SWAT) modeled total phosphorus loads by subbasin for the project watershed

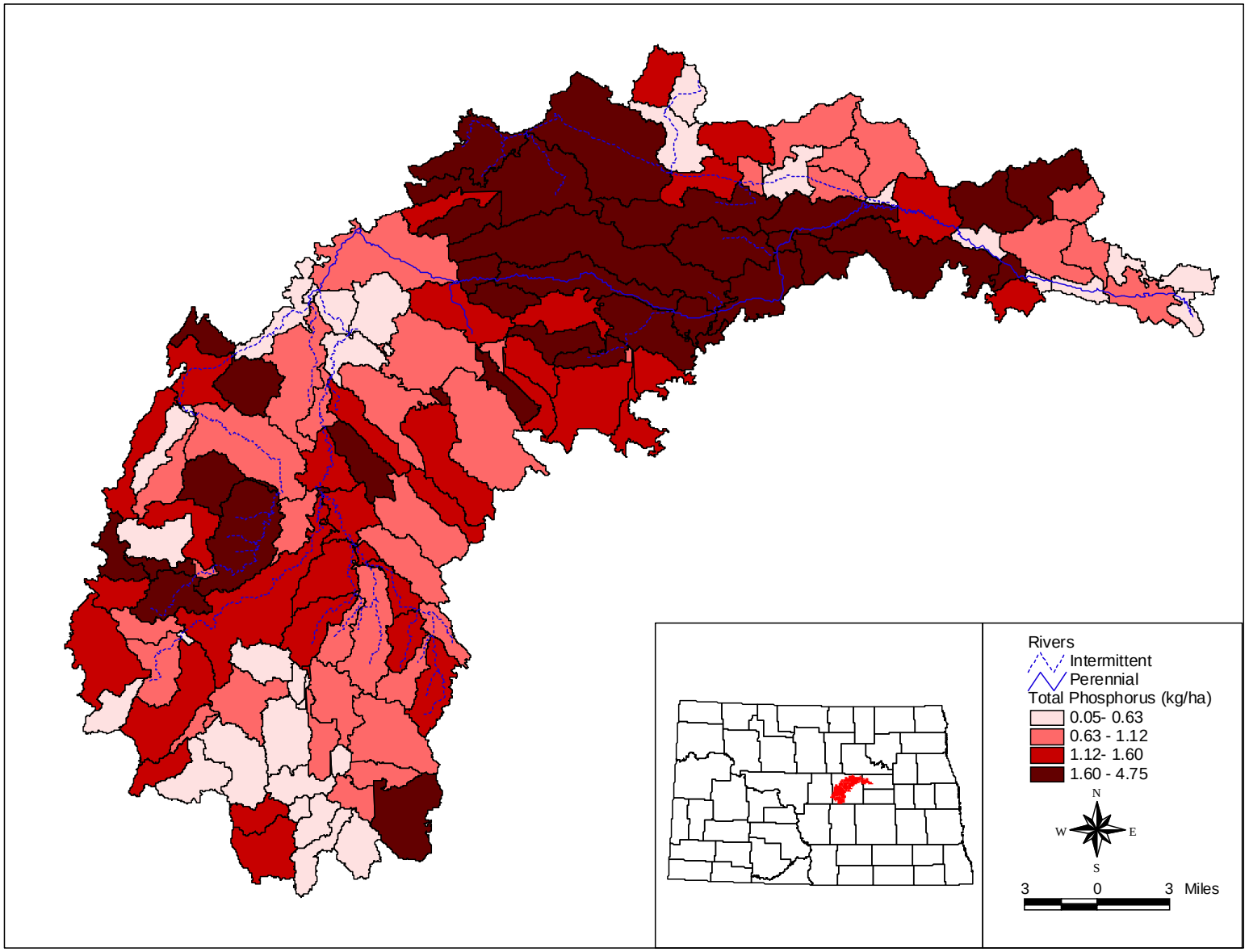


Figure 14. Soil and Water Assessment Tool (SWAT) modeled sediment loads by subbasin for the project watershed

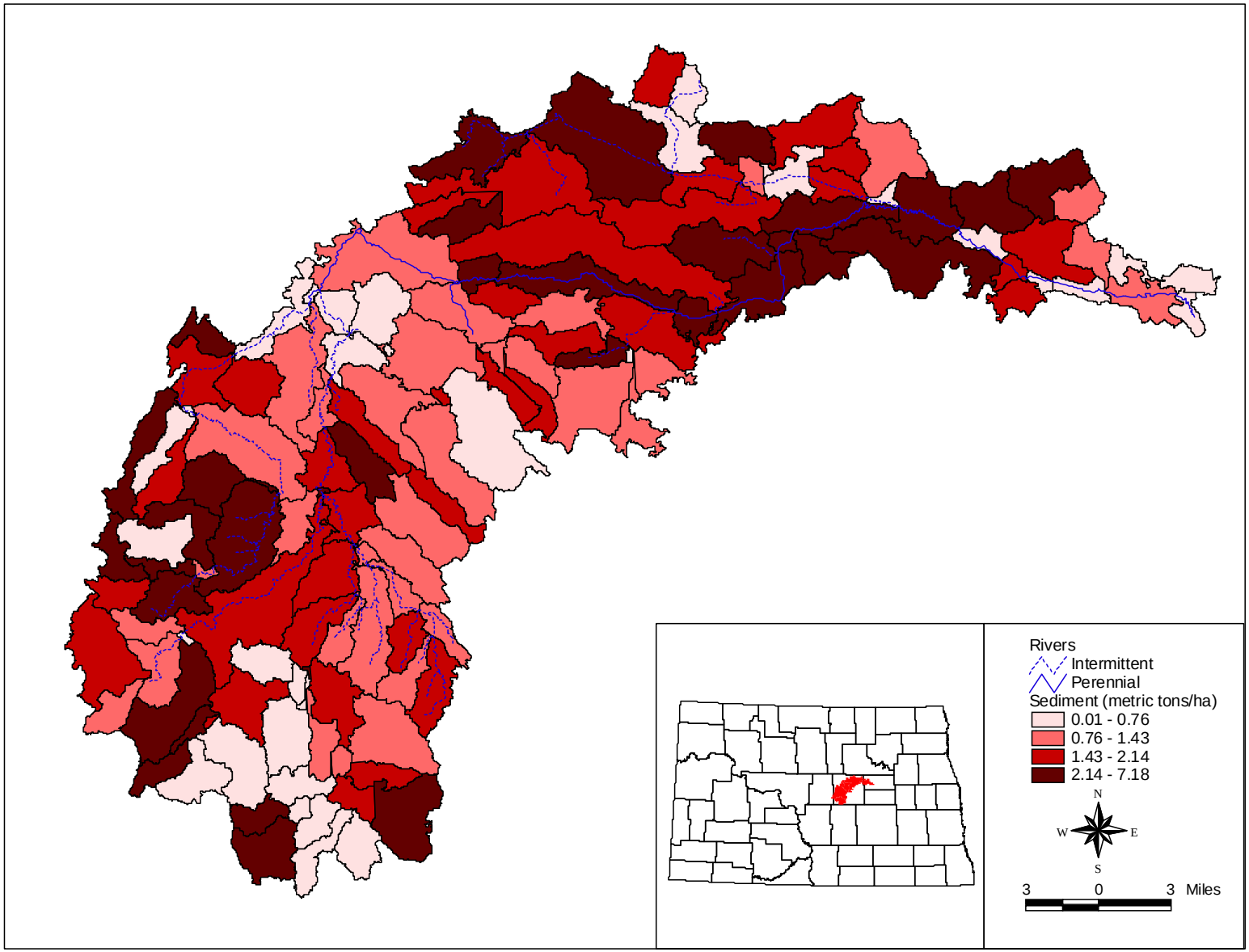


Figure 15. Reaches of the James River in the project watershed identified as having threatened recreation and aquatic life uses

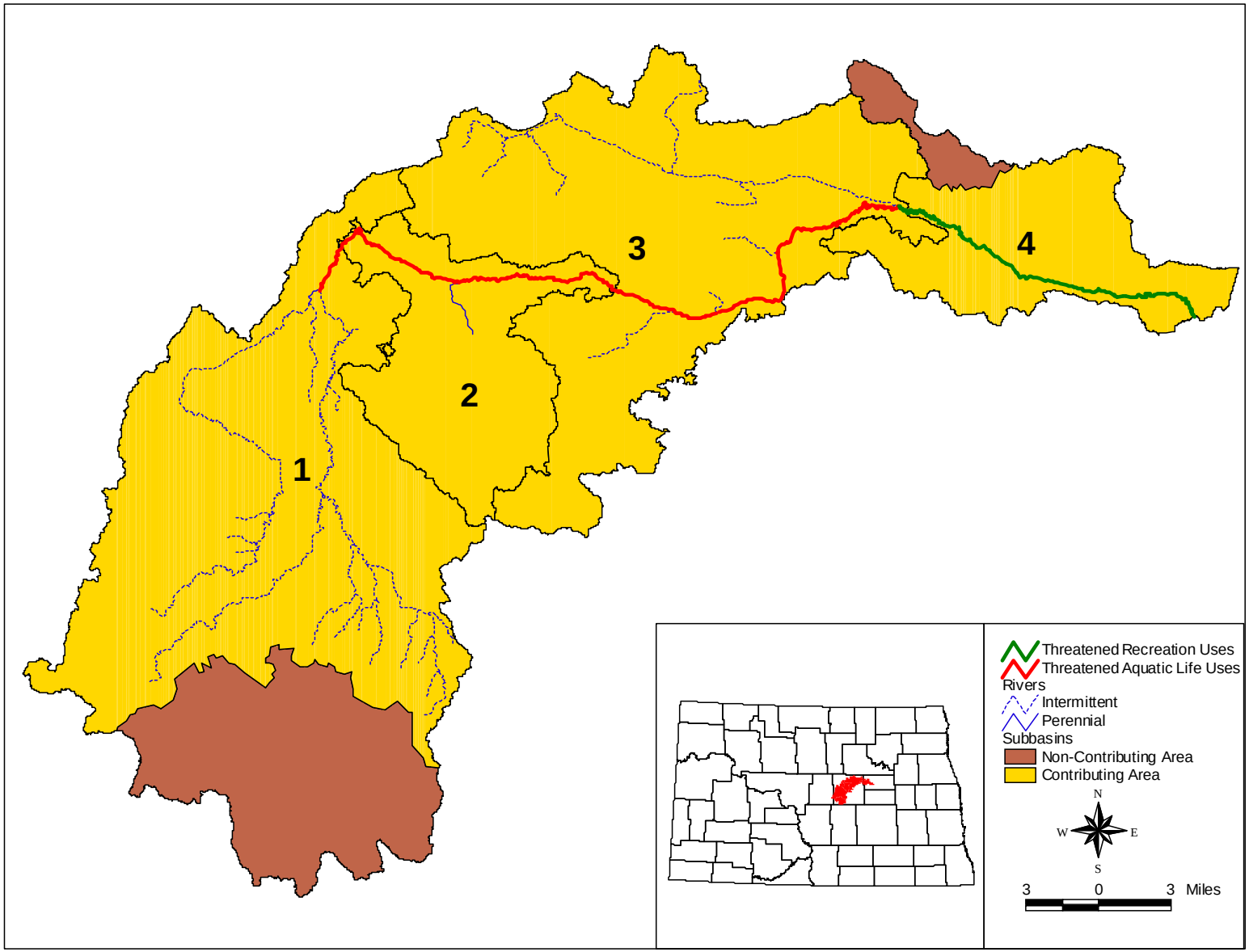


Figure 16. Location of permitted wastewater treatment plants in the project watershed

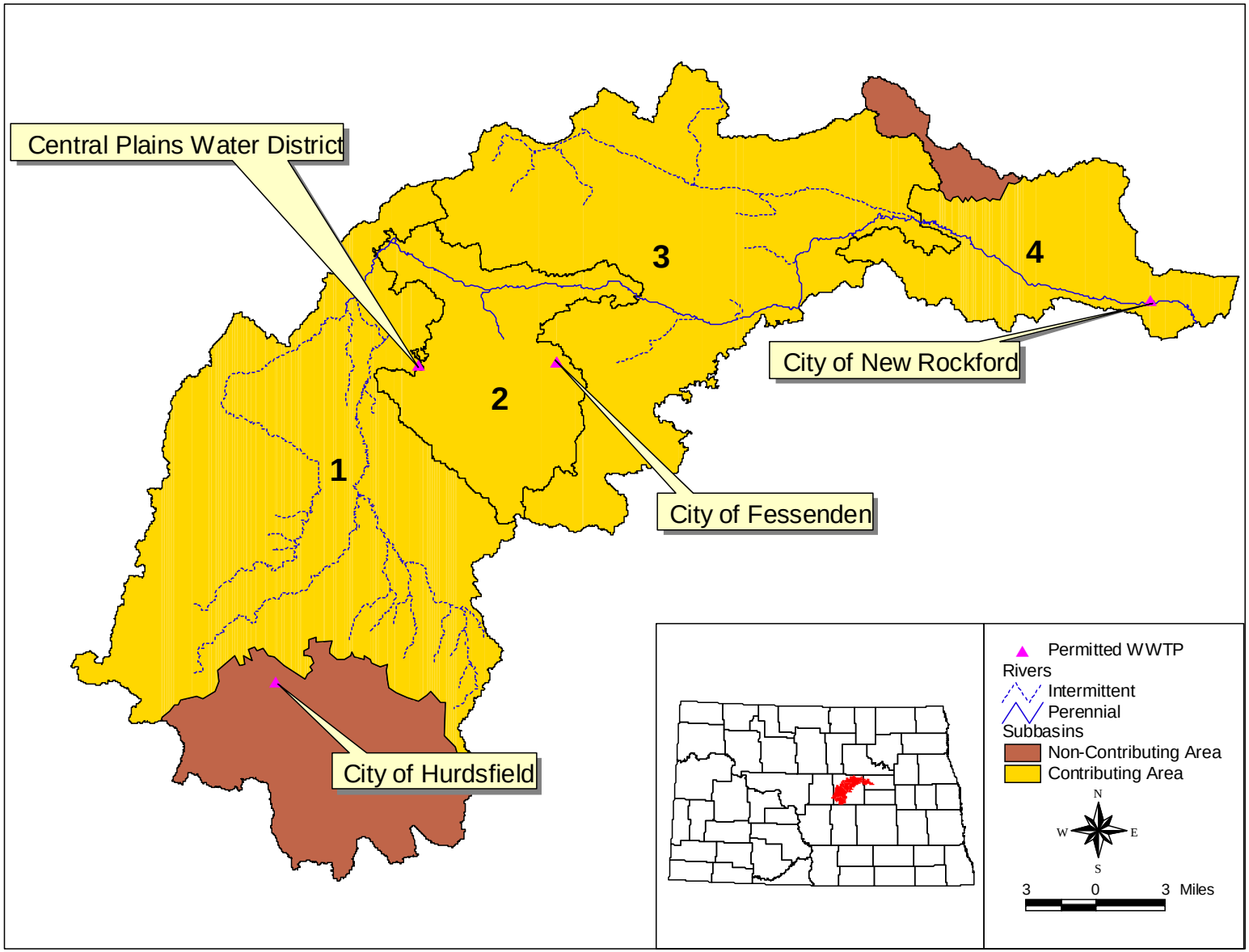


Figure 17. Location of impoundments on the James River in the project watershed

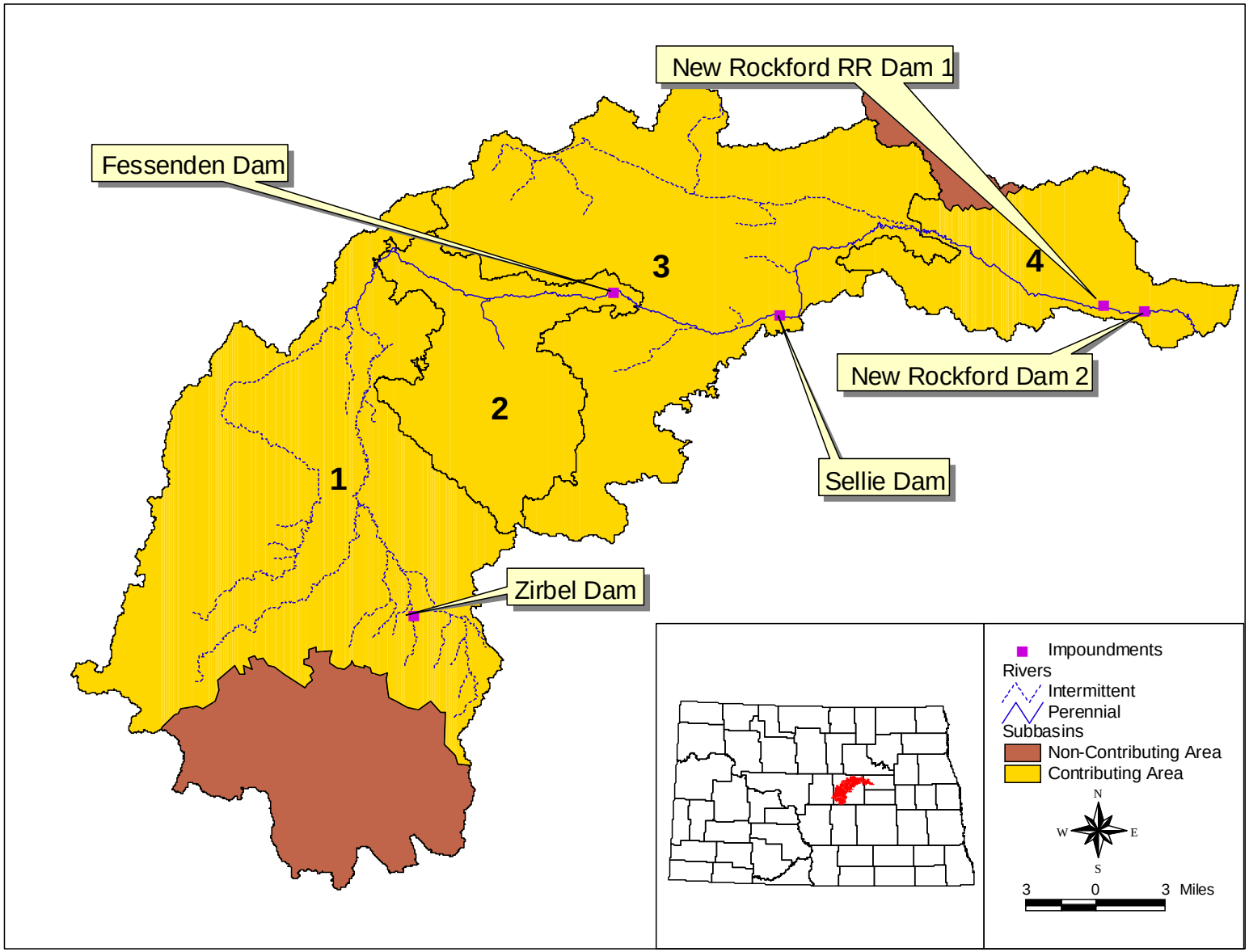


Figure 18. Subbasin ranking system based on the average percentile rank of Soil and Water Assessment Tool (SWAT) modeled total nitrogen, total phosphorus, and sediment loadings.

