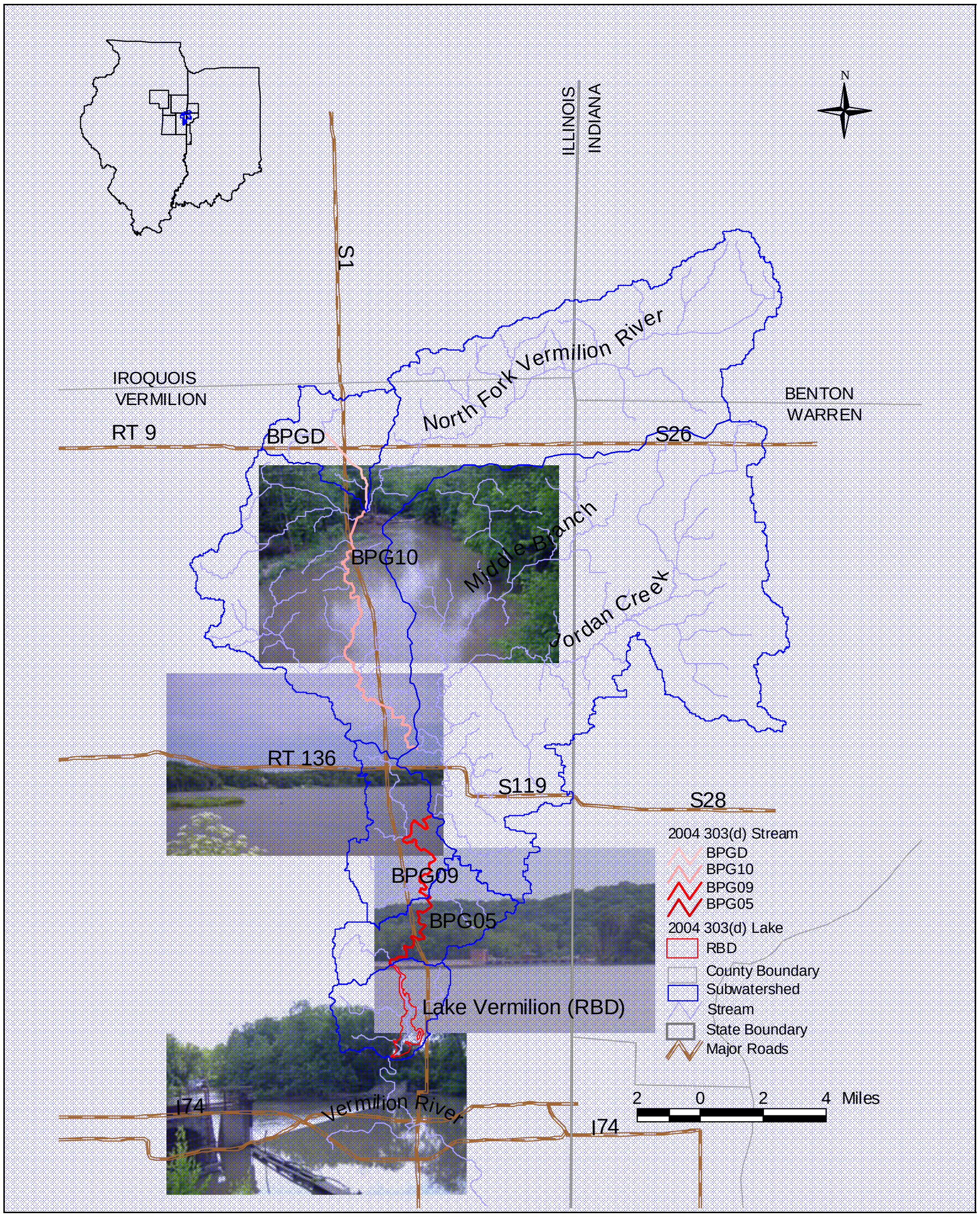
North Fork Vermilion River and Lake Vermilion TMDL

DRAFT FINAL REPORT FOR USEPA APPROVAL

Prepared for
Illinois Environmental Protection Agency



TETRA TECH, INC

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TABLE OF CONTENTS

Chapter **Page**

1.0 INTRODUCTION 1-1

2.0 WATERSHED AND WATER BODY CHARACTERISTICS 2-1

2.1 LOCATION 2-1
2.2 POPULATION 2-1
2.3 LAND USE AND LAND COVER 2-4
2.4 TOPOGRAPHY AND GEOLOGY 2-7
2.5 SOILS 2-8
2.6 WATERBODY CHARACTERISTICS 2-13

2.6.1 Hoopeston Branch 2-13
2.6.2 North Fork Vermilion River 2-13
2.6.3 Lake Vermilion 2-13

3.0 CLIMATE AND HYDROLOGY 3-1

3.1 CLIMATE 3-1
3.2 HYDROLOGY 3-2

4.0 WATER QUALITY 4-1

4.1 WATER QUALITY STANDARDS AND END POINTS 4-1

4.1.1 River Water Quality Standards 4-1
4.1.2 Lake Water Quality Standards 4-1
4.1.3 TMDL Endpoints 4-2

4.2 DATA AVAILABILITY 4-3
4.3 ASSESSMENT OF WATER QUALITY DATA 4-6

4.3.1 Hoopeston Branch (BPGD) 4-6
4.3.2 North Fork Vermilion River 4-6
4.3.2.1 Phosphorus 4-6
4.3.2.2 Nitrate Nitrogen 4-9
4.3.2.3 Fecal Coliform 4-10
4.3.3 Lake Vermilion (RBD) 4-13
4.3.3.1 Phosphorus 4-13
4.3.3.2 Nitrate Nitrogen 4-15
4.3.3.3 Limiting Nutrients 4-15
4.3.3.4 Trophic Index 4-16
4.3.3.5 Excessive Algal Growth/Chlorophyll-a 4-17

5.0 SOURCE ASSESSMENT 5-1

5.1 NONPOINT SOURCES 5-1
5.2 POINT SOURCES 5-2

TABLE OF CONTENTS (Continued)

Chapter **Page**

6.0 TECHNICAL ANALYSIS 6-1

6.1 WATERSHED FLOW ESTIMATE AND DURATION CURVE 6-1
6.2 LOAD CURVE AND LOAD ESTIMATE 6-3
6.3 BATHTUB MODEL DEVELOPMENT 6-5

6.3.1 Model Setup 6-6
6.3.2 Model Calibration 6-9

7.0 TMDL CALCULATION 7-1

7.1 LOADING CAPACITY – LINKING THE SOURCES WITH WATER QUALITY 7-1

7.1.1 North Fork Vermilion River Segment BPG05 7-1
7.1.2 North Fork Vermilion River Segment BPG09 7-1
7.1.3 Lake Vermilion River RBD 7-2

7.2 LOAD ALLOCATIONS 7-4

7.2.1 North Fork Vermilion River Segment BPG05 7-4
7.2.2 North Fork Vermilion River Segment BPG09 7-5
7.2.3 Lake Vermilion (RBD) 7-6
7.2.3.1 Total Phosphorus 7-6
7.2.3.2 Nitrate 7-7

7.3 MARGIN OF SAFETY 7-7
7.4 SEASONAL VARIATION 7-7

8.0 REFERENCES 8-1

APPENDIX

A FIELD PHOTO
B WATER QUALITY DATA
C BATHTUB INPUT AND OUTPUT
D WATER QUALITY SITE MAP IN LAKE VERMILION
E RESPONSIVENESS SUMMARY

TABLES

Table		Page
1-1	DESIGNATED USES OF IMPAIRED SEGMENTS	1-2
2-1	WATERSHED AREA DISTRIBUTION BY COUNTY	2-1
2-2	MUNICIPALITY POPULATION IN THE NORTH FORK VERMILION RIVER WATERSHED	2-3
2-3	WATERSHED POPULATION SUMMARIZED BY WATER BODY SEGMENT	2-3
2-4	POPULATION CHANGE	2-4
2-5	LAND USES IN SUBWATERSHED OF BPGD	2-4
2-6	LAND USES IN SUBWATERSHEDS (CUMULATIVE) OF BPG10	2-6
2-7	LAND USES IN SUBWATERSHEDS (CUMULATIVE) OF BPG09	2-6
2-8	LAND USES IN SUBWATERSHED (CUMULATIVE) OF BPG05	2-7
2-9	LAND USE IN RBD SUBWATERSHED (CUMULATIVE)	2-7
2-10	NRCS HYDROLOGIC SOIL GROUP	2-8
2-11	NORTH FORK VERMILION RIVER CHARACTERISTICS	2-13
2-12	LAKE VERMILION CHARACTERISTICS	2-14
3-1	CLIMATE CHARACTERISTICS NEAR DANVILLE, ILLINOIS	3-1
4-1	WATER QUALITY STANDARDS FOR LAKE VERMILION	4-2
4-2	TMDL ENDPOINTS	4-2
4-3	MONTHLY AVERAGE DISSOLVED AND TOTAL PHOSPHORUS CONCENTRATIONS, NORTH FORK VERMILION RIVER (BPG09)	4-9
4-4	MONTHLY AVERAGE DISSOLVED PHOSPHORUS AND TOTAL PHOSPHORUS CONCENTRATIONS IN LAKE VERMILION	4-14
4-5	AVERAGE TOTAL PHOSPHORUS AND TOTAL NITROGEN CONCENTRATIONS IN LAKE VERMILION	4-16
4-6	TROPHIC STATE INDEX FOR LAKE VERMILION	4-17
5-1	MAJOR POINT SOURCES DISCHARGING IN THE NORTH FORK VERMILION RIVER WATERSHED	5-3
6-1	POTENTIAL RELATIONSHIP OF HYDROLOGIC CONDITION AND LOAD CONTRIBUTION BY SOURCE	6-2
6-2.	ALLOWABLE AND EXISTING LOADS OF NITRATE AT BPG05	6-4
6-3	ALLOWABLE AND EXISTING LOADS OF FECAL COLIFORM AT BPG09 UNDER DIFFERENT FLOW CATEGORIES.	6-5
6-4	LAKE VERMILION MORPHOMETRY FOR BATHTUB	6-7
6-5	NORTH FORK VERMILION RIVER (TRIBUTARY) MEAN FLOWS, TP AND TN CONCENTRATIONS	6-8
6-6	PREDICTED AND OBSERVED NUTRIENT CONCENTRATIONS IN LAKE VERMILION FOR CURRENT CONDITIONS	6-10
6-7	PREDICTED CONCENTRATIONS AND LOADS IN LAKE VERMILION FOR CURRENT CONDITIONS	6-11
7-1	PREDICTED NUTRIENT CONCENTRATIONS IN LAKE VERMILION AFTER TARGET LOAD REDUCTIONS	7-2
7-2	TRIBUTARY AND LAKE MAXIMUM FLOWS AND MAXIMUM NITRATE CONCENTRATIONS FOR CURRENT CONDITIONS	7-3
7-3	NITRATE PERCENTAGE REDUCTION IN INPUT CONCENTRATIONS FOR LAKE VERMILION	7-4
7-4	TMDL SUMMARY FOR THE NITRATE AT BPG05	7-5
7-5	SUMMARY OF WASTE LOAD ALLOCATION FROM POINT SOURCE DISCHARGES IN THE NORTH FORK VERMILION RIVER WATERSHED	7-5
7-6	TMDL SUMMARY FOR FECAL COLIFORM AT BPG09	7-6
7-7	TMDL SUMMARY FOR LAKE VERMILION	7-6
7-8	NITRATE TMDL SUMMARY FOR LAKE VERMILION	7-7

FIGURES

Figure Page

2-1 NORTH FORK VERMILION RIVER WATERSHED....2-2
2-2 LAND USE AND LAND COVER MAP 2-5
2-3 HYDROLOGIC SOIL GROUP MAP 2-10
2-4 SOIL EROSION K-FACTOR MAP....2-11
2-5 DEPTH TO SEASONAL HIGH WATER TABLE....2-12
2-6 LAKE VERMILLION DISCHARGE....2-15
3-1 NORTH FORK VERMILION RIVER FLOW (1988 TO 2001) 3-2
3-2 NORTH FORK VERMILION RIVER FLOW FREQUENCY CURVE 3-3
3-3 MONTHLY AVERAGE FLOW AND PRECIPITATION IN NORTH FORK VERMILION RIVER WATERSHED 3-4
4-1 WATER QUALITY SAMPLING SITES....4-4
4-2 LOCATIONS OF SAMPLING SITES IN LAKE VERMILION 4-5
4-3 PHOSPHORUS CONCENTRATIONS IN NORTH FORK VERMILION RIVER AT BISMARCK (1978-2002)....4-7
4-4 INTERANNUAL VARIATION IN TOTAL PHOSPHORUS CONCENTRATIONS NORTH FORK VERMILION RIVER (BPG09) 4-8
4-5 MONTHLY TOTAL PHOSPHORUS CONCENTRATIONS NORTH FORK VERMILLION RIVER (BPG09) 4-8
4-6 MONTHLY NITRATE NITROGEN CONCENTRATIONS NORTH FORK VERMILION RIVER AT BISMARCK....4-11
4-7 FECAL COLIFORM CONCENTRATIONS NORTH FORK VERMILION RIVER AT BISMARCK (1978 TO 1998)....4-11
4-8 RELATIONSHIP BETWEEN FECAL COLIFORM CONCENTRATIONS AND FLOW RATE 4-12
4-9 MONTHLY FECAL COLIFORM CONCENTRATIONS NORTH FORK VERMILION RIVER (BPG09) 4-12
4-10 TOTAL PHOSPHORUS CONCENTRATIONS IN LAKE VERMILION (1977-2003)....4-13
4-11 MONTHLY AVERAGE TOTAL PHOSPHORUS CONCENTRATION IN LAKE VERMILION 4-14
4-12 NITRITE AND NITRATE CONCENTRATIONS IN LAKE VERMILION 4-15
4-13 TSI RELATIONSHIP TO LAKE FERTILITY 4-17
4-14 CHLOROPHYLL-A CONCENTRATIONS IN LAKE VERMILION....4-18
4-15 MONTHLY AVERAGE CHLOROPHYLL-A CONCENTRATIONS IN LAKE VERMILION....4-18
5-1 POINT SOURCE LOCATION MAP 5-4
6-1 FLOW DURATION CURVE FOR NORTH FORK VERMILION RIVER BPG05....6-2
6-2 NITRATE DURATION CURVE FOR BPG05....6-3
6-3 FECAL COLIFORM DURATION CURVE FOR BPG09....6-4
6-4 TKN VS. NO_3 + NO_2 MEASURED CONCENTRATIONS IN LAKE VERMILION....6-6
6-5 LAKE VERMILION SEGMENTS FOR BATHTUB 6-7
6-6 ANNUAL INFLOWS, OUTFLOWS, AND RAINFALL FOR LAKE VERMILION 6-10
7-1 REGRESSION CURVE FOR NITRATE CONCENTRATIONS....7-3

1.0 INTRODUCTION

Section 303(d) of the Clean Water Act (CWA) and the U.S. Environmental Protection Agency (USEPA) Water Quality Planning and Management Regulations (40 CFR Part 130) require states to identify water bodies that do not meet water quality standards and to determine the Total Maximum Daily Load (TMDL) for pollutants causing the impairment. A TMDL is the total amount of pollutant load that a water body can receive and still meet the water quality standards. It is the sum of the individual waste load allocation for point sources and load allocations for nonpoint sources and natural background with a margin of safety. The CWA establishes the process for completing TMDLs to provide more stringent, water-quality based controls when technology-based controls are not sufficient to achieve state water quality standards. A TMDL is also required to be developed with seasonal variations and must include a margin of safety that addresses the uncertainty in the analysis. The overall goals and objectives in developing the TMDLs include:

- Assess the water quality of the impaired waterbodies and identify key issues associated with the impairments and potential pollutant sources.
- Use the best available science and available data to determine the maximum load the waterbodies can receive and fully support all of their designated uses.
- Use the best available science and available data to determine current loads of pollutants to the impaired waterbodies.
- If current loads exceed the maximum allowable load, determine the load reduction that is needed.
- Identify feasible and cost-effective actions that can be taken to reduce loads.
- Inform and involve the public throughout the project to ensure that key concerns are addressed and the best available information is used.
- Submit a final TMDL report to USEPA for review and approval.

Under Section 303(d) of the CWA, the State of Illinois prepared a list of waters that are not meeting state water quality standards (hereafter referred to as the “303(d) list”) in each 2-year cycle. The most recent list was reviewed and approved by USEPA in 2004. The 303(d) list identifies five water bodies as impaired:

- North Fork Vermilion River (BPG05)
- North Fork Vermilion River (BPG09)
- North Fork Vermilion River (BPG10)
- Hoopeston Branch (BPGD)
- Lake Vermilion (RBD)

This report documents the analysis and findings of characterization of overall hydrology and water quality for the North Fork Vermilion River watershed; the TMDL development for Segments BPG05, BPG09, and RBD; and the implementation plan. The BPGD TMDL will be developed and included with this report as an addendum after the Stage 2 water quality sampling is completed by the end of September 2006. The bi-monthly sampling has been conducted since April 2006 in Hoopeston Branch. 80 percent of the sampling is completed. No TMDL will be developed for BPG10 because there is no numeric water quality standard for total nitrogen in streams. The focus of this TMDL is on the portion of the North Fork Vermilion River watershed that drains into Lake Vermilion. In this report, “North Fork Vermilion River watershed” refers to the watershed area upstream of Lake Vermilion dam, unless otherwise specified.

This chapter discusses the rationale for beneficial use designations and impairments for waters of the State of Illinois, and specifically, for the listed North Fork Vermilion River segments and Lake Vermilion in eastern Illinois. Chapter 2 describes the characteristics of the watershed and water bodies, and Chapter 3 addresses the climate and hydrology conditions. Chapter 4 describes the water quality standards and water quality assessment. Chapter 5 discusses the potential nonpoint and point sources that may cause the impairment. Chapter 6 describes the technical analysis for hydrology, loading, and linkage of sources and water quality. Chapter 7 presents the TMDL for Segments BPG05, BPG09, and RBD.

All waters of Illinois are assigned one of the following four designations: general use waters, public and food processing water supplies, Lake Michigan, and secondary contact and indigenous aquatic life waters. All Illinois waters must meet general use water quality standards unless they are subject to another specific designation (CWA Section 302.201). The general use standards protect the state's water for aquatic life (except as provided in Illinois Water Quality Standard Section 302.213), wildlife, agricultural use, secondary contact use, and most industrial uses, and they ensure the aesthetic quality of the state's aquatic environment. Primary contact uses are protected for all general use waters where the physical configuration permits such use. Unless otherwise specifically provided for and in addition to the general use standards, waters of the state must meet the public and food processing water quality standards at the points of water withdrawal for treatment and distribution as a potable supply or for food processing.

The designated uses and the causes of impairment addressed in this TMDL are summarized in Table 1-1. When a waterbody is assessed as partial support for a designated use, one violation of an applicable Illinois water quality standard at an Intensive Basin Surveys (IBS) or Facility-Related Stream Surveys (FRSS) site or one violation over three years at an Ambient Water Quality Monitoring Network (AWQMN) station is considered a basis for listing the violating parameter as a potential cause.

TABLE 1-1 DESIGNATED USES OF IMPAIRED SEGMENTS

Segment	Designated Use (Support Status)	Causes of Impairment	Impairments addressed in TMDL
North Fork Vermilion River (BPG05)	Aquatic life (full) Drinking water supply (partial)	Nitrogen Nitrate	Nitrogen Nitrate
North Fork Vermilion River (BPG09)	Aquatic life (full) Primary contact (not supporting)	Pathogen	Fecal Coliform
North Fork Vermilion River (BPG10)	Aquatic life (partial) Fish Consumption (not assessed)	Total Nitrogen (TN)	None
Hoopeston Branch (BPGD)	Aquatic life (partial)	Total Nitrogen (TN) Dissolved Oxygen (DO)	DO
Lake Vermilion (RBD)	Overall use (partial) Aquatic life support (full) Fish consumption (full) Primary contact (partial) Secondary contact (partial) Drinking water supply (partial)	Total Phosphorus (TP) and Nitrate	TP and Nitrate

Source: IEPA 2004 303(d) list

The North Fork Vermilion River and Hoopeston Branch segments addressed in this report are designated as a general use water body. As specified under Title 35 of the Illinois Administrative Code, Subtitle C, Part 302, waters of the state shall be free from sludge or bottom deposits (narrative standard for siltation), visible oil, odor, plant or algal growth (narrative standards for nutrients, eutrophication, or noxious aquatic plants), and color or turbidity of other than natural origin. Aquatic life is fully supported in segments BPG05, BPG09, and RBD while partially supported in segments BPG10 and BPGD. The primary contact use of the river is listed as non-support in segment BPG09 due to violation of the fecal coliform standard. Lake Vermilion (RBD) is the drinking water supply for the City of Danville. Drinking water supply use of Lake Vermilion is listed as partial support due to nitrate concentrations in excess of the 10 mg/L Public and Food Processing Standard. This standard applies to raw (untreated) source water at any point at which water is withdrawn from the waterbody for treatment and distribution as a potable water supply or for food processing. BPG05 is also assessed as partial support segment for drinking water supply use because it is located immediately upstream of RBD. In Lake Vermilion, aquatic life and fish consumption are fully supported, while its uses as a drinking water supply and for primary and secondary contact are partially supported, resulting in partial support of overall use. One purpose of this report is to verify the causes of impairment by comparing the available data to water quality standards.

In the 2004 Illinois Water Quality Report (IEPA, 2004), dissolved oxygen, total nitrogen, nitrate nitrogen, total suspended solids, sedimentation/siltation, and excessive algal growth were listed as potential causes of impairment for Lake Vermilion. The determination of these potential causes was based on applying the 2002 assessment methodology to the data collected from Lake Vermilion in 2000. As a result of the 2004 assessment update for Lake Vermilion, dissolved oxygen, sedimentation/siltation, and total nitrogen no longer apply as potential causes of impairment because Aquatic Life Use is not impaired. Therefore, since dissolved oxygen is not considered a potential cause of Aquatic Life Use impairment, a TMDL will not be developed for dissolved oxygen at this time. Furthermore, data show that the numeric general use water quality standard for total phosphorus (0.05 mg/L) was exceeded during the 2000 monitoring season and therefore, total phosphorus will be added as a potential cause of impairment for Secondary Contact Use and a TMDL will be developed for total phosphorus.

2.0 WATERSHED AND WATER BODY CHARACTERISTICS

This chapter describes the general hydrological characteristics of the North Fork Vermilion River watershed and water bodies, including their location, population, land use and cover, topography and geology, and soils. The discussion of general watershed characteristics is followed by specific information for the listed segments of the river and the lake.

2.1 LOCATION

The North Fork Vermillion River Watershed is located in central Illinois along the Illinois-Indiana border, as shown on Figure 2-1. Most of the watershed is located in Vermilion County, Illinois, with portions extending to Iroquois County in Illinois, and to Warren and Benton Counties in Indiana. The watershed drains about 295 square miles, with about 200 square miles in Illinois and 95 square miles in Indiana. The distribution of watershed area by county is shown in Table 2-1.

TABLE 2-1 WATERSHED AREA DISTRIBUTION BY COUNTY

County, State	Area of Watershed in County (Square Miles)	Percent of Watershed in County (Percent)
Vermilion County, Illinois	190	64
Iroquois County, Illinois	10	3
Warren County, Indiana	66	23
Benton County, Indiana	29	10

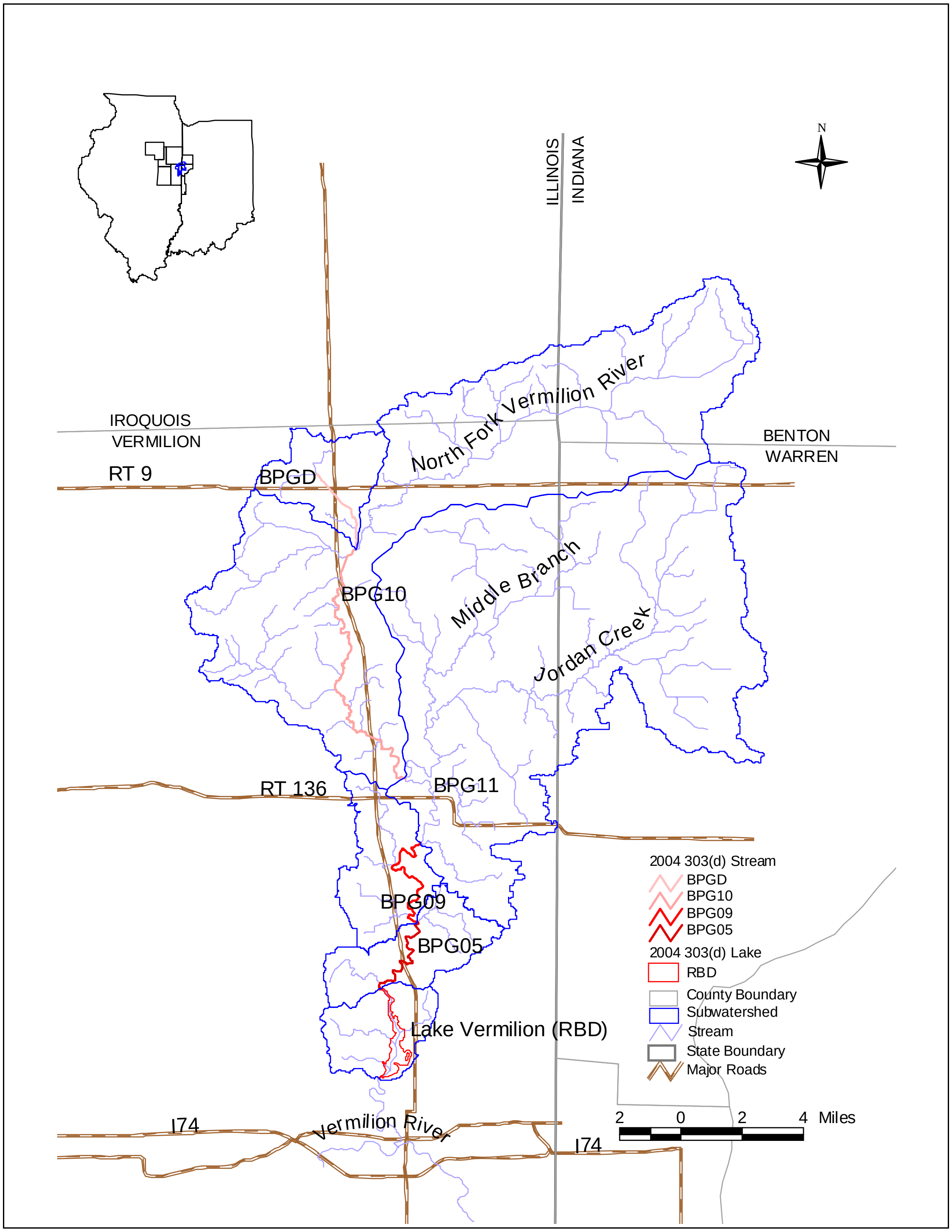
Lake Vermilion (RBD) is located in the southern portion of the watershed, 1 mile northwest of the City of Danville, about 5.2 miles upstream of the confluence of the North Fork Vermilion River with Vermilion River. BPG05 is located immediately upstream of Lake Vermilion, and extends about 9.82 miles. BPG09 starts at the confluence with Painter Creek and extends downstream 5.91 miles, directly flowing into BPG05. BPG10 starts at the confluence of Middle Branch and extends upstream 24.1 miles. BPGD is 4.72 mile Hoopeston Branch, extending from the confluence with North Fork Vermilion to the source water. The North Fork Vermilion River watershed is delineated into six subwatersheds, including the one draining to BPG11 (Figure 2-1). This TMDL focuses on the subwatersheds that drain to the listed North Fork Vermilion River segments (except BPG10), Hoopeston Branch, and Lake Vermilion segments. The watershed area between the dam and the confluence with the Vermilion River is not included in the TMDL. The characteristics of subwatersheds will be used for the load allocation for each segment in the TMDL development. The load allocation from the river segment (BPG05) can be treated as a lumped point source load to Lake Vermilion.

2.2 POPULATION

Total watershed population data is not directly available but population estimates may be calculated from the 2000 U.S. Census data. The census data were downloaded for all towns, cities, and counties with boundaries that were fully or partially within the watershed (U.S. Census Bureau 2000). Urban and nonurban populations were estimated for the watershed area and were summed to obtain the total watershed population. This section describes how urban and nonurban population estimates were determined from town, city, and county census data.

The urban watershed population is the sum of the populations for all municipalities located entirely in the watershed. For Danville, which is located partially in the watershed, a population weighting method was used to estimate its contribution to the urban watershed population. A geographic information system (GIS) spatial overlay of the town and city boundaries was used to determine that 27 percent of Danville is located in the Lake Vermilion subwatershed. Assuming a uniform distribution of population throughout

FIGURE 2-1 NORTH FORK VERMILION RIVER WATERSHED



Danville, the population of Danville was multiplied by 27 percent to estimate its contribution to the urban population. Table 2-2 lists the populations of each municipality in the watershed. The contributing population for each area was summed to obtain total urban watershed population for the two subwatersheds.

TABLE 2-2 MUNICIPALITY POPULATION IN THE NORTH FORK VERMILION RIVER WATERSHED

Subwatershed	Municipality/County	Urban population
BPGD	Hoopeston/Vermilion	5,965
BPG10	Ambia/Benton Rossville/Vermilion	197 1,217
BPG09	Alvin/Vermilion Bismarck/Vermilion Henning/Vermilion	316 542 241
BPG05	NA	NA
RBD	Danville/Vermilion	9,154[a]
Total		**17,632**

Notes:
NA Not applicable (no municipalities located in the subwatershed)
a Represents 27 percent of the total Danville population of 33,904; 27 percent of Danville is located in the watershed.
Source: U.S. Census Bureau 2000

The first step in calculating the nonurban watershed population was to subtract the county urban population from the total county population. The portion of nonurban population in each subwatershed was then calculated by multiplying the percent area of the county in the subwatershed by the nonurban population of the county. For example, the nonurban population of Vermilion County is 23,263. 2.51 percent of Vermilion County is in the Lake Vermilion subwatershed, and 18.7 percent of Vermilion County is in the North Fork Vermilion River subwatershed. Therefore, 2.51 percent of 23,263 (584) is assumed to be in the Lake Vermilion subwatershed, and 18.7 percent of 23,263 (4,350) is assumed to be in the North Fork Vermilion River subwatershed. The results from these calculations for each subwatershed and county are shown in Table 2-3. These results are based on the assumption that nonurban populations are uniformly distributed throughout each county.

TABLE 2-3 WATERSHED POPULATION SUMMARIZED BY WATER BODY SEGMENT

Waterbody Segment	County	Watershed Population	Percent Watershed Population	Urban population	Percent Urban Population	Nonurban Population	Percent Nonurban Population
North Fork Vermilion River[a]	Benton	424	2.99	197	1.39	227	1.60
	Iroquois	102	0.73	0	0.00	102	0.73
	Vermilion	12,631	89.21	8,281	58.49	4,350	30.72
	Warren	1,001	7.07	0	0.00	1,001	7.07
	Total	**14,158**	**100**	**8,478**	**59.88**	**5,680**	**40.12**
Lake (RBD)	Vermilion	**9,738**	**100**	**9,154**	**94.00**	**584**	**6.00**

a Include BPGD, BPG05, BPG09, and BPG10 subwatersheds

Source: U.S Census Bureau 2000 and USEPA 1998

Table 2-4 shows the population change between 1990 and 2000 for each county in the watershed. Detailed population data by county and town were not available for 1990, so percent urban and nonurban population change in each watershed could not be calculated. However, data indicate that the population in the watershed is likely decreasing. Between 1990 and 2000, the population of Danville decreased from

37,025 to 33,904, which further supports a decreasing population trend in the watershed (U.S. Census Bureau 1990 and 2000).

TABLE 2-4 POPULATION CHANGE

County in the Watershed	1990 Population	2000 Population	Absolute Change	Percent Change
Benton	**9,441**	**9,421**	**-20**	**-0.21%**
Iroquois	**30,787**	**31,334**	**547**	**1.78%**
Vermilion	**88,254**	**83,919**	**-4,335**	**-5.17%**
Warren	**8,176**	**8,419**	**243**	**2.97%**
Weighted Average				**-2.61%**

Sources: U.S Census Bureau 1990 and 2000

2.3 LAND USE AND LAND COVER

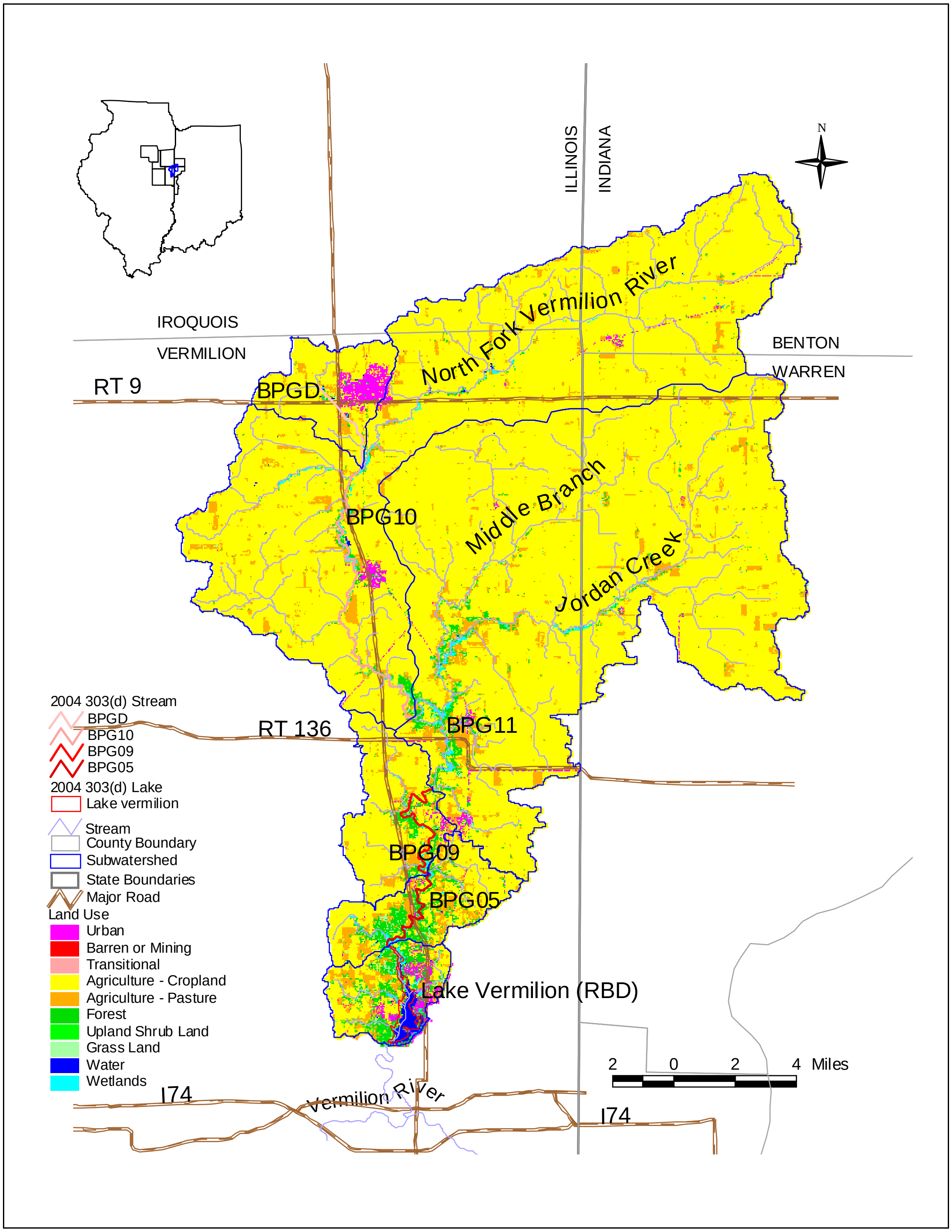
Figure 2-2 presents land use and land cover in the North Fork Vermilion River watershed. Land use data for the North Fork Vermilion River Watershed was obtained from the U.S. Geological Survey (USGS) Geographic Information Retrieval and Analysis (GIRAS) data files. The files consist of 1993 land use/land cover digital data collected by USGS and converted to ARC/INFO by USEPA (EPA 2000). The data can be used for environmental assessment of land use patterns with respect to water quality analysis, growth management, and other types of environmental impact assessment. Illinois Gap Analysis Program (GAP) land use and land cover data provides detailed classification of agriculture land. However, the State of Indiana does not have land classification compatible to Illinois. The GAP data is not used for land use analysis. Land use is calculated for subwatersheds contributing to each listed segment.

Table 2-5 summarizes the land use for the BPGD subwatershed and shows that the agriculture cropland accounts for about 75 percent of the 6,926 acre subwatershed area. The urban land accounts for 14 percent, mainly attributed to the City of Hoopeston. The other land uses account for less than 1 percent each. BPGD subwatershed drains to North Fork Vermilion River BPG10. Pasture land (8.3 percent) is considered rural grassland with possible grazing activities.

TABLE 2-5 LAND USES IN SUBWATERSHED OF BPGD

Land Use	Area (acre)	Percentage of Upstream Watershed Area
Cropland	5,230.2	75.52
Pasture	575.9	8.31
Forest	68.1	0.98
Urban	979.1	14.14
Wetland	16.7	0.24
Grass Land	41.3	0.60
Water	13.1	0.19
Barren or Mining	1.6	0.02
Total	**6,925.9**	**100.00**

FIGURE 2-2 LAND USE AND LAND COVER MAP



The BPG10 subwatershed consists of predominantly agricultural land, over 90 percent, as shown in Table 2-6. Pasture land is about 6 percent, followed by urban land 1.8 percent, and forestland 1.2 percent. No TMDL will be developed for BPG10 because there is no existing numeric water quality standard for total nitrogen, which is the cause for listing.

TABLE 2-6 LAND USES IN SUBWATERSHEDS (CUMULATIVE) OF BPG10

Land Use	**Area (acre)**	**Percentage of Upstream Watershed Area**
Cropland	72,865.3	90.25
Pasture	4,706.3	5.83
Forest	960.5	1.19
Urban	1,464.4	1.81
Wetland	408.5	0.51
Grass Land	254.7	0.32
Water	73.4	0.09
Barren or Mining	2.3	0.003
Total	**80,735.5**	**100.00**

Table 2-7 summarizes land use for the BPG09 subwatershed of North Fork Vermilion River. It is predominantly agricultural crop land, accounting for 89.6 percent of the total watershed area. Pasture land accounts for about 6.5 percent, and forest land accounts for 1.8 percent. Agricultural lands are mostly located upstream near the headwater area. Major crops are corn, small grains, and soybeans.

TABLE 2-7 LAND USES IN SUBWATERSHEDS (CUMULATIVE) OF BPG09

Land Use	**Area (acre)**	**Percentage of Upstream Watershed Area**
Cropland	156,359.1	89.56
Pasture	11,293.4	6.47
Forest	3,215.1	1.84
Urban	1,896.3	1.09
Wetland	969.7	0.56
Grass Land	752.8	0.43
Water	93.5	0.05
Barren or Mining	3.0	0.002
Total	**174,583.0**	**100.00**

The BPG05 subwatershed represents the drainage area upstream of Lake Vermilion, which includes BPG09 subwatershed plus the lateral contributing area along the BPG05 segment. The land use distribution is similar to BPG09 subwatershed, with cropland at 88 percent, pasture at 7 percent, forest at 2.5 percent, and urban at 1.1 percent. Wetland, grassland, water, and barren or mining together account for about 1.4 percent (Table 2-8).

TABLE 2-8 LAND USES IN SUBWATERSHED (CUMULATIVE) OF BPG05

Land Use	Area (acre)	Percentage of Upstream Watershed Area
Cropland	160,803.2	88.10
Pasture	12,925.4	7.08
Forest	4,541.8	2.49
Urban	1,984.6	1.09
Wetland	1,132.7	0.62
Grass Land	1,037.3	0.57
Water	105.0	0.06
Barren or Mining	3.0	0.002
Total	**182,532.9**	**100.00**

The RBD subwatershed is the portion of the Vermilion River Watershed upstream of Lake Vermilion, including BPG05 watershed and the area that drains directly to the lake. Table 2-9 summarizes the land use for the RBD subwatershed that drains directly to the lake. The area surrounding Lake Vermilion is also predominately agricultural land and urban land.

TABLE 2-9 LAND USE IN RBD SUBWATERSHED (CUMULATIVE)

Land Use	Area (acre)	Percentage of Upstream Watershed Area
Cropland	162,868.9	86.20
Pasture	14,102.5	7.46
Forest	5,981.2	3.17
Urban	2,604.2	1.38
Wetland	1,344.7	0.71
Grass Land	1,307.4	0.69
Water	708.8	0.38
Upland Shrub Land	27.5	0.01
Barren or Mining	3.0	0.002
Transitional	1.6	0.001
Total	**188,949.9**	**100.00**

2.4 TOPOGRAPHY AND GEOLOGY

The North Fork Vermilion River watershed has rough topography resulting from fluvial erosion through glacial drift. The rivers have broad floodplains formed by glacial lakes. The highest point in the watershed is at an elevation of about 820 feet and the lowest point is at about 520 feet (NGVD 1929). The rivers have incised through a relatively thin cover of unconsolidated materials overlying the La Salle Anticlinorium, and their drainage patterns are largely controlled by joint patterns associated with the La Salle Anticlinorium. Sedimentary rocks of Ordovician and Pennsylvanian age are exposed along the waterways throughout the area. Two geological time periods are well represented: the Pennsylvanian (the age of coal) and the Quaternary (the age of glaciers).

The bedrock strata that immediately underlie most of the surface materials in the Vermilion River area are Pennsylvanian age. They were formed from sediments deposited some 290 million years ago when what is now Illinois was covered by shallow seas with large swamps near the shore. These wet, swampy areas supported a lush forest of large trees, tree and seed ferns, and giant scouring rushes. As the plants fell into the swampy waters, they were partially preserved, buried by later sediments and eventually converted into coal. Pennsylvanian-age bedrock is classified by cyclothems, which are based on this cyclical sedimentation.

Other landscape features resulted from the multiple glacial advances across the region. The glaciers left moraines, terraces, kames, an entrenched meander, and sand dunes. A succession of moraines (deposits that mark where a glacier melted and advanced at the same rate) are present across the land surface. These moraine ridges generally trend northwest to southeast, then continue to loop around to the east. The Bloomington Moraine, a prominent feature of the Oakwood area, is one of the largest in Illinois and represents the southernmost extent of a re-advance of a glacier some 15,000 years ago.

As the glaciers melted, water poured down the Wabash Valley, rapidly deepening it. In addition, glacial Lake Watseka, located to the north, breached the Chatsworth Moraine. Its outwash material flowed south following what is now the course of the North Fork Vermilion River. The valley of the Vermilion River, including the Salt Fork, became entrenched below the upland. The Vermilion River cut its channel 60 feet below the upland into the Pennsylvanian bedrock.

East of Rossville is an area of sand 2 miles wide and 3 miles long that has been blown into dunes. The sand dunes are the result of glacial ice. They were deposited when the valley of the North Fork Vermilion River filled with outwash from a melting glacier or with valley train deposits (outwash that has been deposited in a stream valley) from the draining of ancient Lake Watseka.

2.5 SOILS

Soils data and GIS files from the Natural Resources Conservation Service (NRCS) were used to characterize soils in the North Fork Vermilion River watershed. General soils data and map unit delineations for the country are provided as part of the State Soil Geographic (STATSGO) database. GIS coverage provide locations for the soil map units at a scale of 1:250,000 (USDA, 1995). A map unit is composed of several soil series having similar properties. Identification fields in the GIS coverage can be linked to a database that provides information on chemical and physical soil characteristics. The STATSGO database contains many soil characteristics associated with each map unit. Of particular interest are the hydrologic soil group, the K-factor of the Universal Soil Loss Equation (USLE), and depth to water table.

The hydrologic soil group classification identifies soil groups with similar infiltration and runoff characteristics during periods of prolonged wetting. Typically, clay soils that are poorly drained have lower infiltration rates, while well-drained sandy soils have the greatest infiltration rates. NRCS (2001) has defined four hydrologic groups for soils as listed in Table 2-10.

TABLE 2-10 NRCS HYDROLOGIC SOIL GROUP

Hydrologic Soil Group	Description
A	Soils with high infiltrations rates. Usually deep, well drained sands or gravels. Little runoff.
B	Soils with moderate infiltration rates. Usually moderately deep, moderately well drained soils.
C	Soils with slow infiltration rates. Soils with finer textures and slow water movement.
D	Soils with very slow infiltration rates. Soils with high clay content and poor drainage. High amounts of runoff.

Dual hydrologic groups, A/D, B/D, and C/D, are given for certain wet soils that can be adequately drained. The first letter applies to the drained condition, the second to the undrained. Only soils that are rated D in their natural condition are assigned to dual classes. Soils may be assigned to dual groups if drainage is feasible and practical. Figure 2-3 displays the STATSGO hydrologic soil group map for the North Fork Vermillion River watershed. For the North Fork Vermilion River watershed, Hydrologic Soil Group C accounts for 30.2 percent and is mostly located along the river channel. Hydrologic Soil Group D (poorly drained) accounts for 42.7 percent and located in upper land of the watershed. Hydrologic Soil Group B covers about 27.1 percent in the northern portion of the watershed.

A commonly used soil attribute of interest is the K-factor, a coefficient used in the USLE (Wischmeier and Smith, 1978). The K-factor is a dimensionless measure of a soil's natural susceptibility to erosion. Factor values may range from 0 for water surfaces to 1.00 (although in practice, maximum factor values do not generally exceed 0.67). Large K-factor values reflect greater potential soil erodibility. The distribution of K-factor values in the North Fork Vermilion River watershed is shown in Figure 2-4. The figure indicates K-Factors ranging from 0.28 to 0.43; 44 percent of watershed area has a K-factor of 0.32, 35 percent has a K-factor of 0.43, and 21 percent of the area has a K-factor of 0.28. A very small portion of the watershed in Indiana has a K-factor of 0.37. These more highly erodible soils are primarily distributed on both sides of North Fork Vermilion River in the central portion of the watershed.

FIGURE 2-3 HYDROLOGIC SOIL GROUP MAP

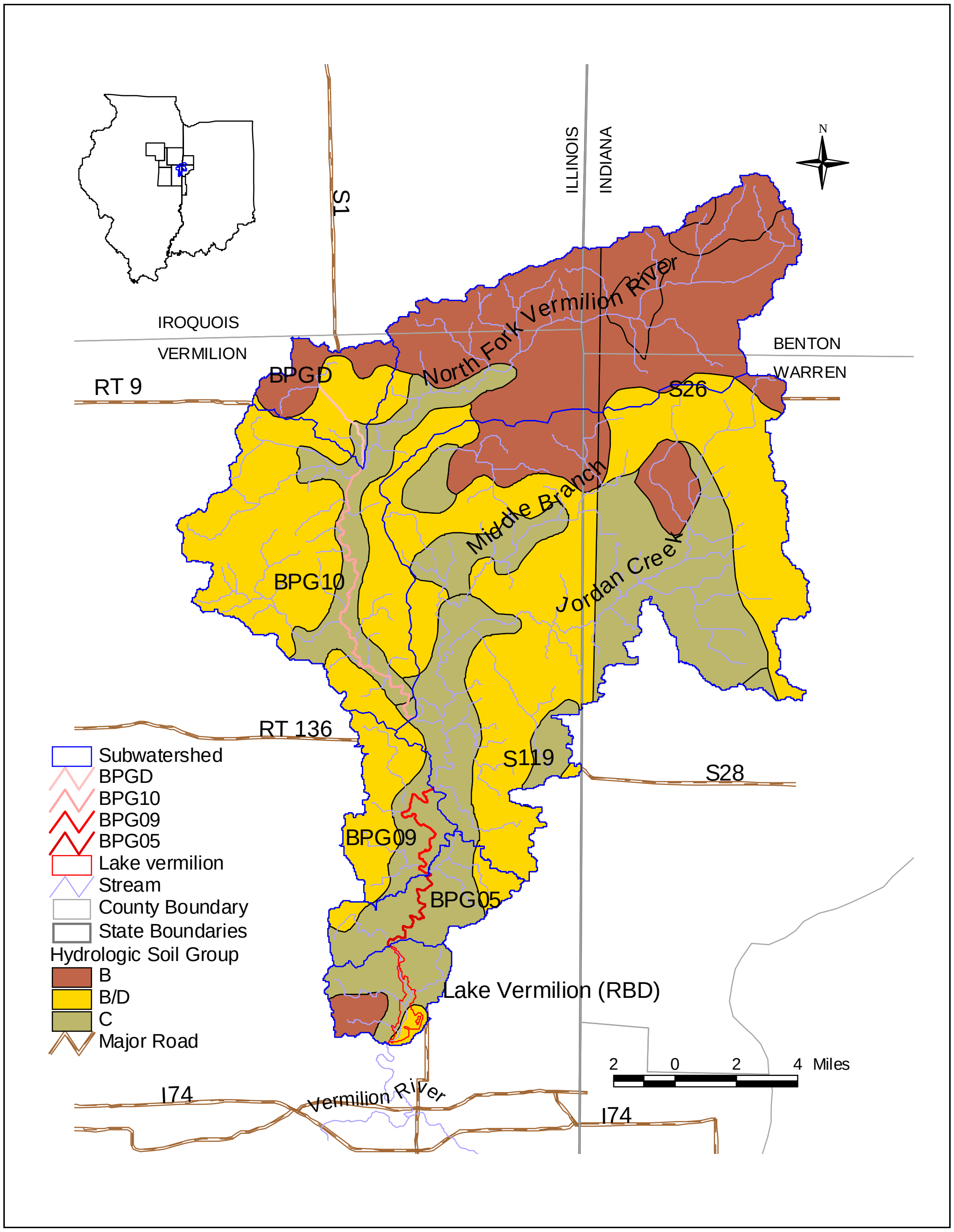
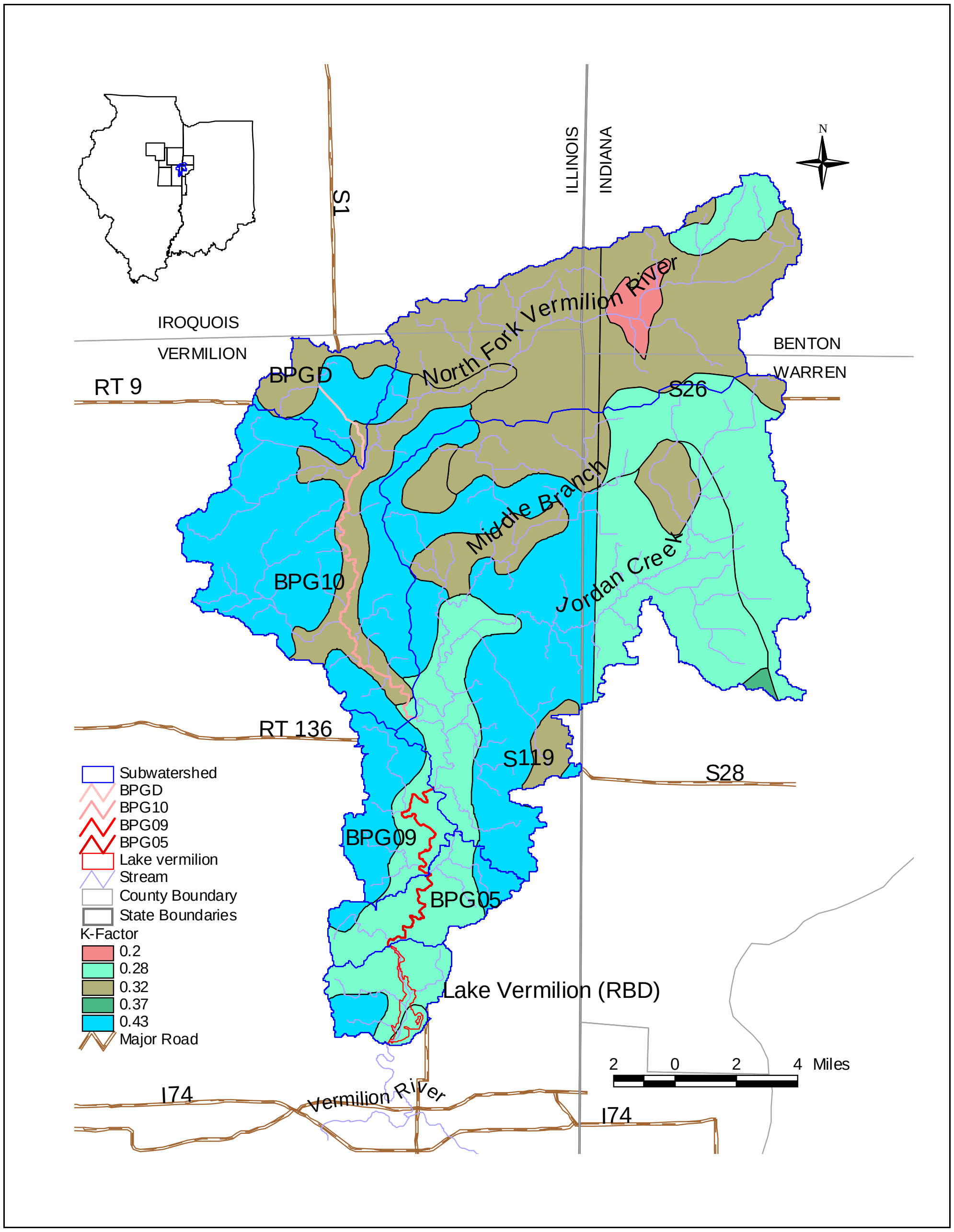
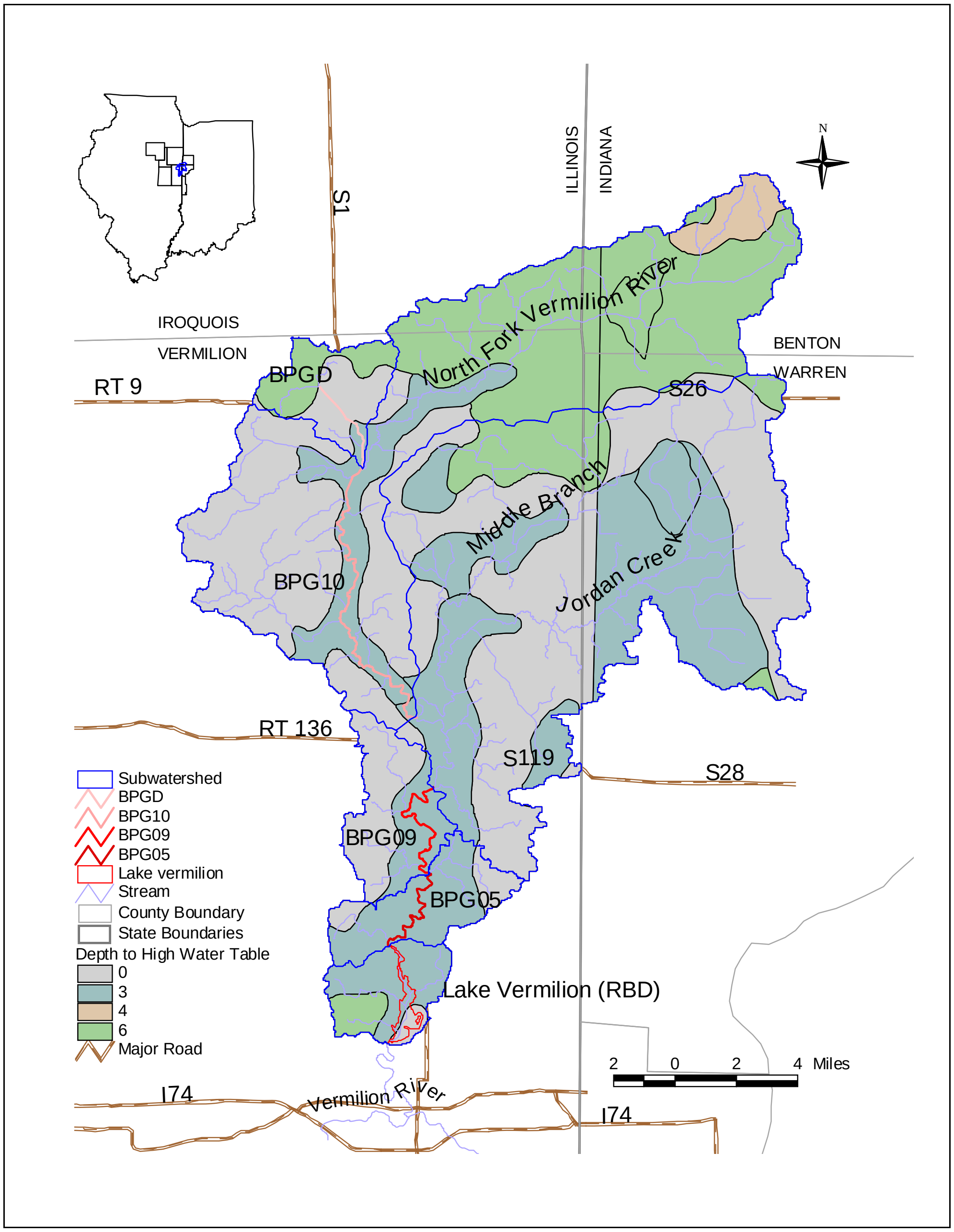


FIGURE 2-4   SOIL EROSION K-FACTOR MAP



The depth to the groundwater table determines the groundwater flow contribution to the North Fork Vermilion River. When the depth is shallower, there is a better chance for groundwater to discharge to the river and lake. The depth to the water table varies seasonally. The estimated depth to the water table is based on NRCS Soil Survey. Each soil unit has an estimated depth to the water table associated with it. Figure 2-5 presents the distribution of depth to the seasonal high water table in the watershed. The southern portion of the watershed and channel valley has a relatively shallow groundwater level, with the depth to water table ranging from 0 to 3 feet. The water table at the northern end of the watershed is deeper, with a depth of about 6 feet.

FIGURE 2-5 DEPTH TO SEASONAL HIGH WATER TABLE



2.6 WATERBODY CHARACTERISTICS

This section discusses waterbody characteristics for the North Fork Vermilion River and Lake Vermilion.

2.6.1 Hoopeston Branch

Hoopeston Branch is a 4.72 mile, second-order tributary to North Fork Vermilion River, flowing from northwest to southeast. Its headwater is located in the northwest corner of the North Fork Vermillion River watershed. The average slope of the branch is about 0.006%. The subwatershed area is 10.8 square miles. Based on USGS topography, the portion of Hoopeston Branch near Hoopeston is channelized. The estimated channel width is about 8 feet.

2.6.2 North Fork Vermilion River

The North Fork Vermilion River flows about 62 miles from its headwaters in Benton County, Indiana, to Lake Vermilion in Danville, Illinois, then into the Vermilion River. The river flows through the following towns from upstream to downstream: Ambia, Indiana; and Hoopeston, Rossville, Henning, Alvin, Bismarck, and Danville, Illinois. The North Fork Vermilion River has a sand, gravel, and rubble substrate. The listed segments include BPG10, BPG09, and BPG05 from upstream to downstream, as shown on Figure 2-1. Table 2-11 summarizes the characteristics of the North Fork Vermilion River including both listed and not listed segments.

TABLE 2-11 NORTH FORK VERMILION RIVER CHARACTERISTICS

Characteristic	Value[a]
Reach length	62 miles[b]
10-year, 7-day low flow	1.24 cubic feet per second (cfs)
Low flow mean velocity	0.22 cfs
Mean flow	297 cfs
Mean velocity	1.01 fs
Bottom of reach elevation	520 feet above sea level[b]
Mean stream slope	0.071 percent[b]
Mean width	24.1 ft

Notes:
a Table includes characteristics for segments of North Fork Vermilion River upstream of Lake Vermilion.
b Source: Illinois State Water Survey 2003

Source: USEPA 1998 unless otherwise noted

2.6.3 Lake Vermilion

Lake Vermilion is a drinking water reservoir located northwest of Danville, Illinois. The lake is managed by Consumer Illinois Water Company (Tetra Tech, 2004a). In 1902, a dam was constructed near Jaycee’s Park to increase storage for water supply. The dam was reconstructed in 1914 to augment flow to the pre-existing channel dam adjacent to the water treatment plant. A review of the lake bathymetry indicates that the old dam still exists, which may affect local hydrodynamic and lake circulation.

The present dam and spillway was constructed in 1925 south of the old dam. In 1991, it was further enhanced to increase reservoir capacity. The dam is located at 40°9'24" North latitude and 87°39'8" West longitude in Section 31, T 20N R 11W Township in Vermillion County, Illinois. The 1991 enhancements increased the pool level from 576 to 582.2 feet (NGVD 1929) using extensions that had been added to the original spillway gates (ISWS, 1999). The elongated lake has an average length-width ratio of about 18. County Highway 20 (Denmark Road) crosses the southern portion of the lake. The road embankment narrows the waterway, which separates the lake into two parts and may affect lake circulation. West Newell Road crosses the lake's north end, where the North Fork Vermilion River flows in. More detailed information about the old dam and roads will be needed to model the lake's hydrodynamic conditions and water quality. Consumer Illinois Water Company uses 13 cubic feet per second from the lake to meet water supply demands. Table 2-12 summarizes characteristics of Lake Vermilion.

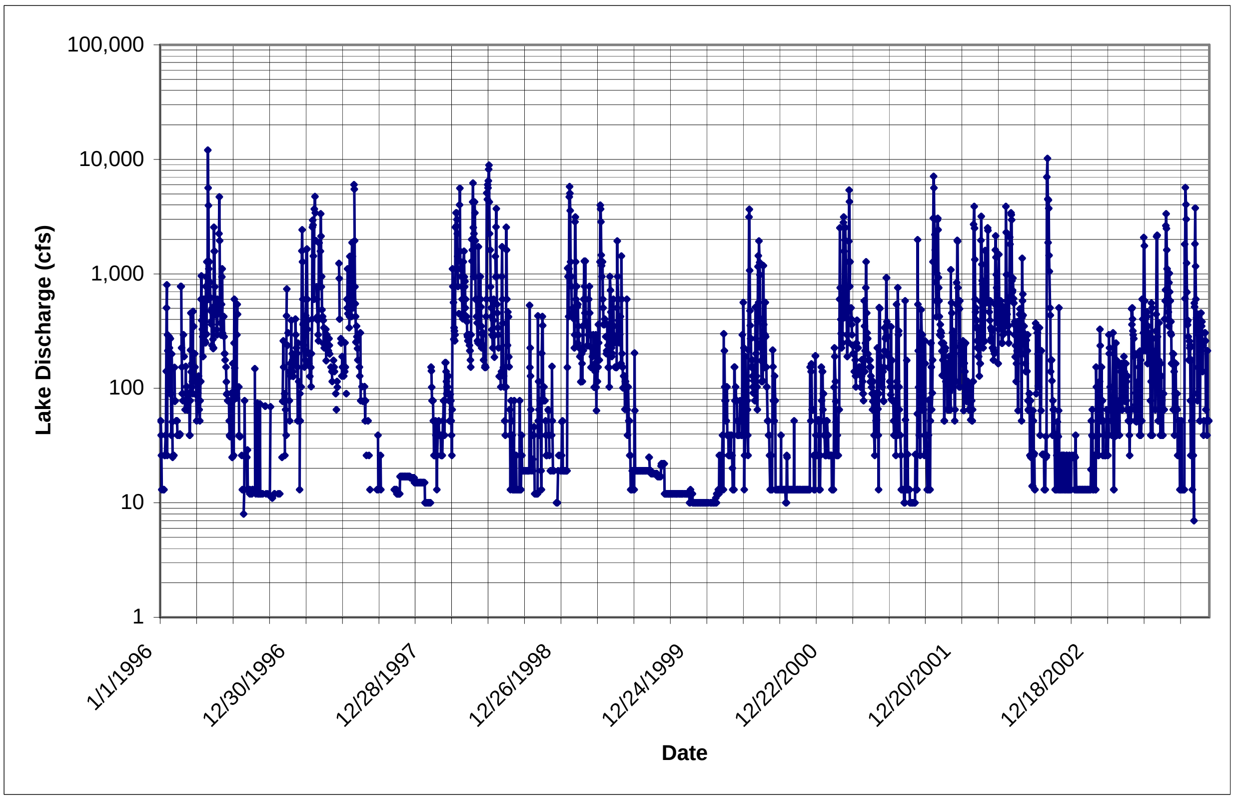
TABLE 2-12 LAKE VERMILION CHARACTERISTICS

Characteristic	Value
Drainage area	295 square miles
Water surface	880 acres[a]
Service spillway crest elevation	582.2 feet NGVD[a,b]
Emergency spillway elevation	582.7 feet NGVD[b]
Maximum storage	7,900 acre-feet[a]
Normal storage	7,900 acre-feet[a]
Maximum pool length	3.6 miles[a]
Shoreline length	22 miles[b]
Average depth	12 feet near center [a,b] 6 feet near northern end[a,b]
Maximum depth	22 feet (near dam)[b]
Dam length	600 feet[b]
Designed maximum discharge	38,220 cfs[b]
Average hydraulic retention time	15 days

Notes:
NGVD National Geodetic Vertical Datum
a Source: Illinois State Water Survey 1999
b Source: Tetra Tech 2004a
Source: USEPA 1998 unless otherwise noted

Discharge from the lake is controlled by the extended spillway gate. Figure 2-6 shows the lake discharge data for 1996 to 2002. The minimum discharge from the lake is 13 cfs, the average discharge from the lake is 100 cfs, and the maximum discharge of 16,000 cfs was recorded in 1994 (Tetra Tech, 2004a). The average annual lake evaporation rate observed at Urbana, Illinois, is 10.5 inches per year. The Consumers Illinois Water Company treatment plant is located near the downstream side of the new dam. There is no water intake structure in the lake; instead, water is released through the spillway to a holding basin 2.5 river miles downstream near the water treatment plant, then pumped in to the plant. The plant's design production capacity is 14 million gallons per day (MGD). The spillway gate is regulated to maintain the stable lake level. During low flows, the release is controlled to sustain the water yield of the plant. In 2002, the water treatment plant was improved to increase the nitrate removal efficiency, chloramine disinfection, and other performance enhancements (Lin and Bogner, 2004).

FIGURE 2-6 LAKE VERMILLION DISCHARGE



Source: Consumer Illinois Water Company (2004)

3.0 CLIMATE AND HYDROLOGY

This section discusses the climate of the watershed and its hydrology.

3.1 CLIMATE

The eastern portion of Illinois has a continental climate with cold, rather dry winters, and warm humid summers. Table 3-1 summarizes climate characteristic near Danville, Illinois. The average annual precipitation at Danville, Illinois is about 40.8 inches. Monthly average precipitation is about 3.4 inches. Months from March through August are wet months, with average precipitation between 3.2 and 4.7 inches per month. Months from September to February are relatively dry, with average precipitation of 2.5 inches for the normally driest months of October and February. On average, there are 122 days with precipitation. Severe droughts are infrequent, but prolonged dry periods during a part of the growing season are not unusual. Such periods usually cause reduced crop yields. A single thunderstorm often produces more than 1 inch of rain and occasionally is accompanied by hail and damaging winds. More than 4.5 inches of rain has fallen within a 24-hour period and nearly 15 inches during a month. Some fall and winter months have had less than 0.25 inch of precipitation. The average annual temperature at Danville, Illinois is approximately 52.5 °F. The maximum and minimum average temperatures are 65.9 and 42.9 °F, respectively.

TABLE 3-1 CLIMATE CHARACTERISTICS NEAR DANVILLE, ILLINOIS

Climate Variable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Average temp. (°F)	25.8	31	41.9	52.8	63	71.8	75.3	73.4	66.6	55	42.7	30.9	52.5
High temperature (°F)	34.2	40	52	64.5	75.2	83.5	86.2	84.1	78.4	66.6	51.6	38.7	62.9
Low temperature (°F)	17.3	21.9	31.7	41	50.7	60	64.3	62.6	54.7	43.3	33.8	23	42.0
Precipitation (in)	2	2	3.2	3.8	4.5	4.7	4.4	3.9	3	3	3.5	2.8	40.8 (total)
Days with Precip	11	9	12	12	12	10	10	9	8	8	10	11	122 (total)
Average Wind speed (mph)	11.1	11.1	11.9	11.6	9.9	8.8	7.7	7.3	8.1	9.2	10.8	10.8	9.9
Morning humidity (%)	81	81	80	79	82	83	87	90	89	86	84	83	83.8
Afternoon humidity (%)	71	68	62	57	58	58	61	61	59	58	67	72	62.7
Sunshine (%)	42	50	50	54	61	66	67	68	65	61	43	40	55.6
Days clear of clouds	6	6	6	6	7	7	8	9	11	11	6	6	7.4
Partly cloudy days	6	6	7	7	9	11	12	11	9	8	7	6	8.3
Cloudy days	19	16	18	17	15	12	10	10	11	12	17	20	14.8
Snowfall (in)	6.6	5.4	3.7	0.6	0	0	0	0	0	0.2	1.9	5.4	2.0

Notes:

°F Degrees Fahrenheit
in Inch
mph Miles per hour
% Percent
Source: http://www.sws.uiuc.edu/atmos/statecli/Summary/112140.htm, Data Period: 1971-2000

The region has daily high temperatures greater than 90 °F about 45 days per year and subzero degree Fahrenheit temperatures on the average 1 day, or less, per year. Annual average snowfall is about 10 inches with large variations in snowfall occurring from year to year. Sunshine averages more than 70 percent during the three summer months, but only 45 percent during the winter months. Precipitation occurs an average of 10-days per month with snowfall occurring in October through April (ISWS, 1998).

3.2 HYDROLOGY

Hydrology in North Fork Vermilion River is mostly affected by glacial processes and deposits that cover the watershed. The principal source of surface runoff is precipitation that enters the stream as overland flow, which is rainwater or snowmelt that flows over the land surface toward stream channels. In agricultural areas, there is more infiltration and much less overland flow compared to urban areas. The average annual runoff is 15.43 inches (total annual runoff volume divided by watershed area), which accounts for about 38 percent of annual precipitation. Groundwater discharge to streams affects the flow and water quality of the stream. The actual groundwater contribution can be determined by a water balance in the river.

USGS station 03338780 is located in the North Fork Vermilion River near the bridge at the intersection of Vermilion County Road 2750 N, about 1.8 miles west of Bismarck, 1.9 miles downstream from the Painter Creek confluence, and 6.6 miles downstream from the confluence of the Middle Branch of the North Fork Vermilion River. The station measured flow from June 1970 to September 1974 partially and fully from October 1988 to present. Figure 3-1 shows the flows from 1988 to 2001. The mean flow is 297.4 cfs, and the median flow is 107 cfs. The maximum flow of 14,500 cfs was recorded on April 12, 1994. The minimum flow of 2.5 cfs was recorded in September 1991, which was a very dry month.

FIGURE 3-1 NORTH FORK VERMILION RIVER FLOW (1988 TO 2001)

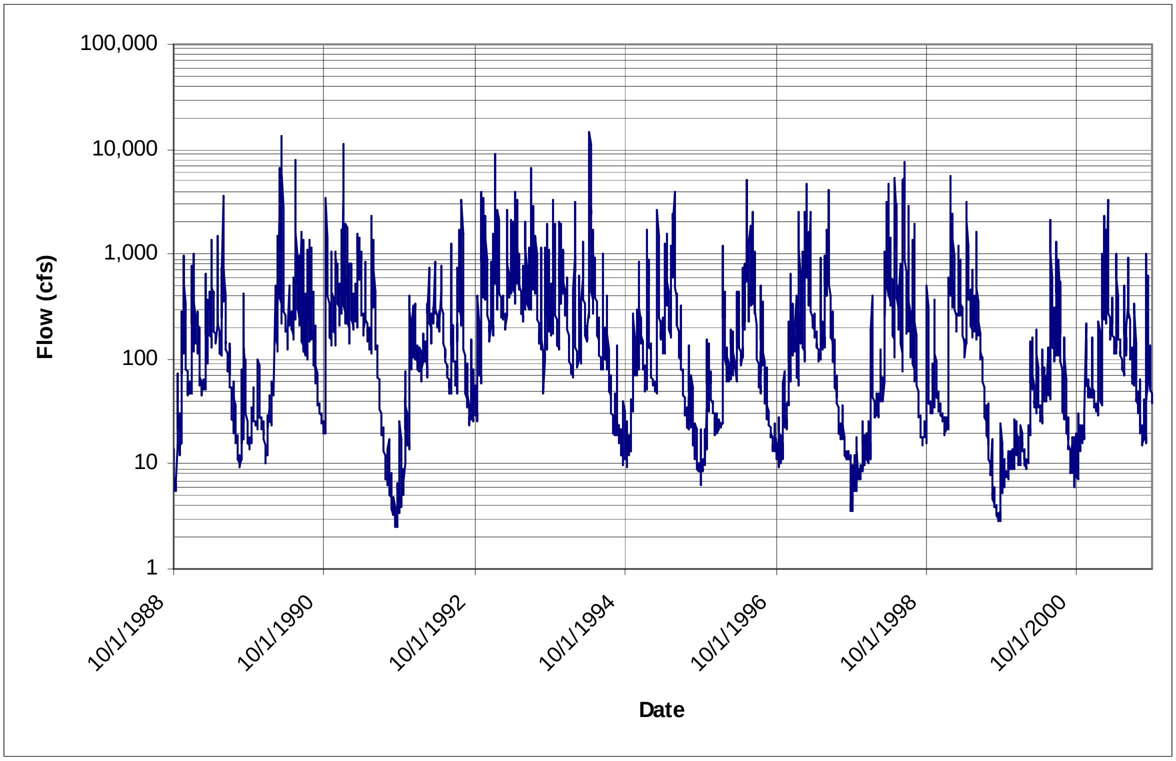


Figure 3-2 presents a flow frequency curve for the North Fork Vermilion River, based on flow data from 1988 to 2001. It shows the 25th percentile flow of 28 cfs and 75th percentile flow of 289 cfs. The flow in the river is greater than 100 cfs 50 percent of the time.

FIGURE 3-2 NORTH FORK VERMILION RIVER FLOW FREQUENCY CURVE

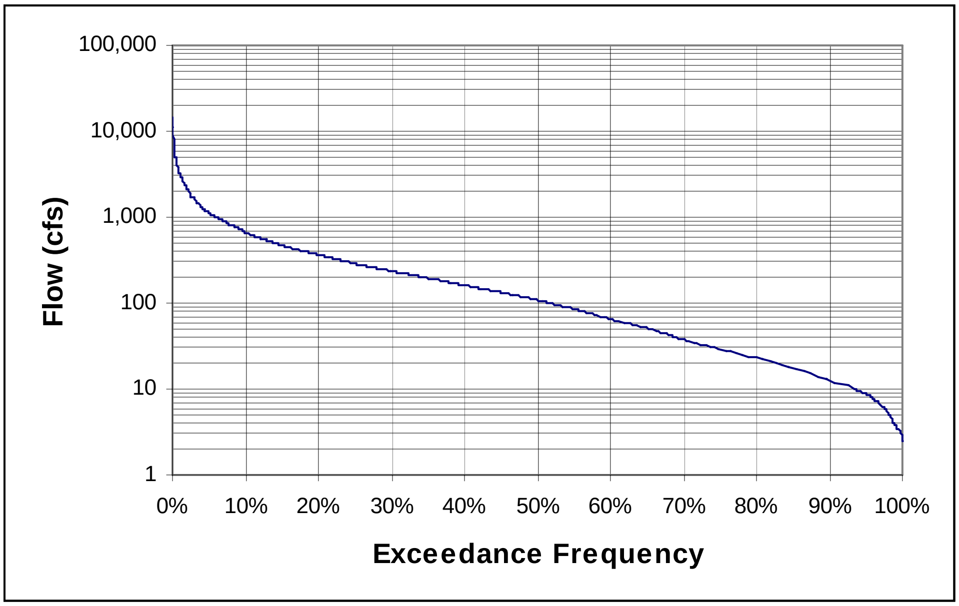
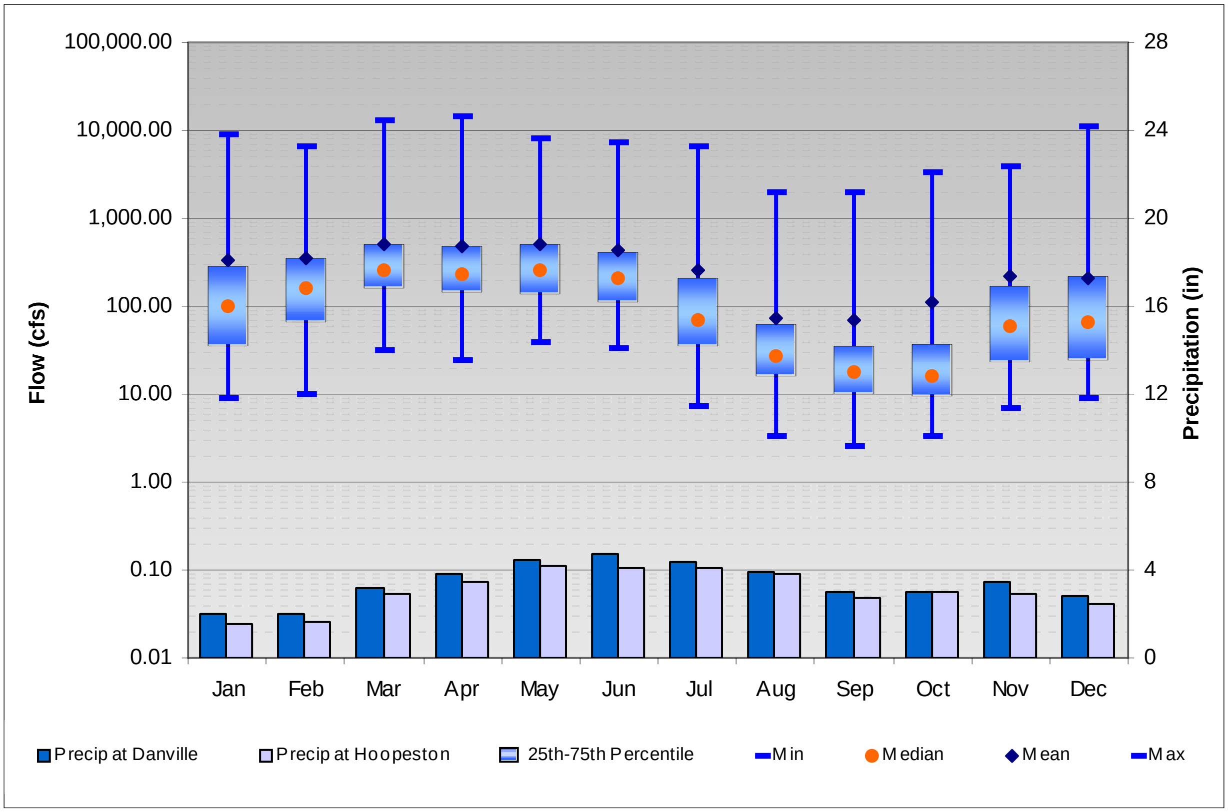


Figure 3-3 shows the monthly statistics of North Fork Vermilion River Flow and monthly average precipitation at Danville and Hoopeston, Illinois. The Hoopeston climate station is located near the northwest boundary of the watershed. The monthly variation of flow is somewhat different from precipitation in the watershed though both exhibit the yearly cycle. The monthly average flow starts to increase in January and peaks in May and decreases to reach the lowest in September. However, the monthly average rainfall starts to increase in March, reaches the highest in June, and then decreases. January and February have the lowest rainfall, but lowest monthly average flows occur in August and September. The yearly cycle of flow and precipitation differs by about 2 months. The phenomena may be attributed to snow melting, temperature trends, and vegetation growth throughout the year.

FIGURE 3-3 MONTHLY AVERAGE FLOW AND PRECIPITATION IN NORTH FORK VERMILION RIVER WATERSHED



The hydrology of the North Fork Vermilion River watershed is also affected by the channelization of streams and drainage ditches and extensive use of artificial drainage tiles. Subsurface tile drains predominantly drain agricultural fields in East-Central Illinois, as in many other regions of the central plains. Improved subsurface drainage not only improves crop production and farm income, but also reduces surface runoff. This results in reduced soil erosion and sediment load to streams and water bodies. The subsurface drainage system, however, results in increased flow through the soil profile, increasing leaching of nitrates and dissolved phosphorus to the streams. If private septic systems are connected to drain tile, the domestic wastewater moves faster to downstream water bodies.

4.0 WATER QUALITY

This chapter discusses applicable water quality standards and the pollutants of concern in the North Fork Vermilion River and Lake Vermilion. The available water quality data is evaluated to verify impairments in listed segments by comparing observed data with water quality standards or appropriate targets. The spatial and temporal water quality variation as well as the correlation among the constituents are assessed.

4.1 WATER QUALITY STANDARDS AND END POINTS

This section describes applicable water quality standards for the North Fork Vermilion River and Lake Vermilion. Based on the standards, TMDL endpoints were identified as numeric water quality targets.

4.1.1 River Water Quality Standards

The North Fork Vermilion River Segment BPG09 is listed on the Illinois 2004 303(d) list for pathogens. Fecal coliform will be used as the indicator of pathogens. The Illinois fecal coliform standards for general use requires that during the months May through October, based on a minimum of five samples taken over not more than a 30-day period, fecal coliform shall not exceed a geometric mean (GM) of 200 colony forming units (cfu) per 100 mL (cfu/100 mL), nor shall more than 10 percent of the samples during any 30 days period exceed 400 cfu/100 mL in protected waters. Fecal coliform is the pollutant of concern in the North Fork Vermilion River Segment BPG09.

The North Fork Vermilion River Segment BPG05 is listed on the Illinois 2004 303(d) list for nitrate nitrogen, which caused the impairment of the designated use of public and food processing water supply. The not-to-exceed numeric standard for nitrate nitrogen is 10 mg/L.

Although they are not listed in North Fork Vermilion River, nutrients are listed as the causes for impairment in Lake Vermilion, which is the downstream receiving water. USEPA regulations at CFR Part 131.10(b) requires that in "designating uses of a waterbody and the appropriate criteria for those uses, the State shall take into consideration the water quality standards of downstream waters and shall ensure that its water quality standards provide for the attainment and maintenance of the water quality standards for downstream waters." There is no phosphorus standard for rivers and streams in Illinois, but IEPA considers total phosphorus (TP) concentration of 0.61 mg/L as a guideline to protect aquatic life. The phosphorus standard for a lake states that TP shall not exceed 0.05 mg/L in any reservoir or lake with a surface area of 20 acres or more or in any stream at the point where it enters any such reservoir or lake.

Hoopeston Branch is listed for impairment caused by low DO. The applicable DO standard states that DO shall not be less than 6.0 mg/L during at least 16 hours of any 24 hour period, nor less than 5.0 mg/L at any time.

4.1.2 Lake Water Quality Standards

Lake Vermilion is listed on the Illinois 2004 303(d) list for use impairment caused by nutrients, siltation, organic enrichment, excessive algal growth, nitrates, and suspended solids. The water quality standards associated with the listing include TP, DO, total ammonia nitrogen, and nitrate. The total ammonia nitrogen must never exceed 15 mg/L in state waters. The total ammonia nitrogen acute, chronic, and sub-chronic standards are determined by temperature and pH in water. A review of total ammonia nitrogen in Lake Vermilion shows that there is no exceedance of the standard (including acute, chronic, and sub-chronic standards) at possible ranges of temperature and pH. Therefore, a total ammonia nitrogen TMDL will not be developed at this time.

Table 4-1 summarizes the applicable numeric water quality standards for Lake Vermilion. The State of Illinois does not have TSS or turbidity numeric standards that could be used as a surrogate for siltation impairment. Nevertheless, sedimentation appears to be a concern in Lake Vermilion because between 1976 and 1998, the lake lost 1,186 acre-feet of storage capacity. The storage loss rate is about 0.9 percent per year. Based on IEPA guidelines, the storage loss rate is classified as moderate. IEPA does not require the TMDL development for constituents without numeric standards. Therefore, a TMDL will not be developed for TSS at this time. Because phosphorus load is largely associated with TSS load, the measures implemented for phosphorus reduction may also reduce the sediment load to the lake and decrease the storage loss rate.

TABLE 4-1 WATER QUALITY STANDARDS FOR LAKE VERMILION

Parameter	Standard
Nitrate	Shall not exceed 10 mg/L
Total Phosphorus	Phosphorus as TP shall not exceed 0.05 mg/L in any reservoir or lake with a surface area of 8.1 hectares (20 acres) or more, or in any stream at the point where it enters any such reservoir or lake

Excessive algal growth is listed as a cause of impairment in Lake Vermilion. Algal biomass is commonly measured through a surrogate, Chlorophyll-a (Chl-a), which is a plant pigment. The abundance of Chl-a in water highly correlates with the amount of algae present. The State of Illinois does not have a numeric standard for Chl-a. The algal growth is directly related to excessive amounts of limiting nutrients and light availability for photosynthesis. Phosphorus is identified as a limiting nutrient in this report. Consequently, TP can be considered a surrogate indicator for excessive algal growth.

4.1.3 TMDL Endpoints

To meet all designated uses, a water body must meet the standards identified for its most sensitive use. TMDL endpoints are the numeric target values of pollutants and parameters for a water body that represent the conditions that will attain water quality standards and restore the water body to its designated uses. The most stringent standards are chosen as the endpoints for the TMDL analysis. Usually, if an applicable numeric water quality standard violation is the basis for 303(d) listing, the numeric criterion is selected as the TMDL endpoint. If the applicable water quality standard or guideline is narrative or is not protective of the designated use, a numeric water quality target must be established or adopted from site-specific water quality and biologic assessment. Table 4-2 summarizes the endpoints that will be used in the TMDL development for the North Fork Vermilion River and Lake Vermilion.

TABLE 4-2 TMDL ENDPOINTS

Parameter	TMDL Endpoint			Indicator
	North Fork Vermilion River	Hoopeston Branch	Lake Vermilion	
Total Phosphorus (mg/L)	N/A	N/A	<0.05	Direct measurement
Fecal Coliform (cfu/100 mL)	<200 (GM)	N/A	N/A	Indicator for Pathogen
Dissolved Oxygen (mg/L)	N/A	>5.0	N/A	Direct measurement
Nitrate (mg/L)	10	N/A	10	Direct measurement

4.2 DATA AVAILABILITY

From 1977 to 1998, USGS collected monthly water samples at Station 03338780 (see Figure 4-1) in the North Fork Vermilion River near Bismarck, Illinois. Continuous daily average flows are recorded at this site. Water quality constituents include TP, dissolved phosphorus (DP), ammonia nitrogen, DO, TSS, nitrite and nitrate, and fecal coliform. Data for the USGS site were retrieved from NWIS database and USEPA STORET database. IEPA collected and provided fecal coliform data at Station 03338780 from January 24, 2000 to November 04, 2003. Jordan Creek (BPGC) and Middle Branch (BPGE) are monitored during the 2001 IEPA Intensive Basin Survey. Both tributaries are listed as fully supporting aquatic life. The data is not included in this report.

As many as 26 sampling sites are located in Lake Vermillion. Only five of them monitored water quality on a regular basis since 1978. The rest of the sites either have few water quality data points or the data point is prior to 1977 so that they are not included in the analysis. The five sampling sites are RBD-1, RBD-2, RBD-3, RBD-4, and RBD-5, as shown in Figure 4-2. A topographic map is also included in Appendix D to show the site locations and surrounding areas. RBD-1 is located in the area of deep water near the Lake Vermilion dam. RBD-2 is located in the middle of the lake, 50 feet south of the old dam. RBD-3 is located in the upper portion of the lake, 500 feet north of the old dam. RBD-4 is located at the north side of the old dam. RBD-5 is located near the southeast overbank of the lake. Water quality constituents from the five sites include TP, ammonia nitrogen, nitrate and nitrites, total Kjeldahl nitrogen, DO, and Chlorophyll-a. Data up to 1998 were retrieved from the USEPA STORET site. Data after 1998 were provided by IEPA. Illinois State Water Survey (Lin and Bogner, 2004) collected water quality data from May 8, 2000, through April 19, 2001, as part of a diagnostic study. In that report, RBD-5 was located at the upstream end of the lake. Both IEPA and Illinois State Water Survey (ISWS) collected water samples at a site near USGS site (03338780) in the North Fork Vermillion River inflow (RBD-T2) and the lake spillway (RBD-T1) to assess the water quality inflow and outflows. Collectively, water quality data is available for Lake Vermilion from 1978 to 2002.

In addition, the IEPA Facility-Related Stream Survey event collected microvertebrate and water quality data at 8 locations at the vicinity of the Hoopeston STP. The data resulted in the listing of Hoopeston Branch and BPG10 for impairment.

FIGURE 4-1 WATER QUALITY SAMPLING SITES

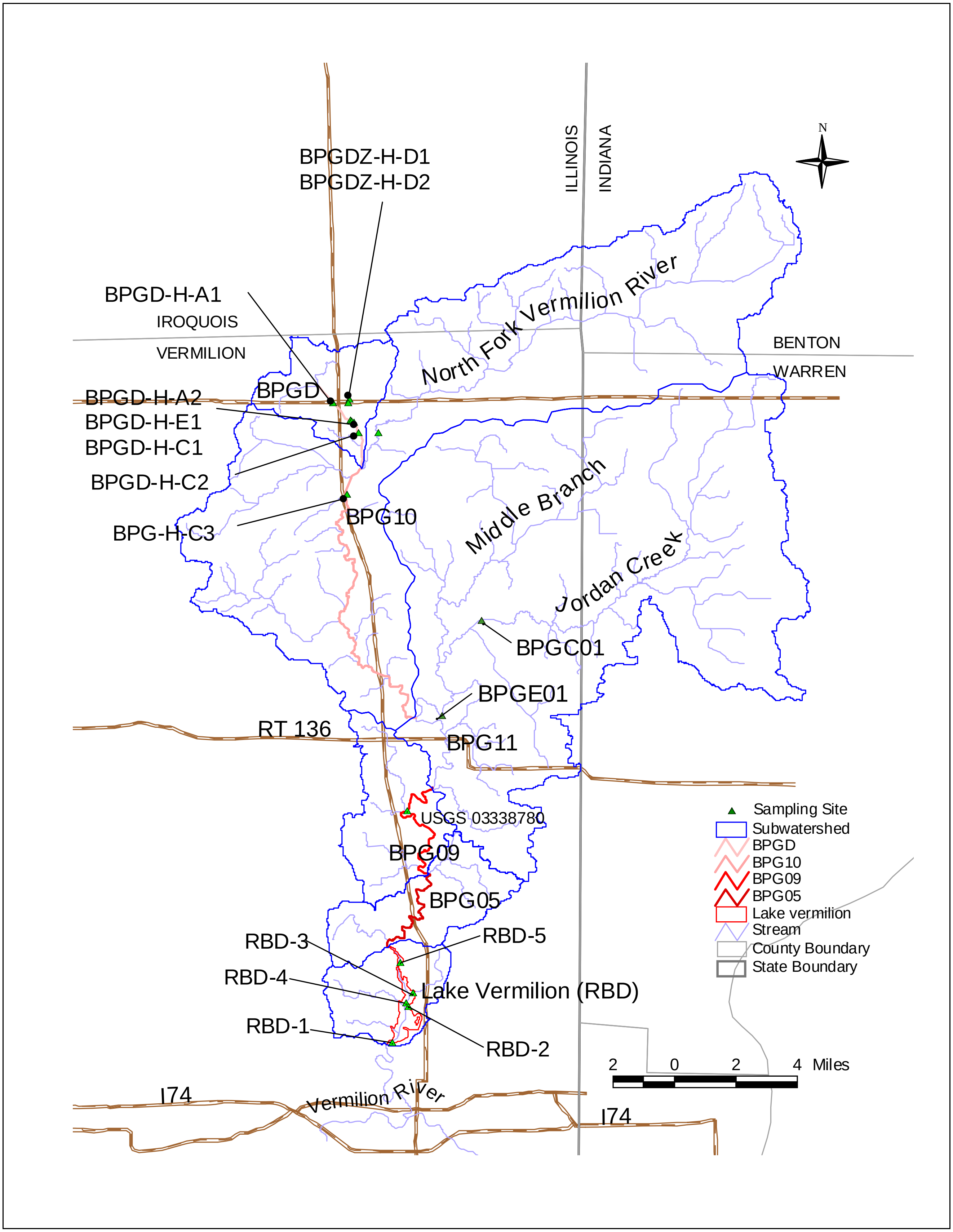
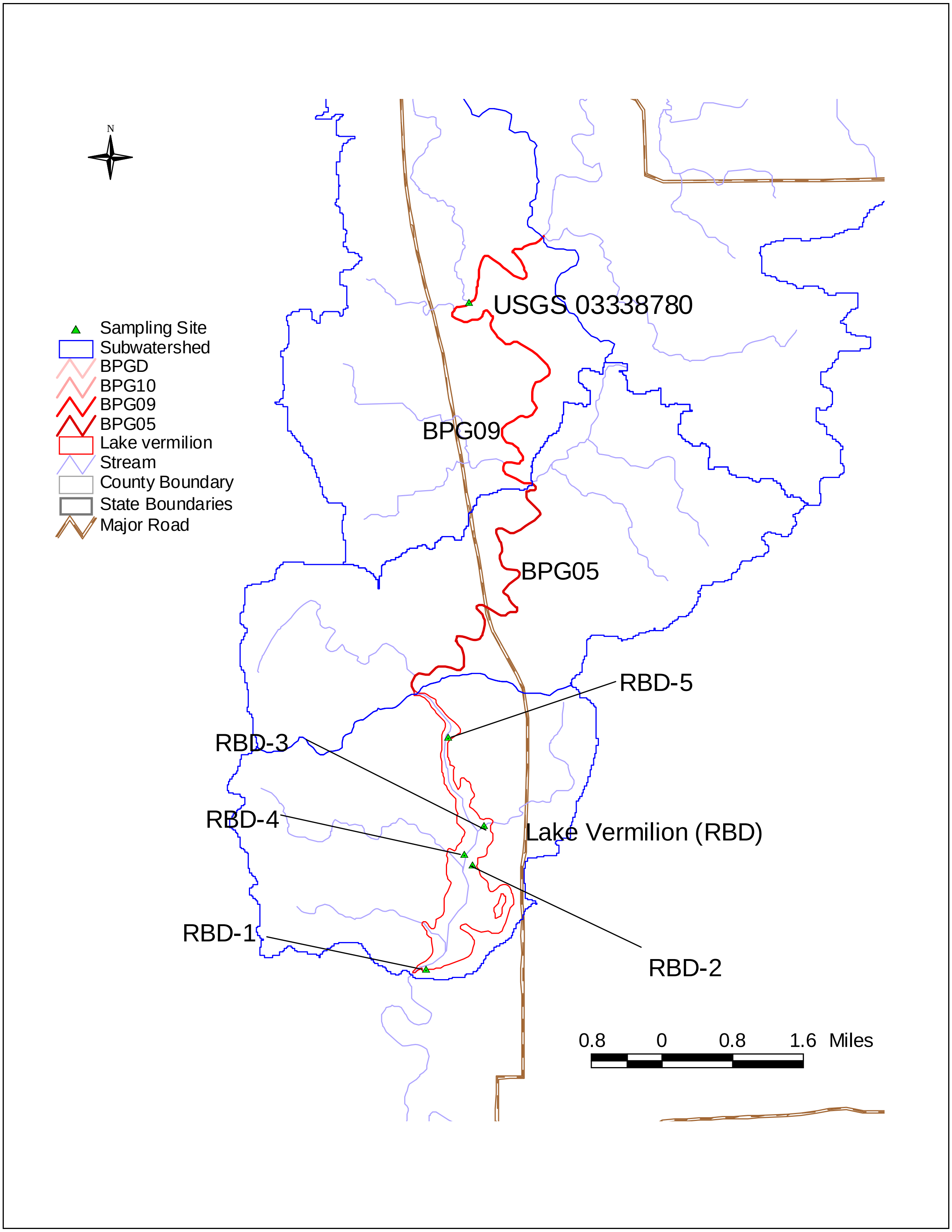


FIGURE 4-2 LOCATIONS OF SAMPLING SITES IN LAKE VERMILION



4.3 ASSESSMENT OF WATER QUALITY DATA

This section discusses the pollutants of concern for the listed segments: BPGD, BPG09, BPG05, and RBD. The available water quality data is analyzed and assessed to verify the impairments of the listed segments by comparing observed data with water quality standards or appropriate targets. The potential spatial and temporal variation of water quality conditions is evaluated for the river segment and the lake.

4.3.1 Hoopeston Branch (BPGD)

The BPGD segment is assessed based on 2002 Facility-Related Stream Survey (FRSS) data. Results from the 2002 survey indicated slightly impaired conditions within Hoopeston Branch upstream and downstream of the STP. Severely impaired conditions to the biotic communities were also recorded for Hoopeston Ditch (IEPA, 2003). General use water quality standards were not met for dissolved oxygen on Hoopeston Branch, according to FRSS data collected in September 2002. A DO concentration of 4.7 mg/L was recorded, violating the Illinois DO standards for general use.

The Stage 2 water quality sampling in BPGD will collect additional DO data to support the TMDL development for this segment. The sampling will be completed by the end of September 2006. The TMDL will then be calculated and included in the final report.

4.3.2 North Fork Vermilion River

This section assesses nutrient and fecal coliform in North Fork Vermilion River based on data from the USGS sampling site at Bismarck, Illinois (03338780), located in BPG09. BPG05 is assessed based on extrapolation of data from the upstream site in BPG09 and the downstream site in RBD. No TMDL is developed for BPG10 because no numeric water quality standard is available for total nitrogen. Phosphorus is assessed in the North Fork Vermilion River because of the TP listing for Lake Vermilion.

4.3.2.1 Phosphorus

Phosphorus is an important component of organic matter. As a constituent of nucleic acids in all cells, it is vital for all organisms. In streams and rivers, phosphorus is usually the limiting nutrient of photosynthetic production of algae. Phosphorus enters streams and rivers not only through stormwater runoff, but also through natural mineralization of phosphates in the soil and rock and man-made sources. Phosphorus is measured in two ways: as total phosphorus (TP) and as dissolved phosphorus (DP). Streams with high TP and low DP levels usually have the most phosphorus input from nonpoint source pollution, such as agricultural runoff. Since phosphorus can be bound to sediments such as clay, phosphorus is measured through the suspended solids potency. DP measurements provide insights into how much of the phosphorus entering a stream is from point sources and diffusive sources such as livestock operations and animal feedlots or septic systems. Untreated wastewater can have phosphorus concentrations as high as 10 mg/L and feedlot overflow can contribute up to 4 or 5 mg/L.

The Illinois water quality standard requires that TP not exceed the 0.05 mg/L in any stream at the point where it enters any reservoir or lake with a surface area of 20 acres or more. Although the listed North Fork Vermilion River segment is about 3 miles upstream of the entrance to the lake, it seems reasonable to set the segment's phosphorus target at the 0.05 mg/L because there is not likely to be any dramatic deposition of particulate and dissolved phosphorus in the short distance from the listed river segment to the entrance. Figure 4-3 presents the TP data at Bismarck, Illinois (03338780). It shows that TP is frequently higher than the lake standard.

Figure 4-4 shows the interannual variation in TP concentration. There is no noticeable increasing or decreasing trend from 1978 to present. The average annual concentration goes up and down, likely attributed to the precipitation change. The average annual concentrations exceed the lake phosphorus standard in almost every year.

Figure 4-5 presents the monthly descriptive statistics for TP in the North Fork Vermilion River. The month of April has the overall lowest TP during the spring season, and then TP starts to increase through the summer growing season reaching a higher level. TP decreases slightly in late fall and early winter. Phosphorus is fairly high in January through March, with a large deviation as indicated by the range between the 25^{th} and 75^{th} percentiles, while flow in the river is near the annual average (see Figure 3-3). A possible explanation is that the phosphorus sources may include steady sources other than precipitation induced overland runoff. This explanation seems appropriate based on a review of the ratio of DP to TP in Table 4-3.

FIGURE 4-3 PHOSPHORUS CONCENTRATIONS IN NORTH FORK VERMILION RIVER AT BISMARCK (1978-2002)

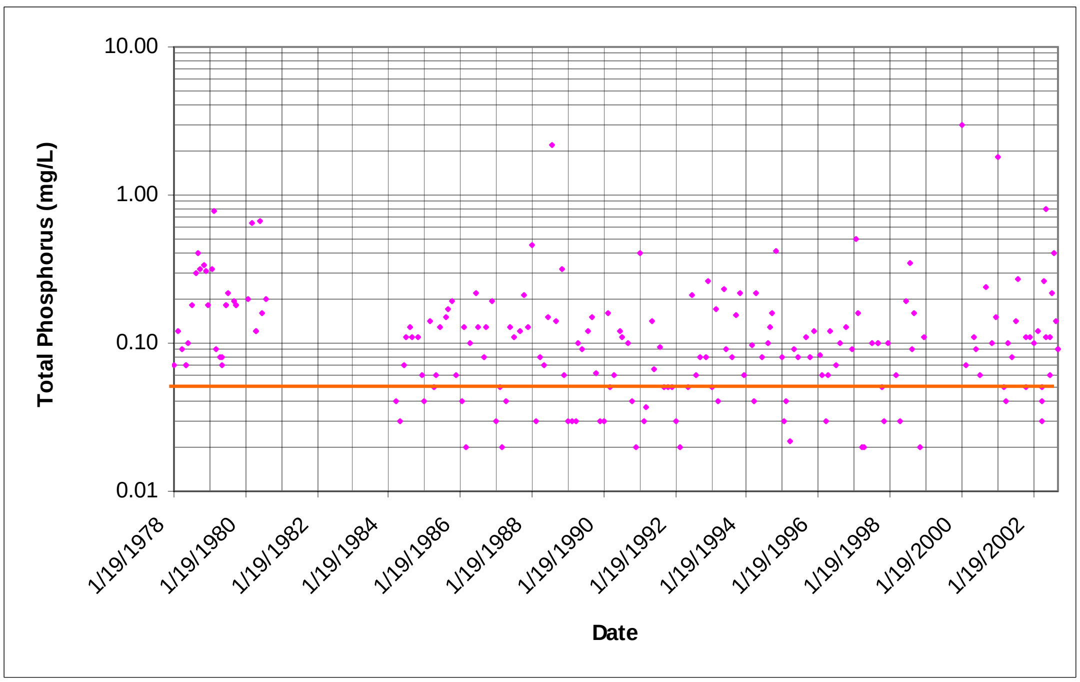


FIGURE 4-4 INTERANNUAL VARIATION IN TOTAL PHOSPHORUS CONCENTRATIONS NORTH FORK VERMILION RIVER (BPG09)

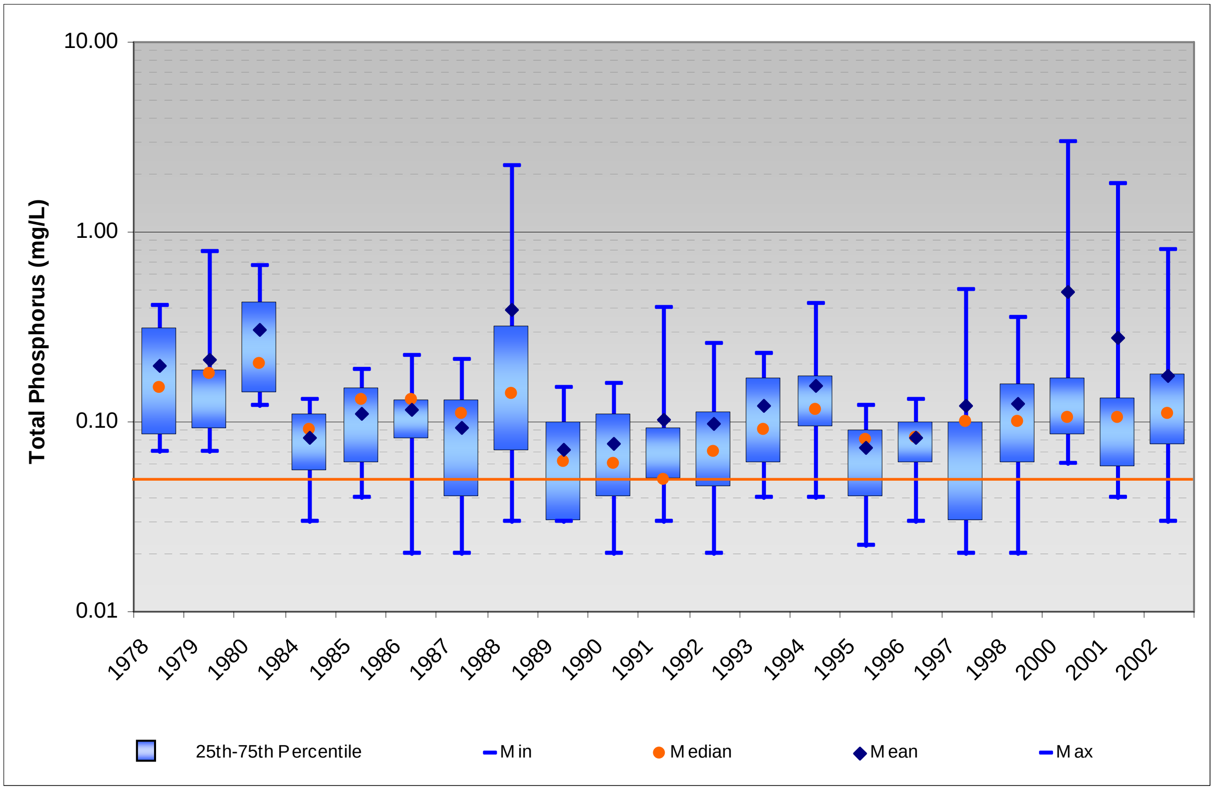
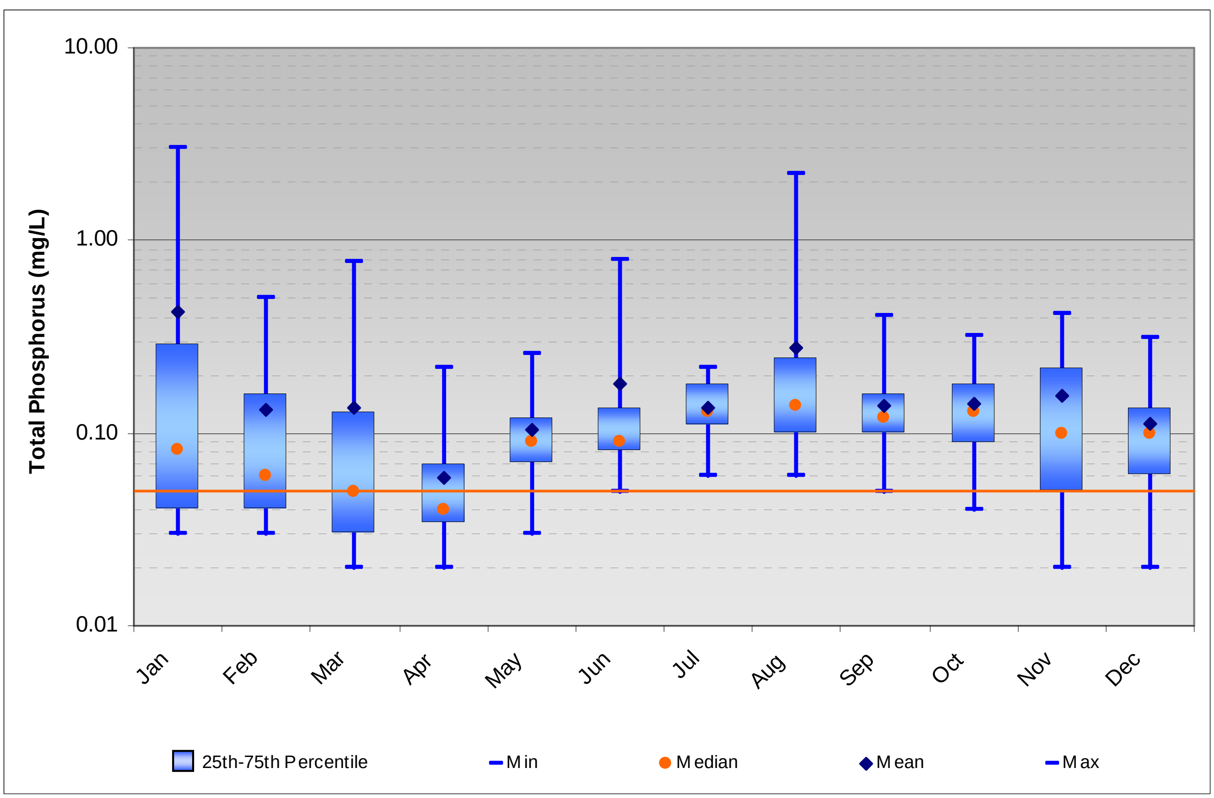


FIGURE 4-5 MONTHLY TOTAL PHOSPHORUS CONCENTRATIONS NORTH FORK VERMILLION RIVER (BPG09)



DP is the portion of TP that is biologically available for plant uptake. It is the soluble form of phosphorus that is not absorbed to soil particles. In rivers and lakes with short retention time, DP concentration is crucial for plant growth. Table 4-3 summarizes the monthly DP and TP concentrations at Bismarck. The average monthly DP is about 0.08 versus TP at 0.13, meaning that an average 60 percent of TP concentration is in the dissolved form. This ratio implies that nonpoint sources other than soil erosion may contribute to TP. A close review of Table 4-3 shows that the DP percentage is relatively higher in January and February than March through July, when the flow is higher and runoff-induced sediments deliver more particulate phosphorus to the river. As the flow decreases in October through December, DP increases as the steady low flow sources such as septic systems account for a larger percentage of the load. DP concentration and percentage is highest in August. Groundwater seepage may be another source of dissolved phosphorus. Speculation on sources needs to be further verified as more site-specific information becomes available in the next stage of TMDL development.

TABLE 4-3 MONTHLY AVERAGE DISSOLVED AND TOTAL PHOSPHORUS CONCENTRATIONS, NORTH FORK VERMILION RIVER (BPG09)

Month	DP	TP	Percentage of TDP in TP
Jan	0.08	0.13	60
Feb	0.07	0.12	63
Mar	0.04	0.11	40
Apr	0.03	0.06	44
May	0.06	0.10	57
Jun	0.06	0.15	40
Jul	0.07	0.13	56
Aug	0.23	0.29	78
Sep	0.09	0.12	74
Oct	0.08	0.10	77
Nov	0.10	0.15	66
Dec	0.06	0.10	61
Average	**0.08**	**0.13**	**60**

4.3.2.2 Nitrate Nitrogen

The ingestion of excessive amounts of nitrate can cause adverse health effects in very young infants and susceptible adults. Consequently, the State of Illinois has set a maximum acceptable level of 10 mg/L as the food processing and public water supply standard. The most common sources of nitrate are agriculture overuse of fertilizer, municipal and industrial wastewaters, refuse dumps, animal feed lots, and septic systems. Other sources include runoff or leachate from manured or fertilized agricultural lands and urban drainage. The fertilizers and wastes are sources of nitrogen-containing compounds that are converted to nitrates in the soil. These sources also result in elevated levels of nitrate in groundwater. Nitrates are extremely soluble in water and can move easily through soil into the drinking water supply. In addition, nitrogen compounds are emitted into the air by power plants and automobiles and are carried from the atmosphere to the earth with rainfall. Once nitrate is formed, its movement in soil and its potential to contaminate groundwater depend on several factors including soil characteristics, location and characteristics of the underground water formations (aquifers), and climatic conditions. Nitrate nitrogen is evaluated in North Fork Vermilion River BPG05 because it is listed as a cause for the partial impairment in Lake Vermilion for food processing and public water supply. The North Fork Vermilion River Segment BPG05 upstream of the lake is a potential loading source of nitrate nitrogen for the lake.

ISWS (Keefer, 2003) collected nitrate nitrogen data at Bismarck, Illinois, from April 2000 to March 2002. Figure 4-6 presents the variation of the nitrate nitrogen over 2 years. The elevated nitrate nitrogen concentrations are observed from February to June, with the peak in June. From July to December, nitrogen nitrate concentrations are lower. The trend of nitrate nitrogen follows the flow pattern fairly well, meaning the nitrate nitrogen exceedance in Lake Vermilion may be caused by nonpoint sources although other sources are also significant.

4.3.2.3 Fecal Coliform

North Fork Vermilion River (BPG09) is listed for pathogen impairment. Fecal coliform is used as the indicator for pathogens in TMDL development. Various point and nonpoint sources may potentially contribute to fecal coliform loads to the North Fork Vermilion River. Point sources include wastewater treatment plants and households that are served by wastewater disposal systems. Because of the very small amount of discharge and the fact they are treated, these point sources do not pose a primary concern in the North Fork Vermilion River watershed, but they do contribute to the fecal coliform load. In addition, septic systems that discharge to tile drains are potential fecal coliform sources in the North Fork Vermilion River watershed. The further data and information on wastewater treatment plant and private wastewater disposal systems are crucial to quantify loading from these point sources. Nonpoint sources that contribute fecal coliform load include septic systems, urban runoff, wildlife, animal feedlots, and manure applications.

Fecal coliform data collected at Bismarck from 1978 to 1998 was used for listing the North Fork Vermilion River on the 2004 303(d) List. The data were collected on a monthly basis. This sampling approach cannot facilitate the calculation of the geometric mean based on the standard, which requires a minimum of 5 samples within 30 days. However, the monthly data from 1978 to 1998 shows that fecal coliform concentrations constantly exceeded the 200 cfu/100 mL standard and the 10 percent frequency standard of 200 cfu/100 mL. The maximum fecal coliform concentration is as high as 20,000 cfu/100 mL. As a result, North Fork Vermilion River was listed as partially supporting its designated use because of elevated fecal coliform concentrations. Figure 4-7 shows the fecal coliform concentration trend from 1978 to 1998. There is no obvious decreasing or increasing pattern.

Figure 4-8 presents the relationship between fecal coliform and flow. The graph reveals that the fecal coliform concentration exceeds the geometric mean standard of 200 cfu/100 mL in both low flow and high flow conditions. Fecal coliform was present at 1,700 cfu/100 mL at a low flow rate of about 11 cfs, when no overland runoff would occur. In addition, there appears to be a positive correlation between fecal coliform concentrations and flow when the flow is higher than 100 cfs.

Figure 4-9 shows the variation of monthly average fecal coliform concentration within a year based on the data from all years. The average fecal coliform concentration reached the highest values in the low flow months of July, August, and September. This implies that low flow steady sources contribute to the elevated fecal coliform concentration.

FIGURE 4-6 MONTHLY NITRATE NITROGEN CONCENTRATIONS NORTH FORK VERMILION RIVER AT BISMARCK

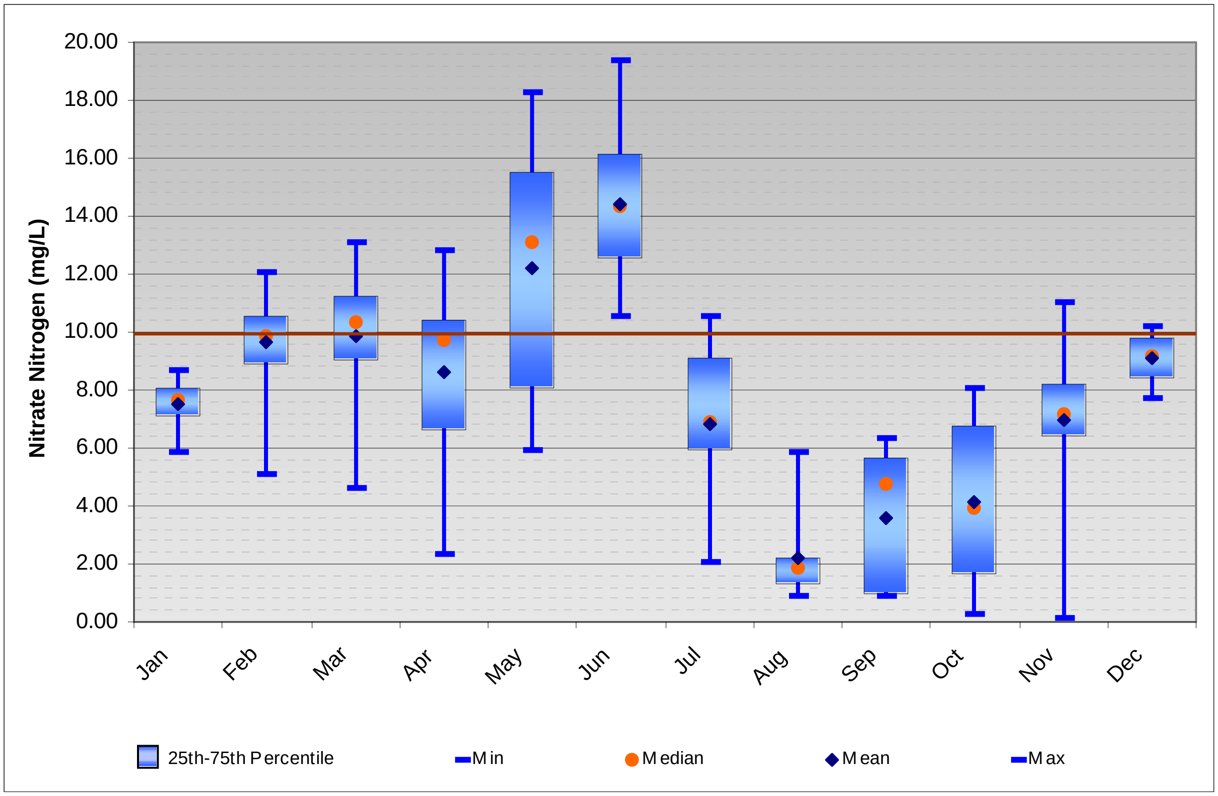


FIGURE 4-7 FECAL COLIFORM CONCENTRATIONS NORTH FORK VERMILION RIVER AT BISMARCK (1978 TO 1998)

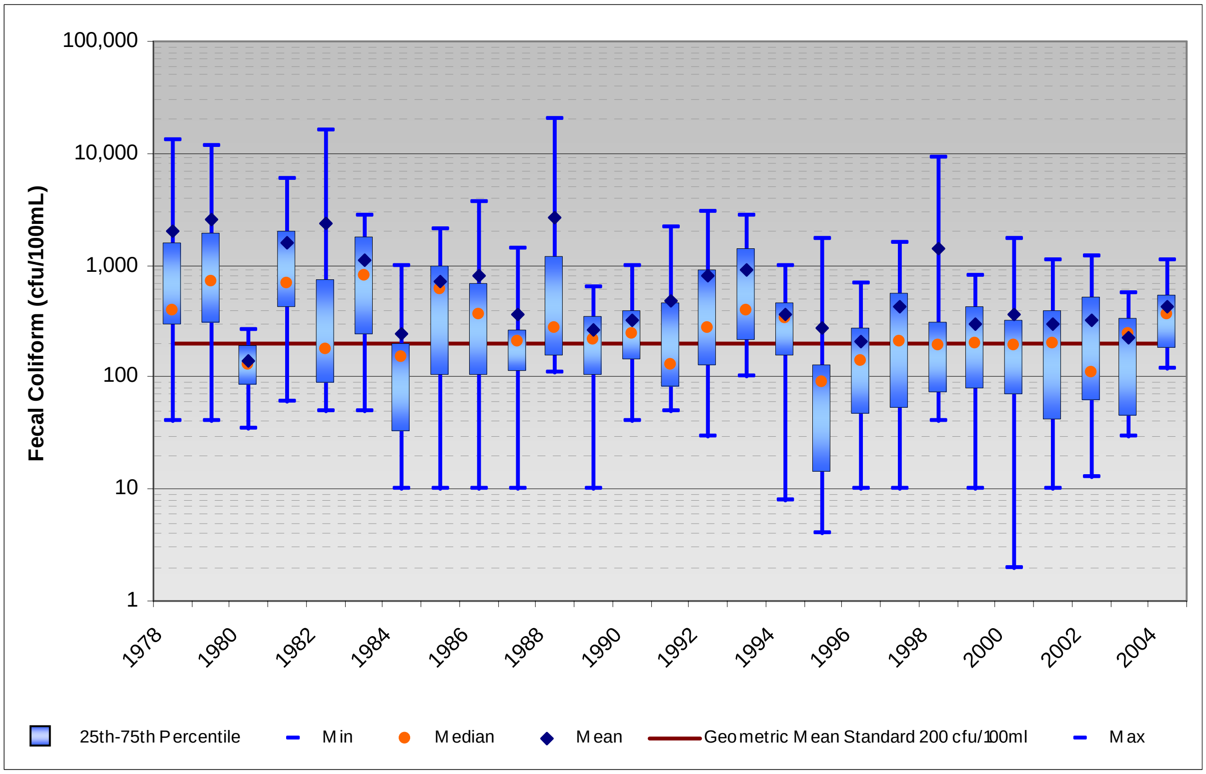


FIGURE 4-8 RELATIONSHIP BETWEEN FECAL COLIFORM CONCENTRATIONS AND FLOW RATE

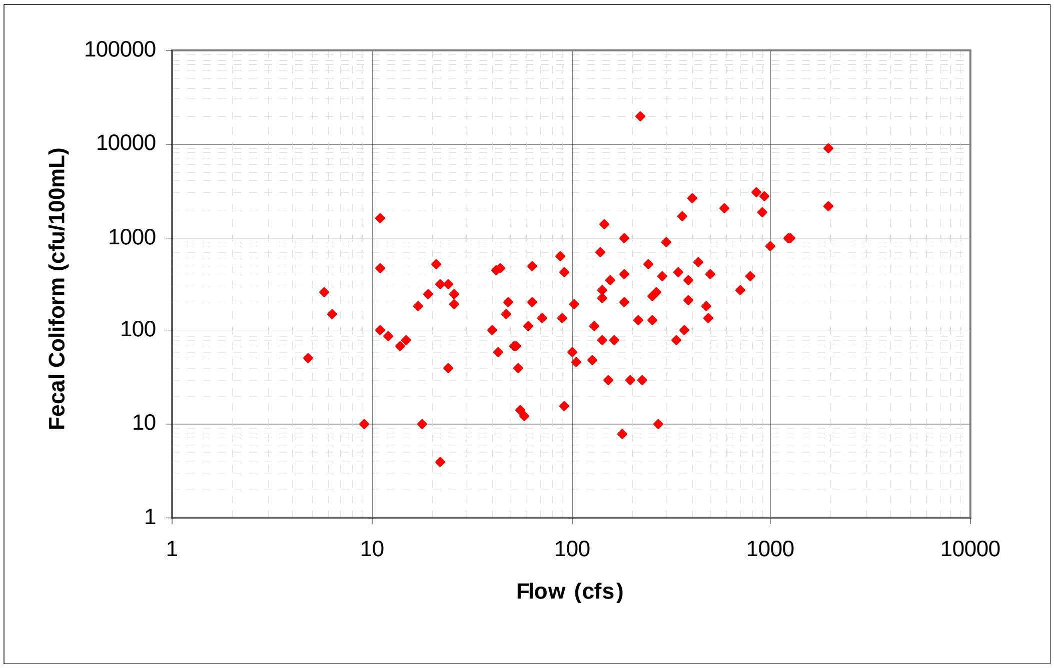
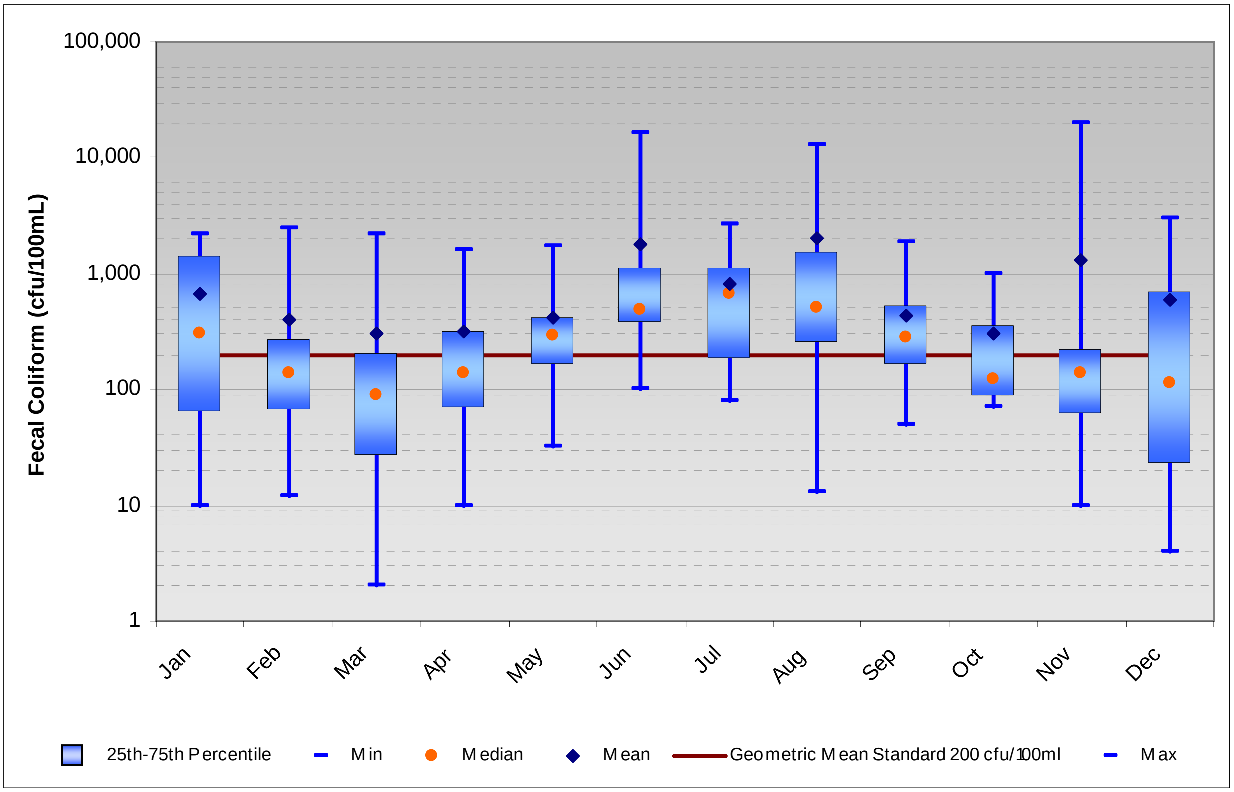


FIGURE 4-9 MONTHLY FECAL COLIFORM CONCENTRATIONS NORTH FORK VERMILION RIVER (BPG09)



4.3.3 Lake Vermilion (RBD)

This section presents the water quality assessment in Lake Vermilion using the available data from the RBD-1, RBD-2, RBD-3, RBD-4, and RBD-5 sites.

4.3.3.1 Phosphorus

Phosphorus was not explicitly listed as the cause of impairment in the 2004 IEPA 303(d) list. TP, however, is used as an indicator for organic enrichment, low DO, and excessive algae growth in Lake Vermilion (see Section 4.1.2). Figure 4-10 presents TP data collected at various sites in the lake from 1977 to 2001. RBD-T2 is located upstream of the lake in North Fork Vermilion River. The figure indicates that at all locations, TP concentrations exceed the water quality standard of 0.05 mg/L.

TP concentrations at RBD-3 and -4 are higher than other locations. One possible explanation is that TP concentrations at these two locations are affected by direct inflow from two nearby tributaries, which may provide sufficient phosphorus load to elevate the concentration locally.

FIGURE 4-10 TOTAL PHOSPHORUS CONCENTRATIONS IN LAKE VERMILION (1977-2003)

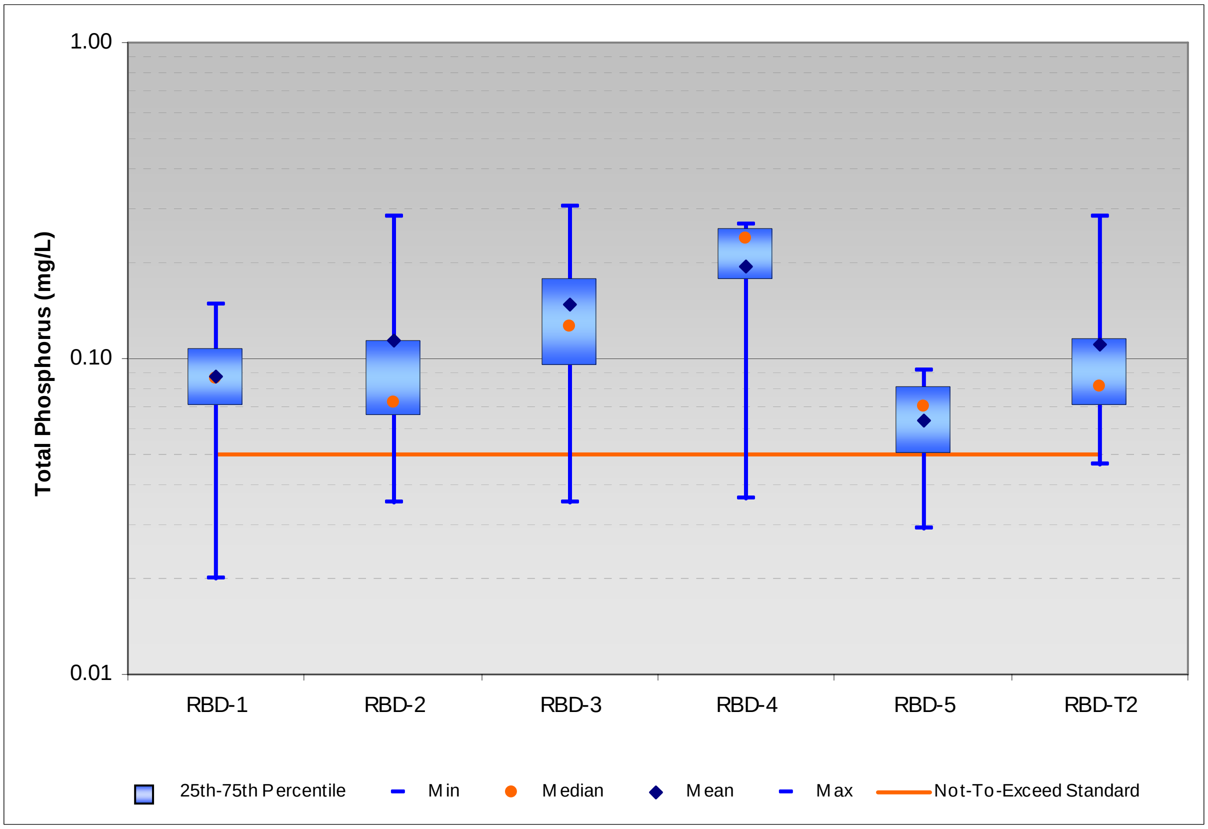


Figure 4-11 presents the variation of monthly average TP concentration in Lake Vermilion, based on data from all locations. The monthly average TP concentrations exceed the Illinois water quality standard from March to October. The monthly average TP is highest in June when flow is relatively high (Figure 3-3). The data indicate that the phosphorus load from non-erosion related sources may be an important load component for Lake Vermilion.

Table 4-4 summarizes the monthly average DP and TP concentrations in the lake. The trend is slightly different from the North Fork Vermilion River, most likely because of algae uptake, settlement, and the long retention time of the lake.

FIGURE 4-11 MONTHLY AVERAGE TOTAL PHOSPHORUS CONCENTRATION IN LAKE VERMILION

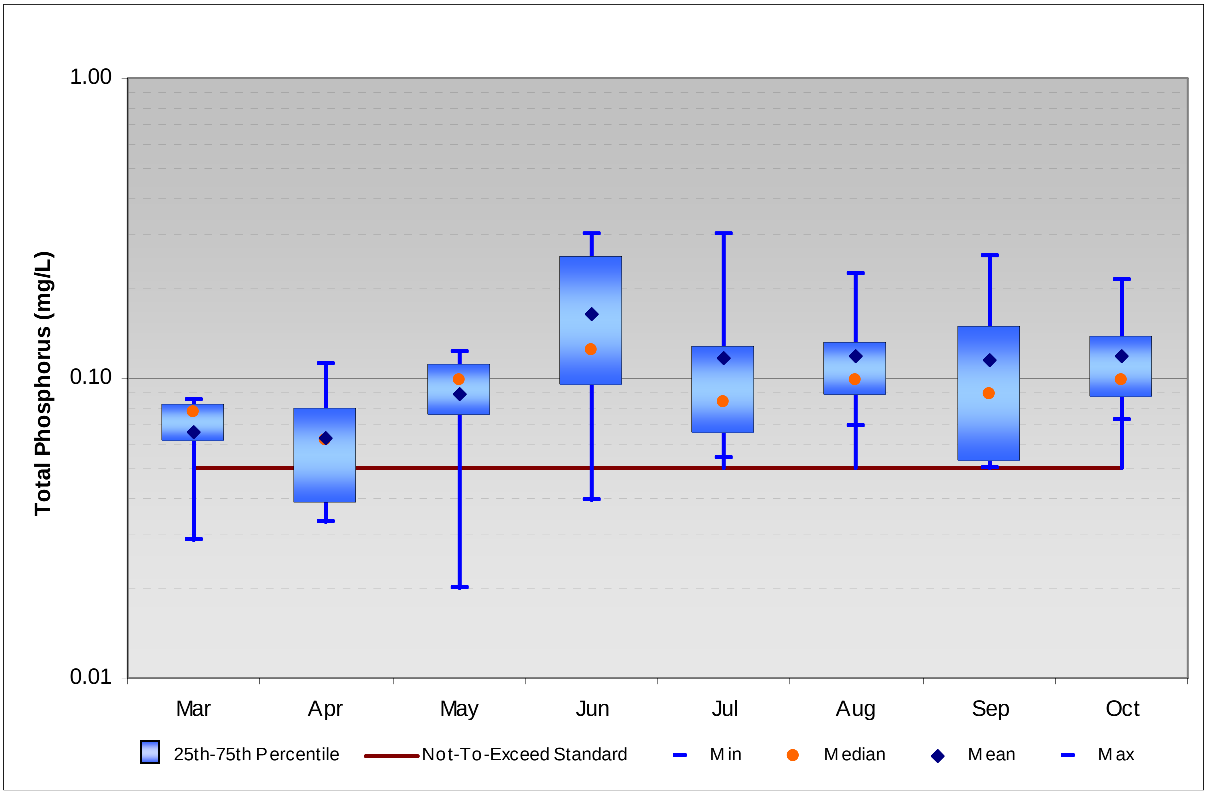


TABLE 4-4 MONTHLY AVERAGE DISSOLVED PHOSPHORUS AND TOTAL PHOSPHORUS CONCENTRATIONS IN LAKE VERMILION

Month	DP	TP	Percent DP
Apr	0.01	0.04	22
May	0.06	0.11	56
Jun	0.06	0.18	33
Jul	0.01	0.07	20
Aug	0.03	0.10	28
Sep	0.03	0.08	31
Oct	0.02	0.09	25
Average	**0.03**	**0.09**	**30**

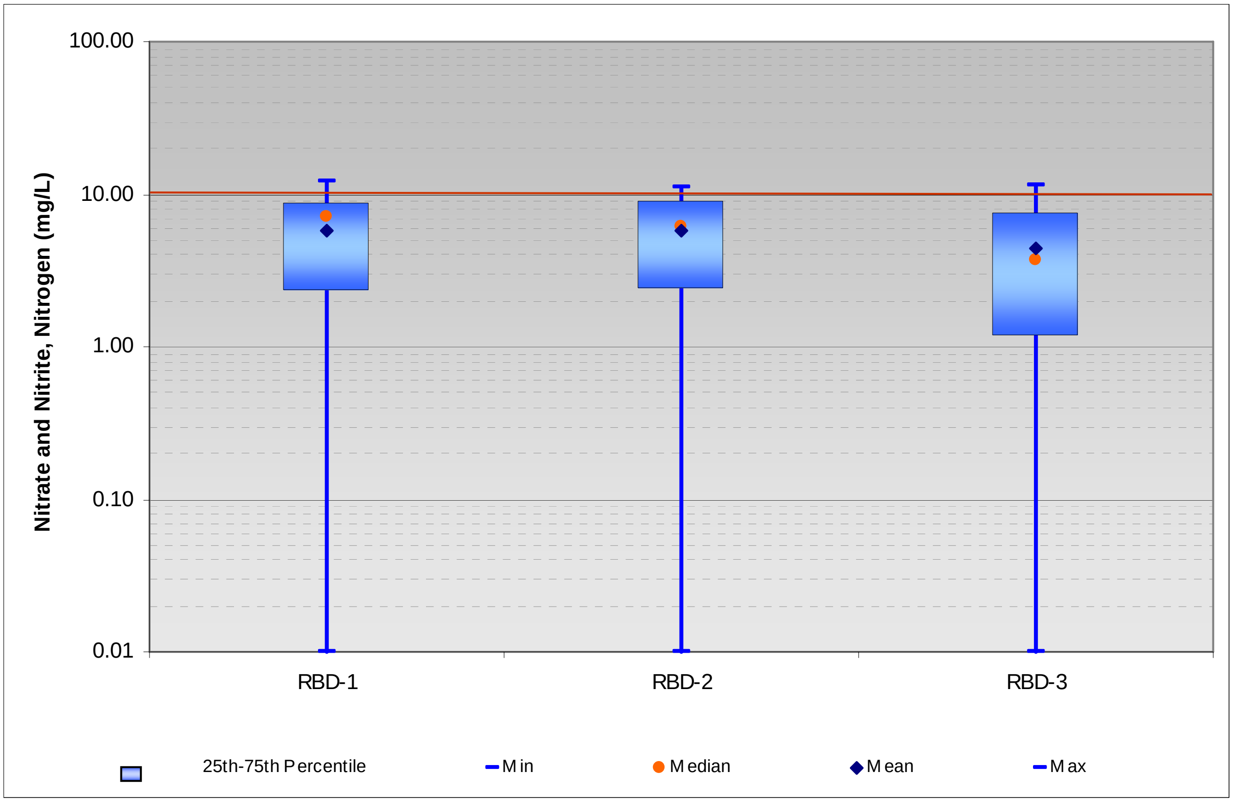
Source: IEPA 2001

Lake mixing dynamics can greatly affect water quality in terms of chemical (nutrient) availability and the concentrations, location, and forms in which chemicals are present. Phosphorus settles out of the water column to the lake bottom as particulate-phosphorus and is bound to the lake bottom sediment. This phosphorus generally is not available for aquatic plant growth and is not a water quality problem. However, anoxic conditions at the lake bottom can result in the release of bound phosphorus in the dissolved form. If no subsequent mixing occurs in the water column, the dissolved phosphorus will remain at the lake bottom. If mixing occurs (from wind action, tributary inflow, fish activity, or seasonal lake turnover following thermal stratification), the dissolved phosphorus is brought up to the surface, where it is available for algal uptake and growth.

4.3.3.2 Nitrate Nitrogen

Nitrate nitrogen is a listed cause of impairment in Lake Vermilion. The water quality standard for drinking water supply sources is 10 mg/L. Because nitrite nitrogen seldom appears in concentration greater than 1 mg/L and tends to transform to nitrate, the nitrate and nitrite concentration data is used to verify the exceedance. Figure 4-12 presents all the nitrite and nitrate data from RBD-1, RBD-2, and RBD-3. Equivalent data points are not available for RBD-4 and RBD-5. The maximum observed nitrite and nitrate concentration exceeds the standards at all three locations, although the average concentrations do not exceed the standard. As discussed in Section 4.3.2.2, the nitrate nitrogen concentration exceeds the standard of 10 mg/L in North Fork Vermilion River at Bismarck. The nitrate loads from the North Fork Vermilion River may be the main reason for the exceedance in Lake Vermilion.

FIGURE 4-12 NITRITE AND NITRATE CONCENTRATIONS IN LAKE VERMILION



4.3.3.3 Limiting Nutrients

A limiting nutrient is a nutrient or trace element that is essential for plants to grow but that is not available in quantities required by plants and algae to increase in abundance. Therefore, if more of a limiting nutrient is added to an aquatic ecosystem, larger algal populations will develop until nutrient limitation or another environmental factor (such as light or water temperature) curtails production at a higher threshold than previously possible. Reducing the limiting nutrient can lower the eutrophication level in the lake and improve the water quality. The stoichiometry ratio of nitrogen to phosphorus (TN:TP) in phytoplankton biomass is about 7.2:1. If the N:P ratio in a water body is less than 7.2, nitrogen is the limiting nutrient. Otherwise, phosphorus is the limiting nutrient. Table 4-5 summarizes the average TN:TP ratio in Lake Vermilion, based on the IEPA 2001 sampling data. The average TN:TP ratio is about 156.54. Therefore, phosphorus is considered to be the limiting nutrient for plant growth in Lake Vermilion. TP contributes to lake eutrophication (fertility) and algal blooms. Nitrogen is also an essential nutrient for plant growth; however, it is often so abundant that it does not limit algal growth, especially in water systems with low retention times (fast-flowing systems). Some species of algae can also “fix” their own atmospheric nitrogen and do not need another nitrogen source. With nitrogen abundant and available, an increase in limiting nutrient, TP, results in rapid algal growth.

TABLE 4-5 AVERAGE TOTAL PHOSPHORUS AND TOTAL NITROGEN CONCENTRATIONS IN LAKE VERMILION

Station	Date	TP	TN	TN:TP
RBD-1	03/28/01	0.08	10.46	129.14
RBD-1	03/28/01	0.08	10.89	129.64
RBD-1	04/19/01	0.09	13.68	157.24
RBD-1	04/19/01	0.11	11.25	100.45
RBD-1	04/26/01	0.06	10.02	161.61
RBD-1	04/26/01	0.07	9.74	141.16
RBD-2	03/28/01	0.07	10.91	151.53
RBD-2	04/19/01	0.10	11.25	114.80
RBD-2	04/26/01	0.07	9.98	151.21
RBD-5	03/28/01	0.03	10.74	370.34
RBD-5	04/19/01	0.07	11.80	166.20
RBD-5	04/26/01	0.09	9.57	105.16
Average		**0.08**	**10.86**	**156.54**

4.3.3.4 Trophic Index

Trophic status (or “fertility” status) is often used to describe the nutrient enrichment status of a lake ecosystem. Higher trophic status is associated with more nutrient availability and higher productivity. Generally, mesotrophic to eutrophic lakes are considered to be the best environments for supporting a variety of uses, including fishing, aquatic life support, swimming, boating, and other uses. Excessive nutrient loads can result in nuisance algal blooms and excessive turbidity. Very low nutrient status also can limit the support of aquatic life. Carlson Trophic State Index (TSI) values are used as indicators of trophic status, which can be calculated using TP concentrations, Chl-a concentrations, or Secchi disk depth respectively (Carlson, 1977). Generally, TP is considered the best indicator of *potential* trophic status, especially when the TP is the limiting nutrient. The diagram in Figure 4-13 depicts the relationship between the TSI, trophic status, and nutrient status.

Table 4-6 summarizes the TSI in Lake Vermilion, based on TP, Chl-a, and Secchi disk depth. Using the TP-based TSI, Lake Vermilion is classified as hypereutrophic. This conclusion is similar to that of Lin and Bogner (2004).

FIGURE 4-13 TSI RELATIONSHIP TO LAKE FERTILITY

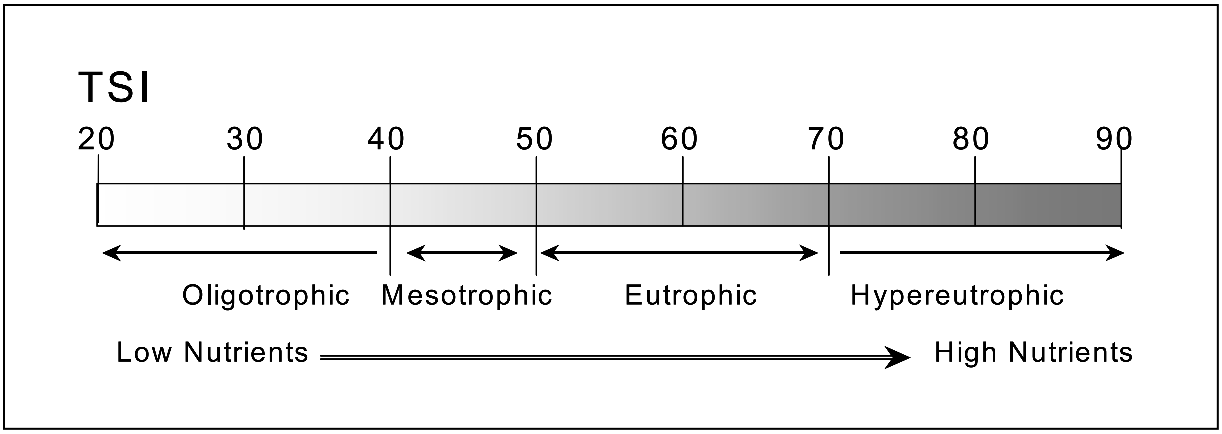


TABLE 4-6 TROPHIC STATE INDEX FOR LAKE VERMILION

Location	TSI (for Total Phosphorus)	TSI (for Chl-a)	TSI (for Secchi Depth)
TSI-1	68.7	62.0	71.9
TSI-2	72.5	65.9	75.2
TSI-3	76.2	65.9	78.1
TSI-4	80.1	no data	78.6
TSI-5	64.0	60.7	72.1
TSI-T2	72.1	no data	no data
Average	72.3	63.6	75.2

4.3.3.5 Excessive Algal Growth/Chlorophyll-a

Lake Vermilion is listed for impairment due to excessive algal growth. Chl-a, as an indicator for algal growth, is the dominant pigment in the algal cell and is commonly used as a surrogate measurement for algae. Algal blooms are also a direct cause of low DO related to nutrient enrichment. The narrative water quality standard for general use in the State of Illinois requires that waters of the state shall be free from algal growth other than natural origin. Figure 4-14 shows the Chl-a concentration at five sampling locations. Chl-a concentrations do not show large spatial variation, although stations 2 and 3 near the center of the lake have greater ranges of unmeasured Chl-a. The maximum Chl-a concentration of 170 ug/L occurred at RBD-3.

Figure 4-15 shows the observed monthly average Chl-a concentration values in Lake Vermilion. The figure indicates that the average Chl-a concentration is slightly higher in late summer and fall than the rest of the year. The highest observations, however, occurred in June.

FIGURE 4-14 CHLOROPHYLL-A CONCENTRATIONS IN LAKE VERMILION

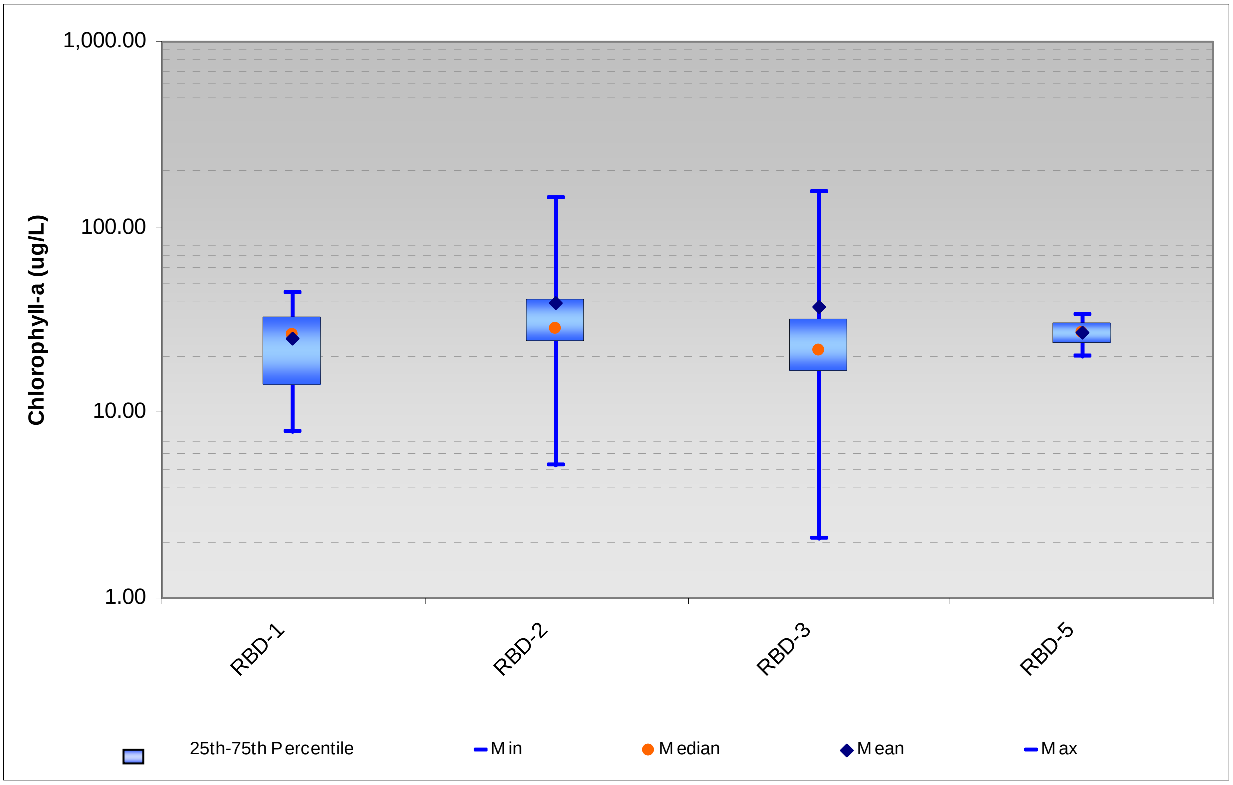
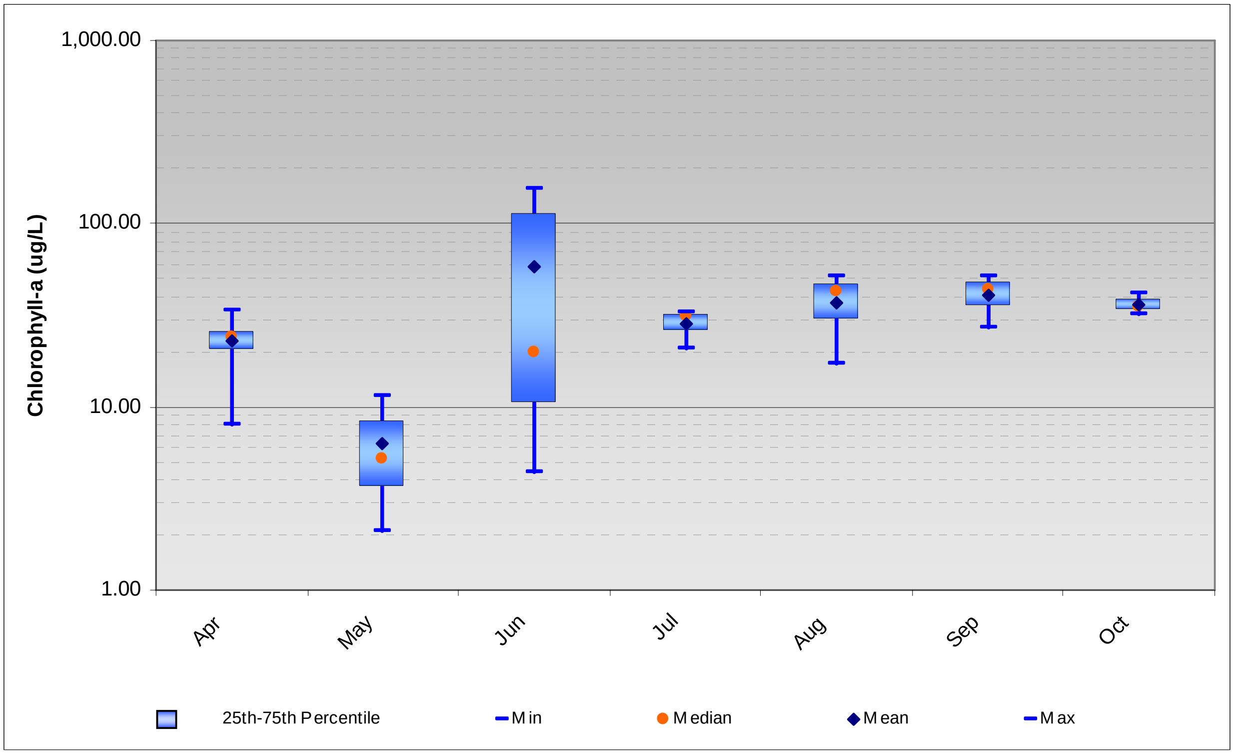


FIGURE 4-15 MONTHLY AVERAGE CHLOROPHYLL-A CONCENTRATIONS IN LAKE VERMILION



5.0 SOURCE ASSESSMENT

This section discusses point and nonpoint sources that potentially contribute to the impairment of the North Fork Vermilion River and Lake Vermilion.

5.1 NONPOINT SOURCES

The Illinois 2004 303(d) List identified agriculture (crop related, non-irrigated crop production) and hydrologic/habitat modification (flow regulation, stream bank modification, destabilization, recreation, salt storage, and unknown sources) as sources of nutrient loads to Lake Vermilion. Sources of pathogens to the North Fork Vermilion River have not been identified. Row crop agriculture is a common source of sediment and nutrient loads and is prevalent in the watershed. Overall, about 96 percent of the watershed is agricultural land. Crops primarily consist of corn and soybean rotations. Fertilizers commonly used in the watershed include anhydrous ammonia, ammonium phosphate, and potash. Fertilizers are applied in the fall and spring with a variety of application methods (Tetra Tech, 2004b).

Animal feedlots are another potential source of nutrient loads and pathogens. According to local Natural Resources Conservation Services (NRCS) staff, only 9,063 animal units were distributed among 217 farms in Vermilion County in 1997. Only five farms had more than 200 animal units, and only one farm had more than 500 animal units. No farm had more than 1,000 animal units.

Soils in the North Fork Vermilion River watershed have a relatively low permeability of 0.5 inch per hour. Rainfall does not easily infiltrate low permeability soils, and the resulting overland runoff rates may be high. Increased overland runoff typically results in larger nutrient and sediment loads to receiving water bodies. The absence of cropland buffer and filter strips in agricultural areas may not allow for adequate trapping of particles, uptake of dissolved nutrients, and infiltration of water and nutrients. Furthermore, grazing areas and pastureland may be crossed by small tributaries that are damaged and degraded by livestock. The 2004 Illinois Soil Conservation Transect Survey Summary indicates that about 15 percent of the points (locations) surveyed are still exceeding tolerable soil loss levels (Illinois Department of Agriculture, 2004). Vermilion County recorded 13 percent of the survey points exceeding tolerable soil loss levels, slightly lower than the state average. Vermilion County, however, has a high percentage (89 percent) of conventional tillage in corn fields, compared to the state average of 35.5 percent. The need for soil management is warranted to lower the soil loss level. It was also observed that the State average ephemeral and/or gully erosion increased in the past 8 years. Although this may be partially attributed to heavy rainfall intensity, the disturbance of soil surface may have contributed to the increased erosion.

Private septic systems are prevalent in Vermilion County and are another potential source of nutrient, sediment, and pathogen loads. Septic systems can potentially leach nutrients into the groundwater and can contaminate surface water if the system is not functioning properly. Except for residents of Danville, Rossville, and Hoopeston, all residents in the watershed use septic systems, for which the population is estimated to be 7,560, based on urban and nonurban population data shown in Tables 2-2 and 2-3 (Tetra Tech, 2004c). According to U.S. Census data, each household represents an average of 2.3 people; therefore, about 3,300 septic systems exist in the watershed. Only septic systems installed after 1970 are permitted. The number of permitted and nonpermitted septic systems in the watershed was determined as follows. There are 7,560 permitted septic systems in Vermilion County, and 1,013 permitted septic systems in Warren County (Tetra Tech, 2004c and d). Assuming permitted septic systems are distributed evenly throughout the county, and knowing that 21 percent of Vermillion County is in the watershed and 19 percent of Warren County, Indiana is in the watershed, about 1,767 permitted septic systems are located in the watershed. By subtracting 1,767 from 3,300, there are about 1,533 nonpermitted septic systems in the watershed. These nonpermitted septic systems may be a significant source of nutrient and fecal coliform loads to North Fork Vermilion River and Lake Vermilion.

Furthermore, it was reported that there are about 70 houses located around the shoreline of Lake Vermilion. About 40 percent of the houses discharge to the Danville wastewater treatment plant. The rest use septic tanks to treat their wastewater (Tetra Tech, 2004c). The potential influence of septic tank effluent on the lake will be investigated, based on site-specific information. About 95 percent of the soils in Warren County have severe limitations for conventional septic systems. Some older systems are connected to underground tile drains or discharge directly to drainage ditches. Both practices are illegal in Illinois and Indiana. Information from a detailed drain tile survey is needed to further quantify the density of the drain tile and its impact on the water quality.

5.2 POINT SOURCES

Most facilities in the North Fork Vermilion River watershed discharge a negligible flow and do not discharge loads of pollutants of concern. Six facilities either discharge a significant flow or potentially discharge sediment and nutrient loads. The six facilities are as follows, listed from upstream to downstream (see Table 5-1 and Figure 5-1):

1. **Hoopeston Foods Inc.** discharges non-contact cooling water and boiler blowdown through two outfalls. Each is monitored for temperature, biological oxygen demand (BOD), pH, and TSS (EPA 2003). It is likely that the receiving ditch of the discharge is a tributary to Hoopeston Branch (BPGD), which is listed as impaired by low DO. A new NPDES discharge permit is issued to the facility, which sets 30-day average BOD (5-day) discharge at 10 mg/L and daily maximum at 30 mg/L. Discharge monitoring reports (DMR) for Hoopeston Foods Incorporated will be evaluated as part of TMDL development.

2. **Hoopeston Sewage Treatment Plant** (STP) regularly discharges through one main outfall. The treatment processes include bar screens, grit chambers, two treatment tanks, two oxidation ditches, and four sand filters. The monitoring discharge record from April 2000 to May 2001 shows that the maximum discharge rate in the year is about 2.36 MGD. Monthly average CBOD, ammonia, and TSS are included in Table 5-1. The concentrations of these constituents did not exceed the NPDES permitted limits (Lin and Bogner 2004). Hoopeston STP has a year-round disinfection exemption that includes the entire length of Hoopeston Branch to the point where it enters North Fork Vermilion River.

3. **Rossville STP** discharges regularly through one outfall, which is monitored for pH, TSS, total residual chlorine, and BOD (EPA 2003). The treatment facility uses a two-lagoon system for primary and secondary treatment. Two intermittent sand filters polish the effluent before discharge (Lin and Bogner, 2004). The average discharge concentrations of BOD and TSS are included in Table 5-1. No discharge violation was reported. Rossville has a year-round disinfection exemption and discharges to Segment BPG-10.

4. **Alvin Water Treatment Plant** (WTP) discharges regularly through one outfall. The WTP regularly monitors pH, TSS, iron, and total residual chlorine (EPA, 2003). The DMR has not been retrieved. The Village of Alvin is an unsewered community.

5. **Bismarck Community Unit School** has an STP outfall that discharges regularly to Painter Creek, a tributary to North Fork Vermilion River. The school uses a septic tank system and two tertiary sand filers to treat the wastewater. The outfall is monitored monthly for pH, TSS, ammonia-nitrogen, total residual chlorine, and BOD (EPA, 2003). The DMR records from July 2002 to October 2003 show that the average discharge is about 0.005 MGD. The discharge record in January 2001exceeded the NPDES permitted ammonia concentration of 4.00 mg/L (Lin and Bogner, 2004).

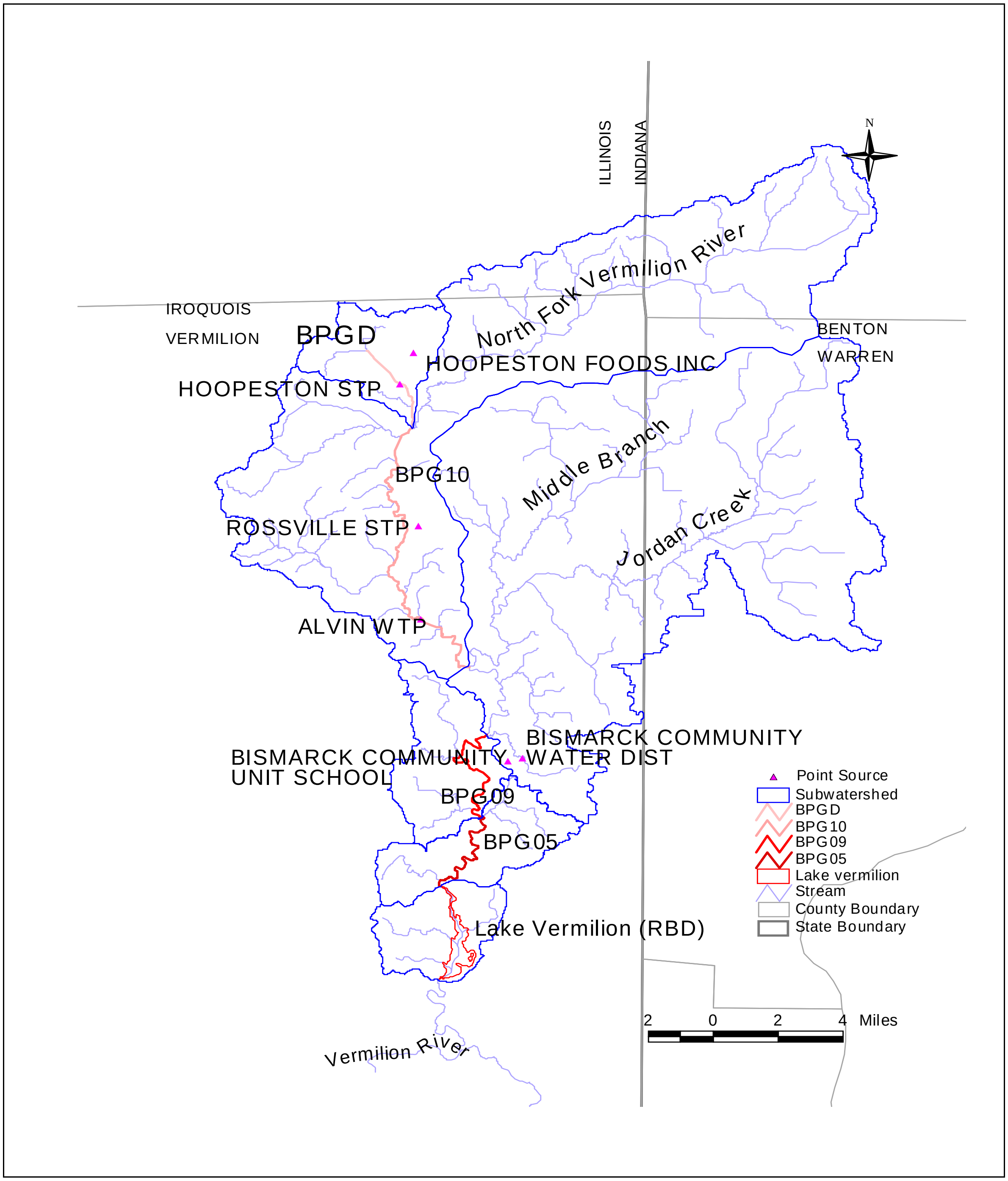
6. **Bismarck Community Water District** is the water treatment plant for local water supply. The outfall is only monitored for suspended sediment discharge and pH since it probably does not contribute significant nutrient and fecal coliform to the North Fork Vermilion River.

TABLE 5-1 MAJOR POINT SOURCES DISCHARGING IN THE NORTH FORK VERMILION RIVER WATERSHED

Facility Name	Location	NPDES No.	SIC No.	Receiving Waterbody	Average CBOD (mg/L)	Average TSS (mg/L)	Average Ammonia (mg/L)	Average Discharge (MGD)
Hoopeston Foods Inc.	Hoopeston, IL	IL0022250	2033	Stream Sewer to North Fork Vermilion River	Unknown	Unknown	Unknown	0.15
Hoopeston STP	Hoopeston, IL	IL0024830	4952	Unnamed Ditch to North Fork Vermilion River	3	3	0.21	1.652
Rossville STP	Rossville, IL	ILG580064	4952	North Fork Vermilion River	11.5	16	Unknown	0.18
Alvin WTP	Alvin, IL	ILG640002	4941	North Fork Vermilion River	Unknown	Unknown	Unknown	0.0006
Bismarck Community Unit School	Bismarck, IL	IL0067156	4941	Painter Creek	4.3	3.8	1.7	0.004
Bismarck Community Water District	Bismarck, IL	ILG640101	8211	Unnamed Tributary of Painter Creek	Unknown	Unknown	Unknown	0.007

Notes:
IL Illinois
MGD Million gallons per day
STP Sewage treatment plant
WTP Water treatment plant (water supply)
Source: USEPA 2003 and USEPA 1998

FIGURE 5-1 POINT SOURCE LOCATION MAP



6.0 TECHNICAL ANALYSIS

This chapter describes the technical analysis that was used for the development of TMDLs in North Fork Vermilion River (BPG05 and BPG09), and Lake Vermilion (RBD). A simpler approach is employed based on the recommendation of IL EPA Scientific Advisory Committee (SAC) and the consultation with IL EPA. The goal of a simple approach is to develop an approvable TMDLs that meet basic requirements of the Clean Water Act (CWA) without creating a sophisticated model that takes more time and resources. The technical approach involves a watershed flow estimate (Section 6.1), load duration curve and load estimate (Section 6.2), and a mass-balanced BATHTUB model (Section 6.3).

6.1 WATERSHED FLOW ESTIMATE AND DURATION CURVE

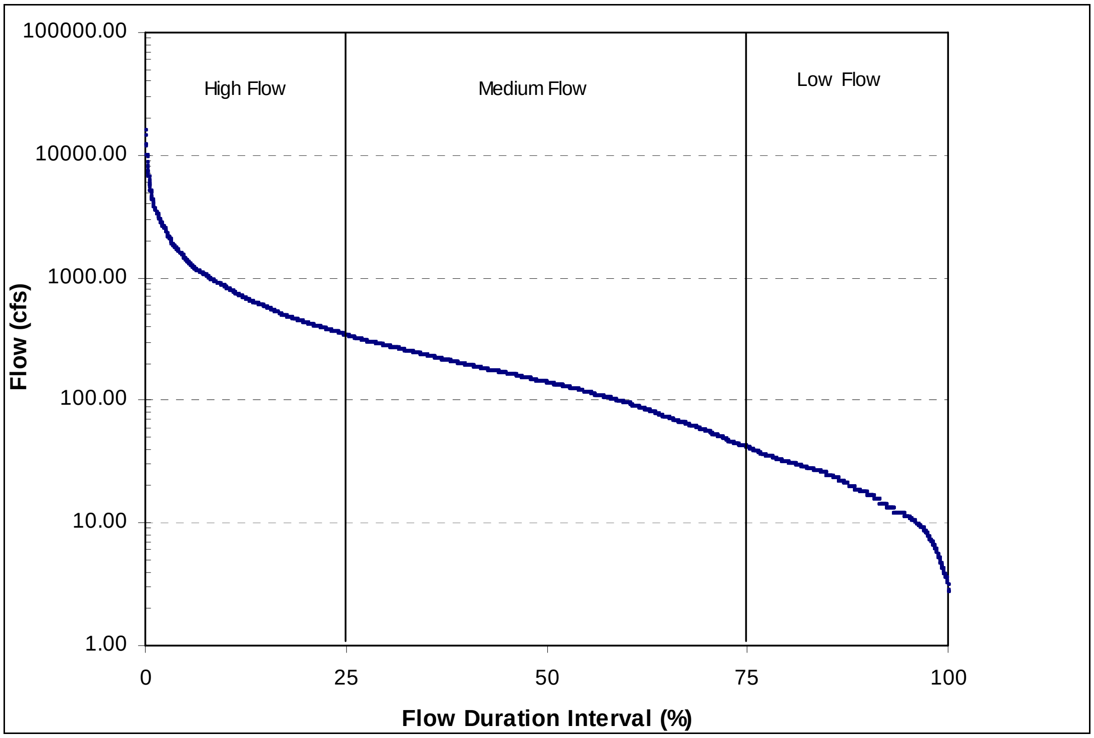
In order to calculate the total load for a water body, flows need to be estimated. Rather than developing a watershed hydrologic model, the flows in each segment were estimated indirectly using the observed flow data at the USGS gage (03338780) at Bismarck, Illinois, based on drainage area proportion. The ratio of the USGS station flow to its watershed drainage area was multiplied by the watershed area of BPG09 and BPG05 to calculate the respective flow at each location. For instance, the flow at BPG09 was calculated by using the formula:

$$Flow_{BPG09} = \frac{Flow_{USGS} \times DrainageArea_{BPG09}}{Drainage\ Area_{USGS}}$$

Flow duration curves were developed for BPG05 and BPG09 using the extrapolated flows to characterize the cumulative frequency of historic flow data over a specified period of time. The flow data from 1988 to 2006 were plotted against the duration intervals in a logarithmic scale. The entire daily flow data series is first ranked from highest to lowest and then the percent of days a flow value is exceeded is calculated. Flow duration intervals are expressed in percentage, with zero corresponding to the highest discharge (i.e. flood conditions) and 100 corresponding to the lowest (i.e. drought conditions).

Flow duration curve percentiles are grouped into three broad categories or zones to represent three major flow regimes: high flow (0 to 25th percentile), medium flow (25th to 75th percentiles), and low flow (75th to 100th percentile). The load capacity and existing loads are calculated for each flow zone in BPG05 and BPG09 segments. The use of duration curve zones allows for analysis of general patterns by conveying information about distribution of the data within each zone. It also provides additional insight about conditions and patterns associated with the impairment. Figure 6-1 presents flow duration curve and flow zones for BPG05. The flow duration curve for BPG-09 is similar since the drainage area is very close to that of BPG05.

FIGURE 6-1 FLOW DURATION CURVE FOR NORTH FORK VERMILION RIVER BPG05



The duration curves are based on the entire range of flow conditions estimated for the North Fork Vermilion River watershed, and may be used to enhance development of source assessments. Pollutant delivery mechanisms with the greatest potential influence on receiving waters (e.g. point source discharges, surface runoff) can be matched with the appropriate flow regime, as shown in Table 6-1.

TABLE 6-1 POTENTIAL RELATIONSHIP OF HYDROLOGIC CONDITION AND LOAD CONTRIBUTION BY SOURCE

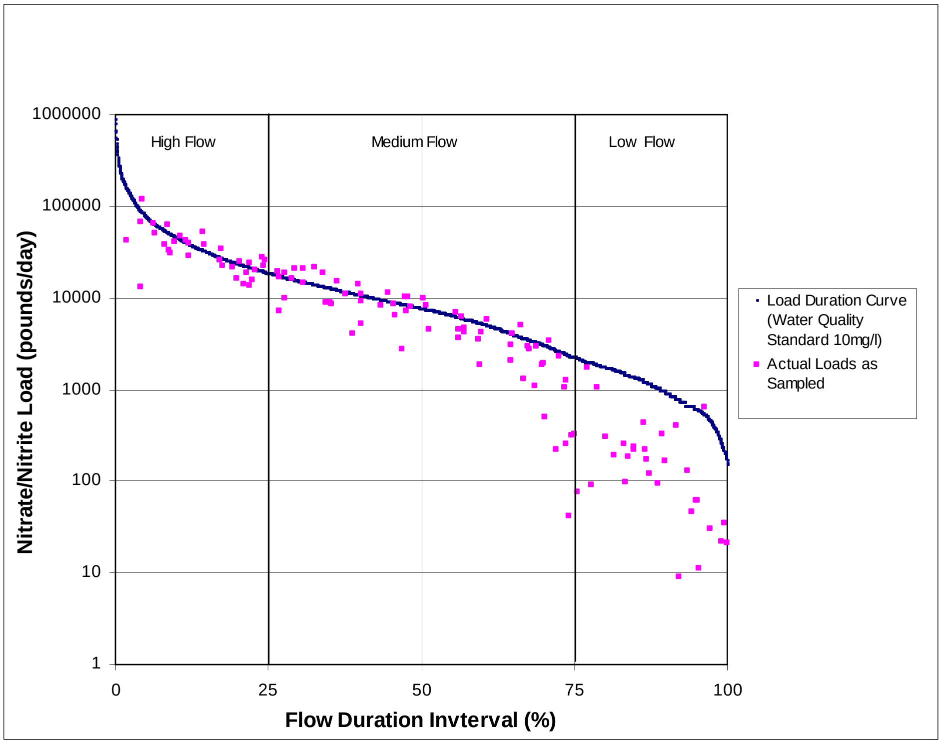
Contributing Source	Hydrologic Condition		
	High Flow	**Medium Flow**	**Low Flow**
Point Sources	L	M	H
Septic System	L	M	H
Riparian Areas	H	M	L
Stormwater: Impervious	H	M	L
Combined Sewer Overflow	H	M	L
Stormwater: Upland	H	M	L
Bank Erosion	H	L	L
Tile Drainage	M	H	L
Livestock in streams	L	L	H
Note: 1) Potential relative importance of sources area to contribute loads under given hydrologic condition: H – High, M – Medium, and L – low. 2) The information is derived from Basic Hydrology and Water Quality Management, Guide to use of duration curve by Cleland (2002)			

6.2 LOAD CURVE AND LOAD ESTIMATE

The flow duration curves for BPG05 and BPG09 were converted to load duration (TMDL) curves (Cleland 2002) for each water quality parameter of concern by multiplying the flow, water quality standard, and a conversion factor. Nitrate and fecal coliform were identified as the causes of impairment at BPG05 and BPG09, respectively, in the North Fork Vermilion River. The load duration curve was used to determine the allowable loads and the load reduction needed in the stream for each parameter. The load duration curve approach involves calculating the desired load over the range of flow conditions expected to occur in the stream. The resulting data points are plotted against the duration interval to produce a TMDL load curve, which represents allowable loads for various flows.

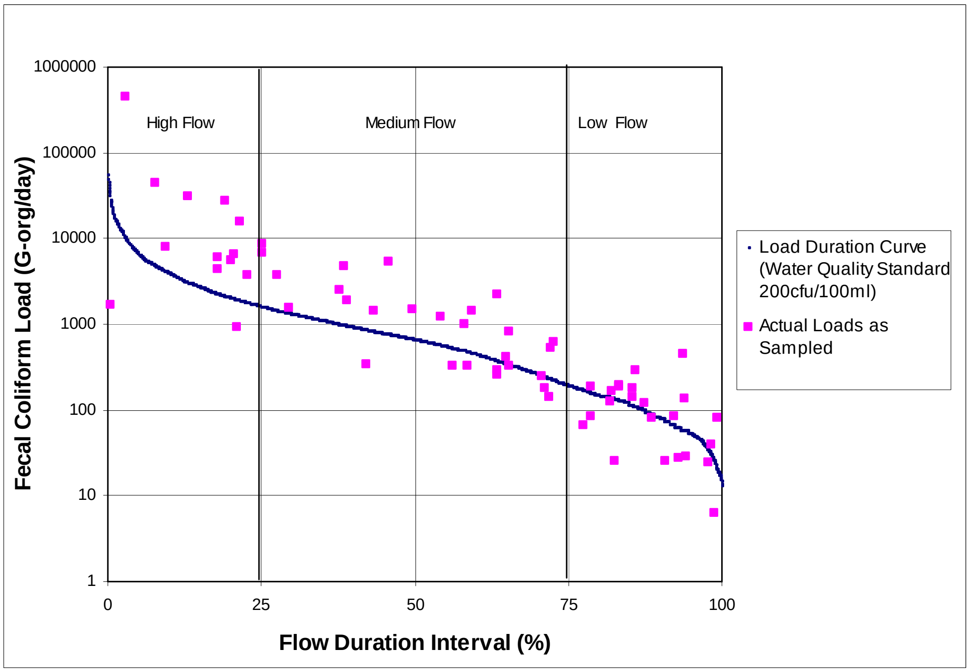
The water quality data for nitrate and fecal coliform were obtained from the USGS and IL EPA. Nitrate data were available from 1988 through 2002, and fecal coliform data were available from 1994 through 2005. For fecal coliform, only the data from May through October was considered for developing the duration curves because the Illinois water quality standard (fecal coliform 200 cfu/100ml) only applies for these months. The water quality data is converted to a load by multiplying the water quality concentration by the daily average flow on the day of sampling and by a conversion factor. The actual load is then plotted on the TMDL duration curve. Resulting points above the TMDL curve represent exceedances of the water quality standard (Figure 6-2 and Figure 6-3). Points existing below the curves represent compliance with the water quality standard.

FIGURE 6-2 NITRATE DURATION CURVE FOR BPG05



In Figure 6-2, 29 nitrate data points are above the loading curve and represent non-compliance with the water quality standard at BPG05. As shown in Figure 6-2, there is only one data point that exceeds the TMDL curve in the low flow condition. More than 96 percent of the exceedance occurs during medium to high flow conditions. This indicates that the point sources are not likely a major load contributor in low flows.

FIGURE 6-3 FECAL COLIFORM DURATION CURVE FOR BPG09



At BPG09, 42 fecal coliform data points were observed above the loading curve and exceed the water quality standard (Figure 6-3). The fecal coliform excursions occur consistently in all flow conditions, indicating several sources contributing to the problem.

The area below the loading curve is interpreted as the loading capacity of the segments. The difference between the loading curve and the existing load represents the load reduction needed to meet the water quality standards. Table 6-2 presents the existing and allowable loads under high, medium, and low flow conditions for nitrate in BPG05. Table 6-3 presents the existing and allowable average loads under high, medium, and low flow conditions for fecal coliform in BPG09.

TABLE 6-2. ALLOWABLE AND EXISTING LOADS OF NITRATE AT BPG05

Flow Zone	Average Flow (cfs)	Allowable Load (lbs/day)	Existing Average Load (lbs/day)	Reduction
Low (75%-100%)	19.8	1.07E+03	2.54E+02	0%
Medium (25%-75%)	138	7.47E+03	6.95E+03	48%
High (0-25%)	667	3.55E+04	3.56E+04	26%

TABLE 6-3. ALLOWABLE AND EXISTING LOADS OF FECAL COLIFORM AT BPG09 UNDER DIFFERENT FLOW CATEGORIES.

Flow Zone	Average Flow (cfs)	Allowable Load (10^9 cfu/day)	Existing Average Load (10^9 cfu/day)	Reduction
Low (75%-100%)	18.9	9.30E+01	1.19E+02	70%
Medium (25%-75%)	132	6.45E+02	1.80E+03	47%
High (0-25%)	637	3.15E+03	4.65E+04	8%

6.3 BATHTUB MODEL DEVELOPMENT

For Lake Vermilion, a mass-balancing BATHTUB model is used as a simple approach to link the nutrient loads with water quality. BATHTUB applies a series of empirical eutrophication equations and performs steady-state water and nutrient calculations for a lake. Eutrophication-related water quality conditions (total phosphorus and total nitrogen) are predicted using empirical relationships derived from assessments of lake data. Applications of BATHTUB are limited to steady-state evaluations of relations between nutrient loading, hydrology, and eutrophication responses.

This section explains the technical approach used in developing TMDLs for nutrients causing impairment in Lake Vermilion. TMDLs were developed for total phosphorus and nitrate. The State of Illinois lake water quality numeric standards specified for these nutrients are as follows:

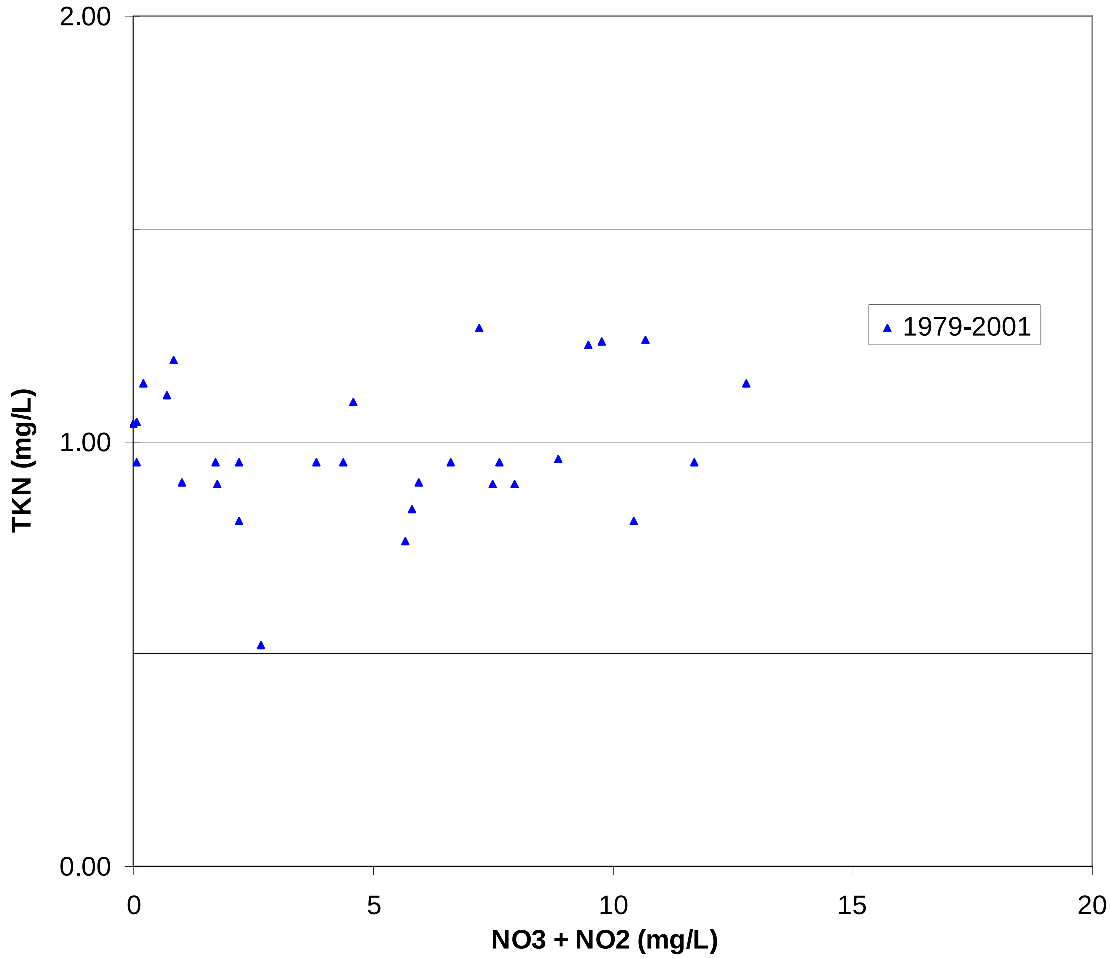
- Total Phosphorus (TP) shall not exceed 0.05 mg/L
- Nitrates (NO_3) shall not exceed 10 mg/L

BATHTUB v6.1, a steady-state water and nutrient mass balance model, was used for Lake Vermilion. BATHTUB performs a nutrient balance analysis in a spatially segmented hydraulic network, linking nutrient load inputs to the lake with the resulting concentration in Lake Vermilion. Empirical relationships previously developed and tested for lake applications are used in BATHTUB to predict water quality conditions related to eutrophication. This model was selected because it requires fairly simple inputs to predict the parameters of concern; it accounts for pollutant transport, sedimentation, and nutrient cycling; and it has been used for lake TMDLs in Illinois and other states.

The BATHTUB model uses total phosphorus and total nitrogen to represent nutrient concentrations. Total nitrogen (TN) is composed of total kjeldahl nitrogen (TKN), nitrite nitrogen (NO_2), and nitrate nitrogen (NO_3). Based on the water quality data observed in the lake, NO_2 seldom appears in concentrations greater than 1 mg/L and tends to transform to $N0_3$ through nitrification. Therefore, NO_2 is not considered and measured values of NO_3 + NO_2 are used for Nitrates. TN was not measured directly in laboratory test for all water quality samples and can be estimated using TKN and NO_3+NO_2. TKN was measured at North Fork Vermilion River from 1988 to 1998 and at few samples in recent years showing values fairly constant. To estimate TN input concentrations for the model, a statistical analysis was performed on the available samples for TKN and NO_3+NO_2. It was found that the TKN concentration is fairly steady, with a median concentration of 0.5 mg/L for all ranges of NO_3+NO_2. Therefore, the median of TKN values (0.5 mg/L) was used as a constant TKN concentration to predict TN for years with no TKN data. TN was estimated as the sum of NO_3 + NO_2 and TKN.

In Lake Vermilion, a similar relationship within the concentrations of TKN and NO_3+NO_2 is evident, with fairly constant values for TKN, although the concentrations of TKN in the lake are higher than in the river on average (Figure 6-4). There is a fairly flat linear relationship between TKN and NO_3+NO_2 with a mean TKN concentration of 1.0 mg/L for all ranges of NO_3+NO_2. As a percentage base, NO_3+NO_2 concentrations range from 16% to 94% of the TN concentrations, with an average percentage of 77%.

FIGURE 6-4 TKN VS. NO_3 + NO_2 MEASURED CONCENTRATIONS IN LAKE VERMILION



Total nitrogen (TN) is used for modeling purpose as a surrogate for Nitrates (NO_3+NO_2) because most of the TN content is from nitrates.

6.3.1 Model Setup

BATHTUB requires segment and tributary information such as lake bathymetry, hydrologic parameters, in-lake water quality concentrations, tributary flows and concentrations.

Lake Vermilion was divided into 4 segments, or reservoir zones linked in a network according to the lake's morphometry features. Figure 6-5 depicts the segmented areas used for Lake Vermilion modeling and the location of the water quality monitoring stations. At least 1 water quality monitoring station is located in each segment. Table 6-4 shows the segment names with the respective water quality station and morphometry parameters used in the model.

Lake bathymetry data was available from the "Phase I: Diagnostic Study of Lake Vermilion, Vermilion County, IL" prepared by the Consumers Illinois Water Company and Illinois Environmental Protection Agency.

TABLE 6-4 LAKE VERMILION MORPHOMETRY FOR BATHTUB

Seg	Name	WQ Station	Area km^2	Zmean m	Zmix m	Length km	Volume hm^3	Width km	L/W -
1	Upper Lake	RBD5	0.6	1.2	1.2	2.2	0.7	0.3	8.2
2	Mid Upper	RBD3	0.5	1.8	1.8	1.1	0.9	0.5	2.3
3	Mid Lower	RBD2	1.3	3.0	3.0	1.4	4.0	0.9	1.5
4	Lower Lake	RBD1	0.6	5.5	5.5	1.1	3.4	0.5	2.1
Totals			3.0	3.0			9.0		

Note: 1) RBD4 is not considered because no data is available from the site.
2) It is assumed that the lake is well-mixed.

FIGURE 6-5 LAKE VERMILION SEGMENTS FOR BATHTUB

Hydrologic data needed for the model include precipitation, evaporation, and increase in storage. Monthly total and annual precipitation data from Danville, Illinois, were available from 1977 to 2006. The average annual lake evaporation rate was calculated from pan A evaporation. According to the US Class A Pan Evaporation Maps (Kohler et al, 1959), the pan evaporation in this area is 42 inches with a pan coefficient of 0.77. Therefore, a lake evaporation of 32.34 inches per year or 0.82 meters per year was used in all models.

The North Fork Vermilion River is the main tributary discharging into Lake Vermilion. Flows and concentrations for the river were not available at the upstream end of Lake Vermilion. Flows from this tributary; however, are available at the USGS Station 3338780 near Danville at Bismark (upstream of Lake Vermilion). Daily flows from this station have been recorded since 1988. Tributary flows for the Lake Vermilion drainage area were estimated from the USGS station based on the ratio of drainage area. The drainage area for the USGS station is 259 mi^2 and the drainage area for Lake Vermilion is 296 mi^2. Thus, the USGS stream flows were multiplied by 1.14 to estimate daily flow from all tributaries and direct runoff areas into Lake Vermilion.

Water quality concentrations for TP and NO_3+NO_2 at North Fork Vermilion River were measured at the USGS station during 1997 and 1998. Nutrient concentrations are also available from IEPA and ISWS near this location for 2000, 2001, and 2002. TKN was measured prior to 1998 and during certain days on 2000 and 2001.

The duration selected for the mass balance calculations is one year. Concentrations and loadings are predicted on an annual basis from 1997 to 2003 with the exception of 1999 for which no sampling data is available at all. Water quality data in the tributary and the lake is available for years 1997, 2000, and 2001. Years 1998 and 2002 do not have measured in-lake water quality data.

FLUX was used in combination with BATHTUB to estimate tributary mass loadings from sample concentration data and continuous daily flow records. FLUX provided annual mean flows, weighted concentrations, and coefficient of variance (CV) for the years selected. Six regression models were applied to the data and the best fit was selected based on the lowest coefficient of variance and the highest slope significance for residuals vs. date or residuals vs. flow. If good fit was not possible for all records, the data was stratified in two series to improve the fit. Stratification was performed by separating flow and concentration data points in two groups, in most cases using the mean flow rate. The mean flow rates and mean concentrations for the modeling period are shown in Table 6-5.

TABLE 6-5 NORTH FORK VERMILION RIVER (TRIBUTARY) MEAN FLOWS, TP AND TN CONCENTRATIONS

Year	Concentrations		Flow Rate cfs
	TP mg/L	TN mg/L	
1997	0.200	8.869	302.7
1998	0.393	3.301	488.7
1999	-	-	-
2000	0.210	11.937	101.4
2001	0.406	10.103	368.0
2002	0.244	9.136	471.3

Tributary inflows, concentration, and coefficients of variance from FLUX were used as input in BATHTUB to predict in-lake concentration and mass loads. Observed water quality data for the years selected were used to calibrate the model.

BATHTUB has several models to predict in-lake concentrations. Total Phosphorus was predicted using the 2nd order, available P model. Total Nitrogen was predicted using the 2nd order, available N model. These two models provide generally accurate second-order sedimentation coefficients. Chlorophyll-a (Chl-a) was predicted using P, light, and flushing because phosphorus and light are the limiting factors for this lake. Transparence vs. Chl-a and Turbidity was computed. Longitudinal dispersion was calculated based on the Fischer equation. Mass balance tables and phosphorus and nitrogen calibrations were performed using predicted concentrations. Model input data for each year is included in Appendix C.

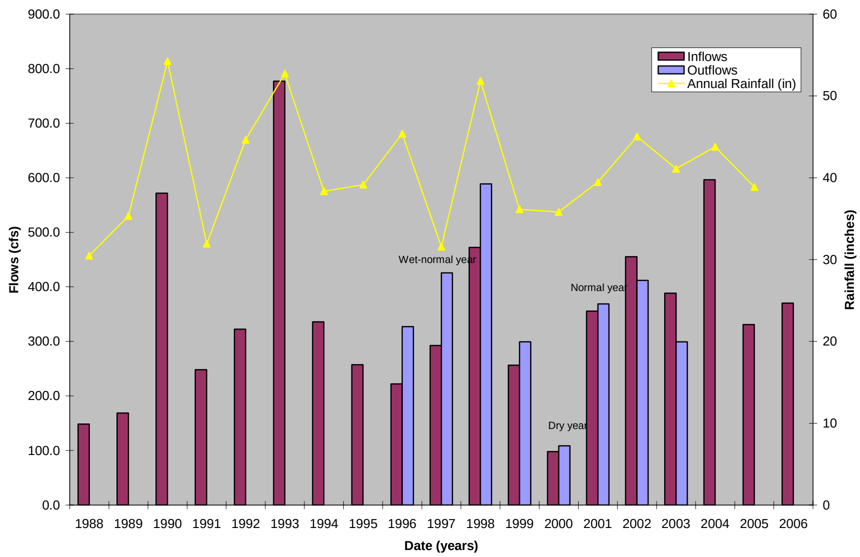
6.3.2 Model Calibration

Lakes are typically highly responsive to current and previous year weather and transport conditions. Therefore, it is difficult to validate the results of a model without looking at various weather oscillation periods. BATHTUB was calibrated for variable weather conditions that include significant climatic fluctuations. For Lake Vermilion, these conditions include wet (2001), dry (2000), and normal years (1997). For Lake Vermilion, 2000 was a dry year with the lowest discharge flows and below average rainfall for the monitoring period. 1997 was a normal year with near average inflows, high outflows and below average rainfall. 2001 was a wet-normal year, that had average rainfall during the year but slightly higher discharge flows. 1997 and 2000 were used for calibration because they have significant inflow data and water quality for both tributary and in-lake concentrations. 2001 has sufficient water quality data measured at the river but only few samples measured at the lake during March and April. This year was not used for calibration because the data was not representative of the entire year. Years 1998 and 2002 were not used for calibration due to the lack of in-lake measured nutrient concentrations. Figure 6-6 present a comparison of flows and rainfall data in Lake Vermilion.

Predicted concentrations in the lake were calibrated against observed concentration by adjusting the model coefficient factors in BATHTUB. Coefficient factors for TP, TN, Chlorophyll-a and Secchi depth were used for all the segments and in some instances a different factor was used in specific segments until the predicted weighted mean lake concentrations matched observed in-lake concentrations. Nutrient calibration factors were adjusted within the nominal ranges for Phosphorus (0.5 to 2.0) and Nitrogen (0.33 to 3). A calibration factor of 1 indicates that no adjustment was needed for the specific nutrient. The predicted current-condition concentrations are shown in Table 6-6.

BATHTUB also performs statistical comparison of observed and predicted concentrations in each model segment using the Student's t-Statistic testing (t-test) with alternative error terms (T1, T2, and T3). The t-test results are low confirming that the calibration is appropriate. T-test results are included in Appendix C.

FIGURE 6-6 ANNUAL INFLOWS, OUTFLOWS, AND RAINFALL FOR LAKE VERMILION



Predicted and observed average concentrations (based on measurements at all depths) for Lake Vermilion are shown in Table 6-6 for the years 1997 and 2000. Table 6-7 summarizes the predicted concentrations and watershed loading for all years modeled under the initial (current) conditions.

TABLE 6-6 PREDICTED AND OBSERVED NUTRIENT CONCENTRATIONS IN LAKE VERMILION FOR CURRENT CONDITIONS

Year	TP Concentrations		% Relative Error	TN Concentrations		% Relative Error
	Predicted mg/L	Observed mg/L		Predicted mg/L	Observed mg/L	
1997	0.086	0.099	-13%	6.283	6.348	-1%
1998	0.158	-		3.177	-	
1999	-	-		-	-	
2000	0.069	0.060	14%	5.650	5.472	3%
2001	0.150	-		7.253	-	-
2002	0.110	-		7.148	-	

TABLE 6-7 PREDICTED CONCENTRATIONS AND LOADS IN LAKE VERMILION FOR CURRENT CONDITIONS

Year	Concentrations		Loads	
	TP mg/L	TN mg/L	TP kg/yr	TN kg/yr
1997	0.086	6.283	54,237	2,402,337
1998	0.158	3.177	171,833	1,444,955
1999	-	-	-	-
2000	0.069	5.650	19,115	1,084,422
2001	0.150	7.253	133,526	3,325,699
2002	0.110	7.148	103,021	3,851,270

As shown in Table 6-7, the predicted in-lake average annual concentrations for total phosphorous exceeded the target concentration of 0.05 mg/L every year during the simulation period. In contrast, the predicted average annual concentrations for Total Nitrogen, used herein as surrogate for nitrates, do not exceed the target concentration of 10 mg/L in any single year.

7.0 TMDL CALCULATION

This Chapter describes the TMDL calculation for each segment based on the load duration curve and BATHTUB model discussed in Chapter 6. The load capacity, load allocations, and margin of safety are discussed.

7.1 LOADING CAPACITY – LINKING THE SOURCES WITH WATER QUALITY

A loading capacity, or allowable load, is the maximum amount of a pollutant that a water body can receive without violating water quality standards. TMDLs are the sum of the allocations plus a margin of safety, as shown in the following equation:

$$TMDL = WLA + LA + MOS$$

Where WLA (Waste Load Allocation) is the loading assigned to point sources, LA (Load Allocation) is the loading assigned to non-point sources, and MOS (Margin of Safety) is to account for any lack of knowledge, uncertainty, and potential error in the TMDL calculation. The loading capacity sets the target for the pollutant reduction needed to bring segments into compliance with the water quality standards.

For BPG05 and BPG09, the TMDL load curve is used to define the loading capacity for each flow zone. The median of the load curve for each flow zone is selected to define the load capacity for that flow zone. The median points above the TMDL load curve within each flow zone were used to obtain the existing load to be compared with the load capacity. The difference between load capacity and existing load represent the load reduction needed to meet the water quality standard.

For Lake Vermilion, the calibrated BATHTUB model is used to calculate the load capacities for total phosphorus and nitrate. The load input from tributary and direct runoff area are reduced until the average in-lake concentration is equal or lower than the standards.

7.1.1 North Fork Vermilion River Segment BPG05

Nitrate load capacities in BPG05 are 35,500 lb/day for high flow, 7,470 lb/day for medium flow, and 1,067 lb/day for low flow. A 26 percent load reduction is required to meet the water quality standard during high flow conditions. During moderate flow conditions, a 48 percent load reduction is required to meet the target concentration of 10 mg/l nitrate/nitrite at BPG05. No load reduction is needed during low flow condition because the average existing load is lower than the allowable load. The load capacity and reduction percentage are included in Table 6-2 in Section 6.2.

7.1.2 North Fork Vermilion River Segment BPG09

Fecal coliform load capacities for BPG09 are $3{,}150\times10^9$ cfu/day for high flow, 645×10^9 cfu/day for medium flow, and 93×10^9 cfu/day for low flow. A 70 percent of reduction is required to meet the not-to-exceed water quality standard of 200 cfu/100 ml for high flow conditions from May through October. A 47 percent load reduction is required to meet the water quality standard for medium flow condition. A 8 percent reduction is required for low flow. The load capacity and reduction percentage are included in Table 6-3 in Section 6.2.

7.1.3 Lake Vermilion River RBD

The BATHTUB model with calibrated nutrient concentrations was used to identify the reduction loading needed for TP. Predicted total phosphorous (TP) was in exceedance in all years (TP > 0.05 mg/L). Table 7-1 shows the TP existing concentration, percent reductions needed in the input loads to meet the target value, the load capacity, and the concentration after load reduction is implemented.

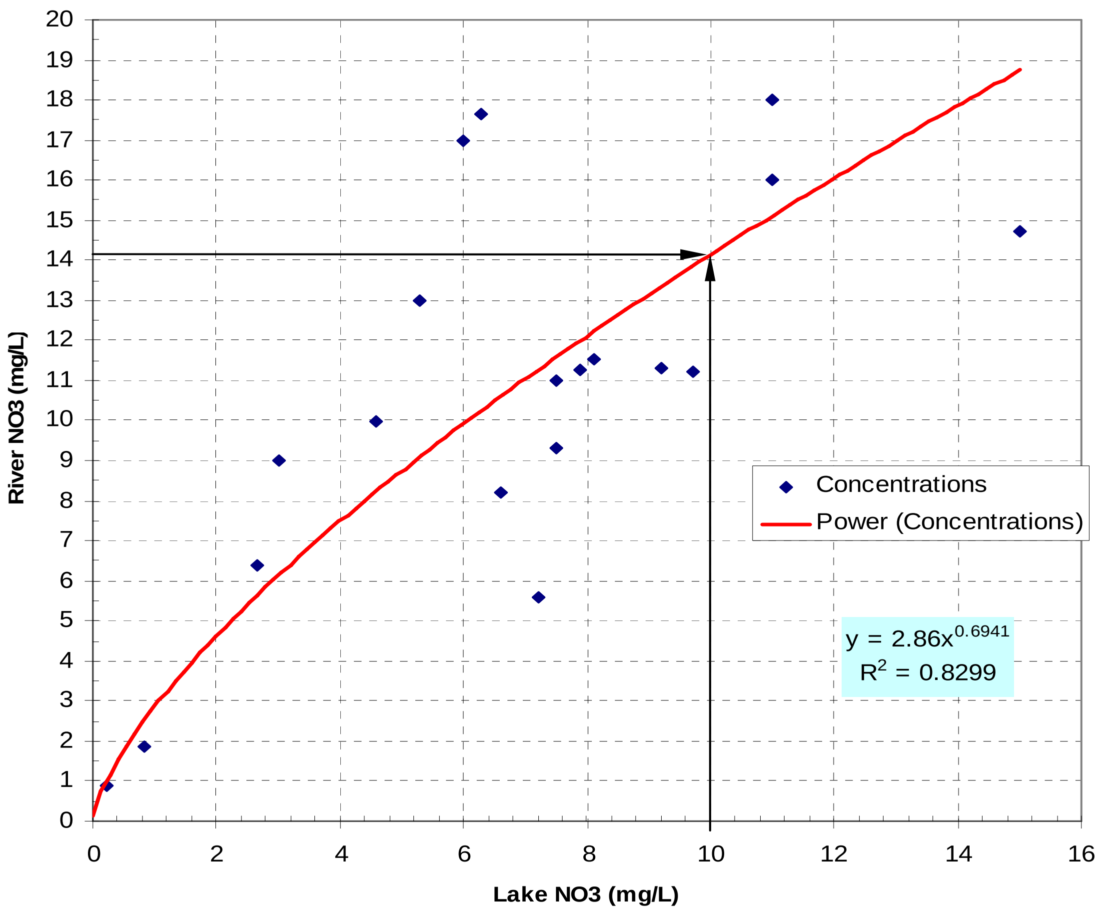
TABLE 7-1. PREDICTED NUTRIENT CONCENTRATIONS IN LAKE VERMILION AFTER TARGET LOAD REDUCTIONS

Year	Post-Reduction Tributary Concentrations	% Reduction	Post-Reduction Concentration	Load Capacity
	TP mg/L		TP mg/L	kg/yr
1997	0.100	50%	0.050	27,163
1998	0.090	77%	0.050	63,635
1999	-		-	-
2000	0.132	37%	0.050	12,076
2001	0.096	76%	0.050	31,662
2002	0.093	62%	0.050	39,204

Nitrates are not calculated directly by the BATHTUB model. Therefore, the concentration of TN was used in this analysis as a surrogate for NO3. The TN concentrations initially predicted in BATHTUB were based on mean annual input concentrations and resulted in in-lake concentrations lower than the target concentrations. There are, however, several measured concentrations at the tributary that are significantly higher than the target concentration. As a result, the Nitrates reduction loads needed to meet the target concentration in the lake of 10 mg/L were estimated in BATHTUB based on the input concentrations exceeding 10 mg/L at the North Fork Vermilion River.

A regression curve showing the relationship between the measured concentrations at the river compared to the measured concentrations at the lake is shown in Figure 7-1. In total, 19 samples were measured during 2000 and 2001 on the same day at both locations.

FIGURE 7-1 REGRESSION CURVE FOR NITRATE CONCENTRATIONS



As shown in Figure 7-1, the data points fit well the power regression curve with a relatively high coefficient of determination ($R^2 = 0.83$). According to the curve, for a value of 10 mg/L in the lake, the maximum concentration at the river should be 14.1 mg/L. This concentration, however, violates the water quality standard in BPG05, which has to meet 10 mg/L target. The correlation in Figure 7-1 indicates that the implementation measures in BPG05 will likely result in the compliance in Lake Vermilion RBD.

Concentrations in the river, greater than 10 mg/L were used to calculate the Nitrate reduction loads. Table 7-2 summarizes the input and output concentrations and load for the initial (current) conditions.

TABLE 7-2 TRIBUTARY AND LAKE MAXIMUM FLOWS AND MAXIMUM NITRATE CONCENTRATIONS FOR CURRENT CONDITIONS

Year	North Fork Vermilion River			Lake Vermilion
	Average Concentration mg/L	Flow Rate Cfs	Loads kg/yr	Concentrations mg/L
2000	16.780	1,112.8	16,693,057	13.838
2001	13.245	843.4	9,987,741	10.838

Total Nitrogen (or Nitrate) concentrations were only simulated for years 2000 and 2001 because the measured concentrations at the tributary and at the lake on the same date are available for the two years. Table 7-3 shows the Nitrate percentage reductions needed in the input loads to meet the target value, load capacity, and Nitrate concentration after the reduction measures are implemented.

TABLE 7-3 NITRATE PERCENTAGE REDUCTION IN INPUT CONCENTRATIONS FOR LAKE VERMILION

Year	Post-Reduction Tributary Concentrations	% Reduction	Post-Reduction In-lake Concentrations	Load Capacity
	mg/L		mg/L	kg/yr
2000	11.15	34%	10.00	11,093,234
2001	11.92	10%	9.99	8,989,267

7.2 LOAD ALLOCATIONS

The pollutant loads have been linked to violations of applicable standards through the duration curve and BATHTUB modeling. The magnitudes of the loads have been determined by a reliable quantitative procedure that is based either on duration curves for the river segments or in-lake measurements for climate conditions that cover the range of expected precipitation conditions. For simplicity, a watershed model was not developed for the TMDLs in this report. The load allocation (non-point sources) cannot therefore be calculated directly. Instead, the load allocation is calculated by subtracting the margin of safety (discussed in Section 7.3) and the waste load allocations (WLA) from the load capacity, as indicated in following formula:

$$LA = TMDL - WLA - MOS$$

The decay of fecal coliform and nutrients from point sources load is neglected to be conservative. The TMDLs were obtained from the duration curves presented in Figures 6-2 and 6-3. The WLA is the combination of discharge loads from the known facilities identified Chapter 5. After determining the margin of safety, the only information that remains to be calculated is the LA.

7.2.1 North Fork Vermilion River Segment BPG05

As shown in Figure 6-2, the nitrate concentration rarely exceeds the 10 mg/l standard during low flow conditions, which indicates the point sources contribution is negligible. Therefore, the nitrate contribution from all point sources is not considered in waste load allocations. The allocation of loads for BPG05 is summarized in Table 7-4. The total non-point source load allocation for BPG05 was about 6723 lb/day of nitrate during median flow conditions. Likely, the impairment is caused primarily due to the agricultural activities in the watershed because approximately 96 percent of the land use in the upstream watershed area is agricultural and loads from agricultural areas typically occur during runoff events. A margin of safety (MOS) of 10 percent was used.

TABLE 7-4. TMDL SUMMARY FOR THE NITRATE AT BPG05

Flow Range	High	Medium	Low
Flow Intervals	0-25%	25%-75%	75%-100%
Reduction (%)	26%	48%	0%
TMDL (lb/day)	35,500	7,470	1,067
Load Allocation (lb/day)	3,1962	6,723	960
Waste Load Allocation (lb/day)	0	0	0
Margin of Safety (lb/day) (10%)	3,551	747	107

7.2.2 North Fork Vermilion River Segment BPG09

The Hoopeston, Rossville, and Bismark School sewage treatment plants (STP) are considered potential sources of fecal coliform load to segment BPG09. The three plants have been granted disinfection exemptions by IL EPA as a part of each facility's NPDES permit. Each facility should be meeting the 200 cfu/100ml at the end of their respective disinfection exemption stream reach as identified in the permits under all flow conditions. Daily fecal coliform loads from the three point sources were averaged and incorporated into the waste load allocation calculation (total $14x10^9$ cfu/day). The load allocation is calculated by multiplying the average discharges with 200 cfu/100ml and a unit conversion factor. It is assumed that Alvin water treatment plant, Hoopeston Foods Inc. and Bismarck community district water plant do not contribute fecal coliform to the segment and were not considered in the waste load allocation. Table 7-5 summarizes the point source discharge and load allocation for fecal coliform.

TABLE 7-5 SUMMARY OF WASTE LOAD ALLOCATION FROM POINT SOURCE DISCHARGES IN THE NORTH FORK VERMILION RIVER WATERSHED

Facility Name	Discharge Flow (cfs)	F. Coliform Conc. (cfu/100ml)	F. Coliform Load (10^9 cfu/day)
Hoopeston STP	2.56	200	12.52
Rossville STP	0.28	200	1.37
Bismarck Community Unit School	0.01	200	.05
Total	2.85	200	14

Note: the 200 cfu/100mL standard applies to the end of each facility's exempted stream reach

During moderate flow conditions, a total load of $1,183x10^9$ cfu/day of fecal coliform is discharged into BPG09 from various non-point sources. The percent reductions on non-point source loads for medium and low flows are 47 and 8 percents respectively, while a 70 percent reduction is needed to meet the water quality standards under high flow condition. The reduction percentages were calculated only for the non-point sources at this time because current total fecal coliform data are not available from each discharger. Based on the historical fecal coliform data obtained from each facility used in granting the disinfection exemptions, it was determined that the exempted stream reaches for each facility would not adversely impact the North Fork Vermilion River. A margin of safety is not explicitly incorporated because it is included implicitly by using the more stringent standard. Table 7-6 summarizes the fecal coliform TMDL for BPG09.

Fecal coliform bacteria occur in ambient water as a result of the overflow of domestic sewage or non-point sources of human and animal waste. Nonpermitted septic systems (about 1,533 in the entire Lake Vermillion watershed) are potentially a significant source of nutrient and fecal coliform loads to both the river and the lake. Other non-point sources include uncontrolled discharges, wildlife, land application of manure, poultry litter, cattle contributions directly deposited in-stream, and grazing animals. Additionally, animal feedlots are also potential sources of nutrients and fecal coliform. Urban land use in the watershed area is only 1.8 percent for BPG05 and 1.1 percent for BPG09.

TABLE 7-6. TMDL SUMMARY FOR FECAL COLIFORM AT BPG09

Flow Range	**High**	**Medium**	**Low**
Flow Intervals	0-25%	25%-75%	75%-100%
Nonpoint Sources Load Reduction (%)	70%	47%	8%
TMDL (10^9 cfu/day)	3,150	645	93
Load Allocation (10^9 cfu/day)	10,370	1,183	85
Waste Load Allocation (10^9 cfu/day)	14	14	14
Margin of Safety (10^9 cfu/day) (%)	0	0	0

7.2.3 Lake Vermilion (RBD)

This section presents the load allocations for Lake Vermilions.

7.2.3.1 Total Phosphorus

The load allocation for Lake Vermilion TP TMDL was calculated based on the maximum percentage reduction from the three years calibrated. As a result, a reduction of 77% was used for TMDL development. Table 7-7 shows the TMDL allocations for total phosphorus. The existing load is the mean load for the three years modeled and calibrated. The loading capacity represents the 77% reduction in the existing load. The waste load allocation (WLA) is the sum of the waste loads from the treatment plants discharging to Lake Vermilion. An average TP concentration of 3.5 mg/L and average flows from the point sources were used to calculate the WLA. A margin of safety (MOS) of 10% was used. The MOS is calculated as 10% of the load capacity.

TABLE 7-7 TMDL SUMMARY FOR LAKE VERMILION

Category	**TP (lb/day)**
Existing Load	581.9
Reduction	77%
Loading Capacity (TMDL)	133.8
Waste Load Allocation	58.3
MOS	13.4
Load Allocation	62.1

7.2.3.2 Nitrate

Table 7-8 shows the TMDL allocations for nitrates. The existing load is the mean load based on concentrations and flows from the samples measured on the same day at the river and the lake. The loading capacity represents the 34% reduction in the existing load, which is the maximum reduction predicted by the model required to meet the water quality standard. The waste load allocation (WLA) is assumed zero because it is very small compared to the non point source loading. A margin of safety (MOS) of 10% was used. The MOS is calculated as 10% of the load capacity.