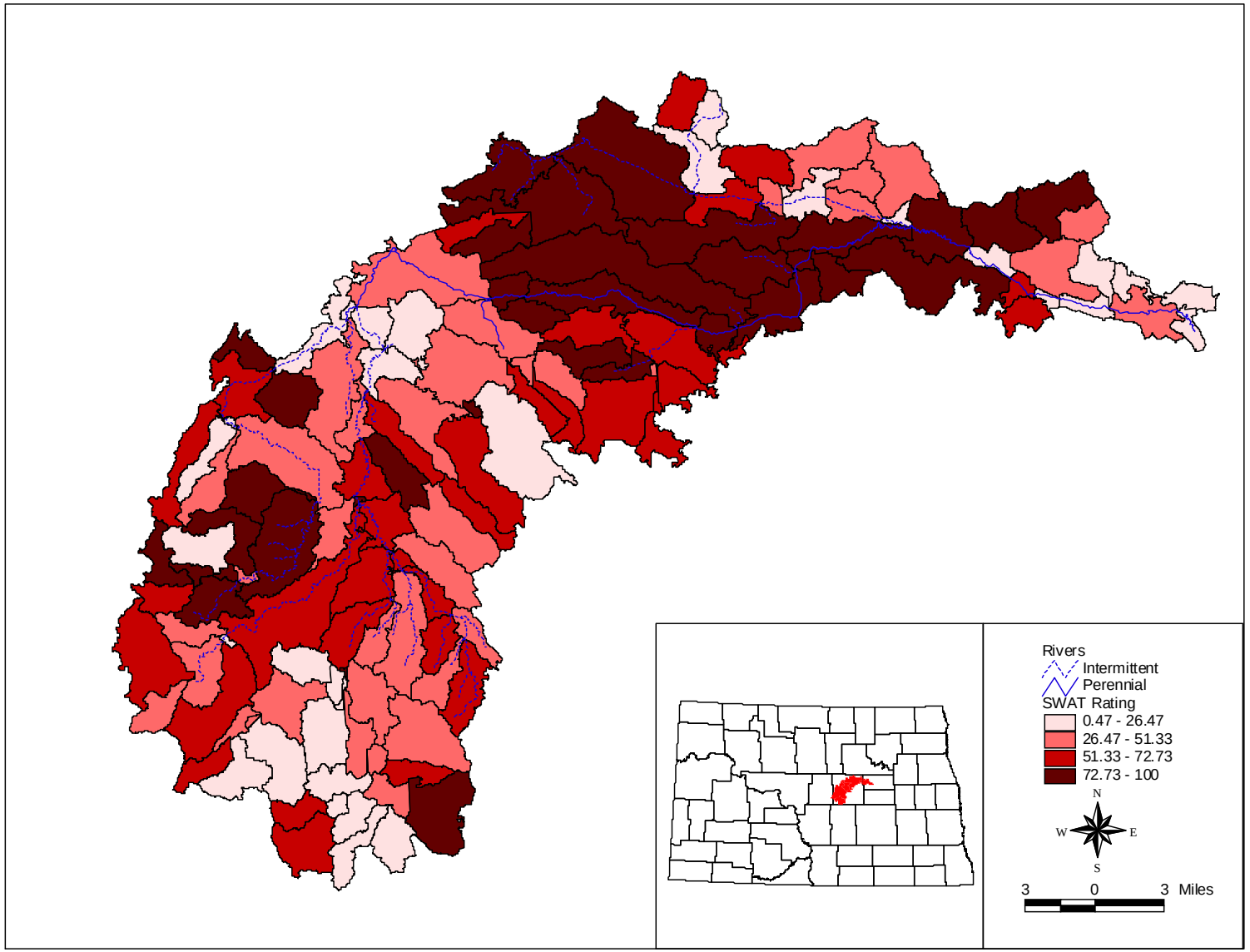


Figure 19. Priority areas for best management practice (BMP) implementation to address sources of stressors threatening aquatic life uses

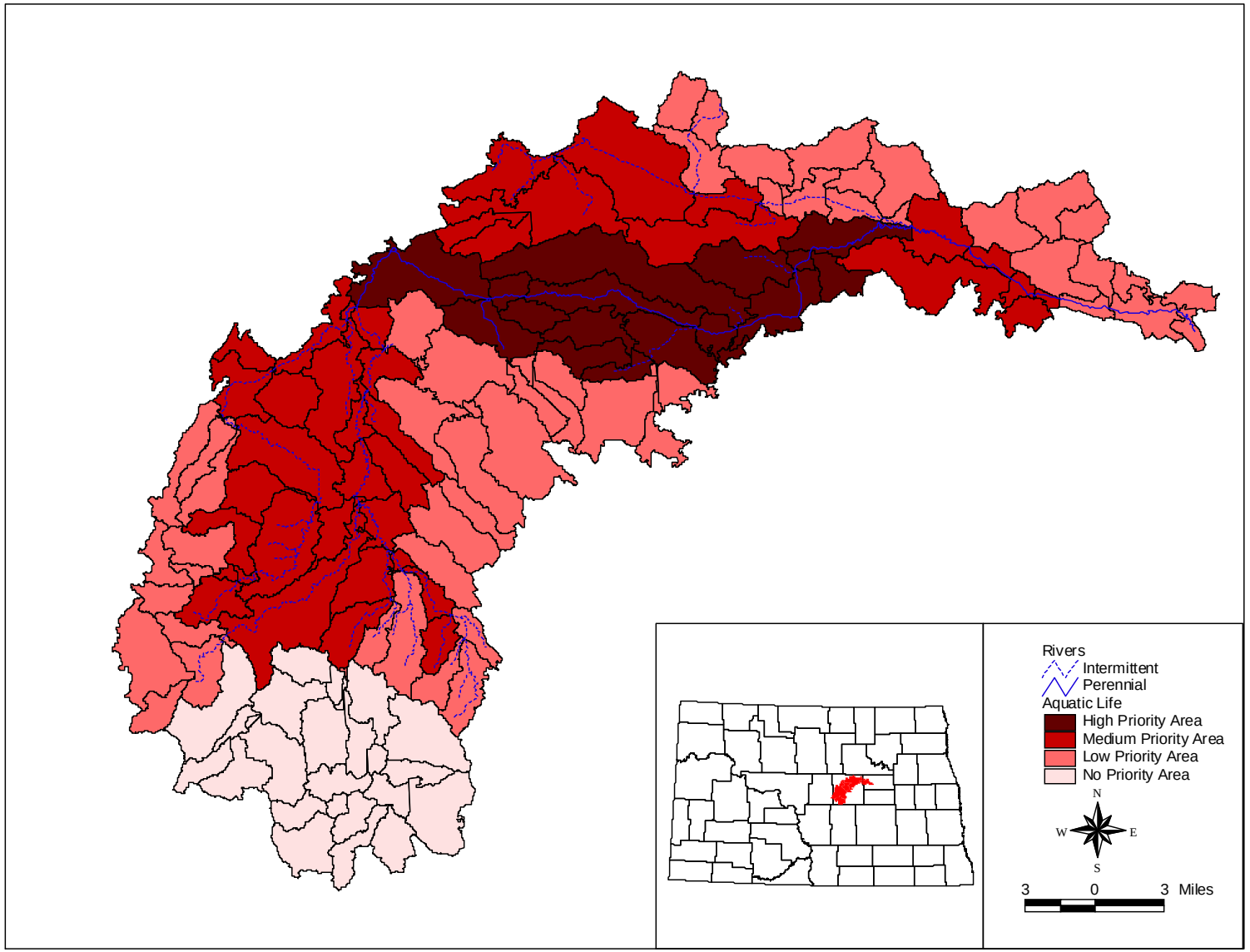
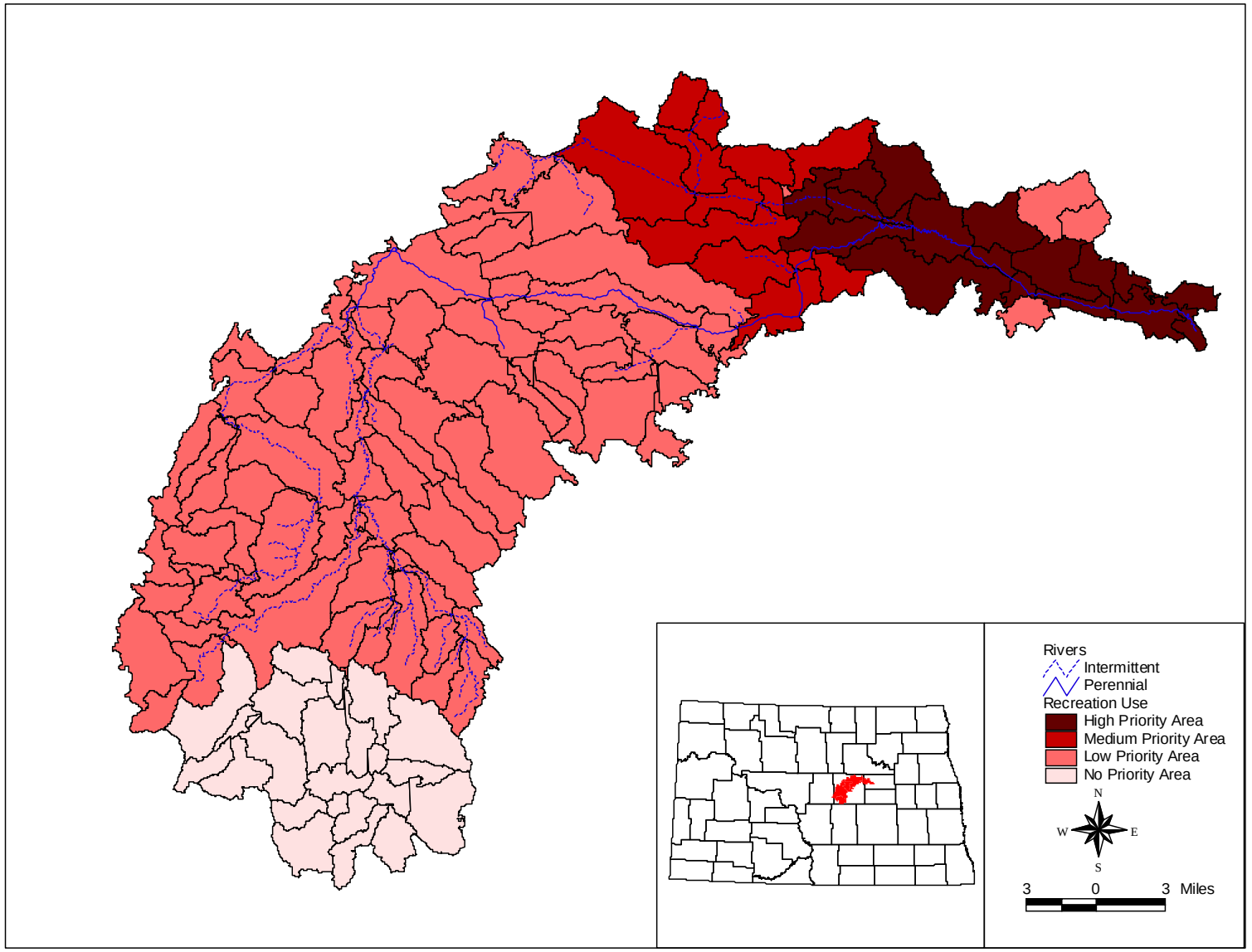


Figure 20. Priority areas for best management practice (BMP) implementation to address sources of stressors threatening recreation uses