TABLE 7-8 NITRATE TMDL SUMMARY FOR LAKE VERMILION

Category	**TN (lb/day)**
Existing Load	14,627.4
Reduction	34%
Loading Capacity (TMDL)	9,719.7
Waste Load Allocation	-
MOS	972.0
Load Allocation	8,747.7

7.3 MARGIN OF SAFETY

The margin of safety (MOS) is an additional factor included in the TMDL to account for scientific uncertainties, growth, etc., such that applicable water quality standards/guidelines are achieved and maintained. The MOS can be included implicitly in the calculations of the WLA and LA expressed explicitly as a separate value. The BATHTUB model calculated a measure of potential model error (coefficient of variation). This error term was used in combination with the coefficient of variation for percent load reductions in order to meet target water quality goals. The summation of these error terms was used to determine an explicit MOS. The coefficient of variation is a measure of variation in numbers relative to the mean value and can be expressed as either a fraction or percent of the mean. A 10 percent margin of safety has been incorporated into the North Fork Vermilion River TMDL for nitrate and Lake Vermilion for total phosphorus and nitrate. A margin of safety for fecal coliform is included implicitly by using the more stringent standard, 200 cfu/100 ml.

7.4 SEASONAL VARIATION

Section 303(d)(1)(C) of the Clean Water Act and USEPA's regulations at 40CFR 130.7 (c)(1) require that a TMDL be established that addresses seasonal variations normally found in the natural system. It is often essential to account for seasonal variations in the concentrations of contaminants addressed in the TMDL. However, while seasonal variation is important for reservoir and lake systems, climate conditions and climate history can have a great effect on transport and transformation processes. Runoff and transport will be affected by previous year climate as well as current climate conditions. Flushing or storage in the reservoir will be affected by the climate (amount of precipitation and runoff) and past inputs. Seasonal variation was addressed by using an averaging program, FLUX, to determine yearly flow-weighted average pollutant concentrations, which integrate the effects of seasonal variation and flow. Seasonal variation is modeled implicitly by including coefficients of variation for measured in-lake water quality parameters, which are descriptive of seasonal variations.

For the North Fork Vermilion River, the impact of seasonal and other short-term variability in nutrient loading will not be significant since the long-term average nutrient concentrations drive the biotic response. Previous investigations of seasonal trends of indicator bacteria densities in surface waters indicate that the summer months typically exhibit the highest densities of any season (DEP 2005). This is likely due to the enhanced ability of indicator bacteria to survive in surface waters and sediment when ambient temperatures more closely approximate those of warm-blooded animals, from which the bacteria originate (DEP, 2005). In addition, resident wildlife populations are likely to be more active during the warmer months and more migratory species are present during summer time (DEP, 2005). These factors combined, result in higher fecal coliform loads in the summer relative to the other seasons.

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APPENDIX A
FIELD PHOTOS

Lake Vermilion Dam and Spillway

Water Plant Intake

Lake Vermilion Bank Erosion

North Fork Vermilion River near Lake Vermilion

APPENDIX B
WATER QUALITY DATA

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPGD	BPGD-H-A1	9/23/2002	BOD		6	mg/L
BPGD	BPGD-H-A2	9/23/2002	BOD		2	mg/L
BPGD	BPGD-H-C1	9/23/2002	BOD		2	mg/L
BPGD	BPGD-H-C2	9/23/2002	BOD		1	mg/L
BPGD	BPGD-H-C3	9/23/2002	BOD		<1	mg/L
BPGD	BPGD-H-D2	9/23/2002	BOD		4	mg/L
BPGD	BPGD-H-D3	9/23/2002	BOD		<1	mg/L
BPGD	BPGD-H-E1	9/23/2002	BOD		<1	mg/L
BPGD	BPGD-H-A1	9/23/2002	BOD carb (Inh.)		4	mg/L
BPGD	BPGD-H-A2	9/23/2002	BOD carb (Inh.)		1	mg/L
BPGD	BPGD-H-C1	9/23/2002	BOD carb (Inh.)		1	mg/L
BPGD	BPGD-H-C2	9/23/2002	BOD carb (Inh.)		<1	mg/L
BPGD	BPGD-H-C3	9/23/2002	BOD carb (Inh.)		<1	mg/L
BPGD	BPGD-H-D2	9/23/2002	BOD carb (Inh.)		2	mg/L
BPGD	BPGD-H-D3	9/23/2002	BOD carb (Inh.)		<1	mg/L
BPGD	BPGD-H-E1	9/23/2002	BOD carb (Inh.)		<1	mg/L
RBD	RBD-1	6/28/1979	Chlorophyll a	4	27	mg/L
RBD	RBD-1	9/5/1979	Chlorophyll a	3	44	mg/L
RBD	RBD-1	5/18/1983	Chlorophyll a	1	11.46	mg/L
RBD	RBD-1	4/21/1997	Chlorophyll a	4	31.71	mg/L
RBD	RBD-1	6/9/1997	Chlorophyll a	2	12.57	mg/L
RBD	RBD-1	7/14/1997	Chlorophyll a	6	32.71	mg/L
RBD	RBD-1	8/12/1997	Chlorophyll a	3	17.32	mg/L
RBD	RBD-1	10/22/1997	Chlorophyll a	3	41.72	mg/L
RBD	RBD-1	5/1/2003	Chlorophyll a		33.9	mg/L
RBD	RBD-1	6/18/2003	Chlorophyll a		9	mg/L
RBD	RBD-1	04/19/01	Chlorophyll a		7.92	mg/L
RBD	RBD-1	04/26/01	Chlorophyll a		25.4	mg/L
RBD	RBD-2	6/28/1979	Chlorophyll a	1	144	mg/L
RBD	RBD-2	9/5/1979	Chlorophyll a	2	52	mg/L
RBD	RBD-2	5/18/1983	Chlorophyll a	1	5.24	mg/L
RBD	RBD-2	4/21/1997	Chlorophyll a	3	23.5	mg/L
RBD	RBD-2	6/9/1997	Chlorophyll a	1	9.54	mg/L
RBD	RBD-2	7/14/1997	Chlorophyll a	4	31.37	mg/L
RBD	RBD-2	8/12/1997	Chlorophyll a	3	42.86	mg/L
RBD	RBD-2	10/22/1997	Chlorophyll a	4	34.99	mg/L
RBD	RBD-2	04/19/01	Chlorophyll a		24.4	mg/L
RBD	RBD-2	04/26/01	Chlorophyll a		25.8	mg/L
RBD	RBD-2	5/1/2003	Chlorophyll a		39.2	mg/L
RBD	RBD-2	6/18/2003	Chlorophyll a		4.24	mg/L
RBD	RBD-3	6/28/1979	Chlorophyll a	1	154	mg/L
RBD	RBD-3	9/5/1979	Chlorophyll a	1	27	mg/L
RBD	RBD-3	5/18/1983	Chlorophyll a	1	2.11	mg/L
RBD	RBD-3	4/21/1997	Chlorophyll a	3	16.529	mg/L
RBD	RBD-3	6/9/1997	Chlorophyll a	1	4.45	mg/L
RBD	RBD-3	7/14/1997	Chlorophyll a	2	20.84	mg/L
RBD	RBD-3	8/12/1997	Chlorophyll a	2	51.49	mg/L
RBD	RBD-3	10/22/1997	Chlorophyll a	3	32.24	mg/L
RBD	RBD-4	4/21/1997	Chlorophyll a	3	21.76	mg/L
RBD	RBD-5	04/19/01	Chlorophyll a		20	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
RBD	RBD-5	04/26/01	Chlorophyll a		33.6	mg/L
RBD	RBD-5	5/1/2003	Chlorophyll a		28.4	mg/L
RBD	RBD-5	6/18/2003	Chlorophyll a		3.99	mg/L
RBD	RBD-01	7/2/1977	Dissolved Oxygen	0	6.5	mg/L
RBD	RBD-01	7/2/1977	Dissolved Oxygen	2	5.5	mg/L
RBD	RBD-01	7/2/1977	Dissolved Oxygen	4	4.5	mg/L
RBD	RBD-01	7/2/1977	Dissolved Oxygen	6	3.7	mg/L
RBD	RBD-01	7/2/1977	Dissolved Oxygen	8	3	mg/L
RBD	RBD-01	7/2/1977	Dissolved Oxygen	10	2.5	mg/L
RBD	RBD-01	7/2/1977	Dissolved Oxygen	12	1.8	mg/L
RBD	RBD-01	7/2/1977	Dissolved Oxygen	14	0.2	mg/L
RBD	RBD-01	7/2/1977	Dissolved Oxygen	16	0.1	mg/L
RBD	RBD-01	7/2/1977	Dissolved Oxygen	18	0.1	mg/L
RBD	RBD-01	7/2/1977	Dissolved Oxygen	19	0.1	mg/L
RBD	RBD-01	6/28/1979	Dissolved Oxygen	0	10.2	mg/L
RBD	RBD-01	6/28/1979	Dissolved Oxygen	1	10.5	mg/L
RBD	RBD-01	6/28/1979	Dissolved Oxygen	3	9.9	mg/L
RBD	RBD-01	6/28/1979	Dissolved Oxygen	5	9.5	mg/L
RBD	RBD-01	6/28/1979	Dissolved Oxygen	7	9.4	mg/L
RBD	RBD-01	6/28/1979	Dissolved Oxygen	9	9.2	mg/L
RBD	RBD-01	6/28/1979	Dissolved Oxygen	11	4.4	mg/L
RBD	RBD-01	6/28/1979	Dissolved Oxygen	13	3.2	mg/L
RBD	RBD-01	6/28/1979	Dissolved Oxygen	14	2.9	mg/L
RBD	RBD-01	9/5/1979	Dissolved Oxygen	0	15.7	mg/L
RBD	RBD-01	9/5/1979	Dissolved Oxygen	1	16	mg/L
RBD	RBD-01	9/5/1979	Dissolved Oxygen	3	15.8	mg/L
RBD	RBD-01	9/5/1979	Dissolved Oxygen	5	16.4	mg/L
RBD	RBD-01	9/5/1979	Dissolved Oxygen	7	16.9	mg/L
RBD	RBD-01	9/5/1979	Dissolved Oxygen	9	14.3	mg/L
RBD	RBD-01	9/5/1979	Dissolved Oxygen	11	4.3	mg/L
RBD	RBD-01	9/5/1979	Dissolved Oxygen	12	0.9	mg/L
RBD	RBD-01	5/18/1983	Dissolved Oxygen	0	9.4	mg/L
RBD	RBD-01	5/18/1983	Dissolved Oxygen	1	9.2	mg/L
RBD	RBD-01	5/18/1983	Dissolved Oxygen	3	9	mg/L
RBD	RBD-01	5/18/1983	Dissolved Oxygen	5	8.8	mg/L
RBD	RBD-01	5/18/1983	Dissolved Oxygen	7	8.7	mg/L
RBD	RBD-01	5/18/1983	Dissolved Oxygen	9	8.1	mg/L
RBD	RBD-01	5/18/1983	Dissolved Oxygen	10	8.2	mg/L
RBD	RBD-01	5/18/1983	Dissolved Oxygen	11	8	mg/L
RBD	RBD-01	5/18/1983	Dissolved Oxygen	12	7.9	mg/L
RBD	RBD-01	5/5/1993	Dissolved Oxygen	0	7.9	mg/L
RBD	RBD-01	5/5/1993	Dissolved Oxygen	1	7.8	mg/L
RBD	RBD-01	5/5/1993	Dissolved Oxygen	3	7.5	mg/L
RBD	RBD-01	5/5/1993	Dissolved Oxygen	5	7.1	mg/L
RBD	RBD-01	5/5/1993	Dissolved Oxygen	7	7.1	mg/L
RBD	RBD-01	5/5/1993	Dissolved Oxygen	9	8	mg/L
RBD	RBD-01	5/5/1993	Dissolved Oxygen	11	7.9	mg/L
RBD	RBD-01	5/5/1993	Dissolved Oxygen	13	7	mg/L
RBD	RBD-01	5/5/1993	Dissolved Oxygen	15	6.7	mg/L
RBD	RBD-01	5/12/1993	Dissolved Oxygen	0	15	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
RBD	RBD-01	5/12/1993	Dissolved Oxygen	1	15.5	mg/L
RBD	RBD-01	5/12/1993	Dissolved Oxygen	3	15.4	mg/L
RBD	RBD-01	5/12/1993	Dissolved Oxygen	5	14.5	mg/L
RBD	RBD-01	5/12/1993	Dissolved Oxygen	7	11.2	mg/L
RBD	RBD-01	5/12/1993	Dissolved Oxygen	9	9	mg/L
RBD	RBD-01	5/12/1993	Dissolved Oxygen	11	7	mg/L
RBD	RBD-01	5/12/1993	Dissolved Oxygen	13	5.4	mg/L
RBD	RBD-01	5/12/1993	Dissolved Oxygen	15	5	mg/L
RBD	RBD-01	5/27/1993	Dissolved Oxygen	0	13	mg/L
RBD	RBD-01	5/27/1993	Dissolved Oxygen	1	13	mg/L
RBD	RBD-01	5/27/1993	Dissolved Oxygen	3	13.1	mg/L
RBD	RBD-01	5/27/1993	Dissolved Oxygen	5	13	mg/L
RBD	RBD-01	5/27/1993	Dissolved Oxygen	7	10.4	mg/L
RBD	RBD-01	5/27/1993	Dissolved Oxygen	9	10	mg/L
RBD	RBD-01	5/27/1993	Dissolved Oxygen	11	10	mg/L
RBD	RBD-01	5/27/1993	Dissolved Oxygen	13	9.8	mg/L
RBD	RBD-01	5/27/1993	Dissolved Oxygen	15	9.5	mg/L
RBD	RBD-01	6/24/1993	Dissolved Oxygen	0	7	mg/L
RBD	RBD-01	6/24/1993	Dissolved Oxygen	1	6.9	mg/L
RBD	RBD-01	6/24/1993	Dissolved Oxygen	3	6.2	mg/L
RBD	RBD-01	6/24/1993	Dissolved Oxygen	5	4.5	mg/L
RBD	RBD-01	6/24/1993	Dissolved Oxygen	7	4.5	mg/L
RBD	RBD-01	6/24/1993	Dissolved Oxygen	9	4.2	mg/L
RBD	RBD-01	6/24/1993	Dissolved Oxygen	11	4	mg/L
RBD	RBD-01	6/24/1993	Dissolved Oxygen	13	4	mg/L
RBD	RBD-01	6/24/1993	Dissolved Oxygen	15	4	mg/L
RBD	RBD-01	7/1/1993	Dissolved Oxygen	0	6.5	mg/L
RBD	RBD-01	7/1/1993	Dissolved Oxygen	1	7	mg/L
RBD	RBD-01	7/1/1993	Dissolved Oxygen	3	7	mg/L
RBD	RBD-01	7/1/1993	Dissolved Oxygen	5	7.2	mg/L
RBD	RBD-01	7/1/1993	Dissolved Oxygen	7	7.4	mg/L
RBD	RBD-01	7/1/1993	Dissolved Oxygen	9	7.8	mg/L
RBD	RBD-01	7/1/1993	Dissolved Oxygen	11	8	mg/L
RBD	RBD-01	7/1/1993	Dissolved Oxygen	13	7.9	mg/L
RBD	RBD-01	7/1/1993	Dissolved Oxygen	15	8	mg/L
RBD	RBD-01	7/8/1993	Dissolved Oxygen	0	6.5	mg/L
RBD	RBD-01	7/8/1993	Dissolved Oxygen	1	7	mg/L
RBD	RBD-01	7/8/1993	Dissolved Oxygen	3	6.3	mg/L
RBD	RBD-01	7/8/1993	Dissolved Oxygen	5	6.5	mg/L
RBD	RBD-01	7/8/1993	Dissolved Oxygen	7	6.5	mg/L
RBD	RBD-01	7/8/1993	Dissolved Oxygen	9	6.5	mg/L
RBD	RBD-01	7/8/1993	Dissolved Oxygen	11	6	mg/L
RBD	RBD-01	7/8/1993	Dissolved Oxygen	13	5.5	mg/L
RBD	RBD-01	7/8/1993	Dissolved Oxygen	15	5	mg/L
RBD	RBD-01	7/22/1993	Dissolved Oxygen	0	8.5	mg/L
RBD	RBD-01	7/22/1993	Dissolved Oxygen	1	8.8	mg/L
RBD	RBD-01	7/22/1993	Dissolved Oxygen	3	8.7	mg/L
RBD	RBD-01	7/22/1993	Dissolved Oxygen	5	8.5	mg/L
RBD	RBD-01	7/22/1993	Dissolved Oxygen	7	8.5	mg/L
RBD	RBD-01	7/22/1993	Dissolved Oxygen	9	9	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
RBD	RBD-01	7/22/1993	Dissolved Oxygen	11	8.5	mg/L
RBD	RBD-01	7/22/1993	Dissolved Oxygen	13	7.5	mg/L
RBD	RBD-01	7/22/1993	Dissolved Oxygen	15	4	mg/L
RBD	RBD-01	8/5/1993	Dissolved Oxygen	0	7.1	mg/L
RBD	RBD-01	8/5/1993	Dissolved Oxygen	1	7	mg/L
RBD	RBD-01	8/5/1993	Dissolved Oxygen	3	6.9	mg/L
RBD	RBD-01	8/5/1993	Dissolved Oxygen	5	7.1	mg/L
RBD	RBD-01	8/5/1993	Dissolved Oxygen	7	6.9	mg/L
RBD	RBD-01	8/5/1993	Dissolved Oxygen	9	6.5	mg/L
RBD	RBD-01	8/5/1993	Dissolved Oxygen	11	5	mg/L
RBD	RBD-01	8/5/1993	Dissolved Oxygen	13	5	mg/L
RBD	RBD-01	8/5/1993	Dissolved Oxygen	15	5	mg/L
RBD	RBD-01	8/20/1993	Dissolved Oxygen	0	8.5	mg/L
RBD	RBD-01	8/20/1993	Dissolved Oxygen	1	9	mg/L
RBD	RBD-01	8/20/1993	Dissolved Oxygen	3	8.8	mg/L
RBD	RBD-01	8/20/1993	Dissolved Oxygen	5	8.4	mg/L
RBD	RBD-01	8/20/1993	Dissolved Oxygen	7	8	mg/L
RBD	RBD-01	8/20/1993	Dissolved Oxygen	9	8	mg/L
RBD	RBD-01	8/20/1993	Dissolved Oxygen	11	7	mg/L
RBD	RBD-01	8/20/1993	Dissolved Oxygen	13	7.4	mg/L
RBD	RBD-01	8/20/1993	Dissolved Oxygen	15	6	mg/L
RBD	RBD-01	9/1/1993	Dissolved Oxygen	0	8.6	mg/L
RBD	RBD-01	9/1/1993	Dissolved Oxygen	1	8.6	mg/L
RBD	RBD-01	9/1/1993	Dissolved Oxygen	3	8.3	mg/L
RBD	RBD-01	9/1/1993	Dissolved Oxygen	5	8.3	mg/L
RBD	RBD-01	9/1/1993	Dissolved Oxygen	9	8.5	mg/L
RBD	RBD-01	9/1/1993	Dissolved Oxygen	11	8.3	mg/L
RBD	RBD-01	9/1/1993	Dissolved Oxygen	13	8.3	mg/L
RBD	RBD-01	9/1/1993	Dissolved Oxygen	15	8.2	mg/L
RBD	RBD-01	9/24/1993	Dissolved Oxygen	0	6.4	mg/L
RBD	RBD-01	9/24/1993	Dissolved Oxygen	1	6.4	mg/L
RBD	RBD-01	9/24/1993	Dissolved Oxygen	3	6.9	mg/L
RBD	RBD-01	9/24/1993	Dissolved Oxygen	5	5.6	mg/L
RBD	RBD-01	9/24/1993	Dissolved Oxygen	7	5.6	mg/L
RBD	RBD-01	9/24/1993	Dissolved Oxygen	9	5.5	mg/L
RBD	RBD-01	9/24/1993	Dissolved Oxygen	11	5.5	mg/L
RBD	RBD-01	9/24/1993	Dissolved Oxygen	13	6	mg/L
RBD	RBD-01	9/24/1993	Dissolved Oxygen	15	6	mg/L
RBD	RBD-01	4/21/1997	Dissolved Oxygen	0	12.6	mg/L
RBD	RBD-01	4/21/1997	Dissolved Oxygen	1	12.5	mg/L
RBD	RBD-01	4/21/1997	Dissolved Oxygen	3	12.4	mg/L
RBD	RBD-01	4/21/1997	Dissolved Oxygen	5	12.4	mg/L
RBD	RBD-01	4/21/1997	Dissolved Oxygen	7	12.4	mg/L
RBD	RBD-01	4/21/1997	Dissolved Oxygen	9	12.3	mg/L
RBD	RBD-01	4/21/1997	Dissolved Oxygen	11	12.2	mg/L
RBD	RBD-01	4/21/1997	Dissolved Oxygen	13	11.9	mg/L
RBD	RBD-01	4/21/1997	Dissolved Oxygen	15	11.8	mg/L
RBD	RBD-01	4/21/1997	Dissolved Oxygen	17	10.4	mg/L
RBD	RBD-01	4/21/1997	Dissolved Oxygen	18	9.7	mg/L
RBD	RBD-01	4/21/1997	Dissolved Oxygen	19	8.7	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
RBD	RBD-01	4/21/1997	Dissolved Oxygen	20	8	mg/L
RBD	RBD-01	6/9/1997	Dissolved Oxygen	0	8.7	mg/L
RBD	RBD-01	6/9/1997	Dissolved Oxygen	1	8.6	mg/L
RBD	RBD-01	6/9/1997	Dissolved Oxygen	3	8.4	mg/L
RBD	RBD-01	6/9/1997	Dissolved Oxygen	5	8.3	mg/L
RBD	RBD-01	6/9/1997	Dissolved Oxygen	7	8.3	mg/L
RBD	RBD-01	6/9/1997	Dissolved Oxygen	9	8.1	mg/L
RBD	RBD-01	6/9/1997	Dissolved Oxygen	11	8.1	mg/L
RBD	RBD-01	6/9/1997	Dissolved Oxygen	13	8	mg/L
RBD	RBD-01	6/9/1997	Dissolved Oxygen	15	7.9	mg/L
RBD	RBD-01	6/9/1997	Dissolved Oxygen	17	7.8	mg/L
RBD	RBD-01	6/9/1997	Dissolved Oxygen	18	7.8	mg/L
RBD	RBD-01	6/9/1997	Dissolved Oxygen	19	7.8	mg/L
RBD	RBD-01	6/9/1997	Dissolved Oxygen	20	7.7	mg/L
RBD	RBD-01	7/14/1997	Dissolved Oxygen	0	10.8	mg/L
RBD	RBD-01	7/14/1997	Dissolved Oxygen	1	10.8	mg/L
RBD	RBD-01	7/14/1997	Dissolved Oxygen	3	10.7	mg/L
RBD	RBD-01	7/14/1997	Dissolved Oxygen	5	10.2	mg/L
RBD	RBD-01	7/14/1997	Dissolved Oxygen	7	9.1	mg/L
RBD	RBD-01	7/14/1997	Dissolved Oxygen	9	7.2	mg/L
RBD	RBD-01	7/14/1997	Dissolved Oxygen	11	6.4	mg/L
RBD	RBD-01	7/14/1997	Dissolved Oxygen	13	3.6	mg/L
RBD	RBD-01	7/14/1997	Dissolved Oxygen	15	2.3	mg/L
RBD	RBD-01	7/14/1997	Dissolved Oxygen	17	1.3	mg/L
RBD	RBD-01	7/14/1997	Dissolved Oxygen	18	0.6	mg/L
RBD	RBD-01	7/14/1997	Dissolved Oxygen	19	0.6	mg/L
RBD	RBD-01	7/14/1997	Dissolved Oxygen	20	0.5	mg/L
RBD	RBD-01	8/12/1997	Dissolved Oxygen	0	4.7	mg/L
RBD	RBD-01	8/12/1997	Dissolved Oxygen	1	4.6	mg/L
RBD	RBD-01	8/12/1997	Dissolved Oxygen	3	4.3	mg/L
RBD	RBD-01	8/12/1997	Dissolved Oxygen	5	4.3	mg/L
RBD	RBD-01	8/12/1997	Dissolved Oxygen	7	4.3	mg/L
RBD	RBD-01	8/12/1997	Dissolved Oxygen	9	4.1	mg/L
RBD	RBD-01	8/12/1997	Dissolved Oxygen	11	3.5	mg/L
RBD	RBD-01	8/12/1997	Dissolved Oxygen	13	2.7	mg/L
RBD	RBD-01	8/12/1997	Dissolved Oxygen	15	1.7	mg/L
RBD	RBD-01	8/12/1997	Dissolved Oxygen	17	1.3	mg/L
RBD	RBD-01	8/12/1997	Dissolved Oxygen	19	0.5	mg/L
RBD	RBD-01	10/22/1997	Dissolved Oxygen	0	11.7	mg/L
RBD	RBD-01	10/22/1997	Dissolved Oxygen	1	10.8	mg/L
RBD	RBD-01	10/22/1997	Dissolved Oxygen	3	10.1	mg/L
RBD	RBD-01	10/22/1997	Dissolved Oxygen	5	9.8	mg/L
RBD	RBD-01	10/22/1997	Dissolved Oxygen	7	9.6	mg/L
RBD	RBD-01	10/22/1997	Dissolved Oxygen	9	9.4	mg/L
RBD	RBD-01	10/22/1997	Dissolved Oxygen	11	9.4	mg/L
RBD	RBD-01	10/22/1997	Dissolved Oxygen	13	9.4	mg/L
RBD	RBD-01	10/22/1997	Dissolved Oxygen	15	9.4	mg/L
RBD	RBD-01	10/22/1997	Dissolved Oxygen	16	9.5	mg/L
RBD	RBD-01	10/22/1997	Dissolved Oxygen	17	9.5	mg/L
RBD	RBD-01	10/22/1997	Dissolved Oxygen	18	9.5	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
RBD	RBD-01	5/1/2003	Dissolved Oxygen	0	12.4	mg/L
RBD	RBD-01	5/1/2003	Dissolved Oxygen	1	12.3	mg/L
RBD	RBD-01	5/1/2003	Dissolved Oxygen	3	12.1	mg/L
RBD	RBD-01	5/1/2003	Dissolved Oxygen	5	11.5	mg/L
RBD	RBD-01	5/1/2003	Dissolved Oxygen	9	8.8	mg/L
RBD	RBD-01	5/1/2003	Dissolved Oxygen	11	7.7	mg/L
RBD	RBD-01	5/1/2003	Dissolved Oxygen	13	6.7	mg/L
RBD	RBD-01	5/1/2003	Dissolved Oxygen	15	5.8	mg/L
RBD	RBD-01	6/18/2003	Dissolved Oxygen	0	6.6	mg/L
RBD	RBD-01	6/18/2003	Dissolved Oxygen	1	5.9	mg/L
RBD	RBD-01	6/18/2003	Dissolved Oxygen	3	5.5	mg/L
RBD	RBD-01	6/18/2003	Dissolved Oxygen	5	5.1	mg/L
RBD	RBD-01	6/18/2003	Dissolved Oxygen	7	5	mg/L
RBD	RBD-01	6/18/2003	Dissolved Oxygen	9	4.8	mg/L
RBD	RBD-01	6/18/2003	Dissolved Oxygen	11	4.5	mg/L
RBD	RBD-01	6/18/2003	Dissolved Oxygen	13	4	mg/L
RBD	RBD-01	6/18/2003	Dissolved Oxygen	15	3.5	mg/L
RBD	RBD-01	7/16/2003	Dissolved Oxygen	0	9.4	mg/L
RBD	RBD-01	7/16/2003	Dissolved Oxygen	1	9.3	mg/L
RBD	RBD-01	7/16/2003	Dissolved Oxygen	3	8.9	mg/L
RBD	RBD-01	7/16/2003	Dissolved Oxygen	5	8	mg/L
RBD	RBD-01	7/16/2003	Dissolved Oxygen	7	7.6	mg/L
RBD	RBD-01	7/16/2003	Dissolved Oxygen	9	7.2	mg/L
RBD	RBD-01	7/16/2003	Dissolved Oxygen	11	7.2	mg/L
RBD	RBD-01	7/16/2003	Dissolved Oxygen	13	4.7	mg/L
RBD	RBD-01	7/16/2003	Dissolved Oxygen	15	2.7	mg/L
RBD	RBD-01	8/11/2003	Dissolved Oxygen	0	11	mg/L
RBD	RBD-01	8/11/2003	Dissolved Oxygen	1	11.4	mg/L
RBD	RBD-01	8/11/2003	Dissolved Oxygen	3	8.2	mg/L
RBD	RBD-01	8/11/2003	Dissolved Oxygen	5	8.2	mg/L
RBD	RBD-01	8/11/2003	Dissolved Oxygen	7	6.5	mg/L
RBD	RBD-01	8/11/2003	Dissolved Oxygen	9	6.9	mg/L
RBD	RBD-01	8/11/2003	Dissolved Oxygen	11	6.9	mg/L
RBD	RBD-01	8/11/2003	Dissolved Oxygen	13	5	mg/L
RBD	RBD-01	8/11/2003	Dissolved Oxygen	14	4.6	mg/L
RBD	RBD-02	7/2/1977	Dissolved Oxygen	0	7.9	mg/L
RBD	RBD-02	7/2/1977	Dissolved Oxygen	2	6.5	mg/L
RBD	RBD-02	7/2/1977	Dissolved Oxygen	4	5.1	mg/L
RBD	RBD-02	7/2/1977	Dissolved Oxygen	6	3.9	mg/L
RBD	RBD-02	7/2/1977	Dissolved Oxygen	7	3.7	mg/L
RBD	RBD-02	6/28/1979	Dissolved Oxygen	0	16.4	mg/L
RBD	RBD-02	6/28/1979	Dissolved Oxygen	1	12.2	mg/L
RBD	RBD-02	6/28/1979	Dissolved Oxygen	3	10.6	mg/L
RBD	RBD-02	6/28/1979	Dissolved Oxygen	5	11.1	mg/L
RBD	RBD-02	6/28/1979	Dissolved Oxygen	7	8.9	mg/L
RBD	RBD-02	9/5/1979	Dissolved Oxygen	0	14.2	mg/L
RBD	RBD-02	9/5/1979	Dissolved Oxygen	1	13.8	mg/L
RBD	RBD-02	9/5/1979	Dissolved Oxygen	3	13	mg/L
RBD	RBD-02	9/5/1979	Dissolved Oxygen	5	10.1	mg/L
RBD	RBD-02	5/18/1983	Dissolved Oxygen	0	9.9	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
RBD	RBD-02	5/18/1983	Dissolved Oxygen	1	9.6	mg/L
RBD	RBD-02	5/18/1983	Dissolved Oxygen	3	9.4	mg/L
RBD	RBD-02	5/18/1983	Dissolved Oxygen	5	9.2	mg/L
RBD	RBD-02	5/18/1983	Dissolved Oxygen	6	9.2	mg/L
RBD	RBD-02	5/5/1993	Dissolved Oxygen	0	7.5	mg/L
RBD	RBD-02	5/5/1993	Dissolved Oxygen	1	7.4	mg/L
RBD	RBD-02	5/5/1993	Dissolved Oxygen	3	7.9	mg/L
RBD	RBD-02	5/5/1993	Dissolved Oxygen	5	8	mg/L
RBD	RBD-02	5/5/1993	Dissolved Oxygen	7	8	mg/L
RBD	RBD-02	5/12/1993	Dissolved Oxygen	0	13.2	mg/L
RBD	RBD-02	5/12/1993	Dissolved Oxygen	1	12.5	mg/L
RBD	RBD-02	5/12/1993	Dissolved Oxygen	3	12.8	mg/L
RBD	RBD-02	5/12/1993	Dissolved Oxygen	5	12.4	mg/L
RBD	RBD-02	5/12/1993	Dissolved Oxygen	7	10.4	mg/L
RBD	RBD-02	5/27/1993	Dissolved Oxygen	0	13.1	mg/L
RBD	RBD-02	5/27/1993	Dissolved Oxygen	1	13	mg/L
RBD	RBD-02	5/27/1993	Dissolved Oxygen	3	12.9	mg/L
RBD	RBD-02	5/27/1993	Dissolved Oxygen	5	13.3	mg/L
RBD	RBD-02	5/27/1993	Dissolved Oxygen	7	13.3	mg/L
RBD	RBD-02	6/24/1993	Dissolved Oxygen	0	8.5	mg/L
RBD	RBD-02	6/24/1993	Dissolved Oxygen	1	8.5	mg/L
RBD	RBD-02	6/24/1993	Dissolved Oxygen	3	8.5	mg/L
RBD	RBD-02	6/24/1993	Dissolved Oxygen	5	8.2	mg/L
RBD	RBD-02	6/24/1993	Dissolved Oxygen	7	8.5	mg/L
RBD	RBD-02	6/24/1993	Dissolved Oxygen	9	8.5	mg/L
RBD	RBD-02	7/1/1993	Dissolved Oxygen	0	9	mg/L
RBD	RBD-02	7/1/1993	Dissolved Oxygen	1	8.8	mg/L
RBD	RBD-02	7/1/1993	Dissolved Oxygen	3	9	mg/L
RBD	RBD-02	7/1/1993	Dissolved Oxygen	5	9	mg/L
RBD	RBD-02	7/1/1993	Dissolved Oxygen	7	9	mg/L
RBD	RBD-02	7/1/1993	Dissolved Oxygen	9	9	mg/L
RBD	RBD-02	7/8/1993	Dissolved Oxygen	0	8	mg/L
RBD	RBD-02	7/8/1993	Dissolved Oxygen	1	9	mg/L
RBD	RBD-02	7/8/1993	Dissolved Oxygen	3	8.5	mg/L
RBD	RBD-02	7/8/1993	Dissolved Oxygen	5	8.3	mg/L
RBD	RBD-02	7/22/1993	Dissolved Oxygen	0	6.5	mg/L
RBD	RBD-02	7/22/1993	Dissolved Oxygen	1	6	mg/L
RBD	RBD-02	7/22/1993	Dissolved Oxygen	3	6.5	mg/L
RBD	RBD-02	7/22/1993	Dissolved Oxygen	5	6.5	mg/L
RBD	RBD-02	7/22/1993	Dissolved Oxygen	7	6.5	mg/L
RBD	RBD-02	8/5/1993	Dissolved Oxygen	0	6.5	mg/L
RBD	RBD-02	8/5/1993	Dissolved Oxygen	1	5	mg/L
RBD	RBD-02	8/5/1993	Dissolved Oxygen	3	5	mg/L
RBD	RBD-02	8/5/1993	Dissolved Oxygen	5	5	mg/L
RBD	RBD-02	8/20/1993	Dissolved Oxygen	0	7	mg/L
RBD	RBD-02	8/20/1993	Dissolved Oxygen	1	7	mg/L
RBD	RBD-02	8/20/1993	Dissolved Oxygen	3	7	mg/L
RBD	RBD-02	8/20/1993	Dissolved Oxygen	5	7	mg/L
RBD	RBD-02	8/20/1993	Dissolved Oxygen	7	6.3	mg/L
RBD	RBD-02	9/24/1993	Dissolved Oxygen	0	6.7	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
RBD	RBD-02	9/24/1993	Dissolved Oxygen	1	6.7	mg/L
RBD	RBD-02	9/24/1993	Dissolved Oxygen	3	6	mg/L
RBD	RBD-02	9/24/1993	Dissolved Oxygen	5	6	mg/L
RBD	RBD-02	9/24/1993	Dissolved Oxygen	7	6	mg/L
RBD	RBD-02	4/21/1997	Dissolved Oxygen	0	11.1	mg/L
RBD	RBD-02	4/21/1997	Dissolved Oxygen	1	11.1	mg/L
RBD	RBD-02	4/21/1997	Dissolved Oxygen	3	11	mg/L
RBD	RBD-02	4/21/1997	Dissolved Oxygen	5	11	mg/L
RBD	RBD-02	4/21/1997	Dissolved Oxygen	7	9.2	mg/L
RBD	RBD-02	4/21/1997	Dissolved Oxygen	9	8.7	mg/L
RBD	RBD-02	4/21/1997	Dissolved Oxygen	10	8	mg/L
RBD	RBD-02	6/9/1997	Dissolved Oxygen	0	8.8	mg/L
RBD	RBD-02	6/9/1997	Dissolved Oxygen	1	8.5	mg/L
RBD	RBD-02	6/9/1997	Dissolved Oxygen	3	8.4	mg/L
RBD	RBD-02	6/9/1997	Dissolved Oxygen	5	8.2	mg/L
RBD	RBD-02	6/9/1997	Dissolved Oxygen	7	8.1	mg/L
RBD	RBD-02	6/9/1997	Dissolved Oxygen	9	8	mg/L
RBD	RBD-02	6/9/1997	Dissolved Oxygen	10	7.9	mg/L
RBD	RBD-02	7/14/1997	Dissolved Oxygen	0	9.9	mg/L
RBD	RBD-02	7/14/1997	Dissolved Oxygen	1	9.9	mg/L
RBD	RBD-02	7/14/1997	Dissolved Oxygen	3	9.9	mg/L
RBD	RBD-02	7/14/1997	Dissolved Oxygen	5	9.8	mg/L
RBD	RBD-02	7/14/1997	Dissolved Oxygen	7	9.8	mg/L
RBD	RBD-02	7/14/1997	Dissolved Oxygen	9	9.8	mg/L
RBD	RBD-02	7/14/1997	Dissolved Oxygen	11	6.8	mg/L
RBD	RBD-02	8/12/1997	Dissolved Oxygen	0	7.1	mg/L
RBD	RBD-02	8/12/1997	Dissolved Oxygen	1	7	mg/L
RBD	RBD-02	8/12/1997	Dissolved Oxygen	3	6.9	mg/L
RBD	RBD-02	8/12/1997	Dissolved Oxygen	5	6.8	mg/L
RBD	RBD-02	8/12/1997	Dissolved Oxygen	7	6.7	mg/L
RBD	RBD-02	8/12/1997	Dissolved Oxygen	9	6.5	mg/L
RBD	RBD-02	8/12/1997	Dissolved Oxygen	10	5.6	mg/L
RBD	RBD-02	10/22/1997	Dissolved Oxygen	0	12.6	mg/L
RBD	RBD-02	10/22/1997	Dissolved Oxygen	1	11.9	mg/L
RBD	RBD-02	10/22/1997	Dissolved Oxygen	3	11.5	mg/L
RBD	RBD-02	10/22/1997	Dissolved Oxygen	5	11.4	mg/L
RBD	RBD-02	10/22/1997	Dissolved Oxygen	7	11.1	mg/L
RBD	RBD-02	10/22/1997	Dissolved Oxygen	9	10.6	mg/L
RBD	RBD-02	6/18/2003	Dissolved Oxygen	0	6.5	mg/L
RBD	RBD-02	6/18/2003	Dissolved Oxygen	1	6.1	mg/L
RBD	RBD-02	6/18/2003	Dissolved Oxygen	3	6.1	mg/L
RBD	RBD-02	6/18/2003	Dissolved Oxygen	5	6.1	mg/L
RBD	RBD-02	6/18/2003	Dissolved Oxygen	7	5.9	mg/L
RBD	RBD-02	7/16/2003	Dissolved Oxygen	0	9.9	mg/L
RBD	RBD-02	7/16/2003	Dissolved Oxygen	1	10.2	mg/L
RBD	RBD-02	7/16/2003	Dissolved Oxygen	3	7.5	mg/L
RBD	RBD-02	7/16/2003	Dissolved Oxygen	5	7.1	mg/L
RBD	RBD-02	7/16/2003	Dissolved Oxygen	7	6.7	mg/L
RBD	RBD-02	7/16/2003	Dissolved Oxygen	8	6.1	mg/L
RBD	RBD-02	8/11/2003	Dissolved Oxygen	0	9.4	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
RBD	RBD-02	8/11/2003	Dissolved Oxygen	1	8.7	mg/L
RBD	RBD-02	8/11/2003	Dissolved Oxygen	3	6.7	mg/L
RBD	RBD-02	8/11/2003	Dissolved Oxygen	5	6.3	mg/L
RBD	RBD-02	8/11/2003	Dissolved Oxygen	6	6.2	mg/L
RBD	RBD-03	7/2/1977	Dissolved Oxygen	0	9.5	mg/L
RBD	RBD-03	7/2/1977	Dissolved Oxygen	2	6	mg/L
RBD	RBD-03	7/22/1977	Dissolved Oxygen	1	8.3	mg/L
RBD	RBD-03	6/28/1979	Dissolved Oxygen	0	16.6	mg/L
RBD	RBD-03	6/28/1979	Dissolved Oxygen	1	15	mg/L
RBD	RBD-03	6/28/1979	Dissolved Oxygen	3	7.2	mg/L
RBD	RBD-03	9/5/1979	Dissolved Oxygen	0	7.5	mg/L
RBD	RBD-03	9/5/1979	Dissolved Oxygen	1	7.4	mg/L
RBD	RBD-03	9/5/1979	Dissolved Oxygen	2	7.1	mg/L
RBD	RBD-03	5/18/1983	Dissolved Oxygen	0	9.9	mg/L
RBD	RBD-03	5/18/1983	Dissolved Oxygen	1	9.6	mg/L
RBD	RBD-03	5/18/1983	Dissolved Oxygen	2	9.4	mg/L
RBD	RBD-03	5/5/1993	Dissolved Oxygen	0	8.2	mg/L
RBD	RBD-03	5/5/1993	Dissolved Oxygen	1	7.7	mg/L
RBD	RBD-03	5/5/1993	Dissolved Oxygen	3	7.7	mg/L
RBD	RBD-03	5/5/1993	Dissolved Oxygen	5	7.6	mg/L
RBD	RBD-03	5/5/1993	Dissolved Oxygen	6	7.6	mg/L
RBD	RBD-03	5/12/1993	Dissolved Oxygen	0	12	mg/L
RBD	RBD-03	5/12/1993	Dissolved Oxygen	1	11.9	mg/L
RBD	RBD-03	5/12/1993	Dissolved Oxygen	3	11.2	mg/L
RBD	RBD-03	5/12/1993	Dissolved Oxygen	5	8.2	mg/L
RBD	RBD-03	6/24/1993	Dissolved Oxygen	0	8.5	mg/L
RBD	RBD-03	6/24/1993	Dissolved Oxygen	1	8.5	mg/L
RBD	RBD-03	6/24/1993	Dissolved Oxygen	3	8.2	mg/L
RBD	RBD-03	6/24/1993	Dissolved Oxygen	5	8.1	mg/L
RBD	RBD-03	7/1/1993	Dissolved Oxygen	0	10	mg/L
RBD	RBD-03	7/1/1993	Dissolved Oxygen	1	10	mg/L
RBD	RBD-03	7/1/1993	Dissolved Oxygen	3	9.7	mg/L
RBD	RBD-03	7/1/1993	Dissolved Oxygen	5	9.6	mg/L
RBD	RBD-03	7/8/1993	Dissolved Oxygen	0	8	mg/L
RBD	RBD-03	7/8/1993	Dissolved Oxygen	1	7.5	mg/L
RBD	RBD-03	7/8/1993	Dissolved Oxygen	3	7	mg/L
RBD	RBD-03	7/22/1993	Dissolved Oxygen	0	6	mg/L
RBD	RBD-03	7/22/1993	Dissolved Oxygen	1	6	mg/L
RBD	RBD-03	7/22/1993	Dissolved Oxygen	3	5.5	mg/L
RBD	RBD-03	7/22/1993	Dissolved Oxygen	5	5.5	mg/L
RBD	RBD-03	8/5/1993	Dissolved Oxygen	0	8.5	mg/L
RBD	RBD-03	8/5/1993	Dissolved Oxygen	1	8	mg/L
RBD	RBD-03	8/5/1993	Dissolved Oxygen	3	8	mg/L
RBD	RBD-03	8/5/1993	Dissolved Oxygen	5	5	mg/L
RBD	RBD-03	8/20/1993	Dissolved Oxygen	0	10	mg/L
RBD	RBD-03	8/20/1993	Dissolved Oxygen	1	10.5	mg/L
RBD	RBD-03	8/20/1993	Dissolved Oxygen	3	8	mg/L
RBD	RBD-03	8/20/1993	Dissolved Oxygen	5	6.5	mg/L
RBD	RBD-03	9/24/1993	Dissolved Oxygen	0	7	mg/L
RBD	RBD-03	9/24/1993	Dissolved Oxygen	1	7	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
RBD	RBD-03	9/24/1993	Dissolved Oxygen	3	7	mg/L
RBD	RBD-03	9/24/1993	Dissolved Oxygen	5	7	mg/L
RBD	RBD-03	4/21/1997	Dissolved Oxygen	0	10.9	mg/L
RBD	RBD-03	4/21/1997	Dissolved Oxygen	1	10.8	mg/L
RBD	RBD-03	4/21/1997	Dissolved Oxygen	3	10.6	mg/L
RBD	RBD-03	4/21/1997	Dissolved Oxygen	5	10.5	mg/L
RBD	RBD-03	6/9/1997	Dissolved Oxygen	0	8.5	mg/L
RBD	RBD-03	6/9/1997	Dissolved Oxygen	1	8.4	mg/L
RBD	RBD-03	6/9/1997	Dissolved Oxygen	3	8	mg/L
RBD	RBD-03	6/9/1997	Dissolved Oxygen	5	8	mg/L
RBD	RBD-03	7/14/1997	Dissolved Oxygen	0	8.7	mg/L
RBD	RBD-03	7/14/1997	Dissolved Oxygen	1	8.7	mg/L
RBD	RBD-03	7/14/1997	Dissolved Oxygen	3	8.6	mg/L
RBD	RBD-03	7/14/1997	Dissolved Oxygen	5	5.9	mg/L
RBD	RBD-03	8/12/1997	Dissolved Oxygen	0	6.2	mg/L
RBD	RBD-03	8/12/1997	Dissolved Oxygen	1	6.1	mg/L
RBD	RBD-03	8/12/1997	Dissolved Oxygen	3	4.9	mg/L
RBD	RBD-03	8/12/1997	Dissolved Oxygen	5	1	mg/L
RBD	RBD-03	10/22/1997	Dissolved Oxygen	0	12.8	mg/L
RBD	RBD-03	10/22/1997	Dissolved Oxygen	1	11.6	mg/L
RBD	RBD-03	10/22/1997	Dissolved Oxygen	3	11.5	mg/L
RBD	RBD-04	5/5/1993	Dissolved Oxygen	0	7.7	mg/L
RBD	RBD-04	5/5/1993	Dissolved Oxygen	1	7.7	mg/L
RBD	RBD-04	5/5/1993	Dissolved Oxygen	3	7.5	mg/L
RBD	RBD-04	5/5/1993	Dissolved Oxygen	5	7.4	mg/L
RBD	RBD-04	5/12/1993	Dissolved Oxygen	0	11.7	mg/L
RBD	RBD-04	5/12/1993	Dissolved Oxygen	1	11.5	mg/L
RBD	RBD-04	5/12/1993	Dissolved Oxygen	3	11	mg/L
RBD	RBD-04	5/12/1993	Dissolved Oxygen	4	11.5	mg/L
RBD	RBD-04	5/27/1993	Dissolved Oxygen	0	11	mg/L
RBD	RBD-04	5/27/1993	Dissolved Oxygen	1	10.8	mg/L
RBD	RBD-04	5/27/1993	Dissolved Oxygen	3	10.5	mg/L
RBD	RBD-04	6/24/1993	Dissolved Oxygen	0	8.5	mg/L
RBD	RBD-04	6/24/1993	Dissolved Oxygen	1	8.5	mg/L
RBD	RBD-04	6/24/1993	Dissolved Oxygen	3	8.2	mg/L
RBD	RBD-04	6/24/1993	Dissolved Oxygen	5	8.1	mg/L
RBD	RBD-04	7/1/1993	Dissolved Oxygen	0	10.5	mg/L
RBD	RBD-04	7/1/1993	Dissolved Oxygen	1	10.3	mg/L
RBD	RBD-04	7/1/1993	Dissolved Oxygen	3	10.3	mg/L
RBD	RBD-04	7/1/1993	Dissolved Oxygen	5	10.3	mg/L
RBD	RBD-04	7/8/1993	Dissolved Oxygen	0	8.3	mg/L
RBD	RBD-04	7/8/1993	Dissolved Oxygen	1	8.5	mg/L
RBD	RBD-04	7/8/1993	Dissolved Oxygen	3	8	mg/L
RBD	RBD-04	7/8/1993	Dissolved Oxygen	5	6.5	mg/L
RBD	RBD-04	7/22/1993	Dissolved Oxygen	0	6.5	mg/L
RBD	RBD-04	7/22/1993	Dissolved Oxygen	1	6.5	mg/L
RBD	RBD-04	7/22/1993	Dissolved Oxygen	3	6.5	mg/L
RBD	RBD-04	7/22/1993	Dissolved Oxygen	5	7	mg/L
RBD	RBD-04	8/5/1993	Dissolved Oxygen	0	8.5	mg/L
RBD	RBD-04	8/5/1993	Dissolved Oxygen	1	8.5	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
RBD	RBD-04	8/5/1993	Dissolved Oxygen	3	8	mg/L
RBD	RBD-04	8/5/1993	Dissolved Oxygen	5	7.5	mg/L
RBD	RBD-04	8/20/1993	Dissolved Oxygen	0	7.5	mg/L
RBD	RBD-04	8/20/1993	Dissolved Oxygen	1	6	mg/L
RBD	RBD-04	8/20/1993	Dissolved Oxygen	3	5.5	mg/L
RBD	RBD-04	8/20/1993	Dissolved Oxygen	5	5.5	mg/L
RBD	RBD-04	9/24/1993	Dissolved Oxygen	0	8.2	mg/L
RBD	RBD-04	9/24/1993	Dissolved Oxygen	1	8.2	mg/L
RBD	RBD-04	9/24/1993	Dissolved Oxygen	3	8	mg/L
RBD	RBD-04	9/24/1993	Dissolved Oxygen	5	7.5	mg/L
RBD	RBD-04	4/21/1997	Dissolved Oxygen	0	10.7	mg/L
RBD	RBD-04	4/21/1997	Dissolved Oxygen	1	10.6	mg/L
RBD	RBD-04	4/21/1997	Dissolved Oxygen	3	10.4	mg/L
RBD	RBD-04	4/21/1997	Dissolved Oxygen	5	10.2	mg/L
RBD	RBD-04	4/21/1997	Dissolved Oxygen	7	8.2	mg/L
RBD	RBD-05	5/1/2003	Dissolved Oxygen	0	9.2	mg/L
RBD	RBD-05	5/1/2003	Dissolved Oxygen	1	9.1	mg/L
RBD	RBD-05	5/1/2003	Dissolved Oxygen	3	8.8	mg/L
RBD	RBD-05	5/1/2003	Dissolved Oxygen	4	8.4	mg/L
RBD	RBD-05	6/18/2003	Dissolved Oxygen	0	6.2	mg/L
RBD	RBD-05	6/18/2003	Dissolved Oxygen	1	6.2	mg/L
RBD	RBD-05	6/18/2003	Dissolved Oxygen	3	6.3	mg/L
RBD	RBD-05	6/18/2003	Dissolved Oxygen	5	6.3	mg/L
RBD	RBD-05	7/16/2003	Dissolved Oxygen	0	6.1	mg/L
RBD	RBD-05	7/16/2003	Dissolved Oxygen	1	6.1	mg/L
RBD	RBD-05	7/16/2003	Dissolved Oxygen	3	6.2	mg/L
RBD	RBD-05	7/16/2003	Dissolved Oxygen	5	6	mg/L
RBD	RBD-05	8/11/2003	Dissolved Oxygen	0	8.5	mg/L
RBD	RBD-05	8/11/2003	Dissolved Oxygen	1	7.9	mg/L
RBD	RBD-05	8/11/2003	Dissolved Oxygen	3	6.5	mg/L
BPGD	BPGD-H-A1	9/23/2002	Dissolved Oxygen (field)		4.7	mg/L
BPGD	BPGD-H-A2	9/23/2002	Dissolved Oxygen (field)		10.4	mg/L
BPGD	BPGD-H-C1	9/23/2002	Dissolved Oxygen (field)		9.1	mg/L
BPGD	BPGD-H-C2	9/23/2002	Dissolved Oxygen (field)		11.4	mg/L
BPGD	BPGD-H-C3	9/23/2002	Dissolved Oxygen (field)		9.4	mg/L
BPGD	BPGD-H-D2	9/23/2002	Dissolved Oxygen (field)		5.1	mg/L
BPGD	BPGD-H-D3	9/23/2002	Dissolved Oxygen (field)		9.9	mg/L
BPGD	BPGD-H-E1	9/23/2002	Dissolved Oxygen (field)		9.1	mg/L
BPG 09	BPG09	2/14/1980	Dissolved Phosphorus	1	0.2	mg/L
BPG 09	BPG09	3/31/1980	Dissolved Phosphorus	1	0.1	mg/L
BPG 09	BPG09	5/2/1980	Dissolved Phosphorus	1	0.09	mg/L
BPG 09	BPG09	5/2/1980	Dissolved Phosphorus	1	0.09	mg/L
BPG 09	BPG09	6/4/1980	Dissolved Phosphorus	1	0.11	mg/L
BPG 09	BPG09	7/7/1980	Dissolved Phosphorus	1	0.09	mg/L
BPG 09	BPG09	8/11/1980	Dissolved Phosphorus	1	0.17	mg/L
BPG 09	BPG09	5/2/1984	Dissolved Phosphorus	1	0.01	mg/L
BPG 09	BPG09	6/21/1984	Dissolved Phosphorus	1	0.05	mg/L
BPG 09	BPG09	7/18/1984	Dissolved Phosphorus	1	0.09	mg/L
BPG 09	BPG09	8/22/1984	Dissolved Phosphorus	1	0.1	mg/L
BPG 09	BPG09	9/19/1984	Dissolved Phosphorus	1	0.09	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	11/7/1984	Dissolved Phosphorus	1	0.09	mg/L
BPG 09	BPG09	12/13/1984	Dissolved Phosphorus	1	0.02	mg/L
BPG 09	BPG09	1/16/1985	Dissolved Phosphorus	1	0.03	mg/L
BPG 09	BPG09	3/6/1985	Dissolved Phosphorus	1	0.05	mg/L
BPG 09	BPG09	4/15/1985	Dissolved Phosphorus	1	0.02	mg/L
BPG 09	BPG09	5/23/1985	Dissolved Phosphorus	1	0.04	mg/L
BPG 09	BPG09	7/2/1985	Dissolved Phosphorus	1	0.1	mg/L
BPG 09	BPG09	8/19/1985	Dissolved Phosphorus	1	0.08	mg/L
BPG 09	BPG09	9/16/1985	Dissolved Phosphorus	1	0.13	mg/L
BPG 09	BPG09	10/16/1985	Dissolved Phosphorus	1	0.15	mg/L
BPG 09	BPG09	12/10/1985	Dissolved Phosphorus	1	0.05	mg/L
BPG 09	BPG09	1/29/1986	Dissolved Phosphorus	1	0.03	mg/L
BPG 09	BPG09	2/20/1986	Dissolved Phosphorus	1	0.08	mg/L
BPG 09	BPG09	3/25/1986	Dissolved Phosphorus	1	0.01	mg/L
BPG 09	BPG09	4/30/1986	Dissolved Phosphorus	1	0.05	mg/L
BPG 09	BPG09	6/17/1986	Dissolved Phosphorus	1	0.06	mg/L
BPG 09	BPG09	7/15/1986	Dissolved Phosphorus	1	0.07	mg/L
BPG 09	BPG09	9/10/1986	Dissolved Phosphorus	1	0.05	mg/L
BPG 09	BPG09	10/7/1986	Dissolved Phosphorus	1	0.1	mg/L
BPG 09	BPG09	12/2/1986	Dissolved Phosphorus	1	0.14	mg/L
BPG 09	BPG09	1/13/1987	Dissolved Phosphorus	1	0.03	mg/L
BPG 09	BPG09	2/17/1987	Dissolved Phosphorus	1	0.03	mg/L
BPG 09	BPG09	3/24/1987	Dissolved Phosphorus	1	0.01	mg/L
BPG 09	BPG09	4/28/1987	Dissolved Phosphorus	1	0.02	mg/L
BPG 09	BPG09	6/2/1987	Dissolved Phosphorus	1	0.08	mg/L
BPG 09	BPG09	7/20/1987	Dissolved Phosphorus	1	0.08	mg/L
BPG 09	BPG09	9/9/1987	Dissolved Phosphorus	1	0.09	mg/L
BPG 09	BPG09	11/3/1987	Dissolved Phosphorus	1	0.08	mg/L
BPG 09	BPG09	12/10/1987	Dissolved Phosphorus	1	0.07	mg/L
BPG 09	BPG09	1/21/1988	Dissolved Phosphorus	1	0.25	mg/L
BPG 09	BPG09	3/3/1988	Dissolved Phosphorus	1	0.03	mg/L
BPG 09	BPG09	4/5/1988	Dissolved Phosphorus	1	0.03	mg/L
BPG 09	BPG09	5/19/1988	Dissolved Phosphorus	1	0.05	mg/L
BPG 09	BPG09	6/23/1988	Dissolved Phosphorus	1	0.12	mg/L
BPG 09	BPG09	8/11/1988	Dissolved Phosphorus	1	1.9	mg/L
BPG 09	BPG09	9/15/1988	Dissolved Phosphorus	1	0.12	mg/L
BPG 09	BPG09	11/10/1988	Dissolved Phosphorus	1	0.19	mg/L
BPG 09	BPG09	12/14/1988	Dissolved Phosphorus	1	0.04	mg/L
BPG 09	BPG09	1/19/1989	Dissolved Phosphorus	1	0.029	mg/L
BPG 09	BPG09	2/23/1989	Dissolved Phosphorus	1	0.02	mg/L
BPG 09	BPG09	4/13/1989	Dissolved Phosphorus	1	0.01	mg/L
BPG 09	BPG09	5/10/1989	Dissolved Phosphorus	1	0.07	mg/L
BPG 09	BPG09	6/20/1989	Dissolved Phosphorus	1	0.06	mg/L
BPG 09	BPG09	8/2/1989	Dissolved Phosphorus	1	0.09	mg/L
BPG 09	BPG09	9/14/1989	Dissolved Phosphorus	1	0.12	mg/L
BPG 09	BPG09	11/8/1989	Dissolved Phosphorus	1	0.04	mg/L
BPG 09	BPG09	12/12/1989	Dissolved Phosphorus	1	0.02	mg/L
BPG 09	BPG09	1/24/1990	Dissolved Phosphorus	1	0.02	mg/L
BPG 09	BPG09	2/28/1990	Dissolved Phosphorus	1	0.08	mg/L
BPG 09	BPG09	3/28/1990	Dissolved Phosphorus	1	0.03	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	5/9/1990	Dissolved Phosphorus	1	0.03	mg/L
BPG 09	BPG09	7/3/1990	Dissolved Phosphorus	1	0.05	mg/L
BPG 09	BPG09	8/2/1990	Dissolved Phosphorus	1	0.07	mg/L
BPG 09	BPG09	9/26/1990	Dissolved Phosphorus	1	0.07	mg/L
BPG 09	BPG09	10/31/1990	Dissolved Phosphorus	1	0.03	mg/L
BPG 09	BPG09	12/10/1990	Dissolved Phosphorus	1	0.01	mg/L
BPG 09	BPG09	1/16/1991	Dissolved Phosphorus	1	0.2	mg/L
BPG 09	BPG09	3/5/1991	Dissolved Phosphorus	1	0.02	mg/L
BPG 09	BPG09	4/3/1991	Dissolved Phosphorus	1	0.02	mg/L
BPG 09	BPG09	5/22/1991	Dissolved Phosphorus	1	0.06	mg/L
BPG 09	BPG09	6/26/1991	Dissolved Phosphorus	1	0.04	mg/L
BPG 09	BPG09	8/21/1991	Dissolved Phosphorus	1	0.06	mg/L
BPG 09	BPG09	9/30/1991	Dissolved Phosphorus	1	0.03	mg/L
BPG 09	BPG09	11/14/1991	Dissolved Phosphorus	1	0.04	mg/L
BPG 09	BPG09	12/18/1991	Dissolved Phosphorus	1	0.03	mg/L
BPG 09	BPG09	2/4/1992	Dissolved Phosphorus	1	0.02	mg/L
BPG 09	BPG09	3/17/1992	Dissolved Phosphorus	1	0.01	mg/L
BPG 09	BPG09	6/3/1992	Dissolved Phosphorus	1	0.03	mg/L
BPG 09	BPG09	7/13/1992	Dissolved Phosphorus	1	0.08	mg/L
BPG 09	BPG09	8/12/1992	Dissolved Phosphorus	1	0.05	mg/L
BPG 09	BPG09	9/23/1992	Dissolved Phosphorus	1	0.07	mg/L
BPG 09	BPG09	11/18/1992	Dissolved Phosphorus	1	0.05	mg/L
BPG 09	BPG09	12/16/1992	Dissolved Phosphorus	1	0.12	mg/L
BPG 09	BPG09	2/1/1993	Dissolved Phosphorus	1	0.04	mg/L
BPG 09	BPG09	3/9/1993	Dissolved Phosphorus	1	0.083	mg/L
BPG 09	BPG09	4/7/1993	Dissolved Phosphorus	1	0.03	mg/L
BPG 09	BPG09	5/24/1993	Dissolved Phosphorus	1	0.12	mg/L
BPG 09	BPG09	6/28/1993	Dissolved Phosphorus	1	0.05	mg/L
BPG 09	BPG09	8/18/1993	Dissolved Phosphorus	1	0.05	mg/L
BPG 09	BPG09	9/28/1993	Dissolved Phosphorus	1	0.07	mg/L
BPG 09	BPG09	11/15/1993	Dissolved Phosphorus	1	0.14	mg/L
BPG 09	BPG09	12/20/1993	Dissolved Phosphorus	1	0.04	mg/L
BPG 09	BPG09	3/2/1994	Dissolved Phosphorus	1	0.08	mg/L
BPG 09	BPG09	3/29/1994	Dissolved Phosphorus	1	0.03	mg/L
BPG 09	BPG09	4/28/1994	Dissolved Phosphorus	1	0.08	mg/L
BPG 09	BPG09	6/30/1994	Dissolved Phosphorus	1	0.05	mg/L
BPG 09	BPG09	8/15/1994	Dissolved Phosphorus	1	0.06	mg/L
BPG 09	BPG09	9/6/1994	Dissolved Phosphorus	1	0.09	mg/L
BPG 09	BPG09	9/26/1994	Dissolved Phosphorus	1	0.12	mg/L
BPG 09	BPG09	11/2/1994	Dissolved Phosphorus	1	0.34	mg/L
BPG 09	BPG09	1/4/1995	Dissolved Phosphorus	1	0.06	mg/L
BPG 09	BPG09	2/1/1995	Dissolved Phosphorus	1	0.02	mg/L
BPG 09	BPG09	2/27/1995	Dissolved Phosphorus	1	0.021	mg/L
BPG 09	BPG09	5/11/1995	Dissolved Phosphorus	1	0.04	mg/L
BPG 09	BPG09	6/14/1995	Dissolved Phosphorus	1	0.035	mg/L
BPG 09	BPG09	9/7/1995	Dissolved Phosphorus	1	0.08	mg/L
BPG 09	BPG09	10/16/1995	Dissolved Phosphorus	1	0.055	mg/L
BPG 09	BPG09	12/12/1995	Dissolved Phosphorus	1	0.09	mg/L
BPG 09	BPG09	1/29/1996	Dissolved Phosphorus	1	0.055	mg/L
BPG 09	BPG09	2/29/1996	Dissolved Phosphorus	1	0.04	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	3/28/1996	Dissolved Phosphorus	1	0.02	mg/L
BPG 09	BPG09	4/19/1996	Dissolved Phosphorus	1	0.02	mg/L
BPG 09	BPG09	5/20/1996	Dissolved Phosphorus	1	0.05	mg/L
BPG 09	BPG09	7/18/1996	Dissolved Phosphorus	1	0.05	mg/L
BPG 09	BPG09	8/26/1996	Dissolved Phosphorus	1	0.06	mg/L
BPG 09	BPG09	10/28/1996	Dissolved Phosphorus	1	0.1	mg/L
BPG 09	BPG09	12/16/1996	Dissolved Phosphorus	1	0.051	mg/L
BPG 09	BPG09	2/4/1997	Dissolved Phosphorus	1	0.25	mg/L
BPG 09	BPG09	3/4/1997	Dissolved Phosphorus	1	0.1	mg/L
BPG 09	BPG09	4/2/1997	Dissolved Phosphorus	1	0.01	mg/L
BPG 09	BPG09	4/30/1997	Dissolved Phosphorus	1	0.01	mg/L
BPG 09	BPG09	7/9/1997	Dissolved Phosphorus	1	0.05	mg/L
BPG 09	BPG09	9/9/1997	Dissolved Phosphorus	1	0.07	mg/L
BPG 09	BPG09	9/26/1997	Dissolved Phosphorus	1	0.08	mg/L
BPG 09	BPG09	10/30/1997	Dissolved Phosphorus	1	0.04	mg/L
BPG 09	BPG09	11/19/1997	Dissolved Phosphorus	1	0.02	mg/L
BPG 09	BPG09	1/6/1998	Dissolved Phosphorus	1	0.05	mg/L
BPG 09	BPG09	3/13/1998	Dissolved Phosphorus	1	0.04	mg/L
BPG 09	BPG09	4/28/1998	Dissolved Phosphorus	1	0.02	mg/L
BPG 09	BPG09	7/1/1998	Dissolved Phosphorus	1	0.08	mg/L
BPG 09	BPG09	8/4/1998	Dissolved Phosphorus	1	0.21	mg/L
BPG 09	BPG09	8/31/1998	Dissolved Phosphorus	1	0.07	mg/L
BPG 09	BPG09	9/28/1998	Dissolved Phosphorus	1	0.14	mg/L
BPG 09	BPG09	11/23/1998	Dissolved Phosphorus	1	0.01	mg/L
BPG 09	BPG09	12/30/1998	Dissolved Phosphorus	1	0.08	mg/L
BPG 09	BPG09	01/24/00	Dissolved Phosphorus	1	2.8	mg/L
BPG 09	BPG09	03/03/00	Dissolved Phosphorus	1	0.06	mg/L
BPG 09	BPG09	05/23/00	Dissolved Phosphorus	1	0.09	mg/L
BPG 09	BPG09	06/14/00	Dissolved Phosphorus	1	0.07	mg/L
BPG 09	BPG09	07/26/00	Dissolved Phosphorus	1	0.06	mg/L
BPG 09	BPG09	09/28/00	Dissolved Phosphorus	1	0.22	mg/L
BPG 09	BPG09	11/28/00	Dissolved Phosphorus	1	0.09	mg/L
BPG 09	BPG09	12/28/00	Dissolved Phosphorus	1	0.13	mg/L
BPG 09	BPG09	01/30/01	Dissolved Phosphorus	1	1.5	mg/L
BPG 09	BPG09	03/19/01	Dissolved Phosphorus	1	0.03	mg/L
BPG 09	BPG09	04/18/01	Dissolved Phosphorus	1	0.03	mg/L
BPG 09	BPG09	05/14/01	Dissolved Phosphorus	1	0.08	mg/L
BPG 09	BPG09	06/19/01	Dissolved Phosphorus	1	0.06	mg/L
BPG 09	BPG09	6/28/01	Dissolved Phosphorus	1	0.16	mg/L
BPG 09	BPG09	08/02/01	Dissolved Phosphorus	1	0.09	mg/L
BPG 09	BPG09	08/21/01	Dissolved Phosphorus	1	0.21	mg/L
BPG 09	BPG09	8/21/01	Dissolved Phosphorus	1	0.47	mg/L
BPG 09	BPG09	10/10/01	Dissolved Phosphorus	1	0.16	mg/L
BPG 09	BPG09	10/29/01	Dissolved Phosphorus	1	0.08	mg/L
BPG 09	BPG09	11/08/01	Dissolved Phosphorus	1	0.04	mg/L
BPG 09	BPG09	12/20/01	Dissolved Phosphorus	1	0.07	mg/L
BPG 09	BPG09	01/30/02	Dissolved Phosphorus	1	0.07	mg/L
BPG 09	BPG09	03/04/02	Dissolved Phosphorus	1	0.07	mg/L
BPG 09	BPG09	04/11/02	Dissolved Phosphorus	1	0.03	mg/L
BPG 09	BPG09	04/18/02	Dissolved Phosphorus	1	0.02	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	04/24/02	Dissolved Phosphorus	1	0.02	mg/L
BPG 09	BPG09	05/14/02	Dissolved Phosphorus	1	0.15	mg/L
BPG 09	BPG09	06/05/02	Dissolved Phosphorus	1	0.03	mg/L
BPG 09	BPG09	06/05/02	Dissolved Phosphorus	1	0.63	mg/L
BPG 09	BPG09	07/01/02	Dissolved Phosphorus	1	0.04	mg/L
BPG 09	BPG09	07/11/02	Dissolved Phosphorus	1	0.09	mg/L
BPG 09	BPG09	07/24/02	Dissolved Phosphorus	1	0.14	mg/L
BPG 09	BPG09	08/19/02	Dissolved Phosphorus	1	0.23	mg/L
BPG 09	BPG09	08/31/02	Dissolved Phosphorus	1	0.12	mg/L
BPG 09	BPG09	09/20/02	Dissolved Phosphorus	1	0.07	mg/L
BPG 09	BPG09	09/27/02	Dissolved Phosphorus	1	0.07	mg/L
BPG 09	BPG09	11/12/02	Dissolved Phosphorus	1	0.06	mg/L
BPG 09	BPG09	11/14/02	Dissolved Phosphorus	1	0.08	mg/L
BPG 09	BPG09	12/12/02	Dissolved Phosphorus	1	0.02	mg/L
BPG 09	BPG09	12/19/02	Dissolved Phosphorus	1	0.07	mg/L
RBD	RBD-1	6/28/1979	Dissolved Phosphorus	1	0.02	mg/L
RBD	RBD-1	6/28/1979	Dissolved Phosphorus	14	0.04	mg/L
RBD	RBD-1	9/5/1979	Dissolved Phosphorus	1	0.01	mg/L
RBD	RBD-1	9/5/1979	Dissolved Phosphorus	12	0.01	mg/L
RBD	RBD-1	5/18/1983	Dissolved Phosphorus	1	0.101	mg/L
RBD	RBD-1	5/18/1983	Dissolved Phosphorus	10	0.065	mg/L
RBD	RBD-1	4/21/1997	Dissolved Phosphorus	1	0.01	mg/L
RBD	RBD-1	4/21/1997	Dissolved Phosphorus	18	0.007	mg/L
RBD	RBD-1	6/9/1997	Dissolved Phosphorus	1	0.053	mg/L
RBD	RBD-1	6/9/1997	Dissolved Phosphorus	18	0.053	mg/L
RBD	RBD-1	8/12/1997	Dissolved Phosphorus	1	0.026	mg/L
RBD	RBD-1	8/12/1997	Dissolved Phosphorus	17	0.035	mg/L
RBD	RBD-1	10/22/1997	Dissolved Phosphorus	1	0.026	mg/L
RBD	RBD-1	10/22/1997	Dissolved Phosphorus	16	0.025	mg/L
RBD	RBD-2	6/28/1979	Dissolved Phosphorus	1	0.02	mg/L
RBD	RBD-2	9/5/1979	Dissolved Phosphorus	1	0.01	mg/L
RBD	RBD-2	5/18/1983	Dissolved Phosphorus	1	0.054	mg/L
RBD	RBD-2	4/21/1997	Dissolved Phosphorus	1	0.008	mg/L
RBD	RBD-2	6/9/1997	Dissolved Phosphorus	1	0.11	mg/L
RBD	RBD-2	7/14/1997	Dissolved Phosphorus	1	0.009	mg/L
RBD	RBD-2	8/12/1997	Dissolved Phosphorus	1	0.018	mg/L
RBD	RBD-2	10/22/1997	Dissolved Phosphorus	1	0.018	mg/L
RBD	RBD-3	6/28/1979	Dissolved Phosphorus	1	0.02	mg/L
RBD	RBD-3	9/5/1979	Dissolved Phosphorus	1	0.07	mg/L
RBD	RBD-3	5/18/1983	Dissolved Phosphorus	1	0.028	mg/L
RBD	RBD-3	4/21/1997	Dissolved Phosphorus	1	0.007	mg/L
RBD	RBD-3	6/9/1997	Dissolved Phosphorus	1	0.155	mg/L
RBD	RBD-3	7/14/1997	Dissolved Phosphorus	1	0.018	mg/L
RBD	RBD-3	8/12/1997	Dissolved Phosphorus	1	0.032	mg/L
RBD	RBD-3	10/22/1997	Dissolved Phosphorus	1	0.018	mg/L
RBD	RBD-4	4/21/1997	Dissolved Phosphorus	1	0.008	mg/L
RBD	RBD-1	7/16/2003	Dissolved Phosphorus	15	0.131	mg/L
RBD	RBD-1	7/16/2003	Dissolved Phosphorus	9	0.123	mg/L
RBD	RBD-1	7/16/2003	Dissolved Phosphorus	1	0.122	mg/L
RBD	RBD-1	8/11/2003	Dissolved Phosphorus	7	0.005	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
RBD	RBD-1	10/16/2003	Dissolved Phosphorus	15	0.025	mg/L
RBD	RBD-1	10/16/2003	Dissolved Phosphorus	9	0.024	mg/L
RBD	RBD-1	10/16/2003	Dissolved Phosphorus	1	0.025	mg/L
RBD	RBD-2	7/16/2003	Dissolved Phosphorus	1	0.109	mg/L
RBD	RBD-2	8/11/2003	Dissolved Phosphorus	1	0.016	mg/L
RBD	RBD-2	10/16/2003	Dissolved Phosphorus	1	0.023	mg/L
RBD	RBD-5	7/16/2003	Dissolved Phosphorus	1	0.105	mg/L
RBD	RBD-5	8/11/2003	Dissolved Phosphorus	1	0.036	mg/L
RBD	RBD-5	10/16/2003	Dissolved Phosphorus	1	0.035	mg/L
BPG 09	BPG09	1/19/1978	FECAL COLIFORM	1	1700	#/100 mL
BPG 09	BPG09	2/28/1978	FECAL COLIFORM	1	70	#/100 mL
BPG 09	BPG09	4/13/1978	FECAL COLIFORM	1	1600	#/100 mL
BPG 09	BPG09	5/11/1978	FECAL COLIFORM	1	400	#/100 mL
BPG 09	BPG09	5/31/1978	FECAL COLIFORM	1	41	#/100 mL
BPG 09	BPG09	6/14/1978	FECAL COLIFORM	1	290	#/100 mL
BPG 09	BPG09	6/28/1978	FECAL COLIFORM	1	310	#/100 mL
BPG 09	BPG09	7/11/1978	FECAL COLIFORM	1	430	#/100 mL
BPG 09	BPG09	8/2/1978	FECAL COLIFORM	1	13000	#/100 mL
BPG 09	BPG09	2/6/1979	FECAL COLIFORM	1	40	#/100 mL
BPG 09	BPG09	3/7/1979	FECAL COLIFORM	1	2200	#/100 mL
BPG 09	BPG09	5/1/1979	FECAL COLIFORM	1	1100	#/100 mL
BPG 09	BPG09	5/31/1979	FECAL COLIFORM	1	330	#/100 mL
BPG 09	BPG09	5/31/1979	FECAL COLIFORM	1	290	#/100 mL
BPG 09	BPG09	8/1/1979	FECAL COLIFORM	1	11600	#/100 mL
BPG 09	BPG09	2/14/1980	FECAL COLIFORM	1	34	#/100 mL
BPG 09	BPG09	5/2/1980	FECAL COLIFORM	1	260	#/100 mL
BPG 09	BPG09	5/2/1980	FECAL COLIFORM	1	130	#/100 mL
BPG 09	BPG09	2/18/1981	FECAL COLIFORM	1	2500	#/100 mL
BPG 09	BPG09	3/19/1981	FECAL COLIFORM	1	60	#/100 mL
BPG 09	BPG09	4/16/1981	FECAL COLIFORM	1	660	#/100 mL
BPG 09	BPG09	5/21/1981	FECAL COLIFORM	1	500	#/100 mL
BPG 09	BPG09	6/23/1981	FECAL COLIFORM	1	6000	#/100 mL
BPG 09	BPG09	8/4/1981	FECAL COLIFORM	1	1900	#/100 mL
BPG 09	BPG09	8/19/1981	FECAL COLIFORM	1	710	#/100 mL
BPG 09	BPG09	11/10/1981	FECAL COLIFORM	1	150	#/100 mL
BPG 09	BPG09	1/6/1982	FECAL COLIFORM	1	1700	#/100 mL
BPG 09	BPG09	3/10/1982	FECAL COLIFORM	1	220	#/100 mL
BPG 09	BPG09	4/8/1982	FECAL COLIFORM	1	90	#/100 mL
BPG 09	BPG09	5/13/1982	FECAL COLIFORM	1	80	#/100 mL
BPG 09	BPG09	6/16/1982	FECAL COLIFORM	1	16000	#/100 mL
BPG 09	BPG09	8/12/1982	FECAL COLIFORM	1	420	#/100 mL
BPG 09	BPG09	9/30/1982	FECAL COLIFORM	1	130	#/100 mL
BPG 09	BPG09	11/10/1982	FECAL COLIFORM	1	50	#/100 mL
BPG 09	BPG09	1/4/1983	FECAL COLIFORM	1	200	#/100 mL
BPG 09	BPG09	2/4/1983	FECAL COLIFORM	1	1600	#/100 mL
BPG 09	BPG09	3/16/1983	FECAL COLIFORM	1	50	#/100 mL
BPG 09	BPG09	4/13/1983	FECAL COLIFORM	1	330	#/100 mL
BPG 09	BPG09	5/4/1983	FECAL COLIFORM	1	800	#/100 mL
BPG 09	BPG09	6/22/1983	FECAL COLIFORM	1	1800	#/100 mL
BPG 09	BPG09	8/18/1983	FECAL COLIFORM	1	2100	#/100 mL

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	11/2/1983	FECAL COLIFORM	1	230	#/100 mL
BPG 09	BPG09	12/8/1983	FECAL COLIFORM	1	2800	#/100 mL
BPG 09	BPG09	3/7/1984	FECAL COLIFORM	1	10	#/100 mL
BPG 09	BPG09	4/11/1984	FECAL COLIFORM	1	10	#/100 mL
BPG 09	BPG09	5/2/1984	FECAL COLIFORM	1	32	#/100 mL
BPG 09	BPG09	6/21/1984	FECAL COLIFORM	1	1000	#/100 mL
BPG 09	BPG09	7/18/1984	FECAL COLIFORM	1	180	#/100 mL
BPG 09	BPG09	8/22/1984	FECAL COLIFORM	1	500	#/100 mL
BPG 09	BPG09	9/19/1984	FECAL COLIFORM	1	150	#/100 mL
BPG 09	BPG09	11/7/1984	FECAL COLIFORM	1	80	#/100 mL
BPG 09	BPG09	12/13/1984	FECAL COLIFORM	1	200	#/100 mL
BPG 09	BPG09	1/16/1985	FECAL COLIFORM	1	80	#/100 mL
BPG 09	BPG09	3/6/1985	FECAL COLIFORM	1	2100	#/100 mL
BPG 09	BPG09	4/15/1985	FECAL COLIFORM	1	100	#/100 mL
BPG 09	BPG09	5/23/1985	FECAL COLIFORM	1	150	#/100 mL
BPG 09	BPG09	7/2/1985	FECAL COLIFORM	1	700	#/100 mL
BPG 09	BPG09	8/19/1985	FECAL COLIFORM	1	1700	#/100 mL
BPG 09	BPG09	9/16/1985	FECAL COLIFORM	1	620	#/100 mL
BPG 09	BPG09	10/16/1985	FECAL COLIFORM	1	1000	#/100 mL
BPG 09	BPG09	12/10/1985	FECAL COLIFORM	1	10	#/100 mL
BPG 09	BPG09	1/29/1986	FECAL COLIFORM	1	40	#/100 mL
BPG 09	BPG09	2/20/1986	FECAL COLIFORM	1	200	#/100 mL
BPG 09	BPG09	3/25/1986	FECAL COLIFORM	1	10	#/100 mL
BPG 09	BPG09	4/30/1986	FECAL COLIFORM	1	100	#/100 mL
BPG 09	BPG09	6/17/1986	FECAL COLIFORM	1	3700	#/100 mL
BPG 09	BPG09	7/15/1986	FECAL COLIFORM	1	680	#/100 mL
BPG 09	BPG09	9/10/1986	FECAL COLIFORM	1	370	#/100 mL
BPG 09	BPG09	10/7/1986	FECAL COLIFORM	1	430	#/100 mL
BPG 09	BPG09	12/2/1986	FECAL COLIFORM	1	1700	#/100 mL
BPG 09	BPG09	1/13/1987	FECAL COLIFORM	1	10	#/100 mL
BPG 09	BPG09	2/17/1987	FECAL COLIFORM	1	140	#/100 mL
BPG 09	BPG09	3/24/1987	FECAL COLIFORM	1	110	#/100 mL
BPG 09	BPG09	4/28/1987	FECAL COLIFORM	1	260	#/100 mL
BPG 09	BPG09	6/2/1987	FECAL COLIFORM	1	1400	#/100 mL
BPG 09	BPG09	7/20/1987	FECAL COLIFORM	1	90	#/100 mL
BPG 09	BPG09	9/9/1987	FECAL COLIFORM	1	210	#/100 mL
BPG 09	BPG09	11/3/1987	FECAL COLIFORM	1	210	#/100 mL
BPG 09	BPG09	12/10/1987	FECAL COLIFORM	1	800	#/100 mL
BPG 09	BPG09	1/21/1988	FECAL COLIFORM	1	1300	#/100 mL
BPG 09	BPG09	3/3/1988	FECAL COLIFORM	1	140	#/100 mL
BPG 09	BPG09	4/5/1988	FECAL COLIFORM	1	1200	#/100 mL
BPG 09	BPG09	5/19/1988	FECAL COLIFORM	1	280	#/100 mL
BPG 09	BPG09	6/23/1988	FECAL COLIFORM	1	240	#/100 mL
BPG 09	BPG09	8/11/1988	FECAL COLIFORM	1	710	#/100 mL
BPG 09	BPG09	9/15/1988	FECAL COLIFORM	1	150	#/100 mL
BPG 09	BPG09	11/10/1988	FECAL COLIFORM	1	20000	#/100 mL
BPG 09	BPG09	12/14/1988	FECAL COLIFORM	1	110	#/100 mL
BPG 09	BPG09	1/19/1989	FECAL COLIFORM	1	220	#/100 mL
BPG 09	BPG09	2/23/1989	FECAL COLIFORM	1	70	#/100 mL
BPG 09	BPG09	4/13/1989	FECAL COLIFORM	1	520	#/100 mL

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	5/10/1989	FECAL COLIFORM	1	350	#/100 mL
BPG 09	BPG09	6/20/1989	FECAL COLIFORM	1	640	#/100 mL
BPG 09	BPG09	8/2/1989	FECAL COLIFORM	1	250	#/100 mL
BPG 09	BPG09	9/14/1989	FECAL COLIFORM	1	200	#/100 mL
BPG 09	BPG09	11/8/1989	FECAL COLIFORM	1	100	#/100 mL
BPG 09	BPG09	12/12/1989	FECAL COLIFORM	1	10	#/100 mL
BPG 09	BPG09	1/24/1990	FECAL COLIFORM	1	40	#/100 mL
BPG 09	BPG09	2/28/1990	FECAL COLIFORM	1	140	#/100 mL
BPG 09	BPG09	3/28/1990	FECAL COLIFORM	1	200	#/100 mL
BPG 09	BPG09	5/9/1990	FECAL COLIFORM	1	240	#/100 mL
BPG 09	BPG09	7/3/1990	FECAL COLIFORM	1	1000	#/100 mL
BPG 09	BPG09	8/2/1990	FECAL COLIFORM	1	540	#/100 mL
BPG 09	BPG09	9/26/1990	FECAL COLIFORM	1	320	#/100 mL
BPG 09	BPG09	10/31/1990	FECAL COLIFORM	1	80	#/100 mL
BPG 09	BPG09	12/10/1990	FECAL COLIFORM	1	390	#/100 mL
BPG 09	BPG09	1/16/1991	FECAL COLIFORM	1	2200	#/100 mL
BPG 09	BPG09	3/5/1991	FECAL COLIFORM	1	80	#/100 mL
BPG 09	BPG09	4/3/1991	FECAL COLIFORM	1	130	#/100 mL
BPG 09	BPG09	5/22/1991	FECAL COLIFORM	1	880	#/100 mL
BPG 09	BPG09	6/26/1991	FECAL COLIFORM	1	460	#/100 mL
BPG 09	BPG09	8/21/1991	FECAL COLIFORM	1	260	#/100 mL
BPG 09	BPG09	9/30/1991	FECAL COLIFORM	1	50	#/100 mL
BPG 09	BPG09	11/14/1991	FECAL COLIFORM	1	80	#/100 mL
BPG 09	BPG09	12/18/1991	FECAL COLIFORM	1	110	#/100 mL
BPG 09	BPG09	2/4/1992	FECAL COLIFORM	1	80	#/100 mL
BPG 09	BPG09	3/17/1992	FECAL COLIFORM	1	30	#/100 mL
BPG 09	BPG09	6/3/1992	FECAL COLIFORM	1	150	#/100 mL
BPG 09	BPG09	7/13/1992	FECAL COLIFORM	1	2100	#/100 mL
BPG 09	BPG09	8/12/1992	FECAL COLIFORM	1	140	#/100 mL
BPG 09	BPG09	9/23/1992	FECAL COLIFORM	1	500	#/100 mL
BPG 09	BPG09	11/18/1992	FECAL COLIFORM	1	400	#/100 mL
BPG 09	BPG09	12/16/1992	FECAL COLIFORM	1	3000	#/100 mL
BPG 09	BPG09	2/1/1993	FECAL COLIFORM	1	210	#/100 mL
BPG 09	BPG09	3/9/1993	FECAL COLIFORM	1	1000	#/100 mL
BPG 09	BPG09	4/7/1993	FECAL COLIFORM	1	180	#/100 mL
BPG 09	BPG09	5/24/1993	FECAL COLIFORM	1	390	#/100 mL
BPG 09	BPG09	6/28/1993	FECAL COLIFORM	1	100	#/100 mL
BPG 09	BPG09	8/18/1993	FECAL COLIFORM	1	1400	#/100 mL
BPG 09	BPG09	9/28/1993	FECAL COLIFORM	1	1900	#/100 mL
BPG 09	BPG09	11/15/1993	FECAL COLIFORM	1	2800	#/100 mL
BPG 09	BPG09	12/20/1993	FECAL COLIFORM	1	350	#/100 mL
BPG 09	BPG09	3/2/1994	FECAL COLIFORM	1	16	#/100 mL
BPG 09	BPG09	3/29/1994	FECAL COLIFORM	1	8	#/100 mL
BPG 09	BPG09	4/28/1994	FECAL COLIFORM	1	1000	#/100 mL
BPG 09	BPG09	6/30/1994	FECAL COLIFORM	1	420	#/100 mL
BPG 09	BPG09	8/15/1994	FECAL COLIFORM	1	200	#/100 mL
BPG 09	BPG09	9/6/1994	FECAL COLIFORM	1	530	#/100 mL
BPG 09	BPG09	9/26/1994	FECAL COLIFORM	1	250	#/100 mL
BPG 09	BPG09	11/2/1994	FECAL COLIFORM	1	440	#/100 mL
BPG 09	BPG09	1/4/1995	FECAL COLIFORM	1	14	#/100 mL

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	2/1/1995	FECAL COLIFORM	1	48	#/100 mL
BPG 09	BPG09	2/27/1995	FECAL COLIFORM	1	12	#/100 mL
BPG 09	BPG09	3/29/1995	FECAL COLIFORM	1	130	#/100 mL
BPG 09	BPG09	5/11/1995	FECAL COLIFORM	1	1700	#/100 mL
BPG 09	BPG09	6/14/1995	FECAL COLIFORM	1	400	#/100 mL
BPG 09	BPG09	9/7/1995	FECAL COLIFORM	1	90	#/100 mL
BPG 09	BPG09	10/16/1995	FECAL COLIFORM	1	100	#/100 mL
BPG 09	BPG09	12/12/1995	FECAL COLIFORM	1	4	#/100 mL
BPG 09	BPG09	1/29/1996	FECAL COLIFORM	1	700	#/100 mL
BPG 09	BPG09	2/29/1996	FECAL COLIFORM	1	270	#/100 mL
BPG 09	BPG09	3/28/1996	FECAL COLIFORM	1	30	#/100 mL
BPG 09	BPG09	4/19/1996	FECAL COLIFORM	1	46	#/100 mL
BPG 09	BPG09	5/20/1996	FECAL COLIFORM	1	420	#/100 mL
BPG 09	BPG09	7/18/1996	FECAL COLIFORM	1	140	#/100 mL
BPG 09	BPG09	8/26/1996	FECAL COLIFORM	1	190	#/100 mL
BPG 09	BPG09	10/28/1996	FECAL COLIFORM	1	70	#/100 mL
BPG 09	BPG09	12/16/1996	FECAL COLIFORM	1	10	#/100 mL
BPG 09	BPG09	2/4/1997	FECAL COLIFORM	1	800	#/100 mL
BPG 09	BPG09	3/4/1997	FECAL COLIFORM	1	270	#/100 mL
BPG 09	BPG09	4/2/1997	FECAL COLIFORM	1	30	#/100 mL
BPG 09	BPG09	4/30/1997	FECAL COLIFORM	1	60	#/100 mL
BPG 09	BPG09	9/9/1997	FECAL COLIFORM	1	480	#/100 mL
BPG 09	BPG09	9/26/1997	FECAL COLIFORM	1	1600	#/100 mL
BPG 09	BPG09	10/30/1997	FECAL COLIFORM	1	150	#/100 mL
BPG 09	BPG09	11/19/1997	FECAL COLIFORM	1	10	#/100 mL
BPG 09	BPG09	1/6/1998	FECAL COLIFORM	1	70	#/100 mL
BPG 09	BPG09	3/13/1998	FECAL COLIFORM	1	260	#/100 mL
BPG 09	BPG09	4/28/1998	FECAL COLIFORM	1	190	#/100 mL
BPG 09	BPG09	7/1/1998	FECAL COLIFORM	1	2650	#/100 mL
BPG 09	BPG09	8/4/1998	FECAL COLIFORM	1	9000	#/100 mL
BPG 09	BPG09	8/31/1998	FECAL COLIFORM	1	310	#/100 mL
BPG 09	BPG09	9/28/1998	FECAL COLIFORM	1	185	#/100 mL
BPG 09	BPG09	11/23/1998	FECAL COLIFORM	1	60	#/100 mL
BPG 09	BPG09	12/30/1998	FECAL COLIFORM	1	40	#/100 mL
BPG 09	BPG09	04/29/99	FECAL COLIFORM	1	100	#/100 mL
BPG 09	BPG09	08/31/99	FECAL COLIFORM	1	800	#/100 mL
BPG 09	BPG09	09/29/99	FECAL COLIFORM	1	300	#/100 mL
BPG 09	BPG09	11/10/99	FECAL COLIFORM	1	10	#/100 mL
BPG 09	BPG09	01/24/00	FECAL COLIFORM	1	1700	#/100 mL
BPG 09	BPG09	03/03/00	FECAL COLIFORM	1	2	#/100 mL
BPG 09	BPG09	05/23/00	FECAL COLIFORM	1	250	#/100 mL
BPG 09	BPG09	06/14/00	FECAL COLIFORM	1	460	#/100 mL
BPG 09	BPG09	07/26/00	FECAL COLIFORM	1	80	#/100 mL
BPG 09	BPG09	09/28/00	FECAL COLIFORM	1	270	#/100 mL
BPG 09	BPG09	11/28/00	FECAL COLIFORM	1	140	#/100 mL
BPG 09	BPG09	12/28/00	FECAL COLIFORM	1	30	#/100 mL
BPG 09	BPG09	01/30/01	FECAL COLIFORM	1	400	#/100 mL
BPG 09	BPG09	03/19/01	FECAL COLIFORM	1	10	#/100 mL
BPG 09	BPG09	04/18/01	FECAL COLIFORM	1	40	#/100 mL
BPG 09	BPG09	05/14/01	FECAL COLIFORM	1	160	#/100 mL