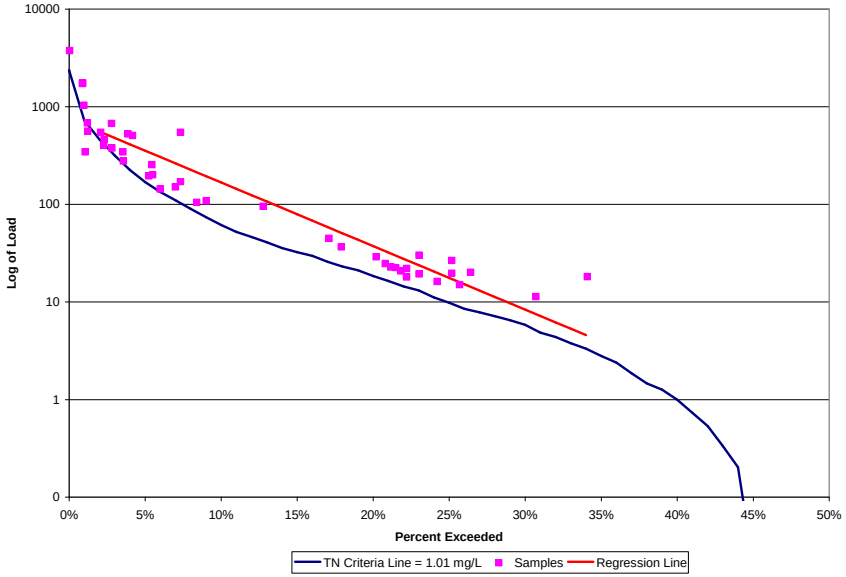


Appendix B
James River Sampling Analysis Plan

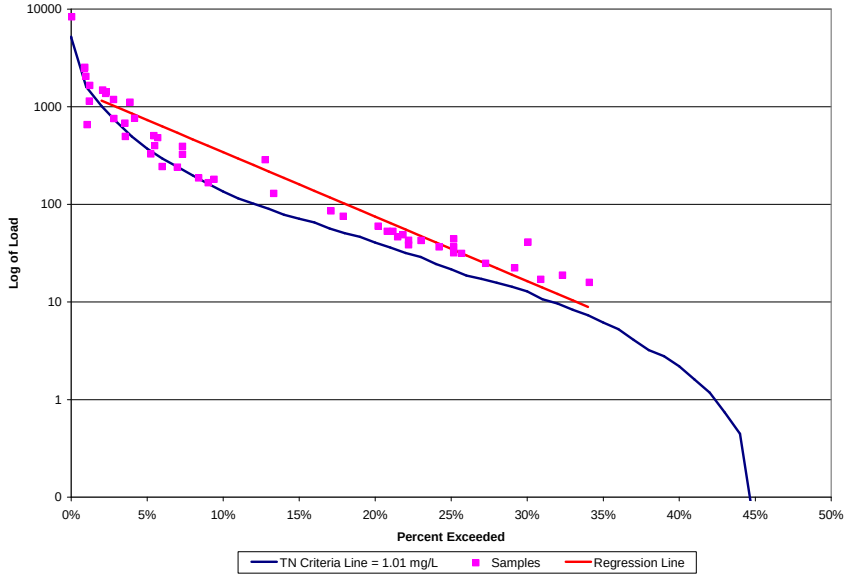
Appendix C
Load Duration Curves

Total Nitrogen

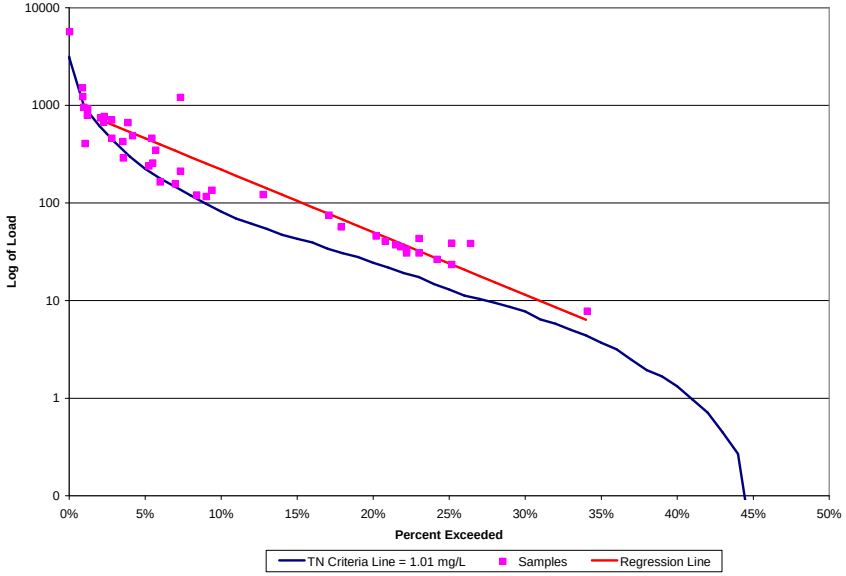
Site 385010



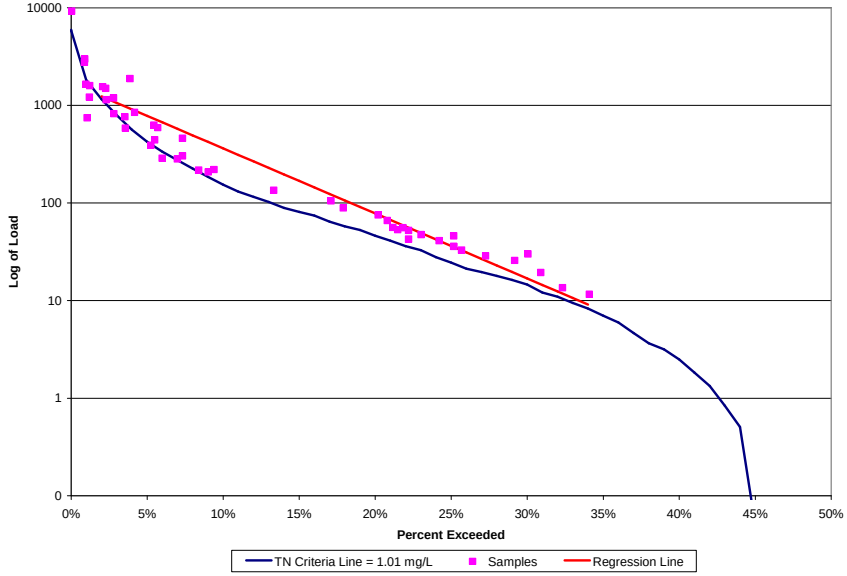
Site 385012



Site 385011

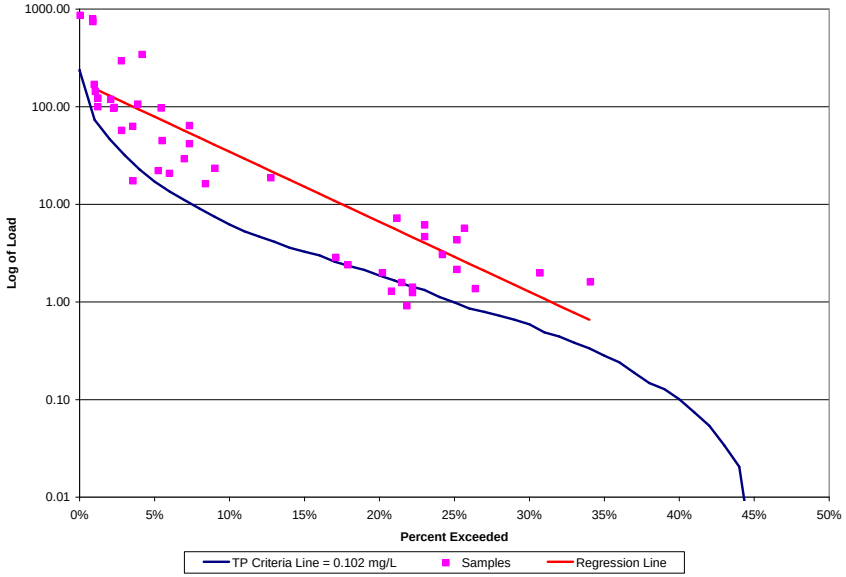


Site 385013

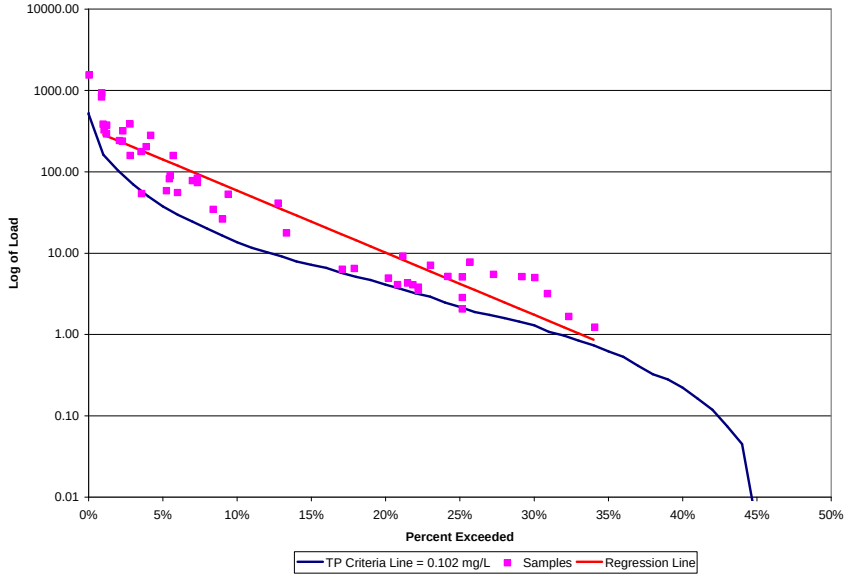


Total Phosphorus

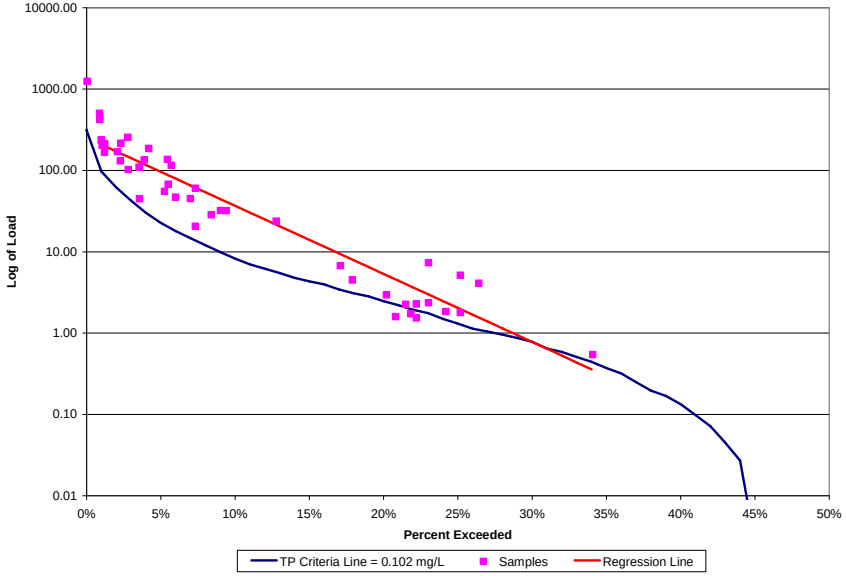
Site 385010



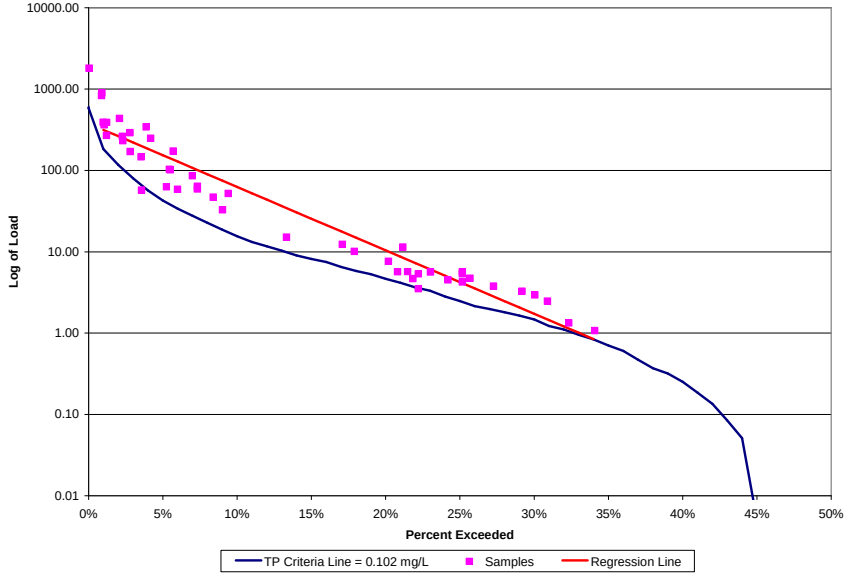
Site 385012



Site 385011

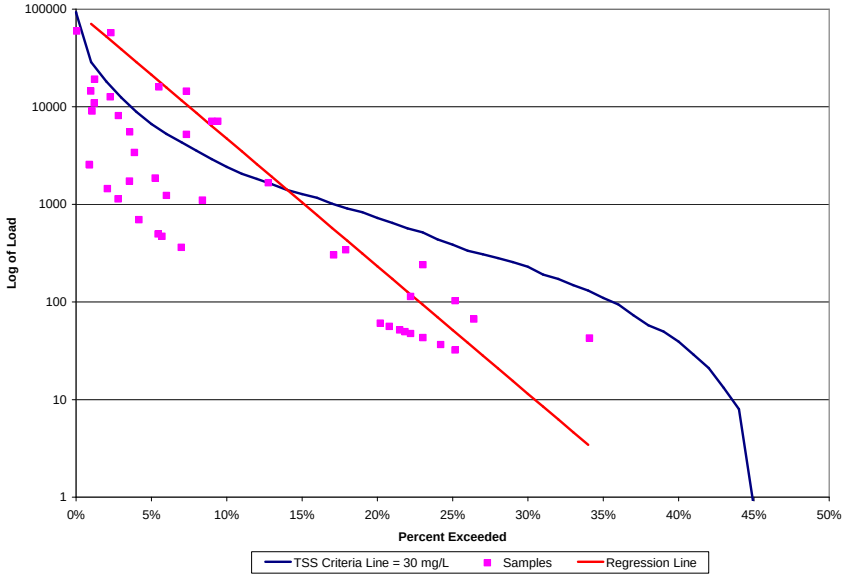


Site 385013



Total Suspended Solids

Site 385011



APPENDIX D

QUALITY ASSURANCE PROJECT PLAN

Quality Assurance Project Plan for the James River Headwaters Watershed Project Implementation Plan

Prepared for:
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And
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Bismarck, ND

Final November 2006

This quality assurance project plan (QAPP) has been to ensure that environmental and related data collected, compiled, and/or generated for this program/project are complete, accurate, and of the type, quantity, and quality required for their intended use. The work conducted will be in conformance with the Quality Management Plan (QMP) for the Department's Environmental Health Section (NDDH, June 2000) and with the procedures described in this QAPP. The QMP and this QAPP reflect provisions from the Environmental Protection Agency (EPA) entitled "EPA Requirements for Quality Assurance Project Plans" (March 2001).

Approvals:

_____	_____	_____	_____
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A. Project Management

A1. Project/Task Organization

This Quality Assurance Project Plan (QAPP) describes the quality assurance (QA) and quality control (QC) activities/procedures that will be used while collecting samples for the James River Headwaters Watershed Project Implementation Plan – Phase II (PIP). The purpose of this document is to describe the methods and procedures that will be used to collect physical, chemical, and biological samples and measurements for James River Headwaters in support of the James River Headwaters PIP and the quality assurance procedures that will be employed.

The US Environmental Protection Agency (EPA) Region 8 has provided funding for this project through the North Dakota Department of Health's (NDDH) Section 319 Non-Point Source (NPS) Pollution Management Program. The Project Officer for the US EPA is Roger Dean.

Overall organization for the North Dakota Department Health's (NDDH) Environmental Health Section (EHS) is detailed in the Quality Management Plan (QMP) for the Environmental Health Section (NDDH, June 2000)[1]. The Environmental Health Section is one of four sections in the Department. Within the EHS there are five divisions, including the Divisions of Air Quality, Municipal Facilities, Waste Management, Water Quality, and Chemistry. Martin Schock is the Quality Assurance Coordinator (QAC) for the EHS. The QAC is located in the EHS Chiefs Office and reports directly to the Chief of the EHS. The EHS Chief's Office through the QAC is responsible for oversight of the EHS's quality system for QA and QC as delineated in the QMP for the EHS, including approving project QAPPs. It is the policy of the EHS that the primary responsibility for QA resides among program staff and Designated Project Managers (DPMs) in each division, therefore each program is responsible for the preparation, implementation, and assessment of its QAPP(s).

Within the EHS, the Division of Water Quality is organized in three programs, the North Dakota Permit Discharge Elimination System (NDPDES) Program, the Groundwater Program, and the Surface Water Quality Management Program (SWQMP). The James River Headwaters Watershed PIP is the responsibility of the SWQMP. The organization structure for the James River Headwaters Watershed PIP is outlined in Figure 1.

[1] This QAPP was prepared according to the EHS's QMP, which has been approved by EPA.

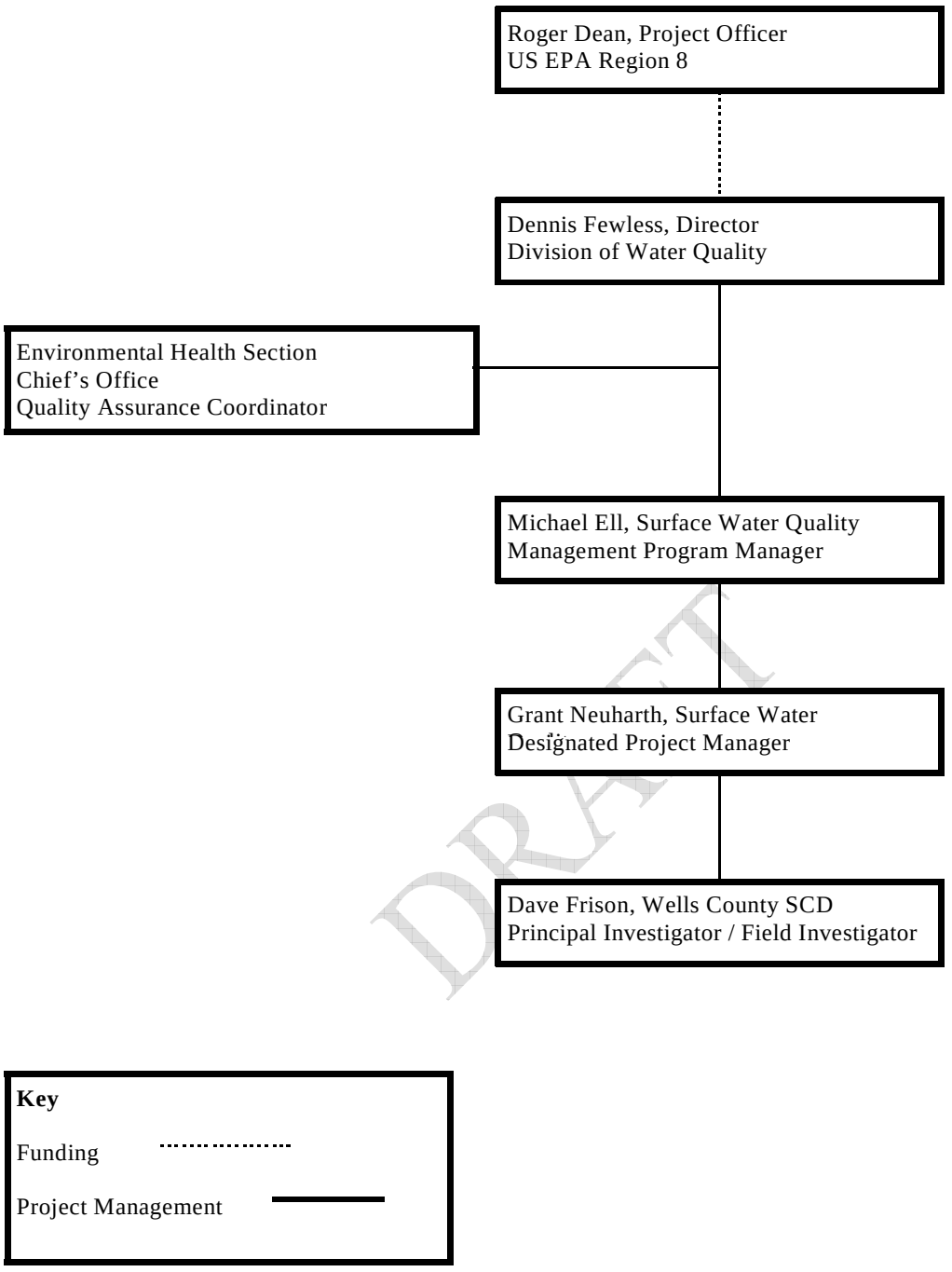

Figure 1. Organizational Diagram for the James River Headwater Watershed PIP

Michael J. Ell is Program Manager for the SWQMP. As Program Manager in the SWQMP he has the following responsibilities:

- review and edit the QAPP;
- providing oversight for study design, site selection, and adherence to design objectives;
- reviewing and approving the final project workplan and other materials to support the project (e.g., standard operating procedures);
- selecting appropriate project subcontractors, as needed; and
- coordinating with contractors, reviewers, and US EPA to ensure technical quality and contract adherence.

Grant Neuharth is an Environmental Scientist with the SWQMP and is the Designated Project Manager (DPM) for the James River Headwaters Watershed Project. As such, he is responsible for overall project coordination and supervision, including the reduction and analysis of project data and the preparation of the final report. For purposes of this project, project implementation has been contracted to the Wells County Soil Conservation District (SCD). The Wells County SCD will determine the principle investigator to be assigned to the project and the principle investigator will be responsible for day-to-day project oversight, data collection and sample custody. The SWQMP and the Wells County SCD will be responsible for data interpretation and report preparation.

A2. Problem Definition Background

A2.1 Background Information

The James River headwaters (HUCs: 10160001-010, 020, 030) are located in central-east central Wells County and west-central Eddy County, North Dakota. This sub-watershed area of the James River is listed in the FY 1999 North Dakota Unified Watershed Assessment as a Category I watershed (watersheds in need of restoration) with medium priority. The James River watershed ranked 20th out of 42 Category I hydrological unit areas (HUA) with a total score of 90.0 out of a possible 150 points.

The watershed area encompasses 407,268 acres in Wells and Eddy counties. Approximately 344,559 acres are located in Wells County and 62,709 acres in Eddy County. With the exception of 6440 acres (2760 acres Federal and 3680 acres owned by the State of North Dakota), the remaining acres in the James River Headwaters Watershed are in private ownership. This project will address only the 344,559 acres located in Wells County.

The James River headwaters are ephemeral / intermittent 1st – 4th order streams with peak flows during spring runoff and major rainfall events. The precipitation in the watershed averages 18 inches annually with 70% of it occurring during the growing season (May through September).

Based on the State Water Quality Standards (February 1, 1991), the James River has a stream classification of IA. Standards of water quality for North Dakota states that all tributaries not specifically mentioned are classified as Class III streams; therefore the James River Headwaters are identified as Class III streams. As Class III streams, the beneficial uses of James River Headwaters are aquatic life, recreation, industrial, and agriculture. Designated beneficial uses for Class IA streams are aquatic life, recreation, industrial, and agricultural. In addition, the quality of Class IA streams shall be such that they can be used for a municipal water supply after treatment. The James River headwaters and the James River are subject to the same physical and chemical criteria as a Class IA stream.

The topography of the James River Headwaters Watershed project area is level to undulating hills with slopes averaging 1 percent to 8 percent. The area adjacent to the James River channel is characterized by rolling hills with slopes of up to 4 percent in the lowland areas to more than 20 percent in the Bremen area. The James River has a drop of less than 3 feet per mile and is entrenched as much as 35 feet in the areas south of Bremen. The elevation of the watershed ranges between 2,000 feet above sea level in the southwestern part of the watershed to 1,425 feet on bottom lands in the northeastern corner where the James River exits the county (Seago 1970).

The average size per farm unit is 1,500 acres. Most operating units are diversified and raise small grains, row crops and livestock. Most acres are intensively farmed leaving little or no residue over winter. A typical rotation is one year small grain followed by soybeans or dry beans, corn, flax or canola, etc. Grazing practices are typically season long.

A2.2 Problem Definition

Agricultural nutrients (nitrogen and phosphorous), total suspended solids and fecal coliform bacteria are the primary pollutants impacting and threatening the beneficial uses and long-term water quality of the James River headwaters and downstream water. Beneficial uses being threatened are aquatic life and recreation.

The land use in the watershed project area is as follows:

Cropland	- 193,987 acres
Range / Pastureland	- 96,477 acres
CRP	- 28,253 acres
Water area	- 13,782 acres
Urban	- 4,135 acres
Farmsteads, roads, misc.	- 7,925 acres

Local NRCS personnel have estimated that the average annual soil loss of 4 tons per acre watershed wide. Based on the Revised Universal Soil Loss Equation (RUSLE) estimates, the total annual soil loss from water and wind erosion is 1,378,236 tons. At a conservative 5 percent delivery rate, approximately 68,912 tons of soil could reach the James River annually.

Agricultural nutrients (nitrogen and phosphorous), total suspended solids and fecal coliform bacteria are the primary pollutants impacting and threatening the beneficial uses and long-term water quality of the James River and downstream waters.

The main sources of pollutants, based on information from the North Dakota Department of Health and data collected by the Wells Co. SCD staff, are poorly managed cropland, degraded riparian areas used by livestock as loafing areas and concentrated livestock feeding areas.

Livestock feeding areas are impacting water quality with nutrients and fecal coliform bacteria. Ninety five concentrated feeding areas have been identified with 28 ranked as priority areas due to proximity to surface waters.

In 2004 the Soil and Water Assessment Tool (SWAT) model was used to estimate total nitrogen loads, total phosphorus loads, and sediment loads for the watershed project area. Nitrogen loads ranged from 0.15 – 28.88 lbs/ac, phosphorus loads ranged from 0.04 – 4.24 lbs/ac and sediment loads from 0.004 – 3.20 tons/ac. The SWAT model also identified reaches of the James River having threatened aquatic life and recreation uses.

Priority work areas were determined using SWAT modeling. Work activities will focus on the high and medium priority areas of basins 3 & 4, for best management practice (BMP) implementation. Emphasis will be placed on applying BMP within 1 mile of the river and/or its major tributaries in the priority areas to address sources of stressors threatening aquatic life and recreation uses (appendix C, Figures 19 and 20).

The following are water quality sampling results from year 2000 of the assessment phase. Total nitrogen medians; Headwaters – 1.66 mg/l, Fessenden – 1.81 mg/l, Munster – 1.525 mg/l, New Rockford – 1.485 mg/l. Total phosphorous medians; Headwaters – 0.277 mg/l, Fessenden – 0.147 mg/l, Munster – 0.243 mg/l, New Rockford – 0.201 mg/l. Total suspended solid medians; Headwaters – 2.5 mg/l, Fessenden – 2.5 mg/l, Munster – 2.5 mg/l, New Rockford – 13.5 mg/l. Fecal Coliform colonies; Headwaters – 5, Fessenden – 5, Munster – 40, New Rockford – 20. Concentrations for parameters measured, which include total N, total P, TSS and Fecal Coliform start out high and generally decrease as stream discharge and runoff volume decreased. This trend indicates that the majority of the nutrients entering the James River Headwaters are delivered during spring runoff and storm events.

Macroinvertebrates samples were collected from four sites in the project area in 1998. Headwaters site (554009), near Fessenden (554010), Munster site (554011) and near New Rockford (554012) (see appendix F, Figure F.3). Site 554009 was classified as

having *poor* biotic integrity while the remaining sites were classified as having *fair* biotic integrity.

Aquatic habitat health was assessed in 1998. The four sites sampled for macroinvertebrates were also sampled for aquatic habitat health. The habitat score at site 554011 rated *poor* for habitat health with the remaining sites ranking in the bottom 37th percentile of all samples taken in North Dakota from 1996 through 2000.

Hydromodification in the form of surface water drainage is impairing water quality in the watershed. Four legal drains that are located within the James River Headwaters Watershed encompass approximately 58,990 acres, Crystal Lake Drain is 4,090 acres, Wells Drain #1 is 44,160 acres, Heimdal Drain is 3,700 acres and Hamberg-West Norway Drain is 7,040 acres. (See James River Headwaters Watershed – Phase II – EPA Section 319 Project Proposal). The majority of wetlands located in each of these legal drains are drained to the James River. Runoff from the drainage areas collects to a main channel that then discharges into the James River. These drainage areas are intensively farmed with extensive acres of low residue crops (dry beans, sunflowers, etc.) leaving little or no residue over winter.

Riparian area degradation resulting from overgrazing or crop production was also observed within the watershed. Both of these practices reduce the vegetative buffer strip along portions of the watershed. Without this protective vegetation and proper land management strategies along the headwaters, excessive sediment and nutrient deposition will continue to degrade water quality in the James River.

Waste water treatment facilities for the city of Fessenden and the Wells County Rural Water System are the only known point sources in the watershed. These systems are under a current NDPDES permit.

A3. Project Monitoring Goals/Objectives/Tasks Description

The primary monitoring goal of this project is to measure and document the effectiveness of accelerated technical assistance and installed BMPs, provided through the Section 319 NPS Pollution PIP, at improving the water quality and restoring the beneficial uses within the James River Headwaters. This plan will address water quality improvements needed to restore the impaired beneficial uses (primarily aquatic life and agriculture) of the James River Headwaters.

Objective 1: Collect and analyze chemical, physical and biological data to measure and document the effectiveness of installed BMPs in the project area at improving the water quality and restoring impaired beneficial uses.

Task 1: Collect and analyze a minimum of 20 water quality samples from each sampling site (Appendices A and B). Stream water quality samples will be analyzed for total nitrogen, Total Kjeldahl Nitrogen, nitrate-nitrite,

ammonia, total phosphorus, total suspended sediment, and fecal coliform bacteria.
Product: Water quality data for each sampling site
Milestone: 2006-2011

Task 2: Collect mean daily stream stage and discharge data from the selected sampling sites (Appendices D, E, and H).
Product: Mean daily stream stage/ discharge from the selected sites.
Milestone: 2006-2011

Task 3: Obtain and analyze precipitation data from the National Climatic Data Center (NCDC) or other available sources. The NCDC has data available for stations within the James River headwaters watershed.
Product: Precipitation data for the James River headwaters watershed.
Milestone: 2006-2011

Task 4: Document acreage and location of planned and installed BMPs to assess progress and target areas for annual work activities. Monitor operation and maintenance of Section 319 cost-share practices in accordance with ND NPS Management Plan.
Product: Database report of location and acres of planned and/or installed BMPs. A BMP installation report should be provided to NDDH on an annual basis.
Milestone: 2006-2011

Task 5: Collect and identify benthic macroinvertebrates, a minimum of once a year in 2007 and 2010 of the project (Appendix E). The identification of the macroinvertebrates will be contracted out. Calculate an Index of Biotic Integrity (IBI) and assess aquatic life uses for each sample site and event.
Product: Macroinvertebrate IBI for each sample site
Milestone: 2007 and 2010

Task 6: Update and run the calibrated Basins model developed during the assessment phase of this project to track and reflect land management changes and evaluate the water quality changes as BMPs are installed in the project area.
Product: Output data from the calibrated Basins model
Milestone: Annually

Task 7: Compile chemical, physical, and biological stream data with the BMP installation records to evaluate effectiveness of installed BMPs at improving water quality and restoring aquatic life and recreational uses.
Product: Annual data summaries and a final report comparing the chemical, physical and biological stream data with BMP installation and land use trends.
Milestone: 2006-2011

Note: Refer to the James River Headwaters Watershed – Phase II – EPA Section 319 Project Proposal for other goals, objectives, and tasks associated with this watershed project.

A4. Data Quality Objectives and Criteria for Measurement Data

A4.1 Data Quality Objectives

It is the policy of the US EPA and the Department's EHS that data quality objectives (DQOs) be developed for all environmental data collection activities. Data of known quality are essential to the success of any monitoring or sampling project. Data quality objectives are qualitative and quantitative statements that clarify the intended use of the data, define the type of data needed to support the decision, identify the conditions under which the data should be collected, and specify tolerable limits on the probability of making a decision error due to uncertainty in the data. DQOs are developed by data users to specify the data quality needed to support specific decisions. Sources of error or uncertainty include the following:

- Sampling error: The difference between sample values and *in situ* true values from unknown biases due to collection methods and sampling design;
- Measurement error: The difference between sample values and *in situ* true values associated with the measurement process;
- Natural variation: Natural spatial heterogeneity and temporal variability in population abundance and distribution; and
- Error sources or biases associated with compositing, sampling handling, storage, and preservation.

The primary data quality objective of this project is to determine, through the collection of chemical, physical and biological data, the effectiveness of BMPs installed in the James River headwaters and to observe improvements in water quality and the beneficial uses. Methods and procedures described in this document are intended to reduce the magnitude of the sources of uncertainty (and their frequency of occurrence) by applying the following approaches:

- use of standardized sample collection, handling, and analysis procedures; and
- use of trained scientists and technicians to perform the sample collection and handling activities.

A4.2 Measurement Performance Criteria

In order to meet the DQO for the project, the types of data needed for this project and their intended use are described in Table 1. For each of these data, a discussion of the measurement performance criteria or data quality indicators is provided. Data quality indicators include the following:

- precision;
- accuracy;
- representativeness;
- completeness; and
- comparability.

This QAPP does not address measurement performance criteria for the laboratory analysis of chemical samples. Measurement performance criteria for all lab analysis are described in the NDDH, Division of Chemistry, Quality Assurance Plan (NDDH 2000).

Table 1. Project data needs and intended use.

Data Needed	Intended Use
Stream Chemical Characteristics: (e.g. nutrients, total suspended solids, fecal coliform bacteria).	Characterize temporal and spatial trends of the nutrient, total suspended solids and fecal coliform bacteria concentrations in the James River Headwaters and it's tributaries. Combine mean daily discharge data with concentration to provide sub-watershed estimates of nutrient and sediment loading and yields.
Stream Stage/Discharge: (e.g. water level, flows)	Develop a stage-discharge rating curve for each site and estimate the mean daily discharge based on stream stage.
Benthic Macroinvertebrate Assemblage (e.g. Index of Biotic Integrity).	Characterize temporal and spatial trends in the macroinvertebrate Index of Biotic Integrity (IBI) scores for the James River Headwaters.
Watershed/land use Characteristics (e.g. BASINS input variables, BMP acreage).	Track land management changes and BMP installation. Update the calibrated BASINS model developed during the assessment phase of the project.
Climate Variables (e.g. precipitation, snow, temperature)	Characterize temporal and spatial climate trends as a potential explanatory variable for stream chemical characteristic trends.

Precision is a measure of mutual agreement among individual measurements or enumerated values of the same property of a sample, usually under demonstrated similar conditions. Precision is best measured in terms of the standard deviation. For purposes of this project, precision of biological samples and chemical analysis will be calculated from replicate samples and expressed as relative percent difference (RPD), if it is calculated from duplicate samples, or as relative standard deviation (RSD), if it is to be calculated from three or more samples. Table 2 provides a summary of the precision requirements for data collected for this project.

Accuracy is the degree of agreement between an observed or measured value and the true or expected value of the measured quality. Many kinds of error, including unintentional bias affect the inherent accuracy of data. Unfortunately, the investigator almost never knows true population values. This is especially true when working with natural biological communities. Therefore, the best an investigator can do is to avoid bias by assuring consistency of sampling and sample processing and striving for repeatability of measurements. Table 2 provides a summary of the accuracy requirements for data collected for this project.

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter, variation at a sampling point, process condition, or an environmental condition. The representativeness of the project relies in part, on the selection of sample sites and the collection of a significant number of samples.

Completeness is defined as the percentage of measurements made that are judged to be valid according to specific criteria and entered into the data management system. To optimize completeness, every effort is made to avoid sample and/or data loss. Accidents during sample transport or lab activities that cause the loss of the original samples will result in irreparable loss of data, which will reduce the ability to perform analysis, integrate results, and prepare reports. In order to maximize completeness, all samples will be stored and transported in unbreakable (plastic) containers.

Percent completeness (%C) for measurement parameters and samples is defined as:

$$\%C = v/T \times 100$$

Where v = the number of measurements or samples judged valid; and
T = the total number of measurements of samples collected.

In order to fulfill statistical criteria, samples will be collected at 100% of the sites unless unanticipated conditions (i.e. bad weather) prevent sampling. Table 2 provides a summary of the completeness requirements for data collected for this project.

Table 2. Summary of precision, accuracy, and completeness requirements for measurement data.

Measurement Parameter	Precision	Accuracy	Percent Completeness
Stream Water Chemistry	20 %	NA	95 %
Stream Stage/Discharge	± 5 %	0.1 ft/0.1 cfs	99 %
Benthic Macroinvertebrate Assemblage			
# of individuals	25%	NA	100%
# of taxa	10%	NA	100%
BASINS Model Variables	NA	NA	100 %

Comparability is a measure of the confidence with which one data set can be compared to another. Comparability is dependent on the proper design of the sampling program and on strict adherence to accepted sampling techniques, standard operating procedures, and quality assurance guidelines. For this project, comparability of data will be accomplished by standardizing the sampling season, the geographic extent of the project, the field sampling methods and the field training as follows:

- All samples will be collected from specific stream sites located within the James River headwaters (Appendix F). The project-sampling period will be between January 2002 and September 2007.
- Standard sampling and analytical methods, as well as standard units of reporting for all parameters sampled will be used (Appendices A-G).
- All field personnel involved with sampling will have adequate training and experience.

A5. Special Training/Certification

SCD staff will be responsible for all field data collection including water quality, stream stage/discharge, macroinvertebrate, and BASINS data. The field sampling crew is required to have the necessary knowledge and experience to perform all field activities. Training in the proper methods for sample collection, preservation, and the transfer of water chemistry and macroinvertebrate samples will be provided by Grant Neuharth, Designated Project Manager. Mr. Neuharth will also be responsible for assisting SCD staff with the installation of stream stage recording equipment as well as providing training in its operation and the measurement of stream discharge.

A6. Documents and Records

Thorough documentation of all field sampling and handling activities is necessary for proper processing in the laboratory, data reduction and, ultimately, for the interpretation of study results. Field sample collection and handling will be documented in writing (the following forms and labels will be used):

- a set of Sample Identification/Custody Record forms that accompanies each water chemistry or sediment samples submitted to the Division of Chemistry laboratory for analysis (Appendix A);

- a Sample Identification Label that accompanies and identifies all water samples (Appendix A); and

- a Stream Discharge Recording form to calculate instantaneous stream discharge (Appendix C)

Each sample collected will be uniquely identified on the sample label and field custody forms by specifying the site ID and location; sample depth; and sample date and time

B. Data Generation and Acquisition

B1. Sampling Process Design

B1.1 Monitoring Goal

The primary monitoring goal of this project is to measure and document the effectiveness of accelerated technical assistance and installed BMPs at meeting the pollutant reduction goals of the James River Headwaters' NPS Pollution PIP and to assess the effectiveness of those goals at restoring the water quality and beneficial uses of the headwaters. This goal will be accomplished by:

1) Collecting and analyzing chemical, physical, and biological data at four sites in the James River headwaters and its tributaries;
2) Documenting acreage, location, and type of installed BMPs in the watershed; and
3) Compiling, analyzing, and integrating the chemical, physical, biological, and BMP installation data in order to characterize the temporal and spatial trends in water quality as BMPs are installed.

B1.2 Sampling Site Locations in the James River Headwaters

Sampling locations were selected on the James River in the project watershed for collection of various chemical (e.g. nutrients and suspended solids), physical (e.g. habitat assessments) and biological (e.g. macroinvertebrate community and pathogens) data. Descriptions and locations of sites and parameters sampled are illustrated in Table 1 and Figures F.1, F.2, and F.3.

Table 3. Description of sites and parameters to be sampled

Storet Number	Description	Parameter
385010	James River Headwaters Lat: 47.71126 Long: -99.8217	Water Quality[1]
385011	James River near Fessenden Lat: 47.68781 Long: -99.58079	Water Quality[1]
385012	James River near Munster Lat 47.73457 Long: -99.3185	Water Quality[1]
385013	James River near New Rockford Lat: 47.67299 Long: -99.06319	Water Quality[1]
554009	James River Headwaters Lat: 47.69569 Long: -99.21148	Macroinvertebrate Community Habitat Assessment
554010	James River near Fessenden Lat: 47.73588 Long: -99.36176	Macroinvertebrate Community Habitat Assessment
554011	James River near Munster Lat: 47.68638 Long: -99.57584	Macroinvertebrate Community Habitat Assessment
554012	James River near New Rockford Lat: 47.64615 Long: -99.82942	Macroinvertebrate Community Habitat Assessment

1 – Water Quality includes Nutrients Complete (Total Nitrogen, Total Kjeldahl Nitrogen, Nitrite-Nitrate, Ammonia, and Total Phosphorus), Chlorophyll-a, Dissolved Total Phosphorus, Fecal Coliform Bacteria, and Total Suspended Solids

B1.3 Water Quality Parameters of Interest

Samples collected at each site will be analyzed for fecal coliform bacteria, total suspended solids, and nutrient variables. Specific nutrient analyses include ammonia as N (NH_3-N), nitrate-nitrite as N (NO_3-NO_2), total nitrogen (TN), total Kjeldahl nitrogen as N (TKN), and total phosphorus as P (TP).

B1.4 Sampling Frequency

Nutrients, Total Suspended Solids, and Fecal Coliform Bacteria

Six stream sampling sites will be established and sampled throughout the open water season (Appendix G). Sampling frequency for the stream sampling sites will be stratified to coincide with the typical hydrograph for the region. This sampling design will result in more frequent sampling during spring and early summer, typically when stream discharge is the greatest and less frequent sampling during the late summer and fall. Water quality sampling will be discontinued during ice cover in winter. Water quality sampling will also be discontinued if the stream stops flowing and reinitiated when flow returns to the stream. Table 3 provides a summary of the stream sampling frequency.

Table 4. Sampling frequency for stream monitoring sites

Sampling Period	Date	Frequency
1st and 2nd month	April - May	Twice per week
3rd month	June	Once per week
4th - 7th month	July -	Once per month

This schedule is to be used only as a guide. Climatic conditions may and probably will alter the sampling dates. The starting point and duration of the time period with a sampling frequency of twice a week will be adjusted according to the timing and duration of spring snowmelt and runoff. In addition, water quality samples should be collected from each site during the rising and declining storm hydrograph following any major precipitation events. Storm event samples will be collected in addition to the regularly scheduled samples.

Stream Stage and Discharge

Stream stage will be measured using an automated stage recorder with a manual staff gage as a backup (Appendices D and G). The automated stage recorder will be set to record stage every 4 hours. Stored data will be downloaded from the data logger approximately every two weeks to prevent data loss. A stage measurement using the manual staff gages or other available manual methods will be recorded every time water quality samples are collected at the sampling sites.