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	06/19/01	FECAL COLIFORM	1	440	#/100 mL
BPG 09	BPG09	08/02/01	FECAL COLIFORM	1	40	#/100 mL
BPG 09	BPG09	08/21/01	FECAL COLIFORM	1	260	#/100 mL
BPG 09	BPG09	11/08/01	FECAL COLIFORM	1	200	#/100 mL
BPG 09	BPG09	12/20/01	FECAL COLIFORM	1	1100	#/100 mL
BPG 09	BPG09	01/30/02	FECAL COLIFORM	1	520	#/100 mL
BPG 09	BPG09	03/04/02	FECAL COLIFORM	1	100	#/100 mL
BPG 09	BPG09	04/18/02	FECAL COLIFORM	1	150	#/100 mL
BPG 09	BPG09	06/05/02	FECAL COLIFORM	1	690	#/100 mL
BPG 09	BPG09	07/11/02	FECAL COLIFORM	1	1200	#/100 mL
BPG 09	BPG09	08/19/02	FECAL COLIFORM	1	13	#/100 mL
BPG 09	BPG09	09/27/02	FECAL COLIFORM	1	110	#/100 mL
BPG 09	BPG09	11/12/02	FECAL COLIFORM	1	60	#/100 mL
BPG 09	BPG09	12/12/02	FECAL COLIFORM	1	20	#/100 mL
BPG 09	BPG09	02/06/03	FECAL COLIFORM	1	270	#/100 mL
BPG 09	BPG09	03/18/03	FECAL COLIFORM	1	39	#/100 mL
BPG 09	BPG09	04/24/03	FECAL COLIFORM	1	50	#/100 mL
BPG 09	BPG09	06/02/03	FECAL COLIFORM	1	570	#/100 mL
BPG 09	BPG09	07/22/03	FECAL COLIFORM	1	400	#/100 mL
BPG 09	BPG09	08/25/03	FECAL COLIFORM	1	240	#/100 mL
BPG 09	BPG09	11/04/03	FECAL COLIFORM	1	30	#/100 mL
BPG 09	BPG09	3/18/04	FECAL COLIFORM	1	120	#/100 mL
BPG 09	BPG09	04/20/04	FECAL COLIFORM	1	220	#/100 mL
BPG 09	BPG09	06/08/04	FECAL COLIFORM	1	510	#/100 mL
BPG 09	BPG09	07/15/04	FECAL COLIFORM	1	1100	#/100 mL
BPG 09	BPG09	09/01/04	FECAL COLIFORM	1	530	#/100 mL
BPG 09	BPG09	09/20/04	FECAL COLIFORM	1	570	#/100 mL
BPG 09	BPG09	11/08/04	FECAL COLIFORM	1	200	#/100 mL
BPG 09	BPG09	12/20/04	FECAL COLIFORM	1	120	#/100 mL
BPG 09	BPG09	3/9/2000	Nitrate (NO3)	1	4.61	mg/L
BPG 09	BPG09	3/29/2000	Nitrate (NO3)	1	8.27	mg/L
BPG 09	BPG09	4/4/2000	Nitrate (NO3)	1	5.68	mg/L
BPG 09	BPG09	4/10/2000	Nitrate (NO3)	1	4.96	mg/L
BPG 09	BPG09	4/17/2000	Nitrate (NO3)	1	2.32	mg/L
BPG 09	BPG09	4/24/2000	Nitrate (NO3)	1	10.19	mg/L
BPG 09	BPG09	5/1/2000	Nitrate (NO3)	1	5.91	mg/L
BPG 09	BPG09	5/8/2000	Nitrate (NO3)	1	6.39	mg/L
BPG 09	BPG09	5/17/2000	Nitrate (NO3)	1	9.19	mg/L
BPG 09	BPG09	5/22/2000	Nitrate (NO3)	1	13.7	mg/L
BPG 09	BPG09	5/28/2000	Nitrate (NO3)	1	13.13	mg/L
BPG 09	BPG09	5/28/2000	Nitrate (NO3)	1	15.54	mg/L
BPG 09	BPG09	5/29/2000	Nitrate (NO3)	1	16.7	mg/L
BPG 09	BPG09	5/29/2000	Nitrate (NO3)	1	17	mg/L
BPG 09	BPG09	5/30/2000	Nitrate (NO3)	1	18.26	mg/L
BPG 09	BPG09	6/1/2000	Nitrate (NO3)	1	16.59	mg/L
BPG 09	BPG09	6/7/2000	Nitrate (NO3)	1	13.95	mg/L
BPG 09	BPG09	6/12/2000	Nitrate (NO3)	1	11.45	mg/L
BPG 09	BPG09	6/19/2000	Nitrate (NO3)	1	12.81	mg/L
BPG 09	BPG09	6/26/2000	Nitrate (NO3)	1	14.72	mg/L
BPG 09	BPG09	7/5/2000	Nitrate (NO3)	1	9.83	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	7/11/2000	Nitrate (NO3)	1	10.55	mg/L
BPG 09	BPG09	7/17/2000	Nitrate (NO3)	1	10.09	mg/L
BPG 09	BPG09	7/24/2000	Nitrate (NO3)	1	6.55	mg/L
BPG 09	BPG09	7/31/2000	Nitrate (NO3)	1	5.73	mg/L
BPG 09	BPG09	8/8/2000	Nitrate (NO3)	1	5.84	mg/L
BPG 09	BPG09	8/14/2000	Nitrate (NO3)	1	3.57	mg/L
BPG 09	BPG09	8/22/2000	Nitrate (NO3)	1	1.45	mg/L
BPG 09	BPG09	8/29/2000	Nitrate (NO3)	1	0.9	mg/L
BPG 09	BPG09	9/5/2000	Nitrate (NO3)	1	0.95	mg/L
BPG 09	BPG09	9/12/2000	Nitrate (NO3)	1	0.94	mg/L
BPG 09	BPG09	9/18/2000	Nitrate (NO3)	1	1.41	mg/L
BPG 09	BPG09	9/25/2000	Nitrate (NO3)	1	0.93	mg/L
BPG 09	BPG09	10/2/2000	Nitrate (NO3)	1	1.19	mg/L
BPG 09	BPG09	10/10/2000	Nitrate (NO3)	1	1.47	mg/L
BPG 09	BPG09	10/17/2000	Nitrate (NO3)	1	2.13	mg/L
BPG 09	BPG09	10/24/2000	Nitrate (NO3)	1	0.88	mg/L
BPG 09	BPG09	10/30/2000	Nitrate (NO3)	1	0.26	mg/L
BPG 09	BPG09	11/6/2000	Nitrate (NO3)	1	0.14	mg/L
BPG 09	BPG09	11/13/2000	Nitrate (NO3)	1	11.02	mg/L
BPG 09	BPG09	11/20/2000	Nitrate (NO3)	1	9.9	mg/L
BPG 09	BPG09	11/27/2000	Nitrate (NO3)	1	7.27	mg/L
BPG 09	BPG09	12/4/2000	Nitrate (NO3)	1	7.96	mg/L
BPG 09	BPG09	12/14/2000	Nitrate (NO3)	1	9.8	mg/L
BPG 09	BPG09	12/18/2000	Nitrate (NO3)	1	9.74	mg/L
BPG 09	BPG09	1/2/2001	Nitrate (NO3)	1	7.58	mg/L
BPG 09	BPG09	2/5/2001	Nitrate (NO3)	1	9.98	mg/L
BPG 09	BPG09	2/9/2001	Nitrate (NO3)	1	9.42	mg/L
BPG 09	BPG09	2/10/2001	Nitrate (NO3)	1	9.1	mg/L
BPG 09	BPG09	2/12/2001	Nitrate (NO3)	1	12.09	mg/L
BPG 09	BPG09	2/13/2001	Nitrate (NO3)	1	11.96	mg/L
BPG 09	BPG09	2/20/2001	Nitrate (NO3)	1	12.04	mg/L
BPG 09	BPG09	2/25/2001	Nitrate (NO3)	1	5.12	mg/L
BPG 09	BPG09	2/26/2001	Nitrate (NO3)	1	8.21	mg/L
BPG 09	BPG09	2/27/2001	Nitrate (NO3)	1	10.53	mg/L
BPG 09	BPG09	2/28/2001	Nitrate (NO3)	1	11.27	mg/L
BPG 09	BPG09	3/1/2001	Nitrate (NO3)	1	11.52	mg/L
BPG 09	BPG09	3/5/2001	Nitrate (NO3)	1	11.32	mg/L
BPG 09	BPG09	3/12/2001	Nitrate (NO3)	1	10.44	mg/L
BPG 09	BPG09	3/19/2001	Nitrate (NO3)	1	13.09	mg/L
BPG 09	BPG09	3/26/2001	Nitrate (NO3)	1	11.2	mg/L
BPG 09	BPG09	4/2/2001	Nitrate (NO3)	1	10.04	mg/L
BPG 09	BPG09	4/9/2001	Nitrate (NO3)	1	9.39	mg/L
BPG 09	BPG09	4/16/2001	Nitrate (NO3)	1	12.84	mg/L
BPG 09	BPG09	4/23/2001	Nitrate (NO3)	1	10.5	mg/L
BPG 09	BPG09	4/30/2001	Nitrate (NO3)	1	9.35	mg/L
BPG 09	BPG09	5/7/2001	Nitrate (NO3)	1	8.05	mg/L
BPG 09	BPG09	5/14/2001	Nitrate (NO3)	1	7.38	mg/L
BPG 09	BPG09	5/21/2001	Nitrate (NO3)	1	15.42	mg/L
BPG 09	BPG09	5/30/2001	Nitrate (NO3)	1	12.35	mg/L
BPG 09	BPG09	6/6/2001	Nitrate (NO3)	1	17.67	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	6/8/2001	Nitrate (NO3)	1	19.41	mg/L
BPG 09	BPG09	6/13/2001	Nitrate (NO3)	1	14.76	mg/L
BPG 09	BPG09	6/18/2001	Nitrate (NO3)	1	12.49	mg/L
BPG 09	BPG09	6/25/2001	Nitrate (NO3)	1	10.57	mg/L
BPG 09	BPG09	7/2/2001	Nitrate (NO3)	1	6.79	mg/L
BPG 09	BPG09	7/9/2001	Nitrate (NO3)	1	6.97	mg/L
BPG 09	BPG09	7/16/2001	Nitrate (NO3)	1	6.98	mg/L
BPG 09	BPG09	7/23/2001	Nitrate (NO3)	1	2.37	mg/L
BPG 09	BPG09	7/30/2001	Nitrate (NO3)	1	2.1	mg/L
BPG 09	BPG09	8/6/2001	Nitrate (NO3)	1	1.97	mg/L
BPG 09	BPG09	8/14/2001	Nitrate (NO3)	1	0.95	mg/L
BPG 09	BPG09	8/20/2001	Nitrate (NO3)	1	1.83	mg/L
BPG 09	BPG09	8/27/2001	Nitrate (NO3)	1	1.31	mg/L
BPG 09	BPG09	8/31/2001	Nitrate (NO3)	1	2.19	mg/L
BPG 09	BPG09	9/1/2001	Nitrate (NO3)	1	5.05	mg/L
BPG 09	BPG09	9/4/2001	Nitrate (NO3)	1	4.73	mg/L
BPG 09	BPG09	9/10/2001	Nitrate (NO3)	1	6.35	mg/L
BPG 09	BPG09	9/17/2001	Nitrate (NO3)	1	5.64	mg/L
BPG 09	BPG09	9/24/2001	Nitrate (NO3)	1	6	mg/L
BPG 09	BPG09	10/1/2001	Nitrate (NO3)	1	4.18	mg/L
BPG 09	BPG09	10/9/2001	Nitrate (NO3)	1	8.08	mg/L
BPG 09	BPG09	10/15/2001	Nitrate (NO3)	1	3.07	mg/L
BPG 09	BPG09	10/15/2001	Nitrate (NO3)	1	3.75	mg/L
BPG 09	BPG09	10/16/2001	Nitrate (NO3)	1	5.01	mg/L
BPG 09	BPG09	10/17/2001	Nitrate (NO3)	1	6.14	mg/L
BPG 09	BPG09	10/18/2001	Nitrate (NO3)	1	6.99	mg/L
BPG 09	BPG09	10/22/2001	Nitrate (NO3)	1	7.49	mg/L
BPG 09	BPG09	10/31/2001	Nitrate (NO3)	1	7.62	mg/L
BPG 09	BPG09	11/5/2001	Nitrate (NO3)	1	7.68	mg/L
BPG 09	BPG09	11/14/2001	Nitrate (NO3)	1	7.07	mg/L
BPG 09	BPG09	11/19/2001	Nitrate (NO3)	1	6.39	mg/L
BPG 09	BPG09	11/26/2001	Nitrate (NO3)	1	6.38	mg/L
BPG 09	BPG09	12/3/2001	Nitrate (NO3)	1	8.93	mg/L
BPG 09	BPG09	12/10/2001	Nitrate (NO3)	1	7.71	mg/L
BPG 09	BPG09	12/19/2001	Nitrate (NO3)	1	10.2	mg/L
BPG 09	BPG09	12/27/2001	Nitrate (NO3)	1	9.2	mg/L
BPG 09	BPG09	1/2/2002	Nitrate (NO3)	1	8.68	mg/L
BPG 09	BPG09	1/7/2002	Nitrate (NO3)	1	7.77	mg/L
BPG 09	BPG09	1/14/2002	Nitrate (NO3)	1	7.22	mg/L
BPG 09	BPG09	1/23/2002	Nitrate (NO3)	1	6.63	mg/L
BPG 09	BPG09	1/28/2002	Nitrate (NO3)	1	5.85	mg/L
BPG 09	BPG09	1/31/2002	Nitrate (NO3)	1	8.72	mg/L
BPG 09	BPG09	1/31/2002	Nitrate (NO3)	1	7.91	mg/L
BPG 09	BPG09	2/1/2002	Nitrate (NO3)	1	7.49	mg/L
BPG 09	BPG09	2/2/2002	Nitrate (NO3)	1	9.43	mg/L
BPG 09	BPG09	2/4/2002	Nitrate (NO3)	1	10.32	mg/L
BPG 09	BPG09	2/5/2002	Nitrate (NO3)	1	9.79	mg/L
BPG 09	BPG09	2/13/2002	Nitrate (NO3)	1	9.19	mg/L
BPG 09	BPG09	2/19/2002	Nitrate (NO3)	1	8.06	mg/L
BPG 09	BPG09	2/20/2002	Nitrate (NO3)	1	8.17	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	2/21/2002	Nitrate (NO3)	1	9.87	mg/L
BPG 09	BPG09	2/22/2002	Nitrate (NO3)	1	10.6	mg/L
BPG 09	BPG09	2/25/2002	Nitrate (NO3)	1	10.27	mg/L
BPG 09	BPG09	3/6/2002	Nitrate (NO3)	1	10.36	mg/L
BPG 09	BPG09	3/11/2002	Nitrate (NO3)	1	10.01	mg/L
BPG 09	BPG09	3/18/2002	Nitrate (NO3)	1	9.85	mg/L
BPG 09	BPG09	3/27/2002	Nitrate (NO3)	1	8.18	mg/L
BPG 09	BPG09	4/4/2002	Nitrate (NO3)	1	10.7	mg/L
BPGD	BPGD-H-A1	9/23/2002	Nitrate + Nitrite		1.32	mg/L
BPGD	BPGD-H-A2	9/23/2002	Nitrate + Nitrite		2.01	mg/L
BPGD	BPGD-H-C1	9/23/2002	Nitrate + Nitrite		9.67	mg/L
BPGD	BPGD-H-C2	9/23/2002	Nitrate + Nitrite		8.91	mg/L
BPGD	BPGD-H-C3	9/23/2002	Nitrate + Nitrite		2.32	mg/L
BPGD	BPGD-H-D2	9/23/2002	Nitrate + Nitrite		1.86	mg/L
BPGD	BPGD-H-D3	9/23/2002	Nitrate + Nitrite		0.55	mg/L
BPGD	BPGD-H-E1	9/23/2002	Nitrate + Nitrite		13.10	mg/L
BPG 09	BPG09	1/19/1978	Nitrite + Nitrate	1	5.39999	mg/L
BPG 09	BPG09	2/28/1978	Nitrite + Nitrate	1	3.2	mg/L
BPG 09	BPG09	4/13/1978	Nitrite + Nitrate	1	7.29999	mg/L
BPG 09	BPG09	5/11/1978	Nitrite + Nitrate	1	7.89999	mg/L
BPG 09	BPG09	5/31/1978	Nitrite + Nitrate	1	6.99999	mg/L
BPG 09	BPG09	6/14/1978	Nitrite + Nitrate	1	4.5	mg/L
BPG 09	BPG09	6/28/1978	Nitrite + Nitrate	1	4	mg/L
BPG 09	BPG09	7/11/1978	Nitrite + Nitrate	1	4.6	mg/L
BPG 09	BPG09	8/2/1978	Nitrite + Nitrate	1	1.2	mg/L
BPG 09	BPG09	8/23/1978	Nitrite + Nitrate	1	0.7	mg/L
BPG 09	BPG09	9/13/1978	Nitrite + Nitrate	1	1	mg/L
BPG 09	BPG09	10/11/1978	Nitrite + Nitrate	1	1.8	mg/L
BPG 09	BPG09	11/15/1978	Nitrite + Nitrate	1	0.6	mg/L
BPG 09	BPG09	12/6/1978	Nitrite + Nitrate	1	1.7	mg/L
BPG 09	BPG09	1/10/1979	Nitrite + Nitrate	1	4.2	mg/L
BPG 09	BPG09	2/6/1979	Nitrite + Nitrate	1	1.8	mg/L
BPG 09	BPG09	3/7/1979	Nitrite + Nitrate	1	6.4	mg/L
BPG 09	BPG09	4/2/1979	Nitrite + Nitrate	1	12	mg/L
BPG 09	BPG09	5/1/1979	Nitrite + Nitrate	1	12	mg/L
BPG 09	BPG09	5/31/1979	Nitrite + Nitrate	1	7.6	mg/L
BPG 09	BPG09	5/31/1979	Nitrite + Nitrate	1	7.7	mg/L
BPG 09	BPG09	7/9/1979	Nitrite + Nitrate	1	7.6	mg/L
BPG 09	BPG09	7/9/1979	Nitrite + Nitrate	1	7.7	mg/L
BPG 09	BPG09	8/1/1979	Nitrite + Nitrate	1	5.1	mg/L
BPG 09	BPG09	9/13/1979	Nitrite + Nitrate	1	1.6	mg/L
BPG 09	BPG09	10/4/1979	Nitrite + Nitrate	1	1.2	mg/L
BPG 09	BPG09	10/4/1979	Nitrite + Nitrate	1	1.2	mg/L
BPG 09	BPG09	11/5/1979	Nitrite + Nitrate	1	0.6	mg/L
BPG 09	BPG09	12/5/1979	Nitrite + Nitrate	1	6.3	mg/L
BPG 09	BPG09	1/10/1980	Nitrite + Nitrate	1	7.3	mg/L
BPG 09	BPG09	2/14/1980	Nitrite + Nitrate	1	4.9	mg/L
BPG 09	BPG09	3/31/1980	Nitrite + Nitrate	1	8.9	mg/L
BPG 09	BPG09	5/2/1980	Nitrite + Nitrate	1	8.5	mg/L
BPG 09	BPG09	5/2/1980	Nitrite + Nitrate	1	8.6	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	6/4/1980	Nitrite + Nitrate	1	7.1	mg/L
BPG 09	BPG09	6/17/1980	Nitrite + Nitrate	1	12	mg/L
BPG 09	BPG09	7/7/1980	Nitrite + Nitrate	1	6	mg/L
BPG 09	BPG09	8/11/1980	Nitrite + Nitrate	1	1.4	mg/L
BPG 09	BPG09	9/10/1980	Nitrite + Nitrate	1	1.6	mg/L
BPG 09	BPG09	10/2/1980	Nitrite + Nitrate	1	1.5	mg/L
BPG 09	BPG09	10/27/1980	Nitrite + Nitrate	1	0.5	mg/L
BPG 09	BPG09	11/24/1980	Nitrite + Nitrate	1	1.1	mg/L
BPG 09	BPG09	12/22/1980	Nitrite + Nitrate	1	3.1	mg/L
BPG 09	BPG09	1/22/1981	Nitrite + Nitrate	1	1.6	mg/L
BPG 09	BPG09	2/18/1981	Nitrite + Nitrate	1	3.7	mg/L
BPG 09	BPG09	3/19/1981	Nitrite + Nitrate	1	3.5	mg/L
BPG 09	BPG09	4/16/1981	Nitrite + Nitrate	1	15	mg/L
BPG 09	BPG09	5/21/1981	Nitrite + Nitrate	1	15	mg/L
BPG 09	BPG09	6/23/1981	Nitrite + Nitrate	1	16	mg/L
BPG 09	BPG09	8/4/1981	Nitrite + Nitrate	1	9.4	mg/L
BPG 09	BPG09	8/19/1981	Nitrite + Nitrate	1	8.7	mg/L
BPG 09	BPG09	11/10/1981	Nitrite + Nitrate	1	8.4	mg/L
BPG 09	BPG09	1/6/1982	Nitrite + Nitrate	1	11	mg/L
BPG 09	BPG09	3/10/1982	Nitrite + Nitrate	1	7.2	mg/L
BPG 09	BPG09	4/8/1982	Nitrite + Nitrate	1	7.3	mg/L
BPG 09	BPG09	5/13/1982	Nitrite + Nitrate	1	13	mg/L
BPG 09	BPG09	6/16/1982	Nitrite + Nitrate	1	7.9	mg/L
BPG 09	BPG09	8/12/1982	Nitrite + Nitrate	1	4.1	mg/L
BPG 09	BPG09	9/30/1982	Nitrite + Nitrate	1	0.76	mg/L
BPG 09	BPG09	11/10/1982	Nitrite + Nitrate	1	2.9	mg/L
BPG 09	BPG09	1/4/1983	Nitrite + Nitrate	1	9.3	mg/L
BPG 09	BPG09	2/4/1983	Nitrite + Nitrate	1	9	mg/L
BPG 09	BPG09	3/16/1983	Nitrite + Nitrate	1	6.9	mg/L
BPG 09	BPG09	4/13/1983	Nitrite + Nitrate	1	10	mg/L
BPG 09	BPG09	5/4/1983	Nitrite + Nitrate	1	8.1	mg/L
BPG 09	BPG09	6/22/1983	Nitrite + Nitrate	1	8	mg/L
BPG 09	BPG09	8/18/1983	Nitrite + Nitrate	1	1.3	mg/L
BPG 09	BPG09	11/2/1983	Nitrite + Nitrate	1	3.2	mg/L
BPG 09	BPG09	12/8/1983	Nitrite + Nitrate	1	11	mg/L
BPG 09	BPG09	3/7/1984	Nitrite + Nitrate	1	7.4	mg/L
BPG 09	BPG09	4/11/1984	Nitrite + Nitrate	1	8.7	mg/L
BPG 09	BPG09	5/2/1984	Nitrite + Nitrate	1	8.8	mg/L
BPG 09	BPG09	6/21/1984	Nitrite + Nitrate	1	7.1	mg/L
BPG 09	BPG09	7/18/1984	Nitrite + Nitrate	1	2.2	mg/L
BPG 09	BPG09	8/22/1984	Nitrite + Nitrate	1	1.1	mg/L
BPG 09	BPG09	9/19/1984	Nitrite + Nitrate	1	1.3	mg/L
BPG 09	BPG09	11/7/1984	Nitrite + Nitrate	1	1.8	mg/L
BPG 09	BPG09	12/13/1984	Nitrite + Nitrate	1	3.6	mg/L
BPG 09	BPG09	1/16/1985	Nitrite + Nitrate	1	9.8	mg/L
BPG 09	BPG09	3/6/1985	Nitrite + Nitrate	1	12	mg/L
BPG 09	BPG09	4/15/1985	Nitrite + Nitrate	1	11	mg/L
BPG 09	BPG09	5/23/1985	Nitrite + Nitrate	1	9.3	mg/L
BPG 09	BPG09	7/2/1985	Nitrite + Nitrate	1	3.5	mg/L
BPG 09	BPG09	8/19/1985	Nitrite + Nitrate	1	4.5	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	9/16/1985	Nitrite + Nitrate	1	1.3	mg/L
BPG 09	BPG09	10/16/1985	Nitrite + Nitrate	1	1.5	mg/L
BPG 09	BPG09	12/10/1985	Nitrite + Nitrate	1	8.1	mg/L
BPG 09	BPG09	1/29/1986	Nitrite + Nitrate	1	7	mg/L
BPG 09	BPG09	2/20/1986	Nitrite + Nitrate	1	8.5	mg/L
BPG 09	BPG09	3/25/1986	Nitrite + Nitrate	1	9.5	mg/L
BPG 09	BPG09	4/30/1986	Nitrite + Nitrate	1	4.5	mg/L
BPG 09	BPG09	6/17/1986	Nitrite + Nitrate	1	9	mg/L
BPG 09	BPG09	7/15/1986	Nitrite + Nitrate	1	8	mg/L
BPG 09	BPG09	9/10/1986	Nitrite + Nitrate	1	1.4	mg/L
BPG 09	BPG09	10/7/1986	Nitrite + Nitrate	1	2.2	mg/L
BPG 09	BPG09	12/2/1986	Nitrite + Nitrate	1	3.8	mg/L
BPG 09	BPG09	1/13/1987	Nitrite + Nitrate	1	2.7	mg/L
BPG 09	BPG09	2/17/1987	Nitrite + Nitrate	1	12	mg/L
BPG 09	BPG09	3/24/1987	Nitrite + Nitrate	1	8	mg/L
BPG 09	BPG09	4/28/1987	Nitrite + Nitrate	1	12	mg/L
BPG 09	BPG09	6/2/1987	Nitrite + Nitrate	1	11	mg/L
BPG 09	BPG09	7/20/1987	Nitrite + Nitrate	1	2.4	mg/L
BPG 09	BPG09	9/9/1987	Nitrite + Nitrate	1	2	mg/L
BPG 09	BPG09	11/3/1987	Nitrite + Nitrate	1	0.1	mg/L
BPG 09	BPG09	12/10/1987	Nitrite + Nitrate	1	12	mg/L
BPG 09	BPG09	1/21/1988	Nitrite + Nitrate	1	5.7	mg/L
BPG 09	BPG09	3/3/1988	Nitrite + Nitrate	1	9.6	mg/L
BPG 09	BPG09	4/5/1988	Nitrite + Nitrate	1	12	mg/L
BPG 09	BPG09	5/19/1988	Nitrite + Nitrate	1	5.7	mg/L
BPG 09	BPG09	6/23/1988	Nitrite + Nitrate	1	1.5	mg/L
BPG 09	BPG09	8/11/1988	Nitrite + Nitrate	1	2.2	mg/L
BPG 09	BPG09	9/15/1988	Nitrite + Nitrate	1	1.4	mg/L
BPG 09	BPG09	11/10/1988	Nitrite + Nitrate	1	6.8	mg/L
BPG 09	BPG09	12/14/1988	Nitrite + Nitrate	1	8.2	mg/L
BPG 09	BPG09	1/19/1989	Nitrite + Nitrate	1	12	mg/L
BPG 09	BPG09	2/23/1989	Nitrite + Nitrate	1	11	mg/L
BPG 09	BPG09	4/13/1989	Nitrite + Nitrate	1	15	mg/L
BPG 09	BPG09	5/10/1989	Nitrite + Nitrate	1	12	mg/L
BPG 09	BPG09	6/20/1989	Nitrite + Nitrate	1	11	mg/L
BPG 09	BPG09	8/2/1989	Nitrite + Nitrate	1	0.83	mg/L
BPG 09	BPG09	9/14/1989	Nitrite + Nitrate	1	3.5	mg/L
BPG 09	BPG09	11/8/1989	Nitrite + Nitrate	1	1.4	mg/L
BPG 09	BPG09	12/12/1989	Nitrite + Nitrate	1	3.1	mg/L
BPG 09	BPG09	1/24/1990	Nitrite + Nitrate	1	6	mg/L
BPG 09	BPG09	2/28/1990	Nitrite + Nitrate	1	12	mg/L
BPG 09	BPG09	3/28/1990	Nitrite + Nitrate	1	10	mg/L
BPG 09	BPG09	5/9/1990	Nitrite + Nitrate	1	14	mg/L
BPG 09	BPG09	7/3/1990	Nitrite + Nitrate	1	13	mg/L
BPG 09	BPG09	8/2/1990	Nitrite + Nitrate	1	8.5	mg/L
BPG 09	BPG09	9/26/1990	Nitrite + Nitrate	1	1.7	mg/L
BPG 09	BPG09	10/31/1990	Nitrite + Nitrate	1	8.5	mg/L
BPG 09	BPG09	12/10/1990	Nitrite + Nitrate	1	11	mg/L
BPG 09	BPG09	1/16/1991	Nitrite + Nitrate	1	5.9	mg/L
BPG 09	BPG09	3/5/1991	Nitrite + Nitrate	1	11	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	4/3/1991	Nitrite + Nitrate	1	9.7	mg/L
BPG 09	BPG09	5/22/1991	Nitrite + Nitrate	1	11	mg/L
BPG 09	BPG09	6/26/1991	Nitrite + Nitrate	1	4	mg/L
BPG 09	BPG09	8/21/1991	Nitrite + Nitrate	1	1	mg/L
BPG 09	BPG09	9/30/1991	Nitrite + Nitrate	1	0.75	mg/L
BPG 09	BPG09	11/14/1991	Nitrite + Nitrate	1	4.5	mg/L
BPG 09	BPG09	12/18/1991	Nitrite + Nitrate	1	13	mg/L
BPG 09	BPG09	2/4/1992	Nitrite + Nitrate	1	12	mg/L
BPG 09	BPG09	3/17/1992	Nitrite + Nitrate	1	14	mg/L
BPG 09	BPG09	6/3/1992	Nitrite + Nitrate	1	8.4	mg/L
BPG 09	BPG09	7/13/1992	Nitrite + Nitrate	1	15	mg/L
BPG 09	BPG09	8/12/1992	Nitrite + Nitrate	1	7.9	mg/L
BPG 09	BPG09	9/23/1992	Nitrite + Nitrate	1	3.5	mg/L
BPG 09	BPG09	11/18/1992	Nitrite + Nitrate	1	8.9	mg/L
BPG 09	BPG09	12/16/1992	Nitrite + Nitrate	1	8.1	mg/L
BPG 09	BPG09	2/1/1993	Nitrite + Nitrate	1	8.3	mg/L
BPG 09	BPG09	3/9/1993	Nitrite + Nitrate	1	7	mg/L
BPG 09	BPG09	4/7/1993	Nitrite + Nitrate	1	7.9	mg/L
BPG 09	BPG09	5/24/1993	Nitrite + Nitrate	1	10	mg/L
BPG 09	BPG09	6/28/1993	Nitrite + Nitrate	1	7.2	mg/L
BPG 09	BPG09	8/18/1993	Nitrite + Nitrate	1	3.2	mg/L
BPG 09	BPG09	9/28/1993	Nitrite + Nitrate	1	5.7	mg/L
BPG 09	BPG09	11/15/1993	Nitrite + Nitrate	1	6	mg/L
BPG 09	BPG09	12/20/1993	Nitrite + Nitrate	1	6.1	mg/L
BPG 09	BPG09	3/2/1994	Nitrite + Nitrate	1	3.4	mg/L
BPG 09	BPG09	3/29/1994	Nitrite + Nitrate	1	4.8	mg/L
BPG 09	BPG09	4/28/1994	Nitrite + Nitrate	1	8.8	mg/L
BPG 09	BPG09	6/30/1994	Nitrite + Nitrate	1	6.5	mg/L
BPG 09	BPG09	8/15/1994	Nitrite + Nitrate	1	0.78	mg/L
BPG 09	BPG09	9/6/1994	Nitrite + Nitrate	1	0.98	mg/L
BPG 09	BPG09	9/26/1994	Nitrite + Nitrate	1	0.63	mg/L
BPG 09	BPG09	11/2/1994	Nitrite + Nitrate	1	0.17	mg/L
BPG 09	BPG09	1/4/1995	Nitrite + Nitrate	1	5.7	mg/L
BPG 09	BPG09	2/1/1995	Nitrite + Nitrate	1	6.1	mg/L
BPG 09	BPG09	2/27/1995	Nitrite + Nitrate	1	3.2	mg/L
BPG 09	BPG09	3/29/1995	Nitrite + Nitrate	1	6.7	mg/L
BPG 09	BPG09	5/11/1995	Nitrite + Nitrate	1	9.5	mg/L
BPG 09	BPG09	6/14/1995	Nitrite + Nitrate	1	8.6	mg/L
BPG 09	BPG09	9/7/1995	Nitrite + Nitrate	1	0.64	mg/L
BPG 09	BPG09	10/16/1995	Nitrite + Nitrate	1	0.17	mg/L
BPG 09	BPG09	12/12/1995	Nitrite + Nitrate	1	3.3	mg/L
BPG 09	BPG09	1/29/1996	Nitrite + Nitrate	1	9.7	mg/L
BPG 09	BPG09	2/29/1996	Nitrite + Nitrate	1	8.4	mg/L
BPG 09	BPG09	3/28/1996	Nitrite + Nitrate	1	9.6	mg/L
BPG 09	BPG09	4/19/1996	Nitrite + Nitrate	1	5.9	mg/L
BPG 09	BPG09	5/20/1996	Nitrite + Nitrate	1	13.7	mg/L
BPG 09	BPG09	7/18/1996	Nitrite + Nitrate	1	5	mg/L
BPG 09	BPG09	8/26/1996	Nitrite + Nitrate	1	1.64	mg/L
BPG 09	BPG09	10/28/1996	Nitrite + Nitrate	1	0.11	mg/L
BPG 09	BPG09	12/16/1996	Nitrite + Nitrate	1	9.9	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	2/4/1997	Nitrite + Nitrate	1	6.5	mg/L
BPG 09	BPG09	3/4/1997	Nitrite + Nitrate	1	9.39	mg/L
BPG 09	BPG09	4/2/1997	Nitrite + Nitrate	1	9.4	mg/L
BPG 09	BPG09	4/30/1997	Nitrite + Nitrate	1	7	mg/L
BPG 09	BPG09	7/9/1997	Nitrite + Nitrate	1	7.1	mg/L
BPG 09	BPG09	9/9/1997	Nitrite + Nitrate	1	0.93	mg/L
BPG 09	BPG09	9/26/1997	Nitrite + Nitrate	1	0.93	mg/L
BPG 09	BPG09	10/30/1997	Nitrite + Nitrate	1	0.57	mg/L
BPG 09	BPG09	11/19/1997	Nitrite + Nitrate	1	0.56	mg/L
BPG 09	BPG09	1/6/1998	Nitrite + Nitrate	1	1.61	mg/L
BPG 09	BPG09	3/13/1998	Nitrite + Nitrate	1	13	mg/L
BPG 09	BPG09	4/28/1998	Nitrite + Nitrate	1	10.07	mg/L
BPG 09	BPG09	7/1/1998	Nitrite + Nitrate	1	10.51	mg/L
BPG 09	BPG09	8/4/1998	Nitrite + Nitrate	1	1.15	mg/L
BPG 09	BPG09	8/31/1998	Nitrite + Nitrate	1	1.53	mg/L
BPG 09	BPG09	9/28/1998	Nitrite + Nitrate	1	1.68	mg/L
BPG 09	BPG09	11/23/1998	Nitrite + Nitrate	1	4.98	mg/L
BPG 09	BPG09	12/30/1998	Nitrite + Nitrate	1	1.64	mg/L
BPG 09	BPG09	01/24/00	Nitrite + Nitrate	1	11	mg/L
BPG 09	BPG09	03/03/00	Nitrite + Nitrate	1	8.7	mg/L
BPG 09	BPG09	05/23/00	Nitrite + Nitrate	1	13	mg/L
BPG 09	BPG09	06/14/00	Nitrite + Nitrate	1	11	mg/L
BPG 09	BPG09	07/26/00	Nitrite + Nitrate	1	5.6	mg/L
BPG 09	BPG09	09/28/00	Nitrite + Nitrate	1	1.85	mg/L
BPG 09	BPG09	11/28/00	Nitrite + Nitrate	1	7.7	mg/L
BPG 09	BPG09	12/28/00	Nitrite + Nitrate	1	8.3	mg/L
BPG 09	BPG09	01/30/01	Nitrite + Nitrate	1	4.1	mg/L
BPG 09	BPG09	03/19/01	Nitrite + Nitrate	1	13	mg/L
BPG 09	BPG09	04/18/01	Nitrite + Nitrate	1	12	mg/L
BPG 09	BPG09	05/14/01	Nitrite + Nitrate	1	7.3	mg/L
BPG 09	BPG09	06/19/01	Nitrite + Nitrate	1	11	mg/L
BPG 09	BPG09	6/28/01	Nitrite + Nitrate	1	9.7	mg/L
BPG 09	BPG09	08/02/01	Nitrite + Nitrate	1	1.26	mg/L
BPG 09	BPG09	08/21/01	Nitrite + Nitrate	1	1.37	mg/L
BPG 09	BPG09	8/21/01	Nitrite + Nitrate	1	3.1	mg/L
BPG 09	BPG09	10/10/01	Nitrite + Nitrate	1	7.1	mg/L
BPG 09	BPG09	10/29/01	Nitrite + Nitrate	1	7	mg/L
BPG 09	BPG09	11/08/01	Nitrite + Nitrate	1	6.8	mg/L
BPG 09	BPG09	12/20/01	Nitrite + Nitrate	1	9.8	mg/L
BPG 09	BPG09	01/30/02	Nitrite + Nitrate	1	5.8	mg/L
BPG 09	BPG09	03/04/02	Nitrite + Nitrate	1	11	mg/L
BPG 09	BPG09	04/11/02	Nitrite + Nitrate	1	11	mg/L
BPG 09	BPG09	04/18/02	Nitrite + Nitrate	1	9.6	mg/L
BPG 09	BPG09	04/24/02	Nitrite + Nitrate	1	11	mg/L
BPG 09	BPG09	05/14/02	Nitrite + Nitrate	1	11	mg/L
BPG 09	BPG09	06/05/02	Nitrite + Nitrate	1	2.4	mg/L
BPG 09	BPG09	06/05/02	Nitrite + Nitrate	1	9.8	mg/L
BPG 09	BPG09	07/01/02	Nitrite + Nitrate	1	7.91	mg/L
BPG 09	BPG09	07/11/02	Nitrite + Nitrate	1	4.93	mg/L
BPG 09	BPG09	07/24/02	Nitrite + Nitrate	1	6.62	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	08/19/02	Nitrite + Nitrate	1	1.39	mg/L
BPG 09	BPG09	08/31/02	Nitrite + Nitrate	1	3.55	mg/L
BPG 09	BPG09	09/20/02	Nitrite + Nitrate	1	1.35	mg/L
BPG 09	BPG09	09/27/02	Nitrite + Nitrate	1	1.74	mg/L
BPG 09	BPG09	11/12/02	Nitrite + Nitrate	1	0.34	mg/L
BPG 09	BPG09	11/14/02	Nitrite + Nitrate	1	0.46	mg/L
BPG 09	BPG09	12/12/02	Nitrite + Nitrate	1	1.16	mg/L
BPG 09	BPG09	12/19/02	Nitrite + Nitrate	1	0.99	mg/L
RBD	RBD-1	7/2/1977	Nitrite + Nitrate	0	3	mg/L
RBD	RBD-1	6/28/1979	Nitrite + Nitrate	12	4.5	mg/L
RBD	RBD-1	6/28/1979	Nitrite + Nitrate	1	5.1	mg/L
RBD	RBD-1	9/5/1979	Nitrite + Nitrate	1	4.1	mg/L
RBD	RBD-1	9/5/1979	Nitrite + Nitrate	1	3.8	mg/L
RBD	RBD-1	5/18/1983	Nitrite + Nitrate	1	8.4	mg/L
RBD	RBD-1	5/18/1983	Nitrite + Nitrate	1	8	mg/L
RBD	RBD-1	5/10/1991	Nitrite + Nitrate	1	7.1	mg/L
RBD	RBD-1	6/11/1991	Nitrite + Nitrate	1	7.7	mg/L
RBD	RBD-1	7/16/1991	Nitrite + Nitrate	1	2.5	mg/L
RBD	RBD-1	8/27/1991	Nitrite + Nitrate		0.01	mg/L
RBD	RBD-1	9/10/1991	Nitrite + Nitrate		0.01	mg/L
RBD	RBD-1	10/9/1991	Nitrite + Nitrate		0.06	mg/L
RBD	RBD-1	4/21/1997	Nitrite + Nitrate	1	7.7	mg/L
RBD	RBD-1	4/21/1997	Nitrite + Nitrate	1	7.8	mg/L
RBD	RBD-1	6/9/1997	Nitrite + Nitrate	1	12	mg/L
RBD	RBD-1	6/9/1997	Nitrite + Nitrate	1	12.3	mg/L
RBD	RBD-1	8/12/1997	Nitrite + Nitrate		1.92	mg/L
RBD	RBD-1	8/12/1997	Nitrite + Nitrate	0	2.1	mg/L
RBD	RBD-1	10/22/1997	Nitrite + Nitrate	1	0.12	mg/L
RBD	RBD-1	10/22/1997	Nitrite + Nitrate	1	0.12	mg/L
RBD	RBD-1	03/28/01	Nitrite + Nitrate	1	9.2	mg/L
RBD	RBD-1	03/28/01	Nitrite + Nitrate	1	9.3	mg/L
RBD	RBD-1	04/19/01	Nitrite + Nitrate	1	12	mg/L
RBD	RBD-1	04/19/01	Nitrite + Nitrate	1	9.8	mg/L
RBD	RBD-1	04/26/01	Nitrite + Nitrate		8.9	mg/L
RBD	RBD-1	04/26/01	Nitrite + Nitrate		8.8	mg/L
RBD	RBD-2	7/2/1977	Nitrite + Nitrate	14	2.4	mg/L
RBD	RBD-2	6/28/1979	Nitrite + Nitrate	10	4.2	mg/L
RBD	RBD-2	9/5/1979	Nitrite + Nitrate	1	3.8	mg/L
RBD	RBD-2	5/18/1983	Nitrite + Nitrate	18	8.8	mg/L
RBD	RBD-2	10/9/1991	Nitrite + Nitrate	0	0.06	mg/L
RBD	RBD-2	4/21/1997	Nitrite + Nitrate	1	7.7	mg/L
RBD	RBD-2	6/9/1997	Nitrite + Nitrate	1	11.2	mg/L
RBD	RBD-2	7/14/1997	Nitrite + Nitrate		6.2	mg/L
RBD	RBD-2	8/12/1997	Nitrite + Nitrate	1	1.78	mg/L
RBD	RBD-2	10/22/1997	Nitrite + Nitrate	1	0.01	mg/L
RBD	RBD-2	03/28/01	Nitrite + Nitrate	1	9.5	mg/L
RBD	RBD-2	04/19/01	Nitrite + Nitrate	1	9.9	mg/L
RBD	RBD-2	04/26/01	Nitrite + Nitrate		9.1	mg/L
RBD	RBD-3	7/2/1977	Nitrite + Nitrate	1	1.2	mg/L
RBD	RBD-3	6/28/1979	Nitrite + Nitrate	1	3.7	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
RBD	RBD-3	9/5/1979	Nitrite + Nitrate	1	3.6	mg/L
RBD	RBD-3	5/18/1983	Nitrite + Nitrate	1	1.3	mg/L
RBD	RBD-3	5/10/1991	Nitrite + Nitrate	17	7.9	mg/L
RBD	RBD-3	6/11/1991	Nitrite + Nitrate	16	8.2	mg/L
RBD	RBD-3	7/16/1991	Nitrite + Nitrate		0.99	mg/L
RBD	RBD-3	4/21/1997	Nitrite + Nitrate	1	7.4	mg/L
RBD	RBD-3	6/9/1997	Nitrite + Nitrate	1	11.3	mg/L
RBD	RBD-3	7/14/1997	Nitrite + Nitrate		5.7	mg/L
RBD	RBD-3	8/12/1997	Nitrite + Nitrate	1	1.11	mg/L
RBD	RBD-3	10/22/1997	Nitrite + Nitrate	1	0.01	mg/L
RBD	RBD-4	6/20/1988	Nitrite + Nitrate	18	0.1	mg/L
RBD	RBD-4	8/27/1991	Nitrite + Nitrate		0.01	mg/L
RBD	RBD-4	9/10/1991	Nitrite + Nitrate		0.01	mg/L
RBD	RBD-4	4/21/1997	Nitrite + Nitrate	1	7.4	mg/L
RBD	RBD-5	03/28/01	Nitrite + Nitrate	1	9.9	mg/L
RBD	RBD-5	04/19/01	Nitrite + Nitrate	1	11	mg/L
RBD	RBD-5	04/26/01	Nitrite + Nitrate		8.6	mg/L
RBD	RBD-T1	06/06/01	Nitrite + Nitrate		6.3	mg/L
RBD	RBD-T2	04/09/01	Nitrite + Nitrate	1	9.2	mg/L
RBD	RBD-T2	04/23/01	Nitrite + Nitrate		11	mg/L
RBD	RBD-T2	05/07/01	Nitrite + Nitrate		8.2	mg/L
RBD	RBD-T2	05/21/01	Nitrite + Nitrate		14	mg/L
RBD	RBD-T2	06/06/01	Nitrite + Nitrate		16	mg/L
RBD	RBD-T2	06/08/01	Nitrite + Nitrate		17	mg/L
RBD	RBD-T2	06/13/01	Nitrite + Nitrate		14	mg/L
RBD	RBD-1	5/1/2003	Nitrite+Nitrate	15	3.77	mg/L
RBD	RBD-1	5/1/2003	Nitrite+Nitrate	9	3.85	mg/L
RBD	RBD-1	5/1/2003	Nitrite+Nitrate	1	4.11	mg/L
RBD	RBD-1	6/18/2003	Nitrite+Nitrate	1	11	mg/L
RBD	RBD-1	6/18/2003	Nitrite+Nitrate	9	11.1	mg/L
RBD	RBD-1	6/18/2003	Nitrite+Nitrate	15	11.3	mg/L
RBD	RBD-1	7/16/2003	Nitrite+Nitrate	15	5.8	mg/L
RBD	RBD-1	7/16/2003	Nitrite+Nitrate	9	5.71	mg/L
RBD	RBD-1	7/16/2003	Nitrite+Nitrate	1	5.52	mg/L
RBD	RBD-1	8/11/2003	Nitrite+Nitrate	14	4.18	mg/L
RBD	RBD-1	8/11/2003	Nitrite+Nitrate	7	4.17	mg/L
RBD	RBD-1	8/11/2003	Nitrite+Nitrate	1	4.14	mg/L
RBD	RBD-1	10/16/2003	Nitrite+Nitrate	15	4.93	mg/L
RBD	RBD-1	10/16/2003	Nitrite+Nitrate	9	5.01	mg/L
RBD	RBD-1	10/16/2003	Nitrite+Nitrate	1	5	mg/L
RBD	RBD-2	5/1/2003	Nitrite+Nitrate	1	3.88	mg/L
RBD	RBD-2	6/18/2003	Nitrite+Nitrate	1	12.5	mg/L
RBD	RBD-2	7/16/2003	Nitrite+Nitrate	1	5.88	mg/L
RBD	RBD-2	8/11/2003	Nitrite+Nitrate	1	3.88	mg/L
RBD	RBD-2	10/16/2003	Nitrite+Nitrate	1	4.91	mg/L
RBD	RBD-5	5/1/2003	Nitrite+Nitrate	1	4.66	mg/L
RBD	RBD-5	6/18/2003	Nitrite+Nitrate	1	14	mg/L
RBD	RBD-5	7/16/2003	Nitrite+Nitrate	1	5.75	mg/L
RBD	RBD-5	8/11/2003	Nitrite+Nitrate	1	3.6	mg/L
RBD	RBD-5	10/16/2003	Nitrite+Nitrate	1	5.2	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	1/19/1978	Nitrogen, Ammonia	1	0.30	mg/L
BPG 09	BPG09	2/28/1978	Nitrogen, Ammonia	1	0.30	mg/L
BPG 09	BPG09	4/13/1978	Nitrogen, Ammonia	1	0.40	mg/L
BPG 09	BPG09	5/11/1978	Nitrogen, Ammonia	1	0.60	mg/L
BPG 09	BPG09	5/31/1978	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	6/14/1978	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	6/28/1978	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	7/11/1978	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	8/2/1978	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	8/23/1978	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	9/13/1978	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	10/11/1978	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	11/15/1978	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	12/6/1978	Nitrogen, Ammonia	1	0.50	mg/L
BPG 09	BPG09	1/10/1979	Nitrogen, Ammonia	1	0.60	mg/L
BPG 09	BPG09	2/6/1979	Nitrogen, Ammonia	1	1.20	mg/L
BPG 09	BPG09	3/7/1979	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	4/2/1979	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	5/1/1979	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	5/31/1979	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	5/31/1979	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	7/9/1979	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	7/9/1979	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	8/1/1979	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	9/13/1979	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	10/4/1979	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	10/4/1979	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	11/5/1979	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	12/5/1979	Nitrogen, Ammonia	1	0.20	mg/L
BPG 09	BPG09	1/10/1980	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	2/14/1980	Nitrogen, Ammonia	1	0.20	mg/L
BPG 09	BPG09	3/31/1980	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	5/2/1980	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	5/2/1980	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	6/4/1980	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	6/17/1980	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	7/7/1980	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	8/11/1980	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	9/10/1980	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	10/2/1980	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	10/27/1980	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	11/24/1980	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	12/22/1980	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	1/22/1981	Nitrogen, Ammonia	1	0.50	mg/L
BPG 09	BPG09	2/18/1981	Nitrogen, Ammonia	1	0.30	mg/L
BPG 09	BPG09	3/19/1981	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	4/16/1981	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	5/21/1981	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	6/23/1981	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	8/4/1981	Nitrogen, Ammonia	1	0.01	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	8/19/1981	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	11/10/1981	Nitrogen, Ammonia	1	0.12	mg/L
BPG 09	BPG09	1/6/1982	Nitrogen, Ammonia	1	0.17	mg/L
BPG 09	BPG09	3/10/1982	Nitrogen, Ammonia	1	0.11	mg/L
BPG 09	BPG09	4/8/1982	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	5/13/1982	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	6/16/1982	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	8/12/1982	Nitrogen, Ammonia	1	0.15	mg/L
BPG 09	BPG09	9/30/1982	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	11/10/1982	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	1/4/1983	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	2/4/1983	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	3/16/1983	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	4/13/1983	Nitrogen, Ammonia	1	0.18	mg/L
BPG 09	BPG09	5/4/1983	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	6/22/1983	Nitrogen, Ammonia	1	0.14	mg/L
BPG 09	BPG09	8/18/1983	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	11/2/1983	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	12/8/1983	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	3/7/1984	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	4/11/1984	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	5/2/1984	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	6/21/1984	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	7/18/1984	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	8/22/1984	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	9/19/1984	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	11/7/1984	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	12/13/1984	Nitrogen, Ammonia	1	0.12	mg/L
BPG 09	BPG09	1/16/1985	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	3/6/1985	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	4/15/1985	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	5/23/1985	Nitrogen, Ammonia	1	0.13	mg/L
BPG 09	BPG09	7/2/1985	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	8/19/1985	Nitrogen, Ammonia	1	0.17	mg/L
BPG 09	BPG09	9/16/1985	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	10/16/1985	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	12/10/1985	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	1/29/1986	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	2/20/1986	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	3/25/1986	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	4/30/1986	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	6/17/1986	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	7/15/1986	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	9/10/1986	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	10/7/1986	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	12/2/1986	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	1/13/1987	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	2/17/1987	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	3/24/1987	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	4/28/1987	Nitrogen, Ammonia	1	0.10	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	6/2/1987	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	7/20/1987	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	9/9/1987	Nitrogen, Ammonia	1	0.14	mg/L
BPG 09	BPG09	11/3/1987	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	12/10/1987	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	1/21/1988	Nitrogen, Ammonia	1	0.18	mg/L
BPG 09	BPG09	3/3/1988	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	4/5/1988	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	5/19/1988	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	6/23/1988	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	8/11/1988	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	9/15/1988	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	11/10/1988	Nitrogen, Ammonia	1	0.21	mg/L
BPG 09	BPG09	12/14/1988	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	1/19/1989	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	2/23/1989	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	4/13/1989	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	5/10/1989	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	6/20/1989	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	8/2/1989	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	9/14/1989	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	11/8/1989	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	12/12/1989	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	1/24/1990	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	2/28/1990	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	3/28/1990	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	5/9/1990	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	7/3/1990	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	8/2/1990	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	9/26/1990	Nitrogen, Ammonia	1	0.04	mg/L
BPG 09	BPG09	10/31/1990	Nitrogen, Ammonia	1	0.02	mg/L
BPG 09	BPG09	12/10/1990	Nitrogen, Ammonia	1	0.03	mg/L
BPG 09	BPG09	1/16/1991	Nitrogen, Ammonia	1	0.20	mg/L
BPG 09	BPG09	3/5/1991	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	4/3/1991	Nitrogen, Ammonia	1	0.02	mg/L
BPG 09	BPG09	5/22/1991	Nitrogen, Ammonia	1	0.05	mg/L
BPG 09	BPG09	6/26/1991	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	8/21/1991	Nitrogen, Ammonia	1	0.08	mg/L
BPG 09	BPG09	9/30/1991	Nitrogen, Ammonia	1	0.04	mg/L
BPG 09	BPG09	11/14/1991	Nitrogen, Ammonia	1	0.02	mg/L
BPG 09	BPG09	12/18/1991	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	2/4/1992	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	3/17/1992	Nitrogen, Ammonia	1	0.17	mg/L
BPG 09	BPG09	6/3/1992	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	7/13/1992	Nitrogen, Ammonia	1	0.05	mg/L
BPG 09	BPG09	8/12/1992	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	9/23/1992	Nitrogen, Ammonia	1	0.02	mg/L
BPG 09	BPG09	11/18/1992	Nitrogen, Ammonia	1	0.07	mg/L
BPG 09	BPG09	12/16/1992	Nitrogen, Ammonia	1	0.07	mg/L
BPG 09	BPG09	2/1/1993	Nitrogen, Ammonia	1	0.08	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	3/9/1993	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	4/7/1993	Nitrogen, Ammonia	1	0.02	mg/L
BPG 09	BPG09	5/24/1993	Nitrogen, Ammonia	1	0.18	mg/L
BPG 09	BPG09	6/28/1993	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	8/18/1993	Nitrogen, Ammonia	1	0.09	mg/L
BPG 09	BPG09	9/28/1993	Nitrogen, Ammonia	1	0.02	mg/L
BPG 09	BPG09	11/15/1993	Nitrogen, Ammonia	1	0.35	mg/L
BPG 09	BPG09	12/20/1993	Nitrogen, Ammonia	1	0.02	mg/L
BPG 09	BPG09	3/2/1994	Nitrogen, Ammonia	1	0.06	mg/L
BPG 09	BPG09	3/29/1994	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	4/28/1994	Nitrogen, Ammonia	1	0.11	mg/L
BPG 09	BPG09	6/30/1994	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	8/15/1994	Nitrogen, Ammonia	1	0.05	mg/L
BPG 09	BPG09	9/6/1994	Nitrogen, Ammonia	1	0.25	mg/L
BPG 09	BPG09	9/26/1994	Nitrogen, Ammonia	1	0.06	mg/L
BPG 09	BPG09	11/2/1994	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	1/4/1995	Nitrogen, Ammonia	1	0.05	mg/L
BPG 09	BPG09	2/1/1995	Nitrogen, Ammonia	1	0.06	mg/L
BPG 09	BPG09	2/27/1995	Nitrogen, Ammonia	1	0.04	mg/L
BPG 09	BPG09	3/29/1995	Nitrogen, Ammonia	1	0.02	mg/L
BPG 09	BPG09	5/11/1995	Nitrogen, Ammonia	1	0.45	mg/L
BPG 09	BPG09	6/14/1995	Nitrogen, Ammonia	1	0.02	mg/L
BPG 09	BPG09	9/7/1995	Nitrogen, Ammonia	1	0.12	mg/L
BPG 09	BPG09	10/16/1995	Nitrogen, Ammonia	1	0.03	mg/L
BPG 09	BPG09	12/12/1995	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	1/29/1996	Nitrogen, Ammonia	1	0.12	mg/L
BPG 09	BPG09	2/29/1996	Nitrogen, Ammonia	1	0.07	mg/L
BPG 09	BPG09	3/28/1996	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	4/19/1996	Nitrogen, Ammonia	1	0.28	mg/L
BPG 09	BPG09	5/20/1996	Nitrogen, Ammonia	1	0.13	mg/L
BPG 09	BPG09	7/18/1996	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	8/26/1996	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	10/28/1996	Nitrogen, Ammonia	1	0.07	mg/L
BPG 09	BPG09	12/16/1996	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	2/4/1997	Nitrogen, Ammonia	1	0.23	mg/L
BPG 09	BPG09	3/4/1997	Nitrogen, Ammonia	1	0.17	mg/L
BPG 09	BPG09	4/2/1997	Nitrogen, Ammonia	1	0.15	mg/L
BPG 09	BPG09	4/30/1997	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	7/9/1997	Nitrogen, Ammonia	1	0.44	mg/L
BPG 09	BPG09	9/9/1997	Nitrogen, Ammonia	1	0.30	mg/L
BPG 09	BPG09	9/26/1997	Nitrogen, Ammonia	1	0.10	mg/L
BPG 09	BPG09	10/30/1997	Nitrogen, Ammonia	1	0.23	mg/L
BPG 09	BPG09	11/19/1997	Nitrogen, Ammonia	1	0.19	mg/L
BPG 09	BPG09	1/6/1998	Nitrogen, Ammonia	1	0.20	mg/L
BPG 09	BPG09	3/13/1998	Nitrogen, Ammonia	1	0.14	mg/L
BPG 09	BPG09	4/28/1998	Nitrogen, Ammonia	1	0.39	mg/L
BPG 09	BPG09	7/1/1998	Nitrogen, Ammonia	1	0.21	mg/L
BPG 09	BPG09	8/4/1998	Nitrogen, Ammonia	1	0.24	mg/L
BPG 09	BPG09	8/31/1998	Nitrogen, Ammonia	1	0.18	mg/L
BPG 09	BPG09	9/28/1998	Nitrogen, Ammonia	1	0.38	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	11/23/1998	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	12/30/1998	Nitrogen, Ammonia	1	0.04	mg/L
BPG 09	BPG09	01/24/00	Nitrogen, Ammonia	1	0.02	mg/L
BPG 09	BPG09	03/03/00	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	05/23/00	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	06/14/00	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	07/26/00	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	09/28/00	Nitrogen, Ammonia	1	0.16	mg/L
BPG 09	BPG09	11/28/00	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	12/28/00	Nitrogen, Ammonia	1	0.05	mg/L
BPG 09	BPG09	01/30/01	Nitrogen, Ammonia	1	1.6	mg/L
BPG 09	BPG09	03/19/01	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	04/18/01	Nitrogen, Ammonia	1	0.03	mg/L
BPG 09	BPG09	05/14/01	Nitrogen, Ammonia	1	0.08	mg/L
BPG 09	BPG09	06/19/01	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	6/28/01	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	08/02/01	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	08/21/01	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	8/21/01	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	10/10/01	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	10/29/01	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	11/08/01	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	12/20/01	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	01/30/02	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	03/04/02	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	04/11/02	Nitrogen, Ammonia	1	0.02	mg/L
BPG 09	BPG09	04/18/02	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	04/24/02	Nitrogen, Ammonia	1	0.03	mg/L
BPG 09	BPG09	05/14/02	Nitrogen, Ammonia	1	0.12	mg/L
BPG 09	BPG09	06/05/02	Nitrogen, Ammonia	1	0.04	mg/L
BPG 09	BPG09	06/05/02	Nitrogen, Ammonia	1	0.33	mg/L
BPG 09	BPG09	07/01/02	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	07/11/02	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	07/24/02	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	08/19/02	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	08/31/02	Nitrogen, Ammonia	1	0.1	mg/L
BPG 09	BPG09	09/20/02	Nitrogen, Ammonia	1	0.08	mg/L
BPG 09	BPG09	09/27/02	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	11/12/02	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	11/14/02	Nitrogen, Ammonia	1	0.05	mg/L
BPG 09	BPG09	12/12/02	Nitrogen, Ammonia	1	0.01	mg/L
BPG 09	BPG09	12/19/02	Nitrogen, Ammonia	1	0.03	mg/L
BPGD	BPGD-H-A1	9/23/2002	Nitrogen, Ammonia		0.30	mg/L
BPGD	BPGD-H-A2	9/23/2002	Nitrogen, Ammonia		0.89	mg/L
BPGD	BPGD-H-C1	9/23/2002	Nitrogen, Ammonia		0.32	mg/L
BPGD	BPGD-H-C2	9/23/2002	Nitrogen, Ammonia		0.22	mg/L
BPGD	BPGD-H-C3	9/23/2002	Nitrogen, Ammonia		0.11	mg/L
BPGD	BPGD-H-D2	9/23/2002	Nitrogen, Ammonia		0.5	mg/L
BPGD	BPGD-H-D3	9/23/2002	Nitrogen, Ammonia		0.03	mg/L
BPGD	BPGD-H-E1	9/23/2002	Nitrogen, Ammonia		0.01	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
RBD	RBD-1	6/28/1979	Nitrogen, Ammonia	14	0.24	mg/L
RBD	RBD-1	6/28/1979	Nitrogen, Ammonia	1	0.06	mg/L
RBD	RBD-1	9/5/1979	Nitrogen, Ammonia	12	0.1	mg/L
RBD	RBD-1	9/5/1979	Nitrogen, Ammonia	1	0.01	mg/L
RBD	RBD-1	5/18/1983	Nitrogen, Ammonia	10	0.1	mg/L
RBD	RBD-1	5/18/1983	Nitrogen, Ammonia	1	0.1	mg/L
RBD	RBD-1	5/10/1991	Nitrogen, Ammonia	1	0.27	mg/L
RBD	RBD-1	6/11/1991	Nitrogen, Ammonia	1	0.07	mg/L
RBD	RBD-1	7/16/1991	Nitrogen, Ammonia	1	0.03	mg/L
RBD	RBD-1	9/10/1991	Nitrogen, Ammonia	1	0.04	mg/L
RBD	RBD-1	10/9/1991	Nitrogen, Ammonia	1	0.22	mg/L
RBD	RBD-1	4/21/1997	Nitrogen, Ammonia	18	0.07	mg/L
RBD	RBD-1	4/21/1997	Nitrogen, Ammonia	1	0.04	mg/L
RBD	RBD-1	6/9/1997	Nitrogen, Ammonia	18	0.21	mg/L
RBD	RBD-1	6/9/1997	Nitrogen, Ammonia	1	0.12	mg/L
RBD	RBD-1	8/12/1997	Nitrogen, Ammonia	17	0.54	mg/L
RBD	RBD-1	8/12/1997	Nitrogen, Ammonia	1	0.5	mg/L
RBD	RBD-1	10/22/1997	Nitrogen, Ammonia	16	0.23	mg/L
RBD	RBD-1	10/22/1997	Nitrogen, Ammonia	1	0.27	mg/L
RBD	RBD-1	03/28/01	Nitrogen, Ammonia		0.07	mg/L
RBD	RBD-1	03/28/01	Nitrogen, Ammonia		0.08	mg/L
RBD	RBD-1	04/19/01	Nitrogen, Ammonia		0.15	mg/L
RBD	RBD-1	04/19/01	Nitrogen, Ammonia		0.17	mg/L
RBD	RBD-1	04/26/01	Nitrogen, Ammonia		0.05	mg/L
RBD	RBD-1	04/26/01	Nitrogen, Ammonia		0.03	mg/L
RBD	RBD-2	07/02/77	Nitrogen, Ammonia	0	0.1	mg/L
RBD	RBD-2	06/28/79	Nitrogen, Ammonia	1	0.03	mg/L
RBD	RBD-2	09/05/79	Nitrogen, Ammonia	1	0.02	mg/L
RBD	RBD-2	05/18/83	Nitrogen, Ammonia	1	0.1	mg/L
RBD	RBD-2	10/09/91	Nitrogen, Ammonia	1	0.2	mg/L
RBD	RBD-2	04/21/97	Nitrogen, Ammonia	1	0.06	mg/L
RBD	RBD-2	06/09/97	Nitrogen, Ammonia	1	0.14	mg/L
RBD	RBD-2	07/14/97	Nitrogen, Ammonia	1	0.06	mg/L
RBD	RBD-2	08/12/97	Nitrogen, Ammonia	1	0.34	mg/L
RBD	RBD-2	10/22/97	Nitrogen, Ammonia	1	0.21	mg/L
RBD	RBD-2	03/28/01	Nitrogen, Ammonia		0.01	mg/L
RBD	RBD-2	04/19/01	Nitrogen, Ammonia		0.24	mg/L
RBD	RBD-2	04/26/01	Nitrogen, Ammonia		0.06	mg/L
RBD	RBD-3	06/28/79	Nitrogen, Ammonia	1	0.02	mg/L
RBD	RBD-3	09/05/79	Nitrogen, Ammonia	1	0.03	mg/L
RBD	RBD-3	05/18/83	Nitrogen, Ammonia	1	0.1	mg/L
RBD	RBD-3	05/10/91	Nitrogen, Ammonia	1	0.29	mg/L
RBD	RBD-3	06/11/91	Nitrogen, Ammonia	1	0.05	mg/L
RBD	RBD-3	07/16/91	Nitrogen, Ammonia	1	0.17	mg/L
RBD	RBD-3	04/21/97	Nitrogen, Ammonia	1	0.13	mg/L
RBD	RBD-3	06/09/97	Nitrogen, Ammonia	1	0.13	mg/L
RBD	RBD-3	07/14/97	Nitrogen, Ammonia	1	0.09	mg/L
RBD	RBD-3	08/12/97	Nitrogen, Ammonia	1	0.45	mg/L
RBD	RBD-3	10/22/97	Nitrogen, Ammonia	1	0.21	mg/L
RBD	RBD-4	06/20/88	Nitrogen, Ammonia	1	0.01	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
RBD	RBD-4	08/27/91	Nitrogen, Ammonia	1	0.03	mg/L
RBD	RBD-4	09/10/91	Nitrogen, Ammonia	1	0.08	mg/L
RBD	RBD-4	04/21/97	Nitrogen, Ammonia	1	0.07	mg/L
RBD	RBD-5	03/28/01	Nitrogen, Ammonia		0.06	mg/L
RBD	RBD-5	04/19/01	Nitrogen, Ammonia		0.14	mg/L
RBD	RBD-5	04/26/01	Nitrogen, Ammonia		0.08	mg/L
RBD	RBD-T1	06/06/01	Nitrogen, Ammonia		0.01	mg/L
RBD	RBD-T2	04/09/01	Nitrogen, Ammonia		0.05	mg/L
RBD	RBD-T2	04/23/01	Nitrogen, Ammonia		0.05	mg/L
RBD	RBD-T2	05/07/01	Nitrogen, Ammonia		0.14	mg/L
RBD	RBD-T2	05/21/01	Nitrogen, Ammonia		0.32	mg/L
RBD	RBD-T2	06/06/01	Nitrogen, Ammonia		0.06	mg/L
RBD	RBD-T2	06/08/01	Nitrogen, Ammonia		0.03	mg/L
RBD	RBD-T2	06/13/01	Nitrogen, Ammonia		0.01	mg/L
BPGD	BPGD-H-A1	9/23/2002	pH (field)		7.2	unit
BPGD	BPGD-H-A2	9/23/2002	pH (field)		7.6	unit
BPGD	BPGD-H-C1	9/23/2002	pH (field)		7.6	unit
BPGD	BPGD-H-C2	9/23/2002	pH (field)		7.9	unit
BPGD	BPGD-H-C3	9/23/2002	pH (field)		8.0	unit
BPGD	BPGD-H-D2	9/23/2002	pH (field)		8.0	unit
BPGD	BPGD-H-D3	9/23/2002	pH (field)		7.8	unit
BPGD	BPGD-H-E1	9/23/2002	pH (field)		7.7	unit
BPG 09	BPG09	1/19/1978	Total Phosphorus	1	0.07	mg/L
BPG 09	BPG09	2/28/1978	Total Phosphorus	1	0.12	mg/L
BPG 09	BPG09	4/13/1978	Total Phosphorus	1	0.09	mg/L
BPG 09	BPG09	5/11/1978	Total Phosphorus	1	0.07	mg/L
BPG 09	BPG09	5/31/1978	Total Phosphorus	1	0.07	mg/L
BPG 09	BPG09	6/14/1978	Total Phosphorus	1	0.10	mg/L
BPG 09	BPG09	7/11/1978	Total Phosphorus	1	0.18	mg/L
BPG 09	BPG09	8/23/1978	Total Phosphorus	1	0.3	mg/L
BPG 09	BPG09	9/13/1978	Total Phosphorus	1	0.41	mg/L
BPG 09	BPG09	10/11/1978	Total Phosphorus	1	0.32	mg/L
BPG 09	BPG09	11/15/1978	Total Phosphorus	1	0.34	mg/L
BPG 09	BPG09	12/6/1978	Total Phosphorus	1	0.31	mg/L
BPG 09	BPG09	1/10/1979	Total Phosphorus	1	0.18	mg/L
BPG 09	BPG09	2/6/1979	Total Phosphorus	1	0.32	mg/L
BPG 09	BPG09	3/7/1979	Total Phosphorus	1	0.78	mg/L
BPG 09	BPG09	4/2/1979	Total Phosphorus	1	0.09	mg/L
BPG 09	BPG09	5/1/1979	Total Phosphorus	1	0.08	mg/L
BPG 09	BPG09	5/31/1979	Total Phosphorus	1	0.08	mg/L
BPG 09	BPG09	5/31/1979	Total Phosphorus	1	0.07	mg/L
BPG 09	BPG09	7/9/1979	Total Phosphorus	1	0.18	mg/L
BPG 09	BPG09	7/9/1979	Total Phosphorus	1	0.18	mg/L
BPG 09	BPG09	8/1/1979	Total Phosphorus	1	0.22	mg/L
BPG 09	BPG09	9/13/1979	Total Phosphorus	1	0.19	mg/L
BPG 09	BPG09	10/4/1979	Total Phosphorus	1	0.18	mg/L
BPG 09	BPG09	10/4/1979	Total Phosphorus	1	0.18	mg/L
BPG 09	BPG09	2/14/1980	Total Phosphorus	1	0.2	mg/L
BPG 09	BPG09	3/31/1980	Total Phosphorus	1	0.65	mg/L
BPG 09	BPG09	5/2/1980	Total Phosphorus	1	0.12	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	5/2/1980	Total Phosphorus	1	0.12	mg/L
BPG 09	BPG09	6/4/1980	Total Phosphorus	1	0.67	mg/L
BPG 09	BPG09	7/7/1980	Total Phosphorus	1	0.16	mg/L
BPG 09	BPG09	8/11/1980	Total Phosphorus	1	0.2	mg/L
BPG 09	BPG09	4/11/1984	Total Phosphorus	1	0.04	mg/L
BPG 09	BPG09	5/2/1984	Total Phosphorus	1	0.03	mg/L
BPG 09	BPG09	6/21/1984	Total Phosphorus	1	0.07	mg/L
BPG 09	BPG09	7/18/1984	Total Phosphorus	1	0.11	mg/L
BPG 09	BPG09	8/22/1984	Total Phosphorus	1	0.13	mg/L
BPG 09	BPG09	9/19/1984	Total Phosphorus	1	0.11	mg/L
BPG 09	BPG09	11/7/1984	Total Phosphorus	1	0.11	mg/L
BPG 09	BPG09	12/13/1984	Total Phosphorus	1	0.06	mg/L
BPG 09	BPG09	1/16/1985	Total Phosphorus	1	0.04	mg/L
BPG 09	BPG09	3/6/1985	Total Phosphorus	1	0.14	mg/L
BPG 09	BPG09	4/15/1985	Total Phosphorus	1	0.05	mg/L
BPG 09	BPG09	5/23/1985	Total Phosphorus	1	0.06	mg/L
BPG 09	BPG09	7/2/1985	Total Phosphorus	1	0.13	mg/L
BPG 09	BPG09	8/19/1985	Total Phosphorus	1	0.15	mg/L
BPG 09	BPG09	9/16/1985	Total Phosphorus	1	0.17	mg/L
BPG 09	BPG09	10/16/1985	Total Phosphorus	1	0.19	mg/L
BPG 09	BPG09	12/10/1985	Total Phosphorus	1	0.06	mg/L
BPG 09	BPG09	1/29/1986	Total Phosphorus	1	0.04	mg/L
BPG 09	BPG09	2/20/1986	Total Phosphorus	1	0.13	mg/L
BPG 09	BPG09	3/25/1986	Total Phosphorus	1	0.02	mg/L
BPG 09	BPG09	4/30/1986	Total Phosphorus	1	0.1	mg/L
BPG 09	BPG09	6/17/1986	Total Phosphorus	1	0.22	mg/L
BPG 09	BPG09	7/15/1986	Total Phosphorus	1	0.13	mg/L
BPG 09	BPG09	9/10/1986	Total Phosphorus	1	0.08	mg/L
BPG 09	BPG09	10/7/1986	Total Phosphorus	1	0.13	mg/L
BPG 09	BPG09	12/2/1986	Total Phosphorus	1	0.19	mg/L
BPG 09	BPG09	1/13/1987	Total Phosphorus	1	0.03	mg/L
BPG 09	BPG09	2/17/1987	Total Phosphorus	1	0.05	mg/L
BPG 09	BPG09	3/24/1987	Total Phosphorus	1	0.02	mg/L
BPG 09	BPG09	4/28/1987	Total Phosphorus	1	0.04	mg/L
BPG 09	BPG09	6/2/1987	Total Phosphorus	1	0.13	mg/L
BPG 09	BPG09	7/20/1987	Total Phosphorus	1	0.11	mg/L
BPG 09	BPG09	9/9/1987	Total Phosphorus	1	0.12	mg/L
BPG 09	BPG09	11/3/1987	Total Phosphorus	1	0.21	mg/L
BPG 09	BPG09	12/10/1987	Total Phosphorus	1	0.13	mg/L
BPG 09	BPG09	1/21/1988	Total Phosphorus	1	0.46	mg/L
BPG 09	BPG09	3/3/1988	Total Phosphorus	1	0.03	mg/L
BPG 09	BPG09	4/5/1988	Total Phosphorus	1	0.08	mg/L
BPG 09	BPG09	5/19/1988	Total Phosphorus	1	0.07	mg/L
BPG 09	BPG09	6/23/1988	Total Phosphorus	1	0.15	mg/L
BPG 09	BPG09	8/11/1988	Total Phosphorus	1	2.2	mg/L
BPG 09	BPG09	9/15/1988	Total Phosphorus	1	0.14	mg/L
BPG 09	BPG09	11/10/1988	Total Phosphorus	1	0.32	mg/L
BPG 09	BPG09	12/14/1988	Total Phosphorus	1	0.06	mg/L
BPG 09	BPG09	1/19/1989	Total Phosphorus	1	0.03	mg/L
BPG 09	BPG09	2/23/1989	Total Phosphorus	1	0.03	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	4/13/1989	Total Phosphorus	1	0.03	mg/L
BPG 09	BPG09	5/10/1989	Total Phosphorus	1	0.1	mg/L
BPG 09	BPG09	6/20/1989	Total Phosphorus	1	0.09	mg/L
BPG 09	BPG09	8/2/1989	Total Phosphorus	1	0.12	mg/L
BPG 09	BPG09	9/14/1989	Total Phosphorus	1	0.15	mg/L
BPG 09	BPG09	11/8/1989	Total Phosphorus	1	0.062	mg/L
BPG 09	BPG09	12/12/1989	Total Phosphorus	1	0.03	mg/L
BPG 09	BPG09	1/24/1990	Total Phosphorus	1	0.03	mg/L
BPG 09	BPG09	2/28/1990	Total Phosphorus	1	0.16	mg/L
BPG 09	BPG09	3/28/1990	Total Phosphorus	1	0.05	mg/L
BPG 09	BPG09	5/9/1990	Total Phosphorus	1	0.06	mg/L
BPG 09	BPG09	7/3/1990	Total Phosphorus	1	0.12	mg/L
BPG 09	BPG09	8/2/1990	Total Phosphorus	1	0.111	mg/L
BPG 09	BPG09	9/26/1990	Total Phosphorus	1	0.1	mg/L
BPG 09	BPG09	10/31/1990	Total Phosphorus	1	0.04	mg/L
BPG 09	BPG09	12/10/1990	Total Phosphorus	1	0.02	mg/L
BPG 09	BPG09	1/16/1991	Total Phosphorus	1	0.4	mg/L
BPG 09	BPG09	3/5/1991	Total Phosphorus	1	0.03	mg/L
BPG 09	BPG09	4/3/1991	Total Phosphorus	1	0.037	mg/L
BPG 09	BPG09	5/22/1991	Total Phosphorus	1	0.14	mg/L
BPG 09	BPG09	6/26/1991	Total Phosphorus	1	0.066	mg/L
BPG 09	BPG09	8/21/1991	Total Phosphorus	1	0.093	mg/L
BPG 09	BPG09	9/30/1991	Total Phosphorus	1	0.05	mg/L
BPG 09	BPG09	11/14/1991	Total Phosphorus	1	0.05	mg/L
BPG 09	BPG09	12/18/1991	Total Phosphorus	1	0.05	mg/L
BPG 09	BPG09	2/4/1992	Total Phosphorus	1	0.03	mg/L
BPG 09	BPG09	3/17/1992	Total Phosphorus	1	0.02	mg/L
BPG 09	BPG09	6/3/1992	Total Phosphorus	1	0.05	mg/L
BPG 09	BPG09	7/13/1992	Total Phosphorus	1	0.21	mg/L
BPG 09	BPG09	8/12/1992	Total Phosphorus	1	0.06	mg/L
BPG 09	BPG09	9/23/1992	Total Phosphorus	1	0.08	mg/L
BPG 09	BPG09	11/18/1992	Total Phosphorus	1	0.08	mg/L
BPG 09	BPG09	12/16/1992	Total Phosphorus	1	0.26	mg/L
BPG 09	BPG09	2/1/1993	Total Phosphorus	1	0.05	mg/L
BPG 09	BPG09	3/9/1993	Total Phosphorus	1	0.17	mg/L
BPG 09	BPG09	4/7/1993	Total Phosphorus	1	0.04	mg/L
BPG 09	BPG09	5/24/1993	Total Phosphorus	1	0.23	mg/L
BPG 09	BPG09	6/28/1993	Total Phosphorus	1	0.09	mg/L
BPG 09	BPG09	8/18/1993	Total Phosphorus	1	0.08	mg/L
BPG 09	BPG09	9/28/1993	Total Phosphorus	1	0.154	mg/L
BPG 09	BPG09	11/15/1993	Total Phosphorus	1	0.22	mg/L
BPG 09	BPG09	12/20/1993	Total Phosphorus	1	0.06	mg/L
BPG 09	BPG09	3/2/1994	Total Phosphorus	1	0.098	mg/L
BPG 09	BPG09	3/29/1994	Total Phosphorus	1	0.04	mg/L
BPG 09	BPG09	4/28/1994	Total Phosphorus	1	0.22	mg/L
BPG 09	BPG09	6/30/1994	Total Phosphorus	1	0.08	mg/L
BPG 09	BPG09	8/15/1994	Total Phosphorus	1	0.1	mg/L
BPG 09	BPG09	9/6/1994	Total Phosphorus	1	0.13	mg/L
BPG 09	BPG09	9/26/1994	Total Phosphorus	1	0.16	mg/L
BPG 09	BPG09	11/2/1994	Total Phosphorus	1	0.42	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	1/4/1995	Total Phosphorus	1	0.08	mg/L
BPG 09	BPG09	2/1/1995	Total Phosphorus	1	0.03	mg/L
BPG 09	BPG09	2/27/1995	Total Phosphorus	1	0.04	mg/L
BPG 09	BPG09	3/29/1995	Total Phosphorus	1	0.022	mg/L
BPG 09	BPG09	5/11/1995	Total Phosphorus	1	0.09	mg/L
BPG 09	BPG09	6/14/1995	Total Phosphorus	1	0.08	mg/L
BPG 09	BPG09	9/7/1995	Total Phosphorus	1	0.11	mg/L
BPG 09	BPG09	10/16/1995	Total Phosphorus	1	0.08	mg/L
BPG 09	BPG09	12/12/1995	Total Phosphorus	1	0.12	mg/L
BPG 09	BPG09	1/29/1996	Total Phosphorus	1	0.082	mg/L
BPG 09	BPG09	2/29/1996	Total Phosphorus	1	0.06	mg/L
BPG 09	BPG09	3/28/1996	Total Phosphorus	1	0.03	mg/L
BPG 09	BPG09	4/19/1996	Total Phosphorus	1	0.06	mg/L
BPG 09	BPG09	5/20/1996	Total Phosphorus	1	0.12	mg/L
BPG 09	BPG09	7/18/1996	Total Phosphorus	1	0.07	mg/L
BPG 09	BPG09	8/26/1996	Total Phosphorus	1	0.1	mg/L
BPG 09	BPG09	10/28/1996	Total Phosphorus	1	0.13	mg/L
BPG 09	BPG09	12/16/1996	Total Phosphorus	1	0.09	mg/L
BPG 09	BPG09	2/4/1997	Total Phosphorus	1	0.5	mg/L
BPG 09	BPG09	3/4/1997	Total Phosphorus	1	0.16	mg/L
BPG 09	BPG09	4/2/1997	Total Phosphorus	1	0.02	mg/L
BPG 09	BPG09	4/30/1997	Total Phosphorus	1	0.02	mg/L
BPG 09	BPG09	7/9/1997	Total Phosphorus	1	0.1	mg/L
BPG 09	BPG09	9/9/1997	Total Phosphorus	1	0.1	mg/L
BPG 09	BPG09	9/26/1997	Total Phosphorus	1	0.1	mg/L
BPG 09	BPG09	10/30/1997	Total Phosphorus	1	0.05	mg/L
BPG 09	BPG09	11/19/1997	Total Phosphorus	1	0.03	mg/L
BPG 09	BPG09	1/6/1998	Total Phosphorus	1	0.1	mg/L
BPG 09	BPG09	3/13/1998	Total Phosphorus	1	0.06	mg/L
BPG 09	BPG09	4/28/1998	Total Phosphorus	1	0.03	mg/L
BPG 09	BPG09	7/1/1998	Total Phosphorus	1	0.19	mg/L
BPG 09	BPG09	8/4/1998	Total Phosphorus	1	0.35	mg/L
BPG 09	BPG09	8/31/1998	Total Phosphorus	1	0.09	mg/L
BPG 09	BPG09	9/28/1998	Total Phosphorus	1	0.16	mg/L
BPG 09	BPG09	11/23/1998	Total Phosphorus	1	0.02	mg/L
BPG 09	BPG09	12/30/1998	Total Phosphorus	1	0.11	mg/L
BPG 09	BPG09	1/24/2000	Total Phosphorus	1	3	mg/L
BPG 09	BPG09	3/3/2000	Total Phosphorus	1	0.07	mg/L
BPG 09	BPG09	5/23/2000	Total Phosphorus	1	0.11	mg/L
BPG 09	BPG09	6/14/2000	Total Phosphorus	1	0.09	mg/L
BPG 09	BPG09	7/26/2000	Total Phosphorus	1	0.06	mg/L
BPG 09	BPG09	9/28/2000	Total Phosphorus	1	0.24	mg/L
BPG 09	BPG09	11/28/2000	Total Phosphorus	1	0.1	mg/L
BPG 09	BPG09	12/28/2000	Total Phosphorus	1	0.15	mg/L
BPG 09	BPG09	1/30/2001	Total Phosphorus	1	1.8	mg/L
BPG 09	BPG09	3/19/2001	Total Phosphorus	1	0.05	mg/L
BPG 09	BPG09	4/18/2001	Total Phosphorus	1	0.04	mg/L
BPG 09	BPG09	5/14/2001	Total Phosphorus	1	0.1	mg/L
BPG 09	BPG09	6/19/2001	Total Phosphorus	1	0.08	mg/L
BPG 09	BPG09	8/2/2001	Total Phosphorus	1	0.14	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	8/21/2001	Total Phosphorus	1	0.27	mg/L
BPG 09	BPG09	10/29/2001	Total Phosphorus	1	0.11	mg/L
BPG 09	BPG09	11/8/2001	Total Phosphorus	1	0.05	mg/L
BPG 09	BPG09	12/20/2001	Total Phosphorus	1	0.11	mg/L
BPG 09	BPG09	1/30/2002	Total Phosphorus	1	0.1	mg/L
BPG 09	BPG09	3/4/2002	Total Phosphorus	1	0.12	mg/L
BPG 09	BPG09	4/11/2002	Total Phosphorus	1	0.05	mg/L
BPG 09	BPG09	4/18/2002	Total Phosphorus	1	0.04	mg/L
BPG 09	BPG09	4/24/2002	Total Phosphorus	1	0.03	mg/L
BPG 09	BPG09	5/14/2002	Total Phosphorus	1	0.26	mg/L
BPG 09	BPG09	6/5/2002	Total Phosphorus	1	0.11	mg/L
BPG 09	BPG09	6/5/2002	Total Phosphorus	1	0.8	mg/L
BPG 09	BPG09	7/1/2002	Total Phosphorus	1	0.06	mg/L
BPG 09	BPG09	7/11/2002	Total Phosphorus	1	0.11	mg/L
BPG 09	BPG09	7/24/2002	Total Phosphorus	1	0.22	mg/L
BPG 09	BPG09	8/19/2002	Total Phosphorus	1	0.4	mg/L
BPG 09	BPG09	8/31/2002	Total Phosphorus	1	0.14	mg/L
BPG 09	BPG09	9/20/2002	Total Phosphorus	1	0.09	mg/L
BPG 09	BPG09	9/27/2002	Total Phosphorus	1	0.09	mg/L
BPG 09	BPG09	11/12/2002	Total Phosphorus	1	0.09	mg/L
BPG 09	BPG09	11/14/2002	Total Phosphorus	1	0.1	mg/L
BPG 09	BPG09	12/12/2002	Total Phosphorus	1	0.04	mg/L
BPG 09	BPG09	12/19/2002	Total Phosphorus	1	0.3	mg/L
BPGD	BPGD-H-A1	9/23/2002	Total Phosphorus		0.08	mg/L
BPGD	BPGD-H-A2	9/23/2002	Total Phosphorus		0.52	mg/L
BPGD	BPGD-H-C1	9/23/2002	Total Phosphorus		1.91	mg/L
BPGD	BPGD-H-C2	9/23/2002	Total Phosphorus		1.68	mg/L
BPGD	BPGD-H-C3	9/23/2002	Total Phosphorus		0.41	mg/L
BPGD	BPGD-H-D2	9/23/2002	Total Phosphorus		0.58	mg/L
BPGD	BPGD-H-D3	9/23/2002	Total Phosphorus		0.04	mg/L
BPGD	BPGD-H-E1	9/23/2002	Total Phosphorus		2.54	mg/L
RBD	RBD-1	7/2/1977	Total Phosphorus	0	0.06	mg/L
RBD	RBD-1	6/28/1979	Total Phosphorus	1	0.05	mg/L
RBD	RBD-1	6/28/1979	Total Phosphorus	14	0.08	mg/L
RBD	RBD-1	9/5/1979	Total Phosphorus	1	0.05	mg/L
RBD	RBD-1	9/5/1979	Total Phosphorus	12	0.05	mg/L
RBD	RBD-1	5/18/1983	Total Phosphorus	1	0.11	mg/L
RBD	RBD-1	5/18/1983	Total Phosphorus	10	0.123	mg/L
RBD	RBD-1	5/10/1991	Total Phosphorus	1	0.02	mg/L
RBD	RBD-1	6/11/1991	Total Phosphorus	1	0.124	mg/L
RBD	RBD-1	7/16/1991	Total Phosphorus	1	0.07	mg/L
RBD	RBD-1	8/27/1991	Total Phosphorus	1	0.095	mg/L
RBD	RBD-1	9/10/1991	Total Phosphorus	1	0.116	mg/L
RBD	RBD-1	10/9/1991	Total Phosphorus	1	0.149	mg/L
RBD	RBD-1	4/21/1997	Total Phosphorus	1	0.04	mg/L
RBD	RBD-1	4/21/1997	Total Phosphorus	18	0.033	mg/L
RBD	RBD-1	6/9/1997	Total Phosphorus	1	0.107	mg/L
RBD	RBD-1	6/9/1997	Total Phosphorus	18	0.106	mg/L
RBD	RBD-1	8/12/1997	Total Phosphorus	1	0.084	mg/L
RBD	RBD-1	8/12/1997	Total Phosphorus	17	0.101	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
RBD	RBD-1	10/22/1997	Total Phosphorus	1	0.096	mg/L
RBD	RBD-1	10/22/1997	Total Phosphorus	16	0.082	mg/L
RBD	RBD-1	03/28/01	Total Phosphorus		0.081	mg/L
RBD	RBD-1	03/28/01	Total Phosphorus		0.084	mg/L
RBD	RBD-1	04/19/01	Total Phosphorus		0.087	mg/L
RBD	RBD-1	04/19/01	Total Phosphorus		0.112	mg/L
RBD	RBD-1	04/26/01	Total Phosphorus		0.062	mg/L
RBD	RBD-1	04/26/01	Total Phosphorus		0.069	mg/L
RBD	RBD-2	7/2/1977	Total Phosphorus	0	0.11	mg/L
RBD	RBD-2	6/28/1979	Total Phosphorus	1	0.28	mg/L
RBD	RBD-2	9/5/1979	Total Phosphorus	1	0.06	mg/L
RBD	RBD-2	5/18/1983	Total Phosphorus	1	0.114	mg/L
RBD	RBD-2	10/9/1991	Total Phosphorus	1	0.213	mg/L
RBD	RBD-2	4/21/1997	Total Phosphorus	1	0.035	mg/L
RBD	RBD-2	6/9/1997	Total Phosphorus	1	0.244	mg/L
RBD	RBD-2	7/14/1997	Total Phosphorus	1	0.054	mg/L
RBD	RBD-2	8/12/1997	Total Phosphorus	1	0.069	mg/L
RBD	RBD-2	10/22/1997	Total Phosphorus	1	0.073	mg/L
RBD	RBD-2	03/28/01	Total Phosphorus		0.072	mg/L
RBD	RBD-2	04/19/01	Total Phosphorus		0.098	mg/L
RBD	RBD-2	04/26/01	Total Phosphorus		0.066	mg/L
RBD	RBD-3	7/2/1977	Total Phosphorus	0	0.3	mg/L
RBD	RBD-3	6/28/1979	Total Phosphorus	1	0.24	mg/L
RBD	RBD-3	9/5/1979	Total Phosphorus	1	0.16	mg/L
RBD	RBD-3	5/18/1983	Total Phosphorus	1	0.098	mg/L
RBD	RBD-3	5/10/1991	Total Phosphorus	1	0.059	mg/L
RBD	RBD-3	6/11/1991	Total Phosphorus	1	0.11	mg/L
RBD	RBD-3	7/16/1991	Total Phosphorus	1	0.144	mg/L
RBD	RBD-3	4/21/1997	Total Phosphorus	1	0.035	mg/L
RBD	RBD-3	6/9/1997	Total Phosphorus	1	0.304	mg/L
RBD	RBD-3	7/14/1997	Total Phosphorus	1	0.083	mg/L
RBD	RBD-3	8/12/1997	Total Phosphorus	1	0.142	mg/L
RBD	RBD-3	10/22/1997	Total Phosphorus	1	0.102	mg/L
RBD	RBD-4	6/20/1988	Total Phosphorus	1	0.265	mg/L
RBD	RBD-4	8/27/1991	Total Phosphorus	1	0.222	mg/L
RBD	RBD-4	9/10/1991	Total Phosphorus	1	0.255	mg/L
RBD	RBD-4	4/21/1997	Total Phosphorus	1	0.036	mg/L
RBD	RBD-5	03/28/01	Total Phosphorus		0.029	mg/L
RBD	RBD-5	04/19/01	Total Phosphorus		0.071	mg/L
RBD	RBD-5	04/26/01	Total Phosphorus		0.091	mg/L
RBD	RBD-T1	06/06/01	Total Phosphorus		0.039	mg/L
RBD	RBD-T2	04/09/01	Total Phosphorus		0.046	mg/L
RBD	RBD-T2	04/23/01	Total Phosphorus		0.06	mg/L
RBD	RBD-T2	05/07/01	Total Phosphorus		0.08	mg/L
RBD	RBD-T2	05/21/01	Total Phosphorus		0.099	mg/L
RBD	RBD-T2	06/06/01	Total Phosphorus		0.282	mg/L
RBD	RBD-T2	06/08/01	Total Phosphorus		0.131	mg/L
RBD	RBD-T2	06/13/01	Total Phosphorus		0.082	mg/L
RBD	RBD-1	7/16/2003	Total Phosphorus	15	0.176	mg/L
RBD	RBD-1	7/16/2003	Total Phosphorus	9	0.17	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
RBD	RBD-1	7/16/2003	Total Phosphorus	1	0.169	mg/L
RBD	RBD-1	8/11/2003	Total Phosphorus	14	0.046	mg/L
RBD	RBD-1	8/11/2003	Total Phosphorus	7	0.083	mg/L
RBD	RBD-1	8/11/2003	Total Phosphorus	1	0.058	mg/L
RBD	RBD-1	10/16/2003	Total Phosphorus	15	0.062	mg/L
RBD	RBD-1	10/16/2003	Total Phosphorus	9	0.064	mg/L
RBD	RBD-1	10/16/2003	Total Phosphorus	1	0.069	mg/L
RBD	RBD-2	7/16/2003	Total Phosphorus	1	0.153	mg/L
RBD	RBD-2	8/11/2003	Total Phosphorus	1	0.064	mg/L
RBD	RBD-2	10/16/2003	Total Phosphorus	1	0.083	mg/L
RBD	RBD-5	7/16/2003	Total Phosphorus	1	0.168	mg/L
RBD	RBD-5	8/11/2003	Total Phosphorus	1	0.103	mg/L
RBD	RBD-5	10/16/2003	Total Phosphorus	1	0.07	mg/L
RBD	RBD-1	6/18/2003	Total Phosphorus	1	0.202	mg/L
RBD	RBD-1	6/18/2003	Total Phosphorus	9	0.183	mg/L
RBD	RBD-1	6/18/2003	Total Phosphorus	15	0.192	mg/L
RBD	RBD-2	6/18/2003	Total Phosphorus	1	0.196	mg/L
RBD	RBD-5	6/18/2003	Total Phosphorus	1	0.131	mg/L
BPG 09	BPG09	3/9/2000	Total Suspended Solids	1	16.14	mg/L
BPG 09	BPG09	3/29/2000	Total Suspended Solids	1	11.97	mg/L
BPG 09	BPG09	4/4/2000	Total Suspended Solids	1	6.92	mg/L
BPG 09	BPG09	4/10/2000	Total Suspended Solids	1	31.82	mg/L
BPG 09	BPG09	4/17/2000	Total Suspended Solids	1	20.08	mg/L
BPG 09	BPG09	4/24/2000	Total Suspended Solids	1	12.51	mg/L
BPG 09	BPG09	5/1/2000	Total Suspended Solids	1	10.74	mg/L
BPG 09	BPG09	5/8/2000	Total Suspended Solids	1	12.02	mg/L
BPG 09	BPG09	5/17/2000	Total Suspended Solids	1	30.52	mg/L
BPG 09	BPG09	5/22/2000	Total Suspended Solids	1	29.75	mg/L
BPG 09	BPG09	5/28/2000	Total Suspended Solids	1	158.34	mg/L
BPG 09	BPG09	5/29/2000	Total Suspended Solids	1	114.22	mg/L
BPG 09	BPG09	5/30/2000	Total Suspended Solids	1	80.98	mg/L
BPG 09	BPG09	6/1/2000	Total Suspended Solids	1	66.27	mg/L
BPG 09	BPG09	6/7/2000	Total Suspended Solids	1	21.97	mg/L
BPG 09	BPG09	6/12/2000	Total Suspended Solids	1	31.82	mg/L
BPG 09	BPG09	6/19/2000	Total Suspended Solids	1	67.35	mg/L
BPG 09	BPG09	6/26/2000	Total Suspended Solids	1	92.43	mg/L
BPG 09	BPG09	7/5/2000	Total Suspended Solids	1	301.97	mg/L
BPG 09	BPG09	7/11/2000	Total Suspended Solids	1	144.33	mg/L
BPG 09	BPG09	7/17/2000	Total Suspended Solids	1	117.36	mg/L
BPG 09	BPG09	7/24/2000	Total Suspended Solids	1	101.45	mg/L
BPG 09	BPG09	7/31/2000	Total Suspended Solids	1	32.35	mg/L
BPG 09	BPG09	8/8/2000	Total Suspended Solids	1	31.75	mg/L
BPG 09	BPG09	8/14/2000	Total Suspended Solids	1	74.11	mg/L
BPG 09	BPG09	8/22/2000	Total Suspended Solids	1	10.78	mg/L
BPG 09	BPG09	8/29/2000	Total Suspended Solids	1	11.48	mg/L
BPG 09	BPG09	9/5/2000	Total Suspended Solids	1	14.53	mg/L
BPG 09	BPG09	9/12/2000	Total Suspended Solids	1	18.67	mg/L
BPG 09	BPG09	9/18/2000	Total Suspended Solids	1	11.49	mg/L
BPG 09	BPG09	9/25/2000	Total Suspended Solids	1	17.62	mg/L
BPG 09	BPG09	10/2/2000	Total Suspended Solids	1	9.73	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	10/10/2000	Total Suspended Solids	1	4.05	mg/L
BPG 09	BPG09	10/17/2000	Total Suspended Solids	1	55.85	mg/L
BPG 09	BPG09	10/24/2000	Total Suspended Solids	1	22.06	mg/L
BPG 09	BPG09	10/30/2000	Total Suspended Solids	1	16.36	mg/L
BPG 09	BPG09	11/6/2000	Total Suspended Solids	1	94.83	mg/L
BPG 09	BPG09	11/13/2000	Total Suspended Solids	1	17.52	mg/L
BPG 09	BPG09	11/20/2000	Total Suspended Solids	1	104.54	mg/L
BPG 09	BPG09	11/27/2000	Total Suspended Solids	1	72.61	mg/L
BPG 09	BPG09	12/4/2000	Total Suspended Solids	1	144.57	mg/L
BPG 09	BPG09	12/14/2000	Total Suspended Solids	1	132.36	mg/L
BPG 09	BPG09	12/18/2000	Total Suspended Solids	1	115.55	mg/L
BPG 09	BPG09	1/2/2001	Total Suspended Solids	1	111.26	mg/L
BPG 09	BPG09	2/5/2001	Total Suspended Solids	1	20.6	mg/L
BPG 09	BPG09	2/9/2001	Total Suspended Solids	1	292.23	mg/L
BPG 09	BPG09	2/10/2001	Total Suspended Solids	1	256.19	mg/L
BPG 09	BPG09	2/12/2001	Total Suspended Solids	1	47.72	mg/L
BPG 09	BPG09	2/13/2001	Total Suspended Solids	1	37.07	mg/L
BPG 09	BPG09	2/20/2001	Total Suspended Solids	1	42.72	mg/L
BPG 09	BPG09	2/25/2001	Total Suspended Solids	1	1680.57	mg/L
BPG 09	BPG09	2/26/2001	Total Suspended Solids	1	295.03	mg/L
BPG 09	BPG09	2/27/2001	Total Suspended Solids	1	186.73	mg/L
BPG 09	BPG09	2/28/2001	Total Suspended Solids	1	105.65	mg/L
BPG 09	BPG09	3/1/2001	Total Suspended Solids	1	68.13	mg/L
BPG 09	BPG09	3/5/2001	Total Suspended Solids	1	40.49	mg/L
BPG 09	BPG09	3/12/2001	Total Suspended Solids	1	118.56	mg/L
BPG 09	BPG09	3/19/2001	Total Suspended Solids	1	104.5	mg/L
BPG 09	BPG09	3/26/2001	Total Suspended Solids	1	81.71	mg/L
BPG 09	BPG09	4/2/2001	Total Suspended Solids	1	74.11	mg/L
BPG 09	BPG09	4/16/2001	Total Suspended Solids	1	67.21	mg/L
BPG 09	BPG09	4/23/2001	Total Suspended Solids	1	94.87	mg/L
BPG 09	BPG09	4/30/2001	Total Suspended Solids	1	82.71	mg/L
BPG 09	BPG09	5/7/2001	Total Suspended Solids	1	38.89	mg/L
BPG 09	BPG09	5/14/2001	Total Suspended Solids	1	74.21	mg/L
BPG 09	BPG09	5/21/2001	Total Suspended Solids	1	81.72	mg/L
BPG 09	BPG09	5/30/2001	Total Suspended Solids	1	66.47	mg/L
BPG 09	BPG09	6/6/2001	Total Suspended Solids	1	212.54	mg/L
BPG 09	BPG09	6/8/2001	Total Suspended Solids	1	120.09	mg/L
BPG 09	BPG09	6/13/2001	Total Suspended Solids	1	122.08	mg/L
BPG 09	BPG09	6/18/2001	Total Suspended Solids	1	115.93	mg/L
BPG 09	BPG09	6/25/2001	Total Suspended Solids	1	123.93	mg/L
BPG 09	BPG09	7/2/2001	Total Suspended Solids	1	90.52	mg/L
BPG 09	BPG09	7/9/2001	Total Suspended Solids	1	72.09	mg/L
BPG 09	BPG09	7/16/2001	Total Suspended Solids	1	108.56	mg/L
BPG 09	BPG09	7/23/2001	Total Suspended Solids	1	68.73	mg/L
BPG 09	BPG09	7/30/2001	Total Suspended Solids	1	58.15	mg/L
BPG 09	BPG09	8/6/2001	Total Suspended Solids	1	42.93	mg/L
BPG 09	BPG09	8/14/2001	Total Suspended Solids	1	28.75	mg/L
BPG 09	BPG09	8/20/2001	Total Suspended Solids	1	44.26	mg/L
BPG 09	BPG09	8/27/2001	Total Suspended Solids	1	24.97	mg/L
BPG 09	BPG09	8/31/2001	Total Suspended Solids	1	402.34	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPG 09	BPG09	9/1/2001	Total Suspended Solids	1	111.7	mg/L
BPG 09	BPG09	9/4/2001	Total Suspended Solids	1	31.55	mg/L
BPG 09	BPG09	9/10/2001	Total Suspended Solids	1	121.81	mg/L
BPG 09	BPG09	9/18/2001	Total Suspended Solids	1	82.15	mg/L
BPG 09	BPG09	9/24/2001	Total Suspended Solids	1	68.94	mg/L
BPG 09	BPG09	10/1/2001	Total Suspended Solids	1	101.54	mg/L
BPG 09	BPG09	10/9/2001	Total Suspended Solids	1	86.47	mg/L
BPG 09	BPG09	10/15/2001	Total Suspended Solids	1	45.58	mg/L
BPG 09	BPG09	10/15/2001	Total Suspended Solids	1	48.24	mg/L
BPG 09	BPG09	10/16/2001	Total Suspended Solids	1	68.62	mg/L
BPG 09	BPG09	10/18/2001	Total Suspended Solids	1	49.72	mg/L
BPG 09	BPG09	10/18/2001	Total Suspended Solids	1	52.56	mg/L
BPG 09	BPG09	10/22/2001	Total Suspended Solids	1	37.8	mg/L
BPG 09	BPG09	10/31/2001	Total Suspended Solids	1	97.38	mg/L
BPG 09	BPG09	11/5/2001	Total Suspended Solids	1	106.22	mg/L
BPG 09	BPG09	11/14/2001	Total Suspended Solids	1	112.73	mg/L
BPG 09	BPG09	11/19/2001	Total Suspended Solids	1	101.43	mg/L
BPG 09	BPG09	11/26/2001	Total Suspended Solids	1	96.95	mg/L
BPG 09	BPG09	12/3/2001	Total Suspended Solids	1	57.02	mg/L
BPG 09	BPG09	12/10/2001	Total Suspended Solids	1	94.07	mg/L
BPG 09	BPG09	12/19/2001	Total Suspended Solids	1	43.71	mg/L
BPG 09	BPG09	12/27/2001	Total Suspended Solids	1	112.89	mg/L
BPG 09	BPG09	1/2/2002	Total Suspended Solids	1	107.19	mg/L
BPG 09	BPG09	1/7/2002	Total Suspended Solids	1	92.61	mg/L
BPG 09	BPG09	1/14/2002	Total Suspended Solids	1	90.19	mg/L
BPG 09	BPG09	1/23/2002	Total Suspended Solids	1	86.68	mg/L
BPG 09	BPG09	1/28/2002	Total Suspended Solids	1	73.74	mg/L
BPG 09	BPG09	1/31/2002	Total Suspended Solids	1	790.47	mg/L
BPG 09	BPG09	1/31/2002	Total Suspended Solids	1	484.54	mg/L
BPG 09	BPG09	2/1/2002	Total Suspended Solids	1	201.32	mg/L
BPG 09	BPG09	2/2/2002	Total Suspended Solids	1	96.14	mg/L
BPG 09	BPG09	2/4/2002	Total Suspended Solids	1	45.04	mg/L
BPG 09	BPG09	2/5/2002	Total Suspended Solids	1	23.51	mg/L
BPG 09	BPG09	2/13/2002	Total Suspended Solids	1	86.76	mg/L
BPG 09	BPG09	2/19/2002	Total Suspended Solids	1	88.51	mg/L
BPG 09	BPG09	2/20/2002	Total Suspended Solids	1	329.46	mg/L
BPG 09	BPG09	2/21/2002	Total Suspended Solids	1	165.63	mg/L
BPG 09	BPG09	2/22/2002	Total Suspended Solids	1	93.84	mg/L
BPG 09	BPG09	2/25/2002	Total Suspended Solids	1	40.53	mg/L
BPG 09	BPG09	3/6/2002	Total Suspended Solids	1	75.24	mg/L
BPG 09	BPG09	3/11/2002	Total Suspended Solids	1	85.11	mg/L
BPG 09	BPG09	3/18/2002	Total Suspended Solids	1	59.5	mg/L
BPG 09	BPG09	3/27/2002	Total Suspended Solids	1	6.29	mg/L
BPG 09	BPG09	4/4/2002	Total Suspended Solids	1	19.98	mg/L
BPGD	BPGD-H-A1	9/23/2002	Total Suspended Solids		29	mg/L
BPGD	BPGD-H-A2	9/23/2002	Total Suspended Solids		11	mg/L
BPGD	BPGD-H-C1	9/23/2002	Total Suspended Solids		17	mg/L
BPGD	BPGD-H-C2	9/23/2002	Total Suspended Solids		12	mg/L
BPGD	BPGD-H-C3	9/23/2002	Total Suspended Solids		13	mg/L
BPGD	BPGD-H-D2	9/23/2002	Total Suspended Solids		10	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPGD	BPGD-H-D3	9/23/2002	Total Suspended Solids		19	mg/L
BPGD	BPGD-H-E1	9/23/2002	Total Suspended Solids		5	mg/L
RBD	RBD-1	03/28/01	Total Suspended Solids		16	mg/L
RBD	RBD-1	03/28/01	Total Suspended Solids		18	mg/L
RBD	RBD-1	04/19/01	Total Suspended Solids		26	mg/L
RBD	RBD-1	04/19/01	Total Suspended Solids		28	mg/L
RBD	RBD-1	04/19/01	Total Suspended Solids			mg/L
RBD	RBD-1	04/26/01	Total Suspended Solids			mg/L
RBD	RBD-1	04/26/01	Total Suspended Solids		14	mg/L
RBD	RBD-1	04/26/01	Total Suspended Solids		23	mg/L
RBD	RBD-2	03/28/01	Total Suspended Solids		16	mg/L
RBD	RBD-2	04/19/01	Total Suspended Solids		21	mg/L
RBD	RBD-2	04/19/01	Total Suspended Solids			mg/L
RBD	RBD-2	04/26/01	Total Suspended Solids			mg/L
RBD	RBD-2	04/26/01	Total Suspended Solids		18	mg/L
RBD	RBD-5	03/28/01	Total Suspended Solids		7	mg/L
RBD	RBD-5	04/19/01	Total Suspended Solids		32	mg/L
RBD	RBD-5	04/19/01	Total Suspended Solids			mg/L
RBD	RBD-5	04/26/01	Total Suspended Solids			mg/L
RBD	RBD-5	04/26/01	Total Suspended Solids		42	mg/L
RBD	RBD-T1	06/06/01	Total Suspended Solids		4	mg/L
RBD	RBD-T2	04/09/01	Total Suspended Solids		10	mg/L
RBD	RBD-T2	04/23/01	Total Suspended Solids		17	mg/L
RBD	RBD-T2	05/07/01	Total Suspended Solids		15	mg/L
RBD	RBD-T2	05/21/01	Total Suspended Solids		41	mg/L
RBD	RBD-T2	06/06/01	Total Suspended Solids		199	mg/L
RBD	RBD-T2	06/08/01	Total Suspended Solids		49	mg/L
RBD	RBD-T2	06/13/01	Total Suspended Solids		46	mg/L
BPGD	BPGD-H-A1	9/23/2002	Turbidity		5.6	NTU
BPGD	BPGD-H-A2	9/23/2002	Turbidity		8.5	NTU
BPGD	BPGD-H-C1	9/23/2002	Turbidity		8.0	NTU
BPGD	BPGD-H-C2	9/23/2002	Turbidity		4.9	NTU
BPGD	BPGD-H-C3	9/23/2002	Turbidity		NA	NTU
BPGD	BPGD-H-D2	9/23/2002	Turbidity		4.8	NTU
BPGD	BPGD-H-D3	9/23/2002	Turbidity		16	NTU
BPGD	BPGD-H-E1	9/23/2002	Turbidity		1.0	NTU
BPGD	BPGD-H-A1	9/23/2002	Unionized Ammonia		#VALUE!	mg/L
BPGD	BPGD-H-A2	9/23/2002	Unionized Ammonia		#VALUE!	mg/L
BPGD	BPGD-H-C1	9/23/2002	Unionized Ammonia		#VALUE!	mg/L
BPGD	BPGD-H-C2	9/23/2002	Unionized Ammonia		#VALUE!	mg/L
BPGD	BPGD-H-C3	9/23/2002	Unionized Ammonia		#VALUE!	mg/L
BPGD	BPGD-H-D2	9/23/2002	Unionized Ammonia		#VALUE!	mg/L
BPGD	BPGD-H-D3	9/23/2002	Unionized Ammonia		#VALUE!	mg/L
BPGD	BPGD-H-E1	9/23/2002	Unionized Ammonia		#VALUE!	mg/L
BPGD	BPGD-H-A1	9/23/2002	Water Temp. (field).		13.8	Deg C
BPGD	BPGD-H-A2	9/23/2002	Water Temp. (field).		18.7	Deg C
BPGD	BPGD-H-C1	9/23/2002	Water Temp. (field).		20.1	Deg C
BPGD	BPGD-H-C2	9/23/2002	Water Temp. (field).		21.5	Deg C
BPGD	BPGD-H-C3	9/23/2002	Water Temp. (field).		14.7	Deg C
BPGD	BPGD-H-D2	9/23/2002	Water Temp. (field).		25.7	Deg C

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
BPGD	BPGD-H-D3	9/23/2002	Water Temp. (field).		14.1	Deg C
BPGD	BPGD-H-E1	9/23/2002	Water Temp. (field).		19.6	Deg C
RBD	RBD-1	25-May-00	Dissolved Oxygen	0	10.6	mg/L
RBD	RBD-1	25-May-00	Dissolved Oxygen	1	10.6	mg/L
RBD	RBD-1	25-May-00	Dissolved Oxygen	3	10.3	mg/L
RBD	RBD-1	25-May-00	Dissolved Oxygen	5	9.3	mg/L
RBD	RBD-1	25-May-00	Dissolved Oxygen	7	9.2	mg/L
RBD	RBD-1	25-May-00	Dissolved Oxygen	9	8.8	mg/L
RBD	RBD-1	25-May-00	Dissolved Oxygen	11	9	mg/L
RBD	RBD-1	25-May-00	Dissolved Oxygen	13	5.3	mg/L
RBD	RBD-1	25-May-00	Dissolved Oxygen	15	3.2	mg/L
RBD	RBD-1	25-May-00	Dissolved Oxygen	17	2.1	mg/L
RBD	RBD-1	25-May-00	Dissolved Oxygen	19	0.8	mg/L
RBD	RBD-1	06-Jun-00	Dissolved Oxygen	0	6.1	mg/L
RBD	RBD-1	06-Jun-00	Dissolved Oxygen	1	6.1	mg/L
RBD	RBD-1	06-Jun-00	Dissolved Oxygen	3	6	mg/L
RBD	RBD-1	06-Jun-00	Dissolved Oxygen	5	6	mg/L
RBD	RBD-1	06-Jun-00	Dissolved Oxygen	7	6	mg/L
RBD	RBD-1	06-Jun-00	Dissolved Oxygen	9	6	mg/L
RBD	RBD-1	06-Jun-00	Dissolved Oxygen	11	5.9	mg/L
RBD	RBD-1	06-Jun-00	Dissolved Oxygen	13	5.9	mg/L
RBD	RBD-1	06-Jun-00	Dissolved Oxygen	15	5.9	mg/L
RBD	RBD-1	06-Jun-00	Dissolved Oxygen	17	5.9	mg/L
RBD	RBD-1	11-Jul-00	Dissolved Oxygen	1	9.1	mg/L
RBD	RBD-1	11-Jul-00	Dissolved Oxygen	3	9	mg/L
RBD	RBD-1	11-Jul-00	Dissolved Oxygen	5	9.3	mg/L
RBD	RBD-1	11-Jul-00	Dissolved Oxygen	7	8.1	mg/L
RBD	RBD-1	11-Jul-00	Dissolved Oxygen	9	8	mg/L
RBD	RBD-1	11-Jul-00	Dissolved Oxygen	11	6.9	mg/L
RBD	RBD-1	11-Jul-00	Dissolved Oxygen	13	4.4	mg/L
RBD	RBD-1	11-Jul-00	Dissolved Oxygen	15	3.8	mg/L
RBD	RBD-1	11-Jul-00	Dissolved Oxygen	17	2	mg/L
RBD	RBD-1	11-Jul-00	Dissolved Oxygen	18	1.6	mg/L
RBD	RBD-1	12-Jul-00	Dissolved Oxygen	0	7.2	mg/L
RBD	RBD-1	12-Jul-00	Dissolved Oxygen	1	7.2	mg/L
RBD	RBD-1	12-Jul-00	Dissolved Oxygen	3	7.2	mg/L
RBD	RBD-1	12-Jul-00	Dissolved Oxygen	5	7	mg/L
RBD	RBD-1	12-Jul-00	Dissolved Oxygen	7	6.8	mg/L
RBD	RBD-1	12-Jul-00	Dissolved Oxygen	9	6.8	mg/L
RBD	RBD-1	12-Jul-00	Dissolved Oxygen	11	6.8	mg/L
RBD	RBD-1	12-Jul-00	Dissolved Oxygen	13	6.8	mg/L
RBD	RBD-1	12-Jul-00	Dissolved Oxygen	15	6.8	mg/L
RBD	RBD-1	12-Jul-00	Dissolved Oxygen	16	6.8	mg/L
RBD	RBD-1	26-Jul-00	Dissolved Oxygen	1	14.1	mg/L
RBD	RBD-1	26-Jul-00	Dissolved Oxygen	3	11.4	mg/L
RBD	RBD-1	26-Jul-00	Dissolved Oxygen	5	8.8	mg/L
RBD	RBD-1	26-Jul-00	Dissolved Oxygen	7	7.4	mg/L
RBD	RBD-1	26-Jul-00	Dissolved Oxygen	9	7.6	mg/L
RBD	RBD-1	26-Jul-00	Dissolved Oxygen	11	3.9	mg/L
RBD	RBD-1	26-Jul-00	Dissolved Oxygen	13	3.2	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
RBD	RBD-1	26-Jul-00	Dissolved Oxygen	15	1.9	mg/L
RBD	RBD-1	26-Jul-00	Dissolved Oxygen	17	2	mg/L
RBD	RBD-1	26-Jul-00	Dissolved Oxygen	18	1.8	mg/L
RBD	RBD-1	02-Aug-00	Dissolved Oxygen	0	4.7	mg/L
RBD	RBD-1	02-Aug-00	Dissolved Oxygen	1	4.6	mg/L
RBD	RBD-1	02-Aug-00	Dissolved Oxygen	3	4.4	mg/L
RBD	RBD-1	02-Aug-00	Dissolved Oxygen	5	4.3	mg/L
RBD	RBD-1	02-Aug-00	Dissolved Oxygen	7	4.2	mg/L
RBD	RBD-1	02-Aug-00	Dissolved Oxygen	9	4.1	mg/L
RBD	RBD-1	02-Aug-00	Dissolved Oxygen	11	4	mg/L
RBD	RBD-1	02-Aug-00	Dissolved Oxygen	13	3.8	mg/L
RBD	RBD-1	02-Aug-00	Dissolved Oxygen	15	3.1	mg/L
RBD	RBD-1	02-Aug-00	Dissolved Oxygen	17	1.6	mg/L
RBD	RBD-1	08-Aug-00	Dissolved Oxygen	1	6.7	mg/L
RBD	RBD-1	08-Aug-00	Dissolved Oxygen	3	6	mg/L
RBD	RBD-1	08-Aug-00	Dissolved Oxygen	5	5	mg/L
RBD	RBD-1	08-Aug-00	Dissolved Oxygen	7	4.8	mg/L
RBD	RBD-1	08-Aug-00	Dissolved Oxygen	11	4.9	mg/L
RBD	RBD-1	08-Aug-00	Dissolved Oxygen	13	4.8	mg/L
RBD	RBD-1	08-Aug-00	Dissolved Oxygen	15	4.8	mg/L
RBD	RBD-1	08-Aug-00	Dissolved Oxygen	17	4.1	mg/L
RBD	RBD-1	08-Aug-00	Dissolved Oxygen	18	3	mg/L
RBD	RBD-1	29-Aug-00	Dissolved Oxygen	1	5.5	mg/L
RBD	RBD-1	29-Aug-00	Dissolved Oxygen	3	5	mg/L
RBD	RBD-1	29-Aug-00	Dissolved Oxygen	5	4.6	mg/L
RBD	RBD-1	29-Aug-00	Dissolved Oxygen	7	4.2	mg/L
RBD	RBD-1	29-Aug-00	Dissolved Oxygen	9	4.1	mg/L
RBD	RBD-1	29-Aug-00	Dissolved Oxygen	11	3.6	mg/L
RBD	RBD-1	29-Aug-00	Dissolved Oxygen	13	3.6	mg/L
RBD	RBD-1	29-Aug-00	Dissolved Oxygen	15	3.5	mg/L
RBD	RBD-1	29-Aug-00	Dissolved Oxygen	17	2.9	mg/L
RBD	RBD-1	29-Aug-00	Dissolved Oxygen	18	2	mg/L
RBD	RBD-2	06-Jun-00	Dissolved Oxygen	0	7.6	mg/L
RBD	RBD-2	06-Jun-00	Dissolved Oxygen	1	7.8	mg/L
RBD	RBD-2	06-Jun-00	Dissolved Oxygen	3	7.4	mg/L
RBD	RBD-2	11-Jul-00	Dissolved Oxygen	1	9.2	mg/L
RBD	RBD-2	11-Jul-00	Dissolved Oxygen	3	9	mg/L
RBD	RBD-2	11-Jul-00	Dissolved Oxygen	5	8.9	mg/L
RBD	RBD-2	11-Jul-00	Dissolved Oxygen	7	8.7	mg/L
RBD	RBD-2	11-Jul-00	Dissolved Oxygen	9	8.7	mg/L
RBD	RBD-2	12-Jul-00	Dissolved Oxygen	0	8.7	mg/L
RBD	RBD-2	12-Jul-00	Dissolved Oxygen	1	8.7	mg/L
RBD	RBD-2	12-Jul-00	Dissolved Oxygen	3	8.6	mg/L
RBD	RBD-2	12-Jul-00	Dissolved Oxygen	5	7.9	mg/L
RBD	RBD-2	12-Jul-00	Dissolved Oxygen	7	8.1	mg/L
RBD	RBD-2	12-Jul-00	Dissolved Oxygen	9	7.5	mg/L
RBD	RBD-2	26-Jul-00	Dissolved Oxygen	1	14.5	mg/L
RBD	RBD-2	26-Jul-00	Dissolved Oxygen	3	14.8	mg/L
RBD	RBD-2	26-Jul-00	Dissolved Oxygen	5	10.4	mg/L
RBD	RBD-2	26-Jul-00	Dissolved Oxygen	7	7.6	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
RBD	RBD-2	26-Jul-00	Dissolved Oxygen	9	5.4	mg/L
RBD	RBD-2	02-Aug-00	Dissolved Oxygen	0	5.2	mg/L
RBD	RBD-2	02-Aug-00	Dissolved Oxygen	1	5.2	mg/L
RBD	RBD-2	02-Aug-00	Dissolved Oxygen	3	5.2	mg/L
RBD	RBD-2	02-Aug-00	Dissolved Oxygen	5	5	mg/L
RBD	RBD-2	02-Aug-00	Dissolved Oxygen	7	4.8	mg/L
RBD	RBD-2	02-Aug-00	Dissolved Oxygen	8	4.7	mg/L
RBD	RBD-2	08-Aug-00	Dissolved Oxygen	1	8.4	mg/L
RBD	RBD-2	08-Aug-00	Dissolved Oxygen	3	8.4	mg/L
RBD	RBD-2	08-Aug-00	Dissolved Oxygen	5	8.4	mg/L
RBD	RBD-2	08-Aug-00	Dissolved Oxygen	7	8.3	mg/L
RBD	RBD-2	08-Aug-00	Dissolved Oxygen	9	8.2	mg/L
RBD	RBD-2	29-Aug-00	Dissolved Oxygen	1	7.6	mg/L
RBD	RBD-2	29-Aug-00	Dissolved Oxygen	3	7.6	mg/L
RBD	RBD-2	29-Aug-00	Dissolved Oxygen	5	7.4	mg/L
RBD	RBD-2	29-Aug-00	Dissolved Oxygen	7	7	mg/L
RBD	RBD-2	29-Aug-00	Dissolved Oxygen	9	6.8	mg/L
RBD	RBD-5	06-Jun-00	Dissolved Oxygen	0	7.7	mg/L
RBD	RBD-5	06-Jun-00	Dissolved Oxygen	1	7.6	mg/L
RBD	RBD-5	06-Jun-00	Dissolved Oxygen	3	7.6	mg/L
RBD	RBD-5	06-Jun-00	Dissolved Oxygen	4	7.5	mg/L
RBD	RBD-5	11-Jul-00	Dissolved Oxygen	1	8	mg/L
RBD	RBD-5	11-Jul-00	Dissolved Oxygen	2	7.6	mg/L
RBD	RBD-5	11-Jul-00	Dissolved Oxygen	3	7	mg/L
RBD	RBD-5	11-Jul-00	Dissolved Oxygen	4	6.9	mg/L
RBD	RBD-5	11-Jul-00	Dissolved Oxygen	5	6.7	mg/L
RBD	RBD-5	12-Jul-00	Dissolved Oxygen	0	7	mg/L
RBD	RBD-5	12-Jul-00	Dissolved Oxygen	1	6.9	mg/L
RBD	RBD-5	12-Jul-00	Dissolved Oxygen	3	5.9	mg/L
RBD	RBD-5	12-Jul-00	Dissolved Oxygen	4	5.9	mg/L
RBD	RBD-5	26-Jul-00	Dissolved Oxygen	1	14	mg/L
RBD	RBD-5	26-Jul-00	Dissolved Oxygen	2	14.5	mg/L
RBD	RBD-5	26-Jul-00	Dissolved Oxygen	3	13.9	mg/L
RBD	RBD-5	26-Jul-00	Dissolved Oxygen	4	12.5	mg/L
RBD	RBD-5	02-Aug-00	Dissolved Oxygen	0	5.6	mg/L
RBD	RBD-5	02-Aug-00	Dissolved Oxygen	1	5.6	mg/L
RBD	RBD-5	02-Aug-00	Dissolved Oxygen	3	4.5	mg/L
RBD	RBD-5	02-Aug-00	Dissolved Oxygen	4	4.1	mg/L
RBD	RBD-5	08-Aug-00	Dissolved Oxygen	1	6.9	mg/L
RBD	RBD-5	08-Aug-00	Dissolved Oxygen	2	8	mg/L
RBD	RBD-5	08-Aug-00	Dissolved Oxygen	3	7.9	mg/L
RBD	RBD-5	08-Aug-00	Dissolved Oxygen	4	7.7	mg/L
RBD	RBD-5	29-Aug-00	Dissolved Oxygen	1	6.7	mg/L
RBD	RBD-5	29-Aug-00	Dissolved Oxygen	2	6	mg/L
RBD	RBD-5	29-Aug-00	Dissolved Oxygen	3	5.2	mg/L
RBD	RBD-5	29-Aug-00	Dissolved Oxygen	4	3.5	mg/L
RBD	RBD-5	29-Aug-00	Dissolved Oxygen	5	3.3	mg/L
RBD	RBD-1	5/8/2000	Total Phosphorus	1	0.037	mg/L
RBD	RBD-1	5/8/2000	Nitrite + Nitrate	1	2.4	mg/L
RBD	RBD-1	5/25/2000	Total Phosphorus	1	0.039	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
RBD	RBD-1	5/25/2000	Nitrite + Nitrate	1	2.7	mg/L
RBD	RBD-1	6/6/2000	Total Phosphorus	1	0.134	mg/L
RBD	RBD-1	6/6/2000	Nitrite + Nitrate	1	12	mg/L
RBD	RBD-1	6/22/2000	Nitrite + Nitrate	1	10	mg/L
RBD	RBD-1	7/12/2000	Total Phosphorus	1	0.029	mg/L
RBD	RBD-1	7/12/2000	Nitrite + Nitrate	1	9.3	mg/L
RBD	RBD-1	7/26/2000	Total Phosphorus	1	0.04	mg/L
RBD	RBD-1	7/26/2000	Nitrite + Nitrate	1	7.7	mg/L
RBD	RBD-1	8/2/2000	Total Phosphorus	1	0.024	mg/L
RBD	RBD-1	8/2/2000	Nitrite + Nitrate	1	6.39	mg/L
RBD	RBD-1	9/13/2000	Total Phosphorus	1	0.046	mg/L
RBD	RBD-1	9/13/2000	Nitrite + Nitrate	1	1.3	mg/L
RBD	RBD-1	9/28/2000	Total Phosphorus	1	0.063	mg/L
RBD	RBD-1	9/28/2000	Nitrite + Nitrate	1	1.05	mg/L
RBD	RBD-1	10/3/2000	Total Phosphorus	1	0.042	mg/L
RBD	RBD-1	10/3/2000	Nitrite + Nitrate	1	0.87	mg/L
RBD	RBD-1	10/24/2000	Total Phosphorus	1	0.032	mg/L
RBD	RBD-1	10/24/2000	Nitrite + Nitrate	1	0.25	mg/L
RBD	RBD-1	11/15/2000	Total Phosphorus	1	0.062	mg/L
RBD	RBD-1	11/15/2000	Nitrite + Nitrate	1	0.43	mg/L
RBD	RBD-2	5/8/2000	Total Phosphorus	1	0.041	mg/L
RBD	RBD-2	5/8/2000	Nitrite + Nitrate	1	0.44	mg/L
RBD	RBD-2	5/25/2000	Total Phosphorus	1	0.037	mg/L
RBD	RBD-2	5/25/2000	Nitrite + Nitrate	1	3.3	mg/L
RBD	RBD-2	6/6/2000	Total Phosphorus	1	0.095	mg/L
RBD	RBD-2	6/6/2000	Nitrite + Nitrate	1	14	mg/L
RBD	RBD-2	6/22/2000	Total Phosphorus	1	0.029	mg/L
RBD	RBD-2	6/22/2000	Nitrite + Nitrate	1	9.9	mg/L
RBD	RBD-2	7/12/2000	Total Phosphorus	1	0.035	mg/L
RBD	RBD-2	7/12/2000	Nitrite + Nitrate	1	9.7	mg/L
RBD	RBD-2	7/26/2000	Total Phosphorus	1	0.046	mg/L
RBD	RBD-2	7/26/2000	Nitrite + Nitrate	1	7.2	mg/L
RBD	RBD-2	8/2/2000	Total Phosphorus	1	0.042	mg/L
RBD	RBD-2	8/2/2000	Nitrite + Nitrate	1	5.7	mg/L
RBD	RBD-2	9/13/2000	Total Phosphorus	1	0.053	mg/L
RBD	RBD-2	9/13/2000	Nitrite + Nitrate	1	1.1	mg/L
RBD	RBD-2	9/28/2000	Total Phosphorus	1	0.052	mg/L
RBD	RBD-2	9/28/2000	Nitrite + Nitrate	1	0.86	mg/L
RBD	RBD-2	10/3/2000	Total Phosphorus	1	0.04	mg/L
RBD	RBD-2	10/3/2000	Nitrite + Nitrate	1	0.63	mg/L
RBD	RBD-2	10/24/2000	Total Phosphorus	1	0.03	mg/L
RBD	RBD-2	10/24/2000	Nitrite + Nitrate	1	0.17	mg/L
RBD	RBD-2	11/15/2000	Total Phosphorus	1	0.061	mg/L
RBD	RBD-2	11/15/2000	Nitrite + Nitrate	1	0.21	mg/L
RBD	RBD-5	5/25/2000	Total Phosphorus	1	0.041	mg/L
RBD	RBD-5	5/25/2000	Nitrite + Nitrate	1	9.5	mg/L
RBD	RBD-5	6/6/2000	Total Phosphorus	1	0.097	mg/L
RBD	RBD-5	6/6/2000	Nitrite + Nitrate	1	14	mg/L
RBD	RBD-5	6/22/2000	Total Phosphorus	1	0.163	mg/L
RBD	RBD-5	6/22/2000	Nitrite + Nitrate	1	12	mg/L

WB_ID	StationID	Date	Parameter	Sample Depth (ft)	Value	Units
RBD	RBD-5	7/12/2000	Total Phosphorus	1	0.085	mg/L
RBD	RBD-5	7/12/2000	Nitrite + Nitrate	1	11	mg/L
RBD	RBD-5	7/26/2000	Total Phosphorus	1	0.035	mg/L
RBD	RBD-5	7/26/2000	Nitrite + Nitrate	1	6.6	mg/L
RBD	RBD-5	8/2/2000	Total Phosphorus	1	0.033	mg/L
RBD	RBD-5	8/2/2000	Nitrite + Nitrate	1	4	mg/L
RBD	RBD-5	9/28/2000	Total Phosphorus	1	0.067	mg/L
RBD	RBD-5	9/28/2000	Nitrite + Nitrate	1	0.41	mg/L
RBD	RBD-5	10/3/2000	Total Phosphorus	1	0.055	mg/L
RBD	RBD-5	10/3/2000	Nitrite + Nitrate	1	0.29	mg/L
RBD	RBD-5	10/24/2000	Total Phosphorus	1	0.046	mg/L
RBD	RBD-5	10/24/2000	Nitrite + Nitrate	1	0.04	mg/L
RBD	RBD-5	11/15/2000	Total Phosphorus	1	0.102	mg/L
RBD	RBD-5	11/15/2000	Nitrite + Nitrate	1	8.1	mg/L

APPENDIX C
BATHTUB INPUT AND OUTPUT

Lake Vermilion TMDL Analysis (year 1997)
File: L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration1997cal&out.btb
Description:

Initial Condititions model for Lake Vermilion in 1997

TP, TN, Chl-a, and Secchi concentrations to be predicted using calibrated factors

Use Outflow from Dam

Global Variables	Mean	CV
Averaging Period (yrs)	1	0.0
Precipitation (m)	0.8	0.3
Evaporation (m)	0.82	0.0
Storage Increase (m)	0	0.0

Atmos. Loads (kg/km^2-yr)	Mean	CV
Conserv. Substance	0	0.00
Total P	30	0.50
Total N	1000	0.50
Ortho P	15	0.50
Inorganic N	500	0.50

Segment Morphometry

Seg	Name	Outflow Segment	Group	Area km^2	Depth m	Length km	Mixed Depth (m) Mean	CV
1	Upper Lake - RBD5	2	1	0.573	1.219	2.164	1.219	0
2	Mid Upper - RBD3	3	1	0.479	1.829	1.052	1.829	0
3	Mid Lower - RBD2	4	1	1.323	3.048	1.393	3.048	0
4	Lower Lake - RBD1	0	1	0.623	5.486	1.149	5.486	0

Segment Observed Water Quality

	Conserv		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	0	0	0	0	0	0	0	0	0
2	0	0	133.2	0.773	5864	0.79	25.11	0.708	0.315
3	0	0	95	0.891	6428	0.703	28.45	0.445	0.467
4	0	0	81.1	0.378	6550	0.838	27.21	0.44	0.549

Segment Calibration Factors

	Dispersion Rate		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	1	0	0.8	0	0.925	0	0.325	0	0.75
2	1	0	1.2	0	0.7	0	0.475	0	1.2
3	1	0	0.8	0	1.05	0	1.3	0	1.215
4	1	0	0.78	0	1.085	0	1.8	0	1.2

Tributary Data

Trib	Trib Name	Segment	Type	Dr Area km^2	Flow (hm^3/yr) Mean	CV	Conserv. Mean	CV
1	North Fork Vermilion River	1	1	764.75	270.53	0	0	0
2	Outflow at DAM	4	4	764.75	380.1	2.027	0	0

Model Options	Code	Description
Conservative Substance	0	NOT COMPUTED
Phosphorus Balance	1	2ND ORDER, AVAIL P
Nitrogen Balance	1	2ND ORDER, AVAIL N
Chlorophyll-a	2	P, LIGHT, T
Secchi Depth	1	VS. CHLA & TURBIDITY
Dispersion	1	FISCHER-NUMERIC
Phosphorus Calibration	2	CONCENTRATIONS
Nitrogen Calibration	2	CONCENTRATIONS
Error Analysis	1	MODEL & DATA
Availability Factors	0	IGNORE
Mass-Balance Tables	1	USE ESTIMATED CONCS
Output Destination	2	EXCEL WORKSHEET

				Internal Loads (mg/m2-day)					
Hypol Depth		**Non-Algal Turb (m^{-1})**		**Conserv.**		**Total P**		**Total N**	
Mean	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0	0	0.08	0.2	0	0	0	0	0	0
0	0	2.55	0.47	0	0	0	0	0	0
0	0	1.43	0.67	0	0	0	0	0	0
0	0	1.14	0.72	0	0	0	0	0	0

	Organic N (ppb)		**TP - Ortho P (ppb)**		**HOD (ppb/day)**		**MOD (ppb/day)**	
CV	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0	0	0	0	0	0	0	0	0
0.35	0	0	0	0	0	0	0	0
0.424	0	0	0	0	0	0	0	0
0.421	0	0	0	0	0	0	0	0

	Organic N (ppb)		**TP - Ortho P (ppb)**		**HOD (ppb/day)**		**MOD (ppb/day)**	
CV	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0

Total P (ppb)		**Total N (ppb)**		**Ortho P (ppb)**		**Inorganic N (ppb)**	
Mean	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
200.15	0.592	8869.03	0.071	0	0	0	0
81.75	0.359	6622.5	0.836	0	0	0	0

Model Coefficients	Mean	CV
Dispersion Rate	1.000	0.70
Total Phosphorus	0.775	0.45
Total Nitrogen	1.200	0.55
Chl-a Model	2.400	0.26
Secchi Model	0.850	0.10
Organic N Model	1.000	0.12
TP-OP Model	1.000	0.15
HODv Model	1.000	0.15
MODv Model	1.000	0.22
Secchi/Chla Slope (m^2/mg)	0.025	0.00
Minimum Qs (m/yr)	0.100	0.00
Chl-a Flushing Term	1.000	0.00
Chl-a Temporal CV	0.620	0
Avail. Factor - Total P	0.330	0
Avail. Factor - Ortho P	1.930	0
Avail. Factor - Total N	0.590	0
Avail. Factor - Inorganic N	0.790	0

Lake Vermilion TMDL Analysis (year 1997)
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Segment & Tributary Network

--------Segment:	1	Upper Lake - RBD5		
Outflow Segment:	2	Mid Upper - RBD3		
Tributary:	1	North Fork Vermilion River	Type:	Monitored Inflow
--------Segment:	2	Mid Upper - RBD3		
Outflow Segment:	3	Mid Lower - RBD2		
--------Segment:	3	Mid Lower - RBD2		
Outflow Segment:	4	Lower Lake - RBD1		
--------Segment:	4	Lower Lake - RBD1		
Outflow Segment:	0	Out of Reservoir		
Tributary:	2	Outflow at DAM	Type:	Reservoir Outflow

Lake Vermilion TMDL Analysis (year 1997)
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Hydraulic & Dispersion Parameters

			Net	Resid	Overflow		Dispersion-------->		
		Outflow	Inflow	Time	Rate	Velocity	Estimated	Numeric	Exchange
Seg	Name	Seg	hm^3/yr	years	m/yr	km/yr	km^2/yr	km^2/yr	hm^3/yr
1	Upper Lake - RBD5	2	270.5	0.0026	472.1	838.1	4975.6	906.8	606.9
2	Mid Upper - RBD3	3	270.5	0.0032	564.7	324.8	4055.3	170.9	3075.0
3	Mid Lower - RBD2	4	270.5	0.0149	204.4	93.4	3304.9	65.1	6732.8
4	Lower Lake - RBD1	0	270.5	0.0126	434.1	90.9	639.8	52.2	0.0

Morphometry

		Area	Zmean	Zmix	Length	Volume	Width	L/W
Seg	Name	km^2	m	m	km	hm^3	km	-
1	Upper Lake - RBD5	0.6	1.2	1.2	2.2	0.7	0.3	8.2
2	Mid Upper - RBD3	0.5	1.8	1.8	1.1	0.9	0.5	2.3
3	Mid Lower - RBD2	1.3	3.0	3.0	1.4	4.0	0.9	1.5
4	Lower Lake - RBD1	0.6	5.5	5.5	1.1	3.4	0.5	2.1
Totals		3.0	3.0			9.0		

Lake Vermilion TMDL Analysis (year 1997)
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Overall Water & Nutrient Balances

Overall Water Balance — **Averaging Period = 1.00 years**

Trb	Type	Seg	Name	Area km^2	Flow hm^3/yr	Variance $(hm3/yr)^2$	CV -	Runoff m/yr
1	1	1	North Fork Vermilion River	764.8	270.5	0.00E+00	0.00	0.35
2	4	4	Outflow at DAM	764.8	380.1	5.94E+05	2.03	0.50
PRECIPITATION				3.0	2.4	6.19E-01	0.33	0.80
TRIBUTARY INFLOW				764.8	270.5	0.00E+00	0.00	0.35
***TOTAL INFLOW				767.7	272.9	6.18E-01	0.00	0.36
GAUGED OUTFLOW				764.8	380.1	5.94E+05	2.03	0.50
ADVECTIVE OUTFLOW				3.0	-109.6	5.94E+05	7.03	
***TOTAL OUTFLOW				767.7	270.5	6.19E-01	0.00	0.35
***EVAPORATION					2.5	0.00E+00	0.00	

Overall Mass Balance Based Upon Component: **Predicted TOTAL P** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance $(kg/yr)^2$	%Total	CV	Conc mg/m^3	Export $kg/km^2/yr$
1	1	1	North Fork Vermilion River	54146.6	99.8%	1.03E+09	100.0%	0.59	200.1	70.8
2	4	4	Outflow at DAM	28135.9		3.55E+09		2.12	74.0	36.8
PRECIPITATION				89.9	0.2%	2.02E+03	0.0%	0.50	37.5	30.0
TRIBUTARY INFLOW				54146.6	99.8%	1.03E+09	100.0%	0.59	200.1	70.8
***TOTAL INFLOW				54236.5	100.0%	1.03E+09	100.0%	0.59	198.7	70.6
GAUGED OUTFLOW				28135.9	51.9%	3.55E+09		2.12	74.0	36.8
ADVECTIVE OUTFLOW				-8115.1		3.28E+09		7.05	74.0	
***TOTAL OUTFLOW				20020.8	36.9%	1.51E+08		0.61	74.0	26.1
***RETENTION				34215.7	63.1%	6.44E+08		0.74		

Overflow Rate (m/yr)	90.2	Nutrient Resid. Time (yrs)	0.0143
Hydraulic Resid. Time (yrs)	0.0334	Turnover Ratio	70.0
Reservoir Conc (mg/m3)	86	Retention Coef.	0.631

Overall Mass Balance Based Upon Component: **Predicted TOTAL N** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance $(kg/yr)^2$	%Total	CV	Conc mg/m^3	Export $kg/km^2/yr$
1	1	1	North Fork Vermilion River	2399338.8	99.9%	2.90E+10	100.0%	0.07	8869.0	3137.4
2	4	4	Outflow at DAM	2511561.0		2.78E+13		2.10	6607.6	3284.2
PRECIPITATION				2998.0	0.1%	2.25E+06	0.0%	0.50	1250.0	1000.0
TRIBUTARY INFLOW				2399338.8	99.9%	2.90E+10	100.0%	0.07	8869.0	3137.4
***TOTAL INFLOW				2402336.8	100.0%	2.90E+10	100.0%	0.07	8802.1	3129.1
GAUGED OUTFLOW				2511561.0	104.5%	2.78E+13		2.10	6607.6	3284.2
ADVECTIVE OUTFLOW				-724394.5		2.61E+13		7.05	6607.6	
***TOTAL OUTFLOW				1787166.5	74.4%	9.74E+11		0.55	6607.6	2327.8
***RETENTION				615170.3	25.6%	9.74E+11		1.60		

Overflow Rate (m/yr)	90.2	Nutrient Resid. Time (yrs)	0.0236
Hydraulic Resid. Time (yrs)	0.0334	Turnover Ratio	42.4
Reservoir Conc (mg/m3)	6283	Retention Coef.	0.256

Lake Vermilion TMDL Analysis (year 1997)
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Segment Mass Balance Based Upon Predicted Concentrations

Component: TOTAL P — Segment: 1 — Upper Lake - RBD5

Trib	Type	Location	Flow hm^3/yr	Flow %Total	Load kg/yr	Load %Total	Conc mg/m^3
1	1	North Fork Vermilion River	270.5	99.8%	54146.6	76.3%	200
PRECIPITATION			0.5	0.2%	17.2	0.0%	38
TRIBUTARY INFLOW			270.5	99.8%	54146.6	76.3%	200
NET DIFFUSIVE INFLOW			0.0	0.0%	16803.0	23.7%	
***TOTAL INFLOW			271.0	100.0%	70966.7	100.0%	262
ADVECTIVE OUTFLOW			270.5	99.8%	24818.8	35.0%	92
***TOTAL OUTFLOW			270.5	99.8%	24818.8	35.0%	92
***EVAPORATION			0.5	0.2%	0.0	0.0%	
***RETENTION			0.0	0.0%	46147.9	65.0%	

Hyd. Residence Time = 0.0026 yrs
Overflow Rate = 472.1 m/yr
Mean Depth = 1.2 m

Component: TOTAL N — Segment: 1 — Upper Lake - RBD5

Trib	Type	Location	Flow hm^3/yr	Flow %Total	Load kg/yr	Load %Total	Conc mg/m^3
1	1	North Fork Vermilion River	270.5	99.8%	2399338.8	100.0%	8869
PRECIPITATION			0.5	0.2%	573.0	0.0%	1250
TRIBUTARY INFLOW			270.5	99.8%	2399338.8	100.0%	8869
***TOTAL INFLOW			271.0	100.0%	2399911.8	100.0%	8856
ADVECTIVE OUTFLOW			270.5	99.8%	1895719.5	79.0%	7008
NET DIFFUSIVE OUTFLOW			0.0	0.0%	1518364.8	63.3%	
***TOTAL OUTFLOW			270.5	99.8%	3414084.3	142.3%	12621
***EVAPORATION			0.5	0.2%	0.0	0.0%	
***RETENTION			0.0	0.0%	-1014172.5	-42.3%	

Hyd. Residence Time = 0.0026 yrs
Overflow Rate = 472.1 m/yr
Mean Depth = 1.2 m

Component: TOTAL P — Segment: 2 — Mid Upper - RBD3

Trib	Type	Location	Flow hm^3/yr	Flow %Total	Load kg/yr	Load %Total	Conc mg/m^3
PRECIPITATION			0.4	0.1%	14.4	0.1%	37
ADVECTIVE INFLOW			270.5	99.9%	24818.8	99.9%	92
***TOTAL INFLOW			270.9	100.0%	24833.2	100.0%	92
ADVECTIVE OUTFLOW			270.5	99.9%	32307.5	130.1%	119
NET DIFFUSIVE OUTFLOW			0.0	0.0%	148542.9	598.2%	
***TOTAL OUTFLOW			270.5	99.9%	180850.4	728.3%	669
***EVAPORATION			0.4	0.1%	0.0	0.0%	
***RETENTION			0.0	0.0%	-156017.2	-628.3%	

Hyd. Residence Time = 0.0032 yrs

Overflow Rate = 564.7 m/yr
Mean Depth = 1.8 m

Component: TOTAL N **Segment: 2 Mid Upper - RBD3**

Trib Type Location	Flow hm^3/yr	Flow %Total	Load kg/yr	Load %Total	Conc mg/m^3
PRECIPITATION	0.4	0.1%	479.0	0.0%	1250
ADVECTIVE INFLOW	270.5	99.9%	1895719.5	20.1%	7008
NET DIFFUSIVE INFLOW	0.0	0.0%	7528583.0	79.9%	
***TOTAL INFLOW	270.9	100.0%	9424782.0	100.0%	34790
ADVECTIVE OUTFLOW	270.5	99.9%	1218872.3	12.9%	4506
***TOTAL OUTFLOW	270.5	99.9%	1218872.3	12.9%	4506
***EVAPORATION	0.4	0.1%	0.0	0.0%	
***RETENTION	0.0	0.0%	8205910.0	87.1%	

Hyd. Residence Time = 0.0032 yrs
Overflow Rate = 564.7 m/yr
Mean Depth = 1.8 m

Component: TOTAL P **Segment: 3 Mid Lower - RBD2**

Trib Type Location	Flow hm^3/yr	Flow %Total	Load kg/yr	Load %Total	Conc mg/m^3
PRECIPITATION	1.1	0.4%	39.7	0.0%	37
ADVECTIVE INFLOW	270.5	99.6%	32307.5	22.0%	119
NET DIFFUSIVE INFLOW	0.0	0.0%	114447.3	78.0%	
***TOTAL INFLOW	271.6	100.0%	146794.5	100.0%	541
ADVECTIVE OUTFLOW	270.5	99.6%	20716.4	14.1%	77
***TOTAL OUTFLOW	270.5	99.6%	20716.4	14.1%	77
***EVAPORATION	1.1	0.4%	0.0	0.0%	
***RETENTION	0.0	0.0%	126078.1	85.9%	

Hyd. Residence Time = 0.0149 yrs
Overflow Rate = 204.4 m/yr
Mean Depth = 3.0 m

Component: TOTAL N **Segment: 3 Mid Lower - RBD2**

Trib Type Location	Flow hm^3/yr	Flow %Total	Load kg/yr	Load %Total	Conc mg/m^3
PRECIPITATION	1.1	0.4%	1323.0	0.1%	1250
ADVECTIVE INFLOW	270.5	99.6%	1218872.3	99.9%	4506
***TOTAL INFLOW	271.6	100.0%	1220195.3	100.0%	4493
ADVECTIVE OUTFLOW	270.5	99.6%	1747414.3	143.2%	6460
NET DIFFUSIVE OUTFLOW	0.0	0.0%	5018668.0	411.3%	
***TOTAL OUTFLOW	270.5	99.6%	6766082.0	554.5%	25015
***EVAPORATION	1.1	0.4%	0.0	0.0%	
***RETENTION	0.0	0.0%	-5545887.0	-454.5%	

Hyd. Residence Time = 0.0149 yrs
Overflow Rate = 204.4 m/yr
Mean Depth = 3.0 m

Component: TOTAL P **Segment: 4 Lower Lake - RBD1**

Trib	Type	Location	Flow hm³/yr	Flow %Total	Load kg/yr	Load %Total	Conc mg/m³
2	4	Outflow at DAM	380.1	140.3%	28135.9	74.0%	74
PRECIPITATION			0.5	0.2%	18.7	0.0%	38
ADVECTIVE INFLOW			270.5	99.8%	20716.4	54.5%	77
NET DIFFUSIVE INFLOW			0.0	0.0%	17292.6	45.5%	
***TOTAL INFLOW			271.0	100.0%	38027.8	100.0%	140
GAUGED OUTFLOW			380.1	140.3%	28135.9	74.0%	74
ADVECTIVE OUTFLOW			-109.6	-40.5%	-8115.1	-21.3%	74
***TOTAL OUTFLOW			270.5	99.8%	20020.8	52.6%	74
***EVAPORATION			0.5	0.2%	0.0	0.0%	
***RETENTION			0.0	0.0%	18006.9	47.4%	

Hyd. Residence Time = 0.0126 yrs
Overflow Rate = 434.1 m/yr
Mean Depth = 5.5 m

Component: TOTAL N **Segment: 4 Lower Lake - RBD1**

Trib	Type	Location	Flow hm³/yr	Flow %Total	Load kg/yr	Load %Total	Conc mg/m³
2	4	Outflow at DAM	380.1	140.3%	2511561.0	143.7%	6608
PRECIPITATION			0.5	0.2%	623.0	0.0%	1250
ADVECTIVE INFLOW			270.5	99.8%	1747414.3	100.0%	6460
***TOTAL INFLOW			271.0	100.0%	1748037.3	100.0%	6451
GAUGED OUTFLOW			380.1	140.3%	2511561.0	143.7%	6608
ADVECTIVE OUTFLOW			-109.6	-40.5%	-724394.5	-41.4%	6608
NET DIFFUSIVE OUTFLOW			0.0	0.0%	991552.0	56.7%	
***TOTAL OUTFLOW			270.5	99.8%	2778718.5	159.0%	10274
***EVAPORATION			0.5	0.2%	0.0	0.0%	
***RETENTION			0.0	0.0%	-1030681.3	-59.0%	

Hyd. Residence Time = 0.0126 yrs
Overflow Rate = 434.1 m/yr
Mean Depth = 5.5 m

Lake Vermilion TMDL Analysis (year 1997)
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Water Balance Terms (hm3/yr) **Averaging Period = 1.00 Years**

Seg	Name	External	Inflows Precip	Advect	Storage Increase	Outflows------> Advect	Disch.	Downstr Exchange	Evap
1	Upper Lake - RBD5	271	0	0	0	271	0	607	0
2	Mid Upper - RBD3	0	0	271	0	271	0	3075	0
3	Mid Lower - RBD2	0	1	271	0	270	0	6733	1
4	Lower Lake - RBD1	0	0	270	0	-110	380	0	1
Net		271	2	0	0	-110	380	0	2

Mass Balance Terms (kg/yr) Based Upon Predicted Reservoir & Outflow Concentrations Component: TOTAL P

Seg	Name	Inflows--> External	Atmos	Advect	Storage Increase	Outflows-----> Advect	Disch.	Net Exchange	Net Retention
1	Upper Lake - RBD5	54147	17	0	0	24819	0	-16803	46148
2	Mid Upper - RBD3	0	14	24819	0	32308	0	148543	-156017
3	Mid Lower - RBD2	0	40	32308	0	20716	0	-114447	126078
4	Lower Lake - RBD1	0	19	20716	0	-8115	28136	-17293	18007
Net		54147	90	0	0	-8115	28136	0	34216

Mass Balance Terms (kg/yr) Based Upon Predicted Reservoir & Outflow Concentrations Component: TOTAL N

Seg	Name	Inflows--> External	Atmos	Advect	Storage Increase	Outflows-----> Advect	Disch.	Net Exchange	Net Retention
1	Upper Lake - RBD5	2399339	573	0	0	1895720	0	1518365	-1014173
2	Mid Upper - RBD3	0	479	1895720	0	1218872	0	-7528583	8205910
3	Mid Lower - RBD2	0	1323	1218872	0	1747414	0	5018668	-5545887
4	Lower Lake - RBD1	0	623	1747414	0	-724395	2511561	991552	-1030681
Net		2399339	2998	0	0	-724395	2511561	0	615169

Lake Vermilion TMDL Analysis (year 1997)
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Predicted & Observed Values Ranked Against CE Model Development Dataset

Segment: **5** **Area-Wtd Mean**

Variable	Predicted Values---> Mean	CV	Rank	Observed Values---> Mean	CV	Rank
TOTAL P MG/M3	85.8	0.63	74.1%	99.0	0.75	79.0%
TOTAL N MG/M3	6283.3	0.55	99.8%	6347.9	0.75	99.8%
C.NUTRIENT MG/M3	84.1	0.60	85.8%	96.9	0.75	89.4%
CHL-A MG/M3	31.8	0.45	94.4%	27.5	0.49	91.8%
SECCHI M	0.5	0.27	14.6%	0.5	0.41	13.0%
ORGANIC N MG/M3	980.2	0.34	92.3%			
TP-ORTHO-P MG/M3	83.2	0.32	85.8%			
ANTILOG PC-1	1506.9	0.74	91.7%	1468.2	0.38	91.4%
ANTILOG PC-2	8.2	0.29	68.1%	6.9	0.29	55.1%
(N - 150) / P	74.6	0.83	98.5%	64.8	0.71	97.5%
INORGANIC N / P	2661.0	0.89	100.0%			
TURBIDITY 1/M	1.3	0.38	80.3%	1.3	0.38	80.3%
ZMIX * TURBIDITY	4.0	0.41	61.9%	4.0	0.41	61.9%
ZMIX / SECCHI	6.3	0.24	68.1%	7.3	0.25	76.6%
CHL-A * SECCHI	15.7	0.38	72.8%	12.6	0.41	61.9%
CHL-A / TOTAL P	0.4	0.46	85.7%	0.3	0.60	72.5%
FREQ(CHL-a>10) %	92.4	0.10	94.4%	90.6	0.09	91.8%
FREQ(CHL-a>20) %	65.0	0.38	94.4%	57.9	0.32	91.8%
FREQ(CHL-a>30) %	40.9	0.65	94.4%	32.5	0.54	91.8%
FREQ(CHL-a>40) %	25.1	0.89	94.4%	18.0	0.72	91.8%
FREQ(CHL-a>50) %	15.6	1.10	94.4%	10.1	0.87	91.8%
FREQ(CHL-a>60) %	9.8	1.28	94.4%	5.9	1.01	91.8%
CARLSON TSI-P	68.1	0.13	74.1%	70.2	0.10	79.0%
CARLSON TSI-CHLA	64.3	0.07	94.4%	63.1	0.05	91.8%
CARLSON TSI-SEC	70.7	0.05	85.4%	71.5	0.05	87.0%

Segment: **1** **Upper Lake - RBD5**

Variable	Predicted Values---> Mean	CV	Rank	Observed Values---> Mean	CV	Rank
TOTAL P MG/M3	91.7	0.67	76.5%			
TOTAL N MG/M3	7007.7	0.56	99.9%			
C.NUTRIENT MG/M3	90.6	0.65	87.8%			
CHL-A MG/M3	38.6	0.53	96.7%			
SECCHI M	0.6	0.49	22.6%			
ORGANIC N MG/M3	1042.4	0.46	93.9%			
TP-ORTHO-P MG/M3	66.4	0.57	79.9%			
ANTILOG PC-1	1602.5	1.05	92.4%			
ANTILOG PC-2	10.9	0.10	84.0%			
(N - 150) / P	74.7	0.86	98.5%			
INORGANIC N / P	235.8	1.59	98.1%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.1	0.20	0.0%	0.1	0.20	0.0%
ZMIX / SECCHI	2.0	0.50	6.7%			
CHL-A * SECCHI	23.5	0.11	88.1%			

CHL-A / TOTAL P	0.4	0.33	88.5%
FREQ(CHL-a>10) %	96.9	0.06	96.7%
FREQ(CHL-a>20) %	77.3	0.33	96.7%
FREQ(CHL-a>30) %	53.8	0.62	96.7%
FREQ(CHL-a>40) %	35.6	0.89	96.7%
FREQ(CHL-a>50) %	23.3	1.13	96.7%
FREQ(CHL-a>60) %	15.3	1.33	96.7%
CARLSON TSI-P	69.3	0.14	76.5%
CARLSON TSI-CHLA	66.4	0.08	96.7%
CARLSON TSI-SEC	67.1	0.11	77.4%

Segment: 2 Mid Upper - RBD3

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	119.4	0.63	84.5%	133.2	0.77	87.2%
TOTAL N MG/M3	4505.8	0.55	99.1%	5864.0	0.79	99.7%
C.NUTRIENT MG/M3	113.4	0.57	92.6%	128.3	0.78	94.5%
CHL-A MG/M3	21.5	0.47	85.9%	25.1	0.71	89.9%
SECCHI M	0.3	0.35	6.0%	0.3	0.35	5.2%
ORGANIC N MG/M3	840.0	0.26	86.9%			
TP-ORTHO-P MG/M3	94.7	0.29	88.7%			
ANTILOG PC-1	1638.2	0.61	92.7%	1862.5	0.74	93.9%
ANTILOG PC-2	4.4	0.47	23.9%	4.8	0.55	29.5%
(N - 150) / P	36.5	0.84	86.9%	42.9	1.10	91.3%
INORGANIC N / P	148.0	2.70	94.7%			
TURBIDITY 1/M	2.5	0.47	94.8%	2.5	0.47	94.8%
ZMIX * TURBIDITY	4.7	0.47	69.3%	4.7	0.47	69.3%
ZMIX / SECCHI	5.5	0.36	60.1%	5.8	0.34	63.2%
CHL-A * SECCHI	7.1	0.68	30.5%	7.9	0.79	36.0%
CHL-A / TOTAL P	0.2	0.51	44.8%	0.2	1.03	47.6%
FREQ(CHL-a>10) %	82.3	0.24	85.9%	88.0	0.25	89.9%
FREQ(CHL-a>20) %	42.4	0.69	85.9%	52.3	0.86	89.9%
FREQ(CHL-a>30) %	19.9	1.06	85.9%	27.5	1.38	89.9%
FREQ(CHL-a>40) %	9.5	1.35	85.9%	14.4	1.82	89.9%
FREQ(CHL-a>50) %	4.8	1.58	85.9%	7.8	2.18	89.9%
FREQ(CHL-a>60) %	2.5	1.78	85.9%	4.3	2.49	89.9%
CARLSON TSI-P	73.1	0.12	84.5%	74.7	0.15	87.2%
CARLSON TSI-CHLA	60.7	0.08	85.9%	62.2	0.11	89.9%
CARLSON TSI-SEC	76.0	0.07	94.0%	76.6	0.06	94.8%

Segment: 3 Mid Lower - RBD2

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	76.6	0.62	69.9%	95.0	0.89	77.7%
TOTAL N MG/M3	6460.4	0.55	99.8%	6428.0	0.70	99.8%
C.NUTRIENT MG/M3	75.8	0.60	82.7%	93.5	0.86	88.6%
CHL-A MG/M3	35.6	0.54	95.8%	28.5	0.44	92.5%
SECCHI M	0.4	0.32	12.2%	0.5	0.42	13.5%
ORGANIC N MG/M3	1076.5	0.39	94.6%			
TP-ORTHO-P MG/M3	93.2	0.30	88.4%			
ANTILOG PC-1	1623.6	0.72	92.6%	1452.8	0.57	91.3%
ANTILOG PC-2	8.7	0.50	71.4%	7.2	0.44	58.0%

(N - 150) / P	82.4	0.82	99.0%	66.1	1.13	97.7%
INORGANIC N / P	5383.8	0.67	100.0%			
TURBIDITY 1/M	1.4	0.67	83.4%	1.4	0.67	83.4%
ZMIX * TURBIDITY	4.4	0.67	66.2%	4.4	0.67	66.2%
ZMIX / SECCHI	6.8	0.32	73.3%	6.5	0.41	70.5%
CHL-A * SECCHI	15.8	0.69	73.3%	13.3	0.61	64.6%
CHL-A / TOTAL P	0.5	0.56	91.3%	0.3	0.97	74.7%
FREQ(CHL-a>10) %	95.9	0.08	95.8%	91.6	0.12	92.5%
FREQ(CHL-a>20) %	73.3	0.39	95.8%	60.2	0.45	92.5%
FREQ(CHL-a>30) %	48.7	0.72	95.8%	34.6	0.76	92.5%
FREQ(CHL-a>40) %	30.9	1.00	95.8%	19.5	1.02	92.5%
FREQ(CHL-a>50) %	19.6	1.24	95.8%	11.1	1.24	92.5%
FREQ(CHL-a>60) %	12.5	1.45	95.8%	6.5	1.43	92.5%
CARLSON TSI-P	66.7	0.13	69.9%	69.8	0.18	77.7%
CARLSON TSI-CHLA	65.6	0.08	95.8%	63.4	0.07	92.5%
CARLSON TSI-SEC	71.7	0.06	87.8%	71.0	0.08	86.5%

Segment: 4 Lower Lake - RBD1

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	74.0	0.61	68.6%	81.1	0.38	72.1%
TOTAL N MG/M3	6607.6	0.55	99.8%	6550.0	0.84	99.8%
C.NUTRIENT MG/M3	73.3	0.60	81.6%	80.2	0.44	84.4%
CHL-A MG/M3	25.6	0.57	90.4%	27.2	0.44	91.6%
SECCHI M	0.6	0.33	20.2%	0.5	0.42	18.7%
ORGANIC N MG/M3	826.3	0.36	86.2%			
TP-ORTHO-P MG/M3	68.5	0.26	80.7%			
ANTILOG PC-1	1070.1	0.64	87.0%	1197.7	0.57	88.7%
ANTILOG PC-2	7.9	0.58	65.1%	7.9	0.44	65.0%
(N - 150) / P	87.2	0.82	99.2%	78.9	0.93	98.8%
INORGANIC N / P	1041.7	6.61	100.0%			
TURBIDITY 1/M	1.1	0.72	76.2%	1.1	0.72	76.2%
ZMIX * TURBIDITY	6.3	0.72	81.2%	6.3	0.72	81.2%
ZMIX / SECCHI	9.6	0.33	88.4%	10.0	0.41	89.8%
CHL-A * SECCHI	14.7	0.79	69.6%	14.9	0.61	70.5%
CHL-A / TOTAL P	0.3	0.67	81.4%	0.3	0.57	80.1%
FREQ(CHL-a>10) %	88.6	0.20	90.4%	90.4	0.13	91.6%
FREQ(CHL-a>20) %	53.5	0.69	90.4%	57.4	0.48	91.6%
FREQ(CHL-a>30) %	28.6	1.09	90.4%	32.0	0.79	91.6%
FREQ(CHL-a>40) %	15.1	1.42	90.4%	17.6	1.05	91.6%
FREQ(CHL-a>50) %	8.2	1.69	90.4%	9.8	1.27	91.6%
FREQ(CHL-a>60) %	4.6	1.92	90.4%	5.6	1.46	91.6%
CARLSON TSI-P	66.2	0.13	68.6%	67.5	0.08	72.1%
CARLSON TSI-CHLA	62.4	0.09	90.4%	63.0	0.07	91.6%
CARLSON TSI-SEC	68.0	0.07	79.8%	68.6	0.09	81.3%

Lake Vermilion TMDL Analysis (year 1997)
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Segment	Name
1	Upper Lake - RBD5
2	Mid Upper - RBD3
3	Mid Lower - RBD2
4	Lower Lake - RBD1
Mean	Area-Wtd Mean

PREDICTED CONCENTRATIONS:

Variable Segment-->	1	2	3	4	Mean
TOTAL P MG/M3	91.7	119.4	76.6	74.0	85.8
TOTAL N MG/M3	7007.7	4505.8	6460.4	6607.6	6283.3
C.NUTRIENT MG/M3	90.6	113.4	75.8	73.3	84.1
CHL-A MG/M3	38.6	21.5	35.6	25.6	31.8
SECCHI M	0.6	0.3	0.4	0.6	0.5
ORGANIC N MG/M3	1042.4	840.0	1076.5	826.3	980.2
TP-ORTHO-P MG/M3	66.4	94.7	93.2	68.5	83.2
ANTILOG PC-1	1602.5	1638.2	1623.6	1070.1	1506.9
ANTILOG PC-2	10.9	4.4	8.7	7.9	8.2
(N - 150) / P	74.7	36.5	82.4	87.2	74.6
INORGANIC N / P	235.8	148.0	5383.8	1041.7	2661.0
TURBIDITY 1/M	0.1	2.5	1.4	1.1	1.3
ZMIX * TURBIDITY	0.1	4.7	4.4	6.3	4.0
ZMIX / SECCHI	2.0	5.5	6.8	9.6	6.3
CHL-A * SECCHI	23.5	7.1	15.8	14.7	15.7
CHL-A / TOTAL P	0.4	0.2	0.5	0.3	0.4
FREQ(CHL-a>10) %	96.9	82.3	95.9	88.6	92.4
FREQ(CHL-a>20) %	77.3	42.4	73.3	53.5	65.0
FREQ(CHL-a>30) %	53.8	19.9	48.7	28.6	40.9
FREQ(CHL-a>40) %	35.6	9.5	30.9	15.1	25.1
FREQ(CHL-a>50) %	23.3	4.8	19.6	8.2	15.6
FREQ(CHL-a>60) %	15.3	2.5	12.5	4.6	9.8
CARLSON TSI-P	69.3	73.1	66.7	66.2	68.1
CARLSON TSI-CHLA	66.4	60.7	65.6	62.4	64.3
CARLSON TSI-SEC	67.1	76.0	71.7	68.0	70.7

OBSERVED CONCENTRATIONS:

Variable Segment-->	1	2	3	4	Mean
TOTAL P MG/M3		133.2	95.0	81.1	99.0
TOTAL N MG/M3		5864.0	6428.0	6550.0	6347.9
C.NUTRIENT MG/M3		128.3	93.5	80.2	96.9
CHL-A MG/M3		25.1	28.5	27.2	27.5
SECCHI M		0.3	0.5	0.5	0.5
ANTILOG PC-1		1862.5	1452.8	1197.7	1468.2
ANTILOG PC-2		4.8	7.2	7.9	6.9
(N - 150) / P		42.9	66.1	78.9	64.8
TURBIDITY 1/M	0.1	2.5	1.4	1.1	1.3
ZMIX * TURBIDITY	0.1	4.7	4.4	6.3	4.0
ZMIX / SECCHI		5.8	6.5	10.0	7.3

CHL-A * SECCHI		7.9	13.3	14.9	12.6
CHL-A / TOTAL P		0.2	0.3	0.3	0.3
FREQ(CHL-a>10) %		88.0	91.6	90.4	90.6
FREQ(CHL-a>20) %		52.3	60.2	57.4	57.9
FREQ(CHL-a>30) %		27.5	34.6	32.0	32.5
FREQ(CHL-a>40) %		14.4	19.5	17.6	18.0
FREQ(CHL-a>50) %		7.8	11.1	9.8	10.1
FREQ(CHL-a>60) %		4.3	6.5	5.6	5.9
CARLSON TSI-P		74.7	69.8	67.5	70.2
CARLSON TSI-CHLA		62.2	63.4	63.0	63.1
CARLSON TSI-SEC		76.6	71.0	68.6	71.5

OBSERVED/PREDICTED RATIOS:

Variable Segment-->	1	2	3	4	Mean
TOTAL P MG/M3		1.1	1.2	1.1	1.2
TOTAL N MG/M3		1.3	1.0	1.0	1.0
C.NUTRIENT MG/M3		1.1	1.2	1.1	1.2
CHL-A MG/M3		1.2	0.8	1.1	0.9
SECCHI M		1.0	1.0	1.0	0.9
ANTILOG PC-1		1.1	0.9	1.1	1.0
ANTILOG PC-2		1.1	0.8	1.0	0.8
(N - 150) / P		1.2	0.8	0.9	0.9
TURBIDITY 1/M	1.0	1.0	1.0	1.0	1.0
ZMIX * TURBIDITY	1.0	1.0	1.0	1.0	1.0
ZMIX / SECCHI		1.0	1.0	1.0	1.2
CHL-A * SECCHI		1.1	0.8	1.0	0.8
CHL-A / TOTAL P		1.0	0.6	1.0	0.7
FREQ(CHL-a>10) %		1.1	1.0	1.0	1.0
FREQ(CHL-a>20) %		1.2	0.8	1.1	0.9
FREQ(CHL-a>30) %		1.4	0.7	1.1	0.8
FREQ(CHL-a>40) %		1.5	0.6	1.2	0.7
FREQ(CHL-a>50) %		1.6	0.6	1.2	0.7
FREQ(CHL-a>60) %		1.7	0.5	1.2	0.6
CARLSON TSI-P		1.0	1.0	1.0	1.0
CARLSON TSI-CHLA		1.0	1.0	1.0	1.0
CARLSON TSI-SEC		1.0	1.0	1.0	1.0

OBSERVED STANDARD ERRORS

Variable Segment-->	1	2	3	4	Mean
TOTAL P MG/M3		103.0	84.6	30.7	74.4
TOTAL N MG/M3		4632.6	4518.9	5488.9	4790.5
C.NUTRIENT MG/M3		99.6	80.6	35.2	72.7
CHL-A MG/M3		17.8	12.7	12.0	13.5
SECCHI M		0.1	0.2	0.2	0.2
ANTILOG PC-1		1382.9	828.9	677.0	556.2
ANTILOG PC-2		2.6	3.2	3.5	2.0
(N - 150) / P		47.4	74.4	73.6	45.7
TURBIDITY 1/M	0.0	1.2	1.0	0.8	0.5
ZMIX * TURBIDITY	0.0	2.2	2.9	4.5	1.6
ZMIX / SECCHI		2.0	2.7	4.1	1.8
CHL-A * SECCHI		6.2	8.2	9.1	5.2
CHL-A / TOTAL P		0.2	0.3	0.2	0.2

FREQ(CHL-a>10) %		21.9	10.6	11.5	7.8
FREQ(CHL-a>20) %		44.7	27.1	27.3	18.6
FREQ(CHL-a>30) %		38.1	26.3	25.3	17.5
FREQ(CHL-a>40) %		26.2	19.9	18.5	12.9
FREQ(CHL-a>50) %		16.9	13.8	12.5	8.8
FREQ(CHL-a>60) %		10.7	9.3	8.2	5.9
CARLSON TSI-P		11.0	12.7	5.4	7.4
CARLSON TSI-CHLA		6.8	4.3	4.3	2.9
CARLSON TSI-SEC		5.0	6.0	6.0	3.8

PREDICTED STANDARD ERRORS

Variable Segment-->	1	2	3	4	Mean
TOTAL P MG/M3	61.6	74.9	47.1	45.4	53.9
TOTAL N MG/M3	3934.8	2491.2	3567.4	3649.1	3472.8
C.NUTRIENT MG/M3	59.3	64.2	45.7	44.1	50.8
CHL-A MG/M3	20.5	10.1	19.4	14.6	14.5
SECCHI M	0.3	0.1	0.1	0.2	0.1
ORGANIC N MG/M3	483.3	215.8	414.9	300.8	336.4
TP-ORTHO-P MG/M3	37.8	27.0	28.3	18.1	26.3
ANTILOG PC-1	1679.3	996.2	1164.4	684.1	1117.9
ANTILOG PC-2	1.0	2.1	4.3	4.6	2.4
(N - 150) / P	64.3	30.5	67.9	71.7	62.0
INORGANIC N / P	375.4	399.3	3591.4	6888.8	2374.1
TURBIDITY 1/M	0.0	1.2	1.0	0.8	0.5
ZMIX * TURBIDITY	0.0	2.2	2.9	4.5	1.6
ZMIX / SECCHI	1.0	2.0	2.2	3.2	1.5
CHL-A * SECCHI	2.6	4.9	10.9	11.5	6.0
CHL-A / TOTAL P	0.1	0.1	0.3	0.2	0.2
FREQ(CHL-a>10) %	5.7	19.4	7.7	17.9	9.0
FREQ(CHL-a>20) %	25.2	29.4	28.8	36.7	24.4
FREQ(CHL-a>30) %	33.6	21.1	35.0	31.2	26.5
FREQ(CHL-a>40) %	31.8	12.8	30.9	21.5	22.3
FREQ(CHL-a>50) %	26.2	7.5	24.2	13.9	17.1
FREQ(CHL-a>60) %	20.4	4.4	18.0	8.8	12.5
CARLSON TSI-P	9.6	8.9	8.8	8.7	8.9
CARLSON TSI-CHLA	5.2	4.6	5.3	5.6	4.3
CARLSON TSI-SEC	7.1	5.1	4.6	4.7	3.7

Lake Vermilion TMDL Analysis (year 1997)
File: **L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration1997cal&ou**

T Statistics Compare Observed and Predicted Means Using the Following Error Terms:
1 = Observed Water Quality Error Only
2 = Error Typical of Model Development Dataset
3 = Observed & Predicted Error

Segment: **Area-Wtd Mean**

Variable		Observed Mean	CV	Predicted Mean	CV	Obs/Pred Ratio	T-Statistics ----> T1	T2	T3
TOTAL P	MG/M3	99.0	0.75	85.8	0.63	1.15	0.19	0.53	0.15
TOTAL N	MG/M3	6347.9	0.75	6283.3	0.55	1.01	0.01	0.05	0.01
C.NUTRIENT	MG/M3	96.9	0.75	84.1	0.60	1.15	0.19	0.70	0.15
CHL-A	MG/M3	27.5	0.49	31.8	0.45	0.86	-0.30	-0.43	-0.22
SECCHI	M	0.5	0.41	0.5	0.27	0.94	-0.14	-0.20	-0.12
ANTILOG PC-1		1468.2	0.38	1506.9	0.74	0.97	-0.07	-0.07	-0.03
ANTILOG PC-2		6.9	0.29	8.2	0.29	0.84	-0.61	-0.58	-0.44
(N - 150) / P		64.8	0.71	74.6	0.83	0.87	-0.20	-0.43	-0.13

Segment: **1** **Upper Lake - RBD5**

Variable	Observed Mean	CV	Predicted Mean	CV	Obs/Pred Ratio	T-Statistics ----> T1	T2	T3

Segment: **2** **Mid Upper - RBD3**

Variable		Observed Mean	CV	Predicted Mean	CV	Obs/Pred Ratio	T-Statistics ----> T1	T2	T3
TOTAL P	MG/M3	133.2	0.77	119.4	0.63	1.12	0.14	0.41	0.11
TOTAL N	MG/M3	5864.0	0.79	4505.8	0.55	1.30	0.33	1.20	0.27
C.NUTRIENT	MG/M3	128.3	0.78	113.4	0.57	1.13	0.16	0.61	0.13
CHL-A	MG/M3	25.1	0.71	21.5	0.47	1.17	0.22	0.44	0.18
SECCHI	M	0.3	0.35	0.3	0.35	0.95	-0.14	-0.17	-0.10
ANTILOG PC-1		1862.5	0.74	1638.2	0.61	1.14	0.17	0.37	0.13
ANTILOG PC-2		4.8	0.55	4.4	0.47	1.09	0.16	0.29	0.13
(N - 150) / P		42.9	1.10	36.5	0.84	1.18	0.15	0.50	0.12

Segment: **3** **Mid Lower - RBD2**

Variable		Observed Mean	CV	Predicted Mean	CV	Obs/Pred Ratio	T-Statistics ----> T1	T2	T3
TOTAL P	MG/M3	95.0	0.89	76.6	0.62	1.24	0.24	0.80	0.20
TOTAL N	MG/M3	6428.0	0.70	6460.4	0.55	0.99	-0.01	-0.02	-0.01
C.NUTRIENT	MG/M3	93.5	0.86	75.8	0.60	1.23	0.24	1.04	0.20
CHL-A	MG/M3	28.5	0.44	35.6	0.54	0.80	-0.50	-0.65	-0.32
SECCHI	M	0.5	0.42	0.4	0.32	1.05	0.11	0.17	0.09
ANTILOG PC-1		1452.8	0.57	1623.6	0.72	0.89	-0.19	-0.32	-0.12
ANTILOG PC-2		7.2	0.44	8.7	0.50	0.83	-0.43	-0.61	-0.28
(N - 150) / P		66.1	1.13	82.4	0.82	0.80	-0.20	-0.68	-0.16

Segment: **4** **Lower Lake - RBD1**

Variable		Observed Mean	CV	Predicted Mean	CV	Obs/Pred Ratio	T-Statistics ----> T1	T2	T3
TOTAL P	MG/M3	81.1	0.38	74.0	0.61	1.10	0.24	0.34	0.13
TOTAL N	MG/M3	6550.0	0.84	6607.6	0.55	0.99	-0.01	-0.04	-0.01
C.NUTRIENT	MG/M3	80.2	0.44	73.3	0.60	1.09	0.20	0.44	0.12
CHL-A	MG/M3	27.2	0.44	25.6	0.57	1.06	0.14	0.18	0.09
SECCHI	M	0.5	0.42	0.6	0.33	0.96	-0.10	-0.15	-0.08
ANTILOG PC-1		1197.7	0.57	1070.1	0.64	1.12	0.20	0.32	0.13
ANTILOG PC-2		7.9	0.44	7.9	0.58	1.00	0.00	-0.01	0.00
(N - 150) / P		78.9	0.93	87.2	0.82	0.90	-0.11	-0.31	-0.08

Lake Vermilion TMDL Analysis (year 1997)
File: L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration1997cal&out.btb

Variable = TOTAL P MG/M3 **R^2 = 0.48**
Global Calibration Factor = 0.77 CV = 0.45

			Calibration Factor		Predicted		Observed		Log (Obs/Pred)		
Seg	Group	Name	Mean	CV	Mean	CV	Mean	CV	Mean	SE	t
2	1	Mid Upper - RBD3	1.20	0.00	119.4	0.63	133.2	0.77	0.11	1.00	0.11
3	1	Mid Lower - RBD2	0.80	0.00	76.6	0.62	95.0	0.89	0.22	1.08	0.20
4	1	Lower Lake - RBD1	0.78	0.00	74.0	0.61	81.1	0.38	0.09	0.72	0.13
5	1	Area-Wtd Mean			85.8	0.63	99.0	0.75	0.14	0.98	0.15

Variable = TOTAL N MG/M3 **R^2 = -8.90**
Global Calibration Factor = 1.20 CV = 0.55

			Calibration Factor		Predicted		Observed		Log (Obs/Pred)		
Seg	Group	Name	Mean	CV	Mean	CV	Mean	CV	Mean	SE	t
2	1	Mid Upper - RBD3	0.70	0.00	4505.8	0.55	5864.0	0.79	0.26	0.96	0.27
3	1	Mid Lower - RBD2	1.05	0.00	6460.4	0.55	6428.0	0.70	-0.01	0.89	-0.01
4	1	Lower Lake - RBD1	1.09	0.00	6607.6	0.55	6550.0	0.84	-0.01	1.00	-0.01
5	1	Area-Wtd Mean			6283.3	0.55	6347.9	0.75	0.01	0.94	0.01

Variable = CHL-A MG/M3 **R^2 = -8.70**
Global Calibration Factor = 2.40 CV = 0.26

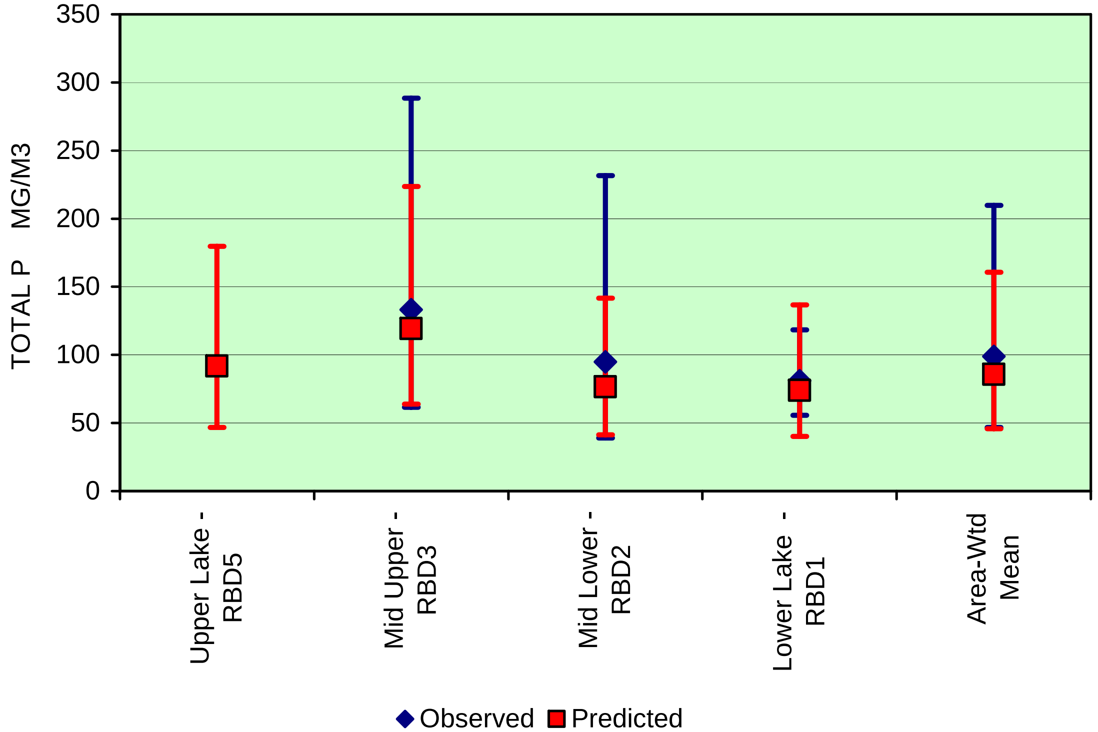
			Calibration Factor		Predicted		Observed		Log (Obs/Pred)		
Seg	Group	Name	Mean	CV	Mean	CV	Mean	CV	Mean	SE	t
2	1	Mid Upper - RBD3	0.47	0.00	21.5	0.47	25.1	0.71	0.15	0.85	0.18
3	1	Mid Lower - RBD2	1.30	0.00	35.6	0.54	28.5	0.44	-0.22	0.70	-0.32
4	1	Lower Lake - RBD1	1.80	0.00	25.6	0.57	27.2	0.44	0.06	0.72	0.09
5	1	Area-Wtd Mean			31.8	0.45	27.5	0.49	-0.15	0.67	-0.22

Lake Vermilion TMDL Analysis (year 1997)

File: **L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration1997cal&out.btb**

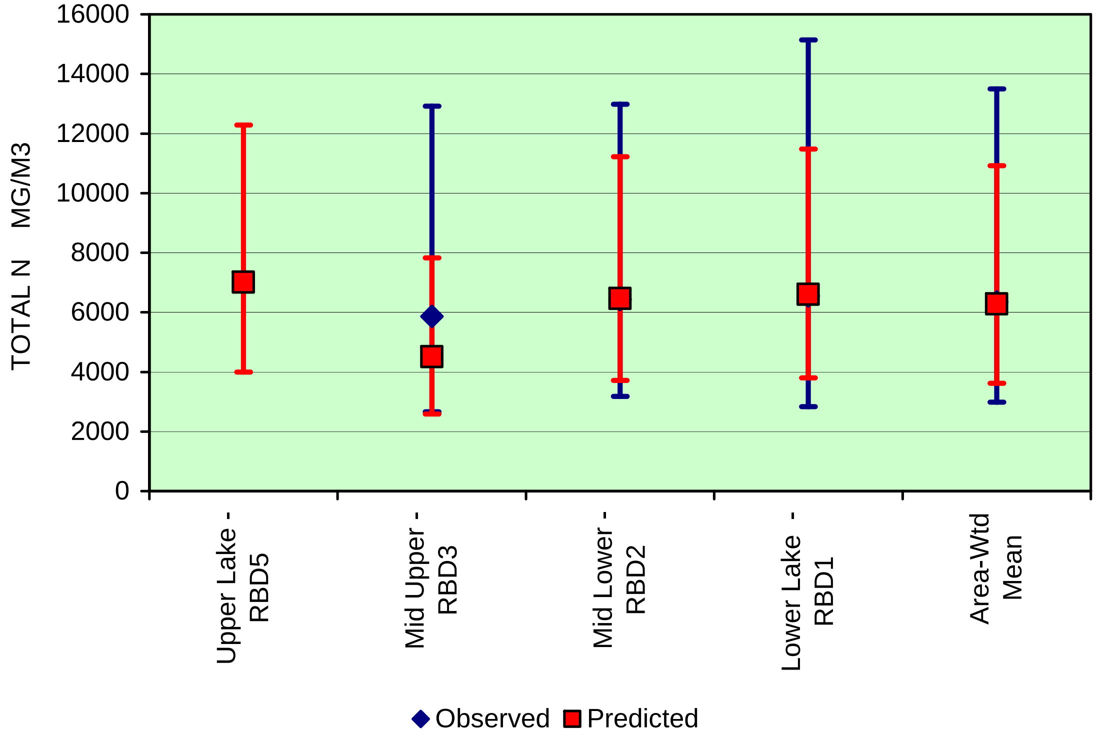
Variable: **TOTAL P MG/M3**

Segment	Predicted Mean	CV	Observed Mean	CV
Upper Lake - RBD5	91.7	0.67		
Mid Upper - RBD3	119.4	0.63	133.2	0.77
Mid Lower - RBD2	76.6	0.62	95.0	0.89
Lower Lake - RBD1	74.0	0.61	81.1	0.38
Area-Wtd Mean	85.8	0.63	99.0	0.75



Lake Vermilion TMDL Analysis (year 1997)
File: **L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration1997cal&out.btb**
Variable: **TOTAL N MG/M3**

Segment	Predicted Mean	CV	Observed Mean	CV
Upper Lake - RBD5	7007.7	0.56		
Mid Upper - RBD3	4505.8	0.55	5864.0	0.79
Mid Lower - RBD2	6460.4	0.55	6428.0	0.70
Lower Lake - RBD1	6607.6	0.55	6550.0	0.84
Area-Wtd Mean	6283.3	0.55	6347.9	0.75

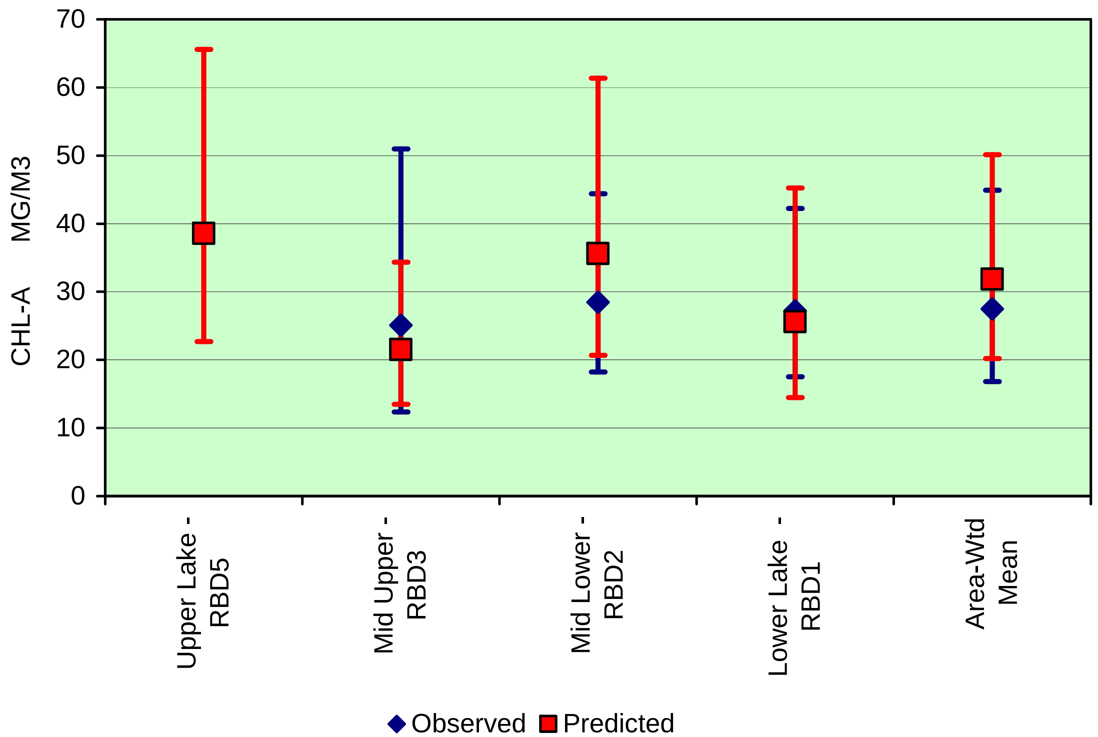


Lake Vermilion TMDL Analysis (year 1997)

File: L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration1997cal&out.btb

Variable: CHL-A MG/M3

Segment	Predicted Mean	CV	Observed Mean	CV
Upper Lake - RBD5	38.6	0.53		
Mid Upper - RBD3	21.5	0.47	25.1	0.71
Mid Lower - RBD2	35.6	0.54	28.5	0.44
Lower Lake - RBD1	25.6	0.57	27.2	0.44
Area-Wtd Mean	31.8	0.45	27.5	0.49

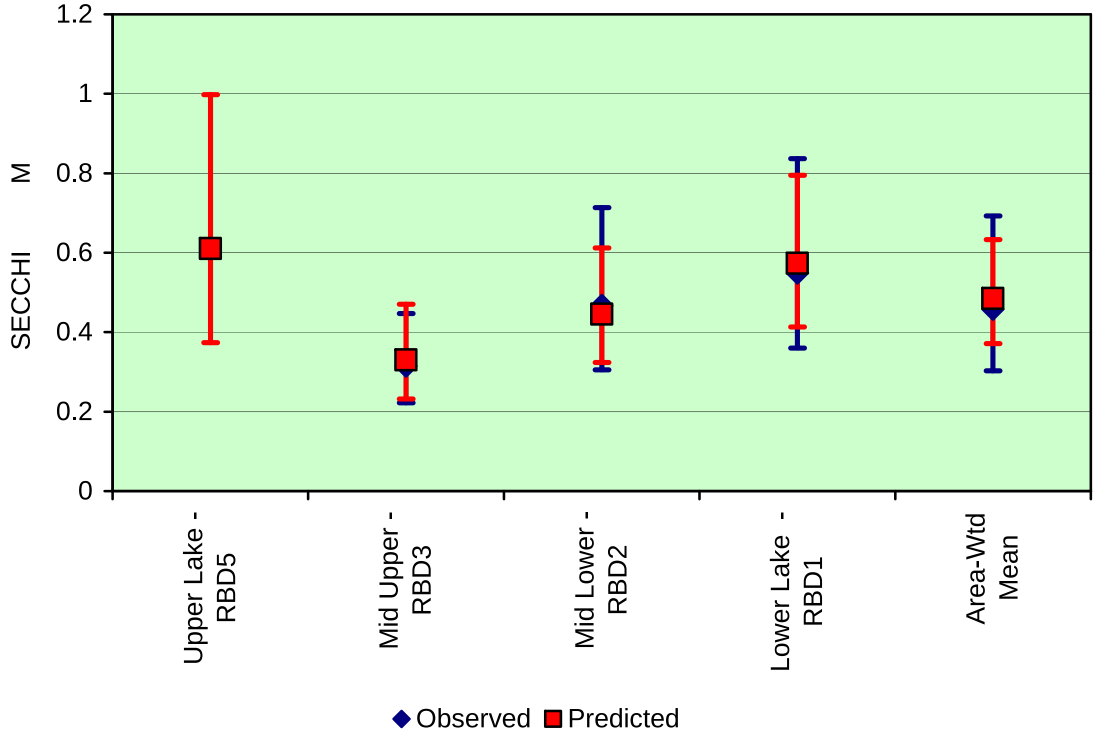


Lake Vermilion TMDL Analysis (year 1997)

File: L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration1997cal&out.btb

Variable: SECCHI M

Segment	Predicted Mean	CV	Observed Mean	CV
Upper Lake - RBD5	0.6	0.49		
Mid Upper - RBD3	0.3	0.35	0.3	0.35
Mid Lower - RBD2	0.4	0.32	0.5	0.42
Lower Lake - RBD1	0.6	0.33	0.5	0.42
Area-Wtd Mean	0.5	0.27	0.5	0.41



Lake Vermilion TMDL Analysis (year 1997)
File: L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration1997cal&out-target.btb
Description:

Reduction Target Condititions model for Lake Vermilion in 1997
TP, TN, Chl-a, and Secchi concentrations to be predicted using calibrated factors
Use Outflow from Dam

Global Variables	Mean	CV
Averaging Period (yrs)	1	0.0
Precipitation (m)	0.8	0.3
Evaporation (m)	0.82	0.0
Storage Increase (m)	0	0.0

Atmos. Loads (kg/km^2-yr)	Mean	CV
Conserv. Substance	0	0.00
Total P	30	0.50
Total N	1000	0.50
Ortho P	15	0.50
Inorganic N	500	0.50

Segment Morphometry

Seg	Name	Outflow Segment	Group	Area km^2	Depth m	Length km	Mixed Depth (m) Mean	CV
1	Upper Lake - RBD5	2	1	0.573	1.219	2.164	1.219	0
2	Mid Upper - RBD3	3	1	0.479	1.829	1.052	1.829	0
3	Mid Lower - RBD2	4	1	1.323	3.048	1.393	3.048	0
4	Lower Lake - RBD1	0	1	0.623	5.486	1.149	5.486	0

Segment Observed Water Quality

Seg	Conserv Mean	CV	Total P (ppb) Mean	CV	Total N (ppb) Mean	CV	Chl-a (ppb) Mean	CV	Secchi (m) Mean
1	0	0	0	0	0	0	0	0	0
2	0	0	133.2	0.773	5864	0.79	25.11	0.708	0.315
3	0	0	95	0.891	6428	0.703	28.45	0.445	0.467
4	0	0	81.1	0.378	6550	0.838	27.21	0.44	0.549

Segment Calibration Factors

Seg	Dispersion Rate Mean	CV	Total P (ppb) Mean	CV	Total N (ppb) Mean	CV	Chl-a (ppb) Mean	CV	Secchi (m) Mean
1	1	0	0.8	0	0.925	0	0.325	0	0.75
2	1	0	1.2	0	0.7	0	0.475	0	1.2
3	1	0	0.8	0	1.05	0	1.3	0	1.215
4	1	0	0.78	0	1.085	0	1.8	0	1.2

Tributary Data

Trib	Trib Name	Segment	Type	Dr Area km^2	Flow (hm^3/yr) Mean	CV	Conserv. Mean	CV
1	North Fork Vermilion River	1	1	764.75	270.53	0	0	0
2	Outflow at DAM	4	4	764.75	380.1	2.027	0	0

Model Options	Code	Description
Conservative Substance	0	NOT COMPUTED
Phosphorus Balance	1	2ND ORDER, AVAIL P
Nitrogen Balance	1	2ND ORDER, AVAIL N
Chlorophyll-a	2	P, LIGHT, T
Secchi Depth	1	VS. CHLA & TURBIDITY
Dispersion	1	FISCHER-NUMERIC
Phosphorus Calibration	2	CONCENTRATIONS
Nitrogen Calibration	2	CONCENTRATIONS
Error Analysis	1	MODEL & DATA
Availability Factors	0	IGNORE
Mass-Balance Tables	1	USE ESTIMATED CONCS
Output Destination	2	EXCEL WORKSHEET

				Internal Loads (mg/m2-day)					
Hypol Depth		Non-Algal Turb (m^{-1})		Conserv.		Total P		Total N	
Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
0	0	0.08	0.2	0	0	0	0	0	0
0	0	2.55	0.47	0	0	0	0	0	0
0	0	1.43	0.67	0	0	0	0	0	0
0	0	1.14	0.72	0	0	0	0	0	0

)	Organic N (ppb)		TP - Ortho P (ppb)		HOD (ppb/day)		MOD (ppb/day)	
CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
0	0	0	0	0	0	0	0	0
0.35	0	0	0	0	0	0	0	0
0.424	0	0	0	0	0	0	0	0
0.421	0	0	0	0	0	0	0	0

)	Organic N (ppb)		TP - Ortho P (ppb)		HOD (ppb/day)		MOD (ppb/day)	
CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0

Total P (ppb)		Total N (ppb)		Ortho P (ppb)		Inorganic N (ppb)	
Mean	CV	Mean	CV	Mean	CV	Mean	CV
100.075	0.592	8869.03	0.071	0	0	0	0
81.75	0.359	6622.5	0.836	0	0	0	0

Model Coefficients	**Mean**	**CV**
Dispersion Rate	1.000	0.70
Total Phosphorus	0.775	0.45
Total Nitrogen	1.200	0.55
Chl-a Model	2.400	0.26
Secchi Model	0.850	0.10
Organic N Model	1.000	0.12
TP-OP Model	1.000	0.15
HODv Model	1.000	0.15
MODv Model	1.000	0.22
Secchi/Chla Slope (m^2/mg)	0.025	0.00
Minimum Qs (m/yr)	0.100	0.00
Chl-a Flushing Term	1.000	0.00
Chl-a Temporal CV	0.620	0
Avail. Factor - Total P	0.330	0
Avail. Factor - Ortho P	1.930	0
Avail. Factor - Total N	0.590	0
Avail. Factor - Inorganic N	0.790	0

Lake Vermilion TMDL Analysis (year 1997)
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Segment & Tributary Network

--------Segment:	1	Upper Lake - RBD5		
Outflow Segment:	2	Mid Upper - RBD3		
Tributary:	1	North Fork Vermilion River	Type:	Monitored Inflow
--------Segment:	2	Mid Upper - RBD3		
Outflow Segment:	3	Mid Lower - RBD2		
--------Segment:	3	Mid Lower - RBD2		
Outflow Segment:	4	Lower Lake - RBD1		
--------Segment:	4	Lower Lake - RBD1		
Outflow Segment:	0	Out of Reservoir		
Tributary:	2	Outflow at DAM	Type:	Reservoir Outflow

Lake Vermilion TMDL Analysis (year 1997)
File: L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration1997cal&out-target.btb

Hydraulic & Dispersion Parameters

Seg	Name	Outflow Seg	Net Inflow hm^3/yr	Resid Time years	Overflow Rate m/yr	Velocity km/yr	Dispersion--------> Estimated km^2/yr	Numeric km^2/yr	Exchange hm^3/yr
1	Upper Lake - RBD5	2	270.5	0.0026	472.1	838.1	4975.6	906.8	606.9
2	Mid Upper - RBD3	3	270.5	0.0032	564.7	324.8	4055.3	170.9	3075.0
3	Mid Lower - RBD2	4	270.5	0.0149	204.4	93.4	3304.9	65.1	6732.8
4	Lower Lake - RBD1	0	270.5	0.0126	434.1	90.9	639.8	52.2	0.0

Morphometry

Seg	Name	Area km^2	Zmean m	Zmix m	Length km	Volume hm^3	Width km	L/W -
1	Upper Lake - RBD5	0.6	1.2	1.2	2.2	0.7	0.3	8.2
2	Mid Upper - RBD3	0.5	1.8	1.8	1.1	0.9	0.5	2.3
3	Mid Lower - RBD2	1.3	3.0	3.0	1.4	4.0	0.9	1.5
4	Lower Lake - RBD1	0.6	5.5	5.5	1.1	3.4	0.5	2.1
Totals		3.0	3.0			9.0		

Lake Vermilion TMDL Analysis (year 1997)
File: L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration1997cal&

Predicted & Observed Values Ranked Against CE Model Development Dataset

Segment: 5 Area-Wtd Mean

Variable	Predicted Values---> Mean	CV	Rank	Observed Values---> Mean	CV	Rank
TOTAL P MG/M3	50.2	0.65	52.1%	99.0	0.75	79.0%
TOTAL N MG/M3	6283.3	0.55	99.8%	6347.9	0.75	99.8%
C.NUTRIENT MG/M3	49.9	0.64	66.2%	96.9	0.75	89.4%
CHL-A MG/M3	22.9	0.58	87.7%	27.5	0.49	91.8%
SECCHI M	0.6	0.34	20.9%	0.5	0.41	13.0%
ORGANIC N MG/M3	776.4	0.39	83.3%			
TP-ORTHO-P MG/M3	67.3	0.36	80.2%			
ANTILOG PC-1	797.6	0.87	81.6%	1468.2	0.38	91.4%
ANTILOG PC-2	7.9	0.31	65.4%	6.9	0.29	55.1%
(N - 150) / P	127.1	0.85	99.8%	64.8	0.71	97.5%
INORGANIC N / P	4410.7	0.64	100.0%			
TURBIDITY 1/M	1.3	0.38	80.3%	1.3	0.38	80.3%
ZMIX * TURBIDITY	4.0	0.41	61.9%	4.0	0.41	61.9%
ZMIX / SECCHI	5.7	0.28	61.5%	7.3	0.25	76.6%
CHL-A * SECCHI	13.5	0.44	65.5%	12.6	0.41	61.9%
CHL-A / TOTAL P	0.5	0.39	91.8%	0.3	0.60	72.5%
FREQ(CHL-a>10) %	83.3	0.25	87.7%	90.6	0.09	91.8%
FREQ(CHL-a>20) %	45.7	0.76	87.7%	57.9	0.32	91.8%
FREQ(CHL-a>30) %	23.0	1.19	87.7%	32.5	0.54	91.8%
FREQ(CHL-a>40) %	11.8	1.55	87.7%	18.0	0.72	91.8%
FREQ(CHL-a>50) %	6.2	1.84	87.7%	10.1	0.87	91.8%
FREQ(CHL-a>60) %	3.4	2.10	87.7%	5.9	1.01	91.8%
CARLSON TSI-P	60.4	0.15	52.1%	70.2	0.10	79.0%
CARLSON TSI-CHLA	61.2	0.09	87.7%	63.1	0.05	91.8%
CARLSON TSI-SEC	68.5	0.06	79.1%	71.5	0.05	87.0%

Segment: 1 Upper Lake - RBD5

Variable	Predicted Values---> Mean	CV	Rank	Observed Values---> Mean	CV	Rank
TOTAL P MG/M3	50.9	0.68	52.7%			
TOTAL N MG/M3	7007.7	0.56	99.9%			
C.NUTRIENT MG/M3	50.7	0.68	67.0%			
CHL-A MG/M3	23.6	0.70	88.5%			
SECCHI M	1.0	0.61	43.3%			
ORGANIC N MG/M3	702.0	0.55	77.9%			
TP-ORTHO-P MG/M3	39.9	0.75	61.8%			
ANTILOG PC-1	613.2	1.27	75.8%			
ANTILOG PC-2	11.0	0.09	84.8%			
(N - 150) / P	134.7	0.87	99.9%			
INORGANIC N / P	570.6	1.56	99.9%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.1	0.20	0.0%	0.1	0.20	0.0%
ZMIX / SECCHI	1.3	0.63	1.2%			
CHL-A * SECCHI	22.5	0.13	86.8%			

CHL-A / TOTAL P	0.5	0.26	91.2%
FREQ(CHL-a>10) %	85.9	0.28	88.5%
FREQ(CHL-a>20) %	48.4	0.92	88.5%
FREQ(CHL-a>30) %	24.4	1.46	88.5%
FREQ(CHL-a>40) %	12.3	1.89	88.5%
FREQ(CHL-a>50) %	6.4	2.25	88.5%
FREQ(CHL-a>60) %	3.5	2.56	88.5%
CARLSON TSI-P	60.8	0.16	52.7%
CARLSON TSI-CHLA	61.6	0.11	88.5%
CARLSON TSI-SEC	60.7	0.15	56.7%

Segment: 2 Mid Upper - RBD3

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	70.0	0.65	66.3%	133.2	0.77	87.2%
TOTAL N MG/M3	4505.8	0.55	99.1%	5864.0	0.79	99.7%
C.NUTRIENT MG/M3	68.7	0.63	79.4%	128.3	0.78	94.5%
CHL-A MG/M3	15.9	0.58	75.4%	25.1	0.71	89.9%
SECCHI M	0.3	0.38	6.7%	0.3	0.35	5.2%
ORGANIC N MG/M3	712.4	0.29	78.8%			
TP-ORTHO-P MG/M3	84.7	0.33	86.3%			
ANTILOG PC-1	954.8	0.76	85.0%	1862.5	0.74	93.9%
ANTILOG PC-2	4.0	0.50	18.4%	4.8	0.55	29.5%
(N - 150) / P	62.2	0.85	97.2%	42.9	1.10	91.3%
INORGANIC N / P	3793.4	0.66	100.0%			
TURBIDITY 1/M	2.5	0.47	94.8%	2.5	0.47	94.8%
ZMIX * TURBIDITY	4.7	0.47	69.3%	4.7	0.47	69.3%
ZMIX / SECCHI	5.3	0.39	57.0%	5.8	0.34	63.2%
CHL-A * SECCHI	5.5	0.78	19.2%	7.9	0.79	36.0%
CHL-A / TOTAL P	0.2	0.43	59.3%	0.2	1.03	47.6%
FREQ(CHL-a>10) %	67.1	0.50	75.4%	88.0	0.25	89.9%
FREQ(CHL-a>20) %	24.9	1.19	75.4%	52.3	0.86	89.9%
FREQ(CHL-a>30) %	9.2	1.70	75.4%	27.5	1.38	89.9%
FREQ(CHL-a>40) %	3.6	2.08	75.4%	14.4	1.82	89.9%
FREQ(CHL-a>50) %	1.6	2.39	75.4%	7.8	2.18	89.9%
FREQ(CHL-a>60) %	0.7	2.65	75.4%	4.3	2.49	89.9%
CARLSON TSI-P	65.4	0.14	66.3%	74.7	0.15	87.2%
CARLSON TSI-CHLA	57.8	0.10	75.4%	62.2	0.11	89.9%
CARLSON TSI-SEC	75.3	0.07	93.3%	76.6	0.06	94.8%

Segment: 3 Mid Lower - RBD2

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	45.6	0.64	47.8%	95.0	0.89	77.7%
TOTAL N MG/M3	6460.4	0.55	99.8%	6428.0	0.70	99.8%
C.NUTRIENT MG/M3	45.4	0.64	61.8%	93.5	0.86	88.6%
CHL-A MG/M3	26.2	0.65	90.9%	28.5	0.44	92.5%
SECCHI M	0.5	0.39	15.3%	0.5	0.42	13.5%
ORGANIC N MG/M3	861.9	0.42	88.0%			
TP-ORTHO-P MG/M3	76.4	0.36	83.8%			
ANTILOG PC-1	892.0	0.86	83.8%	1452.8	0.57	91.3%
ANTILOG PC-2	8.1	0.56	66.7%	7.2	0.44	58.0%

(N - 150) / P	138.4	0.84	99.9%	66.1	1.13	97.7%
INORGANIC N / P	5598.4	0.64	100.0%			
TURBIDITY 1/M	1.4	0.67	83.4%	1.4	0.67	83.4%
ZMIX * TURBIDITY	4.4	0.67	66.2%	4.4	0.67	66.2%
ZMIX / SECCHI	6.2	0.39	66.9%	6.5	0.41	70.5%
CHL-A * SECCHI	13.0	0.80	63.3%	13.3	0.61	64.6%
CHL-A / TOTAL P	0.6	0.50	95.5%	0.3	0.97	74.7%
FREQ(CHL-a>10) %	89.3	0.21	90.9%	91.6	0.12	92.5%
FREQ(CHL-a>20) %	55.0	0.75	90.9%	60.2	0.45	92.5%
FREQ(CHL-a>30) %	29.8	1.21	90.9%	34.6	0.76	92.5%
FREQ(CHL-a>40) %	16.0	1.59	90.9%	19.5	1.02	92.5%
FREQ(CHL-a>50) %	8.8	1.90	90.9%	11.1	1.24	92.5%
FREQ(CHL-a>60) %	5.0	2.17	90.9%	6.5	1.43	92.5%
CARLSON TSI-P	59.2	0.15	47.8%	69.8	0.18	77.7%
CARLSON TSI-CHLA	62.6	0.10	90.9%	63.4	0.07	92.5%
CARLSON TSI-SEC	70.1	0.08	84.7%	71.0	0.08	86.5%

Segment: 4 Lower Lake - RBD1

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	44.2	0.64	46.5%	81.1	0.38	72.1%
TOTAL N MG/M3	6607.6	0.55	99.8%	6550.0	0.84	99.8%
C.NUTRIENT MG/M3	44.1	0.64	60.4%	80.2	0.44	84.4%
CHL-A MG/M3	20.6	0.63	84.6%	27.2	0.44	91.6%
SECCHI M	0.6	0.38	23.0%	0.5	0.42	18.7%
ORGANIC N MG/M3	712.5	0.38	78.8%			
TP-ORTHO-P MG/M3	59.6	0.30	76.5%			
ANTILOG PC-1	646.0	0.75	77.0%	1197.7	0.57	88.7%
ANTILOG PC-2	7.7	0.62	63.7%	7.9	0.44	65.0%
(N - 150) / P	146.0	0.84	99.9%	78.9	0.93	98.8%
INORGANIC N / P	5895.1	0.62	100.0%			
TURBIDITY 1/M	1.1	0.72	76.2%	1.1	0.72	76.2%
ZMIX * TURBIDITY	6.3	0.72	81.2%	6.3	0.72	81.2%
ZMIX / SECCHI	8.9	0.39	85.8%	10.0	0.41	89.8%
CHL-A * SECCHI	12.7	0.86	62.1%	14.9	0.61	70.5%
CHL-A / TOTAL P	0.5	0.61	91.3%	0.3	0.57	80.1%
FREQ(CHL-a>10) %	80.4	0.35	84.6%	90.4	0.13	91.6%
FREQ(CHL-a>20) %	39.6	0.99	84.6%	57.4	0.48	91.6%
FREQ(CHL-a>30) %	18.0	1.48	84.6%	32.0	0.79	91.6%
FREQ(CHL-a>40) %	8.4	1.87	84.6%	17.6	1.05	91.6%
FREQ(CHL-a>50) %	4.1	2.18	84.6%	9.8	1.27	91.6%
FREQ(CHL-a>60) %	2.1	2.44	84.6%	5.6	1.46	91.6%
CARLSON TSI-P	58.8	0.16	46.5%	67.5	0.08	72.1%
CARLSON TSI-CHLA	60.3	0.10	84.6%	63.0	0.07	91.6%
CARLSON TSI-SEC	67.0	0.08	77.0%	68.6	0.09	81.3%

Lake Vermilion TMDL Analysis (year 1997)
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Overall Water & Nutrient Balances

Overall Water Balance — **Averaging Period = 1.00 years**

Trb	Type	Seg	Name	Area km^2	Flow hm^3/yr	Variance $(hm3/yr)^2$	CV -	Runoff m/yr
1	1	1	North Fork Vermilion River	764.8	270.5	0.00E+00	0.00	0.35
2	4	4	Outflow at DAM	764.8	380.1	5.94E+05	2.03	0.50
PRECIPITATION				3.0	2.4	6.19E-01	0.33	0.80
TRIBUTARY INFLOW				764.8	270.5	0.00E+00	0.00	0.35
***TOTAL INFLOW				767.7	272.9	6.18E-01	0.00	0.36
GAUGED OUTFLOW				764.8	380.1	5.94E+05	2.03	0.50
ADVECTIVE OUTFLOW				3.0	-109.6	5.94E+05	7.03	
***TOTAL OUTFLOW				767.7	270.5	6.19E-01	0.00	0.35
***EVAPORATION					2.5	0.00E+00	0.00	

Overall Mass Balance Based Upon Component: **Predicted TOTAL P** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance $(kg/yr)^2$	%Total	CV	Conc mg/m^3	Export $kg/km^2/yr$
1	1	1	North Fork Vermilion River	27073.3	99.7%	2.57E+08	100.0%	0.59	100.1	35.4
2	4	4	Outflow at DAM	16810.1		1.28E+09		2.13	44.2	22.0
PRECIPITATION				89.9	0.3%	2.02E+03	0.0%	0.50	37.5	30.0
TRIBUTARY INFLOW				27073.3	99.7%	2.57E+08	100.0%	0.59	100.1	35.4
***TOTAL INFLOW				27163.2	100.0%	2.57E+08	100.0%	0.59	99.5	35.4
GAUGED OUTFLOW				16810.1	61.9%	1.28E+09		2.13	44.2	22.0
ADVECTIVE OUTFLOW				-4848.4		1.17E+09		7.06	44.2	
***TOTAL OUTFLOW				11961.7	44.0%	5.91E+07		0.64	44.2	15.6
***RETENTION				15201.6	56.0%	1.40E+08		0.78		

Overflow Rate (m/yr)	90.2	Nutrient Resid. Time (yrs)	0.0167
Hydraulic Resid. Time (yrs)	0.0334	Turnover Ratio	59.9
Reservoir Conc (mg/m3)	50	Retention Coef.	0.560

Overall Mass Balance Based Upon Component: **Predicted TOTAL N** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance $(kg/yr)^2$	%Total	CV	Conc mg/m^3	Export $kg/km^2/yr$
1	1	1	North Fork Vermilion River	2399338.8	99.9%	2.90E+10	100.0%	0.07	8869.0	3137.4
2	4	4	Outflow at DAM	2511561.0		2.78E+13		2.10	6607.6	3284.2
PRECIPITATION				2998.0	0.1%	2.25E+06	0.0%	0.50	1250.0	1000.0
TRIBUTARY INFLOW				2399338.8	99.9%	2.90E+10	100.0%	0.07	8869.0	3137.4
***TOTAL INFLOW				2402336.8	100.0%	2.90E+10	100.0%	0.07	8802.1	3129.1
GAUGED OUTFLOW				2511561.0	104.5%	2.78E+13		2.10	6607.6	3284.2
ADVECTIVE OUTFLOW				-724394.5		2.61E+13		7.05	6607.6	
***TOTAL OUTFLOW				1787166.5	74.4%	9.74E+11		0.55	6607.6	2327.8
***RETENTION				615170.3	25.6%	9.74E+11		1.60		

Overflow Rate (m/yr)	90.2	Nutrient Resid. Time (yrs)	0.0236
Hydraulic Resid. Time (yrs)	0.0334	Turnover Ratio	42.4
Reservoir Conc (mg/m3)	6283	Retention Coef.	0.256

Lake Vermilion TMDL Analysis (year 1998)
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Description:

Initial Condititions model for Lake Vermilion in 1998

TP, TN, Chl-a, and Secchi concentrations to be predicted using calibrated factors.