Stream discharge will be measured approximately every time water quality samples are collected at the sampling sites (Appendices F). This measurement frequency will produce approximately 20 discharge measurements. This schedule is to be used only as a guide. The goal of the schedule is to obtain discharge measurements that adequately represent the possible range of discharges. It is possible that this goal will be satisfied with less then 20 discharge measurements. At a minimum, 8-12 discharge measurements distributed over the range of discharges will be collected each year. If time and resources permit, additional discharge measurements will be taken to improve the accuracy of the stage-discharge-rating curve.

Note: These schedules are to be used only as a guide. Actual sampling and measurement dates may and probably will differ quite dramatically due to climatic and ice conditions. Under <u>NO</u> conditions will the safety of the sampler be compromised!

Benthic Macroinvertebrate Community

The macroinvertebrate community will be sampled once in June during the 1st and 5th years of the project (Appendix F). If time and resources permit additional sampling will be conducted in the 2nd, 3rd, and 4th years of the project.

B2. Sampling Methods

Table 4 provides a summary of project sampling methods. Detailed descriptions of all field-sampling methods are described in Appendices B-H.

Table 5. Summary of project sampling methods.

Matrix/ Substrate	Parameter	Sampling Equipment	Max Holding Time	Sample Container	Sample Preservation and Care
Stream Water	Chemistry	1	1	1	1
Stream Discharge		2	NA	NA	NA
Stream Stage		3	NA	NA	NA
Macroinvertebrates		4	NA	NA	NA

1 - See Appendix A and B
2 - See Appendix C
3 - See Appendix D and G
4 - See Appendix E

B3. Sample Handling and Custody Requirements

Following sample collection in the field all the nutrient and total suspended solids water samples will be hand delivered or express mailed to the Division of Chemistry laboratory in Bismarck, North Dakota. The fecal coliform bacteria samples will be hand delivered or expressed mailed to the Division of Microbiology laboratory in Bismarck, North Dakota. All macroinvertebrate samples will be hand delivered or express mailed to the contracted third party for storage and identification.

B4. Analytical Methods Requirements

All water samples will be analyzed according methods and procedures described in the NDDH Division of Chemistry's Quality Assurance Plan (NDDH, 2000). The macroinvertebrate samples will be processed according to the NDDH Division of Water Quality's Standard Operating Procedures for Laboratory Processing of Macroinvertebrate Samples (Appendix H).

B5. Quality Control

For this project, a single person will take the majority of the measurements (i.e. discharge, stage, etc.) in the field. Equipment used for field measurement will be calibrated immediately before and after each sampling trip. Furthermore, field duplicate samples will be collected with ten percent of the stream samples collected for chemical analysis.

Quality control will be assured for macroinvertebrate samples by maintaining a macroinvertebrate voucher collection for all taxa identified in the laboratory, sub-sampling replicate field samples, performing replicate sub-samples on ten percent of field samples, and removing and identifying all organisms from ten percent of the field samples (Appendix H). Voucher collections will be cataloged and placed in the North

Dakota River and Stream Macroinvertebrate Collection located at Valley City State University by Dr. Andre DeLorme, Ph.D.

B6. Instrument/Equipment Testing, Inspection and Maintenance

All field equipment will be inspected prior to sampling activities to ensure that proper use requirements are met (e.g., water samplers are without defects, temperature and DO meters properly calibrated). Inspection of field equipment will occur in advance of field activities to allow time for replacement or repair of defective equipment. The Field Investigator should gather and inspect all equipment prior to each sampling trip.

B7. Instrument Calibration and Frequency

As part of instrument and equipment maintenance, the stream stage and discharge meters will be calibrated according to the manufacturer's specifications.

B8. Inspection/Acceptance of Supplies and Consumables

Careful and thorough planning is necessary to ensure the efficient completion of the field sample collection tasks. A general checklist of field equipment and supplies is provided in the description of SOPs (Appendices A-H). It is the responsibility of the Field Investigator to gather and inspect the necessary sampling gear prior to each sampling trip.

B9. Data Acquisition Requirements (Non-direct Measurements)

Non-direct measurements will include identification and/or verification of each sample location (i.e., latitude and longitude). The latitude and longitude coordinates, in decimal degrees, will be recorded. A hard copy table of the location of each sampling site and a map depicting each location will be provided by the DPM to the Principle Investigator.

B10. Data Management

Samples will be documented and tracked through sample identification labels, field and laboratory recording forms and sample identification/custody forms. Water samples collected for chemical analysis will be transported or sent to the Division of Chemistry laboratory in Bismarck, ND by field personnel (Appendices A).

Results of chemical analysis of water samples are transmitted from the Division of Chemistry to the SWQMP Program Manager via hard copy report and electronically as an ASCII text file. Results transmitted electronically are stored by the Division of Water Quality's SWQMP in an Access 97 based data management system, termed SID (Sample Identification Database). After review by the SWQMP Program Manager, sample results will be retained by the DPM for data reduction and analysis.

Dr. Andre Delorme of Valley City State University will process the macroinvertebrate samples. Laboratory processing will entail identification to lowest taxonomic level

practical (Genus level preferred) and the enumeration of all macroinvertebrates in each sample by taxon. Results from each sample will be recorded on a lab data sheet and entered by Dr. Delorme into a Microsoft Access 97 database provide by SWQMP. Upon completion of the laboratory analysis of the macroinvertebrate samples, copies of the field and lab recording forms and database will be transmitted to the DPM where the hard copy results will be kept on file by the Division of Water's SWQMP.

C. Assessment and Oversight

C1. Assessment and Response Actions

Assessment activities and corrective actions have been identified to ensure that sample collection activities are conducted as prescribed and that the measurement quality objectives and data quality objectives established by this QAPP are met. The QA program under which this project will operate includes performance and system audits with independent checks of the data obtained from sampling activities. Either type of audit could indicate the need for corrective action. The essential steps in the program are as follows:

- identify and define the problem;
- assign responsibility for investigating the problem;
- investigate and determine the cause of the problem;
- assign and accept responsibility for implementing appropriate corrective action;
- establish effectiveness of and implement the corrective action; and
- verify that the corrective action has eliminated the problem.

Immediate corrective actions form the part of normal operating procedures and are noted on project field and laboratory recording forms and will be the responsibility of the Principle Investigator and the Field Investigator. Problems not solved this way may require more formalized long-term corrective action. In the event that quality problems requiring attention are identified, the DPM will determine whether attainment of acceptable data quality requires either short- or long-term actions. Failures in the chemical analysis system (e.g., performance requirements are not met) and corrective actions for those failures are beyond the scope of this QAPP.

Communication and oversight will proceed from Field Investigator to the Principle Investigator and DPM. The DPM will be available throughout the entire sampling period to address questions and receive communications of sampling status from the field personnel. Field personnel will communicate the status of the sampling activities to the

Principle Investigator and the DPM on a weekly basis. During this time the field personnel will communicate any sampling difficulties encountered during the sampling and the corrective actions taken. In most cases the field personnel will initiate corrective actions when a problem is immediately identified and note the problem and corrective action in his logbook. In the event the problem cannot be corrected immediately, the field personnel will contact the Principle Investigator and the DPM to determine the best way to rectify the problem and obtain accurate and useable data. When corrective actions have been taken and a sufficient time period has elapsed that allows a response, the response will be compared with project goals by the DPM. The DPM will verify that the corrective action has been appropriately addressed to eliminate the problem. The DPM has the authority to stop work on the project if problems affecting data quality are identified that will require extensive effort to resolve. When the Principle Investigator and the DPM are contacted with a problem, the Field Investigator should keep a record of the problem and the corrective action taken.

Performance audits are qualitative checks on different segments of project activities, and are most appropriate for field sampling and laboratory analysis activities. A field audit of field sampling activities will be conducted at least once during the project. This audit will be conducted early during the project field season in case any problems are identified they can be corrected quickly to minimize the possibility of compromising data. Field audit techniques include checks on sampling equipment and the review of sampling methods.

System audits are qualitative reviews of project activity to check that overall project quality is functioning and that the appropriate QC measures identified in the QAPP are being implemented. The DPM will conduct semi-annual internal system audits during the project and report all deficiencies to the SWQMP Program Manager and the EPA Project Officer during semi-annual reporting.

C2. Reports to Management

Problems and corrective actions identified by the field personnel will be reported to the Principle Investigator and the DPM each week during the field season. Significant problems identified by the field personnel as well as problems and corrective actions identified by the DPM during the field audit will be reported to the SWQMP Program Manager and the EPA Project Officer as part of annual reports.

D. Data Validation and Usability

D1. Data Review, Validation, and Verification Requirements

Data review and validation services provide a method for determining the usability and limitations of data, and provide a standardized data quality assessment. All field and laboratory report forms will be reviewed by the Principle Investigator and the DPM, while all sample custody forms for chemical analysis will be reviewed by the DPM for completeness and correctness. The Principle Investigator will be responsible for

reviewing all data entries and transmittals for completeness and adherence to QA requirements. Data quality will be assessed by comparing entered data to original data or by comparing results with the measurement performance criteria summarized in Section A4.2 to determine whether to accept, reject, or qualify the data. Results of the review and validation processes will be reported to the DPM.

D2. Verification and Validation Methods

The Principle Investigator will review all field and laboratory record forms. The DPM will review a minimum of five percent of field and laboratory record forms and all of the sample custody forms for chemical analysis. Any discrepancies in the records will be reconciled with the field personnel and recorded in the logbook.

Analytical validation and verification methods are outside the scope of the QAPP. The submission of samples to the Division of Chemistry laboratory will include a Sample Identification/Custody Record sheet documenting the site location, sampling date and time. The Division of Chemistry laboratory to ensure that holding times have not been exceeded will check this information. The laboratory will report violations of holding times to the DPM. The DPM, in consultation with Division of Chemistry personnel, will determine whether or not to proceed with the analysis of that sample and/or analyte.

D3. Reconciliation with Data Quality Objectives

As soon as possible after each sampling event or the analysis of each sample, calculations and determinations for precision, completeness, and accuracy will be made by the field personnel and compared to the criteria discussed in Section A4. This will represent the final determination of whether the data collected are of the correct type, quantity, and quality to support their intended use for this project. Any problems in meeting the performance criteria (or uncertainties and limitations in the use of the data) will be discussed with the Principle Investigator and the DPM, and will be reconciled, if possible.

Literature Cited

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Appendix A - Standard Operating Procedures for the Collection and Preservation of Stream and River of Grab Samples for Chemical Analysis

Summary

Grab samples collected for chemical analysis should be representative of the entire stream or river. To be representative, samples must be carefully collected, properly preserved, and appropriately analyzed. In general, samples should be collected from the main current of the stream or river at 60% of the total stream depth.

Ideally, grab samples are only collected on low gradient slow moving streams. The grab sample can be collected either by wadding or by lower a sampling device such as a kemmerer sampler, van dorn sampler or weighted open bucket from a bridge crossing.

When collecting the sample by wading, enter the stream slightly down current from sampling site then wade to the area with the greatest current. Rinse each sample bottle and lid 3 times with stream water prior to collecting the sample. Place lid on sample bottle then submerge to approximately 60 percent of the stream depth, remove the lid and allow the bottle to fill facing towards the current. Replace the lid prior to removing bottle from stream. A small portion of the sample will need to be decanted off prior to preserving and/or placing in cooler. Note: In very shallow streams care must be taken not to contaminate the sample with bottle sediments.

When collecting from a bridge using a kemmerer or van dorn sampler, lower the device into the stream and trip the sampler at 60 percent of the total stream depth. If using a weighted open-mouthed bucket, allow the bucket to descend nearly the entire stream depth and then rapidly retrieve.

Equipment and Supplies

__2.2. or 3.2 liter non-metallic sampler (e.g., Kemmerer or Van Dorn sampler), with rope marked at 0.5-meter depth intervals and a messenger.
__Sample containers (see Table 3.1)
__Acid for sample preservation (see Table 3.1)
__Sample labels.
__Coolers with ice or frozen gel packs.
__Deionized water for sample blanks and decontamination.
__Filter apparatus.

For vacuum method.
__Vacuum filter holder.
__Vacuum pump.
__0.45 um membrane filters (Millipore HAWP 047 00 or equivalent).
__Pre-filters (Millipore AP40 0047 05 or equivalent)
__Stainless steel forceps.

For peristaltic method.
__Power Drive (Compact Cat No. P-07533-50 or equivalent)
__Paristalic head (Easy Load II Cat No. P-77200-62 or equivalent).
__In-line 0.45 um cartridge filters (Geotech dispos-a-filter or equivalent).
__In-line 5.0 um cartridge pre-filters (Geotech dispos-a-filter or equivalent).
__Tubing (Masterflex silicone Cat No. P-96400-24 or equivalent).
__Churn Splitter.
__Field report form.
__Sample ID/Custody Record.
__Black ballpoint pen or mechanical pencil.
__Sample and blank log forms.
__Power ice auger (winter sampling).
__Ice skimmer (winter sampling).
__Sled (winter sampling).
__Stainless steel forceps.

___Field report form.
___Sample ID/Custody Report
___Pen.
___Sample log forms.
___Power ice auger (winter sampling).
___Ice skimmer (winter sampling).
___Sled (winter sampling).

Procedure

Stream Sample Collection

1. Triple rinse each sample bottle using stream water. Note: Do not rinse the fecal coliform bacteria or the pesticide sample bottles.

2. Fill the sample bottle: Samples should be collected in the main current at that depth which is approximately 0.6 of the total water depth below the surface. When stream depth permits, a sample may be collected by wading the stream and inserting sample container facing against the current, allowing it to fill naturally at the appropriate depth. At greater water depths, an appropriate sampling device should be used. Note: Care should be taken so that the sample is not contaminated by disturbing the streambed upstream from the collection point.

3. Place a label on each sample container (Figure I.1.1).

4. Place the samples in a cooler on ice.

5. Fill out the field report form, Sample ID/Custody Report, and the water chemistry sample log .

6. When a copy of the Sample ID/Custody Report is received from the DC record the laboratory log number on the sample log form.

Stream Blank Sample Collection

1. Field blank samples are collected with first and every tenth stream sample collected (i.e., 1, 10, 20...). If the sample log indicates a blank sample be collected, follow the steps below.

2. Using deionized water, triple rinse each sample bottle.

3. Fill each bottle with deionized water.

4. Preserve each sample appropriately. Note: Do not preserve the total dissolved phosphorus sample.

5. Place a label on each sample container and fill out the sample information log form (Figure I.1.2). Note: Field sample blanks should be identified with STORET number 389990.

6. Place the sample in a cooler on ice.

7. When a copy of the Sample ID/Custody Report is received from the DC laboratory record the laboratory log number on the sample log form.

Stream Duplicate Sample Collection

1. Duplicate samples are collected with the first and every following tenth stream sample collected (i.e., 1st, 10th, 20th...). If the sample log indicates a duplicate sample be collected, follow the steps below.

2. Collect the sample following steps (a) - (c) in the procedure for Stream Sample Collection.

3. Place a label on each sample container and fill out the Sample ID/Custody Report (Figure I.1.1). Note: Duplicate samples should be identified with STORET number 389999. Be sure to indicate on the label the project name and type of sample being duplicated.

4. Place the samples in a cooler on ice.

5. When a copy of the Sample ID/Custody Report is received from the DC record the laboratory log number of the duplicate sample on the NPSMP water chemistry sample log form.

Stream Sample Filtration

1. Total dissolved phosphorus samples should be filtered immediately.

2. Put on new latex surgical gloves.

3. Remove filter holder from the plastic bag and assemble.

4. Rinse the filter apparatus three times with approximately 250 ml of deionized water each time.

5. Load a pre-filter in the filter apparatus and connect the vacuum pump.

6. Leach the filter twice with approximately 250 ml of deionized water each time.

7. Filter the sample through the pre-filter. Place the sample back into the sample container.

8. Remove the pre-filter from the filter apparatus and repeat Step C.

9. Load a 0.45 um filter into the filter apparatus and connect the vacuum pump.

10. Repeat Step (5).

11. Filter the sample through the 0.45 um filter.

12. Triple rinse the sample container with deionized water.

13. Transfer the filtered sample back into the sample container.

14. Preserve the sample with 2 ml 1/5 sulfuric acid or 0.2 ml concentrated sulfuric acid lowering the pH to 2 or less.

15. Place the preserved sample in the cooler on ice.

16. If additional samples require filtration, repeat Steps (3) through (15).

Field Sample Filtration Parestolic Method

1. Rinse the churn splitter three (3) times with water from the stream or river.

2. Fill churn splitter with water from the appropriate stream depth.

3. Assembled and attach pump head to power drive.

4. Plug in power drive.

5. Put on new latex surgical gloves.

6. Remove acid rinsed tubing from plastic bag, taking care to prevent contamination and place in head draping a long end into the churn splitter and dangling the short end out of contact with anything.

7. Turn on pump and begin rinsing tubing with a minimum of 250 ml of sample water from churn splitter.

8. As tubing rinses remove cartridge filter from plastic bag and insert cartridge while pump is still running to the tubes dangling end. Care should be taken to ensure filter cartridge is inserted in the correct direction.

9. Run 250 ml of sample water through cartridge filter.

10. Place labels on bottles.

11. Triple rinse the sample bottles and lids with sample water coming out of the filter cartridge.

12. Fill sample bottles.

13. Preserve nutrient sample with 2 ml 1/5 sulfuric acid or 0.2 ml concentrated sulfuric acid and ICP Metals or Trace metals with 5 ml concentrated nitric acid lowering the pH to 2 or less. Note: Dissolved minerals are not preserved.

14. Place samples in the cooler on ice.

15. If cartridge becomes plugged repeat Steps (6) through (15) with a in-line 2.0 um pre-filter placed in-line prior to the 0.45 um filter

Steam Water Quality Field Log
North Dakota Department of Health
Division of Water Quality

Sample No.	STORET No. Stream Name	Date	Time	D.O.	Temp.	pH	Cond	Sample (Dup)	Sample (Blk)	Observer	Comments

Figure A.1.1 Stream Field Log. Revised April 2001.

North Dakota Department of Health Sample Identification/Custody Record SFN 19220 (05-2000)

Project Information *Must be Completed by Field Personnel*	**Sample Receipt** *Must be Completed by Laboratory Personnel*
Project Code:	Received By:
Project Name:	Date Received:
	Time Received:
Account Number:	Sample Log #:

Reporting *Must be Completed by Field Personnel*	**Comments** *For Laboratory and Field Use*
Return to Sampler:	
Address:	
City/State/Zip:	G Multi Sample Form Used *Skip Sample and Field Info Sections*
Div. of Water Quality Contact:	Multiple Sample Set Sheet Number ***1*** of

Sample Information *Must be Completed by Field Personnel*			**Field Information** *For Field Use*	
Sampler(s):			Collection: (G)rab, (D)epth Width Composite, (T)ime Integrated:	
Station No. or STORET ID:			Cond., umhos/cm:	Avg Length (cm):
Station Loc. or Description:			pH : Temp, (ºC):	Min Length (cm):
			D.O., (mg/L):	Max Length (cm):
Date of Collection:	Sample #	Out Of	Species:	Avg Weight (g):
Time of Collection:			Anatomy:	Min Weight (g):
Sample Media--(W)ater, (S)oil, (F)ish Tissue:			Composite Size:	Max Weight (g):

Analysis Requested *Must be Completed by Field Personnel: Contents of Groups Can be Found on a Copy of the Group Listings*

G Mic)	E. Coli	G 25)	Water-Base/Neutral Pesticide	G 82)	Weight-BTEX
G Mic)	Enterococci	G 65)	Water-BTEX	G 117)	Weight-Carbamates
G Mic)	Fecal Coliform	G 21)	Water-Carbamates	G 148)	Weight-Diesel Range Organics
G Mic)	Fecal Strep	G 105)	Water-Chlorophyll A & B	G 86)	Weight-Mercury
G 106)	SW, Fish-Acid Herbicides	G 2)	Water-Complete	G 88)	Weight-Nitrate+Nitrite
G 108)	SW, Fish-B/N Insecticides	G 35)	Water-Conductivity	G 85)	Weight-PCB
G 76)	SW, Fish-Mercury	G 146)	Water-Diesel Range Organics	G 136)	Weight-Phosphorus
G 107)	SW, Fish-PCB	G 3)	Water-Lagoon Discharge	G 54)	Weight-SemiVOC's
G 78)	SW, Fish-Trace Metals	G 41)	Water-Nitrate+Nitrite	G 134)	Weight-TKN
G 81)	SW, Sed.-Trace Metals	G 84)	Water-PCB	G 49)	Weight-Trace Metals
G 5)	SW-Major Cation/Anions	G 52)	Water-SemiVOC's	G 46)	Weight-VOC's
G 30)	SW-Nutrients, Complete	G 83)	Water-Trace Metals	G	Other Analysis (Write in)
G 6)	SW-Nutrients, Partial	G 118)	Water-TSS		
G 50)	SW-Nutrients, Tot. Diss. P	G 29)	Water-Uranium		
G 7)	SW-Trace Metals	G 28)	Water-VOC's		
G 144)	SW-Trace Metals, Dissolved	G 24)	Weight-Acid Herbicides		
G 23)	Water-Acid Herbicides	G 135)	Weight-Ammonia		
G 34)	Water-Ammonia	G 26)	Weight-Base/Neutral Pesticides		

Copies: White - Chemistry Laboratory Canary - Division of Water Quality Pink - Microbiology Laboratory Goldenrod - Sampler

Figure A.1.2 Sample Identification/Custody form.

Project Description
Sample ID **Project Description**

Analysis: (DC Code) SW-Analyte Group
Container: Preservative:
Date:_ /_ /_ Time:_ :_ Depth:
Sampler

a. Water Chemistry Label

Project Description
389999 **Project Description**

Analysis: (DC Code) SW-Analyte Group
Container: Preservative:
Date:_ /_ /_ Time:_ :_ Depth:
Sampler

b. Water Chemistry Blank Label

Project Description
389990 **Project Description**

Analysis: (DC Code) SW-Analyte Group
Container: Preservative:
Date:_ /_ /_ Time:_ :_ Depth:
Sampler

c. Water Chemistry Duplicate Label

Figure A.1.3 SWQMP Water Chemistry Label, Water Chemistry Blank Label, and Water Chemistry Duplicate Label.

Appendix B - Standard Operating Procedures for the Collection and Preservation of Stream and River Samples for Chemical Analysis Using the Depth Width Integrated Method

Summary

Samples collected for chemical analysis should be representative of the entire stream or river. To be representative, samples must be carefully collected, properly preserved, and appropriately analyzed. A depth width integrated sample gives the most accurate representation of the entire stream concentration. The following procedure is modified from the USGS Field Guide for Collecting and Processing Stream-Water Samples for the National Water-Quality Assessment Program (Sheldon L. R. 1994 U.S. Geological Survey Open File Report 94-445).

The following description requires the use of either a hand held depth width integrated sampler like the DH-81 or a suspended depth integrated sampler like the DH-59. The hand held sampler should be used when the stream is safe to wade and the suspended sampler when flows are great enough to pose a safety hazard.

In practice the method of collecting a water quality sample using either the hand held or suspended sampler is the same. Five to 20 water samples are collected at equally spaced intervals across the stream and composited in a churn splitter. A general guideline is 5 samples for stream 5 feet wide or less and 10 for streams greater then 5 feet. On extremely wide shallow fast running streams 20 samples may be collected. A minimum spacing between sample points is 6 inches.

The sample is collected by lowering and raising the sampler the entire depth of the water column. Care is given to lower and raising the sampler at the same rate at each sampling point. The rate should be slow enough to get a half full bottle at the deepest area in the stream cross section but never so slow as to exceed 3/4 full bottle.

A good method for identifying the rate to lower and raise the sampler through the water column is to practice different rates at the deepest area in the stream cross section. The water collected during this process can be used to triple rinse the churn splitter.

The same rate of raising and lowering the sampler is used at all sample points. This will yield small sample volumes at the shallower and slower flowing sample points and greater volumes at the deeper and faster portions of the stream. The sample sizes at each point are flow proportional as long as the same rate of raising and lower at each sample point is maintained.

Transverse the stream's cross-section as many times as necessary to ensure collection of the volume of sample required for analysis. When additional sample points cannot be sampled without overfilling the bottle (3/4 full), empty the bottle directly into the churn splitter or use another bottle and continue sampling until all sample points have been sampled. When more then one cross section is required to get enough sample, each sample point must be sampled a equal number of times so the composited samples will be proportional to the flow.

Equipment and Supplies

__Suspended depth integrating sediment sampler (DH-59 TC or equivalent)
__Wading depth integrating sediment sampler (DH-81 or equivalent)
__Churn splitter
__Acid for sample preservation (see Table 3.1)
__Sample labels.
__Coolers with ice or frozen gel packs.
__Deionized water for sample blanks and decontamination.
__Filter apparatus.
    For vacuum method.
    __Vacuum filter holder.
    __Vacuum pump.

___0.45 um membrane filters (Millipore HAWP 047 00 or equivalent).
___Pre-filters (Millipore AP40 0047 05 or equivalent).
___Stainless steel forceps.
For peristaltic method.
___Power Drive (Compact Cat No. P-07533-50 or equivalent)
___Paristalic head (Easy Load II Cat No. P-77200-62 or equivalent).
___In-line 0.45 um cartridge filters (Geotech dispos-a-filter or equivalent).
___In-line 5.0 um cartridge pre-filters (Geotech dispos-a-filter or equivalent).
___Tubing (Masterflex silicone Cat No. P-96400-24 or equivalent).
___Churn Splitter.
___Field report form.
___Sample ID/Custody Record.
___Black ballpoint pen or mechanical pencil.
___Sample and blank log forms.
___Power ice auger (winter sampling).
___Ice skimmer (winter sampling).
___Sled (winter sampling).
___Stainless steel forceps.
___Field report form.
___Sample ID/Custody Report
___Pen.
___Sample log forms.
___Power ice auger (winter sampling).
___Ice skimmer (winter sampling).
___Sled (winter sampling).

Procedure

1. Identify number of sample points based on flow and stream depth.

2. Triple rinse churn splitter using stream water from deepest vertical in stream cross section.

3. Begin collecting sample by starting at the left or right edge of water. Raise and lower sampler through the water column at sample point 1.

4. Deposit sample portion into churn splitter when bottle approaches 2 to 3/4 full..

5. Move to next sample point and repeat b and c until the entire cross section has been sampled.

6. After all samples have been composited, triple rinse each sample bottle with water from the churn splitter while gently stirring. Note: Do not break the surface of the water in the churn splitter.

7. Fill the sample bottle with water from the churn splitter while stirring gently:

8. Place a label on each sample container (Figure J.1.1). Each sample container should be labeled accordingly with the appropriate analyte group as indicated in Table 3.1.

9. Place the samples in a cooler on ice.

10. Fill out the field report form (Figure J.1.1), Sample ID/Custody Report (Figure J.1.2) and the water chemistry sample log (Figure J.1.5).

11. When a copy of the Sample ID/Custody Report is received from the DC record the laboratory log number on the sample log form.

Stream Blank Sample Collection

1. Field blank samples are collected with first and every tenth stream sample collected (i.e., 1, 10, 20.....). If the sample log indicates a blank sample be collected, follow the steps below.

2. Using deionized water, triple rinse each sample bottle.

3. Fill each bottle with deionized water.

4. Preserve each sample appropriately. Note: Do not preserve the total dissolved phosphorus sample.

5. Place a label on each sample container and fill out the sample information log form (Figure J.1.2). Note: Field sample blanks should be identified with STORET number 389990.

6. Place the sample in a cooler on ice.

7. When a copy of the Sample ID/Custody Report is received from the DC laboratory record the laboratory log number on the sample log form.

Stream Duplicate Sample Collection

1. Duplicate samples are collected with the first and every following tenth stream sample collected (i.e., 1st, 10th, 20th...). If the sample log indicates a duplicate sample be collected, follow the steps below.

2. Collect the sample following steps 1 - 7 under procedures.

3. Place a label on each sample container and fill out the Sample ID/Custody Report (Figure J.1.2). Note: Duplicate samples should be identified with STORET number 389999. Be sure to indicate on the label the project name and type of sample being duplicated.

4. Place the samples in a cooler on ice.

5. When a copy of the Sample ID/Custody Report is received from the DC record the laboratory log number of the duplicate sample on the NPSMP water chemistry sample log form.

6. Stream Sample Filtration: If one or more of the analyte groups require field filtering use these methods.

Field Sample Filtration Vacuum Method

1. Dissolved nutrient(s), dissolved mineral(s), and dissolved metal(s) be field filtered immediately following sample collection.

2. Put on new latex surgical gloves.

3. Remove filter holder from the plastic bag and assemble.

4. Rinse the filter apparatus three times with approximately 250 ml of deionized water each time.

5. Load a pre-filter in the filter apparatus and connect the vacuum pump.

6. Leach the filter twice with approximately 250 ml of deionized water each time.

7. Filter the sample through the pre-filter. Place the sample back into the sample container.

8. Remove the pre-filter from the filter apparatus and repeat Step 4.

9. Load a 0.45 um filter into the filter apparatus and connect the vacuum pump.

10. Repeat Step (5).

11. Filter the sample through the 0.45 um filter.

12. Triple rinse the sample container with deionized water.

13. Transfer the filtered sample back into the sample container.

14. Preserve the sample with 2 ml 1/5 sulfuric acid or 0.2 ml concentrated sulfuric acid lowering the pH to 2 or less.

15. Place the preserved sample in the cooler on ice.

16. If additional samples require filtration, repeat Steps (3) through (15).

Field Sample Filtration Parestolic Method

1. Assembled and attach pump head to power drive.

2. Plug in power drive.

3. Put on new latex surgical gloves.

4. Remove acid rinsed tubing from plastic bag, taking care to prevent contamination and place in head draping a long end into the churn splitter and dangling the short end out of contact with anything.

5. Turn on pump and begin rinsing tubing with a minimum of 250 ml of sample water from churn splitter.

6. As tubing rinses remove cartridge filter from plastic bag and insert cartridge while pump is still running to the tubes dangling end. Care should be taken to ensure filter cartridge is inserted in the correct direction.

7. Run 250 ml of sample water through cartridge filter.

8. Place labels on bottles.

9. Triple rinse the sample bottles and lids with sample water coming out of the filter cartridge.

10. Fill sample bottles.

11. Place labels on bottles.

12. Preserve nutrient sample with 2 ml 1/5 sulfuric acid or 0.2 ml concentrated sulfuric acid and ICP metals and trace metals with 5 ml concentrated nitric acid lowering the pH to 2 or less. Note: Dissolved minerals are not preserved.

13. Place samples in the cooler on ice.

14. If cartridge becomes plugged repeat Steps (6) through (15) with a in-line 2.0 um pre-filter placed in-line prior to the 0.45 um filter

See **Appendix A** for Field Forms
- Stream Water Quality Field Log
- Sample Identification / Custody Record
- Sample Identification Labels

Appendix C - Standard Operating Procedures for Measuring Stream Discharge in Wadable Streams, Round Culverts and Weirs

Summary

Flow is measured to calculate instantaneous discharge and to develop a rating curve based on the relationship between stage and discharge. For rating curve development a full range of flow measurements are necessary for accuracy. Flow measurements should be collected as soon as ice out occurs to avoid the potential for missing values.

The rating curve is calculated either mathematically using a slope equation that best fits the field data [discharge (cfs) = M (stage (ft)) + B] or by manually drawing the relationship on graph paper. The relationship can be a linear or multiple regression or a combination of both. When calculating the relationship M is the slope and B is the intercept. Both will be derived from a regression using flow as the dependent variable and stage as the independent variable.

Ideally the regression output R squared value should be greater than 0.85 and significant at the $p \leq 0.05$ level. When graphed the calculated curve should be close a close fit to the actual data at the high flow, median flow and low flow. When a good equation has been calculated for a particular site it can then be used for many years to estimate average daily discharge with a minimum of annual maintenance measurements.

Careful selection of sampling sites can greatly reduce the amount of work required to get accurate discharge measurements. Ideal sites to look for are; weirs, bridges, box culverts and round culverts. The advantage of these sites are that a minimum number of measurements are needed to get a significant relationship between flow and stage and flow measurements are possible from above during high flow periods. When none of the above situations exist and the stream is small enough a temporary weir can be constructed to aid in collecting flow measurements.

Flow readings should be collected from the same location throughout the study period. If for any reason the location has to be moved, data will be collected at both sites over a wide enough range in flow to ensure accuracy. The new location will be noted in the field log along with an explanation as to why it was moved.

Equipment and supplies

___Metal, kevlar, or fiberglass flexible measuring tap
___Velocity meter and wading rod
___Field Sheets
___Pencil
___Stakes

Collecting Discharge in Wadable Stream

Measuring stream discharge or flow is accomplished by collecting stream flow velocity and cross sectional measurements of stream width and depth. General guidelines for distance between measurements are 1 foot for stream 20 feet wide or less, and 2 feet for stream 21 to 40 feet across and 3 feet for streams greater then 40 feet.

No individual section measured will exceed 10% of the total stream discharge. If a segment exceed 10% additional measurements will be collected until less then 10% of total flow is represented in all sections.

Flow velocity in segments 3 feet deep will have a single measurement collected at 60% of the total depth. In segments greater then 3 feet will have 2 measurements collected; one at 20% of the total depth and one at 80% of the total depth.

1. Fill out upper portion of flow form (Figure K.1.1) including, STORET number, date, time, party making measurement, description of site, gauge height, method, and type of meter.

2. Anchor the tape at the near shore and stretch it across the stream at a right angle to stream flow.

3. Check meter calibration according to owner's manual.

4. Segment 1 begins at the left edge of water (left bank facing down stream).

5. The first reading is at the waters edge and recorded as segment 1. Distance, depth, and velocity are all zero (Figure K.1.1).

6. Enter the waterbody downstream of the tape. Face into the current with the rod upstream of your body so as not to influence flow.

7. Your second reading will be taken as soon as the stream reaches a depth of 0.2 or 0.4 feet or one half the distance of the following segments.

8. Record distance from point 1 and water depth.

9. Adjust the velocity meter to 60 percent of the depth.

10. Slowly pivot the velocity meter back and forth until the greatest velocity at that segment is found.

11. Record velocity.

12. Repeat steps 6 through 9 until the opposite bank is reached. The final reading is the right edge of water. Depth and velocity are zero (0).

13. Discharge will be calculated individually for each segment. The flow is the area multiplied by velocity. The total discharge is the sum of segments.

Collecting Discharge in Round Culverts

1. Measure the radius (R) of the culvert in feet.

2. Measure water depth (D) in center of culvert in feet.

3. Measure velocity (V) in the center of the culvert at 60% of total water depth if 3 feet deep or less. Measure the velocity (V) at 20% and 80% of total water depth if greater then 3 feet deep.

4. Calculate the area (A) of the discharge with the following formula:

$$Area\,(A) = \frac{\pi R^2}{2} + [R - D\sqrt{R^2 - (R - D)^2} + R^2 \arccos(\frac{R - D}{R})]$$

5. Calculate discharge (cfs) by the following formula:

Discharge (cfs) = V (0.8)*A
where: V (0.8) = average velocity of the discharge
A = area of the discharge

Collecting Discharge at a Weir

1. To physically measure discharge over a weir the procedure is the same as in an open stream bed. The first reading is taken on the edge of the nearest wall of the weir, the second and subsequent readings are taken over the top of the weir ending on the farthest wall.

2. To mathematically estimate discharge over a weir the following formula is used: $Q = MLHx\sqrt{2GH}$

where:

L = length of weir in feet

M = $(0.405 + 0.\frac{00984}{H})x(1 + 0.55(\frac{H}{P+H})^2)$

Q = discharge in cubic feet/second (cfs)

H = head (feet)

G = the acceleration due to gravity = 32.16 feet/second

P = the height (feet) of the head over the downstream surface

When using the above equation many variables can effect the accuracy of the output. To ensure accurate computations a limited amount of physical discharge measurements should be collected. If a variation greater than five percent is discovered, the equation will be adjusted appropriately.

NORTH DAKOTA DEPARTMENT OF HEALTH
DIVISION OF WATER QUALITY
DISCHARGE MEASUREMENT NOTES

Measured by
Project code _____ Checked by
Storet number _____ Sheet no._____ Of
Site description

Date_____ Party
Width_____ Area_____ Mean Velocity _____ G.H._____ Discharge
Method_____ No.Sections_____ G.H. change_____ In _____ Hrs
Meter no._____ Type of meter_____ Date rated_____ Tag checked
Gage start_____ Time_____ Gage end_____ Time
Wading, Cable, Ice, Boat, Upstream, Downstream, Side bridge_____ Feet, mile, above, below gage.
Measurement rated excellent (2%), good (5%), fair (8%), poor (>8%) based on the following conditions:
Flow
Cross section
Remarks

Samples collected: Water Quality, Sediment, Biological, Time_____ , Method
Sampling comments

Dist. From Point	Width	Depth	Observation Depth	Time Revs in Seconds	Velocity at Point	Angle mean in vertical	Adjusted	Area	Discharge

Figure C.1.1. Discharge Measurement Form

Appendix D - Standard Operating Procedures for Measuring Stream Stage Using Automated Stage Recorder

Summary

Daily and annual stage records are essential for estimating daily and annual nutrient, sediment and hydraulic loadings. Daily and annual loading estimates are essential ingredients for assessing the effectiveness of Best Management Practices implementation.