No observed data to compare

Global Variables	Mean	CV
Averaging Period (yrs)	1	0.0
Precipitation (m)	1.32	0.7
Evaporation (m)	0.82	0.0
Storage Increase (m)	0	0.0

Atmos. Loads (kg/km^2-yr)	Mean	CV
Conserv. Substance	0	0.00
Total P	30	0.50
Total N	1000	0.50
Ortho P	15	0.50
Inorganic N	500	0.50

Segment Morphometry

		Outflow		Area	Depth	Length	Mixed Depth (m)	
Seg	Name	Segment	Group	km^2	m	km	Mean	CV
1	Upper Lake - RBD5	2	1	0.573	1.219	2.164	1.219	0
2	Mid Upper - RBD3	3	1	0.479	1.829	1.052	1.829	0
3	Mid Lower - RBD2	4	1	1.323	3.048	1.393	3.048	0
4	Lower Lake - RBD1	0	1	0.623	5.486	1.149	5.486	0

Segment Observed Water Quality

	Conserv		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0

Segment Calibration Factors

	Dispersion Rate		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	1	0	0.8	0	0.925	0	0.325	0	0.75
2	1	0	1.2	0	0.7	0	0.475	0	1.2
3	1	0	0.8	0	1.05	0	1.3	0	1.215
4	1	0	0.78	0	1.085	0	1.8	0	1.2

Tributary Data

				Dr Area	Flow (hm^3/yr)		Conserv.	
Trib	Trib Name	Segment	Type	km^2	Mean	CV	Mean	CV
1	North Fork Vermilion River	1	1	764.75	436.815	0	0	0
2	Outfall at Dam	4	4	764.75	525.8	0	0	0

Model Coefficients	Mean	CV
Dispersion Rate	1.000	0.70
Total Phosphorus	0.775	0.45
Total Nitrogen	1.200	0.55
Chl-a Model	2.400	0.26
Secchi Model	0.850	0.10
Organic N Model	1.000	0.12
TP-OP Model	1.000	0.15
HODv Model	1.000	0.15
MODv Model	1.000	0.22
Secchi/Chla Slope (m^2/mg)	0.025	0.00
Minimum Qs (m/yr)	0.100	0.00
Chl-a Flushing Term	1.000	0.00
Chl-a Temporal CV	0.620	0
Avail. Factor - Total P	0.330	0
Avail. Factor - Ortho P	1.930	0
Avail. Factor - Total N	0.590	0
Avail. Factor - Inorganic N	0.790	0

Model Options	Code	Description
Conservative Substance	0	NOT COMPUTED
Phosphorus Balance	1	2ND ORDER, AVAIL P
Nitrogen Balance	1	2ND ORDER, AVAIL N
Chlorophyll-a	2	P, LIGHT, T
Secchi Depth	1	VS. CHLA & TURBIDITY
Dispersion	1	FISCHER-NUMERIC
Phosphorus Calibration	2	CONCENTRATIONS
Nitrogen Calibration	2	CONCENTRATIONS
Error Analysis	1	MODEL & DATA
Availability Factors	0	IGNORE
Mass-Balance Tables	1	USE ESTIMATED CONCS
Output Destination	2	EXCEL WORKSHEET

				Internal Loads (mg/m2-day)					
Hypol Depth		**Non-Algal Turb (m^{-1})**		**Conserv.**		**Total P**		**Total N**	
Mean	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0	0	0.08	0.2	0	0	0	0	0	0
0	0	0.08	0.2	0	0	0	0	0	0
0	0	0.08	0.2	0	0	0	0	0	0
0	0	0.08	0.2	0	0	0	0	0	0

)	**Organic N (ppb)**		**TP - Ortho P (ppb)**		**HOD (ppb/day)**		**MOD (ppb/day)**	
CV	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0

)	**Organic N (ppb)**		**TP - Ortho P (ppb)**		**HOD (ppb/day)**		**MOD (ppb/day)**	
CV	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0

Total P (ppb)		**Total N (ppb)**		**Ortho P (ppb)**		**Inorganic N (ppb)**	
Mean	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
393.17	0.134	3301.07	0.458	0	0	0	0
0	0	0	0	0	0	0	0

Lake Vermilion TMDL Analysis (year 1998)
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Segment & Tributary Network

--------Segment:	1	Upper Lake - RBD5		
Outflow Segment:	2	Mid Upper - RBD3		
Tributary:	1	North Fork Vermilion River	Type:	Monitored Inflow
--------Segment:	2	Mid Upper - RBD3		
Outflow Segment:	3	Mid Lower - RBD2		
--------Segment:	3	Mid Lower - RBD2		
Outflow Segment:	4	Lower Lake - RBD1		
--------Segment:	4	Lower Lake - RBD1		
Outflow Segment:	0	Out of Reservoir		
Tributary:	2	Outfall at Dam	Type:	Reservoir Outflow

Lake Vermilion TMDL Analysis (year 1998)
File: L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration1998cal&out.btb

Hydraulic & Dispersion Parameters

Seg	Name	Outflow Seg	Net Inflow hm^3/yr	Resid Time years	Overflow Rate m/yr	Velocity km/yr	Dispersion--------> Estimated km^2/yr	Numeric km^2/yr	Exchange hm^3/yr
1	Upper Lake - RBD5	2	437.1	0.0016	762.8	1354.2	8039.6	1465.2	980.6
2	Mid Upper - RBD3	3	437.3	0.0020	913.0	525.2	6556.4	276.2	4971.5
3	Mid Lower - RBD2	4	438.0	0.0092	331.1	151.3	5351.8	105.4	10902.7
4	Lower Lake - RBD1	0	438.3	0.0078	703.6	147.4	1036.9	84.7	0.0

Morphometry

Seg	Name	Area km^2	Zmean m	Zmix m	Length km	Volume hm^3	Width km	L/W -
1	Upper Lake - RBD5	0.6	1.2	1.2	2.2	0.7	0.3	8.2
2	Mid Upper - RBD3	0.5	1.8	1.8	1.1	0.9	0.5	2.3
3	Mid Lower - RBD2	1.3	3.0	3.0	1.4	4.0	0.9	1.5
4	Lower Lake - RBD1	0.6	5.5	5.5	1.1	3.4	0.5	2.1
Totals		3.0	3.0			9.0		

Lake Vermilion TMDL Analysis (year 1998)
File: **L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLake(**

Predicted & Observed Values Ranked Against CE Model Development Dataset

Segment: **5** **Area-Wtd Mean**

Variable	Predicted Values---> Mean	CV	Rank	Observed Values---> Mean	CV	Rank
TOTAL P MG/M3	157.5	0.46	90.7%			
TOTAL N MG/M3	3177.1	0.67	96.4%			
C.NUTRIENT MG/M3	129.0	0.38	94.6%			
CHL-A MG/M3	65.0	0.28	99.4%			
SECCHI M	0.6	0.28	19.9%			
ORGANIC N MG/M3	1646.0	0.28	99.3%			
TP-ORTHO-P MG/M3	113.6	0.32	91.9%			
ANTILOG PC-1	3228.4	0.49	97.5%			
ANTILOG PC-2	14.6	0.11	94.1%			
(N - 150) / P	20.2	0.83	60.0%			
INORGANIC N / P	628.2	9.91	99.9%			
TURBIDITY 1/M	0.1	0.11	1.1%	0.1	0.11	1.1%
ZMIX * TURBIDITY	0.2	0.12	0.0%	0.2	0.12	0.0%
ZMIX / SECCHI	5.4	0.28	57.8%			
CHL-A * SECCHI	36.3	0.10	96.3%			
CHL-A / TOTAL P	0.4	0.44	89.6%			
FREQ(CHL-a>10) %	99.4	0.01	99.4%			
FREQ(CHL-a>20) %	92.8	0.06	99.4%			
FREQ(CHL-a>30) %	80.1	0.14	99.4%			
FREQ(CHL-a>40) %	65.9	0.23	99.4%			
FREQ(CHL-a>50) %	52.9	0.31	99.4%			
FREQ(CHL-a>60) %	41.9	0.39	99.4%			
CARLSON TSI-P	76.9	0.09	90.7%			
CARLSON TSI-CHLA	71.3	0.04	99.4%			
CARLSON TSI-SEC	68.3	0.06	80.1%			

Segment: **1** **Upper Lake - RBD5**

Variable	Predicted Values---> Mean	CV	Rank	Observed Values---> Mean	CV	Rank
TOTAL P MG/M3	172.5	0.47	92.3%			
TOTAL N MG/M3	3190.8	0.69	96.5%			
C.NUTRIENT MG/M3	142.6	0.39	95.8%			
CHL-A MG/M3	46.3	0.31	98.1%			
SECCHI M	0.5	0.30	16.5%			
ORGANIC N MG/M3	1219.2	0.29	96.8%			
TP-ORTHO-P MG/M3	80.3	0.35	85.0%			
ANTILOG PC-1	2649.9	0.55	96.5%			
ANTILOG PC-2	10.3	0.10	81.3%			
(N - 150) / P	17.6	0.85	52.1%			
INORGANIC N / P	21.4	1.37	37.0%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.1	0.20	0.0%	0.1	0.20	0.0%
ZMIX / SECCHI	2.4	0.30	11.4%			
CHL-A * SECCHI	23.9	0.10	88.5%			

CHL-A / TOTAL P	0.3	0.40	69.0%
FREQ(CHL-a>10) %	98.5	0.02	98.1%
FREQ(CHL-a>20) %	85.2	0.13	98.1%
FREQ(CHL-a>30) %	65.2	0.28	98.1%
FREQ(CHL-a>40) %	47.1	0.42	98.1%
FREQ(CHL-a>50) %	33.2	0.54	98.1%
FREQ(CHL-a>60) %	23.4	0.65	98.1%
CARLSON TSI-P	78.4	0.09	92.3%
CARLSON TSI-CHLA	68.2	0.04	98.1%
CARLSON TSI-SEC	69.6	0.06	83.5%

Segment: 2 Mid Upper - RBD3

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	219.1	0.46	95.4%			
TOTAL N MG/M3	2276.5	0.67	90.0%			
C.NUTRIENT MG/M3	137.8	0.46	95.4%			
CHL-A MG/M3	51.2	0.27	98.6%			
SECCHI M	0.7	0.27	31.6%			
ORGANIC N MG/M3	1330.7	0.27	97.9%			
TP-ORTHO-P MG/M3	89.0	0.32	87.4%			
ANTILOG PC-1	2371.3	0.48	95.8%			
ANTILOG PC-2	14.5	0.12	93.9%			
(N - 150) / P	9.7	0.85	20.5%			
INORGANIC N / P	7.3	1.82	7.8%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.1	0.20	0.0%	0.1	0.20	0.0%
ZMIX / SECCHI	2.4	0.28	12.5%			
CHL-A * SECCHI	38.4	0.10	96.9%			
CHL-A / TOTAL P	0.2	0.45	60.9%			
FREQ(CHL-a>10) %	99.0	0.01	98.6%			
FREQ(CHL-a>20) %	88.6	0.09	98.6%			
FREQ(CHL-a>30) %	71.0	0.21	98.6%			
FREQ(CHL-a>40) %	53.5	0.32	98.6%			
FREQ(CHL-a>50) %	39.3	0.43	98.6%			
FREQ(CHL-a>60) %	28.6	0.53	98.6%			
CARLSON TSI-P	81.9	0.08	95.4%			
CARLSON TSI-CHLA	69.2	0.04	98.6%			
CARLSON TSI-SEC	64.1	0.06	68.4%			

Segment: 3 Mid Lower - RBD2

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	139.5	0.46	88.3%			
TOTAL N MG/M3	3362.6	0.67	97.1%			
C.NUTRIENT MG/M3	123.7	0.39	94.0%			
CHL-A MG/M3	79.8	0.28	99.7%			
SECCHI M	0.5	0.28	15.4%			
ORGANIC N MG/M3	1983.6	0.28	99.7%			
TP-ORTHO-P MG/M3	139.9	0.32	94.7%			
ANTILOG PC-1	3992.9	0.50	98.3%			
ANTILOG PC-2	16.3	0.11	96.1%			

(N - 150) / P	23.0	0.83	67.2%			
INORGANIC N / P	1379.1	10.17	100.0%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.2	0.20	0.0%	0.2	0.20	0.0%
ZMIX / SECCHI	6.1	0.28	66.7%			
CHL-A * SECCHI	39.7	0.10	97.3%			
CHL-A / TOTAL P	0.6	0.44	95.4%			
FREQ(CHL-a>10) %	99.9	0.00	99.7%			
FREQ(CHL-a>20) %	97.3	0.03	99.7%			
FREQ(CHL-a>30) %	89.8	0.09	99.7%			
FREQ(CHL-a>40) %	79.0	0.16	99.7%			
FREQ(CHL-a>50) %	67.2	0.24	99.7%			
FREQ(CHL-a>60) %	56.0	0.31	99.7%			
CARLSON TSI-P	75.4	0.09	88.3%			
CARLSON TSI-CHLA	73.6	0.04	99.7%			
CARLSON TSI-SEC	70.1	0.06	84.6%			

Segment: 4 Lower Lake - RBD1

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	134.6	0.46	87.5%			
TOTAL N MG/M3	3462.8	0.67	97.4%			
C.NUTRIENT MG/M3	121.0	0.39	93.6%			
CHL-A MG/M3	61.4	0.27	99.3%			
SECCHI M	0.6	0.27	24.0%			
ORGANIC N MG/M3	1563.9	0.27	99.0%			
TP-ORTHO-P MG/M3	107.2	0.31	91.0%			
ANTILOG PC-1	2795.9	0.47	96.8%			
ANTILOG PC-2	15.4	0.11	95.2%			
(N - 150) / P	24.6	0.83	70.7%			
INORGANIC N / P	69.2	2.49	80.3%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.4	0.20	0.6%	0.4	0.20	0.6%
ZMIX / SECCHI	8.7	0.27	84.9%			
CHL-A * SECCHI	38.8	0.10	97.0%			
CHL-A / TOTAL P	0.5	0.47	90.8%			
FREQ(CHL-a>10) %	99.6	0.01	99.3%			
FREQ(CHL-a>20) %	93.3	0.06	99.3%			
FREQ(CHL-a>30) %	80.1	0.15	99.3%			
FREQ(CHL-a>40) %	64.9	0.24	99.3%			
FREQ(CHL-a>50) %	50.9	0.33	99.3%			
FREQ(CHL-a>60) %	39.3	0.42	99.3%			
CARLSON TSI-P	74.8	0.09	87.5%			
CARLSON TSI-CHLA	71.0	0.04	99.3%			
CARLSON TSI-SEC	66.6	0.06	76.0%			

Lake Vermilion TMDL Analysis (year 1998)
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Overall Water & Nutrient Balances

Overall Water Balance — **Averaging Period = 1.00 years**

Trb	Type	Seg	Name	Area km^2	Flow hm^3/yr	Variance $(hm3/yr)^2$	CV -	Runoff m/yr
1	1	1	North Fork Vermilion River	764.8	436.8	0.00E+00	0.00	0.57
2	4	4	Outfall at Dam	764.8	525.8	0.00E+00	0.00	0.69
PRECIPITATION				3.0	4.0	7.83E+00	0.71	1.32
TRIBUTARY INFLOW				764.8	436.8	0.00E+00	0.00	0.57
***TOTAL INFLOW				767.7	440.8	7.83E+00	0.01	0.57
GAUGED OUTFLOW				764.8	525.8	0.00E+00	0.00	0.69
ADVECTIVE OUTFLOW				3.0	-87.5	7.83E+00	0.03	
***TOTAL OUTFLOW				767.7	438.3	7.83E+00	0.01	0.57
***EVAPORATION					2.5	0.00E+00	0.00	

Overall Mass Balance Based Upon Component: **Predicted TOTAL P** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance $(kg/yr)^2$	%Total	CV	Conc mg/m^3	Export $kg/km^2/yr$
1	1	1	North Fork Vermilion River	171742.6	99.9%	5.30E+08	100.0%	0.13	393.2	224.6
2	4	4	Outfall at Dam	70779.1		1.06E+09		0.46	134.6	92.6
PRECIPITATION				89.9	0.1%	2.02E+03	0.0%	0.50	22.7	30.0
TRIBUTARY INFLOW				171742.6	99.9%	5.30E+08	100.0%	0.13	393.2	224.6
***TOTAL INFLOW				171832.5	100.0%	5.30E+08	100.0%	0.13	389.8	223.8
GAUGED OUTFLOW				70779.1	41.2%	1.06E+09		0.46	134.6	92.6
ADVECTIVE OUTFLOW				-11776.7		2.94E+07		0.46	134.6	
***TOTAL OUTFLOW				59002.5	34.3%	7.34E+08		0.46	134.6	76.9
***RETENTION				112830.0	65.7%	1.02E+09		0.28		

Overflow Rate (m/yr)	146.2	Nutrient Resid. Time (yrs)	0.0083
Hydraulic Resid. Time (yrs)	0.0206	Turnover Ratio	120.9
Reservoir Conc (mg/m3)	158	Retention Coef.	0.657

Overall Mass Balance Based Upon Component: **Predicted TOTAL N** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance $(kg/yr)^2$	%Total	CV	Conc mg/m^3	Export $kg/km^2/yr$
1	1	1	North Fork Vermilion River	1441956.9	99.8%	4.36E+11	100.0%	0.46	3301.1	1885.5
2	4	4	Outfall at Dam	1820745.9		1.48E+12		0.67	3462.8	2380.8
PRECIPITATION				2998.0	0.2%	2.25E+06	0.0%	0.50	757.6	1000.0
TRIBUTARY INFLOW				1441956.9	99.8%	4.36E+11	100.0%	0.46	3301.1	1885.5
***TOTAL INFLOW				1444954.9	100.0%	4.36E+11	100.0%	0.46	3278.2	1882.1
GAUGED OUTFLOW				1820745.9	126.0%	1.48E+12		0.67	3462.8	2380.8
ADVECTIVE OUTFLOW				-302947.3		4.12E+10		0.67	3462.8	
***TOTAL OUTFLOW				1517798.5	105.0%	1.03E+12		0.67	3462.8	1976.9
***RETENTION				-72843.6		7.04E+11		10.00		

Overflow Rate (m/yr)	146.2	Nutrient Resid. Time (yrs)	0.0198
Hydraulic Resid. Time (yrs)	0.0206	Turnover Ratio	50.4
Reservoir Conc (mg/m3)	3177	Retention Coef.	-0.050

Lake Vermilion TMDL Analysis (year 1998)
File: L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration1998cal&out-reduction.btb
Description:

Reduction target concentration's model for Lake Vermilion in 1998

TP, TN, Chl-a, and Secchi concentrations to be predicted using calibrated factors.

No observed data to compare

Global Variables	Mean	CV
Averaging Period (yrs)	1	0.0
Precipitation (m)	1.32	0.7
Evaporation (m)	0.82	0.0
Storage Increase (m)	0	0.0

Atmos. Loads (kg/km^2-yr)	Mean	CV
Conserv. Substance	0	0.00
Total P	30	0.50
Total N	1000	0.50
Ortho P	15	0.50
Inorganic N	500	0.50

Segment Morphometry

		Outflow		Area	Depth	Length	Mixed Depth (m)	
Seg	Name	Segment	Group	km^2	m	km	Mean	CV
1	Upper Lake - RBD5	2	1	0.573	1.219	2.164	1.219	0
2	Mid Upper - RBD3	3	1	0.479	1.829	1.052	1.829	0
3	Mid Lower - RBD2	4	1	1.323	3.048	1.393	3.048	0
4	Lower Lake - RBD1	0	1	0.623	5.486	1.149	5.486	0

Segment Observed Water Quality

	Conserv		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0

Segment Calibration Factors

	Dispersion Rate		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	1	0	0.8	0	0.925	0	0.325	0	0.75
2	1	0	1.2	0	0.7	0	0.475	0	1.2
3	1	0	0.8	0	1.05	0	1.3	0	1.215
4	1	0	0.78	0	1.085	0	1.8	0	1.2

Tributary Data

				Dr Area	Flow (hm^3/yr)		Conserv.	
Trib	Trib Name	Segment	Type	km^2	Mean	CV	Mean	CV
1	North Fork Vermilion River	1	1	764.75	436.815	0	0	0
2	Outfall at Dam	4	4	764.75	525.8	0	0	0

Model Coefficients	Mean	CV

Model Options	Code	Description
Conservative Substance	0	NOT COMPUTED
Phosphorus Balance	1	2ND ORDER, AVAIL P
Nitrogen Balance	1	2ND ORDER, AVAIL N
Chlorophyll-a	2	P, LIGHT, T
Secchi Depth	1	VS. CHLA & TURBIDITY
Dispersion	1	FISCHER-NUMERIC
Phosphorus Calibration	2	CONCENTRATIONS
Nitrogen Calibration	2	CONCENTRATIONS
Error Analysis	1	MODEL & DATA
Availability Factors	0	IGNORE
Mass-Balance Tables	1	USE ESTIMATED CONCS
Output Destination	2	EXCEL WORKSHEET

				Internal Loads (mg/m2-day)					
Hypol Depth		Non-Algal Turb (m^{-1})		Conserv.		Total P		Total N	
Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
0	0	0.08	0.2	0	0	0	0	0	0
0	0	0.08	0.2	0	0	0	0	0	0
0	0	0.08	0.2	0	0	0	0	0	0
0	0	0.08	0.2	0	0	0	0	0	0

)	Organic N (ppb)		TP - Ortho P (ppb)		HOD (ppb/day)		MOD (ppb/day)	
CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0

)	Organic N (ppb)		TP - Ortho P (ppb)		HOD (ppb/day)		MOD (ppb/day)	
CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0

Total P (ppb)		Total N (ppb)		Ortho P (ppb)		Inorganic N (ppb)	
Mean	CV	Mean	CV	Mean	CV	Mean	CV
90.43	0.134	3301.07	0.458	0	0	0	0
0	0	0	0	0	0	0	0

Dispersion Rate	1.000	0.70
Total Phosphorus	0.775	0.45
Total Nitrogen	1.200	0.55
Chl-a Model	2.400	0.26
Secchi Model	0.850	0.10
Organic N Model	1.000	0.12
TP-OP Model	1.000	0.15
HODv Model	1.000	0.15
MODv Model	1.000	0.22
Secchi/Chla Slope (m^2/mg)	0.025	0.00
Minimum Qs (m/yr)	0.100	0.00
Chl-a Flushing Term	1.000	0.00
Chl-a Temporal CV	0.620	0
Avail. Factor - Total P	0.330	0
Avail. Factor - Ortho P	1.930	0
Avail. Factor - Total N	0.590	0
Avail. Factor - Inorganic N	0.790	0

Lake Vermilion TMDL Analysis (year 1998)
File: L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration1998cal&out-reduction.btb

Segment & Tributary Network

--------Segment:	1	Upper Lake - RBD5		
Outflow Segment:	2	Mid Upper - RBD3		
Tributary:	1	North Fork Vermilion River	Type:	Monitored Inflow
--------Segment:	2	Mid Upper - RBD3		
Outflow Segment:	3	Mid Lower - RBD2		
--------Segment:	3	Mid Lower - RBD2		
Outflow Segment:	4	Lower Lake - RBD1		
--------Segment:	4	Lower Lake - RBD1		
Outflow Segment:	0	Out of Reservoir		
Tributary:	2	Outfall at Dam	Type:	Reservoir Outflow

Lake Vermilion TMDL Analysis (year 1998)
File: L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration1998cal&out-reduction.btb

Hydraulic & Dispersion Parameters

Seg	Name	Outflow Seg	Net Inflow hm^3/yr	Resid Time years	Overflow Rate m/yr	Velocity km/yr	Dispersion--------> Estimated km^2/yr	Numeric km^2/yr	Exchange hm^3/yr
1	Upper Lake - RBD5	2	437.1	0.0016	762.8	1354.2	8039.6	1465.2	980.6
2	Mid Upper - RBD3	3	437.3	0.0020	913.0	525.2	6556.4	276.2	4971.5
3	Mid Lower - RBD2	4	438.0	0.0092	331.1	151.3	5351.8	105.4	10902.7
4	Lower Lake - RBD1	0	438.3	0.0078	703.6	147.4	1036.9	84.7	0.0

Morphometry

Seg	Name	Area km^2	Zmean m	Zmix m	Length km	Volume hm^3	Width km	L/W -
1	Upper Lake - RBD5	0.6	1.2	1.2	2.2	0.7	0.3	8.2
2	Mid Upper - RBD3	0.5	1.8	1.8	1.1	0.9	0.5	2.3
3	Mid Lower - RBD2	1.3	3.0	3.0	1.4	4.0	0.9	1.5
4	Lower Lake - RBD1	0.6	5.5	5.5	1.1	3.4	0.5	2.1
Totals		3.0	3.0			9.0		

Lake Vermilion TMDL Analysis (year 1998)
File: **L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration**

Predicted & Observed Values Ranked Against CE Model Development Dataset

Segment: 5 Area-Wtd Mean

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	49.6	0.46	51.5%			
TOTAL N MG/M3	3177.1	0.67	96.4%			
C.NUTRIENT MG/M3	48.2	0.44	64.7%			
CHL-A MG/M3	41.0	0.39	97.2%			
SECCHI M	0.9	0.37	40.2%			
ORGANIC N MG/M3	1098.5	0.35	95.0%			
TP-ORTHO-P MG/M3	70.8	0.42	81.7%			
ANTILOG PC-1	980.9	0.72	85.5%			
ANTILOG PC-2	16.4	0.09	96.2%			
(N - 150) / P	63.7	0.84	97.4%			
INORGANIC N / P	1426.8	1.09	100.0%			
TURBIDITY 1/M	0.1	0.11	1.1%	0.1	0.11	1.1%
ZMIX * TURBIDITY	0.2	0.12	0.0%	0.2	0.12	0.0%
ZMIX / SECCHI	3.6	0.36	31.2%			
CHL-A * SECCHI	35.2	0.10	96.0%			
CHL-A / TOTAL P	0.9	0.31	99.0%			
FREQ(CHL-a>10) %	94.8	0.06	97.2%			
FREQ(CHL-a>20) %	75.3	0.23	97.2%			
FREQ(CHL-a>30) %	54.9	0.39	97.2%			
FREQ(CHL-a>40) %	38.7	0.54	97.2%			
FREQ(CHL-a>50) %	27.1	0.68	97.2%			
FREQ(CHL-a>60) %	19.0	0.80	97.2%			
CARLSON TSI-P	60.2	0.11	51.5%			
CARLSON TSI-CHLA	66.5	0.06	97.2%			
CARLSON TSI-SEC	61.8	0.09	59.8%			

Segment: 1 Upper Lake - RBD5

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	48.9	0.47	50.9%			
TOTAL N MG/M3	3190.8	0.69	96.5%			
C.NUTRIENT MG/M3	48.0	0.45	64.4%			
CHL-A MG/M3	21.0	0.50	85.3%			
SECCHI M	1.1	0.43	48.6%			
ORGANIC N MG/M3	642.7	0.39	72.5%			
TP-ORTHO-P MG/M3	35.2	0.55	56.7%			
ANTILOG PC-1	513.6	0.86	71.4%			
ANTILOG PC-2	10.9	0.09	84.1%			
(N - 150) / P	62.2	0.85	97.2%			
INORGANIC N / P	187.3	1.33	96.8%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.1	0.20	0.0%	0.1	0.20	0.0%
ZMIX / SECCHI	1.2	0.44	0.8%			
CHL-A * SECCHI	22.1	0.12	86.3%			

CHL-A / TOTAL P	0.4	0.26	89.2%
FREQ(CHL-a>10) %	81.3	0.26	85.3%
FREQ(CHL-a>20) %	41.0	0.75	85.3%
FREQ(CHL-a>30) %	18.9	1.15	85.3%
FREQ(CHL-a>40) %	8.9	1.47	85.3%
FREQ(CHL-a>50) %	4.4	1.73	85.3%
FREQ(CHL-a>60) %	2.3	1.95	85.3%
CARLSON TSI-P	60.2	0.11	50.9%
CARLSON TSI-CHLA	60.5	0.08	85.3%
CARLSON TSI-SEC	59.3	0.11	51.4%

Segment: 2 Mid Upper - RBD3

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	69.1	0.46	65.8%			
TOTAL N MG/M3	2276.5	0.67	90.0%			
C.NUTRIENT MG/M3	64.4	0.41	76.9%			
CHL-A MG/M3	32.9	0.38	94.8%			
SECCHI M	1.1	0.36	52.4%			
ORGANIC N MG/M3	913.4	0.34	90.1%			
TP-ORTHO-P MG/M3	56.4	0.43	74.7%			
ANTILOG PC-1	856.8	0.69	83.0%			
ANTILOG PC-2	15.5	0.09	95.3%			
(N - 150) / P	30.8	0.85	80.8%			
INORGANIC N / P	107.1	2.23	90.2%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.1	0.20	0.0%	0.1	0.20	0.0%
ZMIX / SECCHI	1.6	0.36	3.2%			
CHL-A * SECCHI	37.2	0.11	96.6%			
CHL-A / TOTAL P	0.5	0.32	91.9%			
FREQ(CHL-a>10) %	94.6	0.07	94.8%			
FREQ(CHL-a>20) %	68.9	0.31	94.8%			
FREQ(CHL-a>30) %	43.6	0.55	94.8%			
FREQ(CHL-a>40) %	26.6	0.76	94.8%			
FREQ(CHL-a>50) %	16.2	0.94	94.8%			
FREQ(CHL-a>60) %	10.1	1.10	94.8%			
CARLSON TSI-P	65.2	0.10	65.8%			
CARLSON TSI-CHLA	64.9	0.06	94.8%			
CARLSON TSI-SEC	58.2	0.09	47.6%			

Segment: 3 Mid Lower - RBD2

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	45.4	0.46	47.6%			
TOTAL N MG/M3	3362.6	0.67	97.1%			
C.NUTRIENT MG/M3	44.7	0.45	61.1%			
CHL-A MG/M3	50.6	0.39	98.6%			
SECCHI M	0.8	0.37	32.7%			
ORGANIC N MG/M3	1317.0	0.36	97.7%			
TP-ORTHO-P MG/M3	87.9	0.43	87.1%			
ANTILOG PC-1	1204.5	0.74	88.8%			
ANTILOG PC-2	18.3	0.09	97.7%			

(N - 150) / P	70.8	0.83	98.2%			
INORGANIC N / P	2045.7	1.12	100.0%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.2	0.20	0.0%	0.2	0.20	0.0%
ZMIX / SECCHI	4.0	0.38	37.6%			
CHL-A * SECCHI	38.9	0.10	97.1%			
CHL-A / TOTAL P	1.1	0.31	99.7%			
FREQ(CHL-a>10) %	98.9	0.02	98.6%			
FREQ(CHL-a>20) %	88.3	0.14	98.6%			
FREQ(CHL-a>30) %	70.3	0.30	98.6%			
FREQ(CHL-a>40) %	52.8	0.47	98.6%			
FREQ(CHL-a>50) %	38.6	0.62	98.6%			
FREQ(CHL-a>60) %	27.9	0.76	98.6%			
CARLSON TSI-P	59.2	0.11	47.6%			
CARLSON TSI-CHLA	69.1	0.05	98.6%			
CARLSON TSI-SEC	63.8	0.09	67.3%			

Segment: 4 Lower Lake - RBD1

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	44.1	0.46	46.3%			
TOTAL N MG/M3	3462.8	0.67	97.4%			
C.NUTRIENT MG/M3	43.5	0.45	59.8%			
CHL-A MG/M3	45.3	0.33	98.0%			
SECCHI M	0.8	0.32	37.1%			
ORGANIC N MG/M3	1195.8	0.31	96.5%			
TP-ORTHO-P MG/M3	78.4	0.37	84.4%			
ANTILOG PC-1	1031.2	0.64	86.4%			
ANTILOG PC-2	17.9	0.10	97.4%			
(N - 150) / P	75.1	0.83	98.5%			
INORGANIC N / P	2267.0	1.03	100.0%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.4	0.20	0.6%	0.4	0.20	0.6%
ZMIX / SECCHI	6.5	0.33	70.4%			
CHL-A * SECCHI	38.1	0.10	96.9%			
CHL-A / TOTAL P	1.0	0.36	99.5%			
FREQ(CHL-a>10) %	98.3	0.02	98.0%			
FREQ(CHL-a>20) %	84.3	0.15	98.0%			
FREQ(CHL-a>30) %	63.9	0.31	98.0%			
FREQ(CHL-a>40) %	45.6	0.46	98.0%			
FREQ(CHL-a>50) %	31.9	0.60	98.0%			
FREQ(CHL-a>60) %	22.3	0.72	98.0%			
CARLSON TSI-P	58.7	0.11	46.3%			
CARLSON TSI-CHLA	68.0	0.05	98.0%			
CARLSON TSI-SEC	62.5	0.07	62.9%			

Lake Vermilion TMDL Analysis (year 1998)
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Overall Water & Nutrient Balances

Overall Water Balance — **Averaging Period = 1.00 years**

Trb	Type	Seg	Name	Area km^2	Flow hm^3/yr	Variance $(hm3/yr)^2$	CV -	Runoff m/yr
1	1	1	North Fork Vermilion River	764.8	436.8	0.00E+00	0.00	0.57
2	4	4	Outfall at Dam	764.8	525.8	0.00E+00	0.00	0.69
PRECIPITATION				3.0	4.0	7.83E+00	0.71	1.32
TRIBUTARY INFLOW				764.8	436.8	0.00E+00	0.00	0.57
***TOTAL INFLOW				767.7	440.8	7.83E+00	0.01	0.57
GAUGED OUTFLOW				764.8	525.8	0.00E+00	0.00	0.69
ADVECTIVE OUTFLOW				3.0	-87.5	7.83E+00	0.03	
***TOTAL OUTFLOW				767.7	438.3	7.83E+00	0.01	0.57
***EVAPORATION					2.5	0.00E+00	0.00	

Overall Mass Balance Based Upon Component: **Predicted TOTAL P** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance $(kg/yr)^2$	Load Variance %Total	CV	Conc mg/m^3	Export $kg/km^2/yr$
1	1	1	North Fork Vermilion River	39501.2	99.8%	2.80E+07	100.0%	0.13	90.4	51.7
2	4	4	Outfall at Dam	23179.3		1.15E+08		0.46	44.1	30.3
PRECIPITATION				89.9	0.2%	2.02E+03	0.0%	0.50	22.7	30.0
TRIBUTARY INFLOW				39501.2	99.8%	2.80E+07	100.0%	0.13	90.4	51.7
***TOTAL INFLOW				39591.1	100.0%	2.80E+07	100.0%	0.13	89.8	51.6
GAUGED OUTFLOW				23179.3	58.5%	1.15E+08		0.46	44.1	30.3
ADVECTIVE OUTFLOW				-3856.7		3.22E+06		0.46	44.1	
***TOTAL OUTFLOW				19322.6	48.8%	8.02E+07		0.46	44.1	25.2
***RETENTION				20268.5	51.2%	8.55E+07		0.46		

Overflow Rate (m/yr)	146.2	Nutrient Resid. Time (yrs)	0.0113
Hydraulic Resid. Time (yrs)	0.0206	Turnover Ratio	88.5
Reservoir Conc (mg/m3)	50	Retention Coef.	0.512

Overall Mass Balance Based Upon Component: **Predicted TOTAL N** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance $(kg/yr)^2$	Load Variance %Total	CV	Conc mg/m^3	Export $kg/km^2/yr$
1	1	1	North Fork Vermilion River	1441956.9	99.8%	4.36E+11	100.0%	0.46	3301.1	1885.5
2	4	4	Outfall at Dam	1820745.9		1.48E+12		0.67	3462.8	2380.8
PRECIPITATION				2998.0	0.2%	2.25E+06	0.0%	0.50	757.6	1000.0
TRIBUTARY INFLOW				1441956.9	99.8%	4.36E+11	100.0%	0.46	3301.1	1885.5
***TOTAL INFLOW				1444954.9	100.0%	4.36E+11	100.0%	0.46	3278.2	1882.1
GAUGED OUTFLOW				1820745.9	126.0%	1.48E+12		0.67	3462.8	2380.8
ADVECTIVE OUTFLOW				-302947.3		4.12E+10		0.67	3462.8	
***TOTAL OUTFLOW				1517798.5	105.0%	1.03E+12		0.67	3462.8	1976.9
***RETENTION				-72843.6		7.04E+11		10.00		

Overflow Rate (m/yr)	146.2	Nutrient Resid. Time (yrs)	0.0198
Hydraulic Resid. Time (yrs)	0.0206	Turnover Ratio	50.4
Reservoir Conc (mg/m3)	3177	Retention Coef.	-0.050

Lake Vermilion TMDL Analysis (year 2000)
File: **L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration2000cal&out.btb**
Description:

Initial Condititions model for Lake Vermilion in 2000

TP, TN, Chl-a, and Secchi concentrations to be predicted using calibrated factors

Global Variables	Mean	CV
Averaging Period (yrs)	1	0.0
Precipitation (m)	0.91	0.6
Evaporation (m)	0.82	0.0
Storage Increase (m)	0	0.0

Atmos. Loads (kg/km^2-yr)	Mean	CV
Conserv. Substance	0	0.00
Total P	30	0.50
Total N	1000	0.50
Ortho P	15	0.50
Inorganic N	500	0.50

Segment Morphometry

		Outflow		Area	Depth	Length	Mixed Depth (m)	
Seg	Name	Segment	Group	km^2	m	km	Mean	CV
1	Upper Lake - RBD5	2	1	0.573	1.219	2.164	1.219	0
2	Mid Upper - RBD3	3	1	0.479	1.829	1.052	1.829	0
3	Mid Lower - RBD2	4	1	1.323	3.048	1.393	3.048	0
4	Lower Lake - RBD1	0	1	0.623	5.486	1.149	5.486	0

Segment Observed Water Quality

	Conserv		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	0	0	72.4	0.56	7544	0.669	33.43	0.625	0.343
2	0	0	90.5	0.695	2725	0.745	25.11	0.708	0.315
3	0	0	47.27	0.395	5521.7	0.865	69.94	0.886	0.427
4	0	0	53.697	0.547	5571.7	0.791	40.31	0.532	0.569

Segment Calibration Factors

	Dispersion Rate		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	1	0	0.8	0	0.925	0	0.325	0	0.75
2	1	0	1.2	0	0.7	0	0.475	0	1.2
3	1	0	0.8	0	1.05	0	1.3	0	1.215
4	1	0	0.78	0	1.085	0	1.8	0	1.2

Tributary Data

				Dr Area	Flow (hm^3/yr)		Conserv.
Trib	Trib Name	Segment	Type	km^2	Mean	CV	Mean
1	North Fork Vermilion River	1	1	764.75	90.595	0	0
2	Outflow at Dam	4	4	764.75	91.483	0	0

Model Options	Code	Description
Conservative Substance	0	NOT COMPUTED
Phosphorus Balance	1	2ND ORDER, AVAIL P
Nitrogen Balance	1	2ND ORDER, AVAIL N
Chlorophyll-a	2	P, LIGHT, T
Secchi Depth	1	VS. CHLA & TURBIDITY
Dispersion	1	FISCHER-NUMERIC
Phosphorus Calibration	2	CONCENTRATIONS
Nitrogen Calibration	2	CONCENTRATIONS
Error Analysis	1	MODEL & DATA
Availability Factors	0	IGNORE
Mass-Balance Tables	1	USE ESTIMATED CONCS
Output Destination	2	EXCEL WORKSHEET

				Internal Loads (mg/m2-day)					
Hypol Depth		**Non-Algal Turb (m^{-1})**		**Conserv.**		**Total P**		**Total N**	
Mean	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0	0	2.08	0.4	0	0	0	0	0	0
0	0	2.55	0.47	0	0	0	0	0	0
0	0	0.59	2.86	0	0	0	0	0	0
0	0	0.75	1.12	0	0	0	0	0	0

)	**Organic N (ppb)**		**TP - Ortho P (ppb)**		**HOD (ppb/day)**		**MOD (ppb/day)**	
CV	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0.222	0	0	0	0	0	0	0	0
0.35	0	0	0	0	0	0	0	0
0.299	0	0	0	0	0	0	0	0
0.37	0	0	0	0	0	0	0	0

)	**Organic N (ppb)**		**TP - Ortho P (ppb)**		**HOD (ppb/day)**		**MOD (ppb/day)**	
CV	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0

Total P (ppb)		**Total N (ppb)**		**Ortho P (ppb)**		**Inorganic N (ppb)**	
Mean	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
210	0.112	11936.9	0.058	0	0	0	0
132.5	0.102	10356.61	0.095	0	0	0	0

Model Coefficients	Mean	CV
Dispersion Rate	1.000	0.70
Total Phosphorus	0.775	0.45
Total Nitrogen	1.200	0.55
Chl-a Model	2.400	0.26
Secchi Model	0.850	0.10
Organic N Model	1.000	0.12
TP-OP Model	1.000	0.15
HODv Model	1.000	0.15
MODv Model	1.000	0.22
Secchi/Chla Slope (m^2/mg)	0.025	0.00
Minimum Qs (m/yr)	0.100	0.00
Chl-a Flushing Term	1.000	0.00
Chl-a Temporal CV	0.620	0
Avail. Factor - Total P	0.330	0
Avail. Factor - Ortho P	1.930	0
Avail. Factor - Total N	0.590	0
Avail. Factor - Inorganic N	0.790	0

Lake Vermilion TMDL Analysis (year 2000)
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Segment & Tributary Network

--------Segment:	1	Upper Lake - RBD5		
Outflow Segment:	2	Mid Upper - RBD3		
Tributary:	1	North Fork Vermilion River	Type:	Monitored Inflow
--------Segment:	2	Mid Upper - RBD3		
Outflow Segment:	3	Mid Lower - RBD2		
--------Segment:	3	Mid Lower - RBD2		
Outflow Segment:	4	Lower Lake - RBD1		
--------Segment:	4	Lower Lake - RBD1		
Outflow Segment:	0	Out of Reservoir		
Tributary:	2	Outflow at Dam	Type:	Reservoir Outflow

Lake Vermilion TMDL Analysis (year 2000)
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Hydraulic & Dispersion Parameters

Seg	Name	Outflow Seg	Net Inflow hm^3/yr	Resid Time years	Overflow Rate m/yr	Velocity km/yr	Dispersion--------> Estimated km^2/yr	Numeric km^2/yr	Exchange hm^3/yr
1	Upper Lake - RBD5	2	90.6	0.0077	158.2	280.8	1667.3	303.9	203.4
2	Mid Upper - RBD3	3	90.7	0.0097	189.3	108.9	1359.6	57.3	1030.9
3	Mid Lower - RBD2	4	90.8	0.0444	68.6	31.4	1109.6	21.8	2260.4
4	Lower Lake - RBD1	0	90.9	0.0376	145.9	30.5	214.9	17.5	0.0

Morphometry

Seg	Name	Area km^2	Zmean m	Zmix m	Length km	Volume hm^3	Width km	L/W -
1	Upper Lake - RBD5	0.6	1.2	1.2	2.2	0.7	0.3	8.2
2	Mid Upper - RBD3	0.5	1.8	1.8	1.1	0.9	0.5	2.3
3	Mid Lower - RBD2	1.3	3.0	3.0	1.4	4.0	0.9	1.5
4	Lower Lake - RBD1	0.6	5.5	5.5	1.1	3.4	0.5	2.1
Totals		3.0	3.0			9.0		

Lake Vermilion TMDL Analysis (year 2000)
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Predicted & Observed Values Ranked Against CE Model Development Dataset

Segment: 5 Area-Wtd Mean

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	69.0	0.46	65.8%	60.3	0.53	60.1%
TOTAL N MG/M3	5649.6	0.55	99.7%	5471.8	0.79	99.6%
C.NUTRIENT MG/M3	67.9	0.44	78.9%	58.9	0.56	73.4%
CHL-A MG/M3	45.5	0.65	98.0%	49.6	0.78	98.5%
SECCHI M	0.4	0.27	11.0%	0.4	0.31	10.8%
ORGANIC N MG/M3	1286.3	0.50	97.5%			
TP-ORTHO-P MG/M3	105.8	0.41	90.8%			
ANTILOG PC-1	1856.0	0.73	93.9%	2714.9	0.55	96.7%
ANTILOG PC-2	10.9	0.52	84.2%	9.6	0.38	77.4%
(N - 150) / P	83.0	0.72	99.0%	95.2	0.58	99.4%
INORGANIC N / P	4363.2	0.73	100.0%			
TURBIDITY 1/M	1.2	0.66	78.5%	1.2	0.66	78.5%
ZMIX * TURBIDITY	2.9	0.87	45.4%	2.9	0.87	45.4%
ZMIX / SECCHI	6.7	0.25	72.4%	6.8	0.18	72.5%
CHL-A * SECCHI	20.7	0.69	84.2%	21.4	0.60	85.2%
CHL-A / TOTAL P	0.7	0.62	98.0%	0.9	0.69	99.3%
FREQ(CHL-a>10) %	95.8	0.06	98.0%	96.5	0.04	98.5%
FREQ(CHL-a>20) %	78.0	0.24	98.0%	80.4	0.15	98.5%
FREQ(CHL-a>30) %	58.9	0.47	98.0%	62.4	0.29	98.5%
FREQ(CHL-a>40) %	43.4	0.72	98.0%	47.4	0.48	98.5%
FREQ(CHL-a>50) %	31.9	0.98	98.0%	35.9	0.70	98.5%
FREQ(CHL-a>60) %	23.4	1.24	98.0%	27.2	0.94	98.5%
CARLSON TSI-P	64.9	0.10	65.8%	62.8	0.06	60.1%
CARLSON TSI-CHLA	67.4	0.08	98.0%	68.2	0.06	98.5%
CARLSON TSI-SEC	73.0	0.05	89.0%	72.7	0.03	89.2%

Segment: 1 Upper Lake - RBD5

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	81.3	0.48	72.2%	72.4	0.56	67.7%
TOTAL N MG/M3	7367.0	0.57	99.9%	7544.0	0.67	99.9%
C.NUTRIENT MG/M3	80.6	0.47	84.6%	71.9	0.57	80.9%
CHL-A MG/M3	26.0	0.50	90.7%	33.4	0.63	95.0%
SECCHI M	0.2	0.30	2.2%	0.3	0.22	6.6%
ORGANIC N MG/M3	907.0	0.34	89.8%			
TP-ORTHO-P MG/M3	91.5	0.32	88.0%			
ANTILOG PC-1	1806.4	0.69	93.6%	2257.3	0.63	95.5%
ANTILOG PC-2	4.3	0.37	22.6%	6.3	0.45	48.1%
(N - 150) / P	88.7	0.72	99.2%	102.1	0.87	99.6%
INORGANIC N / P	6460.0	0.65	100.0%			
TURBIDITY 1/M	2.1	0.40	91.9%	2.1	0.40	91.9%
ZMIX * TURBIDITY	2.5	0.40	39.0%	2.5	0.40	39.0%
ZMIX / SECCHI	5.2	0.31	56.2%	3.6	0.22	30.7%

CHL-A * SECCHI	6.1	0.56	23.2%	11.5	0.66	56.6%
CHL-A / TOTAL P	0.3	0.31	77.9%	0.5	0.83	91.1%
FREQ(CHL-a>10) %	89.1	0.16	90.7%	94.9	0.11	95.0%
FREQ(CHL-a>20) %	54.6	0.58	90.7%	69.8	0.49	95.0%
FREQ(CHL-a>30) %	29.5	0.95	90.7%	44.6	0.88	95.0%
FREQ(CHL-a>40) %	15.8	1.25	90.7%	27.4	1.22	95.0%
FREQ(CHL-a>50) %	8.6	1.50	90.7%	16.9	1.52	95.0%
FREQ(CHL-a>60) %	4.9	1.71	90.7%	10.5	1.77	95.0%
CARLSON TSI-P	67.6	0.10	72.2%	65.9	0.12	67.7%
CARLSON TSI-CHLA	62.6	0.08	90.7%	65.0	0.09	95.0%
CARLSON TSI-SEC	81.0	0.05	97.8%	75.4	0.04	93.4%

Segment: 2 Mid Upper - RBD3

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	95.8	0.46	77.9%	90.5	0.69	76.0%
TOTAL N MG/M3	4052.8	0.55	98.5%	2725.0	0.75	94.1%
C.NUTRIENT MG/M3	91.9	0.42	88.1%	83.4	0.71	85.6%
CHL-A MG/M3	27.3	0.46	91.7%	25.1	0.71	89.9%
SECCHI M	0.3	0.34	5.3%	0.3	0.35	5.2%
ORGANIC N MG/M3	971.7	0.28	92.0%			
TP-ORTHO-P MG/M3	104.9	0.28	90.6%			
ANTILOG PC-1	1779.9	0.56	93.5%	1862.5	0.74	93.9%
ANTILOG PC-2	5.4	0.44	37.0%	4.8	0.55	29.5%
(N - 150) / P	40.7	0.72	90.0%	28.5	1.04	77.5%
INORGANIC N / P	3081.1	0.73	100.0%			
TURBIDITY 1/M	2.5	0.47	94.8%	2.5	0.47	94.8%
ZMIX * TURBIDITY	4.7	0.47	69.3%	4.7	0.47	69.3%
ZMIX / SECCHI	5.8	0.34	63.1%	5.8	0.34	63.2%
CHL-A * SECCHI	8.6	0.64	40.6%	7.9	0.79	36.0%
CHL-A / TOTAL P	0.3	0.39	72.2%	0.3	0.98	70.8%
FREQ(CHL-a>10) %	90.5	0.14	91.7%	88.0	0.25	89.9%
FREQ(CHL-a>20) %	57.6	0.50	91.7%	52.3	0.86	89.9%
FREQ(CHL-a>30) %	32.2	0.82	91.7%	27.5	1.38	89.9%
FREQ(CHL-a>40) %	17.7	1.09	91.7%	14.4	1.82	89.9%
FREQ(CHL-a>50) %	9.9	1.31	91.7%	7.8	2.18	89.9%
FREQ(CHL-a>60) %	5.7	1.50	91.7%	4.3	2.49	89.9%
CARLSON TSI-P	69.9	0.09	77.9%	69.1	0.14	76.0%
CARLSON TSI-CHLA	63.0	0.07	91.7%	62.2	0.11	89.9%
CARLSON TSI-SEC	76.6	0.06	94.7%	76.6	0.06	94.8%

Segment: 3 Mid Lower - RBD2

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	59.6	0.46	59.6%	47.3	0.40	49.4%
TOTAL N MG/M3	5518.4	0.55	99.6%	5521.7	0.87	99.6%
C.NUTRIENT MG/M3	59.0	0.45	73.5%	47.0	0.44	63.5%
CHL-A MG/M3	61.5	0.93	99.3%	69.9	0.89	99.5%
SECCHI M	0.5	0.36	14.6%	0.4	0.30	11.1%
ORGANIC N MG/M3	1604.5	0.75	99.2%			
TP-ORTHO-P MG/M3	119.4	0.59	92.7%			

ANTILOG PC-1	2105.5	0.94	95.0%	3708.1	0.88	98.1%
ANTILOG PC-2	15.0	0.82	94.7%	12.2	0.64	88.9%
(N - 150) / P	90.1	0.72	99.3%	113.6	0.97	99.7%
INORGANIC N / P	3913.9	0.84	100.0%			
TURBIDITY 1/M	0.6	2.86	48.6%	0.6	2.86	48.6%
ZMIX * TURBIDITY	1.8	2.86	23.5%	1.8	2.86	23.5%
ZMIX / SECCHI	6.3	0.36	68.2%	7.1	0.29	75.6%
CHL-A * SECCHI	29.9	1.03	93.5%	29.9	0.94	93.5%
CHL-A / TOTAL P	1.0	0.89	99.6%	1.5	0.97	99.9%
FREQ(CHL-a>10) %	99.6	0.02	99.3%	99.8	0.01	99.5%
FREQ(CHL-a>20) %	93.4	0.21	99.3%	95.6	0.13	99.5%
FREQ(CHL-a>30) %	80.2	0.52	99.3%	85.4	0.37	99.5%
FREQ(CHL-a>40) %	65.0	0.86	99.3%	72.3	0.64	99.5%
FREQ(CHL-a>50) %	51.0	1.17	99.3%	59.2	0.92	99.5%
FREQ(CHL-a>60) %	39.4	1.46	99.3%	47.5	1.18	99.5%
CARLSON TSI-P	63.1	0.10	59.6%	59.8	0.09	49.4%
CARLSON TSI-CHLA	71.0	0.13	99.3%	72.3	0.12	99.5%
CARLSON TSI-SEC	70.4	0.07	85.4%	72.3	0.06	88.9%

Segment: 4 Lower Lake - RBD1

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	57.1	0.46	57.8%	53.7	0.55	55.1%
TOTAL N MG/M3	5576.3	0.55	99.6%	5571.7	0.79	99.6%
C.NUTRIENT MG/M3	56.7	0.45	71.8%	53.3	0.57	69.2%
CHL-A MG/M3	43.3	0.64	97.6%	40.3	0.53	97.1%
SECCHI M	0.6	0.26	19.1%	0.6	0.37	20.0%
ORGANIC N MG/M3	1201.5	0.50	96.6%			
TP-ORTHO-P MG/M3	90.8	0.41	87.8%			
ANTILOG PC-1	1430.4	0.71	91.1%	1682.1	0.61	92.9%
ANTILOG PC-2	12.4	0.54	89.5%	10.5	0.46	82.7%
(N - 150) / P	95.0	0.72	99.4%	101.0	0.97	99.6%
INORGANIC N / P	4374.8	0.72	100.0%			
TURBIDITY 1/M	0.8	1.12	59.4%	0.8	1.12	59.4%
ZMIX * TURBIDITY	4.1	1.12	63.5%	4.1	1.12	63.5%
ZMIX / SECCHI	9.9	0.27	89.4%	9.6	0.36	88.7%
CHL-A * SECCHI	24.1	0.70	88.8%	22.9	0.65	87.4%
CHL-A / TOTAL P	0.8	0.64	98.3%	0.8	0.75	98.3%
FREQ(CHL-a>10) %	98.0	0.05	97.6%	97.4	0.05	97.1%
FREQ(CHL-a>20) %	82.6	0.32	97.6%	79.4	0.30	97.1%
FREQ(CHL-a>30) %	61.2	0.65	97.6%	56.6	0.58	97.1%
FREQ(CHL-a>40) %	42.8	0.95	97.6%	38.3	0.85	97.1%
FREQ(CHL-a>50) %	29.4	1.21	97.6%	25.5	1.08	97.1%
FREQ(CHL-a>60) %	20.2	1.44	97.6%	17.1	1.29	97.1%
CARLSON TSI-P	62.5	0.10	57.8%	61.6	0.13	55.1%
CARLSON TSI-CHLA	67.6	0.09	97.6%	66.9	0.08	97.1%
CARLSON TSI-SEC	68.4	0.06	80.9%	68.1	0.08	80.0%

Lake Vermilion TMDL Analysis (year 2000)
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Overall Water & Nutrient Balances

Overall Water Balance — **Averaging Period = 1.00 years**

Trb	Type	Seg	Name	Area km^2	Flow hm^3/yr	Variance (hm3/yr)^2	CV -	Runoff m/yr
1	1	1	North Fork Vermilion River	764.8	90.6	0.00E+00	0.00	0.12
2	4	4	Outflow at Dam	764.8	91.5	0.00E+00	0.00	0.12
PRECIPITATION				3.0	2.7	2.83E+00	0.62	0.91
TRIBUTARY INFLOW				764.8	90.6	0.00E+00	0.00	0.12
***TOTAL INFLOW				767.7	93.3	2.83E+00	0.02	0.12
GAUGED OUTFLOW				764.8	91.5	0.00E+00	0.00	0.12
ADVECTIVE OUTFLOW				3.0	-0.6	2.83E+00	2.72	
***TOTAL OUTFLOW				767.7	90.9	2.83E+00	0.02	0.12
***EVAPORATION					2.5	0.00E+00	0.00	

Overall Mass Balance Based Upon Component: **Predicted TOTAL P** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	Load %Total	Load Variance (kg/yr)^2	Load Variance %Total	CV	Conc mg/m^3	Export kg/km^2/yr
1	1	1	North Fork Vermilion River	19025.0	99.5%	4.54E+06	100.0%	0.11	210.0	24.9
2	4	4	Outflow at Dam	5227.8		5.68E+06		0.46	57.1	6.8
PRECIPITATION				89.9	0.5%	2.02E+03	0.0%	0.50	33.0	30.0
TRIBUTARY INFLOW				19025.0	99.5%	4.54E+06	100.0%	0.11	210.0	24.9
***TOTAL INFLOW				19114.9	100.0%	4.54E+06	100.0%	0.11	204.8	24.9
GAUGED OUTFLOW				5227.8	27.3%	5.68E+06		0.46	57.1	6.8
ADVECTIVE OUTFLOW				-35.3		9.56E+03		2.77	57.1	
***TOTAL OUTFLOW				5192.5	27.2%	5.60E+06		0.46	57.1	6.8
***RETENTION				13922.4	72.8%	8.63E+06		0.21		

Overflow Rate (m/yr)	30.3	Nutrient Resid. Time (yrs)	0.0326
Hydraulic Resid. Time (yrs)	0.0993	Turnover Ratio	30.7
Reservoir Conc (mg/m3)	69	Retention Coef.	0.728

Overall Mass Balance Based Upon Component: **Predicted TOTAL N** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	Load %Total	Load Variance (kg/yr)^2	Load Variance %Total	CV	Conc mg/m^3	Export kg/km^2/yr
1	1	1	North Fork Vermilion River	1081423.5	99.7%	3.93E+09	99.9%	0.06	11936.9	1414.1
2	4	4	Outflow at Dam	510139.2		7.93E+10		0.55	5576.3	667.1
PRECIPITATION				2998.0	0.3%	2.25E+06	0.1%	0.50	1098.9	1000.0
TRIBUTARY INFLOW				1081423.5	99.7%	3.93E+09	99.9%	0.06	11936.9	1414.1
***TOTAL INFLOW				1084421.5	100.0%	3.94E+09	100.0%	0.06	11620.1	1412.5
GAUGED OUTFLOW				510139.2	47.0%	7.93E+10		0.55	5576.3	667.1
ADVECTIVE OUTFLOW				-3447.2		9.20E+07		2.78	5576.3	
***TOTAL OUTFLOW				506692.0	46.7%	7.83E+10		0.55	5576.3	660.0
***RETENTION				577729.5	53.3%	8.01E+10		0.49		

Overflow Rate (m/yr)	30.3	Nutrient Resid. Time (yrs)	0.0470
Hydraulic Resid. Time (yrs)	0.0993	Turnover Ratio	21.3
Reservoir Conc (mg/m3)	5650	Retention Coef.	0.533

Lake Vermilion TMDL Analysis (year 2000)
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Water Balance Terms (hm3/yr) **Averaging Period = 1.00 Years**

		Inflows			Storage	Outflows------>		Downstr	
Seg	**Name**	**External**	**Precip**	**Advect**	**Increase**	**Advect**	**Disch.**	**Exchange**	**Evap**
1	Upper Lake - RBD5	91	1	0	0	91	0	203	0
2	Mid Upper - RBD3	0	0	91	0	91	0	1031	0
3	Mid Lower - RBD2	0	1	91	0	91	0	2260	1
4	Lower Lake - RBD1	0	1	91	0	-1	91	0	1
Net		91	3	0	0	-1	91	0	2

Mass Balance Terms (kg/yr) Based Upon Predicted Reservoir & Outflow Concentrations Component: TOTAL P

		Inflows-->			Storage	Outflows----->		Net	Net
Seg	**Name**	**External**	**Atmos**	**Advect**	**Increase**	**Advect**	**Disch.**	**Exchange**	**Retention**
1	Upper Lake - RBD5	19025	17	0	0	7374	0	-2944	14613
2	Mid Upper - RBD3	0	14	7374	0	8690	0	40333	-41636
3	Mid Lower - RBD2	0	40	8690	0	5408	0	-31934	35256
4	Lower Lake - RBD1	0	19	5408	0	-35	5228	-5455	5690
Net		19025	90	0	0	-35	5228	0	13922

Mass Balance Terms (kg/yr) Based Upon Predicted Reservoir & Outflow Concentrations Component: TOTAL N

		Inflows-->			Storage	Outflows----->		Net	Net
Seg	**Name**	**External**	**Atmos**	**Advect**	**Increase**	**Advect**	**Disch.**	**Exchange**	**Retention**
1	Upper Lake - RBD5	1081424	573	0	0	667790	0	673960	-259753
2	Mid Upper - RBD3	0	479	667790	0	367550	0	-2184856	2485575
3	Mid Lower - RBD2	0	1323	367550	0	501119	0	1379970	-1512216
4	Lower Lake - RBD1	0	623	501119	0	-3447	510139	130927	-135877
Net		1081424	2998	0	0	-3447	510139	0	577729

Lake Vermilion TMDL Analysis (year 2000)
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Segment Mass Balance Based Upon Predicted Concentrations

Component: TOTAL P **Segment: 1 Upper Lake - RBD5**

Trib	Type	Location	Flow hm^3/yr	Flow %Total	Load kg/yr	Load %Total	Conc mg/m^3
1	1	North Fork Vermilion River	90.6	99.4%	19025.0	86.5%	210
PRECIPITATION			0.5	0.6%	17.2	0.1%	33
TRIBUTARY INFLOW			90.6	99.4%	19025.0	86.5%	210
NET DIFFUSIVE INFLOW			0.0	0.0%	2944.3	13.4%	
***TOTAL INFLOW			91.1	100.0%	21986.5	100.0%	241
ADVECTIVE OUTFLOW			90.6	99.5%	7373.9	33.5%	81
***TOTAL OUTFLOW			90.6	99.5%	7373.9	33.5%	81
***EVAPORATION			0.5	0.5%	0.0	0.0%	
***RETENTION			0.0	0.0%	14612.6	66.5%	

Hyd. Residence Time = 0.0077 yrs
Overflow Rate = 158.2 m/yr
Mean Depth = 1.2 m

Component: TOTAL N **Segment: 1 Upper Lake - RBD5**

Trib	Type	Location	Flow hm^3/yr	Flow %Total	Load kg/yr	Load %Total	Conc mg/m^3
1	1	North Fork Vermilion River	90.6	99.4%	1081423.5	99.9%	11937
PRECIPITATION			0.5	0.6%	573.0	0.1%	1099
TRIBUTARY INFLOW			90.6	99.4%	1081423.5	99.9%	11937
***TOTAL INFLOW			91.1	100.0%	1081996.5	100.0%	11875
ADVECTIVE OUTFLOW			90.6	99.5%	667789.9	61.7%	7367
NET DIFFUSIVE OUTFLOW			0.0	0.0%	673959.6	62.3%	
***TOTAL OUTFLOW			90.6	99.5%	1341749.5	124.0%	14802
***EVAPORATION			0.5	0.5%	0.0	0.0%	
***RETENTION			0.0	0.0%	-259753.0	-24.0%	

Hyd. Residence Time = 0.0077 yrs
Overflow Rate = 158.2 m/yr
Mean Depth = 1.2 m

Component: TOTAL P **Segment: 2 Mid Upper - RBD3**

Trib	Type	Location	Flow hm^3/yr	Flow %Total	Load kg/yr	Load %Total	Conc mg/m^3
PRECIPITATION			0.4	0.5%	14.4	0.2%	33
ADVECTIVE INFLOW			90.6	99.5%	7373.9	99.8%	81
***TOTAL INFLOW			91.1	100.0%	7388.3	100.0%	81
ADVECTIVE OUTFLOW			90.7	99.6%	8690.5	117.6%	96
NET DIFFUSIVE OUTFLOW			0.0	0.0%	40333.5	545.9%	
***TOTAL OUTFLOW			90.7	99.6%	49023.9	663.5%	541
***EVAPORATION			0.4	0.4%	0.0	0.0%	
***RETENTION			0.0	0.0%	-41635.7	-563.5%	

Hyd. Residence Time = 0.0097 yrs
Overflow Rate = 189.3 m/yr
Mean Depth = 1.8 m

Component: TOTAL N | **Segment: 2** | **Mid Upper - RBD3**

Trib Type Location	Flow hm^3/yr	Flow %Total	Load kg/yr	Load %Total	Conc mg/m^3
PRECIPITATION	0.4	0.5%	479.0	0.0%	1099
ADVECTIVE INFLOW	90.6	99.5%	667789.9	23.4%	7367
NET DIFFUSIVE INFLOW	0.0	0.0%	2184856.0	76.6%	
***TOTAL INFLOW	91.1	100.0%	2853125.0	100.0%	31325
ADVECTIVE OUTFLOW	90.7	99.6%	367550.3	12.9%	4053
***TOTAL OUTFLOW	90.7	99.6%	367550.3	12.9%	4053
***EVAPORATION	0.4	0.4%	0.0	0.0%	
***RETENTION	0.0	0.0%	2485574.8	87.1%	

Hyd. Residence Time = 0.0097 yrs
Overflow Rate = 189.3 m/yr
Mean Depth = 1.8 m

Component: TOTAL P | **Segment: 3** | **Mid Lower - RBD2**

Trib Type Location	Flow hm^3/yr	Flow %Total	Load kg/yr	Load %Total	Conc mg/m^3
PRECIPITATION	1.2	1.3%	39.7	0.1%	33
ADVECTIVE INFLOW	90.7	98.7%	8690.5	21.4%	96
NET DIFFUSIVE INFLOW	0.0	0.0%	31934.0	78.5%	
***TOTAL INFLOW	91.9	100.0%	40664.2	100.0%	443
ADVECTIVE OUTFLOW	90.8	98.8%	5408.5	13.3%	60
***TOTAL OUTFLOW	90.8	98.8%	5408.5	13.3%	60
***EVAPORATION	1.1	1.2%	0.0	0.0%	
***RETENTION	0.0	0.0%	35255.7	86.7%	

Hyd. Residence Time = 0.0444 yrs
Overflow Rate = 68.6 m/yr
Mean Depth = 3.0 m

Component: TOTAL N | **Segment: 3** | **Mid Lower - RBD2**

Trib Type Location	Flow hm^3/yr	Flow %Total	Load kg/yr	Load %Total	Conc mg/m^3
PRECIPITATION	1.2	1.3%	1323.0	0.4%	1099
ADVECTIVE INFLOW	90.7	98.7%	367550.3	99.6%	4053
***TOTAL INFLOW	91.9	100.0%	368873.3	100.0%	4014
ADVECTIVE OUTFLOW	90.8	98.8%	501119.5	135.9%	5518
NET DIFFUSIVE OUTFLOW	0.0	0.0%	1379970.0	374.1%	
***TOTAL OUTFLOW	90.8	98.8%	1881089.5	510.0%	20715
***EVAPORATION	1.1	1.2%	0.0	0.0%	
***RETENTION	0.0	0.0%	-1512216.3	-410.0%	

Hyd. Residence Time = 0.0444 yrs
Overflow Rate = 68.6 m/yr
Mean Depth = 3.0 m

Component: TOTAL P | **Segment: 4 Lower Lake - RBD1**

Trib	Type	Location	Flow hm^3/yr	Flow %Total	Load kg/yr	Load %Total	Conc mg/m^3
2	4	Outflow at Dam	91.5	100.1%	5227.8	48.0%	57
PRECIPITATION			0.6	0.6%	18.7	0.2%	33
ADVECTIVE INFLOW			90.8	99.4%	5408.5	49.7%	60
NET DIFFUSIVE INFLOW			0.0	0.0%	5455.1	50.1%	
***TOTAL INFLOW			91.4	100.0%	10882.2	100.0%	119
GAUGED OUTFLOW			91.5	100.1%	5227.8	48.0%	57
ADVECTIVE OUTFLOW			-0.6	-0.7%	-35.3	-0.3%	57
***TOTAL OUTFLOW			90.9	99.4%	5192.5	47.7%	57
***EVAPORATION			0.5	0.6%	0.0	0.0%	
***RETENTION			0.0	0.0%	5689.7	52.3%	

Hyd. Residence Time = 0.0376 yrs
Overflow Rate = 145.9 m/yr
Mean Depth = 5.5 m

Component: TOTAL N | **Segment: 4 Lower Lake - RBD1**

Trib	Type	Location	Flow hm^3/yr	Flow %Total	Load kg/yr	Load %Total	Conc mg/m^3
2	4	Outflow at Dam	91.5	100.1%	510139.2	101.7%	5576
PRECIPITATION			0.6	0.6%	623.0	0.1%	1099
ADVECTIVE INFLOW			90.8	99.4%	501119.5	99.9%	5518
***TOTAL INFLOW			91.4	100.0%	501742.5	100.0%	5491
GAUGED OUTFLOW			91.5	100.1%	510139.2	101.7%	5576
ADVECTIVE OUTFLOW			-0.6	-0.7%	-3447.2	-0.7%	5576
NET DIFFUSIVE OUTFLOW			0.0	0.0%	130927.0	26.1%	
***TOTAL OUTFLOW			90.9	99.4%	637619.0	127.1%	7017
***EVAPORATION			0.5	0.6%	0.0	0.0%	
***RETENTION			0.0	0.0%	-135876.5	-27.1%	

Hyd. Residence Time = 0.0376 yrs
Overflow Rate = 145.9 m/yr
Mean Depth = 5.5 m

Lake Vermilion TMDL Analysis (year 2000)
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Segment	Name
1	Upper Lake - RBD5
2	Mid Upper - RBD3
3	Mid Lower - RBD2
4	Lower Lake - RBD1
Mean	Area-Wtd Mean

PREDICTED CONCENTRATIONS:

Variable Segment-->	1	2	3	4	Mean
TOTAL P MG/M3	81.3	95.8	59.6	57.1	69.0
TOTAL N MG/M3	7367.0	4052.8	5518.4	5576.3	5649.6
C.NUTRIENT MG/M3	80.6	91.9	59.0	56.7	67.9
CHL-A MG/M3	26.0	27.3	61.5	43.3	45.5
SECCHI M	0.2	0.3	0.5	0.6	0.4
ORGANIC N MG/M3	907.0	971.7	1604.5	1201.5	1286.3
TP-ORTHO-P MG/M3	91.5	104.9	119.4	90.8	105.8
ANTILOG PC-1	1806.4	1779.9	2105.5	1430.4	1856.0
ANTILOG PC-2	4.3	5.4	15.0	12.4	10.9
(N - 150) / P	88.7	40.7	90.1	95.0	83.0
INORGANIC N / P	6460.0	3081.1	3913.9	4374.8	4363.2
TURBIDITY 1/M	2.1	2.5	0.6	0.8	1.2
ZMIX * TURBIDITY	2.5	4.7	1.8	4.1	2.9
ZMIX / SECCHI	5.2	5.8	6.3	9.9	6.7
CHL-A * SECCHI	6.1	8.6	29.9	24.1	20.7
CHL-A / TOTAL P	0.3	0.3	1.0	0.8	0.7
FREQ(CHL-a>10) %	89.1	90.5	99.6	98.0	95.8
FREQ(CHL-a>20) %	54.6	57.6	93.4	82.6	78.0
FREQ(CHL-a>30) %	29.5	32.2	80.2	61.2	58.9
FREQ(CHL-a>40) %	15.8	17.7	65.0	42.8	43.4
FREQ(CHL-a>50) %	8.6	9.9	51.0	29.4	31.9
FREQ(CHL-a>60) %	4.9	5.7	39.4	20.2	23.4
CARLSON TSI-P	67.6	69.9	63.1	62.5	64.9
CARLSON TSI-CHLA	62.6	63.0	71.0	67.6	67.4
CARLSON TSI-SEC	81.0	76.6	70.4	68.4	73.0

OBSERVED CONCENTRATIONS:

Variable Segment-->	1	2	3	4	Mean
TOTAL P MG/M3	72.4	90.5	47.3	53.7	60.3
TOTAL N MG/M3	7544.0	2725.0	5521.7	5571.7	5471.8
C.NUTRIENT MG/M3	71.9	83.4	47.0	53.3	58.9
CHL-A MG/M3	33.4	25.1	69.9	40.3	49.6
SECCHI M	0.3	0.3	0.4	0.6	0.4
ANTILOG PC-1	2257.3	1862.5	3708.1	1682.1	2714.9
ANTILOG PC-2	6.3	4.8	12.2	10.5	9.6
(N - 150) / P	102.1	28.5	113.6	101.0	95.2
TURBIDITY 1/M	2.1	2.5	0.6	0.8	1.2
ZMIX * TURBIDITY	2.5	4.7	1.8	4.1	2.9

ZMIX / SECCHI	3.6	5.8	7.1	9.6	6.8
CHL-A * SECCHI	11.5	7.9	29.9	22.9	21.4
CHL-A / TOTAL P	0.5	0.3	1.5	0.8	0.9
FREQ(CHL-a>10) %	94.9	88.0	99.8	97.4	96.5
FREQ(CHL-a>20) %	69.8	52.3	95.6	79.4	80.4
FREQ(CHL-a>30) %	44.6	27.5	85.4	56.6	62.4
FREQ(CHL-a>40) %	27.4	14.4	72.3	38.3	47.4
FREQ(CHL-a>50) %	16.9	7.8	59.2	25.5	35.9
FREQ(CHL-a>60) %	10.5	4.3	47.5	17.1	27.2
CARLSON TSI-P	65.9	69.1	59.8	61.6	62.8
CARLSON TSI-CHLA	65.0	62.2	72.3	66.9	68.2
CARLSON TSI-SEC	75.4	76.6	72.3	68.1	72.7

OBSERVED/PREDICTED RATIOS:

Variable Segment-->	1	2	3	4	Mean
TOTAL P MG/M3	0.9	0.9	0.8	0.9	0.9
TOTAL N MG/M3	1.0	0.7	1.0	1.0	1.0
C.NUTRIENT MG/M3	0.9	0.9	0.8	0.9	0.9
CHL-A MG/M3	1.3	0.9	1.1	0.9	1.1
SECCHI M	1.5	1.0	0.9	1.0	1.0
ANTILOG PC-1	1.2	1.0	1.8	1.2	1.5
ANTILOG PC-2	1.4	0.9	0.8	0.8	0.9
(N - 150) / P	1.2	0.7	1.3	1.1	1.1
TURBIDITY 1/M	1.0	1.0	1.0	1.0	1.0
ZMIX * TURBIDITY	1.0	1.0	1.0	1.0	1.0
ZMIX / SECCHI	0.7	1.0	1.1	1.0	1.0
CHL-A * SECCHI	1.9	0.9	1.0	1.0	1.0
CHL-A / TOTAL P	1.4	1.0	1.4	1.0	1.3
FREQ(CHL-a>10) %	1.1	1.0	1.0	1.0	1.0
FREQ(CHL-a>20) %	1.3	0.9	1.0	1.0	1.0
FREQ(CHL-a>30) %	1.5	0.9	1.1	0.9	1.1
FREQ(CHL-a>40) %	1.7	0.8	1.1	0.9	1.1
FREQ(CHL-a>50) %	2.0	0.8	1.2	0.9	1.1
FREQ(CHL-a>60) %	2.2	0.8	1.2	0.8	1.2
CARLSON TSI-P	1.0	1.0	0.9	1.0	1.0
CARLSON TSI-CHLA	1.0	1.0	1.0	1.0	1.0
CARLSON TSI-SEC	0.9	1.0	1.0	1.0	1.0

OBSERVED STANDARD ERRORS

Variable Segment-->	1	2	3	4	Mean
TOTAL P MG/M3	40.5	62.9	18.7	29.4	32.1
TOTAL N MG/M3	5046.9	2030.1	4776.3	4407.2	4312.6
C.NUTRIENT MG/M3	41.1	59.2	20.7	30.5	32.8
CHL-A MG/M3	20.9	17.8	62.0	21.4	38.6
SECCHI M	0.1	0.1	0.1	0.2	0.1
ANTILOG PC-1	1412.7	1382.9	3273.4	1018.8	1501.0
ANTILOG PC-2	2.8	2.6	7.8	4.8	3.6
(N - 150) / P	89.1	29.5	110.0	98.0	55.5
TURBIDITY 1/M	0.8	1.2	1.7	0.8	0.8
ZMIX * TURBIDITY	1.0	2.2	5.1	4.6	2.5
ZMIX / SECCHI	0.8	2.0	2.1	3.5	1.2

CHL-A * SECCHI	7.6	6.2	27.9	14.9	12.8
CHL-A / TOTAL P	0.4	0.3	1.4	0.6	0.6
FREQ(CHL-a>10) %	10.0	21.9	1.0	4.9	4.1
FREQ(CHL-a>20) %	34.2	44.7	12.5	23.6	12.2
FREQ(CHL-a>30) %	39.4	38.1	31.4	33.1	18.2
FREQ(CHL-a>40) %	33.6	26.2	46.5	32.5	22.9
FREQ(CHL-a>50) %	25.6	16.9	54.3	27.6	25.3
FREQ(CHL-a>60) %	18.6	10.7	56.1	21.9	25.5
CARLSON TSI-P	8.0	9.9	5.6	7.8	3.7
CARLSON TSI-CHLA	6.0	6.8	8.6	5.1	4.2
CARLSON TSI-SEC	3.2	5.0	4.2	5.3	2.4

PREDICTED STANDARD ERRORS

Variable Segment-->	1	2	3	4	Mean
TOTAL P MG/M3	38.8	43.8	27.1	26.0	31.6
TOTAL N MG/M3	4229.5	2238.9	3043.0	3078.6	3118.2
C.NUTRIENT MG/M3	37.8	38.8	26.4	25.4	30.1
CHL-A MG/M3	13.1	12.5	57.1	27.8	29.5
SECCHI M	0.1	0.1	0.2	0.1	0.1
ORGANIC N MG/M3	306.5	275.5	1205.0	599.1	645.3
TP-ORTHO-P MG/M3	29.2	29.8	70.3	37.0	42.9
ANTILOG PC-1	1243.6	992.9	1982.9	1017.1	1362.4
ANTILOG PC-2	1.6	2.4	12.3	6.8	5.7
(N - 150) / P	63.8	29.5	64.8	68.2	59.6
INORGANIC N / P	4222.2	2254.9	3272.3	3135.6	3183.8
TURBIDITY 1/M	0.8	1.2	1.7	0.8	0.8
ZMIX * TURBIDITY	1.0	2.2	5.1	4.6	2.5
ZMIX / SECCHI	1.6	2.0	2.3	2.6	1.7
CHL-A * SECCHI	3.4	5.5	30.8	16.8	14.4
CHL-A / TOTAL P	0.1	0.1	0.9	0.5	0.4
FREQ(CHL-a>10) %	14.7	12.2	1.9	5.0	5.4
FREQ(CHL-a>20) %	31.7	28.7	19.4	26.7	18.6
FREQ(CHL-a>30) %	27.9	26.4	41.8	39.7	27.6
FREQ(CHL-a>40) %	19.7	19.2	55.6	40.6	31.5
FREQ(CHL-a>50) %	12.9	13.0	59.8	35.7	31.4
FREQ(CHL-a>60) %	8.3	8.5	57.6	29.1	28.9
CARLSON TSI-P	6.8	6.5	6.5	6.5	6.5
CARLSON TSI-CHLA	4.9	4.5	9.1	6.3	5.5
CARLSON TSI-SEC	4.4	4.9	5.2	3.8	3.7

Lake Vermilion TMDL Analysis (year 2000)
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T Statistics Compare Observed and Predicted Means Using the Following Error Terms:
1 = Observed Water Quality Error Only
2 = Error Typical of Model Development Dataset
3 = Observed & Predicted Error

Segment: **Area-Wtd Mean**

Variable	Observed Mean	CV	Predicted Mean	CV	Obs/Pred Ratio	T-Statistics ----> T1	T2	T3
TOTAL P MG/M3	60.3	0.53	69.0	0.46	0.87	-0.25	-0.50	-0.19
TOTAL N MG/M3	5471.8	0.79	5649.6	0.55	0.97	-0.04	-0.15	-0.03
C.NUTRIENT MG/M3	58.9	0.56	67.9	0.44	0.87	-0.26	-0.71	-0.20
CHL-A MG/M3	49.6	0.78	45.5	0.65	1.09	0.11	0.25	0.09
SECCHI M	0.4	0.31	0.4	0.27	0.99	-0.02	-0.02	-0.01
ANTILOG PC-1	2714.9	0.55	1856.0	0.73	1.46	0.69	1.08	0.41
ANTILOG PC-2	9.6	0.38	10.9	0.52	0.88	-0.35	-0.43	-0.20
(N - 150) / P	95.2	0.58	83.0	0.72	1.15	0.24	0.42	0.15

Segment: **1 Upper Lake - RBD5**

Variable	Observed Mean	CV	Predicted Mean	CV	Obs/Pred Ratio	T-Statistics ----> T1	T2	T3
TOTAL P MG/M3	72.4	0.56	81.3	0.48	0.89	-0.21	-0.43	-0.16
TOTAL N MG/M3	7544.0	0.67	7367.0	0.57	1.02	0.04	0.11	0.03
C.NUTRIENT MG/M3	71.9	0.57	80.6	0.47	0.89	-0.20	-0.57	-0.15
CHL-A MG/M3	33.4	0.63	26.0	0.50	1.28	0.40	0.72	0.31
SECCHI M	0.3	0.22	0.2	0.30	1.47	1.73	1.37	1.02
ANTILOG PC-1	2257.3	0.63	1806.4	0.69	1.25	0.36	0.63	0.24
ANTILOG PC-2	6.3	0.45	4.3	0.37	1.45	0.82	1.19	0.63
(N - 150) / P	102.1	0.87	88.7	0.72	1.15	0.16	0.43	0.12

Segment: **2 Mid Upper - RBD3**

Variable	Observed Mean	CV	Predicted Mean	CV	Obs/Pred Ratio	T-Statistics ----> T1	T2	T3
TOTAL P MG/M3	90.5	0.69	95.8	0.46	0.94	-0.08	-0.21	-0.07
TOTAL N MG/M3	2725.0	0.75	4052.8	0.55	0.67	-0.53	-1.80	-0.43
C.NUTRIENT MG/M3	83.4	0.71	91.9	0.42	0.91	-0.14	-0.48	-0.12
CHL-A MG/M3	25.1	0.71	27.3	0.46	0.92	-0.12	-0.24	-0.10
SECCHI M	0.3	0.35	0.3	0.34	1.00	0.00	-0.01	0.00
ANTILOG PC-1	1862.5	0.74	1779.9	0.56	1.05	0.06	0.13	0.05
ANTILOG PC-2	4.8	0.55	5.4	0.44	0.90	-0.20	-0.35	-0.16
(N - 150) / P	28.5	1.04	40.7	0.72	0.70	-0.35	-1.11	-0.28

Segment: **3 Mid Lower - RBD2**

Variable	Observed Mean	CV	Predicted Mean	CV	Obs/Pred Ratio	T-Statistics ----> T1	T2	T3
TOTAL P MG/M3	47.3	0.40	59.6	0.46	0.79	-0.59	-0.86	-0.38
TOTAL N MG/M3	5521.7	0.87	5518.4	0.55	1.00	0.00	0.00	0.00
C.NUTRIENT MG/M3	47.0	0.44	59.0	0.45	0.80	-0.52	-1.13	-0.36
CHL-A MG/M3	69.9	0.89	61.5	0.93	1.14	0.14	0.37	0.10
SECCHI M	0.4	0.30	0.5	0.36	0.88	-0.43	-0.46	-0.27
ANTILOG PC-1	3708.1	0.88	2105.5	0.94	1.76	0.64	1.61	0.44
ANTILOG PC-2	12.2	0.64	15.0	0.82	0.81	-0.32	-0.66	-0.20
(N - 150) / P	113.6	0.97	90.1	0.72	1.26	0.24	0.72	0.19

Segment: **4 Lower Lake - RBD1**

Variable	Observed Mean	CV	Predicted Mean	CV	Obs/Pred Ratio	T-Statistics ----> T1	T2	T3
TOTAL P MG/M3	53.7	0.55	57.1	0.46	0.94	-0.11	-0.23	-0.09
TOTAL N MG/M3	5571.7	0.79	5576.3	0.55	1.00	0.00	0.00	0.00
C.NUTRIENT MG/M3	53.3	0.57	56.7	0.45	0.94	-0.11	-0.31	-0.08
CHL-A MG/M3	40.3	0.53	43.3	0.64	0.93	-0.14	-0.21	-0.09
SECCHI M	0.6	0.37	0.6	0.26	1.02	0.06	0.08	0.05
ANTILOG PC-1	1682.1	0.61	1430.4	0.71	1.18	0.27	0.46	0.17
ANTILOG PC-2	10.5	0.46	12.4	0.54	0.85	-0.36	-0.53	-0.23
(N - 150) / P	101.0	0.97	95.0	0.72	1.06	0.06	0.19	0.05

Lake Vermilion TMDL Analysis (year 2000)
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Variable = TOTAL P MG/M3 R^2 = **0.71**
Global Calibration Factor = 0.77 CV = 0.45

			Calibration Factor		Predicted		Observed		Log (Obs/Pred)		
Seg	Group	Name	Mean	CV	Mean	CV	Mean	CV	Mean	SE	t
1	1	Upper Lake - RBD5	0.80	0.00	81.3	0.48	72.4	0.56	-0.12	0.74	-0.16
2	1	Mid Upper - RBD3	1.20	0.00	95.8	0.46	90.5	0.69	-0.06	0.83	-0.07
3	1	Mid Lower - RBD2	0.80	0.00	59.6	0.46	47.3	0.40	-0.23	0.60	-0.38
4	1	Lower Lake - RBD1	0.78	0.00	57.1	0.46	53.7	0.55	-0.06	0.71	-0.09
5	1	Area-Wtd Mean			69.0	0.46	60.3	0.53	-0.13	0.70	-0.19

Variable = TOTAL N MG/M3 R^2 = **0.72**
Global Calibration Factor = 1.20 CV = 0.55

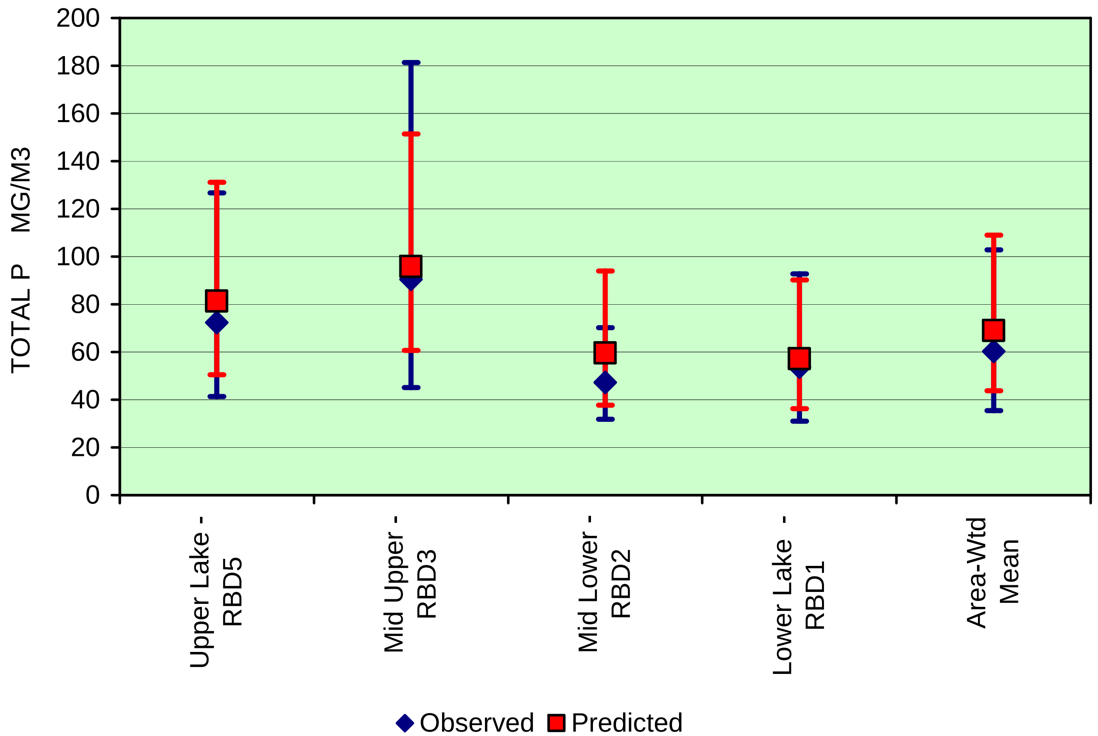
			Calibration Factor		Predicted		Observed		Log (Obs/Pred)		
Seg	Group	Name	Mean	CV	Mean	CV	Mean	CV	Mean	SE	t
1	1	Upper Lake - RBD5	0.93	0.00	7367.0	0.57	7544.0	0.67	0.02	0.88	0.03
2	1	Mid Upper - RBD3	0.70	0.00	4052.8	0.55	2725.0	0.75	-0.40	0.93	-0.43
3	1	Mid Lower - RBD2	1.05	0.00	5518.4	0.55	5521.7	0.87	0.00	1.03	0.00
4	1	Lower Lake - RBD1	1.09	0.00	5576.3	0.55	5571.7	0.79	0.00	0.96	0.00
5	1	Area-Wtd Mean			5649.6	0.55	5471.8	0.79	-0.03	0.96	-0.03

Variable = CHL-A MG/M3 R^2 = **0.84**
Global Calibration Factor = 2.40 CV = 0.26

			Calibration Factor		Predicted		Observed		Log (Obs/Pred)		
Seg	Group	Name	Mean	CV	Mean	CV	Mean	CV	Mean	SE	t
1	1	Upper Lake - RBD5	0.32	0.00	26.0	0.50	33.4	0.63	0.25	0.80	0.31
2	1	Mid Upper - RBD3	0.47	0.00	27.3	0.46	25.1	0.71	-0.08	0.84	-0.10
3	1	Mid Lower - RBD2	1.30	0.00	61.5	0.93	69.9	0.89	0.13	1.28	0.10
4	1	Lower Lake - RBD1	1.80	0.00	43.3	0.64	40.3	0.53	-0.07	0.83	-0.09
5	1	Area-Wtd Mean			45.5	0.65	49.6	0.78	0.09	1.01	0.09

Lake Vermilion TMDL Analysis (year 2000)
File: L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration2000cal&out.btb
Variable: TOTAL P MG/M3

Segment	Predicted Mean	CV	Observed Mean	CV
Upper Lake - RBD5	81.3	0.48	72.4	0.56
Mid Upper - RBD3	95.8	0.46	90.5	0.69
Mid Lower - RBD2	59.6	0.46	47.3	0.40
Lower Lake - RBD1	57.1	0.46	53.7	0.55
Area-Wtd Mean	69.0	0.46	60.3	0.53

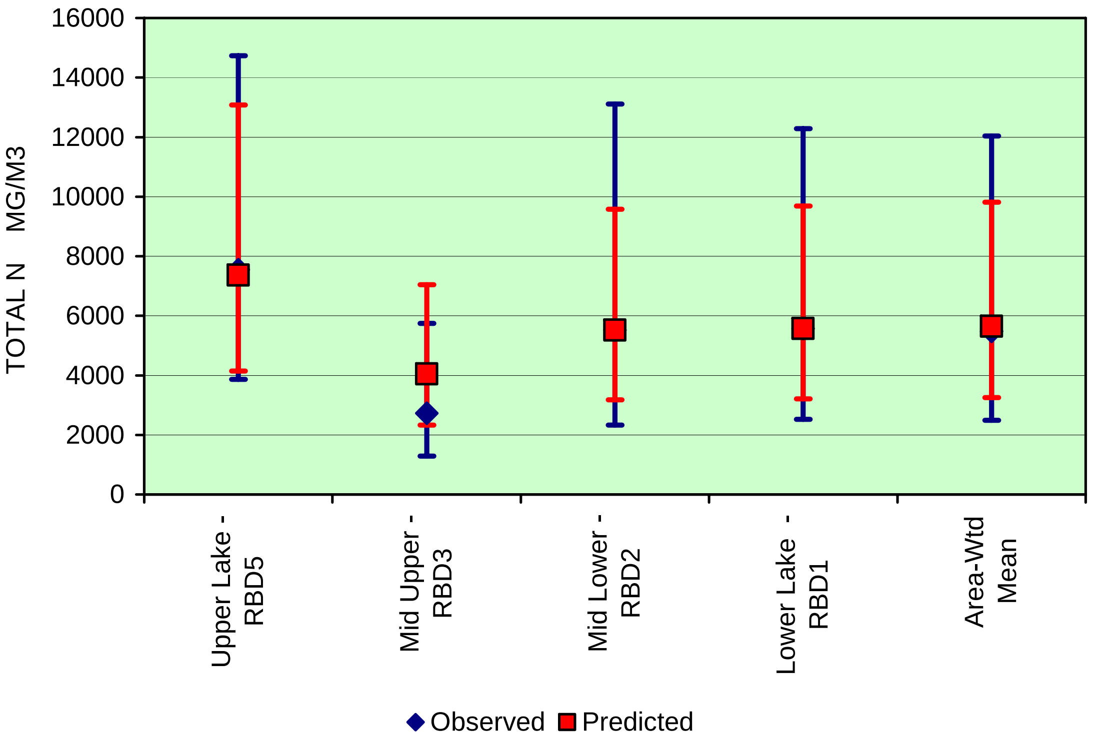


Lake Vermilion TMDL Analysis (year 2000)

File: L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration2000cal&out.btb

Variable: TOTAL N MG/M3

Segment	Predicted Mean	CV	Observed Mean	CV
Upper Lake - RBD5	7367.0	0.57	7544.0	0.67
Mid Upper - RBD3	4052.8	0.55	2725.0	0.75
Mid Lower - RBD2	5518.4	0.55	5521.7	0.87
Lower Lake - RBD1	5576.3	0.55	5571.7	0.79
Area-Wtd Mean	5649.6	0.55	5471.8	0.79

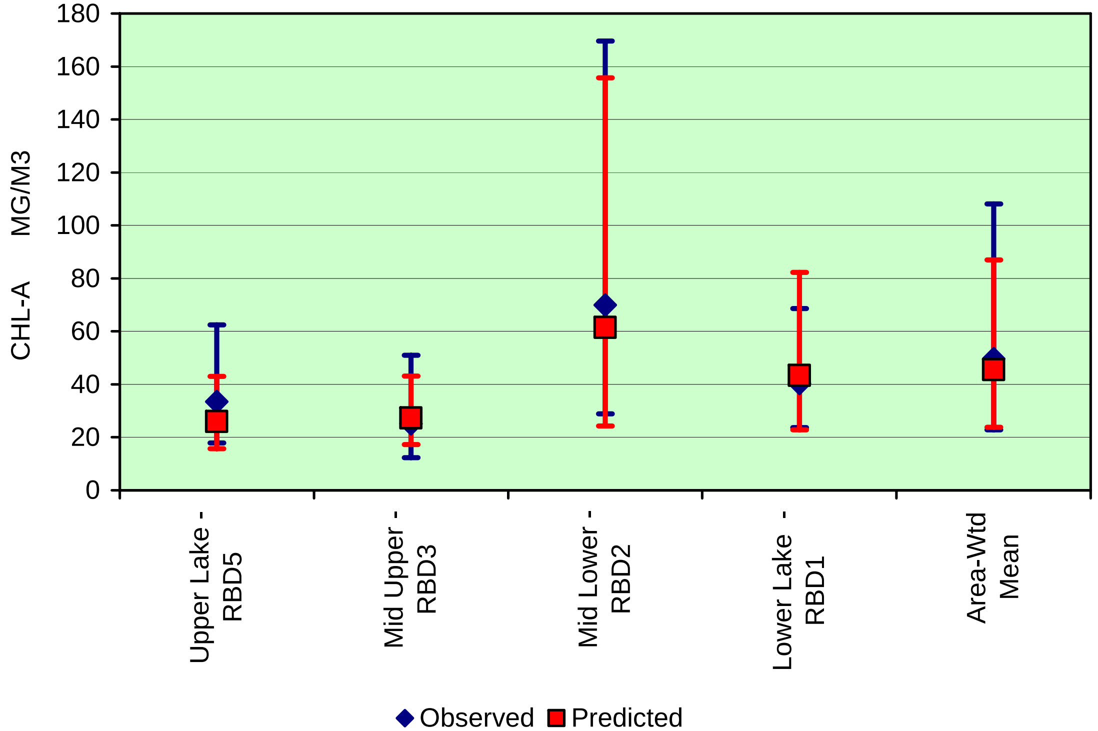


Lake Vermilion TMDL Analysis (year 2000)

File: **L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration2000cal&out.btb**

Variable: **CHL-A MG/M3**

	Predicted		Observed	
Segment	**Mean**	**CV**	**Mean**	**CV**
Upper Lake - RBD5	26.0	0.50	33.4	0.63
Mid Upper - RBD3	27.3	0.46	25.1	0.71
Mid Lower - RBD2	61.5	0.93	69.9	0.89
Lower Lake - RBD1	43.3	0.64	40.3	0.53
Area-Wtd Mean	45.5	0.65	49.6	0.78

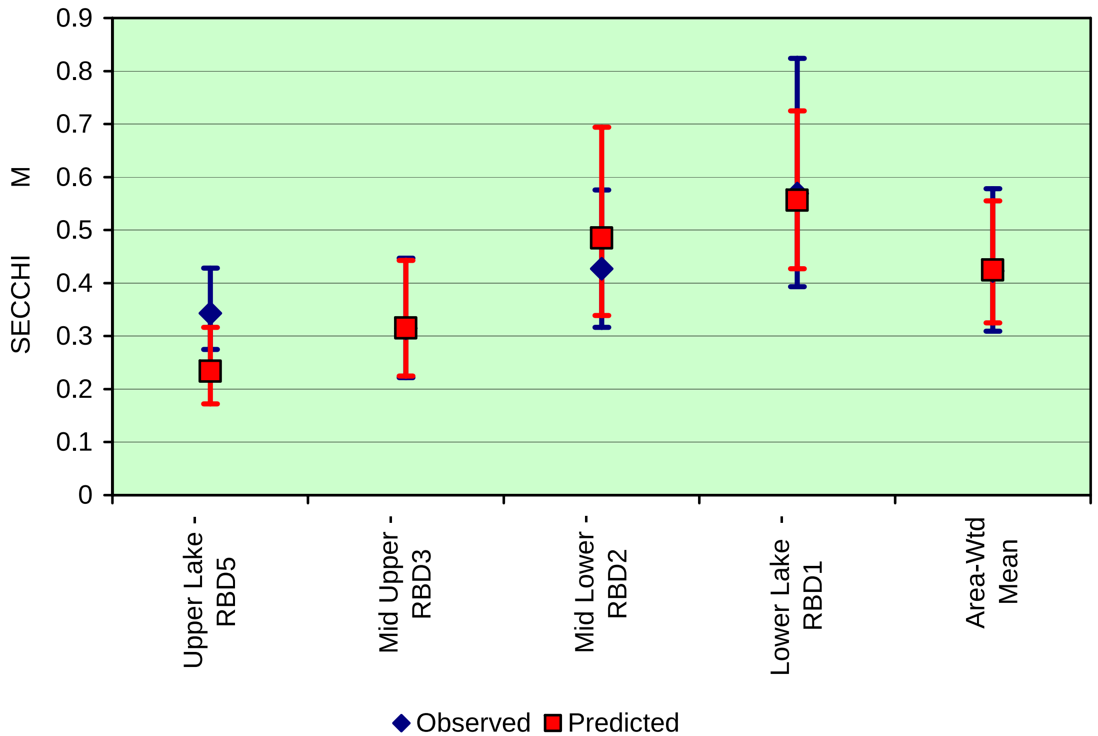


Lake Vermilion TMDL Analysis (year 2000)

File: L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration2000cal&out.btb

Variable: SECCHI M

Segment	Predicted Mean	CV	Observed Mean	CV
Upper Lake - RBD5	0.2	0.30	0.3	0.22
Mid Upper - RBD3	0.3	0.34	0.3	0.35
Mid Lower - RBD2	0.5	0.36	0.4	0.30
Lower Lake - RBD1	0.6	0.26	0.6	0.37
Area-Wtd Mean	0.4	0.27	0.4	0.31



Lake Vermilion TMDL Analysis (year 2000)
File: L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration2000cal&out-reduction.btb
Description:

Reduction Target Condititions model for Lake Vermilion in 2000

TP, TN, Chl-a, and Secchi concentrations to be predicted using calibrated factors

Use outflow at the Dam

Global Variables	Mean	CV
Averaging Period (yrs)	1	0.0
Precipitation (m)	0.91	0.6
Evaporation (m)	0.82	0.0
Storage Increase (m)	0	0.0

Atmos. Loads (kg/km^2-yr)	Mean	CV
Conserv. Substance	0	0.00
Total P	30	0.50
Total N	1000	0.50
Ortho P	15	0.50
Inorganic N	500	0.50

Segment Morphometry

		Outflow		Area	Depth	Length	Mixed Depth (m)	
Seg	Name	Segment	Group	km^2	m	km	Mean	CV
1	Upper Lake - RBD5	2	1	0.573	1.219	2.164	1.219	0
2	Mid Upper - RBD3	3	1	0.479	1.829	1.052	1.829	0
3	Mid Lower - RBD2	4	1	1.323	3.048	1.393	3.048	0
4	Lower Lake - RBD1	0	1	0.623	5.486	1.149	5.486	0

Segment Observed Water Quality

	Conserv		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	0	0	72.4	0.56	7544	0.669	33.43	0.625	0.343
2	0	0	90.5	0.695	2725	0.745	25.11	0.708	0.315
3	0	0	47.27	0.395	5521.7	0.865	69.94	0.886	0.427
4	0	0	53.697	0.547	5571.7	0.791	40.31	0.532	0.569

Segment Calibration Factors

	Dispersion Rate		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	1	0	0.8	0	0.925	0	0.325	0	0.75
2	1	0	1.2	0	0.7	0	0.475	0	1.2
3	1	0	0.8	0	1.05	0	1.3	0	1.215
4	1	0	0.78	0	1.085	0	1.8	0	1.2

Tributary Data

				Dr Area	Flow (hm^3/yr)		Conserv.	
Trib	Trib Name	Segment	Type	km^2	Mean	CV	Mean	CV
1	North Fork Vermilion River	1	1	764.75	90.595	0	0	0
2	Outflow at Dam	4	4	764.75	91.483	0	0	0

Model Coefficients	Mean	CV

Model Options	**Code**	**Description**
Conservative Substance	0	NOT COMPUTED
Phosphorus Balance	1	2ND ORDER, AVAIL P
Nitrogen Balance	1	2ND ORDER, AVAIL N
Chlorophyll-a	2	P, LIGHT, T
Secchi Depth	1	VS. CHLA & TURBIDITY
Dispersion	1	FISCHER-NUMERIC
Phosphorus Calibration	2	CONCENTRATIONS
Nitrogen Calibration	2	CONCENTRATIONS
Error Analysis	1	MODEL & DATA
Availability Factors	0	IGNORE
Mass-Balance Tables	1	USE ESTIMATED CONCS
Output Destination	2	EXCEL WORKSHEET

				Internal Loads (mg/m2-day)					
Hypol Depth		**Non-Algal Turb (m^{-1})**		**Conserv.**		**Total P**		**Total N**	
Mean	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0	0	2.08	0.4	0	0	0	0	0	0
0	0	2.55	0.47	0	0	0	0	0	0
0	0	0.59	2.86	0	0	0	0	0	0
0	0	0.75	1.12	0	0	0	0	0	0

)	**Organic N (ppb)**		**TP - Ortho P (ppb)**		**HOD (ppb/day)**		**MOD (ppb/day)**	
CV	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0.222	0	0	0	0	0	0	0	0
0.35	0	0	0	0	0	0	0	0
0.299	0	0	0	0	0	0	0	0
0.37	0	0	0	0	0	0	0	0

)	**Organic N (ppb)**		**TP - Ortho P (ppb)**		**HOD (ppb/day)**		**MOD (ppb/day)**	
CV	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0

Total P (ppb)		**Total N (ppb)**		**Ortho P (ppb)**		**Inorganic N (ppb)**	
Mean	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
132.3	0.112	11936.9	0.058	0	0	0	0
132.5	0.102	10356.61	0.095	0	0	0	0

Dispersion Rate	1.000	0.70
Total Phosphorus	0.775	0.45
Total Nitrogen	1.200	0.55
Chl-a Model	2.400	0.26
Secchi Model	0.850	0.10
Organic N Model	1.000	0.12
TP-OP Model	1.000	0.15
HODv Model	1.000	0.15
MODv Model	1.000	0.22
Secchi/Chla Slope (m^2/mg)	0.025	0.00
Minimum Qs (m/yr)	0.100	0.00
Chl-a Flushing Term	1.000	0.00
Chl-a Temporal CV	0.620	0
Avail. Factor - Total P	0.330	0
Avail. Factor - Ortho P	1.930	0
Avail. Factor - Total N	0.590	0
Avail. Factor - Inorganic N	0.790	0

Lake Vermilion TMDL Analysis (year 2000)
File: L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration2000cal&out-reduction.btb

Segment & Tributary Network

--------Segment:	1	Upper Lake - RBD5		
Outflow Segment:	2	Mid Upper - RBD3		
Tributary:	1	North Fork Vermilion River	Type:	Monitored Inflow
--------Segment:	2	Mid Upper - RBD3		
Outflow Segment:	3	Mid Lower - RBD2		
--------Segment:	3	Mid Lower - RBD2		
Outflow Segment:	4	Lower Lake - RBD1		
--------Segment:	4	Lower Lake - RBD1		
Outflow Segment:	0	Out of Reservoir		
Tributary:	2	Outflow at Dam	Type:	Reservoir Outflow

Lake Vermilion TMDL Analysis (year 2000)
File: L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration2000cal&out-reduction.btb

Hydraulic & Dispersion Parameters

Seg	Name	Outflow Seg	Net Inflow hm^3/yr	Resid Time years	Overflow Rate m/yr	Velocity km/yr	Dispersion--------> Estimated km^2/yr	Numeric km^2/yr	Exchange hm^3/yr
1	Upper Lake - RBD5	2	90.6	0.0077	158.2	280.8	1667.3	303.9	203.4
2	Mid Upper - RBD3	3	90.7	0.0097	189.3	108.9	1359.6	57.3	1030.9
3	Mid Lower - RBD2	4	90.8	0.0444	68.6	31.4	1109.6	21.8	2260.4
4	Lower Lake - RBD1	0	90.9	0.0376	145.9	30.5	214.9	17.5	0.0

Morphometry

Seg	Name	Area km^2	Zmean m	Zmix m	Length km	Volume hm^3	Width km	L/W -
1	Upper Lake - RBD5	0.6	1.2	1.2	2.2	0.7	0.3	8.2
2	Mid Upper - RBD3	0.5	1.8	1.8	1.1	0.9	0.5	2.3
3	Mid Lower - RBD2	1.3	3.0	3.0	1.4	4.0	0.9	1.5
4	Lower Lake - RBD1	0.6	5.5	5.5	1.1	3.4	0.5	2.1
Totals		3.0	3.0			9.0		

Lake Vermilion TMDL Analysis (year 2000)
File: **L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration2**

Predicted & Observed Values Ranked Against CE Model Development Dataset

Segment: 5 Area-Wtd Mean

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	50.2	0.46	52.1%	60.3	0.53	60.1%
TOTAL N MG/M3	5649.6	0.55	99.7%	5471.8	0.79	99.6%
C.NUTRIENT MG/M3	49.8	0.45	66.1%	58.9	0.56	73.4%
CHL-A MG/M3	36.2	0.68	96.0%	49.6	0.78	98.5%
SECCHI M	0.5	0.33	14.2%	0.4	0.31	10.8%
ORGANIC N MG/M3	1074.6	0.50	94.6%			
TP-ORTHO-P MG/M3	89.3	0.40	87.5%			
ANTILOG PC-1	1205.6	0.76	88.8%	2714.9	0.55	96.7%
ANTILOG PC-2	10.5	0.60	82.6%	9.6	0.38	77.4%
(N - 150) / P	113.7	0.72	99.7%	95.2	0.58	99.4%
INORGANIC N / P	4575.0	0.69	100.0%			
TURBIDITY 1/M	1.2	0.66	78.5%	1.2	0.66	78.5%
ZMIX * TURBIDITY	2.9	0.87	45.4%	2.9	0.87	45.4%
ZMIX / SECCHI	6.0	0.29	65.7%	6.8	0.18	72.5%
CHL-A * SECCHI	19.0	0.82	81.0%	21.4	0.60	85.2%
CHL-A / TOTAL P	0.8	0.61	98.5%	0.9	0.69	99.3%
FREQ(CHL-a>10) %	91.1	0.11	96.0%	96.5	0.04	98.5%
FREQ(CHL-a>20) %	67.1	0.38	96.0%	80.4	0.15	98.5%
FREQ(CHL-a>30) %	46.5	0.70	96.0%	62.4	0.29	98.5%
FREQ(CHL-a>40) %	31.8	1.03	96.0%	47.4	0.48	98.5%
FREQ(CHL-a>50) %	21.8	1.34	96.0%	35.9	0.70	98.5%
FREQ(CHL-a>60) %	15.0	1.64	96.0%	27.2	0.94	98.5%
CARLSON TSI-P	60.4	0.11	52.1%	62.8	0.06	60.1%
CARLSON TSI-CHLA	65.1	0.09	96.0%	68.2	0.06	98.5%
CARLSON TSI-SEC	71.4	0.06	85.8%	72.7	0.03	89.2%

Segment: 1 Upper Lake - RBD5

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	56.1	0.47	57.0%	72.4	0.56	67.7%
TOTAL N MG/M3	7367.0	0.57	99.9%	7544.0	0.67	99.9%
C.NUTRIENT MG/M3	55.8	0.47	71.2%	71.9	0.57	80.9%
CHL-A MG/M3	18.4	0.56	80.9%	33.4	0.63	95.0%
SECCHI M	0.3	0.33	2.7%	0.3	0.22	6.6%
ORGANIC N MG/M3	733.0	0.33	80.4%			
TP-ORTHO-P MG/M3	77.9	0.33	84.3%			
ANTILOG PC-1	1076.9	0.72	87.1%	2257.3	0.63	95.5%
ANTILOG PC-2	3.7	0.41	15.0%	6.3	0.45	48.1%
(N - 150) / P	128.7	0.72	99.9%	102.1	0.87	99.6%
INORGANIC N / P	6634.0	0.64	100.0%			
TURBIDITY 1/M	2.1	0.40	91.9%	2.1	0.40	91.9%
ZMIX * TURBIDITY	2.5	0.40	39.0%	2.5	0.40	39.0%
ZMIX / SECCHI	4.9	0.33	51.2%	3.6	0.22	30.7%
CHL-A * SECCHI	4.6	0.63	13.1%	11.5	0.66	56.6%

CHL-A / TOTAL P	0.3	0.30	79.1%	0.5	0.83	91.1%
FREQ(CHL-a>10) %	74.9	0.37	80.9%	94.9	0.11	95.0%
FREQ(CHL-a>20) %	32.8	0.99	80.9%	69.8	0.49	95.0%
FREQ(CHL-a>30) %	13.6	1.46	80.9%	44.6	0.88	95.0%
FREQ(CHL-a>40) %	5.9	1.83	80.9%	27.4	1.22	95.0%
FREQ(CHL-a>50) %	2.7	2.13	80.9%	16.9	1.52	95.0%
FREQ(CHL-a>60) %	1.3	2.39	80.9%	10.5	1.77	95.0%
CARLSON TSI-P	62.2	0.11	57.0%	65.9	0.12	67.7%
CARLSON TSI-CHLA	59.2	0.09	80.9%	65.0	0.09	95.0%
CARLSON TSI-SEC	79.9	0.06	97.3%	75.4	0.04	93.4%

Segment: 2 Mid Upper - RBD3

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	69.8	0.46	66.2%	90.5	0.69	76.0%
TOTAL N MG/M3	4052.8	0.55	98.5%	2725.0	0.75	94.1%
C.NUTRIENT MG/M3	68.3	0.44	79.1%	83.4	0.71	85.6%
CHL-A MG/M3	21.8	0.50	86.2%	25.1	0.71	89.9%
SECCHI M	0.3	0.36	5.9%	0.3	0.35	5.2%
ORGANIC N MG/M3	845.1	0.29	87.2%			
TP-ORTHO-P MG/M3	95.1	0.31	88.8%			
ANTILOG PC-1	1229.1	0.61	89.1%	1862.5	0.74	93.9%
ANTILOG PC-2	4.9	0.46	30.9%	4.8	0.55	29.5%
(N - 150) / P	55.9	0.72	96.0%	28.5	1.04	77.5%
INORGANIC N / P	3207.7	0.70	100.0%			
TURBIDITY 1/M	2.5	0.47	94.8%	2.5	0.47	94.8%
ZMIX * TURBIDITY	4.7	0.47	69.3%	4.7	0.47	69.3%
ZMIX / SECCHI	5.5	0.37	60.2%	5.8	0.34	63.2%
CHL-A * SECCHI	7.2	0.69	31.0%	7.9	0.79	36.0%
CHL-A / TOTAL P	0.3	0.37	76.7%	0.3	0.98	70.8%
FREQ(CHL-a>10) %	82.7	0.25	86.2%	88.0	0.25	89.9%
FREQ(CHL-a>20) %	43.1	0.74	86.2%	52.3	0.86	89.9%
FREQ(CHL-a>30) %	20.4	1.13	86.2%	27.5	1.38	89.9%
FREQ(CHL-a>40) %	9.8	1.45	86.2%	14.4	1.82	89.9%
FREQ(CHL-a>50) %	4.9	1.70	86.2%	7.8	2.18	89.9%
FREQ(CHL-a>60) %	2.6	1.92	86.2%	4.3	2.49	89.9%
CARLSON TSI-P	65.4	0.10	66.2%	69.1	0.14	76.0%
CARLSON TSI-CHLA	60.8	0.08	86.2%	62.2	0.11	89.9%
CARLSON TSI-SEC	76.0	0.07	94.1%	76.6	0.06	94.8%

Segment: 3 Mid Lower - RBD2

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	44.2	0.46	46.4%	47.3	0.40	49.4%
TOTAL N MG/M3	5518.4	0.55	99.6%	5521.7	0.87	99.6%
C.NUTRIENT MG/M3	44.0	0.45	60.3%	47.0	0.44	63.5%
CHL-A MG/M3	49.0	0.95	98.4%	69.9	0.89	99.5%
SECCHI M	0.6	0.48	19.9%	0.4	0.30	11.1%
ORGANIC N MG/M3	1318.9	0.73	97.8%			
TP-ORTHO-P MG/M3	97.1	0.55	89.2%			
ANTILOG PC-1	1350.8	0.93	90.4%	3708.1	0.88	98.1%
ANTILOG PC-2	14.7	0.93	94.2%	12.2	0.64	88.9%