The least expensive and most reliable method to collect daily and annual stage is to place an electronic data-recording device into the stream at each water quality monitoring site. The recorder is normally set to collect a stage record either at 1 or 3 hour increments. The stage data will be reduced to average daily stage and combined with flow measurements collected during the same period to compute a hydraulic rating curve.

To ensure accurate readings, and protect the data recorder and transducer a stilling well will be established at each monitoring site. The stilling well is constructed by laying a 1.5 inch diameter PVC pipe and well screen horizontally in the stream bed with vertical pipe attached. A pressure transducer placed in the vertical pipe is used to collected stage heights at a predetermined time interval. The stage is recorded by a digital data logger protected in a metal box or a PVC sleeve (L.1.1).

Equipment List

___Date recorder/Data Logger
___Pressure transducer and connecting cable
___Stilling well.

Field Maintenance and Calibration

1. The data logger should be visited a minimum of every two weeks to down-load stored data, batteries and systems checked following manufacturers instruction.

2. Data stored in the data logger will be down loaded every two weeks to prevent data loss. Down loading may be accomplished in the field using a lap top computer, or the whole unit may be retrieved and downloaded on a PC. If removing from field for downloading the unit will be returned to the field and re-calibrated within 48-hours.

3. The transducer should be checked and calibrated monthly to ensure accuracy. Calibration checks should be performed following the owner's manuals.

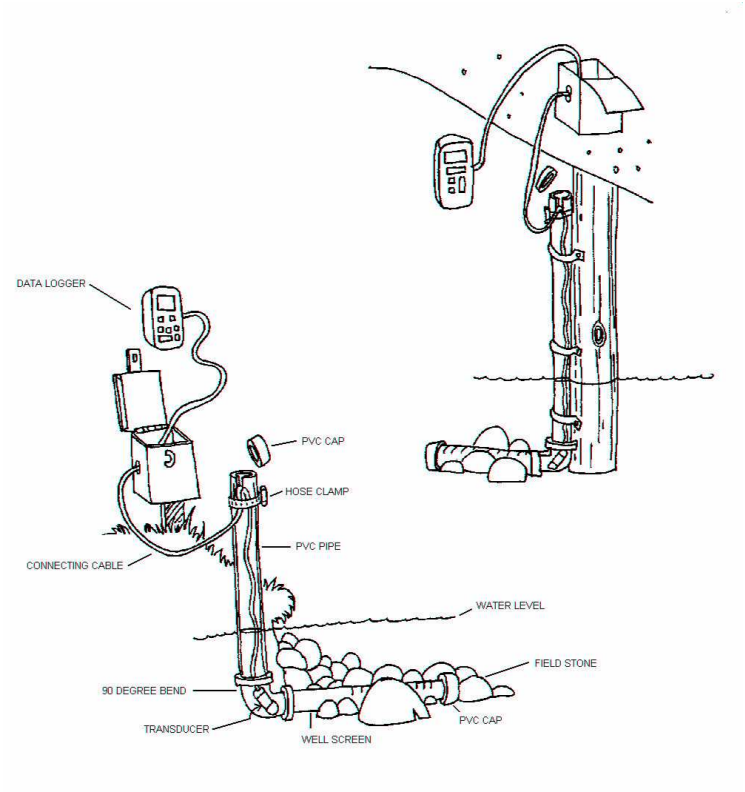


Figure 1. Examples of Automated Stream Stage Recorder Set Up.

Appendix E - Standard Operating Procedures for the Collection of a Macroinvertebrate Sample from Wadable Rivers and Streams

Summary

Macroinvertebrates are excellent indicators of aquatic health. Additionally, due to the range of life spans and varying needs throughout their life span macroinvertebrates are excellent indicators of chronic and acute pollution impacts.

In rivers and streams which naturally contain cobble (riffle/run) habitat, a single sample collected from this habitat is considered representative of the stream reach. Many rivers and streams in the state, however, do not naturally contain cobble substrate. These rivers and streams are typically low gradient streams with sandy or silty sediments. In cases where cobble substrate represents less than 30 % of the sampling reach in reference streams (i.e., least impaired streams which represent the ecoregion or basin) the multi-habitat method for collecting macroinvertebrate samples should be used (Section 3.19.2). It is important to recognize that the appropriate sampling method (single or multi-habitat) should be selected based on the habitat availability of the reference condition and not of potentially impaired streams. For example, the multi-habitat method should not be used for stream reaches where the extent of cobble substrate was reduced due to anthropogenic sediment deposition. Conversely, the single-habitat method should not be used where the stream reach contains artificially introduced rock or cobble material.

The following methods have been developed, in part, based on the Rapid Bioassessment Protocols for Use in Streams and Wadable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition (Barbour et al. 1999).

7.19.1 Field Collection Procedures for Single-Habitat Macroinvertebrate Samples

Equipment list

___ D-Frame net, Kick net, Surber Bottom Sampler, or Hess Bottom Sampler (500-600 μm mesh opening)
___ Waders (chest-high or hip boots)
___ Sample containers (1 and 2 liter plastic jars)
___ Sample container labels (waterproof Nalgene Polypaper)
___ 95 % Ethanol
___ Sieve bucket (500 μm mesh opening)
___ Forceps
___ Permanent marker (black)
___ Pencils, clipboard
___ Field Recording and Log Forms
___ Camera
___ Global Positioning System (GPS) Unit (optional)

Procedures

1. Once the sampling reach has been selected (Note: The area should be at least 100 meters upstream from any road or bridge crossing to minimize its effect on stream velocity, depth and overall habitat quality.), complete the Biological Monitoring Field Collection Data Recording Form (Figure 7.19.1). To record the latitude and longitude, use a hand held Global Positioning System (GPS) and determine latitude and longitude at the furthest downstream point of the sampling reach. On the recording form, draw a site map of the sampling reach. The map should include in-stream attributes (e.g., riffles, fallen trees, pools, bends), important structures, attributes of the bank and near bank area, and the location of all areas sampled. The map should also include an arrow in the direction of flow and an arrow depicting north.

2. A composite sample is collected from a minimum of three “kicks”each located at various velocities, in the riffle or series of riffles. (Note: The composite sample should consist of a minimum of 300 organisms, therefore, additional kick samples may be required.) A “kick” is a stationary sampling accomplished by disturbing area in front of the full width of the net to a distance 1 meter upstream of the net. Using the toe or heel of the boot, dislodge the upper layer of cobble or gravel and scrape the underlying bed. Larger rocks should be picked up and rubbed by hand to remove attached organisms. This method presumes a D-frame net with a 454 cm^2

opening is used, however, other gear types (e.g., kick-net, Surber sample, Hess sampler, etc.) may be used depending on project specific Quality Assurance Project Plans.

3. The individual kicks collected for each area in the riffle or series of riffles is composited into a single homogeneous sample. After every kick, place the sample in a sieve bucket, or in the sample net, wash the collected material with clean stream water 2-3 times. Remove large debris after rinsing and inspecting it for organisms, placing all organisms found into the sample container.

4. Transfer the sample from the sieve bucket or net to the sample container. Once all sample material is deposited in the sample container, decant excess water from the container and preserve in enough 95 % ethanol to cover the sample. (Note: Forceps may be needed to remove organisms from the net.)

5. Place a Nalgene Polypaper label in the sample container and label the outside of the container with black permanent marker. Both labels should contain the station identification number and description, the field number, date and time of collection, and the collector(s) name. The outside of the container should also contain the words: “preservative: 95% ethanol.” If more than one container is used for a sample, each container should contain all the information for the sample and should be numbered 1 of 2, 2 of 2, etc.

6. Record each sample on the Macroinvertebrate Sample Log Form (Figure 7.19.2). Include information such as field number, station identification and description, date and time, and number of containers.

North Dakota Department of Health
Division of Water Quality
Biological Monitoring Field Collection Data Recording Form

Station ID: _____ Field Number: _____
Station Description: _____
Latitude: _____ Longitude: _____
Township: _____ Range: _____ Section: _____
River Basin: _____ Ecoregion: _____
Weather (air temp, wind, etc.): _____
Water Temp: _____ Flow: _____ Comments: _____
Reach Length (m): _____ Average Reach Width (m): _____ Average Reach Depth (m): _____
Stream Habitat Type (%): Riffle: ____ Pool: ____ Snag: ____ Aquatic Vegetation: ____ Undercut Bank: ____
Overhanging Vegetation: ____ Other: _____
Bottom SubstrateType(%): Boulder: ____ Cobble: ____ Gravel: ____ Sand: ____ Silt: ____ Clay: ____
Collection Method: _____Time Start: _____ Time Stop:_____ Total Time:_____
Habitat Assesment: Yes or No Macroinvertebrate Sample: Yes or No Water Chemistry: Yes or No
Sampler(s): _____
Comments: _____
_____

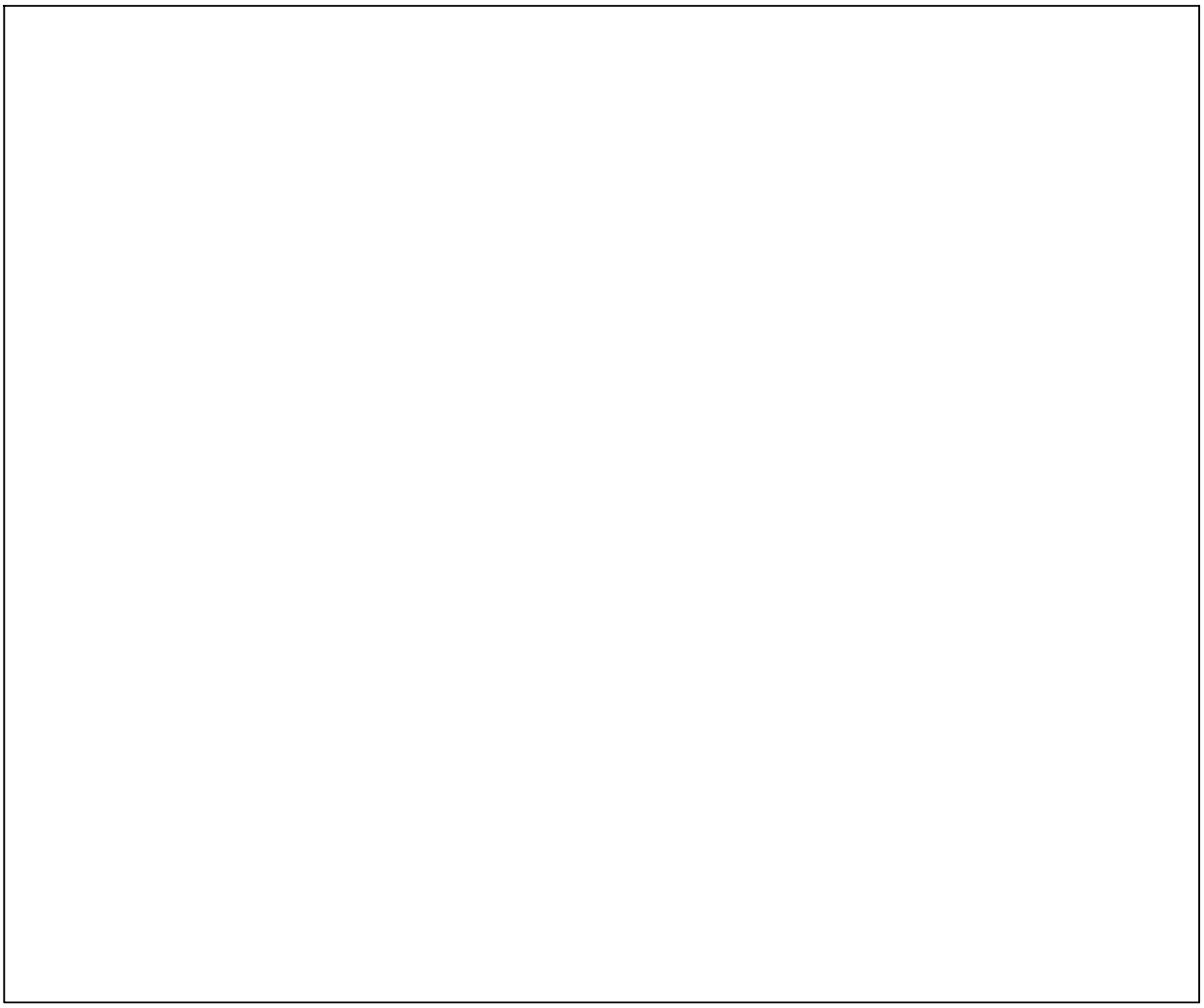


Figure 7.19.1. Macroinvertebrate Field Collection Data Recording Form

North Dakota Department of Health
Division of Water Quality
Macroinvertebrate Field Sample Log

Field Number	Station ID and Description	Date/ Time	Collection Method	Comments

Figure 7.19.2. Macroinvertebrate Sample Log

Equipment list

___ D-frame net (454 cm^2 opening and 600 micron mesh)
___ Waders (chest-high or hip boots)
___ Sample containers (1 and 2 liter plastic jars)
___ Sample container labels (water proof Nalgene Polypaper)
___ 95 % Ethanol
___ Sieve bucket (500 μm mesh opening)
___ Forceps
___ Permanent magic marker (black)
___ Pencils, clipboard
___ Field Recording and Log Forms
___ Camera
___ Global Positioning System (GPS) Unit (optional)___Chest waders

Procedures

1. Once the sampling reach has been selected (Note: The area should be at least 100 meters upstream from any road or bridge crossing to minimize its effect on stream velocity, depth and overall habitat quality.), complete the Macroinvertebrate Field Collection Data Recording Form (Figure 7.19.1). To record the latitude and longitude, use a hand held Global Positioning System (GPS) and determine latitude and longitude at the furthest downstream point of the sampling reach. On the recording form, draw a site map of the sampling reach. The map should include in-stream attributes (e.g., riffles, fallen trees, pools, bends), important structures, attributes of the bank and near bank area, **and the location of all areas sampled**. The map should also include an arrow in the direction of flow and an arrow depicting north.

2. A composite sample is collected from stable stream macroinvertebrate habitats in the sample reach (e.g., riffles, shoreline, aquatic vegetation, leaf pack, root wads, and snags). Each composite sample will consist of collecting 20 individual jab/kick samples apportioned among the stable stream habitats, with a minimum of 2 samples per habitat. Each available habitat is sampled in approximate proportion to their availability in the reach. For example, if a sampling reach is composed of 10 percent riffles, 40 percent pools with vegetation, and 50 percent runs with over hanging banks, 2 samples would be collected from the riffles, 8 from the pools and 10 from the runs. A minimum of two jabs or kicks should be collected from each available habitat type. Habitat types contributing less than 5 percent of stable habitat in the reach should not be sampled. In this case, allocate the remaining jabs proportionately among the predominant substrates. Record the number of jabs and kicks taken in each habitat type in the comments on the Field Data Recording Form (Figure 7.19.1).

3. Sampling begins at the downstream end of the reach and proceeds upstream. Each "jab" sample consists of forcefully thrusting the net into the productive habitat for a linear distance of 1 m. Kick samples should be collected from snag or riffle habitats. A "kick" is a stationary sample taken by positioning the net and disturbing the substrate for a distance of 1 m upstream of the net.

4. All 20 jabs/kicks, which are collected from the multiple habitats, will be composited into a single homogeneous sample. After every three individual jab/kick samples, more often if necessary, place the sample in a sieve bucket and wash the collected material by running clean stream water through the net two to three times. Remove large debris after rinsing and inspecting it for organisms; place any organisms found into the sample container. Do not spend time inspecting small debris in the field.

5. Transfer the sample from the sieve bucket into the sample container. Once all the individual samples are composited in the sample container, decant excess water from the container and preserve in enough 95 % ethanol to cover the sample. (Note: Forceps may be needed to remove organisms from the net.)

6. Place a Nalgene Polypaper label in the sample container and label the outside of the container with black permanent marker. Both labels should contain the station identification number and description, the field number, date and time of collection, and the collector(s) name. The outside of the container should also contain the words: "preservative: 95% ethanol." If more than on container is used for a sample, each container should contain all the information for the sample and should be numbered 1 of 2, 2 of 2, etc.

7. Record each sample on the Macroinvertebrate Field Sample Log Form (Figure 7.19.2). Include information such as field number, station identification and description, date and time, and number of containers.