(N - 150) / P	121.5	0.72	99.8%	113.6	0.97	99.7%
INORGANIC N / P	4199.5	0.76	100.0%			
TURBIDITY 1/M	0.6	2.86	48.6%	0.6	2.86	48.6%
ZMIX * TURBIDITY	1.8	2.86	23.5%	1.8	2.86	23.5%
ZMIX / SECCHI	5.4	0.49	57.9%	7.1	0.29	75.6%
CHL-A * SECCHI	27.9	1.21	92.2%	29.9	0.94	93.5%
CHL-A / TOTAL P	1.1	0.88	99.7%	1.5	0.97	99.9%
FREQ(CHL-a>10) %	98.8	0.05	98.4%	99.8	0.01	99.5%
FREQ(CHL-a>20) %	87.2	0.37	98.4%	95.6	0.13	99.5%
FREQ(CHL-a>30) %	68.5	0.80	98.4%	85.4	0.37	99.5%
FREQ(CHL-a>40) %	50.7	1.21	98.4%	72.3	0.64	99.5%
FREQ(CHL-a>50) %	36.6	1.58	98.4%	59.2	0.92	99.5%
FREQ(CHL-a>60) %	26.2	1.91	98.4%	47.5	1.18	99.5%
CARLSON TSI-P	58.8	0.11	46.4%	59.8	0.09	49.4%
CARLSON TSI-CHLA	68.8	0.14	98.4%	72.3	0.12	99.5%
CARLSON TSI-SEC	68.1	0.10	80.1%	72.3	0.06	88.9%

Segment: 4 Lower Lake - RBD1

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	42.6	0.46	44.8%	53.7	0.55	55.1%
TOTAL N MG/M3	5576.3	0.55	99.6%	5571.7	0.79	99.6%
C.NUTRIENT MG/M3	42.4	0.45	58.5%	53.3	0.57	69.2%
CHL-A MG/M3	36.5	0.67	96.1%	40.3	0.53	97.1%
SECCHI M	0.6	0.31	22.8%	0.6	0.37	20.0%
ORGANIC N MG/M3	1046.2	0.50	94.0%			
TP-ORTHO-P MG/M3	78.7	0.40	84.5%			
ANTILOG PC-1	997.5	0.74	85.8%	1682.1	0.61	92.9%
ANTILOG PC-2	12.3	0.59	89.0%	10.5	0.46	82.7%
(N - 150) / P	127.5	0.72	99.8%	101.0	0.97	99.6%
INORGANIC N / P	4530.2	0.69	100.0%			
TURBIDITY 1/M	0.8	1.12	59.4%	0.8	1.12	59.4%
ZMIX * TURBIDITY	4.1	1.12	63.5%	4.1	1.12	63.5%
ZMIX / SECCHI	8.9	0.31	86.0%	9.6	0.36	88.7%
CHL-A * SECCHI	22.4	0.77	86.7%	22.9	0.65	87.4%
CHL-A / TOTAL P	0.9	0.62	99.0%	0.8	0.75	98.3%
FREQ(CHL-a>10) %	96.2	0.09	96.1%	97.4	0.05	97.1%
FREQ(CHL-a>20) %	74.6	0.46	96.1%	79.4	0.30	97.1%
FREQ(CHL-a>30) %	50.3	0.86	96.1%	56.6	0.58	97.1%
FREQ(CHL-a>40) %	32.4	1.19	96.1%	38.3	0.85	97.1%
FREQ(CHL-a>50) %	20.7	1.48	96.1%	25.5	1.08	97.1%
FREQ(CHL-a>60) %	13.3	1.73	96.1%	17.1	1.29	97.1%
CARLSON TSI-P	58.2	0.11	44.8%	61.6	0.13	55.1%
CARLSON TSI-CHLA	65.9	0.10	96.1%	66.9	0.08	97.1%
CARLSON TSI-SEC	67.0	0.07	77.2%	68.1	0.08	80.0%

Lake Vermilion TMDL Analysis (year 2000)
File: L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration2000cal&out-reduction.btb

Overall Water & Nutrient Balances

Overall Water Balance — **Averaging Period = 1.00 years**

Trb	Type	Seg	Name	Area km²	Flow hm³/yr	Variance (hm3/yr)²	CV -	Runoff m/yr
1	1	1	North Fork Vermilion River	764.8	90.6	0.00E+00	0.00	0.12
2	4	4	Outflow at Dam	764.8	91.5	0.00E+00	0.00	0.12
PRECIPITATION				3.0	2.7	2.83E+00	0.62	0.91
TRIBUTARY INFLOW				764.8	90.6	0.00E+00	0.00	0.12
***TOTAL INFLOW				767.7	93.3	2.83E+00	0.02	0.12
GAUGED OUTFLOW				764.8	91.5	0.00E+00	0.00	0.12
ADVECTIVE OUTFLOW				3.0	-0.6	2.83E+00	2.72	
***TOTAL OUTFLOW				767.7	90.9	2.83E+00	0.02	0.12
***EVAPORATION					2.5	0.00E+00	0.00	

Overall Mass Balance Based Upon Component: **Predicted TOTAL P** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance (kg/yr)²	%Total	CV	Conc mg/m³	Export kg/km²/yr
1	1	1	North Fork Vermilion River	11985.7	99.3%	1.80E+06	99.9%	0.11	132.3	15.7
2	4	4	Outflow at Dam	3893.3		3.16E+06		0.46	42.6	5.1
PRECIPITATION				89.9	0.7%	2.02E+03	0.1%	0.50	33.0	30.0
TRIBUTARY INFLOW				11985.7	99.3%	1.80E+06	99.9%	0.11	132.3	15.7
***TOTAL INFLOW				12075.7	100.0%	1.80E+06	100.0%	0.11	129.4	15.7
GAUGED OUTFLOW				3893.3	32.2%	3.16E+06		0.46	42.6	5.1
ADVECTIVE OUTFLOW				-26.3		5.30E+03		2.77	42.6	
***TOTAL OUTFLOW				3867.0	32.0%	3.11E+06		0.46	42.6	5.0
***RETENTION				8208.7	68.0%	4.16E+06		0.25		

Overflow Rate (m/yr)	30.3	Nutrient Resid. Time (yrs)	0.0375
Hydraulic Resid. Time (yrs)	0.0993	Turnover Ratio	26.6
Reservoir Conc (mg/m3)	50	Retention Coef.	0.680

Overall Mass Balance Based Upon Component: **Predicted TOTAL N** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance (kg/yr)²	%Total	CV	Conc mg/m³	Export kg/km²/yr
1	1	1	North Fork Vermilion River	1081423.5	99.7%	3.93E+09	99.9%	0.06	11936.9	1414.1
2	4	4	Outflow at Dam	510139.2		7.93E+10		0.55	5576.3	667.1
PRECIPITATION				2998.0	0.3%	2.25E+06	0.1%	0.50	1098.9	1000.0
TRIBUTARY INFLOW				1081423.5	99.7%	3.93E+09	99.9%	0.06	11936.9	1414.1
***TOTAL INFLOW				1084421.5	100.0%	3.94E+09	100.0%	0.06	11620.1	1412.5
GAUGED OUTFLOW				510139.2	47.0%	7.93E+10		0.55	5576.3	667.1
ADVECTIVE OUTFLOW				-3447.2		9.20E+07		2.78	5576.3	
***TOTAL OUTFLOW				506692.0	46.7%	7.83E+10		0.55	5576.3	660.0
***RETENTION				577729.5	53.3%	8.01E+10		0.49		

Overflow Rate (m/yr)	30.3	Nutrient Resid. Time (yrs)	0.0470
Hydraulic Resid. Time (yrs)	0.0993	Turnover Ratio	21.3
Reservoir Conc (mg/m3)	5650	Retention Coef.	0.533

Lake Vermilion TMDL Analysis (year 2000)
File: G:\TMDL\Model\BATHTUB\VermilionLakeCalibration2000cal&outTN.btb
Description:

Model for TN only using only TN concentrations exceeding 10 mg/L at the river
Initial Condititions model for Lake Vermilion in 2000
TN concentrations to be predicted using calibrated factors

Global Variables	Mean	CV
Averaging Period (yrs)	1	0.0
Precipitation (m)	0.91	0.6
Evaporation (m)	0.82	0.0
Storage Increase (m)	0	0.0

Atmos. Loads (kg/km^2-yr)	Mean	CV
Conserv. Substance	0	0.00
Total P	30	0.50
Total N	1000	0.50
Ortho P	15	0.50
Inorganic N	500	0.50

Segment Morphometry

		Outflow		Area	Depth	Length	Mixed Depth (m)	
Seg	Name	Segment	Group	km^2	m	km	Mean	CV
1	Upper Lake - RBD5	2	1	0.573	1.219	2.164	1.219	0
2	Mid Upper - RBD3	3	1	0.479	1.829	1.052	1.829	0
3	Mid Lower - RBD2	4	1	1.323	3.048	1.393	3.048	0
4	Lower Lake - RBD1	0	1	0.623	5.486	1.149	5.486	0

Segment Observed Water Quality

	Conserv		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	0	0	72.4	0.56	7544	0.669	33.43	0.625	0.343
2	0	0	90.5	0.695	2725	0.745	25.11	0.708	0.315
3	0	0	47.27	0.395	5521.7	0.865	69.94	0.886	0.427
4	0	0	53.697	0.547	5571.7	0.791	40.31	0.532	0.569

Segment Calibration Factors

	Dispersion Rate		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	1	0	0.8	0	0.925	0	0.325	0	0.75
2	1	0	1.2	0	0.7	0	0.475	0	1.2
3	1	0	0.8	0	1.05	0	1.3	0	1.215
4	1	0	0.78	0	1.085	0	1.8	0	1.2

Tributary Data

				Dr Area	Flow (hm^3/yr)		Conserv.	
Trib	Trib Name	Segment	Type	km^2	Mean	CV	Mean	CV
1	North Fork Vermilion River	1	1	764.75	994.64	0.708	0	0
2	Outflow at Dam	4	4	764.75	91.483	0	0	0

Model Options	**Code**	**Description**
Conservative Substance	0	NOT COMPUTED
Phosphorus Balance	1	2ND ORDER, AVAIL P
Nitrogen Balance	1	2ND ORDER, AVAIL N
Chlorophyll-a	2	P, LIGHT, T
Secchi Depth	1	VS. CHLA & TURBIDITY
Dispersion	1	FISCHER-NUMERIC
Phosphorus Calibration	2	CONCENTRATIONS
Nitrogen Calibration	2	CONCENTRATIONS
Error Analysis	1	MODEL & DATA
Availability Factors	0	IGNORE
Mass-Balance Tables	1	USE ESTIMATED CONCS
Output Destination	2	EXCEL WORKSHEET

				Internal Loads (mg/m2-day)					
Hypol Depth		**Non-Algal Turb (m^{-1})**		**Conserv.**		**Total P**		**Total N**	
Mean	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0	0	2.08	0.4	0	0	0	0	0	0
0	0	2.55	0.47	0	0	0	0	0	0
0	0	0.59	2.86	0	0	0	0	0	0
0	0	0.75	1.12	0	0	0	0	0	0

)	**Organic N (ppb)**		**TP - Ortho P (ppb)**		**HOD (ppb/day)**		**MOD (ppb/day)**	
CV	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0.222	0	0	0	0	0	0	0	0
0.35	0	0	0	0	0	0	0	0
0.299	0	0	0	0	0	0	0	0
0.37	0	0	0	0	0	0	0	0

)	**Organic N (ppb)**		**TP - Ortho P (ppb)**		**HOD (ppb/day)**		**MOD (ppb/day)**	
CV	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0

Total P (ppb)		**Total N (ppb)**		**Ortho P (ppb)**		**Inorganic N (ppb)**	
Mean	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
210	0.112	16780	0.118	0	0	0	0
132.5	0.102	10356.61	0.095	0	0	0	0

Model Coefficients	Mean	CV
Dispersion Rate	1.000	0.70
Total Phosphorus	0.775	0.45
Total Nitrogen	1.200	0.55
Chl-a Model	2.400	0.26
Secchi Model	0.850	0.10
Organic N Model	1.000	0.12
TP-OP Model	1.000	0.15
HODv Model	1.000	0.15
MODv Model	1.000	0.22
Secchi/Chla Slope (m^2/mg)	0.025	0.00
Minimum Qs (m/yr)	0.100	0.00
Chl-a Flushing Term	1.000	0.00
Chl-a Temporal CV	0.620	0
Avail. Factor - Total P	0.330	0
Avail. Factor - Ortho P	1.930	0
Avail. Factor - Total N	0.590	0
Avail. Factor - Inorganic N	0.790	0

Lake Vermilion TMDL Analysis (year 2000)
File: G:\TMDL\Model\BATHTUB\VermilionLakeCalibration2000cal&outTN.btb

Segment & Tributary Network

--------Segment:	1	Upper Lake - RBD5		
Outflow Segment:	2	Mid Upper - RBD3		
Tributary:	1	North Fork Vermilion River	Type:	Monitored Inflow
--------Segment:	2	Mid Upper - RBD3		
Outflow Segment:	3	Mid Lower - RBD2		
--------Segment:	3	Mid Lower - RBD2		
Outflow Segment:	4	Lower Lake - RBD1		
--------Segment:	4	Lower Lake - RBD1		
Outflow Segment:	0	Out of Reservoir		
Tributary:	2	Outflow at Dam	Type:	Reservoir Outflow

Lake Vermilion TMDL Analysis (year 2000)
File: G:\TMDL\Model\BATHTUB\VermilionLakeCalibration2000cal&outTN.btb

Hydraulic & Dispersion Parameters

Seg	Name	Outflow Seg	Net Inflow hm^3/yr	Resid Time years	Overflow Rate m/yr	Velocity km/yr	Dispersion--------> Estimated km^2/yr	Numeric km^2/yr	Exchange hm^3/yr
1	Upper Lake - RBD5	2	994.7	0.0007	1735.9	3081.7	18295.3	3334.4	2231.5
2	Mid Upper - RBD3	3	994.7	0.0009	2076.7	1194.5	14912.6	628.3	11307.8
3	Mid Lower - RBD2	4	994.9	0.0041	752.0	343.7	12155.7	239.4	24763.7
4	Lower Lake - RBD1	0	994.9	0.0034	1597.0	334.5	2353.5	192.2	0.0

Morphometry

Seg	Name	Area km^2	Zmean m	Zmix m	Length km	Volume hm^3	Width km	L/W -
1	Upper Lake - RBD5	0.6	1.2	1.2	2.2	0.7	0.3	8.2
2	Mid Upper - RBD3	0.5	1.8	1.8	1.1	0.9	0.5	2.3
3	Mid Lower - RBD2	1.3	3.0	3.0	1.4	4.0	0.9	1.5
4	Lower Lake - RBD1	0.6	5.5	5.5	1.1	3.4	0.5	2.1
Totals		3.0	3.0			9.0		

Lake Vermilion TMDL Analysis (year 2000)
File: **G:\TMDL\Model\BATHTUB\VermilionLakeCalibration2000cal&outTN.btb**

Predicted & Observed Values Ranked Against CE Model Development Dataset

Segment: **5** **Area-Wtd Mean**

	Predicted Values--->			Observed Values--->			
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**	
TOTAL P MG/M3	114.0	0.47	83.2%	60.3	0.53	60.1%	
TOTAL N MG/M3	13837.7	0.58	100.0%	5471.8	0.79	99.6%	38%
C.NUTRIENT MG/M3	113.2	0.46	92.5%	58.9	0.56	73.4%	
CHL-A MG/M3	16.7	1.24	77.3%	49.6	0.78	98.5%	
SECCHI M	0.7	0.48	27.8%	0.4	0.31	10.8%	
ORGANIC N MG/M3	630.1	0.69	71.2%				
TP-ORTHO-P MG/M3	54.6	0.49	73.6%				
ANTILOG PC-1	916.8	0.85	84.3%	2714.9	0.55	96.7%	
ANTILOG PC-2	6.1	1.19	45.4%	9.6	0.38	77.4%	
(N - 150) / P	125.0	0.72	99.8%	95.2	0.58	99.4%	
INORGANIC N / P	237.1	1.14	98.2%				
TURBIDITY 1/M	1.2	0.66	78.5%	1.2	0.66	78.5%	
ZMIX * TURBIDITY	2.9	0.87	45.4%	2.9	0.87	45.4%	
ZMIX / SECCHI	4.4	0.38	44.3%	6.8	0.18	72.5%	
CHL-A * SECCHI	12.8	1.63	62.4%	21.4	0.60	85.2%	
CHL-A / TOTAL P	0.2	1.37	35.7%	0.9	0.69	99.3%	
FREQ(CHL-a>10) %	61.0	0.75	77.3%	96.5	0.04	98.5%	
FREQ(CHL-a>20) %	27.6	1.96	77.3%	80.4	0.15	98.5%	
FREQ(CHL-a>30) %	13.1	3.14	77.3%	62.4	0.29	98.5%	
FREQ(CHL-a>40) %	6.5	4.12	77.3%	47.4	0.48	98.5%	
FREQ(CHL-a>50) %	3.4	4.93	77.3%	35.9	0.70	98.5%	
FREQ(CHL-a>60) %	1.9	5.61	77.3%	27.2	0.94	98.5%	
CARLSON TSI-P	72.3	0.09	83.2%	62.8	0.06	60.1%	
CARLSON TSI-CHLA	57.3	0.18	77.3%	68.2	0.06	98.5%	
CARLSON TSI-SEC	66.9	0.09	72.2%	72.7	0.03	89.2%	

Segment: **1** **Upper Lake - RBD5**

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	112.7	0.47	82.9%	72.4	0.56	67.7%
TOTAL N MG/M3	14625.2	0.57	100.0%	7544.0	0.67	99.9%
C.NUTRIENT MG/M3	112.2	0.46	92.4%	71.9	0.57	80.9%
CHL-A MG/M3	10.7	0.75	56.8%	33.4	0.63	95.0%
SECCHI M	0.3	0.34	3.5%	0.3	0.22	6.6%
ORGANIC N MG/M3	557.7	0.33	62.5%			
TP-ORTHO-P MG/M3	64.2	0.35	78.9%			
ANTILOG PC-1	1046.8	0.63	86.6%	2257.3	0.63	95.5%
ANTILOG PC-2	2.2	0.62	2.3%	6.3	0.45	48.1%
(N - 150) / P	128.4	0.72	99.9%	102.1	0.87	99.6%
INORGANIC N / P	290.3	1.21	98.9%			
TURBIDITY 1/M	2.1	0.40	91.9%	2.1	0.40	91.9%
ZMIX * TURBIDITY	2.5	0.40	39.0%	2.5	0.40	39.0%
ZMIX / SECCHI	4.5	0.35	45.8%	3.6	0.22	30.7%
CHL-A * SECCHI	2.9	0.85	3.8%	11.5	0.66	56.6%

CHL-A / TOTAL P	0.1	0.84	12.7%	0.5	0.83	91.1%
FREQ(CHL-a>10) %	42.1	1.13	56.8%	94.9	0.11	95.0%
FREQ(CHL-a>20) %	9.4	2.14	56.8%	69.8	0.49	95.0%
FREQ(CHL-a>30) %	2.4	2.79	56.8%	44.6	0.88	95.0%
FREQ(CHL-a>40) %	0.7	3.26	56.8%	27.4	1.22	95.0%
FREQ(CHL-a>50) %	0.3	3.63	56.8%	16.9	1.52	95.0%
FREQ(CHL-a>60) %	0.1	3.93	56.8%	10.5	1.77	95.0%
CARLSON TSI-P	72.3	0.09	82.9%	65.9	0.12	67.7%
CARLSON TSI-CHLA	53.9	0.14	56.8%	65.0	0.09	95.0%
CARLSON TSI-SEC	78.8	0.06	96.5%	75.4	0.04	93.4%

Segment: **2** **Mid Upper - RBD3**

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	158.9	0.47	90.9%	90.5	0.69	76.0%
TOTAL N MG/M3	9919.4	0.58	100.0%	2725.0	0.75	94.1%
C.NUTRIENT MG/M3	156.0	0.46	96.7%	83.4	0.71	85.6%
CHL-A MG/M3	8.2	0.89	42.7%	25.1	0.71	89.9%
SECCHI M	0.4	0.42	8.0%	0.3	0.35	5.2%
ORGANIC N MG/M3	534.9	0.31	59.4%			
TP-ORTHO-P MG/M3	70.8	0.40	81.7%			
ANTILOG PC-1	927.5	0.62	84.5%	1862.5	0.74	93.9%
ANTILOG PC-2	2.1	0.78	1.8%	4.8	0.55	29.5%
(N - 150) / P	61.5	0.72	97.0%	28.5	1.04	77.5%
INORGANIC N / P	106.5	1.03	90.1%			
TURBIDITY 1/M	2.5	0.47	94.8%	2.5	0.47	94.8%
ZMIX * TURBIDITY	4.7	0.47	69.3%	4.7	0.47	69.3%
ZMIX / SECCHI	4.9	0.43	52.4%	5.8	0.34	63.2%
CHL-A * SECCHI	3.0	1.06	4.3%	7.9	0.79	36.0%
CHL-A / TOTAL P	0.1	1.04	1.8%	0.3	0.98	70.8%
FREQ(CHL-a>10) %	26.1	1.78	42.7%	88.0	0.25	89.9%
FREQ(CHL-a>20) %	3.9	3.03	42.7%	52.3	0.86	89.9%
FREQ(CHL-a>30) %	0.8	3.79	42.7%	27.5	1.38	89.9%
FREQ(CHL-a>40) %	0.2	4.34	42.7%	14.4	1.82	89.9%
FREQ(CHL-a>50) %	0.1	4.76	42.7%	7.8	2.18	89.9%
FREQ(CHL-a>60) %	0.0	5.11	42.7%	4.3	2.49	89.9%
CARLSON TSI-P	77.2	0.09	90.9%	69.1	0.14	76.0%
CARLSON TSI-CHLA	51.2	0.17	42.7%	62.2	0.11	89.9%
CARLSON TSI-SEC	74.3	0.08	92.0%	76.6	0.06	94.8%

Segment: **3** **Mid Lower - RBD2**

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	104.3	0.47	80.6%	47.3	0.40	49.4%
TOTAL N MG/M3	14447.7	0.58	100.0%	5521.7	0.87	99.6%
C.NUTRIENT MG/M3	103.9	0.47	90.9%	47.0	0.44	63.5%
CHL-A MG/M3	24.7	1.68	89.5%	69.9	0.89	99.5%
SECCHI M	0.9	0.73	38.0%	0.4	0.30	11.1%
ORGANIC N MG/M3	764.1	1.10	82.5%			
TP-ORTHO-P MG/M3	53.8	0.78	73.1%			
ANTILOG PC-1	1032.9	1.19	86.4%	3708.1	0.88	98.1%
ANTILOG PC-2	9.3	1.66	75.7%	12.2	0.64	88.9%

(N - 150) / P	137.1	0.72	99.9%	113.6	0.97	99.7%
INORGANIC N / P	271.3	1.30	98.7%			
TURBIDITY 1/M	0.6	2.86	48.6%	0.6	2.86	48.6%
ZMIX * TURBIDITY	1.8	2.86	23.5%	1.8	2.86	23.5%
ZMIX / SECCHI	3.6	0.73	30.8%	7.1	0.29	75.6%
CHL-A * SECCHI	21.1	2.16	84.8%	29.9	0.94	93.5%
CHL-A / TOTAL P	0.2	1.76	61.7%	1.5	0.97	99.9%
FREQ(CHL-a>10) %	87.4	0.66	89.5%	99.8	0.01	99.5%
FREQ(CHL-a>20) %	51.2	2.14	89.5%	95.6	0.13	99.5%
FREQ(CHL-a>30) %	26.6	3.35	89.5%	85.4	0.37	99.5%
FREQ(CHL-a>40) %	13.8	4.30	89.5%	72.3	0.64	99.5%
FREQ(CHL-a>50) %	7.4	5.08	89.5%	59.2	0.92	99.5%
FREQ(CHL-a>60) %	4.1	5.73	89.5%	47.5	1.18	99.5%
CARLSON TSI-P	71.2	0.09	80.6%	59.8	0.09	49.4%
CARLSON TSI-CHLA	62.0	0.27	89.5%	72.3	0.12	99.5%
CARLSON TSI-SEC	62.2	0.17	62.0%	72.3	0.06	88.9%

Segment: 4 Lower Lake - RBD1

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	101.3	0.47	79.7%	53.7	0.55	55.1%
TOTAL N MG/M3	14830.5	0.58	100.0%	5571.7	0.79	99.6%
C.NUTRIENT MG/M3	100.9	0.47	90.3%	53.3	0.57	69.2%
CHL-A MG/M3	11.9	1.15	62.2%	40.3	0.53	97.1%
SECCHI M	1.0	0.62	44.6%	0.6	0.37	20.0%
ORGANIC N MG/M3	485.3	0.58	51.8%			
TP-ORTHO-P MG/M3	34.9	0.53	56.3%			
ANTILOG PC-1	542.6	0.80	72.8%	1682.1	0.61	92.9%
ANTILOG PC-2	5.7	1.11	41.3%	10.5	0.46	82.7%
(N - 150) / P	144.9	0.72	99.9%	101.0	0.97	99.6%
INORGANIC N / P	216.1	0.91	97.7%			
TURBIDITY 1/M	0.8	1.12	59.4%	0.8	1.12	59.4%
ZMIX * TURBIDITY	4.1	1.12	63.5%	4.1	1.12	63.5%
ZMIX / SECCHI	5.6	0.63	61.3%	9.6	0.36	88.7%
CHL-A * SECCHI	11.6	1.48	57.2%	22.9	0.65	87.4%
CHL-A / TOTAL P	0.1	1.29	21.1%	0.8	0.75	98.3%
FREQ(CHL-a>10) %	48.9	1.53	62.2%	97.4	0.05	97.1%
FREQ(CHL-a>20) %	12.6	3.02	62.2%	79.4	0.30	97.1%
FREQ(CHL-a>30) %	3.6	3.99	62.2%	56.6	0.58	97.1%
FREQ(CHL-a>40) %	1.2	4.69	62.2%	38.3	0.85	97.1%
FREQ(CHL-a>50) %	0.4	5.24	62.2%	25.5	1.08	97.1%
FREQ(CHL-a>60) %	0.2	5.70	62.2%	17.1	1.29	97.1%
CARLSON TSI-P	70.7	0.10	79.7%	61.6	0.13	55.1%
CARLSON TSI-CHLA	54.9	0.21	62.2%	66.9	0.08	97.1%
CARLSON TSI-SEC	60.4	0.15	55.4%	68.1	0.08	80.0%

Lake Vermilion TMDL Analysis (year 2000)
File: G:\TMDL\Model\BATHTUB\VermilionLakeCalibration2000cal&outTN.btb

Overall Water & Nutrient Balances

Overall Water Balance — **Averaging Period = 1.00 years**

Trb	Type	Seg	Name	Area km^2	Flow hm^3/yr	Variance (hm3/yr)^2	CV -	Runoff m/yr
1	1	1	North Fork Vermilion River	764.8	994.6	4.96E+05	0.71	1.30
2	4	4	Outflow at Dam	764.8	91.5	0.00E+00	0.00	0.12
PRECIPITATION				3.0	2.7	2.83E+00	0.62	0.91
TRIBUTARY INFLOW				764.8	994.6	4.96E+05	0.71	1.30
***TOTAL INFLOW				767.7	997.4	4.96E+05	0.71	1.30
GAUGED OUTFLOW				764.8	91.5	0.00E+00	0.00	0.12
ADVECTIVE OUTFLOW				3.0	903.4	4.96E+05	0.78	301.34
***TOTAL OUTFLOW				767.7	994.9	4.96E+05	0.71	1.30
***EVAPORATION					2.5	0.00E+00	0.00	

Overall Mass Balance Based Upon Component: **Predicted TOTAL P** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance (kg/yr)^2	%Total	CV	Conc mg/m^3	Export kg/km^2/yr
1	1	1	North Fork Vermilion River	208874.4	100.0%	2.24E+10	100.0%	0.72	210.0	273.1
2	4	4	Outflow at Dam	9265.4		1.92E+07		0.47	101.3	12.1
PRECIPITATION				89.9	0.0%	2.02E+03	0.0%	0.50	33.0	30.0
TRIBUTARY INFLOW				208874.4	100.0%	2.24E+10	100.0%	0.72	210.0	273.1
***TOTAL INFLOW				208964.3	100.0%	2.24E+10	100.0%	0.72	209.5	272.2
GAUGED OUTFLOW				9265.4	4.4%	1.92E+07		0.47	101.3	12.1
ADVECTIVE OUTFLOW				91499.5	43.8%	8.51E+09		1.01	101.3	30520.3
***TOTAL OUTFLOW				100764.9	48.2%	9.06E+09		0.94	101.3	131.2
***RETENTION				108199.4	51.8%	6.44E+09		0.74		

Overflow Rate (m/yr)	331.9	Nutrient Resid. Time (yrs)	0.0049
Hydraulic Resid. Time (yrs)	0.0091	Turnover Ratio	203.1
Reservoir Conc (mg/m3)	114	Retention Coef.	0.518

Overall Mass Balance Based Upon Component: **Predicted TOTAL N** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance (kg/yr)^2	%Total	CV	Conc mg/m^3	Export kg/km^2/yr
1	1	1	North Fork Vermilion River	16690059.0	100.0%	1.44E+14	100.0%	0.72	16780.0	21824.2
2	4	4	Outflow at Dam	1356740.8		6.25E+11		0.58	14830.5	1774.1
PRECIPITATION				2998.0	0.0%	2.25E+06	0.0%	0.50	1098.9	1000.0
TRIBUTARY INFLOW				16690059.0	100.0%	1.44E+14	100.0%	0.72	16780.0	21824.2
***TOTAL INFLOW				16693057.0	100.0%	1.44E+14	100.0%	0.72	16737.1	21742.9
GAUGED OUTFLOW				1356740.8	8.1%	6.25E+11		0.58	14830.5	1774.1
ADVECTIVE OUTFLOW				13398292.0	80.3%	2.20E+14		1.11	14830.5	4469098.0
***TOTAL OUTFLOW				14755033.0	88.4%	2.38E+14		1.04	14830.5	19218.6
***RETENTION				1938024.0	11.6%	6.78E+13		4.25		

Overflow Rate (m/yr)	331.9	Nutrient Resid. Time (yrs)	0.0075
Hydraulic Resid. Time (yrs)	0.0091	Turnover Ratio	133.7
Reservoir Conc (mg/m3)	13838	Retention Coef.	0.116

Lake Vermilion TMDL Analysis (year 2000)
File: **G:\TMDL\Model\BATHTUB\VermilionLakeCalibration2000cal&outTNreduction.btb**
Description:

Reduction target concentrations model for Lake Vermilion in 2000
Model for TN only using only TN concentrations exceeding 10 mg/L at the river
TN concentrations to be predicted using calibrated factors

Added outflow from DAM

Global Variables	Mean	CV
Averaging Period (yrs)	1	0.0
Precipitation (m)	0.91	0.6
Evaporation (m)	0.82	0.0
Storage Increase (m)	0	0.0

Atmos. Loads (kg/km^2-yr)	Mean	CV
Conserv. Substance	0	0.00
Total P	30	0.50
Total N	1000	0.50
Ortho P	15	0.50
Inorganic N	500	0.50

Segment Morphometry

		Outflow		Area	Depth	Length	Mixed Depth (m)	
Seg	Name	Segment	Group	km^2	m	km	Mean	CV
1	Upper Lake - RBD5	2	1	0.573	1.219	2.164	1.219	0
2	Mid Upper - RBD3	3	1	0.479	1.829	1.052	1.829	0
3	Mid Lower - RBD2	4	1	1.323	3.048	1.393	3.048	0
4	Lower Lake - RBD1	0	1	0.623	5.486	1.149	5.486	0

Segment Observed Water Quality

	Conserv		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	0	0	72.4	0.56	7544	0.669	33.43	0.625	0.343
2	0	0	90.5	0.695	2725	0.745	25.11	0.708	0.315
3	0	0	47.27	0.395	5521.7	0.865	69.94	0.886	0.427
4	0	0	53.697	0.547	5571.7	0.791	40.31	0.532	0.569

Segment Calibration Factors

	Dispersion Rate		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	1	0	0.8	0	0.925	0	0.325	0	0.75
2	1	0	1.2	0	0.7	0	0.475	0	1.2
3	1	0	0.8	0	1.05	0	1.3	0	1.215
4	1	0	0.78	0	1.085	0	1.8	0	1.2

Tributary Data

				Dr Area	Flow (hm^3/yr)		Conserv.	
Trib	Trib Name	Segment	Type	km^2	Mean	CV	Mean	CV
1	North Fork Vermilion River	1	1	764.75	994.64	0.708	0	0
2	Outflow at Dam	4	4	764.75	91.483	0	0	0

Model Options	**Code**	**Description**
Conservative Substance	0	NOT COMPUTED
Phosphorus Balance	1	2ND ORDER, AVAIL P
Nitrogen Balance	1	2ND ORDER, AVAIL N
Chlorophyll-a	2	P, LIGHT, T
Secchi Depth	1	VS. CHLA & TURBIDITY
Dispersion	1	FISCHER-NUMERIC
Phosphorus Calibration	2	CONCENTRATIONS
Nitrogen Calibration	2	CONCENTRATIONS
Error Analysis	1	MODEL & DATA
Availability Factors	0	IGNORE
Mass-Balance Tables	1	USE ESTIMATED CONCS
Output Destination	2	EXCEL WORKSHEET

				Internal Loads (mg/m2-day)					
Hypol Depth		**Non-Algal Turb (m^{-1})**		**Conserv.**		**Total P**		**Total N**	
Mean	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0	0	2.08	0.4	0	0	0	0	0	0
0	0	2.55	0.47	0	0	0	0	0	0
0	0	0.59	2.86	0	0	0	0	0	0
0	0	0.75	1.12	0	0	0	0	0	0

)	**Organic N (ppb)**		**TP - Ortho P (ppb)**		**HOD (ppb/day)**		**MOD (ppb/day)**	
CV	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0.222	0	0	0	0	0	0	0	0
0.35	0	0	0	0	0	0	0	0
0.299	0	0	0	0	0	0	0	0
0.37	0	0	0	0	0	0	0	0

)	**Organic N (ppb)**		**TP - Ortho P (ppb)**		**HOD (ppb/day)**		**MOD (ppb/day)**	
CV	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0

Total P (ppb)		**Total N (ppb)**		**Ortho P (ppb)**		**Inorganic N (ppb)**	
Mean	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
210	0.112	11242.6	0.118	0	0	0	0
132.5	0.102	10356.61	0.095	0	0	0	0

Model Coefficients	Mean	CV
Dispersion Rate	1.000	0.70
Total Phosphorus	0.775	0.45
Total Nitrogen	1.200	0.55
Chl-a Model	2.400	0.26
Secchi Model	0.850	0.10
Organic N Model	1.000	0.12
TP-OP Model	1.000	0.15
HODv Model	1.000	0.15
MODv Model	1.000	0.22
Secchi/Chla Slope (m^2/mg)	0.025	0.00
Minimum Qs (m/yr)	0.100	0.00
Chl-a Flushing Term	1.000	0.00
Chl-a Temporal CV	0.620	0
Avail. Factor - Total P	0.330	0
Avail. Factor - Ortho P	1.930	0
Avail. Factor - Total N	0.590	0
Avail. Factor - Inorganic N	0.790	0

Lake Vermilion TMDL Analysis (year 2000)
File: G:\TMDL\Model\BATHTUB\VermilionLakeCalibration2000cal&outTNreduction.btb

Segment & Tributary Network

--------Segment:	1	Upper Lake - RBD5		
Outflow Segment:	2	Mid Upper - RBD3		
Tributary:	1	North Fork Vermilion River	Type:	Monitored Inflow
--------Segment:	2	Mid Upper - RBD3		
Outflow Segment:	3	Mid Lower - RBD2		
--------Segment:	3	Mid Lower - RBD2		
Outflow Segment:	4	Lower Lake - RBD1		
--------Segment:	4	Lower Lake - RBD1		
Outflow Segment:	0	Out of Reservoir		
Tributary:	2	Outflow at Dam	Type:	Reservoir Outflow

Lake Vermilion TMDL Analysis (year 2000)
File: G:\TMDL\Model\BATHTUB\VermilionLakeCalibration2000cal&outTNreduction.btb

Hydraulic & Dispersion Parameters

Seg	Name	Outflow Seg	Net Inflow hm^3/yr	Resid Time years	Overflow Rate m/yr	Velocity km/yr	Dispersion--------> Estimated km^2/yr	Numeric km^2/yr	Exchange hm^3/yr
1	Upper Lake - RBD5	2	994.7	0.0007	1735.9	3081.7	18295.3	3334.4	2231.5
2	Mid Upper - RBD3	3	994.7	0.0009	2076.7	1194.5	14912.6	628.3	11307.8
3	Mid Lower - RBD2	4	994.9	0.0041	752.0	343.7	12155.7	239.4	24763.7
4	Lower Lake - RBD1	0	994.9	0.0034	1597.0	334.5	2353.5	192.2	0.0

Morphometry

Seg	Name	Area km^2	Zmean m	Zmix m	Length km	Volume hm^3	Width km	L/W -
1	Upper Lake - RBD5	0.6	1.2	1.2	2.2	0.7	0.3	8.2
2	Mid Upper - RBD3	0.5	1.8	1.8	1.1	0.9	0.5	2.3
3	Mid Lower - RBD2	1.3	3.0	3.0	1.4	4.0	0.9	1.5
4	Lower Lake - RBD1	0.6	5.5	5.5	1.1	3.4	0.5	2.1
Totals		3.0	3.0			9.0		

Lake Vermilion TMDL Analysis (year 2000)
File: G:\TMDL\Model\BATHTUB\VermilionLakeCalibration2000cal&outTNreduct

Predicted & Observed Values Ranked Against CE Model Development Dataset

Segment: 5 Area-Wtd Mean

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	114.0	0.47	83.2%	60.3	0.53	60.1%
TOTAL N MG/M3	10070.0	0.57	100.0%	5471.8	0.79	99.6%
C.NUTRIENT MG/M3	112.5	0.46	92.4%	58.9	0.56	73.4%
CHL-A MG/M3	16.7	1.24	77.3%	49.6	0.78	98.5%
SECCHI M	0.7	0.48	27.8%	0.4	0.31	10.8%
ORGANIC N MG/M3	630.1	0.69	71.2%			
TP-ORTHO-P MG/M3	54.6	0.49	73.6%			
ANTILOG PC-1	913.8	0.84	84.3%	2714.9	0.55	96.7%
ANTILOG PC-2	6.1	1.19	45.5%	9.6	0.38	77.4%
(N - 150) / P	90.7	0.72	99.3%	95.2	0.58	99.4%
INORGANIC N / P	169.3	1.15	96.0%			
TURBIDITY 1/M	1.2	0.66	78.5%	1.2	0.66	78.5%
ZMIX * TURBIDITY	2.9	0.87	45.4%	2.9	0.87	45.4%
ZMIX / SECCHI	4.4	0.38	44.3%	6.8	0.18	72.5%
CHL-A * SECCHI	12.8	1.63	62.4%	21.4	0.60	85.2%
CHL-A / TOTAL P	0.2	1.37	35.7%	0.9	0.69	99.3%
FREQ(CHL-a>10) %	61.0	0.75	77.3%	96.5	0.04	98.5%
FREQ(CHL-a>20) %	27.6	1.96	77.3%	80.4	0.15	98.5%
FREQ(CHL-a>30) %	13.1	3.14	77.3%	62.4	0.29	98.5%
FREQ(CHL-a>40) %	6.5	4.12	77.3%	47.4	0.48	98.5%
FREQ(CHL-a>50) %	3.4	4.93	77.3%	35.9	0.70	98.5%
FREQ(CHL-a>60) %	1.9	5.61	77.3%	27.2	0.94	98.5%
CARLSON TSI-P	72.3	0.09	83.2%	62.8	0.06	60.1%
CARLSON TSI-CHLA	57.3	0.18	77.3%	68.2	0.06	98.5%
CARLSON TSI-SEC	66.9	0.09	72.2%	72.7	0.03	89.2%

Segment: 1 Upper Lake - RBD5

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	112.7	0.47	82.9%	72.4	0.56	67.7%
TOTAL N MG/M3	10351.9	0.57	100.0%	7544.0	0.67	99.9%
C.NUTRIENT MG/M3	111.7	0.46	92.3%	71.9	0.57	80.9%
CHL-A MG/M3	10.7	0.75	56.8%	33.4	0.63	95.0%
SECCHI M	0.3	0.34	3.5%	0.3	0.22	6.6%
ORGANIC N MG/M3	557.7	0.33	62.5%			
TP-ORTHO-P MG/M3	64.2	0.35	78.9%			
ANTILOG PC-1	1044.1	0.63	86.6%	2257.3	0.63	95.5%
ANTILOG PC-2	2.2	0.62	2.3%	6.3	0.45	48.1%
(N - 150) / P	90.5	0.72	99.3%	102.1	0.87	99.6%
INORGANIC N / P	202.1	1.22	97.3%			
TURBIDITY 1/M	2.1	0.40	91.9%	2.1	0.40	91.9%
ZMIX * TURBIDITY	2.5	0.40	39.0%	2.5	0.40	39.0%
ZMIX / SECCHI	4.5	0.35	45.8%	3.6	0.22	30.7%
CHL-A * SECCHI	2.9	0.85	3.8%	11.5	0.66	56.6%

CHL-A / TOTAL P	0.1	0.84	12.7%	0.5	0.83	91.1%
FREQ(CHL-a>10) %	42.1	1.13	56.8%	94.9	0.11	95.0%
FREQ(CHL-a>20) %	9.4	2.14	56.8%	69.8	0.49	95.0%
FREQ(CHL-a>30) %	2.4	2.79	56.8%	44.6	0.88	95.0%
FREQ(CHL-a>40) %	0.7	3.26	56.8%	27.4	1.22	95.0%
FREQ(CHL-a>50) %	0.3	3.63	56.8%	16.9	1.52	95.0%
FREQ(CHL-a>60) %	0.1	3.93	56.8%	10.5	1.77	95.0%
CARLSON TSI-P	72.3	0.09	82.9%	65.9	0.12	67.7%
CARLSON TSI-CHLA	53.9	0.14	56.8%	65.0	0.09	95.0%
CARLSON TSI-SEC	78.8	0.06	96.5%	75.4	0.04	93.4%

Segment: 2 Mid Upper - RBD3

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	158.9	0.47	90.9%	90.5	0.69	76.0%
TOTAL N MG/M3	7217.0	0.57	99.9%	2725.0	0.75	94.1%
C.NUTRIENT MG/M3	153.4	0.44	96.6%	83.4	0.71	85.6%
CHL-A MG/M3	8.2	0.89	42.7%	25.1	0.71	89.9%
SECCHI M	0.4	0.42	8.0%	0.3	0.35	5.2%
ORGANIC N MG/M3	534.9	0.31	59.4%			
TP-ORTHO-P MG/M3	70.8	0.40	81.7%			
ANTILOG PC-1	918.6	0.61	84.3%	1862.5	0.74	93.9%
ANTILOG PC-2	2.1	0.78	1.8%	4.8	0.55	29.5%
(N - 150) / P	44.5	0.72	92.1%	28.5	1.04	77.5%
INORGANIC N / P	75.9	1.04	82.7%			
TURBIDITY 1/M	2.5	0.47	94.8%	2.5	0.47	94.8%
ZMIX * TURBIDITY	4.7	0.47	69.3%	4.7	0.47	69.3%
ZMIX / SECCHI	4.9	0.43	52.4%	5.8	0.34	63.2%
CHL-A * SECCHI	3.0	1.06	4.3%	7.9	0.79	36.0%
CHL-A / TOTAL P	0.1	1.04	1.8%	0.3	0.98	70.8%
FREQ(CHL-a>10) %	26.1	1.78	42.7%	88.0	0.25	89.9%
FREQ(CHL-a>20) %	3.9	3.03	42.7%	52.3	0.86	89.9%
FREQ(CHL-a>30) %	0.8	3.79	42.7%	27.5	1.38	89.9%
FREQ(CHL-a>40) %	0.2	4.34	42.7%	14.4	1.82	89.9%
FREQ(CHL-a>50) %	0.1	4.76	42.7%	7.8	2.18	89.9%
FREQ(CHL-a>60) %	0.0	5.11	42.7%	4.3	2.49	89.9%
CARLSON TSI-P	77.2	0.09	90.9%	69.1	0.14	76.0%
CARLSON TSI-CHLA	51.2	0.17	42.7%	62.2	0.11	89.9%
CARLSON TSI-SEC	74.3	0.08	92.0%	76.6	0.06	94.8%

Segment: 3 Mid Lower - RBD2

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	104.3	0.47	80.6%	47.3	0.40	49.4%
TOTAL N MG/M3	10593.2	0.57	100.0%	5521.7	0.87	99.6%
C.NUTRIENT MG/M3	103.5	0.47	90.8%	47.0	0.44	63.5%
CHL-A MG/M3	24.7	1.68	89.5%	69.9	0.89	99.5%
SECCHI M	0.9	0.73	38.0%	0.4	0.30	11.1%
ORGANIC N MG/M3	764.1	1.10	82.5%			
TP-ORTHO-P MG/M3	53.8	0.78	73.1%			
ANTILOG PC-1	1030.9	1.19	86.4%	3708.1	0.88	98.1%
ANTILOG PC-2	9.3	1.66	75.7%	12.2	0.64	88.9%

(N - 150) / P	100.2	0.72	99.5%	113.6	0.97	99.7%
INORGANIC N / P	194.8	1.30	97.1%			
TURBIDITY 1/M	0.6	2.86	48.6%	0.6	2.86	48.6%
ZMIX * TURBIDITY	1.8	2.86	23.5%	1.8	2.86	23.5%
ZMIX / SECCHI	3.6	0.73	30.8%	7.1	0.29	75.6%
CHL-A * SECCHI	21.1	2.16	84.8%	29.9	0.94	93.5%
CHL-A / TOTAL P	0.2	1.76	61.7%	1.5	0.97	99.9%
FREQ(CHL-a>10) %	87.4	0.66	89.5%	99.8	0.01	99.5%
FREQ(CHL-a>20) %	51.2	2.14	89.5%	95.6	0.13	99.5%
FREQ(CHL-a>30) %	26.6	3.35	89.5%	85.4	0.37	99.5%
FREQ(CHL-a>40) %	13.8	4.30	89.5%	72.3	0.64	99.5%
FREQ(CHL-a>50) %	7.4	5.08	89.5%	59.2	0.92	99.5%
FREQ(CHL-a>60) %	4.1	5.73	89.5%	47.5	1.18	99.5%
CARLSON TSI-P	71.2	0.09	80.6%	59.8	0.09	49.4%
CARLSON TSI-CHLA	62.0	0.27	89.5%	72.3	0.12	99.5%
CARLSON TSI-SEC	62.2	0.17	62.0%	72.3	0.06	88.9%

Segment: 4 Lower Lake - RBD1

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	101.3	0.47	79.7%	53.7	0.55	55.1%
TOTAL N MG/M3	10893.1	0.58	100.0%	5571.7	0.79	99.6%
C.NUTRIENT MG/M3	100.6	0.47	90.2%	53.3	0.57	69.2%
CHL-A MG/M3	11.9	1.15	62.2%	40.3	0.53	97.1%
SECCHI M	1.0	0.62	44.6%	0.6	0.37	20.0%
ORGANIC N MG/M3	485.3	0.58	51.8%			
TP-ORTHO-P MG/M3	34.9	0.53	56.3%			
ANTILOG PC-1	541.7	0.80	72.8%	1682.1	0.61	92.9%
ANTILOG PC-2	5.7	1.11	41.3%	10.5	0.46	82.7%
(N - 150) / P	106.1	0.72	99.6%	101.0	0.97	99.6%
INORGANIC N / P	156.8	0.92	95.3%			
TURBIDITY 1/M	0.8	1.12	59.4%	0.8	1.12	59.4%
ZMIX * TURBIDITY	4.1	1.12	63.5%	4.1	1.12	63.5%
ZMIX / SECCHI	5.6	0.63	61.3%	9.6	0.36	88.7%
CHL-A * SECCHI	11.6	1.48	57.2%	22.9	0.65	87.4%
CHL-A / TOTAL P	0.1	1.29	21.1%	0.8	0.75	98.3%
FREQ(CHL-a>10) %	48.9	1.53	62.2%	97.4	0.05	97.1%
FREQ(CHL-a>20) %	12.6	3.02	62.2%	79.4	0.30	97.1%
FREQ(CHL-a>30) %	3.6	3.99	62.2%	56.6	0.58	97.1%
FREQ(CHL-a>40) %	1.2	4.69	62.2%	38.3	0.85	97.1%
FREQ(CHL-a>50) %	0.4	5.24	62.2%	25.5	1.08	97.1%
FREQ(CHL-a>60) %	0.2	5.70	62.2%	17.1	1.29	97.1%
CARLSON TSI-P	70.7	0.10	79.7%	61.6	0.13	55.1%
CARLSON TSI-CHLA	54.9	0.21	62.2%	66.9	0.08	97.1%
CARLSON TSI-SEC	60.4	0.15	55.4%	68.1	0.08	80.0%

Lake Vermilion TMDL Analysis (year 2000)
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Overall Water & Nutrient Balances

Overall Water Balance — **Averaging Period = 1.00 years**

Trb	Type	Seg	Name	Area km^2	Flow hm^3/yr	Variance (hm3/yr)^2	CV -	Runoff m/yr
1	1	1	North Fork Vermilion River	764.8	994.6	4.96E+05	0.71	1.30
2	4	4	Outflow at Dam	764.8	91.5	0.00E+00	0.00	0.12
PRECIPITATION				3.0	2.7	2.83E+00	0.62	0.91
TRIBUTARY INFLOW				764.8	994.6	4.96E+05	0.71	1.30
***TOTAL INFLOW				767.7	997.4	4.96E+05	0.71	1.30
GAUGED OUTFLOW				764.8	91.5	0.00E+00	0.00	0.12
ADVECTIVE OUTFLOW				3.0	903.4	4.96E+05	0.78	301.34
***TOTAL OUTFLOW				767.7	994.9	4.96E+05	0.71	1.30
***EVAPORATION					2.5	0.00E+00	0.00	

Overall Mass Balance Based Upon Component: **Predicted TOTAL P** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance (kg/yr)^2	%Total	CV	Conc mg/m^3	Export kg/km^2/yr
1	1	1	North Fork Vermilion River	208874.4	100.0%	2.24E+10	100.0%	0.72	210.0	273.1
2	4	4	Outflow at Dam	9265.4		1.92E+07		0.47	101.3	12.1
PRECIPITATION				89.9	0.0%	2.02E+03	0.0%	0.50	33.0	30.0
TRIBUTARY INFLOW				208874.4	100.0%	2.24E+10	100.0%	0.72	210.0	273.1
***TOTAL INFLOW				208964.3	100.0%	2.24E+10	100.0%	0.72	209.5	272.2
GAUGED OUTFLOW				9265.4	4.4%	1.92E+07		0.47	101.3	12.1
ADVECTIVE OUTFLOW				91499.5	43.8%	8.51E+09		1.01	101.3	30520.3
***TOTAL OUTFLOW				100764.9	48.2%	9.06E+09		0.94	101.3	131.2
***RETENTION				108199.4	51.8%	6.44E+09		0.74		

Overflow Rate (m/yr)	331.9	Nutrient Resid. Time (yrs)	0.0049
Hydraulic Resid. Time (yrs)	0.0091	Turnover Ratio	203.1
Reservoir Conc (mg/m3)	114	Retention Coef.	0.518

Overall Mass Balance Based Upon Component: **Predicted TOTAL N** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance (kg/yr)^2	%Total	CV	Conc mg/m^3	Export kg/km^2/yr
1	1	1	North Fork Vermilion River	11182339.0	100.0%	6.44E+13	100.0%	0.72	11242.6	14622.2
2	4	4	Outflow at Dam	996530.4		3.29E+11		0.58	10893.1	1303.1
PRECIPITATION				2998.0	0.0%	2.25E+06	0.0%	0.50	1098.9	1000.0
TRIBUTARY INFLOW				11182339.0	100.0%	6.44E+13	100.0%	0.72	11242.6	14622.2
***TOTAL INFLOW				11185337.0	100.0%	6.44E+13	100.0%	0.72	11214.9	14569.0
GAUGED OUTFLOW				996530.4	8.9%	3.29E+11		0.58	10893.1	1303.1
ADVECTIVE OUTFLOW				9841088.0	88.0%	1.13E+14		1.08	10893.1	3282566.5
***TOTAL OUTFLOW				10837618.0	96.9%	1.22E+14		1.02	10893.1	14116.1
***RETENTION				347719.0	3.1%	3.74E+13		10.00		

Overflow Rate (m/yr)	331.9	Nutrient Resid. Time (yrs)	0.0081
Hydraulic Resid. Time (yrs)	0.0091	Turnover Ratio	123.1
Reservoir Conc (mg/m3)	10070	Retention Coef.	0.031

Lake Vermilion TMDL Analysis (year 2001)
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Description:

Initial Condititions model for Lake Vermilion in 2001

TP, TN, Chl-a, and Secchi concentrations to be predicted using calibrated factors

Added outflow from DAM

Global Variables	Mean	CV
Averaging Period (yrs)	1	0.0
Precipitation (m)	1	0.7
Evaporation (m)	0.82	0.0
Storage Increase (m)	0	0.0

Atmos. Loads (kg/km^2-yr)	Mean	CV
Conserv. Substance	0	0.00
Total P	30	0.50
Total N	1000	0.50
Ortho P	15	0.50
Inorganic N	500	0.50

Segment Morphometry

Seg	Name	Outflow Segment	Group	Area km^2	Depth m	Length km	Mixed Depth (m) Mean	CV
1	Upper Lake - RBD5	2	1	0.573	1.219	2.164	1.219	0
2	Mid Upper - RBD3	3	1	0.479	1.829	1.052	1.829	0
3	Mid Lower - RBD2	4	1	1.323	3.048	1.393	3.048	0
4	Lower Lake - RBD1	0	1	0.623	5.486	1.149	5.486	0

Segment Observed Water Quality

	Conserv		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	0	0	63.75	0.405	10095	0.151	14.03	1.124	0.343
2	0	0	0	0	0	0	0	0	0
3	0	0	80	0.177	9635	0.231	20.375	0.308	0.427
4	0	0	86	0.181	9781.25	0.274	17.28	0.505	0.569

Segment Calibration Factors

	Dispersion Rate		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	1	0	0.8	0	0.925	0	0.325	0	0.75
2	1	0	1.2	0	0.7	0	0.475	0	1.2
3	1	0	0.8	0	1.05	0	1.3	0	1.215
4	1	0	0.78	0	1.085	0	1.8	0	1.2

Tributary Data

Trib	Trib Name	Segment	Type	Dr Area km^2	Flow (hm^3/yr) Mean	CV	Conserv. Mean	CV
1	North Fork Vermilion River	1	1	764.75	328.879	0	0	0
2	Dam Outfall	4	4	764.75	329.375	0	0	0

Model Coefficients	Mean	CV
Dispersion Rate	1.000	0.70
Total Phosphorus	0.775	0.45
Total Nitrogen	1.200	0.55
Chl-a Model	2.400	0.26
Secchi Model	0.850	0.10
Organic N Model	1.000	0.12
TP-OP Model	1.000	0.15
HODv Model	1.000	0.15
MODv Model	1.000	0.22
Secchi/Chla Slope (m^2/mg)	0.025	0.00
Minimum Qs (m/yr)	0.100	0.00
Chl-a Flushing Term	1.000	0.00
Chl-a Temporal CV	0.620	0
Avail. Factor - Total P	0.330	0
Avail. Factor - Ortho P	1.930	0
Avail. Factor - Total N	0.590	0
Avail. Factor - Inorganic N	0.790	0

Model Options	Code	Description
Conservative Substance	0	NOT COMPUTED
Phosphorus Balance	1	2ND ORDER, AVAIL P
Nitrogen Balance	1	2ND ORDER, AVAIL N
Chlorophyll-a	2	P, LIGHT, T
Secchi Depth	1	VS. CHLA & TURBIDITY
Dispersion	1	FISCHER-NUMERIC
Phosphorus Calibration	2	CONCENTRATIONS
Nitrogen Calibration	2	CONCENTRATIONS
Error Analysis	1	MODEL & DATA
Availability Factors	0	IGNORE
Mass-Balance Tables	1	USE ESTIMATED CONCS
Output Destination	2	EXCEL WORKSHEET

Hypol Depth		Non-Algal Turb (m^{-1})		Internal Loads (mg/m2-day) Conserv.		Total P		Total N	
Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
0	0	2.56	0.3	0	0	0	0	0	0
0	0	0.08	0.2	0	0	0	0	0	0
0	0	1.83	0.39	0	0	0	0	0	0
0	0	1.33	0.52	0	0	0	0	0	0

)	Organic N (ppb)		TP - Ortho P (ppb)		HOD (ppb/day)		MOD (ppb/day)	
CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
0.222	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0.299	0	0	0	0	0	0	0	0
0.37	0	0	0	0	0	0	0	0

)	Organic N (ppb)		TP - Ortho P (ppb)		HOD (ppb/day)		MOD (ppb/day)	
CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0

Total P (ppb)		Total N (ppb)		Ortho P (ppb)		Inorganic N (ppb)	
Mean	CV	Mean	CV	Mean	CV	Mean	CV
405.73	0.096	10103.11	0.063	0	0	0	0
606	0.2	9570	0.2	0	0	0	0

Lake Vermilion TMDL Analysis (year 2001)
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Segment & Tributary Network

--------Segment:	1	Upper Lake - RBD5		
Outflow Segment:	2	Mid Upper - RBD3		
Tributary:	1	North Fork Vermilion River	Type:	Monitored Inflow
--------Segment:	2	Mid Upper - RBD3		
Outflow Segment:	3	Mid Lower - RBD2		
--------Segment:	3	Mid Lower - RBD2		
Outflow Segment:	4	Lower Lake - RBD1		
--------Segment:	4	Lower Lake - RBD1		
Outflow Segment:	0	Out of Reservoir		
Tributary:	2	Dam Outfall	Type:	Reservoir Outflow

Lake Vermilion TMDL Analysis (year 2001)
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Hydraulic & Dispersion Parameters

Seg	Name	Outflow Seg	Net Inflow hm^3/yr	Resid Time years	Overflow Rate m/yr	Velocity km/yr	Dispersion--------> Estimated km^2/yr	Numeric km^2/yr	Exchange hm^3/yr
1	Upper Lake - RBD5	2	329.0	0.0021	574.1	1019.2	6050.9	1102.8	738.0
2	Mid Upper - RBD3	3	329.1	0.0027	687.0	395.1	4933.2	207.8	3740.7
3	Mid Lower - RBD2	4	329.3	0.0122	248.9	113.8	4023.7	79.2	8197.0
4	Lower Lake - RBD1	0	329.4	0.0104	528.8	110.7	779.3	63.6	0.0

Morphometry

Seg	Name	Area km^2	Zmean m	Zmix m	Length km	Volume hm^3	Width km	L/W -
1	Upper Lake - RBD5	0.6	1.2	1.2	2.2	0.7	0.3	8.2
2	Mid Upper - RBD3	0.5	1.8	1.8	1.1	0.9	0.5	2.3
3	Mid Lower - RBD2	1.3	3.0	3.0	1.4	4.0	0.9	1.5
4	Lower Lake - RBD1	0.6	5.5	5.5	1.1	3.4	0.5	2.1
Totals		3.0	3.0			9.0		

Lake Vermilion TMDL Analysis (year 2001)
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Predicted & Observed Values Ranked Against CE Model Development Dataset

Segment: **5** **Area-Wtd Mean**

Variable	Predicted Values---> Mean	CV	Rank	Observed Values---> Mean	CV	Rank
TOTAL P MG/M3	149.8	0.46	89.7%	77.8	0.22	70.5%
TOTAL N MG/M3	7253.0	0.55	99.9%	9775.8	0.22	100.0%
C.NUTRIENT MG/M3	143.5	0.42	95.9%	77.4	0.22	83.3%
CHL-A MG/M3	33.4	0.31	95.0%	18.2	0.50	80.4%
SECCHI M	0.4	0.19	11.2%	0.4	0.31	12.0%
ORGANIC N MG/M3	1038.9	0.25	93.8%			
TP-ORTHO-P MG/M3	93.0	0.24	88.3%			
ANTILOG PC-1	2363.6	0.46	95.8%	1015.6	0.35	86.1%
ANTILOG PC-2	7.1	0.21	57.7%	5.1	0.25	32.6%
(N - 150) / P	49.7	0.72	94.2%	125.5	0.20	99.8%
INORGANIC N / P	136.1	1.51	93.7%			
TURBIDITY 1/M	1.6	0.24	86.2%	1.6	0.24	86.2%
ZMIX * TURBIDITY	4.6	0.27	68.7%	4.6	0.27	68.7%
ZMIX / SECCHI	7.2	0.18	76.0%	6.9	0.20	74.0%
CHL-A * SECCHI	15.4	0.25	71.9%	8.1	0.34	37.2%
CHL-A / TOTAL P	0.2	0.44	57.8%	0.2	0.34	60.8%
FREQ(CHL-a>10) %	92.3	0.08	95.0%	73.2	0.25	80.4%
FREQ(CHL-a>20) %	65.1	0.27	95.0%	32.0	0.52	80.4%
FREQ(CHL-a>30) %	41.9	0.43	95.0%	13.5	0.70	80.4%
FREQ(CHL-a>40) %	26.9	0.55	95.0%	6.0	0.85	80.4%
FREQ(CHL-a>50) %	17.5	0.65	95.0%	2.8	0.97	80.4%
FREQ(CHL-a>60) %	11.7	0.74	95.0%	1.4	1.09	80.4%
CARLSON TSI-P	76.1	0.08	89.7%	66.9	0.03	70.5%
CARLSON TSI-CHLA	64.6	0.05	95.0%	58.9	0.05	80.4%
CARLSON TSI-SEC	73.2	0.04	88.8%	72.0	0.04	88.0%

Segment: **1** **Upper Lake - RBD5**

Variable	Predicted Values---> Mean	CV	Rank	Observed Values---> Mean	CV	Rank
TOTAL P MG/M3	169.0	0.47	91.9%	63.8	0.41	62.5%
TOTAL N MG/M3	8049.4	0.56	99.9%	10095.0	0.15	100.0%
C.NUTRIENT MG/M3	163.7	0.44	97.2%	63.6	0.39	76.5%
CHL-A MG/M3	25.5	0.35	90.2%	14.0	1.12	69.9%
SECCHI M	0.2	0.24	1.3%	0.3	0.22	6.6%
ORGANIC N MG/M3	930.3	0.23	90.7%			
TP-ORTHO-P MG/M3	101.9	0.23	90.1%			
ANTILOG PC-1	2932.6	0.48	97.1%	990.2	1.08	85.7%
ANTILOG PC-2	3.3	0.31	10.5%	3.5	0.77	12.3%
(N - 150) / P	46.7	0.72	93.1%	156.0	0.42	99.9%
INORGANIC N / P	106.1	1.22	90.0%			
TURBIDITY 1/M	2.6	0.30	94.9%	2.6	0.30	94.9%
ZMIX * TURBIDITY	3.1	0.30	49.5%	3.1	0.30	49.5%
ZMIX / SECCHI	6.1	0.24	66.5%	3.6	0.22	30.7%
CHL-A * SECCHI	5.1	0.45	16.2%	4.8	1.15	14.4%

CHL-A / TOTAL P	0.2	0.41	34.0%	0.2	1.19	57.2%
FREQ(CHL-a>10) %	88.4	0.12	90.2%	59.3	1.16	69.9%
FREQ(CHL-a>20) %	53.2	0.42	90.2%	18.9	2.61	69.9%
FREQ(CHL-a>30) %	28.3	0.68	90.2%	6.2	3.65	69.9%
FREQ(CHL-a>40) %	14.9	0.89	90.2%	2.3	4.44	69.9%
FREQ(CHL-a>50) %	8.1	1.07	90.2%	0.9	5.09	69.9%
FREQ(CHL-a>60) %	4.5	1.22	90.2%	0.4	5.63	69.9%
CARLSON TSI-P	78.1	0.09	91.9%	64.1	0.09	62.5%
CARLSON TSI-CHLA	62.4	0.06	90.2%	56.5	0.19	69.9%
CARLSON TSI-SEC	83.2	0.04	98.7%	75.4	0.04	93.4%

Segment: 2 Mid Upper - RBD3

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	208.2	0.46	94.9%			
TOTAL N MG/M3	5200.9	0.55	99.5%			
C.NUTRIENT MG/M3	186.6	0.38	98.1%			
CHL-A MG/M3	57.3	0.28	99.1%			
SECCHI M	0.7	0.28	26.8%			
ORGANIC N MG/M3	1469.1	0.28	98.7%			
TP-ORTHO-P MG/M3	99.8	0.32	89.7%			
ANTILOG PC-1	3280.7	0.50	97.6%			
ANTILOG PC-2	13.9	0.10	92.9%			
(N - 150) / P	24.3	0.72	69.9%			
INORGANIC N / P	34.4	1.11	55.9%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.1	0.20	0.0%	0.1	0.20	0.0%
ZMIX / SECCHI	2.7	0.28	16.6%			
CHL-A * SECCHI	38.6	0.10	97.0%			
CHL-A / TOTAL P	0.3	0.43	70.3%			
FREQ(CHL-a>10) %	99.4	0.01	99.1%			
FREQ(CHL-a>20) %	91.7	0.07	99.1%			
FREQ(CHL-a>30) %	76.8	0.17	99.1%			
FREQ(CHL-a>40) %	60.6	0.28	99.1%			
FREQ(CHL-a>50) %	46.4	0.38	99.1%			
FREQ(CHL-a>60) %	35.0	0.48	99.1%			
CARLSON TSI-P	81.1	0.08	94.9%			
CARLSON TSI-CHLA	70.3	0.04	99.1%			
CARLSON TSI-SEC	65.7	0.06	73.2%			

Segment: 3 Mid Lower - RBD2

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	131.3	0.45	86.9%	80.0	0.18	71.6%
TOTAL N MG/M3	7468.2	0.55	99.9%	9635.0	0.23	100.0%
C.NUTRIENT MG/M3	128.4	0.43	94.5%	79.6	0.18	84.2%
CHL-A MG/M3	33.2	0.38	94.9%	20.4	0.31	84.3%
SECCHI M	0.4	0.23	8.9%	0.4	0.30	11.1%
ORGANIC N MG/M3	1051.0	0.27	94.1%			
TP-ORTHO-P MG/M3	98.3	0.23	89.4%			
ANTILOG PC-1	2244.6	0.46	95.5%	1150.4	0.40	88.1%
ANTILOG PC-2	6.7	0.36	53.3%	5.3	0.31	36.1%

(N - 150) / P	55.7	0.72	95.9%	118.6	0.29	99.8%
INORGANIC N / P	194.4	1.73	97.1%			
TURBIDITY 1/M	1.8	0.39	89.4%	1.8	0.39	89.4%
ZMIX * TURBIDITY	5.6	0.39	76.9%	5.6	0.39	76.9%
ZMIX / SECCHI	7.8	0.23	80.4%	7.1	0.29	75.6%
CHL-A * SECCHI	12.9	0.49	62.9%	8.7	0.43	41.1%
CHL-A / TOTAL P	0.3	0.49	65.5%	0.3	0.35	66.0%
FREQ(CHL-a>10) %	94.8	0.07	94.9%	79.9	0.17	84.3%
FREQ(CHL-a>20) %	69.4	0.31	94.9%	39.0	0.48	84.3%
FREQ(CHL-a>30) %	44.1	0.55	94.9%	17.5	0.74	84.3%
FREQ(CHL-a>40) %	27.0	0.75	94.9%	8.1	0.94	84.3%
FREQ(CHL-a>50) %	16.5	0.92	94.9%	3.9	1.10	84.3%
FREQ(CHL-a>60) %	10.3	1.07	94.9%	2.0	1.24	84.3%
CARLSON TSI-P	74.5	0.09	86.9%	67.3	0.04	71.6%
CARLSON TSI-CHLA	64.9	0.06	94.9%	60.2	0.05	84.3%
CARLSON TSI-SEC	73.6	0.05	91.1%	72.3	0.06	88.9%

Segment: 4 Lower Lake - RBD1

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	126.4	0.45	86.0%	86.0	0.18	74.2%
TOTAL N MG/M3	7641.2	0.55	99.9%	9781.3	0.27	100.0%
C.NUTRIENT MG/M3	123.9	0.44	94.0%	85.5	0.19	86.3%
CHL-A MG/M3	23.0	0.45	87.8%	17.3	0.50	78.6%
SECCHI M	0.5	0.28	17.8%	0.6	0.37	20.0%
ORGANIC N MG/M3	782.2	0.28	83.7%			
TP-ORTHO-P MG/M3	68.4	0.22	80.7%			
ANTILOG PC-1	1387.8	0.44	90.7%	752.9	0.58	80.4%
ANTILOG PC-2	6.2	0.48	47.6%	6.0	0.44	44.3%
(N - 150) / P	59.3	0.72	96.7%	112.0	0.33	99.7%
INORGANIC N / P	118.2	1.11	91.8%			
TURBIDITY 1/M	1.3	0.52	81.3%	1.3	0.52	81.3%
ZMIX * TURBIDITY	7.3	0.52	86.0%	7.3	0.52	86.0%
ZMIX / SECCHI	10.2	0.28	90.6%	9.6	0.36	88.7%
CHL-A * SECCHI	12.3	0.64	60.5%	9.8	0.63	47.9%
CHL-A / TOTAL P	0.2	0.58	45.4%	0.2	0.53	51.6%
FREQ(CHL-a>10) %	85.0	0.20	87.8%	71.6	0.37	78.6%
FREQ(CHL-a>20) %	46.7	0.62	87.8%	29.3	0.95	78.6%
FREQ(CHL-a>30) %	23.1	0.96	87.8%	11.5	1.39	78.6%
FREQ(CHL-a>40) %	11.5	1.23	87.8%	4.8	1.74	78.6%
FREQ(CHL-a>50) %	5.9	1.45	87.8%	2.2	2.01	78.6%
FREQ(CHL-a>60) %	3.2	1.63	87.8%	1.0	2.25	78.6%
CARLSON TSI-P	73.9	0.09	86.0%	68.4	0.04	74.2%
CARLSON TSI-CHLA	61.4	0.07	87.8%	58.6	0.08	78.6%
CARLSON TSI-SEC	69.0	0.06	82.2%	68.1	0.08	80.0%

Lake Vermilion TMDL Analysis (year 2001)
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Overall Water & Nutrient Balances

Overall Water Balance — **Averaging Period = 1.00 years**

Trb	Type	Seg	Name	Area km^2	Flow hm^3/yr	Variance $(hm3/yr)^2$	CV -	Runoff m/yr
1	1	1	North Fork Vermilion River	764.8	328.9	0.00E+00	0.00	0.43
2	4	4	Dam Outfall	764.8	329.4	0.00E+00	0.00	0.43
PRECIPITATION				3.0	3.0	4.23E+00	0.69	1.00
TRIBUTARY INFLOW				764.8	328.9	0.00E+00	0.00	0.43
***TOTAL INFLOW				767.7	331.9	4.23E+00	0.01	0.43
GAUGED OUTFLOW				764.8	329.4	0.00E+00	0.00	0.43
ADVECTIVE OUTFLOW				3.0	0.0	4.23E+00	9.99	0.01
***TOTAL OUTFLOW				767.7	329.4	4.23E+00	0.01	0.43
***EVAPORATION					2.5	0.00E+00	0.00	

Overall Mass Balance Based Upon Component: **Predicted TOTAL P** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance $(kg/yr)^2$	%Total	CV	Conc mg/m^3	Export $kg/km^2/yr$
1	1	1	North Fork Vermilion River	133436.1	99.9%	1.64E+08	100.0%	0.10	405.7	174.5
2	4	4	Dam Outfall	41641.5		3.58E+08		0.45	126.4	54.5
PRECIPITATION				89.9	0.1%	2.02E+03	0.0%	0.50	30.0	30.0
TRIBUTARY INFLOW				133436.1	99.9%	1.64E+08	100.0%	0.10	405.7	174.5
***TOTAL INFLOW				133526.0	100.0%	1.64E+08	100.0%	0.10	402.3	173.9
GAUGED OUTFLOW				41641.5	31.2%	3.58E+08		0.45	126.4	54.5
ADVECTIVE OUTFLOW				5.5	0.0%	6.76E+04		10.00	126.4	1.8
***TOTAL OUTFLOW				41647.1	31.2%	3.58E+08		0.45	126.4	54.2
***RETENTION				91879.0	68.8%	4.56E+08		0.23		

Overflow Rate (m/yr)	109.9	Nutrient Resid. Time (yrs)	0.0101
Hydraulic Resid. Time (yrs)	0.0274	Turnover Ratio	98.8
Reservoir Conc (mg/m3)	150	Retention Coef.	0.688

Overall Mass Balance Based Upon Component: **Predicted TOTAL N** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance $(kg/yr)^2$	%Total	CV	Conc mg/m^3	Export $kg/km^2/yr$
1	1	1	North Fork Vermilion River	3322700.8	99.9%	4.38E+10	100.0%	0.06	10103.1	4344.8
2	4	4	Dam Outfall	2516813.0		1.93E+12		0.55	7641.2	3291.0
PRECIPITATION				2998.0	0.1%	2.25E+06	0.0%	0.50	1000.0	1000.0
TRIBUTARY INFLOW				3322700.8	99.9%	4.38E+10	100.0%	0.06	10103.1	4344.8
***TOTAL INFLOW				3325698.8	100.0%	4.38E+10	100.0%	0.06	10020.9	4331.8
GAUGED OUTFLOW				2516813.0	75.7%	1.93E+12		0.55	7641.2	3291.0
ADVECTIVE OUTFLOW				333.5	0.0%	2.47E+08		10.00	7641.2	111.2
***TOTAL OUTFLOW				2517146.5	75.7%	1.93E+12		0.55	7641.2	3278.6
***RETENTION				808552.3	24.3%	1.93E+12		1.72		

Overflow Rate (m/yr)	109.9	Nutrient Resid. Time (yrs)	0.0197
Hydraulic Resid. Time (yrs)	0.0274	Turnover Ratio	50.8
Reservoir Conc (mg/m3)	7253	Retention Coef.	0.243

Lake Vermilion TMDL Analysis (year 2001)
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Description:

Initial Conditition model for Lake Vermilion in 2001

TP, TN, Chl-a, and Secchi concentrations to be predicted using calibrated factors

Added outflow from DAM

Global Variables	Mean	CV
Averaging Period (yrs)	1	0.0
Precipitation (m)	1	0.7
Evaporation (m)	0.82	0.0
Storage Increase (m)	0	0.0

Atmos. Loads (kg/km^2-yr)	Mean	CV
Conserv. Substance	0	0.00
Total P	30	0.50
Total N	1000	0.50
Ortho P	15	0.50
Inorganic N	500	0.50

Model Options
Conservative Substance
Phosphorus Balance
Nitrogen Balance
Chlorophyll-a
Secchi Depth
Dispersion
Phosphorus Calibration
Nitrogen Calibration
Error Analysis
Availability Factors
Mass-Balance Tables
Output Destination

Segment Morphometry

Seg	Name	Outflow Segment	Group	Area km^2	Depth m	Length km	Mixed Depth (m) Mean	CV
1	Upper Lake - RBD5	2	1	0.573	1.219	2.164	1.219	0
2	Mid Upper - RBD3	3	1	0.479	1.829	1.052	1.829	0
3	Mid Lower - RBD2	4	1	1.323	3.048	1.393	3.048	0
4	Lower Lake - RBD1	0	1	0.623	5.486	1.149	5.486	0

Segment Observed Water Quality

	Conserv		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	0	0	63.75	0.405	10095	0.151	14.03	1.124	0.343
2	0	0	0	0	0	0	0	0	0
3	0	0	80	0.177	9635	0.231	20.375	0.308	0.427
4	0	0	86	0.181	9781.25	0.274	17.28	0.505	0.569

Segment Calibration Factors

	Dispersion Rate		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	1	0	0.8	0	0.925	0	0.325	0	0.75
2	1	0	1.2	0	0.7	0	0.475	0	1.2
3	1	0	0.8	0	1.05	0	1.3	0	1.215
4	1	0	0.78	0	1.085	0	1.8	0	1.2

Tributary Data

Trib	Trib Name	Segment	Type	Dr Area km^2	Flow (hm^3/yr) Mean	CV	Conserv. Mean	CV
1	North Fork Vermilion River	1	1	764.75	328.879	0	0	0
2	Dam Outfall	4	4	764.75	329.375	0	0	0

Model Coefficients	Mean	CV
Dispersion Rate	1.000	0.70
Total Phosphorus	0.775	0.45
Total Nitrogen	1.200	0.55
Chl-a Model	2.400	0.26
Secchi Model	0.850	0.10
Organic N Model	1.000	0.12
TP-OP Model	1.000	0.15
HODv Model	1.000	0.15
MODv Model	1.000	0.22
Secchi/Chla Slope (m^2/mg)	0.025	0.00
Minimum Qs (m/yr)	0.100	0.00
Chl-a Flushing Term	1.000	0.00
Chl-a Temporal CV	0.620	0
Avail. Factor - Total P	0.330	0
Avail. Factor - Ortho P	1.930	0
Avail. Factor - Total N	0.590	0
Avail. Factor - Inorganic N	0.790	0

Code	Description
0	NOT COMPUTED
1	2ND ORDER, AVAIL P
1	2ND ORDER, AVAIL N
2	P, LIGHT, T
1	VS. CHLA & TURBIDITY
1	FISCHER-NUMERIC
2	CONCENTRATIONS
2	CONCENTRATIONS
1	MODEL & DATA
0	IGNORE
1	USE ESTIMATED CONCS
2	EXCEL WORKSHEET

				Internal Loads (mg/m2-day)					
Hypol Depth		**Non-Algal Turb (m^{-1})**		**Conserv.**		**Total P**		**Total N**	
Mean	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0	0	2.56	0.3	0	0	0	0	0	0
0	0	0.08	0.2	0	0	0	0	0	0
0	0	1.83	0.39	0	0	0	0	0	0
0	0	1.33	0.52	0	0	0	0	0	0

	Organic N (ppb)		**TP - Ortho P (ppb)**		**HOD (ppb/day)**		**MOD (ppb/day)**	
CV	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0.222	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0.299	0	0	0	0	0	0	0	0
0.37	0	0	0	0	0	0	0	0

	Organic N (ppb)		**TP - Ortho P (ppb)**		**HOD (ppb/day)**		**MOD (ppb/day)**	
CV	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0

Total P (ppb)		**Total N (ppb)**		**Ortho P (ppb)**		**Inorganic N (ppb)**	
Mean	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
96	0.096	10103.11	0.063	0	0	0	0
606	0.2	9570	0.2	0	0	0	0

Lake Vermilion TMDL Analysis (year 2001)
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Segment & Tributary Network

--------Segment:	1	Upper Lake - RBD5		
Outflow Segment:	2	Mid Upper - RBD3		
Tributary:	1	North Fork Vermilion River	Type:	Monitored Inflow
--------Segment:	2	Mid Upper - RBD3		
Outflow Segment:	3	Mid Lower - RBD2		
--------Segment:	3	Mid Lower - RBD2		
Outflow Segment:	4	Lower Lake - RBD1		
--------Segment:	4	Lower Lake - RBD1		
Outflow Segment:	0	Out of Reservoir		
Tributary:	2	Dam Outfall	Type:	Reservoir Outflow

Lake Vermilion TMDL Analysis (year 2001)
File: L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration2001cal&out-reduction.btb

Hydraulic & Dispersion Parameters

Seg	Name	Outflow Seg	Net Inflow hm^3/yr	Resid Time years	Overflow Rate m/yr	Velocity km/yr	Dispersion--------> Estimated km^2/yr	Numeric km^2/yr	Exchange hm^3/yr
1	Upper Lake - RBD5	2	329.0	0.0021	574.1	1019.2	6050.9	1102.8	738.0
2	Mid Upper - RBD3	3	329.1	0.0027	687.0	395.1	4933.2	207.8	3740.7
3	Mid Lower - RBD2	4	329.3	0.0122	248.9	113.8	4023.7	79.2	8197.0
4	Lower Lake - RBD1	0	329.4	0.0104	528.8	110.7	779.3	63.6	0.0

Morphometry

Seg	Name	Area km^2	Zmean m	Zmix m	Length km	Volume hm^3	Width km	L/W -
1	Upper Lake - RBD5	0.6	1.2	1.2	2.2	0.7	0.3	8.2
2	Mid Upper - RBD3	0.5	1.8	1.8	1.1	0.9	0.5	2.3
3	Mid Lower - RBD2	1.3	3.0	3.0	1.4	4.0	0.9	1.5
4	Lower Lake - RBD1	0.6	5.5	5.5	1.1	3.4	0.5	2.1
Totals		3.0	3.0			9.0		

Lake Vermilion TMDL Analysis (year 2001)
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Predicted & Observed Values Ranked Against CE Model Development Dataset

Segment: 5 Area-Wtd Mean

Variable	Predicted Values---> Mean	CV	Rank	Observed Values---> Mean	CV	Rank
TOTAL P MG/M3	50.1	0.46	52.0%	77.8	0.22	70.5%
TOTAL N MG/M3	7253.0	0.55	99.9%	9775.8	0.22	100.0%
C.NUTRIENT MG/M3	49.8	0.45	66.1%	77.4	0.22	83.3%
CHL-A MG/M3	20.4	0.42	84.3%	18.2	0.50	80.4%
SECCHI M	0.5	0.23	17.2%	0.4	0.31	12.0%
ORGANIC N MG/M3	741.5	0.28	81.0%			
TP-ORTHO-P MG/M3	69.8	0.26	81.3%			
ANTILOG PC-1	769.8	0.61	80.9%	1015.6	0.35	86.1%
ANTILOG PC-2	7.0	0.22	56.3%	5.1	0.25	32.6%
(N - 150) / P	147.6	0.72	99.9%	125.5	0.20	99.8%
INORGANIC N / P	5920.7	0.61	100.0%			
TURBIDITY 1/M	1.6	0.24	86.2%	1.6	0.24	86.2%
ZMIX * TURBIDITY	4.6	0.27	68.7%	4.6	0.27	68.7%
ZMIX / SECCHI	6.3	0.21	68.6%	6.9	0.20	74.0%
CHL-A * SECCHI	12.5	0.28	61.2%	8.1	0.34	37.2%
CHL-A / TOTAL P	0.4	0.33	87.0%	0.2	0.34	60.8%
FREQ(CHL-a>10) %	73.9	0.27	84.3%	73.2	0.25	80.4%
FREQ(CHL-a>20) %	36.9	0.61	84.3%	32.0	0.52	80.4%
FREQ(CHL-a>30) %	18.4	0.84	84.3%	13.5	0.70	80.4%
FREQ(CHL-a>40) %	9.7	1.02	84.3%	6.0	0.85	80.4%
FREQ(CHL-a>50) %	5.4	1.16	84.3%	2.8	0.97	80.4%
FREQ(CHL-a>60) %	3.2	1.29	84.3%	1.4	1.09	80.4%
CARLSON TSI-P	60.4	0.11	52.0%	66.9	0.03	70.5%
CARLSON TSI-CHLA	59.6	0.07	84.3%	58.9	0.05	80.4%
CARLSON TSI-SEC	70.8	0.04	82.8%	72.0	0.04	88.0%

Segment: 1 Upper Lake - RBD5

Variable	Predicted Values---> Mean	CV	Rank	Observed Values---> Mean	CV	Rank
TOTAL P MG/M3	50.1	0.46	52.0%	63.8	0.41	62.5%
TOTAL N MG/M3	8049.4	0.56	99.9%	10095.0	0.15	100.0%
C.NUTRIENT MG/M3	50.0	0.46	66.3%	63.6	0.39	76.5%
CHL-A MG/M3	11.3	0.52	59.5%	14.0	1.12	69.9%
SECCHI M	0.2	0.27	1.9%	0.3	0.22	6.6%
ORGANIC N MG/M3	607.4	0.25	68.7%			
TP-ORTHO-P MG/M3	76.7	0.28	83.8%			
ANTILOG PC-1	759.9	0.63	80.6%	990.2	1.08	85.7%
ANTILOG PC-2	2.5	0.39	3.3%	3.5	0.77	12.3%
(N - 150) / P	157.6	0.72	99.9%	156.0	0.42	99.9%
INORGANIC N / P	7442.1	0.61	100.0%			
TURBIDITY 1/M	2.6	0.30	94.9%	2.6	0.30	94.9%
ZMIX * TURBIDITY	3.1	0.30	49.5%	3.1	0.30	49.5%
ZMIX / SECCHI	5.4	0.28	58.9%	3.6	0.22	30.7%
CHL-A * SECCHI	2.5	0.61	2.5%	4.8	1.15	14.4%

CHL-A / TOTAL P	0.2	0.30	58.7%	0.2	1.19	57.2%
FREQ(CHL-a>10) %	45.5	0.73	59.5%	59.3	1.16	69.9%
FREQ(CHL-a>20) %	10.9	1.47	59.5%	18.9	2.61	69.9%
FREQ(CHL-a>30) %	3.0	1.97	59.5%	6.2	3.65	69.9%
FREQ(CHL-a>40) %	0.9	2.35	59.5%	2.3	4.44	69.9%
FREQ(CHL-a>50) %	0.3	2.66	59.5%	0.9	5.09	69.9%
FREQ(CHL-a>60) %	0.1	2.91	59.5%	0.4	5.63	69.9%
CARLSON TSI-P	60.6	0.11	52.0%	64.1	0.09	62.5%
CARLSON TSI-CHLA	54.4	0.09	59.5%	56.5	0.19	69.9%
CARLSON TSI-SEC	81.5	0.05	98.1%	75.4	0.04	93.4%

Segment: 2 Mid Upper - RBD3

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	69.8	0.46	66.2%			
TOTAL N MG/M3	5200.9	0.55	99.5%			
C.NUTRIENT MG/M3	68.8	0.44	79.4%			
CHL-A MG/M3	35.9	0.39	95.9%			
SECCHI M	1.0	0.37	48.2%			
ORGANIC N MG/M3	981.6	0.35	92.3%			
TP-ORTHO-P MG/M3	61.7	0.44	77.6%			
ANTILOG PC-1	996.3	0.73	85.8%			
ANTILOG PC-2	15.6	0.09	95.3%			
(N - 150) / P	72.4	0.72	98.3%			
INORGANIC N / P	522.0	3.44	99.8%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.1	0.20	0.0%	0.1	0.20	0.0%
ZMIX / SECCHI	1.8	0.37	4.3%			
CHL-A * SECCHI	37.5	0.11	96.7%			
CHL-A / TOTAL P	0.5	0.30	93.5%			
FREQ(CHL-a>10) %	96.0	0.05	95.9%			
FREQ(CHL-a>20) %	73.7	0.28	95.9%			
FREQ(CHL-a>30) %	49.2	0.52	95.9%			
FREQ(CHL-a>40) %	31.4	0.72	95.9%			
FREQ(CHL-a>50) %	19.9	0.90	95.9%			
FREQ(CHL-a>60) %	12.7	1.05	95.9%			
CARLSON TSI-P	65.4	0.10	66.2%			
CARLSON TSI-CHLA	65.7	0.06	95.9%			
CARLSON TSI-SEC	59.4	0.09	51.8%			

Segment: 3 Mid Lower - RBD2

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	45.6	0.46	47.8%	80.0	0.18	71.6%
TOTAL N MG/M3	7468.2	0.55	99.9%	9635.0	0.23	100.0%
C.NUTRIENT MG/M3	45.5	0.45	61.9%	79.6	0.18	84.2%
CHL-A MG/M3	20.5	0.47	84.5%	20.4	0.31	84.3%
SECCHI M	0.4	0.28	11.9%	0.4	0.30	11.1%
ORGANIC N MG/M3	762.4	0.29	82.4%			
TP-ORTHO-P MG/M3	75.8	0.27	83.5%			
ANTILOG PC-1	788.4	0.59	81.4%	1150.4	0.40	88.1%
ANTILOG PC-2	6.2	0.41	46.9%	5.3	0.31	36.1%

(N - 150) / P	160.4	0.72	100.0%	118.6	0.29	99.8%
INORGANIC N / P	6705.7	0.62	100.0%			
TURBIDITY 1/M	1.8	0.39	89.4%	1.8	0.39	89.4%
ZMIX * TURBIDITY	5.6	0.39	76.9%	5.6	0.39	76.9%
ZMIX / SECCHI	6.9	0.28	73.8%	7.1	0.29	75.6%
CHL-A * SECCHI	9.0	0.59	43.2%	8.7	0.43	41.1%
CHL-A / TOTAL P	0.4	0.39	90.4%	0.3	0.35	66.0%
FREQ(CHL-a>10) %	80.2	0.26	84.5%	79.9	0.17	84.3%
FREQ(CHL-a>20) %	39.4	0.74	84.5%	39.0	0.48	84.3%
FREQ(CHL-a>30) %	17.8	1.12	84.5%	17.5	0.74	84.3%
FREQ(CHL-a>40) %	8.3	1.42	84.5%	8.1	0.94	84.3%
FREQ(CHL-a>50) %	4.0	1.66	84.5%	3.9	1.10	84.3%
FREQ(CHL-a>60) %	2.1	1.87	84.5%	2.0	1.24	84.3%
CARLSON TSI-P	59.2	0.11	47.8%	67.3	0.04	71.6%
CARLSON TSI-CHLA	60.2	0.08	84.5%	60.2	0.05	84.3%
CARLSON TSI-SEC	71.8	0.06	88.1%	72.3	0.06	88.9%

Segment: 4 Lower Lake - RBD1

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	44.3	0.46	46.5%	86.0	0.18	74.2%
TOTAL N MG/M3	7641.2	0.55	99.9%	9781.3	0.27	100.0%
C.NUTRIENT MG/M3	44.2	0.45	60.5%	85.5	0.19	86.3%
CHL-A MG/M3	16.6	0.50	77.1%	17.3	0.50	78.6%
SECCHI M	0.6	0.33	21.0%	0.6	0.37	20.0%
ORGANIC N MG/M3	635.9	0.27	71.8%			
TP-ORTHO-P MG/M3	57.0	0.25	75.0%			
ANTILOG PC-1	565.2	0.53	73.8%	752.9	0.58	80.4%
ANTILOG PC-2	6.3	0.51	48.6%	6.0	0.44	44.3%
(N - 150) / P	169.2	0.72	100.0%	112.0	0.33	99.7%
INORGANIC N / P	7005.3	0.60	100.0%			
TURBIDITY 1/M	1.3	0.52	81.3%	1.3	0.52	81.3%
ZMIX * TURBIDITY	7.3	0.52	86.0%	7.3	0.52	86.0%
ZMIX / SECCHI	9.4	0.33	87.8%	9.6	0.36	88.7%
CHL-A * SECCHI	9.7	0.72	47.2%	9.8	0.63	47.9%
CHL-A / TOTAL P	0.4	0.50	84.6%	0.2	0.53	51.6%
FREQ(CHL-a>10) %	69.5	0.41	77.1%	71.6	0.37	78.6%
FREQ(CHL-a>20) %	27.1	0.99	77.1%	29.3	0.95	78.6%
FREQ(CHL-a>30) %	10.3	1.40	77.1%	11.5	1.39	78.6%
FREQ(CHL-a>40) %	4.2	1.72	77.1%	4.8	1.74	78.6%
FREQ(CHL-a>50) %	1.8	1.98	77.1%	2.2	2.01	78.6%
FREQ(CHL-a>60) %	0.9	2.19	77.1%	1.0	2.25	78.6%
CARLSON TSI-P	58.8	0.11	46.5%	68.4	0.04	74.2%
CARLSON TSI-CHLA	58.2	0.08	77.1%	58.6	0.08	78.6%
CARLSON TSI-SEC	67.7	0.07	79.0%	68.1	0.08	80.0%

Lake Vermilion TMDL Analysis (year 2001)
File: L:\I-intercompany\I4148\TMDL\Model\BATHTUB\VermilionLakeCalibration2001cal&out-reduction.btb

Overall Water & Nutrient Balances

Overall Water Balance — **Averaging Period = 1.00 years**

Trb	Type	Seg	Name	Area km²	Flow hm³/yr	Variance (hm3/yr)²	CV -	Runoff m/yr
1	1	1	North Fork Vermilion River	764.8	328.9	0.00E+00	0.00	0.43
2	4	4	Dam Outfall	764.8	329.4	0.00E+00	0.00	0.43
PRECIPITATION				3.0	3.0	4.23E+00	0.69	1.00
TRIBUTARY INFLOW				764.8	328.9	0.00E+00	0.00	0.43
***TOTAL INFLOW				767.7	331.9	4.23E+00	0.01	0.43
GAUGED OUTFLOW				764.8	329.4	0.00E+00	0.00	0.43
ADVECTIVE OUTFLOW				3.0	0.0	4.23E+00	9.99	0.01
***TOTAL OUTFLOW				767.7	329.4	4.23E+00	0.01	0.43
***EVAPORATION					2.5	0.00E+00	0.00	

Overall Mass Balance Based Upon Component: **Predicted TOTAL P** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance (kg/yr)²	%Total	CV	Conc mg/m³	Export kg/km²/yr
1	1	1	North Fork Vermilion River	31572.4	99.7%	9.19E+06	100.0%	0.10	96.0	41.3
2	4	4	Dam Outfall	14584.9		4.43E+07		0.46	44.3	19.1
PRECIPITATION				89.9	0.3%	2.02E+03	0.0%	0.50	30.0	30.0
TRIBUTARY INFLOW				31572.4	99.7%	9.19E+06	100.0%	0.10	96.0	41.3
***TOTAL INFLOW				31662.3	100.0%	9.19E+06	100.0%	0.10	95.4	41.2
GAUGED OUTFLOW				14584.9	46.1%	4.43E+07		0.46	44.3	19.1
ADVECTIVE OUTFLOW				1.9	0.0%	8.29E+03		10.00	44.3	0.6
***TOTAL OUTFLOW				14586.8	46.1%	4.43E+07		0.46	44.3	19.0
***RETENTION				17075.5	53.9%	4.68E+07		0.40		

Overflow Rate (m/yr)	109.9	Nutrient Resid. Time (yrs)	0.0143
Hydraulic Resid. Time (yrs)	0.0274	Turnover Ratio	70.1
Reservoir Conc (mg/m3)	50	Retention Coef.	0.539

Overall Mass Balance Based Upon Component: **Predicted TOTAL N** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance (kg/yr)²	%Total	CV	Conc mg/m³	Export kg/km²/yr
1	1	1	North Fork Vermilion River	3322700.8	99.9%	4.38E+10	100.0%	0.06	10103.1	4344.8
2	4	4	Dam Outfall	2516813.0		1.93E+12		0.55	7641.2	3291.0
PRECIPITATION				2998.0	0.1%	2.25E+06	0.0%	0.50	1000.0	1000.0
TRIBUTARY INFLOW				3322700.8	99.9%	4.38E+10	100.0%	0.06	10103.1	4344.8
***TOTAL INFLOW				3325698.8	100.0%	4.38E+10	100.0%	0.06	10020.9	4331.8
GAUGED OUTFLOW				2516813.0	75.7%	1.93E+12		0.55	7641.2	3291.0
ADVECTIVE OUTFLOW				333.5	0.0%	2.47E+08		10.00	7641.2	111.2
***TOTAL OUTFLOW				2517146.5	75.7%	1.93E+12		0.55	7641.2	3278.6
***RETENTION				808552.3	24.3%	1.93E+12		1.72		

Overflow Rate (m/yr)	109.9	Nutrient Resid. Time (yrs)	0.0197
Hydraulic Resid. Time (yrs)	0.0274	Turnover Ratio	50.8
Reservoir Conc (mg/m3)	7253	Retention Coef.	0.243

Lake Vermilion TMDL Analysis (year 2001)
File: G:\TMDL\Model\BATHTUB\VermilionLakeCalibration2001cal&outTNmax.btb
Description:

Model for TN only using only TN concentrations exceeding 10 mg/L at the river
Initial Condititions model for Lake Vermilion in 2001
TN concentrations to be predicted using calibrated factors

Global Variables	Mean	CV
Averaging Period (yrs)	1	0.0
Precipitation (m)	1	0.7
Evaporation (m)	0.82	0.0
Storage Increase (m)	0	0.0

Atmos. Loads (kg/km^2-yr)	Mean	CV
Conserv. Substance	0	0.00
Total P	30	0.50
Total N	1000	0.50
Ortho P	15	0.50
Inorganic N	500	0.50

Segment Morphometry

		Outflow		Area	Depth	Length	Mixed Depth (m)	
Seg	Name	Segment	Group	km^2	m	km	Mean	CV
1	Upper Lake - RBD5	2	1	0.573	1.219	2.164	1.219	0
2	Mid Upper - RBD3	3	1	0.479	1.829	1.052	1.829	0
3	Mid Lower - RBD2	4	1	1.323	3.048	1.393	3.048	0
4	Lower Lake - RBD1	0	1	0.623	5.486	1.149	5.486	0

Segment Observed Water Quality

	Conserv		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	0	0	63.75	0.405	10095	0.151	14.03	1.124	0.343
2	0	0	0	0	0	0	0	0	0
3	0	0	80	0.177	9635	0.231	20.375	0.308	0.427
4	0	0	86	0.181	9781.25	0.274	17.28	0.505	0.569

Segment Calibration Factors

	Dispersion Rate		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	1	0	0.8	0	0.925	0	0.325	0	0.75
2	1	0	1.2	0	0.7	0	0.475	0	1.2
3	1	0	0.8	0	1.05	0	1.3	0	1.215
4	1	0	0.78	0	1.085	0	1.8	0	1.2

Tributary Data

				Dr Area	Flow (hm^3/yr)		Conserv.	
Trib	Trib Name	Segment	Type	km^2	Mean	CV	Mean	CV
1	North Fork Vermilion River	1	1	764.75	753.85	0.645	0	0
2	Dam Outfall	4	4	764.75	329.375	0	0	0

Model Coefficients	**Mean**	**CV**
Dispersion Rate	1.000	0.70
Total Phosphorus	0.775	0.45
Total Nitrogen	1.200	0.55
Chl-a Model	2.400	0.26
Secchi Model	0.850	0.10
Organic N Model	1.000	0.12
TP-OP Model	1.000	0.15
HODv Model	1.000	0.15
MODv Model	1.000	0.22
Secchi/Chla Slope (m^2/mg)	0.025	0.00
Minimum Qs (m/yr)	0.100	0.00
Chl-a Flushing Term	1.000	0.00
Chl-a Temporal CV	0.620	0
Avail. Factor - Total P	0.330	0
Avail. Factor - Ortho P	1.930	0
Avail. Factor - Total N	0.590	0
Avail. Factor - Inorganic N	0.790	0

Model Options	**Code**	**Description**
Conservative Substance	0	NOT COMPUTED
Phosphorus Balance	1	2ND ORDER, AVAIL P
Nitrogen Balance	1	2ND ORDER, AVAIL N
Chlorophyll-a	2	P, LIGHT, T
Secchi Depth	1	VS. CHLA & TURBIDITY
Dispersion	1	FISCHER-NUMERIC
Phosphorus Calibration	2	CONCENTRATIONS
Nitrogen Calibration	2	CONCENTRATIONS
Error Analysis	1	MODEL & DATA
Availability Factors	0	IGNORE
Mass-Balance Tables	1	USE ESTIMATED CONCS
Output Destination	2	EXCEL WORKSHEET

				Internal Loads (mg/m2-day)					
Hypol Depth		**Non-Algal Turb (m^{-1})**		**Conserv.**		**Total P**		**Total N**	
Mean	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0	0	2.56	0.3	0	0	0	0	0	0
0	0	0.08	0.2	0	0	0	0	0	0
0	0	1.83	0.39	0	0	0	0	0	0
0	0	1.33	0.52	0	0	0	0	0	0

)	**Organic N (ppb)**		**TP - Ortho P (ppb)**		**HOD (ppb/day)**		**MOD (ppb/day)**	
CV	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0.222	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0.299	0	0	0	0	0	0	0	0
0.37	0	0	0	0	0	0	0	0

)	**Organic N (ppb)**		**TP - Ortho P (ppb)**		**HOD (ppb/day)**		**MOD (ppb/day)**	
CV	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0

Total P (ppb)		**Total N (ppb)**		**Ortho P (ppb)**		**Inorganic N (ppb)**	
Mean	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
405.73	0.096	13245	0.171	0	0	0	0
606	0.2	9570	0.2	0	0	0	0

Lake Vermilion TMDL Analysis (year 2001)
File: G:\TMDL\Model\BATHTUB\VermilionLakeCalibration2001cal&outTNmax.btb

Segment & Tributary Network

--------Segment:	1	Upper Lake - RBD5	
Outflow Segment:	2	Mid Upper - RBD3	
Tributary:	1	North Fork Vermilion River	Type: Monitored Inflow
--------Segment:	2	Mid Upper - RBD3	
Outflow Segment:	3	Mid Lower - RBD2	
--------Segment:	3	Mid Lower - RBD2	
Outflow Segment:	4	Lower Lake - RBD1	
--------Segment:	4	Lower Lake - RBD1	
Outflow Segment:	0	Out of Reservoir	
Tributary:	2	Dam Outfall	Type: Reservoir Outflow

Lake Vermilion TMDL Analysis (year 2001)
File: G:\TMDL\Model\BATHTUB\VermilionLakeCalibration2001cal&outTNmax.btb

Hydraulic & Dispersion Parameters

Seg	Name	Outflow Seg	Net Inflow hm^3/yr	Resid Time years	Overflow Rate m/yr	Velocity km/yr	Dispersion--------> Estimated km^2/yr	Numeric km^2/yr	Exchange hm^3/yr
1	Upper Lake - RBD5	2	754.0	0.0009	1315.8	2335.8	13867.4	2527.4	1691.4
2	Mid Upper - RBD3	3	754.0	0.0012	1574.2	905.4	11304.2	476.3	8571.6
3	Mid Lower - RBD2	4	754.3	0.0053	570.1	260.6	9216.2	181.5	18775.3
4	Lower Lake - RBD1	0	754.4	0.0045	1210.9	253.6	1784.6	145.7	0.0

Morphometry

Seg	Name	Area km^2	Zmean m	Zmix m	Length km	Volume hm^3	Width km	L/W -
1	Upper Lake - RBD5	0.6	1.2	1.2	2.2	0.7	0.3	8.2
2	Mid Upper - RBD3	0.5	1.8	1.8	1.1	0.9	0.5	2.3
3	Mid Lower - RBD2	1.3	3.0	3.0	1.4	4.0	0.9	1.5
4	Lower Lake - RBD1	0.6	5.5	5.5	1.1	3.4	0.5	2.1
Totals		3.0	3.0			9.0		

Lake Vermilion TMDL Analysis (year 2001)
File: **G:\TMDL\Model\BATHTUB\VermilionLakeCalibration2001cal&outTNmax.bt**

Predicted & Observed Values Ranked Against CE Model Development Dataset

Segment: **5** **Area-Wtd Mean**

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	183.9	0.48	93.3%	77.8	0.22	70.5%
TOTAL N MG/M3	10837.9	0.58	100.0%	9775.8	0.22	100.0%
C.NUTRIENT MG/M3	178.6	0.45	97.8%	77.4	0.22	83.3%
CHL-A MG/M3	18.8	0.63	81.6%	18.2	0.50	80.4%
SECCHI M	0.5	0.27	17.5%	0.4	0.31	12.0%
ORGANIC N MG/M3	704.3	0.40	78.1%			
TP-ORTHO-P MG/M3	66.9	0.35	80.1%			
ANTILOG PC-1	1540.2	0.59	92.0%	1015.6	0.35	86.1%
ANTILOG PC-2	5.0	0.39	31.9%	5.1	0.25	32.6%
(N - 150) / P	60.7	0.72	96.9%	125.5	0.20	99.8%
INORGANIC N / P	93.8	0.96	87.6%			
TURBIDITY 1/M	1.6	0.24	86.2%	1.6	0.24	86.2%
ZMIX * TURBIDITY	4.6	0.27	68.7%	4.6	0.27	68.7%
ZMIX / SECCHI	6.1	0.24	66.4%	6.9	0.20	74.0%
CHL-A * SECCHI	11.5	0.37	56.8%	8.1	0.34	37.2%
CHL-A / TOTAL P	0.1	0.87	13.9%	0.2	0.34	60.8%
FREQ(CHL-a>10) %	67.6	0.55	81.6%	73.2	0.25	80.4%
FREQ(CHL-a>20) %	30.9	1.02	81.6%	32.0	0.52	80.4%
FREQ(CHL-a>30) %	15.4	1.21	81.6%	13.5	0.70	80.4%
FREQ(CHL-a>40) %	8.4	1.31	81.6%	6.0	0.85	80.4%
FREQ(CHL-a>50) %	4.9	1.40	81.6%	2.8	0.97	80.4%
FREQ(CHL-a>60) %	3.0	1.49	81.6%	1.4	1.09	80.4%
CARLSON TSI-P	79.1	0.09	93.3%	66.9	0.03	70.5%
CARLSON TSI-CHLA	58.5	0.12	81.6%	58.9	0.05	80.4%
CARLSON TSI-SEC	70.6	0.05	82.5%	72.0	0.04	88.0%