Appendix F – James River Headwaters Water Quality Monitoring Locations

Figure 1. Water Quality Monitoring Stations and Nearby Population Centers

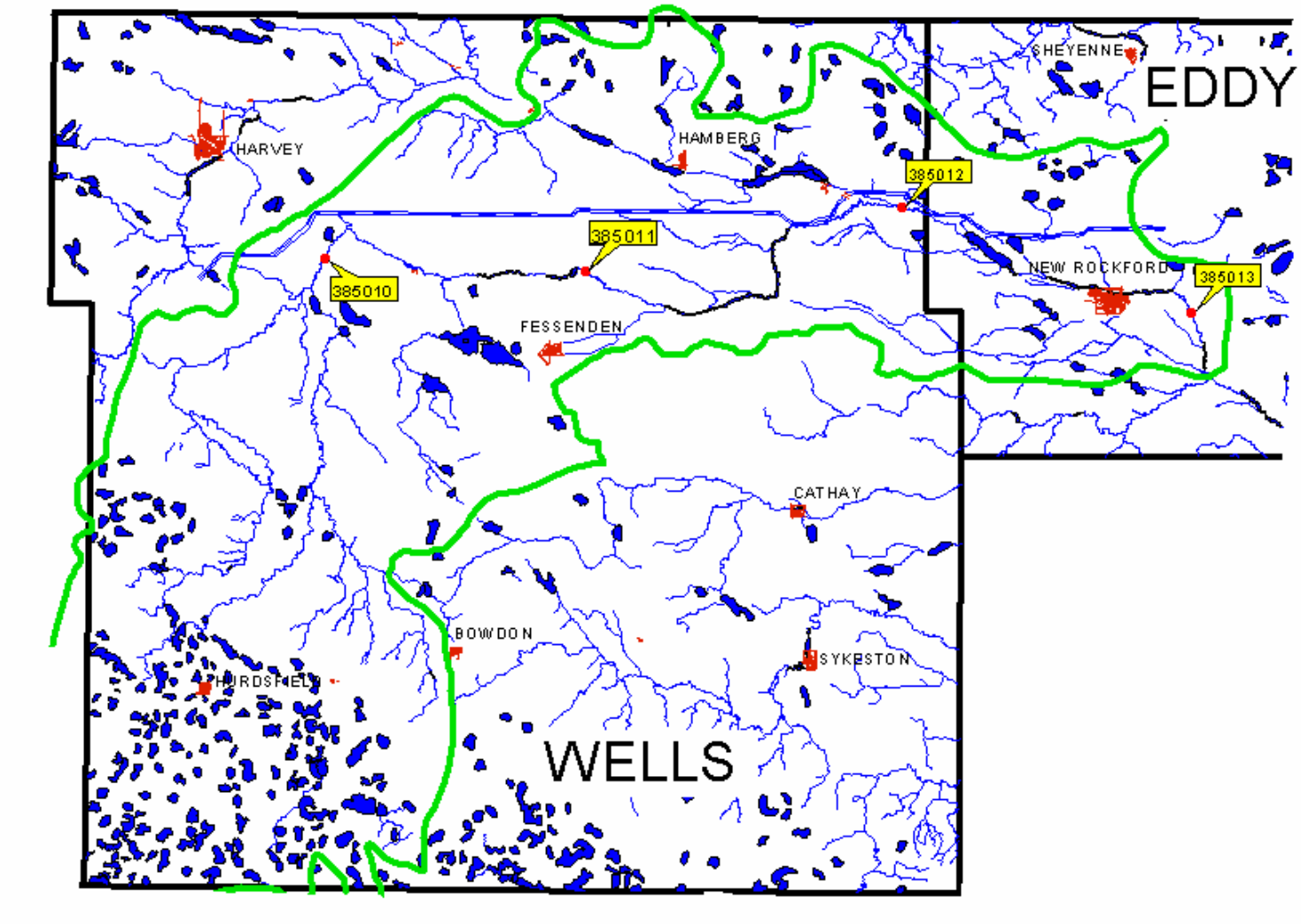


Figure 2. Location of water quality sites in the project watershed.

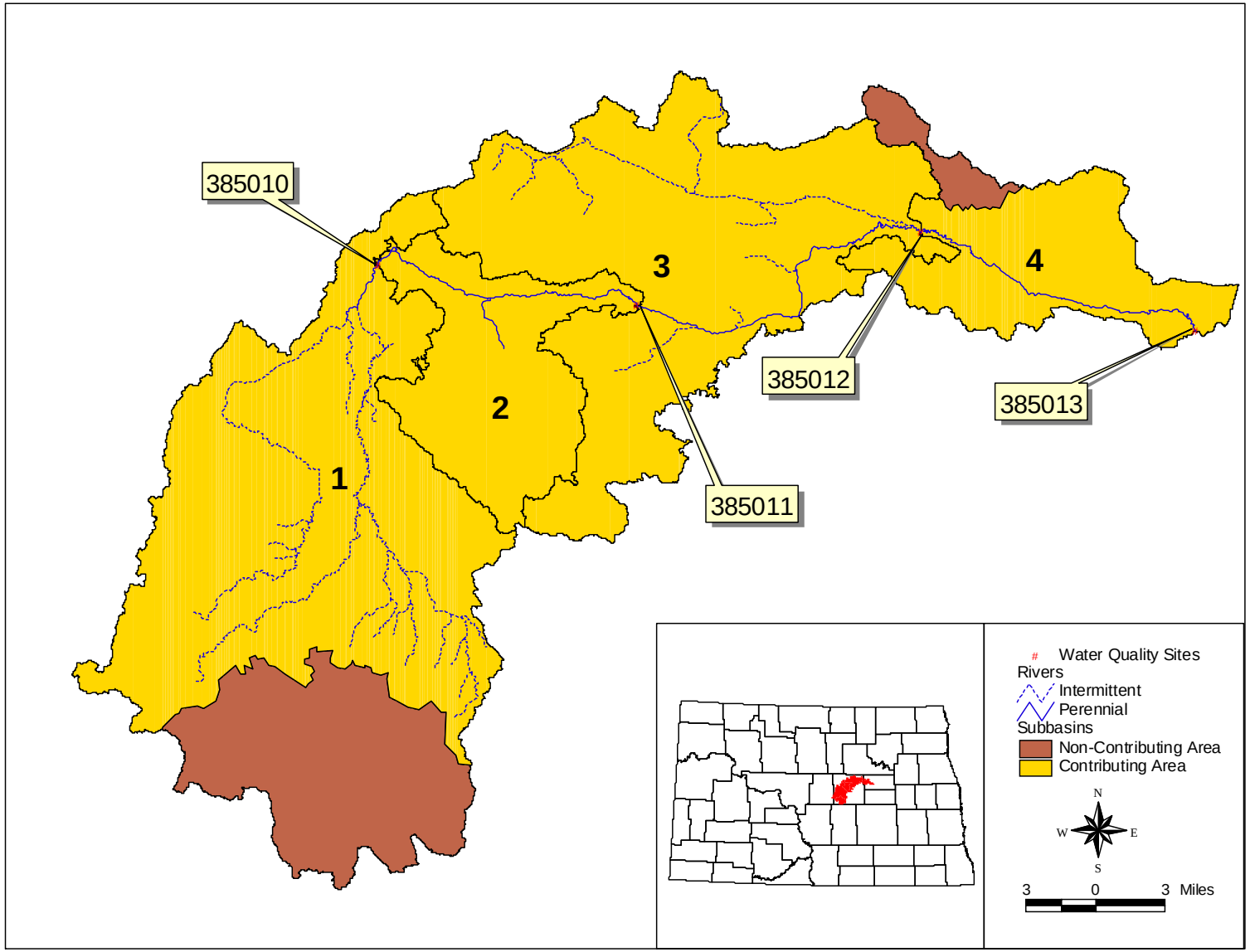
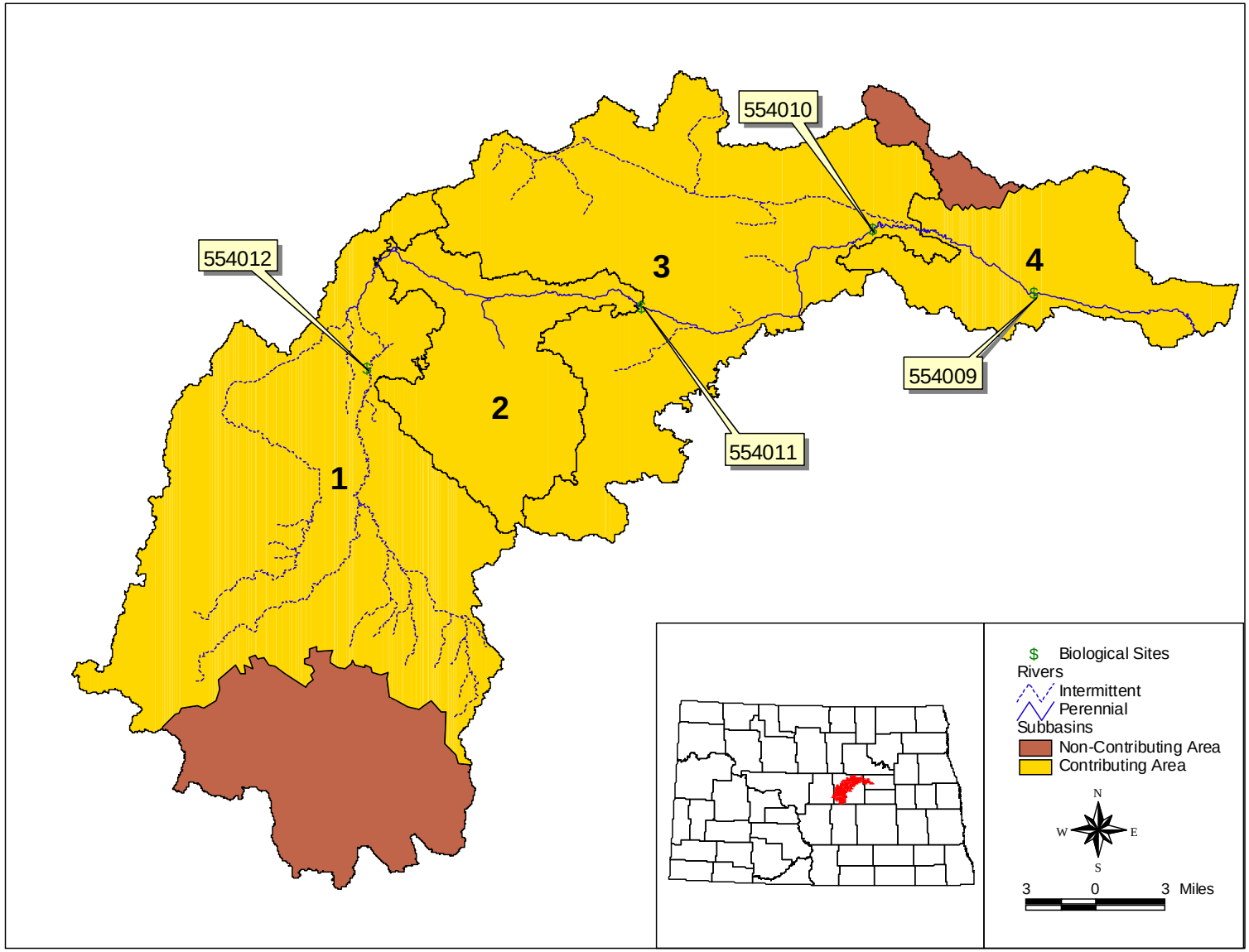


Figure 3. Location of macroinvertebrates sites in the project watershed



Appendix G - Standard Operating Procedures for Measuring Stream Stage Using Staff Gage Measurements

Summary

While continual stage records obtained from an automated stage recording system (stilling well and data logger) will provide the most accurate measurements of stream stage, this system is sometimes not practical. When an automated system is impractical, it may be necessary to obtain stream stage measurements from visual observations of a staff garage placed in the stream.

The accuracy of stream discharge estimates using this method is largely dependent on the frequency of stage measurements taken. When stream discharge is fairly uniform stage should be measured a minimum of once per day. During storm events or during spring runoff discharge should be measured more frequently. Stream stage height should also be measured whenever water quality samples are collected.

Stage Measuring Equipment

__Staff gauge constructed of a durable material that is easy to read with the naked eye or with the aid of binoculars.

Procedure

1. The staff gauge should be placed in the middle of the streambed. The gauge may be fixed to an existing structure (e.g., bridge piling) or may be attached to a pole. The placement should be such that it is easily read from a road or other access point.

2. Measure stream stage to the nearest 0.1 inch and record on the Stream Stage Recording Form (Figure 7.12.1)

Stage/Staff Gauge Record Form
North Dakota Department of Health
Division of Water Quality

LOCATION:
STORET NO.:

DATE	TIME	STAGE (ft)	INITIALS	COMMENTS

Figure G.1.1 Stream Stage Recording Form

Appendix H - Standard Operating Procedures for Laboratory Processing of Macroinvertebrate Samples

Summary

Macroinvertebrate samples collected in the field by either the single or multi-habitat method are best processed in the laboratory under controlled conditions. Aspects of laboratory sample processing include washing, rinsing, sub-sampling, sorting, identification, and enumeration of organisms.

The following protocol describes a method to sub-sample macroinvertebrates collected from a site. In cases where the sample contains large numbers of organisms, sub-sampling reduces the effort required for sorting and identification. The following protocol is based on a 300 organism sub-sample, but it can be used for any size sub-sample (100, 200, 500, etc.).

Equipment list

___ Laboratory sample log in forms (Figure 7.20.1)
___ Laboratory bench sheets for sorting and identification (7.20.2)
___ Sorting Pans (surface area of pan should be divided into grids of equal size for picking)
___ Forceps (both fine tipped, medium tipped and curved)
___ Dissecting Probes and Needles
___ Watch Glasses
___ Dissecting Scope (9X to 110X for final IDs)
___ Dissecting Scope (7X to 30X to aid in sorting)
___ Compound Microscope (4X, l0X, 40X, and 100X oil objectives and phase contrast optics)
___ Specimen Vials (assorted sizes of 1, 2, and 4 drams and larger with screw cap vials for voucher specimens)
___ Squeeze bottles (1 liter for 70% ethanol)
___ Eyedroppers
___ Tally counter
___ Hot plate
___ Microscopes slides
___ Microscope coverslips 1 oz. Round
___ Magnifying lens with light source for picking samples
___ Taxonomic keys
___ 70% Ethanol
___ Euparol and/or CMC 10 mounting media
___ Potassium Hydroxide (KOH) 10% by volume
___ Illuminator compatible with dissecting scope
___ Deck of numbered cards

Procedures

1. Sample Login In

Upon receipt by laboratory personnel, record all samples on the laboratory sample log in form (Figure 7.20.1). Include the date received and all information from the sample container label. If more than one container was used, record the number of containers per sample. All samples should be sorted in the same laboratory to enhance quality control.

2. Washing and Preparing the Sample for Sorting

Thoroughly rinse the sample in a 500 µm-mesh sieve to remove preservative and fine sediment. Large organic material (whole leaves, twigs, algae, or macrophyte mats, etc.) not removed in the field should be rinsed, visually inspected, and discarded. If the samples have been preserved in alcohol, it will be necessary to soak the sample contents in water for about 15 minutes to hydrate the benthic organisms. This

will prevent them from floating on the water surface during sorting. If the sample was stored in more than one container, the contents of all containers for a given sample should be combined at this time. Gently mix the sample by hand while rinsing to make the entire sample homogeneous.

After washing, spread the sample evenly across a pan marked with numbered grids approximately 6 cm × 6 cm. Along the sides and top of the gridded pan, line up numbered specimen vials, which will hold the sorted organisms. Start with vials 1-15 set up and have vials 16-30 available, if needed. If the sample is to be identified that day, these jars can contain water. If it is towards the end of the day and they will not be identified in the next twelve hours the jars should contain 70 percent ethanol.

3. Sample Sorting and Counting

Using a deck of cards that contains numbers corresponding to the numbered grids in the pan, draw a card to select a grid within the gridded pan. This is done to make sure a random sampling is carried out. Begin picking organisms from that square and placing them in the numbered vials. Any organism that is lying over a line separating two grids is considered to be on the grid containing its head. In those instances where it may not be possible to determine the location of the head (worms for instance), the organism is considered to be in the grid containing most of its body. Each numbered vial should contain one taxon of organisms. Use a tally counter to keep track of the total number of organisms. The tally counters can also be used to keep track of specific taxa (i.e., scuds or corixids) that may be in high abundance. When all organisms have been removed from the selected grid, draw another card and remove all the organisms from that grid in the same manner. If new taxa are found, place them in the next empty vial. Continue this process of drawing cards and picking grids. After 10 grids have been picked, determine the average number of organisms per grid and determine approximately how many total grids will be picked to reach 300 organisms. When approaching that number of grids, monitor the total count of organisms. A sample should not be stopped in the middle of picking a grid, so stop on a grid that will give a number of 300 organisms or more. This is done to eliminate any bias as to which organisms would be picked in the last grid. Rarely will the final count be exactly 300 organisms. Note on the bench data sheet how many grids were picked to get the final count. Save the remaining unsorted sample debris residue in a separate container labeled “sample residue”; this container should include the original sample label.

On the laboratory bench data sheet (Figure 7.20.2) write down the tentative identifications and total numbers of organisms for each vial. Examine vials under a 10X dissecting scope to count organisms and ensure that all organisms in a jar are of the same taxon. Do not try and separate taxa that are hard to differentiate, this will be done under higher power during the final identification. Once all vials have been recorded on the bench sheet, place screw tops on the vials, place the vials and bench sheet in to a designated tray and bring it over to the final identification station.

After laboratory processing is complete for a given sample, all sieves, pans, trays, etc., that have come in contact with the sample will be rinsed thoroughly, examined carefully, and picked free of organisms or debris; organisms found will be added to the sample residue.

4. **Sample Identification**

Final organism identifications should be done to the lowest taxonomic level practicable (genus/species preferred). In order to provide accurate taxonomic identification, midge (Chironomidae) larvae and pupae will be mounted on slides in an appropriate medium (e.g., Euperal, CMC-10); slides will be labeled with the site identifier, date collected, and the first initial and last name of the collector. As with midges, worms (Oligochaeta) must also be mounted on slides and should be appropriately labeled. All slides should be archived so further levels of identification can be done at a later date. Each taxon found in a sample is recorded and enumerated on the laboratory bench sheet (Figure 7.20.1). Any difficulties encountered during identification (e.g., missing gills) are noted on these sheets.

Record the identity and number of organisms in each taxonomic group on the laboratory bench sheet. Also, record the life stage of the organisms and the taxonomist’s initials. After each taxon is identified, the organisms will be placed in a container. A label with the site number, location, date of the sample, and taxonomic identification should also be placed in the container.

5. **Sample Vouchers and Storage**

In order to ensure accuracy and precision it is recommended that a voucher collection be established for each set of samples, which are enumerated and identified by a specific laboratory. A voucher collection is established by extracting individual specimens of each taxon from the sample collection. These individuals will be placed in specimen vials and tightly capped. A label that includes site, date, taxon, and identifying taxonomist will be place inside the vial. Slides that are to be included in the voucher collection must be initialed by the identifying taxonomist. A separate label may be added to slides to include the taxon (taxa) name(s) for use in a voucher or reference collection.

For archiving samples, specimen vials (grouped by voucher collection station and date) are placed in jars with a small amount of denatured 70 percent ethanol and tightly capped. The ethanol level in these jars must be examined periodically and replenished as needed, before ethanol loss from the specimen vials takes place. A stick-on label is placed on the outside of the jar indicating sample identifier, date, and preservative (denatured 70 percent ethanol). Voucher collections will be cataloged and placed in the North Dakota River and Stream Macroinvertebrate Collection located at Valley City State University by Dr. Andre DeLorme, Ph.D.

Figure 7.20.1

Page ___ of ___

North Dakota Department of Health
Division of Water Quality
Macroinvertebrate Laboratory Bench Data Sheet

Site: _____ Sample #: _____ Date sampled: _____

No. of Squares picked; _____Pickers: _____ Date ID: _____

Jar #	Phylum/ Order	Family	Genus Species	Final Count	Life Stage	Notes
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
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