Segment: **1** **Upper Lake - RBD5**

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	192.9	0.47	93.9%	63.8	0.41	62.5%
TOTAL N MG/M3	11485.1	0.58	100.0%	10095.0	0.15	100.0%
C.NUTRIENT MG/M3	189.0	0.45	98.1%	63.6	0.39	76.5%
CHL-A MG/M3	14.4	0.66	71.2%	14.0	1.12	69.9%
SECCHI M	0.2	0.27	1.8%	0.3	0.22	6.6%
ORGANIC N MG/M3	678.9	0.33	75.9%			
TP-ORTHO-P MG/M3	82.3	0.30	85.6%			
ANTILOG PC-1	1992.4	0.57	94.5%	990.2	1.08	85.7%
ANTILOG PC-2	2.2	0.54	2.1%	3.5	0.77	12.3%
(N - 150) / P	58.8	0.73	96.6%	156.0	0.42	99.9%
INORGANIC N / P	97.7	0.99	88.5%			
TURBIDITY 1/M	2.6	0.30	94.9%	2.6	0.30	94.9%
ZMIX * TURBIDITY	3.1	0.30	49.5%	3.1	0.30	49.5%
ZMIX / SECCHI	5.6	0.27	60.7%	3.6	0.22	30.7%
CHL-A * SECCHI	3.2	0.70	4.9%	4.8	1.15	14.4%

CHL-A / TOTAL P	0.1	0.81	6.5%	0.2	1.19	57.2%
FREQ(CHL-a>10) %	61.1	0.68	71.2%	59.3	1.16	69.9%
FREQ(CHL-a>20) %	20.2	1.49	71.2%	18.9	2.61	69.9%
FREQ(CHL-a>30) %	6.8	2.04	71.2%	6.2	3.65	69.9%
FREQ(CHL-a>40) %	2.5	2.45	71.2%	2.3	4.44	69.9%
FREQ(CHL-a>50) %	1.0	2.78	71.2%	0.9	5.09	69.9%
FREQ(CHL-a>60) %	0.5	3.04	71.2%	0.4	5.63	69.9%
CARLSON TSI-P	80.0	0.08	93.9%	64.1	0.09	62.5%
CARLSON TSI-CHLA	56.8	0.12	71.2%	56.5	0.19	69.9%
CARLSON TSI-SEC	81.9	0.05	98.2%	75.4	0.04	93.4%

Segment: 2 Mid Upper - RBD3

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	256.1	0.48	96.9%			
TOTAL N MG/M3	7769.2	0.58	99.9%			
C.NUTRIENT MG/M3	237.5	0.42	99.1%			
CHL-A MG/M3	38.9	0.47	96.7%			
SECCHI M	1.0	0.45	44.4%			
ORGANIC N MG/M3	1048.9	0.41	94.0%			
TP-ORTHO-P MG/M3	67.0	0.51	80.1%			
ANTILOG PC-1	2270.9	0.62	95.5%			
ANTILOG PC-2	12.3	0.16	89.0%			
(N - 150) / P	29.8	0.73	79.4%			
INORGANIC N / P	35.5	0.89	57.2%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.1	0.20	0.0%	0.1	0.20	0.0%
ZMIX / SECCHI	1.9	0.44	5.5%			
CHL-A * SECCHI	37.7	0.11	96.8%			
CHL-A / TOTAL P	0.2	0.71	34.4%			
FREQ(CHL-a>10) %	97.0	0.05	96.7%			
FREQ(CHL-a>20) %	77.7	0.29	96.7%			
FREQ(CHL-a>30) %	54.3	0.55	96.7%			
FREQ(CHL-a>40) %	36.1	0.79	96.7%			
FREQ(CHL-a>50) %	23.7	0.99	96.7%			
FREQ(CHL-a>60) %	15.6	1.16	96.7%			
CARLSON TSI-P	84.1	0.08	96.9%			
CARLSON TSI-CHLA	66.5	0.07	96.7%			
CARLSON TSI-SEC	60.4	0.11	55.6%			

Segment: 3 Mid Lower - RBD2

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	165.2	0.48	91.6%	80.0	0.18	71.6%
TOTAL N MG/M3	11307.4	0.59	100.0%	9635.0	0.23	100.0%
C.NUTRIENT MG/M3	162.6	0.47	97.1%	79.6	0.18	84.2%
CHL-A MG/M3	17.0	0.76	77.9%	20.4	0.31	84.3%
SECCHI M	0.5	0.31	13.0%	0.4	0.30	11.1%
ORGANIC N MG/M3	682.2	0.43	76.2%			
TP-ORTHO-P MG/M3	69.5	0.36	81.2%			
ANTILOG PC-1	1408.8	0.61	90.9%	1150.4	0.40	88.1%
ANTILOG PC-2	4.2	0.63	21.0%	5.3	0.31	36.1%

(N - 150) / P	67.5	0.72	97.9%	118.6	0.29	99.8%
INORGANIC N / P	111.1	1.00	90.8%			
TURBIDITY 1/M	1.8	0.39	89.4%	1.8	0.39	89.4%
ZMIX * TURBIDITY	5.6	0.39	76.9%	5.6	0.39	76.9%
ZMIX / SECCHI	6.7	0.31	71.6%	7.1	0.29	75.6%
CHL-A * SECCHI	7.8	0.79	35.1%	8.7	0.43	41.1%
CHL-A / TOTAL P	0.1	0.97	15.5%	0.3	0.35	66.0%
FREQ(CHL-a>10) %	70.7	0.61	77.9%	79.9	0.17	84.3%
FREQ(CHL-a>20) %	28.3	1.47	77.9%	39.0	0.48	84.3%
FREQ(CHL-a>30) %	11.0	2.08	77.9%	17.5	0.74	84.3%
FREQ(CHL-a>40) %	4.5	2.54	77.9%	8.1	0.94	84.3%
FREQ(CHL-a>50) %	2.0	2.90	77.9%	3.9	1.10	84.3%
FREQ(CHL-a>60) %	1.0	3.20	77.9%	2.0	1.24	84.3%
CARLSON TSI-P	77.8	0.09	91.6%	67.3	0.04	71.6%
CARLSON TSI-CHLA	58.4	0.13	77.9%	60.2	0.05	84.3%
CARLSON TSI-SEC	71.3	0.06	87.0%	72.3	0.06	88.9%

Segment: 4 Lower Lake - RBD1

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	159.9	0.48	91.0%	86.0	0.18	74.2%
TOTAL N MG/M3	11605.1	0.59	100.0%	9781.3	0.27	100.0%
C.NUTRIENT MG/M3	157.7	0.47	96.8%	85.5	0.19	86.3%
CHL-A MG/M3	11.1	0.85	58.5%	17.3	0.50	78.6%
SECCHI M	0.6	0.39	24.2%	0.6	0.37	20.0%
ORGANIC N MG/M3	509.5	0.40	55.6%			
TP-ORTHO-P MG/M3	47.1	0.39	68.3%			
ANTILOG PC-1	841.6	0.60	82.7%	752.9	0.58	80.4%
ANTILOG PC-2	3.7	0.75	15.3%	6.0	0.44	44.3%
(N - 150) / P	71.7	0.72	98.3%	112.0	0.33	99.7%
INORGANIC N / P	98.4	0.88	88.6%			
TURBIDITY 1/M	1.3	0.52	81.3%	1.3	0.52	81.3%
ZMIX * TURBIDITY	7.3	0.52	86.0%	7.3	0.52	86.0%
ZMIX / SECCHI	8.6	0.39	84.6%	9.6	0.36	88.7%
CHL-A * SECCHI	7.0	0.98	29.9%	9.8	0.63	47.9%
CHL-A / TOTAL P	0.1	1.06	5.1%	0.2	0.53	51.6%
FREQ(CHL-a>10) %	44.2	1.23	58.5%	71.6	0.37	78.6%
FREQ(CHL-a>20) %	10.3	2.35	58.5%	29.3	0.95	78.6%
FREQ(CHL-a>30) %	2.8	3.06	58.5%	11.5	1.39	78.6%
FREQ(CHL-a>40) %	0.9	3.58	58.5%	4.8	1.74	78.6%
FREQ(CHL-a>50) %	0.3	3.99	58.5%	2.2	2.01	78.6%
FREQ(CHL-a>60) %	0.1	4.32	58.5%	1.0	2.25	78.6%
CARLSON TSI-P	77.3	0.09	91.0%	68.4	0.04	74.2%
CARLSON TSI-CHLA	54.2	0.16	58.5%	58.6	0.08	78.6%
CARLSON TSI-SEC	66.5	0.08	75.8%	68.1	0.08	80.0%

Lake Vermilion TMDL Analysis (year 2001)
File: G:\TMDL\Model\BATHTUB\VermilionLakeCalibration2001cal&outTNmax.btb

Overall Water & Nutrient Balances

Overall Water Balance — **Averaging Period = 1.00 years**

Trb	Type	Seg	Name	Area km^2	Flow hm^3/yr	Variance $(hm3/yr)^2$	CV -	Runoff m/yr
1	1	1	North Fork Vermilion River	764.8	753.8	2.36E+05	0.64	0.99
2	4	4	Dam Outfall	764.8	329.4	0.00E+00	0.00	0.43
PRECIPITATION				3.0	3.0	4.23E+00	0.69	1.00
TRIBUTARY INFLOW				764.8	753.8	2.36E+05	0.64	0.99
***TOTAL INFLOW				767.7	756.8	2.36E+05	0.64	0.99
GAUGED OUTFLOW				764.8	329.4	0.00E+00	0.00	0.43
ADVECTIVE OUTFLOW				3.0	425.0	2.36E+05	1.14	141.77
***TOTAL OUTFLOW				767.7	754.4	2.36E+05	0.64	0.98
***EVAPORATION					2.5	0.00E+00	0.00	

Overall Mass Balance Based Upon Component: **Predicted TOTAL P** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance $(kg/yr)^2$	%Total	CV	Conc mg/m^3	Export $kg/km^2/yr$
1	1	1	North Fork Vermilion River	305859.6	100.0%	3.98E+10	100.0%	0.65	405.7	399.9
2	4	4	Dam Outfall	52653.8		6.47E+08		0.48	159.9	68.9
PRECIPITATION				89.9	0.0%	2.02E+03	0.0%	0.50	30.0	30.0
TRIBUTARY INFLOW				305859.6	100.0%	3.98E+10	100.0%	0.65	405.7	399.9
***TOTAL INFLOW				305949.5	100.0%	3.98E+10	100.0%	0.65	404.2	398.5
GAUGED OUTFLOW				52653.8	17.2%	6.47E+08		0.48	159.9	68.9
ADVECTIVE OUTFLOW				67942.7	22.2%	8.92E+09		1.39	159.9	22662.8
***TOTAL OUTFLOW				120596.5	39.4%	1.26E+10		0.93	159.9	157.1
***RETENTION				185353.0	60.6%	1.33E+10		0.62		

Overflow Rate (m/yr)	251.6	Nutrient Resid. Time (yrs)	0.0054
Hydraulic Resid. Time (yrs)	0.0120	Turnover Ratio	184.3
Reservoir Conc (mg/m3)	184	Retention Coef.	0.606

Overall Mass Balance Based Upon Component: **Predicted TOTAL N** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance $(kg/yr)^2$	%Total	CV	Conc mg/m^3	Export $kg/km^2/yr$
1	1	1	North Fork Vermilion River	9984743.0	100.0%	4.44E+13	100.0%	0.67	13245.0	13056.2
2	4	4	Dam Outfall	3822419.0		5.01E+12		0.59	11605.1	4998.3
PRECIPITATION				2998.0	0.0%	2.25E+06	0.0%	0.50	1000.0	1000.0
TRIBUTARY INFLOW				9984743.0	100.0%	4.44E+13	100.0%	0.67	13245.0	13056.2
***TOTAL INFLOW				9987741.0	100.0%	4.44E+13	100.0%	0.67	13196.5	13009.1
GAUGED OUTFLOW				3822419.0	38.3%	5.01E+12		0.59	11605.1	4998.3
ADVECTIVE OUTFLOW				4932324.0	49.4%	4.94E+13		1.43	11605.1	1645212.6
***TOTAL OUTFLOW				8754743.0	87.7%	7.42E+13		0.98	11605.1	11403.1
***RETENTION				1232998.0	12.3%	2.39E+13		3.97		

Overflow Rate (m/yr)	251.6	Nutrient Resid. Time (yrs)	0.0098
Hydraulic Resid. Time (yrs)	0.0120	Turnover Ratio	102.1
Reservoir Conc (mg/m3)	10838	Retention Coef.	0.123

Lake Vermilion TMDL Analysis (year 2001)
File: G:\TMDL\Model\BATHTUB\VermilionLakeCalibration2001cal&outTNmaxReduction.btb
Description:

Reduction target concentrations model for Lake Vermilion in 2001
Model for TN only using only TN concentrations exceeding 10 mg/L at the river
TN concentrations to be predicted using calibrated factors

Added outflow from DAM

Global Variables	Mean	CV
Averaging Period (yrs)	1	0.0
Precipit Use TN max conce	1	0.7
Evaporation (m)	0.82	0.0
Storage Increase (m)	0	0.0

Atmos. Loads (kg/km^2-yr)	Mean	CV
Conserv. Substance	0	0.00
Total P	30	0.50
Total N	1000	0.50
Ortho P	15	0.50
Inorganic N	500	0.50

Segment Morphometry

Seg	Name	Outflow Segment	Group	Area km^2	Depth m	Length km	Mixed Depth (m) Mean	CV
1	Upper Lake - RBD5	2	1	0.573	1.219	2.164	1.219	0
2	Mid Upper - RBD3	3	1	0.479	1.829	1.052	1.829	0
3	Mid Lower - RBD2	4	1	1.323	3.048	1.393	3.048	0
4	Lower Lake - RBD1	0	1	0.623	5.486	1.149	5.486	0

Segment Observed Water Quality

	Conserv		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	0	0	63.75	0.405	10095	0.151	14.03	1.124	0.343
2	0	0	0	0	0	0	0	0	0
3	0	0	80	0.177	9635	0.231	20.375	0.308	0.427
4	0	0	86	0.181	9781.25	0.274	17.28	0.505	0.569

Segment Calibration Factors

	Dispersion Rate		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	1	0	0.8	0	0.925	0	0.325	0	0.75
2	1	0	1.2	0	0.7	0	0.475	0	1.2
3	1	0	0.8	0	1.05	0	1.3	0	1.215
4	1	0	0.78	0	1.085	0	1.8	0	1.2

Tributary Data

Trib	Trib Name	Segment	Type	Dr Area km^2	Flow (hm^3/yr) Mean	CV	Conserv. Mean	CV
1	North Fork Vermilion River	1	1	764.75	753.85	0.645	0	0
2	Dam Outfall	4	4	764.75	329.375	0	0	0

Model Coefficients	Mean	CV
Dispersion Rate	1.000	0.70
Total Phosphorus	0.775	0.45
Total Nitrogen	1.200	0.55
Chl-a Model	2.400	0.26
Secchi Model	0.850	0.10
Organic N Model	1.000	0.12
TP-OP Model	1.000	0.15
HODv Model	1.000	0.15
MODv Model	1.000	0.22
Secchi/Chla Slope (m^2/mg)	0.025	0.00
Minimum Qs (m/yr)	0.100	0.00
Chl-a Flushing Term	1.000	0.00
Chl-a Temporal CV	0.620	0
Avail. Factor - Total P	0.330	0
Avail. Factor - Ortho P	1.930	0
Avail. Factor - Total N	0.590	0
Avail. Factor - Inorganic N	0.790	0

Model Options	**Code**	**Description**
Conservative Substance	0	NOT COMPUTED
Phosphorus Balance	1	2ND ORDER, AVAIL P
Nitrogen Balance	1	2ND ORDER, AVAIL N
Chlorophyll-a	2	P, LIGHT, T
Secchi Depth	1	VS. CHLA & TURBIDITY
Dispersion	1	FISCHER-NUMERIC
Phosphorus Calibration	2	CONCENTRATIONS
Nitrogen Calibration	2	CONCENTRATIONS
Error Analysis	1	MODEL & DATA
Availability Factors	0	IGNORE
Mass-Balance Tables	1	USE ESTIMATED CONCS
Output Destination	2	EXCEL WORKSHEET

				Internal Loads (mg/m2-day)					
Hypol Depth		**Non-Algal Turb (m^{-1})**		**Conserv.**		**Total P**		**Total N**	
Mean	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0	0	2.56	0.3	0	0	0	0	0	0
0	0	0.08	0.2	0	0	0	0	0	0
0	0	1.83	0.39	0	0	0	0	0	0
0	0	1.33	0.52	0	0	0	0	0	0

)	**Organic N (ppb)**		**TP - Ortho P (ppb)**		**HOD (ppb/day)**		**MOD (ppb/day)**	
CV	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0.222	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0.299	0	0	0	0	0	0	0	0
0.37	0	0	0	0	0	0	0	0

)	**Organic N (ppb)**		**TP - Ortho P (ppb)**		**HOD (ppb/day)**		**MOD (ppb/day)**	
CV	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0

Total P (ppb)		**Total N (ppb)**		**Ortho P (ppb)**		**Inorganic N (ppb)**	
Mean	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
405.73	0.096	11920.5	0.171	0	0	0	0
606	0.2	9570	0.2	0	0	0	0

Lake Vermilion TMDL Analysis (year 2001)
File: G:\TMDL\Model\BATHTUB\VermilionLakeCalibration2001cal&outTNmaxReduction.btb

Segment & Tributary Network

--------Segment:	1	Upper Lake - RBD5		
Outflow Segment:	2	Mid Upper - RBD3		
Tributary:	1	North Fork Vermilion River	Type:	Monitored Inflow
--------Segment:	2	Mid Upper - RBD3		
Outflow Segment:	3	Mid Lower - RBD2		
--------Segment:	3	Mid Lower - RBD2		
Outflow Segment:	4	Lower Lake - RBD1		
--------Segment:	4	Lower Lake - RBD1		
Outflow Segment:	0	Out of Reservoir		
Tributary:	2	Dam Outfall	Type:	Reservoir Outflow

Lake Vermilion TMDL Analysis (year 2001)
File: G:\TMDL\Model\BATHTUB\VermilionLakeCalibration2001cal&outTNmaxReduction.btb

Hydraulic & Dispersion Parameters

Seg	Name	Outflow Seg	Net Inflow hm^3/yr	Resid Time years	Overflow Rate m/yr	Velocity km/yr	Dispersion--------> Estimated km^2/yr	Numeric km^2/yr	Exchange hm^3/yr
1	Upper Lake - RBD5	2	754.0	0.0009	1315.8	2335.8	13867.4	2527.4	1691.4
2	Mid Upper - RBD3	3	754.0	0.0012	1574.2	905.4	11304.2	476.3	8571.6
3	Mid Lower - RBD2	4	754.3	0.0053	570.1	260.6	9216.2	181.5	18775.3
4	Lower Lake - RBD1	0	754.4	0.0045	1210.9	253.6	1784.6	145.7	0.0

Morphometry

Seg	Name	Area km^2	Zmean m	Zmix m	Length km	Volume hm^3	Width km	L/W -
1	Upper Lake - RBD5	0.6	1.2	1.2	2.2	0.7	0.3	8.2
2	Mid Upper - RBD3	0.5	1.8	1.8	1.1	0.9	0.5	2.3
3	Mid Lower - RBD2	1.3	3.0	3.0	1.4	4.0	0.9	1.5
4	Lower Lake - RBD1	0.6	5.5	5.5	1.1	3.4	0.5	2.1
Totals		3.0	3.0			9.0		

Lake Vermilion TMDL Analysis (year 2001)
File: **G:\TMDL\Model\BATHTUB\VermilionLakeCalibration2001cal&outTNmaxRe**

Predicted & Observed Values Ranked Against CE Model Development Dataset

Segment: **5** **Area-Wtd Mean**

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	183.9	0.48	93.3%	77.8	0.22	70.5%
TOTAL N MG/M3	9985.7	0.58	100.0%	9775.8	0.22	100.0%
C.NUTRIENT MG/M3	177.7	0.45	97.8%	77.4	0.22	83.3%
CHL-A MG/M3	18.8	0.63	81.6%	18.2	0.50	80.4%
SECCHI M	0.5	0.27	17.5%	0.4	0.31	12.0%
ORGANIC N MG/M3	704.3	0.40	78.1%			
TP-ORTHO-P MG/M3	66.9	0.35	80.1%			
ANTILOG PC-1	1535.5	0.59	91.9%	1015.6	0.35	86.1%
ANTILOG PC-2	5.0	0.39	32.0%	5.1	0.25	32.6%
(N - 150) / P	55.9	0.73	96.0%	125.5	0.20	99.8%
INORGANIC N / P	86.0	0.96	85.8%			
TURBIDITY 1/M	1.6	0.24	86.2%	1.6	0.24	86.2%
ZMIX * TURBIDITY	4.6	0.27	68.7%	4.6	0.27	68.7%
ZMIX / SECCHI	6.1	0.24	66.4%	6.9	0.20	74.0%
CHL-A * SECCHI	11.5	0.37	56.8%	8.1	0.34	37.2%
CHL-A / TOTAL P	0.1	0.87	13.9%	0.2	0.34	60.8%
FREQ(CHL-a>10) %	67.6	0.55	81.6%	73.2	0.25	80.4%
FREQ(CHL-a>20) %	30.9	1.02	81.6%	32.0	0.52	80.4%
FREQ(CHL-a>30) %	15.4	1.21	81.6%	13.5	0.70	80.4%
FREQ(CHL-a>40) %	8.4	1.31	81.6%	6.0	0.85	80.4%
FREQ(CHL-a>50) %	4.9	1.40	81.6%	2.8	0.97	80.4%
FREQ(CHL-a>60) %	3.0	1.49	81.6%	1.4	1.09	80.4%
CARLSON TSI-P	79.1	0.09	93.3%	66.9	0.03	70.5%
CARLSON TSI-CHLA	58.5	0.12	81.6%	58.9	0.05	80.4%
CARLSON TSI-SEC	70.6	0.05	82.5%	72.0	0.04	88.0%

Segment: **1** **Upper Lake - RBD5**

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	192.9	0.47	93.9%	63.8	0.41	62.5%
TOTAL N MG/M3	10497.6	0.58	100.0%	10095.0	0.15	100.0%
C.NUTRIENT MG/M3	188.2	0.45	98.1%	63.6	0.39	76.5%
CHL-A MG/M3	14.4	0.66	71.2%	14.0	1.12	69.9%
SECCHI M	0.2	0.27	1.8%	0.3	0.22	6.6%
ORGANIC N MG/M3	678.9	0.33	75.9%			
TP-ORTHO-P MG/M3	82.3	0.30	85.6%			
ANTILOG PC-1	1987.8	0.57	94.5%	990.2	1.08	85.7%
ANTILOG PC-2	2.2	0.54	2.1%	3.5	0.77	12.3%
(N - 150) / P	53.6	0.73	95.4%	156.0	0.42	99.9%
INORGANIC N / P	88.8	0.99	86.5%			
TURBIDITY 1/M	2.6	0.30	94.9%	2.6	0.30	94.9%
ZMIX * TURBIDITY	3.1	0.30	49.5%	3.1	0.30	49.5%
ZMIX / SECCHI	5.6	0.27	60.7%	3.6	0.22	30.7%
CHL-A * SECCHI	3.2	0.70	4.9%	4.8	1.15	14.4%

CHL-A / TOTAL P	0.1	0.81	6.5%	0.2	1.19	57.2%
FREQ(CHL-a>10) %	61.1	0.68	71.2%	59.3	1.16	69.9%
FREQ(CHL-a>20) %	20.2	1.49	71.2%	18.9	2.61	69.9%
FREQ(CHL-a>30) %	6.8	2.04	71.2%	6.2	3.65	69.9%
FREQ(CHL-a>40) %	2.5	2.45	71.2%	2.3	4.44	69.9%
FREQ(CHL-a>50) %	1.0	2.78	71.2%	0.9	5.09	69.9%
FREQ(CHL-a>60) %	0.5	3.04	71.2%	0.4	5.63	69.9%
CARLSON TSI-P	80.0	0.08	93.9%	64.1	0.09	62.5%
CARLSON TSI-CHLA	56.8	0.12	71.2%	56.5	0.19	69.9%
CARLSON TSI-SEC	81.9	0.05	98.2%	75.4	0.04	93.4%

Segment: 2 Mid Upper - RBD3

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	256.1	0.48	96.9%			
TOTAL N MG/M3	7157.9	0.58	99.9%			
C.NUTRIENT MG/M3	234.5	0.42	99.1%			
CHL-A MG/M3	38.9	0.47	96.7%			
SECCHI M	1.0	0.45	44.4%			
ORGANIC N MG/M3	1048.9	0.41	94.0%			
TP-ORTHO-P MG/M3	67.0	0.51	80.1%			
ANTILOG PC-1	2254.3	0.62	95.5%			
ANTILOG PC-2	12.3	0.15	89.1%			
(N - 150) / P	27.4	0.73	75.8%			
INORGANIC N / P	32.3	0.89	53.4%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.1	0.20	0.0%	0.1	0.20	0.0%
ZMIX / SECCHI	1.9	0.44	5.5%			
CHL-A * SECCHI	37.7	0.11	96.8%			
CHL-A / TOTAL P	0.2	0.71	34.4%			
FREQ(CHL-a>10) %	97.0	0.05	96.7%			
FREQ(CHL-a>20) %	77.7	0.29	96.7%			
FREQ(CHL-a>30) %	54.3	0.55	96.7%			
FREQ(CHL-a>40) %	36.1	0.79	96.7%			
FREQ(CHL-a>50) %	23.7	0.99	96.7%			
FREQ(CHL-a>60) %	15.6	1.16	96.7%			
CARLSON TSI-P	84.1	0.08	96.9%			
CARLSON TSI-CHLA	66.5	0.07	96.7%			
CARLSON TSI-SEC	60.4	0.11	55.6%			

Segment: 3 Mid Lower - RBD2

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	165.2	0.48	91.6%	80.0	0.18	71.6%
TOTAL N MG/M3	10441.3	0.58	100.0%	9635.0	0.23	100.0%
C.NUTRIENT MG/M3	162.2	0.47	97.1%	79.6	0.18	84.2%
CHL-A MG/M3	17.0	0.76	77.9%	20.4	0.31	84.3%
SECCHI M	0.5	0.31	13.0%	0.4	0.30	11.1%
ORGANIC N MG/M3	682.2	0.43	76.2%			
TP-ORTHO-P MG/M3	69.5	0.36	81.2%			
ANTILOG PC-1	1406.6	0.61	90.9%	1150.4	0.40	88.1%
ANTILOG PC-2	4.2	0.63	21.1%	5.3	0.31	36.1%

(N - 150) / P	62.3	0.72	97.2%	118.6	0.29	99.8%
INORGANIC N / P	102.0	1.01	89.3%			
TURBIDITY 1/M	1.8	0.39	89.4%	1.8	0.39	89.4%
ZMIX * TURBIDITY	5.6	0.39	76.9%	5.6	0.39	76.9%
ZMIX / SECCHI	6.7	0.31	71.6%	7.1	0.29	75.6%
CHL-A * SECCHI	7.8	0.79	35.1%	8.7	0.43	41.1%
CHL-A / TOTAL P	0.1	0.97	15.5%	0.3	0.35	66.0%
FREQ(CHL-a>10) %	70.7	0.61	77.9%	79.9	0.17	84.3%
FREQ(CHL-a>20) %	28.3	1.47	77.9%	39.0	0.48	84.3%
FREQ(CHL-a>30) %	11.0	2.08	77.9%	17.5	0.74	84.3%
FREQ(CHL-a>40) %	4.5	2.54	77.9%	8.1	0.94	84.3%
FREQ(CHL-a>50) %	2.0	2.90	77.9%	3.9	1.10	84.3%
FREQ(CHL-a>60) %	1.0	3.20	77.9%	2.0	1.24	84.3%
CARLSON TSI-P	77.8	0.09	91.6%	67.3	0.04	71.6%
CARLSON TSI-CHLA	58.4	0.13	77.9%	60.2	0.05	84.3%
CARLSON TSI-SEC	71.3	0.06	87.0%	72.3	0.06	88.9%

Segment: 4 Lower Lake - RBD1

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	159.9	0.48	91.0%	86.0	0.18	74.2%
TOTAL N MG/M3	10721.7	0.58	100.0%	9781.3	0.27	100.0%
C.NUTRIENT MG/M3	157.3	0.47	96.8%	85.5	0.19	86.3%
CHL-A MG/M3	11.1	0.85	58.5%	17.3	0.50	78.6%
SECCHI M	0.6	0.39	24.2%	0.6	0.37	20.0%
ORGANIC N MG/M3	509.5	0.40	55.6%			
TP-ORTHO-P MG/M3	47.1	0.39	68.3%			
ANTILOG PC-1	840.5	0.60	82.7%	752.9	0.58	80.4%
ANTILOG PC-2	3.8	0.75	15.3%	6.0	0.44	44.3%
(N - 150) / P	66.1	0.72	97.7%	112.0	0.33	99.7%
INORGANIC N / P	90.6	0.88	86.9%			
TURBIDITY 1/M	1.3	0.52	81.3%	1.3	0.52	81.3%
ZMIX * TURBIDITY	7.3	0.52	86.0%	7.3	0.52	86.0%
ZMIX / SECCHI	8.6	0.39	84.6%	9.6	0.36	88.7%
CHL-A * SECCHI	7.0	0.98	29.9%	9.8	0.63	47.9%
CHL-A / TOTAL P	0.1	1.06	5.1%	0.2	0.53	51.6%
FREQ(CHL-a>10) %	44.2	1.23	58.5%	71.6	0.37	78.6%
FREQ(CHL-a>20) %	10.3	2.35	58.5%	29.3	0.95	78.6%
FREQ(CHL-a>30) %	2.8	3.06	58.5%	11.5	1.39	78.6%
FREQ(CHL-a>40) %	0.9	3.58	58.5%	4.8	1.74	78.6%
FREQ(CHL-a>50) %	0.3	3.99	58.5%	2.2	2.01	78.6%
FREQ(CHL-a>60) %	0.1	4.32	58.5%	1.0	2.25	78.6%
CARLSON TSI-P	77.3	0.09	91.0%	68.4	0.04	74.2%
CARLSON TSI-CHLA	54.2	0.16	58.5%	58.6	0.08	78.6%
CARLSON TSI-SEC	66.5	0.08	75.8%	68.1	0.08	80.0%

Lake Vermilion TMDL Analysis (year 2001)
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Overall Water & Nutrient Balances

Overall Water Balance

Averaging Period = 1.00 years

Trb	Type	Seg	Name	Area km^2	Flow hm^3/yr	Variance (hm3/yr)^2	CV -	Runoff m/yr
1	1	1	North Fork Vermilion River	764.8	753.8	2.36E+05	0.64	0.99
2	4	4	Dam Outfall	764.8	329.4	0.00E+00	0.00	0.43
PRECIPITATION				3.0	3.0	4.23E+00	0.69	1.00
TRIBUTARY INFLOW				764.8	753.8	2.36E+05	0.64	0.99
***TOTAL INFLOW				767.7	756.8	2.36E+05	0.64	0.99
GAUGED OUTFLOW				764.8	329.4	0.00E+00	0.00	0.43
ADVECTIVE OUTFLOW				3.0	425.0	2.36E+05	1.14	141.77
***TOTAL OUTFLOW				767.7	754.4	2.36E+05	0.64	0.98
***EVAPORATION					2.5	0.00E+00	0.00	

Overall Mass Balance Based Upon Predicted Component: TOTAL P

Outflow & Reservoir Concentrations

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance (kg/yr)^2	%Total	CV	Conc mg/m^3	Export kg/km^2/yr
1	1	1	North Fork Vermilion River	305859.6	100.0%	3.98E+10	100.0%	0.65	405.7	399.9
2	4	4	Dam Outfall	52653.8		6.47E+08		0.48	159.9	68.9
PRECIPITATION				89.9	0.0%	2.02E+03	0.0%	0.50	30.0	30.0
TRIBUTARY INFLOW				305859.6	100.0%	3.98E+10	100.0%	0.65	405.7	399.9
***TOTAL INFLOW				305949.5	100.0%	3.98E+10	100.0%	0.65	404.2	398.5
GAUGED OUTFLOW				52653.8	17.2%	6.47E+08		0.48	159.9	68.9
ADVECTIVE OUTFLOW				67942.7	22.2%	8.92E+09		1.39	159.9	22662.8
***TOTAL OUTFLOW				120596.5	39.4%	1.26E+10		0.93	159.9	157.1
***RETENTION				185353.0	60.6%	1.33E+10		0.62		

Overflow Rate (m/yr)	251.6	Nutrient Resid. Time (yrs)	0.0054
Hydraulic Resid. Time (yrs)	0.0120	Turnover Ratio	184.3
Reservoir Conc (mg/m3)	184	Retention Coef.	0.606

Overall Mass Balance Based Upon Predicted Component: TOTAL N

Outflow & Reservoir Concentrations

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance (kg/yr)^2	%Total	CV	Conc mg/m^3	Export kg/km^2/yr
1	1	1	North Fork Vermilion River	8986269.0	100.0%	3.60E+13	100.0%	0.67	11920.5	11750.6
2	4	4	Dam Outfall	3531471.5		4.26E+12		0.58	10721.7	4617.8
PRECIPITATION				2998.0	0.0%	2.25E+06	0.0%	0.50	1000.0	1000.0
TRIBUTARY INFLOW				8986269.0	100.0%	3.60E+13	100.0%	0.67	11920.5	11750.6
***TOTAL INFLOW				8989267.0	100.0%	3.60E+13	100.0%	0.67	11877.2	11708.6
GAUGED OUTFLOW				3531471.5	39.3%	4.26E+12		0.58	10721.7	4617.8
ADVECTIVE OUTFLOW				4556895.0	50.7%	4.18E+13		1.42	10721.7	1519985.5
***TOTAL OUTFLOW				8088366.5	90.0%	6.26E+13		0.98	10721.7	10535.2
***RETENTION				900900.5	10.0%	2.05E+13		5.02		

Overflow Rate (m/yr)	251.6	Nutrient Resid. Time (yrs)	0.0100
Hydraulic Resid. Time (yrs)	0.0120	Turnover Ratio	99.7
Reservoir Conc (mg/m3)	9986	Retention Coef.	0.100

Lake Vermilion TMDL Analysis (year 2002)
File: **G:\TMDL\Model\BATHTUB\VermilionLakeCalibration2002cal&out.btb**
Description:

Initial Condititions model for Lake Vermilion in 2002

TP, TN, Chl-a, and Secchi concentrations to be predicted using calibrated factors.

No observed data to compare

Global Variables	Mean	CV
Averaging Period (yrs)	1	0.0
Precipitation (m)	1.14	0.6
Evaporation (m)	0.82	0.0
Storage Increase (m)	0	0.0

Atmos. Loads (kg/km^2-yr)	Mean	CV
Conserv. Substance	0	0.00
Total P	30	0.50
Total N	1000	0.50
Ortho P	15	0.50
Inorganic N	500	0.50

Segment Morphometry

		Outflow		Area	Depth	Length	Mixed Depth (m)	
Seg	Name	Segment	Group	km^2	m	km	Mean	CV
1	Upper Lake - RBD5	2	1	0.573	1.219	2.164	1.219	0
2	Mid Upper - RBD3	3	1	0.479	1.829	1.052	1.829	0
3	Mid Lower - RBD2	4	1	1.323	3.048	1.393	3.048	0
4	Lower Lake - RBD1	0	1	0.623	5.486	1.149	5.486	0

Segment Observed Water Quality

	Conserv		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0

Segment Calibration Factors

	Dispersion Rate		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	1	0	0.8	0	0.925	0	0.325	0	0.75
2	1	0	1.2	0	0.7	0	0.475	0	1.2
3	1	0	0.8	0	1.05	0	1.3	0	1.215
4	1	0	0.78	0	1.085	0	1.8	0	1.2

Tributary Data

				Dr Area	Flow (hm^3/yr)		Conserv.	
Trib	Trib Name	Segment	Type	km^2	Mean	CV	Mean	CV
1	North Fork Vermilion River	1	1	764.75	421.211	0	0	0
2	Outflow at Dam	4	4	764.75	367.91	0	0	0

Model Coefficients	Mean	CV
Dispersion Rate	1.000	0.70
Total Phosphorus	0.775	0.45
Total Nitrogen	1.200	0.55
Chl-a Model	2.400	0.26
Secchi Model	0.850	0.10
Organic N Model	1.000	0.12
TP-OP Model	1.000	0.15
HODv Model	1.000	0.15
MODv Model	1.000	0.22
Secchi/Chla Slope (m^2/mg)	0.025	0.00
Minimum Qs (m/yr)	0.100	0.00
Chl-a Flushing Term	1.000	0.00
Chl-a Temporal CV	0.620	0
Avail. Factor - Total P	0.330	0
Avail. Factor - Ortho P	1.930	0
Avail. Factor - Total N	0.590	0
Avail. Factor - Inorganic N	0.790	0

Model Options	**Code**	**Description**
Conservative Substance	0	NOT COMPUTED
Phosphorus Balance	1	2ND ORDER, AVAIL P
Nitrogen Balance	1	2ND ORDER, AVAIL N
Chlorophyll-a	2	P, LIGHT, T
Secchi Depth	1	VS. CHLA & TURBIDITY
Dispersion	1	FISCHER-NUMERIC
Phosphorus Calibration	2	CONCENTRATIONS
Nitrogen Calibration	2	CONCENTRATIONS
Error Analysis	1	MODEL & DATA
Availability Factors	0	IGNORE
Mass-Balance Tables	1	USE ESTIMATED CONCS
Output Destination	2	EXCEL WORKSHEET

				Internal Loads (mg/m2-day)					
Hypol Depth		**Non-Algal Turb (m^{-1})**		**Conserv.**		**Total P**		**Total N**	
Mean	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0	0	0.08	0.2	0	0	0	0	0	0
0	0	0.08	0.2	0	0	0	0	0	0
0	0	0.08	0.2	0	0	0	0	0	0
0	0	0.08	0.2	0	0	0	0	0	0

)	**Organic N (ppb)**		**TP - Ortho P (ppb)**		**HOD (ppb/day)**		**MOD (ppb/day)**	
CV	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0

)	**Organic N (ppb)**		**TP - Ortho P (ppb)**		**HOD (ppb/day)**		**MOD (ppb/day)**	
CV	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0

Total P (ppb)		**Total N (ppb)**		**Ortho P (ppb)**		**Inorganic N (ppb)**	
Mean	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
244.37	0.083	9136.21	0.077	0	0	0	0
0	0	0	0	0	0	0	0

Lake Vermilion TMDL Analysis (year 2002)
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Segment & Tributary Network

--------Segment:	1	Upper Lake - RBD5		
Outflow Segment:	2	Mid Upper - RBD3		
Tributary:	1	North Fork Vermilion River	Type:	Monitored Inflow
--------Segment:	2	Mid Upper - RBD3		
Outflow Segment:	3	Mid Lower - RBD2		
--------Segment:	3	Mid Lower - RBD2		
Outflow Segment:	4	Lower Lake - RBD1		
--------Segment:	4	Lower Lake - RBD1		
Outflow Segment:	0	Out of Reservoir		
Tributary:	2	Outflow at Dam	Type:	Reservoir Outflow

Lake Vermilion TMDL Analysis (year 2002)
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Hydraulic & Dispersion Parameters

Seg	Name	Outflow Seg	Net Inflow hm^3/yr	Resid Time years	Overflow Rate m/yr	Velocity km/yr	Dispersion--------> Estimated km^2/yr	Numeric km^2/yr	Exchange hm^3/yr
1	Upper Lake - RBD5	2	421.4	0.0017	735.4	1305.5	7750.7	1412.6	945.4
2	Mid Upper - RBD3	3	421.5	0.0021	880.1	506.2	6319.7	266.3	4792.0
3	Mid Lower - RBD2	4	422.0	0.0096	319.0	145.8	5155.9	101.5	10503.6
4	Lower Lake - RBD1	0	422.2	0.0081	677.6	141.9	998.7	81.5	0.0

Morphometry

Seg	Name	Area km^2	Zmean m	Zmix m	Length km	Volume hm^3	Width km	L/W -
1	Upper Lake - RBD5	0.6	1.2	1.2	2.2	0.7	0.3	8.2
2	Mid Upper - RBD3	0.5	1.8	1.8	1.1	0.9	0.5	2.3
3	Mid Lower - RBD2	1.3	3.0	3.0	1.4	4.0	0.9	1.5
4	Lower Lake - RBD1	0.6	5.5	5.5	1.1	3.4	0.5	2.1
Totals		3.0	3.0			9.0		

Lake Vermilion TMDL Analysis (year 2002)
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Predicted & Observed Values Ranked Against CE Model Development Dataset

Segment: 5 Area-Wtd Mean

Variable	Predicted Values---> Mean	CV	Rank	Observed Values---> Mean	CV	Rank
TOTAL P MG/M3	109.8	0.45	82.2%			
TOTAL N MG/M3	7147.5	0.55	99.9%			
C.NUTRIENT MG/M3	107.1	0.43	91.5%			
CHL-A MG/M3	60.1	0.30	99.2%			
SECCHI M	0.6	0.29	22.9%			
ORGANIC N MG/M3	1533.4	0.29	98.9%			
TP-ORTHO-P MG/M3	104.8	0.34	90.6%			
ANTILOG PC-1	2573.3	0.57	96.4%			
ANTILOG PC-2	15.0	0.11	94.7%			
(N - 150) / P	66.5	0.72	97.7%			
INORGANIC N / P	3763.2	0.73	100.0%			
TURBIDITY 1/M	0.1	0.11	1.1%	0.1	0.11	1.1%
ZMIX * TURBIDITY	0.2	0.12	0.0%	0.2	0.12	0.0%
ZMIX / SECCHI	5.0	0.29	53.4%			
CHL-A * SECCHI	36.1	0.10	96.3%			
CHL-A / TOTAL P	0.6	0.40	95.5%			
FREQ(CHL-a>10) %	99.0	0.01	99.2%			
FREQ(CHL-a>20) %	90.5	0.08	99.2%			
FREQ(CHL-a>30) %	76.1	0.18	99.2%			
FREQ(CHL-a>40) %	61.1	0.28	99.2%			
FREQ(CHL-a>50) %	48.0	0.37	99.2%			
FREQ(CHL-a>60) %	37.3	0.45	99.2%			
CARLSON TSI-P	71.7	0.09	82.2%			
CARLSON TSI-CHLA	70.5	0.04	99.2%			
CARLSON TSI-SEC	67.2	0.06	77.1%			

Segment: 1 Upper Lake - RBD5

Variable	Predicted Values---> Mean	CV	Rank	Observed Values---> Mean	CV	Rank
TOTAL P MG/M3	115.5	0.46	83.6%			
TOTAL N MG/M3	7692.8	0.56	99.9%			
C.NUTRIENT MG/M3	113.6	0.45	92.6%			
CHL-A MG/M3	39.4	0.35	96.9%			
SECCHI M	0.6	0.33	21.9%			
ORGANIC N MG/M3	1061.8	0.32	94.3%			
TP-ORTHO-P MG/M3	68.0	0.39	80.5%			
ANTILOG PC-1	1880.8	0.67	94.0%			
ANTILOG PC-2	10.4	0.10	82.0%			
(N - 150) / P	65.3	0.72	97.6%			
INORGANIC N / P	139.5	1.08	94.0%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.1	0.20	0.0%	0.1	0.20	0.0%
ZMIX / SECCHI	2.0	0.34	7.2%			
CHL-A * SECCHI	23.6	0.10	88.2%			

CHL-A / TOTAL P	0.3	0.34	80.8%
FREQ(CHL-a>10) %	97.1	0.04	96.9%
FREQ(CHL-a>20) %	78.4	0.21	96.9%
FREQ(CHL-a>30) %	55.2	0.40	96.9%
FREQ(CHL-a>40) %	36.9	0.58	96.9%
FREQ(CHL-a>50) %	24.4	0.73	96.9%
FREQ(CHL-a>60) %	16.2	0.87	96.9%
CARLSON TSI-P	72.6	0.09	83.6%
CARLSON TSI-CHLA	66.6	0.05	96.9%
CARLSON TSI-SEC	67.4	0.07	78.1%

Segment: 2 Mid Upper - RBD3

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	152.9	0.45	90.1%			
TOTAL N MG/M3	5124.2	0.55	99.5%			
C.NUTRIENT MG/M3	143.4	0.40	95.9%			
CHL-A MG/M3	47.7	0.29	98.3%			
SECCHI M	0.8	0.29	34.8%			
ORGANIC N MG/M3	1249.8	0.28	97.1%			
TP-ORTHO-P MG/M3	82.6	0.34	85.7%			
ANTILOG PC-1	2208.9	0.54	95.3%			
ANTILOG PC-2	14.2	0.10	93.3%			
(N - 150) / P	32.5	0.72	83.0%			
INORGANIC N / P	55.2	1.14	73.3%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.1	0.20	0.0%	0.1	0.20	0.0%
ZMIX / SECCHI	2.3	0.29	10.2%			
CHL-A * SECCHI	38.2	0.10	96.9%			
CHL-A / TOTAL P	0.3	0.41	76.7%			
FREQ(CHL-a>10) %	98.6	0.02	98.3%			
FREQ(CHL-a>20) %	86.2	0.12	98.3%			
FREQ(CHL-a>30) %	66.9	0.25	98.3%			
FREQ(CHL-a>40) %	48.9	0.38	98.3%			
FREQ(CHL-a>50) %	34.9	0.50	98.3%			
FREQ(CHL-a>60) %	24.8	0.60	98.3%			
CARLSON TSI-P	76.7	0.08	90.1%			
CARLSON TSI-CHLA	68.5	0.04	98.3%			
CARLSON TSI-SEC	63.2	0.07	65.2%			

Segment: 3 Mid Lower - RBD2

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	98.5	0.45	78.8%			
TOTAL N MG/M3	7424.8	0.55	99.9%			
C.NUTRIENT MG/M3	97.2	0.44	89.5%			
CHL-A MG/M3	74.0	0.30	99.6%			
SECCHI M	0.5	0.30	17.8%			
ORGANIC N MG/M3	1851.0	0.30	99.6%			
TP-ORTHO-P MG/M3	129.6	0.34	93.8%			
ANTILOG PC-1	3136.0	0.57	97.4%			
ANTILOG PC-2	16.8	0.11	96.6%			

(N - 150) / P	73.8	0.72	98.4%			
INORGANIC N / P	5573.9	0.74	100.0%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.2	0.20	0.0%	0.2	0.20	0.0%
ZMIX / SECCHI	5.7	0.30	62.0%			
CHL-A * SECCHI	39.6	0.10	97.2%			
CHL-A / TOTAL P	0.8	0.40	98.3%			
FREQ(CHL-a>10) %	99.8	0.00	99.6%			
FREQ(CHL-a>20) %	96.4	0.04	99.6%			
FREQ(CHL-a>30) %	87.4	0.11	99.6%			
FREQ(CHL-a>40) %	75.3	0.20	99.6%			
FREQ(CHL-a>50) %	62.7	0.28	99.6%			
FREQ(CHL-a>60) %	51.2	0.37	99.6%			
CARLSON TSI-P	70.3	0.09	78.8%			
CARLSON TSI-CHLA	72.8	0.04	99.6%			
CARLSON TSI-SEC	69.0	0.06	82.2%			

Segment: 4 Lower Lake - RBD1

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	95.3	0.45	77.8%			
TOTAL N MG/M3	7612.7	0.55	99.9%			
C.NUTRIENT MG/M3	94.2	0.44	88.7%			
CHL-A MG/M3	59.1	0.28	99.2%			
SECCHI M	0.7	0.27	25.5%			
ORGANIC N MG/M3	1510.7	0.27	98.8%			
TP-ORTHO-P MG/M3	103.0	0.32	90.3%			
ANTILOG PC-1	2295.6	0.52	95.6%			
ANTILOG PC-2	16.1	0.11	95.9%			
(N - 150) / P	78.3	0.72	98.8%			
INORGANIC N / P	6102.0	0.69	100.0%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.4	0.20	0.6%	0.4	0.20	0.6%
ZMIX / SECCHI	8.4	0.28	83.3%			
CHL-A * SECCHI	38.7	0.10	97.0%			
CHL-A / TOTAL P	0.6	0.44	96.5%			
FREQ(CHL-a>10) %	99.5	0.01	99.2%			
FREQ(CHL-a>20) %	92.5	0.07	99.2%			
FREQ(CHL-a>30) %	78.3	0.16	99.2%			
FREQ(CHL-a>40) %	62.6	0.27	99.2%			
FREQ(CHL-a>50) %	48.4	0.37	99.2%			
FREQ(CHL-a>60) %	36.9	0.45	99.2%			
CARLSON TSI-P	69.9	0.09	77.8%			
CARLSON TSI-CHLA	70.6	0.04	99.2%			
CARLSON TSI-SEC	66.1	0.06	74.5%			

Lake Vermilion TMDL Analysis (year 2002)
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Overall Water & Nutrient Balances

Overall Water Balance — **Averaging Period = 1.00 years**

Trb	Type	Seg	Name	Area km^2	Flow hm^3/yr	Variance (hm3/yr)^2	CV -	Runoff m/yr
1	1	1	North Fork Vermilion River	764.8	421.2	0.00E+00	0.00	0.55
2	4	4	Outflow at Dam	764.8	367.9	0.00E+00	0.00	0.48
PRECIPITATION				3.0	3.4	3.60E+00	0.55	1.14
TRIBUTARY INFLOW				764.8	421.2	0.00E+00	0.00	0.55
***TOTAL INFLOW				767.7	424.6	3.60E+00	0.00	0.55
GAUGED OUTFLOW				764.8	367.9	0.00E+00	0.00	0.48
ADVECTIVE OUTFLOW				3.0	54.3	3.59E+00	0.03	18.10
***TOTAL OUTFLOW				767.7	422.2	3.59E+00	0.00	0.55
***EVAPORATION					2.5	0.00E+00	0.00	

Overall Mass Balance Based Upon Component: **Predicted TOTAL P** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance (kg/yr)^2	%Total	CV	Conc mg/m^3	Export kg/km^2/yr
1	1	1	North Fork Vermilion River	102931.3	99.9%	7.30E+07	100.0%	0.08	244.4	134.6
2	4	4	Outflow at Dam	35068.4		2.54E+08		0.45	95.3	45.9
PRECIPITATION				89.9	0.1%	2.02E+03	0.0%	0.50	26.3	30.0
TRIBUTARY INFLOW				102931.3	99.9%	7.30E+07	100.0%	0.08	244.4	134.6
***TOTAL INFLOW				103021.3	100.0%	7.30E+07	100.0%	0.08	242.6	134.2
GAUGED OUTFLOW				35068.4	34.0%	2.54E+08		0.45	95.3	45.9
ADVECTIVE OUTFLOW				5172.0	5.0%	5.54E+06		0.46	95.3	1725.2
***TOTAL OUTFLOW				40240.4	39.1%	3.34E+08		0.45	95.3	52.4
***RETENTION				62780.9	60.9%	3.66E+08		0.30		

Overflow Rate (m/yr)	140.8	Nutrient Resid. Time (yrs)	0.0096
Hydraulic Resid. Time (yrs)	0.0214	Turnover Ratio	104.0
Reservoir Conc (mg/m3)	110	Retention Coef.	0.609

Overall Mass Balance Based Upon Component: **Predicted TOTAL N** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance (kg/yr)^2	%Total	CV	Conc mg/m^3	Export kg/km^2/yr
1	1	1	North Fork Vermilion River	3848272.0	99.9%	8.78E+10	100.0%	0.08	9136.2	5032.1
2	4	4	Outflow at Dam	2800777.3		2.40E+12		0.55	7612.7	3662.3
PRECIPITATION				2998.0	0.1%	2.25E+06	0.0%	0.50	877.2	1000.0
TRIBUTARY INFLOW				3848272.0	99.9%	8.78E+10	100.0%	0.08	9136.2	5032.1
***TOTAL INFLOW				3851270.0	100.0%	8.78E+10	100.0%	0.08	9069.7	5016.3
GAUGED OUTFLOW				2800777.3	72.7%	2.40E+12		0.55	7612.7	3662.3
ADVECTIVE OUTFLOW				413066.3	10.7%	5.23E+10		0.55	7612.7	137781.3
***TOTAL OUTFLOW				3213843.5	83.4%	3.16E+12		0.55	7612.7	4186.1
***RETENTION				637426.5	16.6%	3.14E+12		2.78		

Overflow Rate (m/yr)	140.8	Nutrient Resid. Time (yrs)	0.0167
Hydraulic Resid. Time (yrs)	0.0214	Turnover Ratio	59.7
Reservoir Conc (mg/m3)	7148	Retention Coef.	0.166

Lake Vermilion TMDL Analysis (year 2002)
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Description:

Initial Condititions model for Lake Vermilion in 2002

TP, TN, Chl-a, and Secchi concentrations to be predicted using calibrated factors.

No observed data to compare

Global Variables	Mean	CV
Averaging Period (yrs)	1	0.0
Precipitation (m)	1.14	0.6
Evaporation (m)	0.82	0.0
Storage Increase (m)	0	0.0

Atmos. Loads (kg/km^2-yr)	Mean	CV
Conserv. Substance	0	0.00
Total P	30	0.50
Total N	1000	0.50
Ortho P	15	0.50
Inorganic N	500	0.50

Segment Morphometry

		Outflow		Area	Depth	Length	Mixed Depth (m)	
Seg	Name	Segment	Group	km^2	m	km	Mean	CV
1	Upper Lake - RBD5	2	1	0.573	1.219	2.164	1.219	0
2	Mid Upper - RBD3	3	1	0.479	1.829	1.052	1.829	0
3	Mid Lower - RBD2	4	1	1.323	3.048	1.393	3.048	0
4	Lower Lake - RBD1	0	1	0.623	5.486	1.149	5.486	0

Segment Observed Water Quality

	Conserv		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0

Segment Calibration Factors

	Dispersion Rate		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean
1	1	0	0.8	0	0.925	0	0.325	0	0.75
2	1	0	1.2	0	0.7	0	0.475	0	1.2
3	1	0	0.8	0	1.05	0	1.3	0	1.215
4	1	0	0.78	0	1.085	0	1.8	0	1.2

Tributary Data

				Dr Area	Flow (hm^3/yr)		Conserv.	
Trib	Trib Name	Segment	Type	km^2	Mean	CV	Mean	CV
1	North Fork Vermilion River	1	1	764.75	421.211	0	0	0
2	Outflow at Dam	4	4	764.75	367.91	0	0	0

Model Options	Code	Description
Conservative Substance	0	NOT COMPUTED
Phosphorus Balance	1	2ND ORDER, AVAIL P
Nitrogen Balance	1	2ND ORDER, AVAIL N
Chlorophyll-a	2	P, LIGHT, T
Secchi Depth	1	VS. CHLA & TURBIDITY
Dispersion	1	FISCHER-NUMERIC
Phosphorus Calibration	2	CONCENTRATIONS
Nitrogen Calibration	2	CONCENTRATIONS
Error Analysis	1	MODEL & DATA
Availability Factors	0	IGNORE
Mass-Balance Tables	1	USE ESTIMATED CONCS
Output Destination	2	EXCEL WORKSHEET

				Internal Loads (mg/m2-day)					
Hypol Depth		Non-Algal Turb (m^{-1})		Conserv.		Total P		Total N	
Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
0	0	0.08	0.2	0	0	0	0	0	0
0	0	0.08	0.2	0	0	0	0	0	0
0	0	0.08	0.2	0	0	0	0	0	0
0	0	0.08	0.2	0	0	0	0	0	0

)	Organic N (ppb)		TP - Ortho P (ppb)		HOD (ppb/day)		MOD (ppb/day)	
CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0

)	Organic N (ppb)		TP - Ortho P (ppb)		HOD (ppb/day)		MOD (ppb/day)	
CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1	0

Total P (ppb)		Total N (ppb)		Ortho P (ppb)		Inorganic N (ppb)	
Mean	CV	Mean	CV	Mean	CV	Mean	CV
92.86	0.083	9136.21	0.077	0	0	0	0
0	0	0	0	0	0	0	0

Model Coefficients	Mean	CV
Dispersion Rate	1.000	0.70
Total Phosphorus	0.775	0.45
Total Nitrogen	1.200	0.55
Chl-a Model	2.400	0.26
Secchi Model	0.850	0.10
Organic N Model	1.000	0.12
TP-OP Model	1.000	0.15
HODv Model	1.000	0.15
MODv Model	1.000	0.22
Secchi/Chla Slope (m^2/mg)	0.025	0.00
Minimum Qs (m/yr)	0.100	0.00
Chl-a Flushing Term	1.000	0.00
Chl-a Temporal CV	0.620	0
Avail. Factor - Total P	0.330	0
Avail. Factor - Ortho P	1.930	0
Avail. Factor - Total N	0.590	0
Avail. Factor - Inorganic N	0.790	0

Lake Vermilion TMDL Analysis (year 2002)
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Segment & Tributary Network

--------Segment:	1	Upper Lake - RBD5		
Outflow Segment:	2	Mid Upper - RBD3		
Tributary:	1	North Fork Vermilion River	Type:	Monitored Inflow
--------Segment:	2	Mid Upper - RBD3		
Outflow Segment:	3	Mid Lower - RBD2		
--------Segment:	3	Mid Lower - RBD2		
Outflow Segment:	4	Lower Lake - RBD1		
--------Segment:	4	Lower Lake - RBD1		
Outflow Segment:	0	Out of Reservoir		
Tributary:	2	Outflow at Dam	Type:	Reservoir Outflow

Lake Vermilion TMDL Analysis (year 2002)
File: G:\TMDL\Model\BATHTUB\VermilionLakeCalibration2002cal&out-reduction.btb

Hydraulic & Dispersion Parameters

			Net	Resid	Overflow		Dispersion-------->		
		Outflow	Inflow	Time	Rate	Velocity	Estimated	Numeric	Exchange
Seg	**Name**	**Seg**	**hm^3/yr**	**years**	**m/yr**	**km/yr**	**km^2/yr**	**km^2/yr**	**hm^3/yr**
1	Upper Lake - RBD5	2	421.4	0.0017	735.4	1305.5	7750.7	1412.6	945.4
2	Mid Upper - RBD3	3	421.5	0.0021	880.1	506.2	6319.7	266.3	4792.0
3	Mid Lower - RBD2	4	422.0	0.0096	319.0	145.8	5155.9	101.5	10503.6
4	Lower Lake - RBD1	0	422.2	0.0081	677.6	141.9	998.7	81.5	0.0

Morphometry

		Area	Zmean	Zmix	Length	Volume	Width	L/W
Seg	**Name**	**km^2**	**m**	**m**	**km**	**hm^3**	**km**	**-**
1	Upper Lake - RBD5	0.6	1.2	1.2	2.2	0.7	0.3	8.2
2	Mid Upper - RBD3	0.5	1.8	1.8	1.1	0.9	0.5	2.3
3	Mid Lower - RBD2	1.3	3.0	3.0	1.4	4.0	0.9	1.5
4	Lower Lake - RBD1	0.6	5.5	5.5	1.1	3.4	0.5	2.1
Totals		3.0	3.0			9.0		

Lake Vermilion TMDL Analysis (year 2002)
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Predicted & Observed Values Ranked Against CE Model Development Dataset

Segment: **5** **Area-Wtd Mean**

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	50.5	0.46	52.3%			
TOTAL N MG/M3	7147.5	0.55	99.9%			
C.NUTRIENT MG/M3	50.2	0.45	66.5%			
CHL-A MG/M3	42.0	0.38	97.4%			
SECCHI M	0.9	0.37	39.1%			
ORGANIC N MG/M3	1120.7	0.35	95.4%			
TP-ORTHO-P MG/M3	72.6	0.42	82.4%			
ANTILOG PC-1	1032.6	0.72	86.4%			
ANTILOG PC-2	16.3	0.09	96.2%			
(N - 150) / P	144.3	0.72	99.9%			
INORGANIC N / P	4163.4	0.67	100.0%			
TURBIDITY 1/M	0.1	0.11	1.1%	0.1	0.11	1.1%
ZMIX * TURBIDITY	0.2	0.12	0.0%	0.2	0.12	0.0%
ZMIX / SECCHI	3.7	0.36	32.6%			
CHL-A * SECCHI	35.3	0.10	96.0%			
CHL-A / TOTAL P	0.9	0.31	99.0%			
FREQ(CHL-a>10) %	95.1	0.06	97.4%			
FREQ(CHL-a>20) %	76.3	0.22	97.4%			
FREQ(CHL-a>30) %	56.2	0.37	97.4%			
FREQ(CHL-a>40) %	40.0	0.52	97.4%			
FREQ(CHL-a>50) %	28.2	0.66	97.4%			
FREQ(CHL-a>60) %	19.9	0.78	97.4%			
CARLSON TSI-P	60.5	0.11	52.3%			
CARLSON TSI-CHLA	66.8	0.06	97.4%			
CARLSON TSI-SEC	62.1	0.09	60.9%			

Segment: **1** **Upper Lake - RBD5**

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	49.9	0.46	51.8%			
TOTAL N MG/M3	7692.8	0.56	99.9%			
C.NUTRIENT MG/M3	49.7	0.45	66.1%			
CHL-A MG/M3	21.6	0.49	86.0%			
SECCHI M	1.0	0.43	47.4%			
ORGANIC N MG/M3	655.4	0.38	73.7%			
TP-ORTHO-P MG/M3	36.2	0.54	57.9%			
ANTILOG PC-1	541.7	0.85	72.8%			
ANTILOG PC-2	10.9	0.09	84.1%			
(N - 150) / P	151.2	0.72	99.9%			
INORGANIC N / P	515.8	1.20	99.8%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.1	0.20	0.0%	0.1	0.20	0.0%
ZMIX / SECCHI	1.2	0.44	0.8%			
CHL-A * SECCHI	22.2	0.12	86.4%			

CHL-A / TOTAL P	0.4	0.26	89.4%
FREQ(CHL-a>10) %	82.4	0.24	86.0%
FREQ(CHL-a>20) %	42.6	0.72	86.0%
FREQ(CHL-a>30) %	20.0	1.10	86.0%
FREQ(CHL-a>40) %	9.6	1.41	86.0%
FREQ(CHL-a>50) %	4.8	1.67	86.0%
FREQ(CHL-a>60) %	2.5	1.89	86.0%
CARLSON TSI-P	60.5	0.11	51.8%
CARLSON TSI-CHLA	60.7	0.08	86.0%
CARLSON TSI-SEC	59.6	0.10	52.6%

Segment: 2 Mid Upper - RBD3

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	70.4	0.46	66.5%			
TOTAL N MG/M3	5124.2	0.55	99.5%			
C.NUTRIENT MG/M3	69.4	0.44	79.7%			
CHL-A MG/M3	33.7	0.38	95.1%			
SECCHI M	1.1	0.35	51.3%			
ORGANIC N MG/M3	930.8	0.33	90.7%			
TP-ORTHO-P MG/M3	57.7	0.42	75.5%			
ANTILOG PC-1	921.7	0.70	84.4%			
ANTILOG PC-2	15.3	0.09	95.1%			
(N - 150) / P	70.7	0.72	98.2%			
INORGANIC N / P	331.8	2.10	99.2%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.1	0.20	0.0%	0.1	0.20	0.0%
ZMIX / SECCHI	1.7	0.36	3.4%			
CHL-A * SECCHI	37.3	0.11	96.6%			
CHL-A / TOTAL P	0.5	0.31	92.0%			
FREQ(CHL-a>10) %	95.0	0.06	95.1%			
FREQ(CHL-a>20) %	70.2	0.29	95.1%			
FREQ(CHL-a>30) %	45.1	0.53	95.1%			
FREQ(CHL-a>40) %	27.8	0.74	95.1%			
FREQ(CHL-a>50) %	17.2	0.91	95.1%			
FREQ(CHL-a>60) %	10.7	1.06	95.1%			
CARLSON TSI-P	65.5	0.10	66.5%			
CARLSON TSI-CHLA	65.1	0.06	95.1%			
CARLSON TSI-SEC	58.5	0.09	48.7%			

Segment: 3 Mid Lower - RBD2

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	46.2	0.46	48.4%			
TOTAL N MG/M3	7424.8	0.55	99.9%			
C.NUTRIENT MG/M3	46.0	0.45	62.5%			
CHL-A MG/M3	51.8	0.39	98.7%			
SECCHI M	0.8	0.37	31.6%			
ORGANIC N MG/M3	1344.0	0.36	97.9%			
TP-ORTHO-P MG/M3	90.0	0.42	87.6%			
ANTILOG PC-1	1262.7	0.73	89.5%			
ANTILOG PC-2	18.3	0.09	97.7%			

(N - 150) / P	157.6	0.72	99.9%			
INORGANIC N / P	6080.9	0.68	100.0%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.2	0.20	0.0%	0.2	0.20	0.0%
ZMIX / SECCHI	4.1	0.38	39.1%			
CHL-A * SECCHI	38.9	0.10	97.1%			
CHL-A / TOTAL P	1.1	0.31	99.7%			
FREQ(CHL-a>10) %	99.0	0.02	98.7%			
FREQ(CHL-a>20) %	89.0	0.13	98.7%			
FREQ(CHL-a>30) %	71.6	0.29	98.7%			
FREQ(CHL-a>40) %	54.3	0.45	98.7%			
FREQ(CHL-a>50) %	40.0	0.60	98.7%			
FREQ(CHL-a>60) %	29.2	0.73	98.7%			
CARLSON TSI-P	59.4	0.11	48.4%			
CARLSON TSI-CHLA	69.3	0.05	98.7%			
CARLSON TSI-SEC	64.1	0.08	68.4%			

Segment: 4 Lower Lake - RBD1

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	44.9	0.46	47.1%			
TOTAL N MG/M3	7612.7	0.55	99.9%			
C.NUTRIENT MG/M3	44.7	0.45	61.1%			
CHL-A MG/M3	46.4	0.33	98.1%			
SECCHI M	0.8	0.32	36.0%			
ORGANIC N MG/M3	1220.5	0.31	96.8%			
TP-ORTHO-P MG/M3	80.3	0.37	85.0%			
ANTILOG PC-1	1080.6	0.64	87.1%			
ANTILOG PC-2	17.9	0.10	97.4%			
(N - 150) / P	166.4	0.72	100.0%			
INORGANIC N / P	6392.2	0.66	100.0%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.4	0.20	0.6%	0.4	0.20	0.6%
ZMIX / SECCHI	6.7	0.32	71.7%			
CHL-A * SECCHI	38.2	0.10	96.9%			
CHL-A / TOTAL P	1.0	0.36	99.6%			
FREQ(CHL-a>10) %	98.5	0.02	98.1%			
FREQ(CHL-a>20) %	85.2	0.14	98.1%			
FREQ(CHL-a>30) %	65.3	0.30	98.1%			
FREQ(CHL-a>40) %	47.1	0.45	98.1%			
FREQ(CHL-a>50) %	33.3	0.58	98.1%			
FREQ(CHL-a>60) %	23.4	0.70	98.1%			
CARLSON TSI-P	59.0	0.11	47.1%			
CARLSON TSI-CHLA	68.2	0.05	98.1%			
CARLSON TSI-SEC	62.8	0.07	64.0%			

Lake Vermilion TMDL Analysis (year 2002)
File: G:\TMDL\Model\BATHTUB\VermilionLakeCalibration2002cal&out-reduction.btb

Overall Water & Nutrient Balances

Overall Water Balance — **Averaging Period = 1.00 years**

Trb	Type	Seg	Name	Area km^2	Flow hm^3/yr	Variance (hm3/yr)^2	CV -	Runoff m/yr
1	1	1	North Fork Vermilion River	764.8	421.2	0.00E+00	0.00	0.55
2	4	4	Outflow at Dam	764.8	367.9	0.00E+00	0.00	0.48
PRECIPITATION				3.0	3.4	3.60E+00	0.55	1.14
TRIBUTARY INFLOW				764.8	421.2	0.00E+00	0.00	0.55
***TOTAL INFLOW				767.7	424.6	3.60E+00	0.00	0.55
GAUGED OUTFLOW				764.8	367.9	0.00E+00	0.00	0.48
ADVECTIVE OUTFLOW				3.0	54.3	3.59E+00	0.03	18.10
***TOTAL OUTFLOW				767.7	422.2	3.59E+00	0.00	0.55
***EVAPORATION					2.5	0.00E+00	0.00	

Overall Mass Balance Based Upon Predicted Outflow & Reservoir Concentrations
Component: TOTAL P

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance (kg/yr)^2	%Total	CV	Conc mg/m^3	Export kg/km^2/yr
1	1	1	North Fork Vermilion River	39113.7	99.8%	1.05E+07	100.0%	0.08	92.9	51.1
2	4	4	Outflow at Dam	16502.5		5.64E+07		0.46	44.9	21.6
PRECIPITATION				89.9	0.2%	2.02E+03	0.0%	0.50	26.3	30.0
TRIBUTARY INFLOW				39113.7	99.8%	1.05E+07	100.0%	0.08	92.9	51.1
***TOTAL INFLOW				39203.6	100.0%	1.05E+07	100.0%	0.08	92.3	51.1
GAUGED OUTFLOW				16502.5	42.1%	5.64E+07		0.46	44.9	21.6
ADVECTIVE OUTFLOW				2433.8	6.2%	1.23E+06		0.46	44.9	811.8
***TOTAL OUTFLOW				18936.3	48.3%	7.43E+07		0.46	44.9	24.7
***RETENTION				20267.3	51.7%	7.64E+07		0.43		

Overflow Rate (m/yr)	140.8	Nutrient Resid. Time (yrs)	0.0116
Hydraulic Resid. Time (yrs)	0.0214	Turnover Ratio	86.1
Reservoir Conc (mg/m3)	50	Retention Coef.	0.517

Overall Mass Balance Based Upon Predicted Outflow & Reservoir Concentrations
Component: TOTAL N

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance (kg/yr)^2	%Total	CV	Conc mg/m^3	Export kg/km^2/yr
1	1	1	North Fork Vermilion River	3848272.0	99.9%	8.78E+10	100.0%	0.08	9136.2	5032.1
2	4	4	Outflow at Dam	2800777.3		2.40E+12		0.55	7612.7	3662.3
PRECIPITATION				2998.0	0.1%	2.25E+06	0.0%	0.50	877.2	1000.0
TRIBUTARY INFLOW				3848272.0	99.9%	8.78E+10	100.0%	0.08	9136.2	5032.1
***TOTAL INFLOW				3851270.0	100.0%	8.78E+10	100.0%	0.08	9069.7	5016.3
GAUGED OUTFLOW				2800777.3	72.7%	2.40E+12		0.55	7612.7	3662.3
ADVECTIVE OUTFLOW				413066.3	10.7%	5.23E+10		0.55	7612.7	137781.3
***TOTAL OUTFLOW				3213843.5	83.4%	3.16E+12		0.55	7612.7	4186.1
***RETENTION				637426.5	16.6%	3.14E+12		2.78		

Overflow Rate (m/yr)	140.8	Nutrient Resid. Time (yrs)	0.0167
Hydraulic Resid. Time (yrs)	0.0214	Turnover Ratio	59.7
Reservoir Conc (mg/m3)	7148	Retention Coef.	0.166

Vermilion Lake Year 2002 VAR=TP-ppb METHOD= 5 REG-2
COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	155	7	7	3.9	39.149	41.479	.904	.289
2	210	11	11	96.1	703.209	968.031	.442	.102
***	365	18	18	100.0	421.211	607.705		

FLOW STATISTICS
FLOW DURATION = 365.0 DAYS = .999 YEARS
MEAN FLOW RATE = 421.211 HM3/YR
TOTAL FLOW VOLUME = 420.92 HM3
FLOW DATE RANGE = 20020101 TO 20021231
SAMPLE DATE RANGE = 20020130 TO 20021219

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	161199.1	161309.5	.1112E+11	382.97	.654
2 Q WTD C	117571.9	117652.4	.1786E+10	279.32	.359
3 IJC	126125.5	126211.9	.2300E+10	299.64	.380
4 REG-1	102233.6	102303.6	.5365E+09	242.88	.226
5 REG-2	102862.2	102932.6	.7228E+08	244.37	.083
6 REG-3	112438.7	112515.7	.8045E+09	267.12	.252

Vermilion Lake Year 2002 VAR=TP-ppb METHOD= 5 REG-2
X =S FLOW , Y =RESIDUAL

BIVARIATE REGRESSION: Y VS. X
INTERCEPT = -.0042 SLOPE = -.0512
R-SQUARED = .0130 MEAN SQUARED ERROR = .0943
STD ERROR OF SLOPE = .1116 DEGREES OF FREEDOM = 16
T STATISTIC = -.4590 PROBABILITY(>|T|) = .6562
Y MEAN = -.1208 Y STD DEVIATION = .2999
X MEAN = 2.2758 X STD DEVIATION = .6673
RESIDUALS ANALYSIS:
RUNS TEST Z = .7289 PROBABILITY (>|Z|) = .2330
LAG-1 AUTOCORREL. = .1893 PROBABILITY (>|R|) = .2110
EFFECTIVE SAMPLES = 12 SLOPE SIGNIFICANCE = .7154

Vermilion Lake Year 2002 VAR=TP-ppb METHOD= 5 REG-2
X =DATE , Y =RESIDUAL

BIVARIATE REGRESSION: Y VS. X
INTERCEPT = -882.4901 SLOPE = .4406
R-SQUARED = .1561 MEAN SQUARED ERROR = .0807
STD ERROR OF SLOPE = .2562 DEGREES OF FREEDOM = 16
T STATISTIC = 1.7201 PROBABILITY(>|T|) = .1015
Y MEAN = -.1208 Y STD DEVIATION = .2999
X MEAN = 2002.5504 X STD DEVIATION = .2689
RESIDUALS ANALYSIS:
RUNS TEST Z = -.1915 PROBABILITY (>|Z|) = .4240
LAG-1 AUTOCORREL. = .0836 PROBABILITY (>|R|) = .3614
EFFECTIVE SAMPLES = 15 SLOPE SIGNIFICANCE = .1375

Vermilion Lake Year 2001 VAR=TN-ppb METHOD= 6 REG-3
COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	277	41	41	27.6	119.559	121.544	.621	.000
2	88	28	28	72.4	987.760	1307.711	-.165	.130
***	365	69	69	100.0	328.879	602.887		

FLOW STATISTICS
FLOW DURATION = 365.0 DAYS = .999 YEARS
MEAN FLOW RATE = 328.879 HM3/YR
TOTAL FLOW VOLUME = 328.65 HM3
FLOW DATE RANGE = 20010101 TO 20011231
SAMPLE DATE RANGE = 20010102 TO 20011227

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	3763531.0	3766109.0	.1950E+12	11451.37	.117
2 Q WTD C	3046130.0	3048216.0	.7279E+11	9268.52	.089
3 IJC	3025398.0	3027470.0	.8053E+11	9205.43	.094
4 REG-1	3140173.0	3142324.0	.4974E+11	9554.66	.071
5 REG-2	3122972.0	3125111.0	.4141E+11	9502.32	.065
6 REG-3	3320421.0	3322695.0	.4391E+11	10103.11	.063

Vermilion Lake Year 2001 VAR=TN-ppb METHOD= 6 REG-3
X =S FLOW , Y =RESIDUAL

BIVARIATE REGRESSION: Y VS. X
INTERCEPT = -.0239 SLOPE = -.0050
R-SQUARED = .0003 MEAN SQUARED ERROR = .0301
STD ERROR OF SLOPE = .0339 DEGREES OF FREEDOM = 67
T STATISTIC = -.1483 PROBABILITY(>|T|) = .8772
Y MEAN = -.0358 Y STD DEVIATION = .1723
X MEAN = 2.3683 X STD DEVIATION = .6210
RESIDUALS ANALYSIS:
RUNS TEST Z = -5.5508 PROBABILITY (>|Z|) = .0000
LAG-1 AUTOCORREL. = .4717 PROBABILITY (>|R|) = .0000
EFFECTIVE SAMPLES = 25 SLOPE SIGNIFICANCE = .9270

Vermilion Lake Year 2001 VAR=TN-ppb METHOD= 6 REG-3
X =DATE , Y =RESIDUAL

BIVARIATE REGRESSION: Y VS. X
INTERCEPT = 554.2682 SLOPE = -.2769
R-SQUARED = .2066 MEAN SQUARED ERROR = .0239
STD ERROR OF SLOPE = .0663 DEGREES OF FREEDOM = 67
T STATISTIC = -4.1767 PROBABILITY(>|T|) = .0002
Y MEAN = -.0358 Y STD DEVIATION = .1723
X MEAN = 2001.5099 X STD DEVIATION = .2828
RESIDUALS ANALYSIS:
RUNS TEST Z = -3.5898 PROBABILITY (>|Z|) = .0002
LAG-1 AUTOCORREL. = .3663 PROBABILITY (>|R|) = .0012
EFFECTIVE SAMPLES = 32 SLOPE SIGNIFICANCE = .0079

Vermilion Lake Year 2001 VAR=TP-ppb METHOD= 6 REG-3
COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	277	15	15	27.6	119.559	134.866	-.379	.060
2	88	15	15	72.4	987.760	1242.833	1.252	.000
***	365	30	30	100.0	328.879	688.850		

FLOW STATISTICS
FLOW DURATION = 365.0 DAYS = .999 YEARS
MEAN FLOW RATE = 328.879 HM3/YR
TOTAL FLOW VOLUME = 328.65 HM3
FLOW DATE RANGE = 20010101 TO 20011231
SAMPLE DATE RANGE = 20010102 TO 20011220

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	201123.8	201261.5	.6937E+10	611.96	.414
2 Q WTD C	160784.6	160894.8	.1888E+10	489.22	.270
3 IJC	166925.8	167040.1	.2004E+10	507.91	.268
4 REG-1	123285.1	123369.6	.4537E+09	375.12	.173
5 REG-2	143069.6	143167.6	.2467E+09	435.32	.110
6 REG-3	133343.7	133435.0	.1642E+09	405.73	.096

Vermilion Lake Year 2001 VAR=TP-ppb METHOD= 6 REG-3
X =S FLOW , Y =RESIDUAL

BIVARIATE REGRESSION: Y VS. X
INTERCEPT = -.1345 SLOPE = .0357
R-SQUARED = .0123 MEAN SQUARED ERROR = .0366
STD ERROR OF SLOPE = .0604 DEGREES OF FREEDOM = 28
T STATISTIC = .5911 PROBABILITY(>|T|) = .5658
Y MEAN = -.0451 Y STD DEVIATION = .1892
X MEAN = 2.5048 X STD DEVIATION = .5886
RESIDUALS ANALYSIS:
RUNS TEST Z = -1.1243 PROBABILITY (>|Z|) = .1304
LAG-1 AUTOCORREL. = .2575 PROBABILITY (>|R|) = .0792
EFFECTIVE SAMPLES = 18 SLOPE SIGNIFICANCE = .6570

Vermilion Lake Year 2001 VAR=TP-ppb METHOD= 6 REG-3
X =DATE , Y =RESIDUAL

BIVARIATE REGRESSION: Y VS. X
INTERCEPT = 464.0752 SLOPE = -.2319
R-SQUARED = .0889 MEAN SQUARED ERROR = .0338
STD ERROR OF SLOPE = .1403 DEGREES OF FREEDOM = 28
T STATISTIC = -1.6531 PROBABILITY(>|T|) = .1059
Y MEAN = -.0451 Y STD DEVIATION = .1892
X MEAN = 2001.3353 X STD DEVIATION = .2432
RESIDUALS ANALYSIS:
RUNS TEST Z = -.7699 PROBABILITY (>|Z|) = .2207
LAG-1 AUTOCORREL. = .2338 PROBABILITY (>|R|) = .1002
EFFECTIVE SAMPLES = 18 SLOPE SIGNIFICANCE = .2167

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 Vermilion Lake Year 2000          VAR=TN-ppb    METHOD= 4 REG-1
 COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS
 STR       NQ  NC  NE  VOL%   TOTAL FLOW SAMPLED FLOW   C/Q SLOPE SIGNIF
  1       339  45  45  49.3       48.240       50.005        .810   .000
  2        27   8   8  50.7      622.387      975.993       -.097   .543
***       366  53  53 100.0       90.595      189.777

 FLOW STATISTICS
 FLOW DURATION =     366.0 DAYS  =  1.002 YEARS
 MEAN FLOW RATE =    90.595 HM3/YR
 TOTAL FLOW VOLUME =      90.78 HM3
 FLOW DATE RANGE   = 20000101 TO 20001231
 SAMPLE DATE RANGE = 20000124 TO 20001228

 METHOD        MASS (KG)   FLUX (KG/YR)  FLUX VARIANCE CONC (PPB)      CV
 1 AV LOAD      1455777.0      1452794.0      .5309E+11   16036.09    .159
 2 Q WTD C      1065732.0      1063548.0      .3696E+10   11739.55    .057
 3 IJC          1065168.0      1062985.0      .3626E+10   11733.34    .057
 4 REG-1        1083648.0      1081427.0      .3987E+10   11936.90    .058
 5 REG-2        1114373.0      1112090.0      .5312E+10   12275.36    .066
 6 REG-3        1231064.0      1228541.0      .7591E+10   13560.76    .071


Vermilion Lake Year 2000          VAR=TN-ppb    METHOD= 4 REG-1
X =S FLOW  , Y =RESIDUAL

BIVARIATE REGRESSION:  Y VS. X
 INTERCEPT          =      -.1619  SLOPE              =       .0429
 R-SQUARED          =       .0091  MEAN SQUARED ERROR =       .0742
 STD ERROR OF SLOPE =       .0628  DEGREES OF FREEDOM =          51
 T STATISTIC        =       .6832  PROBABILITY(>|T|)  =       .5045
 Y MEAN             =      -.0860  Y STD DEVIATION    =       .2710
 X MEAN             =      1.7703  X STD DEVIATION    =       .6017
RESIDUALS ANALYSIS:
 RUNS TEST Z        =      -.9248  PROBABILITY (>|Z|) =       .1775
 LAG-1 AUTOCORREL.  =       .2126  PROBABILITY (>|R|) =       .0609
 EFFECTIVE SAMPLES  =          34  SLOPE SIGNIFICANCE =       .5944


Vermilion Lake Year 2000          VAR=TN-ppb    METHOD= 4 REG-1
X =DATE    , Y =RESIDUAL

BIVARIATE REGRESSION:  Y VS. X
 INTERCEPT          =    727.2548  SLOPE              =      -.3636
 R-SQUARED          =       .1005  MEAN SQUARED ERROR =       .0674
 STD ERROR OF SLOPE =       .1523  DEGREES OF FREEDOM =          51
 T STATISTIC        =     -2.3873  PROBABILITY(>|T|)  =       .0196
 Y MEAN             =      -.0860  Y STD DEVIATION    =       .2710
 X MEAN             =   2000.5652  X STD DEVIATION    =       .2363
RESIDUALS ANALYSIS:
 RUNS TEST Z        =     -1.6462  PROBABILITY (>|Z|) =       .0499
 LAG-1 AUTOCORREL.  =       .2038  PROBABILITY (>|R|) =       .0689
 EFFECTIVE SAMPLES  =          35  SLOPE SIGNIFICANCE =       .0580
```

Vermilion Lake Year 2000 VAR=TP-ppb METHOD= 5 REG-2
COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	288	17	17	29.0	33.340	33.973	-.326	.017
2	78	11	11	71.0	302.001	680.548	.586	.032
***	366	28	28	100.0	90.595	287.985		

FLOW STATISTICS
FLOW DURATION = 366.0 DAYS = 1.002 YEARS
MEAN FLOW RATE = 90.595 HM3/YR
TOTAL FLOW VOLUME = 90.78 HM3
FLOW DATE RANGE = 20000101 TO 20001231
SAMPLE DATE RANGE = 20000303 TO 20001228

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	53845.8	53735.5	.5829E+09	593.14	.449
2 Q WTD C	25439.7	25387.6	.3199E+08	280.23	.223
3 IJC	26379.4	26325.3	.2990E+08	290.58	.208
4 REG-1	16892.4	16857.8	.5215E+07	186.08	.135
5 REG-2	19063.7	19024.6	.4518E+07	210.00	.112
6 REG-3	18222.7	18185.3	.7122E+07	200.73	.147

Vermilion Lake Year 2000 VAR=TP-ppb METHOD= 5 REG-2
X =S FLOW , Y =RESIDUAL

BIVARIATE REGRESSION: Y VS. X
INTERCEPT = .0700 SLOPE = -.0725
R-SQUARED = .0449 MEAN SQUARED ERROR = .0544
STD ERROR OF SLOPE = .0656 DEGREES OF FREEDOM = 26
T STATISTIC = -1.1058 PROBABILITY(>|T|) = .2786
Y MEAN = -.0687 Y STD DEVIATION = .2342
X MEAN = 1.9130 X STD DEVIATION = .6843
RESIDUALS ANALYSIS:
RUNS TEST Z = -1.1556 PROBABILITY (>|Z|) = .1239
LAG-1 AUTOCORREL. = .1386 PROBABILITY (>|R|) = .2317
EFFECTIVE SAMPLES = 21 SLOPE SIGNIFICANCE = .3527

Vermilion Lake Year 2000 VAR=TP-ppb METHOD= 5 REG-2
X =DATE , Y =RESIDUAL

BIVARIATE REGRESSION: Y VS. X
INTERCEPT = -214.2493 SLOPE = .1071
R-SQUARED = .0100 MEAN SQUARED ERROR = .0564
STD ERROR OF SLOPE = .2084 DEGREES OF FREEDOM = 26
T STATISTIC = .5136 PROBABILITY(>|T|) = .6176
Y MEAN = -.0687 Y STD DEVIATION = .2342
X MEAN = 2000.6104 X STD DEVIATION = .2192
RESIDUALS ANALYSIS:
RUNS TEST Z = -1.2648 PROBABILITY (>|Z|) = .1030
LAG-1 AUTOCORREL. = .1353 PROBABILITY (>|R|) = .2370
EFFECTIVE SAMPLES = 21 SLOPE SIGNIFICANCE = .6650

Vermilion Lake Year 1998 VAR=TN-ppb METHOD= 5 REG-2
COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	240	6	6	8.7	58.080	45.236	.869	.044
2	125	3	3	91.3	1163.988	884.732	-1.292	.080
***	365	9	9	100.0	436.815	325.068		

FLOW STATISTICS
FLOW DURATION = 365.0 DAYS = .999 YEARS
MEAN FLOW RATE = 436.815 HM3/YR
TOTAL FLOW VOLUME = 436.52 HM3
FLOW DATE RANGE = 19980101 TO 19981231
SAMPLE DATE RANGE = 19980106 TO 19981230

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	1364704.0	1365639.0	.6246E+11	3126.35	.183
2 Q WTD C	1789747.0	1790972.0	.5958E+13	4100.07	1.363
3 IJC	1264968.0	1265835.0	.7374E+13	2897.87	2.145
4 REG-1	1380693.0	1381639.0	.1008E+13	3162.98	.727
5 REG-2	1441248.0	1442236.0	.4362E+12	3301.70	.458
6 REG-3	1600046.0	1601142.0	.7846E+12	3665.49	.553

Vermilion Lake Year 1998 VAR=TN-ppb METHOD= 5 REG-2
X =S FLOW , Y =RESIDUAL

BIVARIATE REGRESSION: Y VS. X
INTERCEPT = -.0759 SLOPE = .0212
R-SQUARED = .0100 MEAN SQUARED ERROR = .0240
STD ERROR OF SLOPE = .0796 DEGREES OF FREEDOM = 7
T STATISTIC = .2659 PROBABILITY(>|T|) = .7926
Y MEAN = -.0342 Y STD DEVIATION = .1457
X MEAN = 1.9722 X STD DEVIATION = .6884
RESIDUALS ANALYSIS:
RUNS TEST Z = -.6827 PROBABILITY (>|Z|) = .2474
LAG-1 AUTOCORREL. = .0953 PROBABILITY (>|R|) = .3874
EFFECTIVE SAMPLES = 7 SLOPE SIGNIFICANCE = .8173

Vermilion Lake Year 1998 VAR=TN-ppb METHOD= 5 REG-2
X =DATE , Y =RESIDUAL

BIVARIATE REGRESSION: Y VS. X
INTERCEPT = -364.7674 SLOPE = .1825
R-SQUARED = .1638 MEAN SQUARED ERROR = .0203
STD ERROR OF SLOPE = .1558 DEGREES OF FREEDOM = 7
T STATISTIC = 1.1711 PROBABILITY(>|T|) = .2798
Y MEAN = -.0342 Y STD DEVIATION = .1457
X MEAN = 1998.5463 X STD DEVIATION = .3231
RESIDUALS ANALYSIS:
RUNS TEST Z = -.6827 PROBABILITY (>|Z|) = .2474
LAG-1 AUTOCORREL. = -.0111 PROBABILITY (>|R|) = .4867
EFFECTIVE SAMPLES = 9 SLOPE SIGNIFICANCE = .2798

Vermilion Lake Year 1998 VAR=TP-ppb METHOD= 5 REG-2
COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	68	3	3	1.0	22.496	22.092	-1.011	.232
2	297	6	6	99.0	531.676	476.556	.617	.051
***	365	9	9	100.0	436.815	325.068		

FLOW STATISTICS
FLOW DURATION = 365.0 DAYS = .999 YEARS
MEAN FLOW RATE = 436.815 HM3/YR
TOTAL FLOW VOLUME = 436.52 HM3
FLOW DATE RANGE = 19980101 TO 19981231
SAMPLE DATE RANGE = 19980106 TO 19981230

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	108086.8	108160.8	.8340E+10	247.61	.844
2 Q WTD C	120542.8	120625.3	.3873E+10	276.15	.516
3 IJC	131637.8	131728.0	.4577E+10	301.56	.514
4 REG-1	128921.5	129009.8	.8109E+09	295.34	.221
5 REG-2	171627.3	171744.8	.5302E+09	393.17	.134
6 REG-3	141221.3	141318.0	.9680E+09	323.52	.220

Vermilion Lake Year 1998 VAR=TP-ppb METHOD= 5 REG-2
X =S FLOW , Y =RESIDUAL

BIVARIATE REGRESSION: Y VS. X
INTERCEPT = .0307 SLOPE = -.0538
R-SQUARED = .0266 MEAN SQUARED ERROR = .0572
STD ERROR OF SLOPE = .1229 DEGREES OF FREEDOM = 7
T STATISTIC = -.4375 PROBABILITY(>|T|) = .6764
Y MEAN = -.0754 Y STD DEVIATION = .2269
X MEAN = 1.9722 X STD DEVIATION = .6884
RESIDUALS ANALYSIS:
RUNS TEST Z = 1.4860 PROBABILITY (>|Z|) = .0686
LAG-1 AUTOCORREL. = -.2347 PROBABILITY (>|R|) = .2406
EFFECTIVE SAMPLES = 9 SLOPE SIGNIFICANCE = .6764

Vermilion Lake Year 1998 VAR=TP-ppb METHOD= 5 REG-2
X =DATE , Y =RESIDUAL

BIVARIATE REGRESSION: Y VS. X
INTERCEPT = 214.0299 SLOPE = -.1071
R-SQUARED = .0233 MEAN SQUARED ERROR = .0574
STD ERROR OF SLOPE = .2623 DEGREES OF FREEDOM = 7
T STATISTIC = -.4084 PROBABILITY(>|T|) = .6956
Y MEAN = -.0754 Y STD DEVIATION = .2269
X MEAN = 1998.5463 X STD DEVIATION = .3231
RESIDUALS ANALYSIS:
RUNS TEST Z = 1.4860 PROBABILITY (>|Z|) = .0686
LAG-1 AUTOCORREL. = -.2560 PROBABILITY (>|R|) = .2212
EFFECTIVE SAMPLES = 9 SLOPE SIGNIFICANCE = .6956

Vermilion Lake Year 1997 VAR=TN-ppb METHOD= 2 Q WTD C
COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	190	4	4	4.5	23.168	10.257	.670	.356
2	175	5	5	95.5	539.094	438.053	.091	.284
***	365	9	9	100.0	270.530	247.921		

FLOW STATISTICS
FLOW DURATION = 365.0 DAYS = .999 YEARS
MEAN FLOW RATE = 270.530 HM3/YR
TOTAL FLOW VOLUME = 270.34 HM3
FLOW DATE RANGE = 19970101 TO 19971231
SAMPLE DATE RANGE = 19970204 TO 19971119

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	1942780.0	1944111.0	.6591E+12	7186.31	.418
2 Q WTD C	2397694.0	2399336.0	.2907E+11	8869.03	.071
3 IJC	2398889.0	2400532.0	.4042E+11	8873.45	.084
4 REG-1	2453819.0	2455500.0	.1159E+12	9076.63	.139
5 REG-2	2582236.0	2584005.0	.2821E+12	9551.65	.206
6 REG-3	2479430.0	2481128.0	.3178E+12	9171.37	.227

Vermilion Lake Year 1997 VAR=TN-ppb METHOD= 2 Q WTD C
"X =S FLOW , Y =RESIDUAL"

BIVARIATE REGRESSION: Y VS. X
INTERCEPT = -.0850 SLOPE = .0294
R-SQUARED = .0586 MEAN SQUARED ERROR = .0112
STD ERROR OF SLOPE = .0445 DEGREES OF FREEDOM = 7
T STATISTIC = .6603 PROBABILITY(>|T|) = .5352
Y MEAN = -.0317 Y STD DEVIATION = .1021
X MEAN = 1.8168 X STD DEVIATION = .8421
RESIDUALS ANALYSIS:
RUNS TEST Z = -.6827 PROBABILITY (>|Z|) = .2474
LAG-1 AUTOCORREL. = .1323 PROBABILITY (>|R|) = .3457
EFFECTIVE SAMPLES = 7 SLOPE SIGNIFICANCE = .5892

Vermilion Lake Year 1997 VAR=TN-ppb METHOD= 2 Q WTD C
"X =DATE , Y =RESIDUAL"

BIVARIATE REGRESSION: Y VS. X
INTERCEPT = 225.2945 SLOPE = -.1128
R-SQUARED = .1086 MEAN SQUARED ERROR = .0106
STD ERROR OF SLOPE = .1222 DEGREES OF FREEDOM = 7
T STATISTIC = -.9234 PROBABILITY(>|T|) = .3896
Y MEAN = -.0317 Y STD DEVIATION = .1021
X MEAN = 1997.5000 X STD DEVIATION = .2982
RESIDUALS ANALYSIS:
RUNS TEST Z = -.6827 PROBABILITY (>|Z|) = .2474
LAG-1 AUTOCORREL. = .1358 PROBABILITY (>|R|) = .3418
EFFECTIVE SAMPLES = 7 SLOPE SIGNIFICANCE = .4566

Vermilion Lake Year 1997 VAR=TP-ppb METHOD= 6 REG-3
COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	364	9	9	100.0	271.237	247.921	.230	.255
***	364	9	9	100.0	271.237	247.921		

FLOW STATISTICS
FLOW DURATION = 364.0 DAYS = .997 YEARS
MEAN FLOW RATE = 271.237 HM3/YR
TOTAL FLOW VOLUME = 270.31 HM3
FLOW DATE RANGE = 19970101 TO 19971230
SAMPLE DATE RANGE = 19970204 TO 19971119

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	71637.1	71883.2	.3124E+10	265.02	.778
2 Q WTD C	78374.2	78643.3	.2311E+10	289.94	.611
3 IJC	84885.9	85177.4	.2832E+10	314.03	.625
4 REG-1	80014.3	80289.1	.2552E+10	296.01	.629
5 REG-2	99598.8	99940.8	.4288E+10	368.46	.655
6 REG-3	54102.7	54288.4	.1032E+10	200.15	.592

Vermilion Lake Year 1997 VAR=TP-ppb METHOD= 6 REG-3
X =S FLOW , Y =RESIDUAL

BIVARIATE REGRESSION: Y VS. X
INTERCEPT = -.2265 SLOPE = .0000
R-SQUARED = .0000 MEAN SQUARED ERROR = .1967
STD ERROR OF SLOPE = .1862 DEGREES OF FREEDOM = 7
T STATISTIC = .0000 PROBABILITY(>|T|) = .9955
Y MEAN = -.2265 Y STD DEVIATION = .4149
X MEAN = 1.8168 X STD DEVIATION = .8421
RESIDUALS ANALYSIS:
RUNS TEST Z = -.4082 PROBABILITY (>|Z|) = .3415
LAG-1 AUTOCORREL. = .3468 PROBABILITY (>|R|) = .1491
EFFECTIVE SAMPLES = 4 SLOPE SIGNIFICANCE = .9955

Vermilion Lake Year 1997 VAR=TP-ppb METHOD= 6 REG-3
X =DATE , Y =RESIDUAL

BIVARIATE REGRESSION: Y VS. X
INTERCEPT = -253.7822 SLOPE = .1269
R-SQUARED = .0083 MEAN SQUARED ERROR = .1951
STD ERROR OF SLOPE = .5237 DEGREES OF FREEDOM = 7
T STATISTIC = .2424 PROBABILITY(>|T|) = .8094
Y MEAN = -.2265 Y STD DEVIATION = .4149
X MEAN = 1997.5000 X STD DEVIATION = .2982
RESIDUALS ANALYSIS:
RUNS TEST Z = -.4082 PROBABILITY (>|Z|) = .3415
LAG-1 AUTOCORREL. = .3147 PROBABILITY (>|R|) = .1726
EFFECTIVE SAMPLES = 5 SLOPE SIGNIFICANCE = .8613

Vermilion Lake Year 2002 VAR=TN-ppb METHOD= 6 REG-3
COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	271	21	21	21.4	121.367	163.511	.774	.000
2	94	18	18	78.6	1285.654	1675.310	-.275	.035
***	365	39	39	100.0	421.211	861.264		

FLOW STATISTICS
FLOW DURATION = 365.0 DAYS = .999 YEARS
MEAN FLOW RATE = 421.211 HM3/YR
TOTAL FLOW VOLUME = 420.92 HM3
FLOW DATE RANGE = 20020101 TO 20021231
SAMPLE DATE RANGE = 20020102 TO 20021219

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	4592129.0	4595274.0	.3405E+12	10909.67	.127
2 Q WTD C	3499539.0	3501936.0	.2052E+12	8313.97	.129
3 IJC	3457947.0	3460315.0	.2361E+12	8215.16	.140
4 REG-1	3559859.0	3562297.0	.9413E+11	8457.28	.086
5 REG-2	3479677.0	3482060.0	.1536E+12	8266.78	.113
6 REG-3	3845638.0	3848272.0	.8682E+11	9136.21	.077

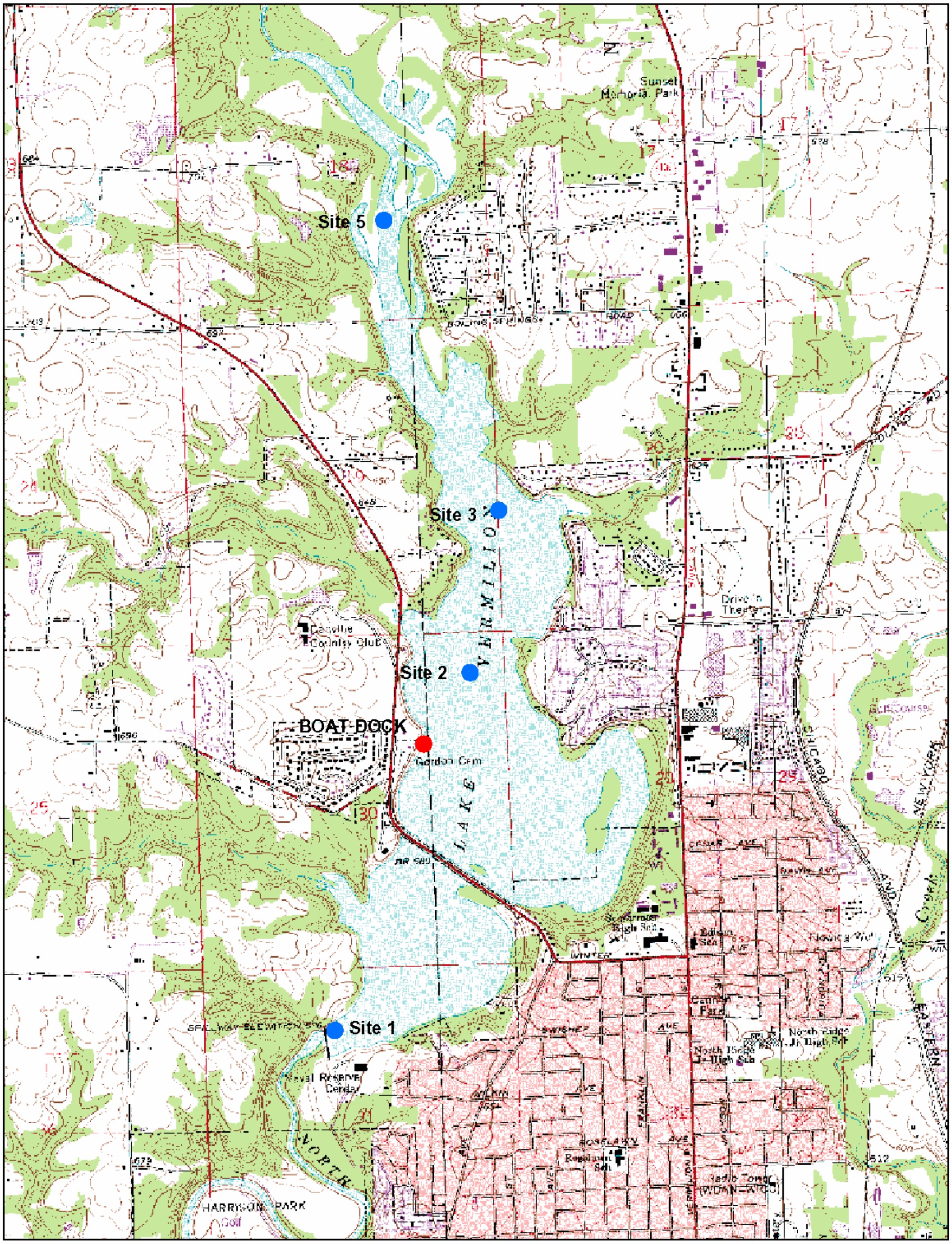
Vermilion Lake Year 2002 VAR=TN-ppb METHOD= 6 REG-3
X =S FLOW , Y =RESIDUAL

BIVARIATE REGRESSION: Y VS. X
INTERCEPT = -.0689 SLOPE = .0115
R-SQUARED = .0017 MEAN SQUARED ERROR = .0327
STD ERROR OF SLOPE = .0460 DEGREES OF FREEDOM = 37
T STATISTIC = .2493 PROBABILITY(>|T|) = .7998
Y MEAN = -.0397 Y STD DEVIATION = .1786
X MEAN = 2.5431 X STD DEVIATION = .6372
RESIDUALS ANALYSIS:
RUNS TEST Z = .3565 PROBABILITY (>|Z|) = .3607
LAG-1 AUTOCORREL. = .2887 PROBABILITY (>|R|) = .0357
EFFECTIVE SAMPLES = 21 SLOPE SIGNIFICANCE = .8508

Vermilion Lake Year 2002 VAR=TN-ppb METHOD= 6 REG-3
X =DATE , Y =RESIDUAL

BIVARIATE REGRESSION: Y VS. X
INTERCEPT = 689.1295 SLOPE = -.3442
R-SQUARED = .3036 MEAN SQUARED ERROR = .0228
STD ERROR OF SLOPE = .0857 DEGREES OF FREEDOM = 37
T STATISTIC = -4.0164 PROBABILITY(>|T|) = .0005
Y MEAN = -.0397 Y STD DEVIATION = .1786
X MEAN = 2002.3193 X STD DEVIATION = .2859
RESIDUALS ANALYSIS:
RUNS TEST Z = -.2889 PROBABILITY (>|Z|) = .3863
LAG-1 AUTOCORREL. = .0363 PROBABILITY (>|R|) = .4103
EFFECTIVE SAMPLES = 36 SLOPE SIGNIFICANCE = .0008

APPENDIX D
WATER QUALITY SITE MAP IN LAKE VERMILION



(Source: IEPA; Site 1,2,3, and 5 stand for RBD-1,-2,-3, and -5)

APPENDIX E
RESPONSIVENESS SUMMARY

Responsiveness Summary

This responsiveness summary responds to substantive questions and comments received during the public comment period from August 8, 2006 to August 30, 2006 postmarked, including those from the August 16, 2006 public meeting discussed below.

What is a TMDL?

A Total Maximum Daily Load (TMDL) is the sum of the allowable amount of a pollutant that a water body can receive from all contributing sources and still meet water quality standards or designated uses. The North Fork Vermilion River Watershed TMDL report contains a plan detailing the actions necessary to reduce pollutant loads to the impaired water bodies and ensure compliance with applicable water quality standards. The Illinois EPA implements the TMDL program in accordance with Section 303(d) of the federal Clean Water Act and regulations there under.

Background

The watershed targeted for TMDL development is the North Fork Vermilion River watershed, which originates in western Indiana and flows into Vermilion County, Illinois. The watershed encompasses an area of approximately 295 square miles. Land use in the watershed is predominately agriculture. TMDLs developed for impaired water bodies in this watershed include North Fork Vermilion River segments BPG-05 (9.82 miles) and BPG-09 (5.91 miles), and Lake Vermilion (880 acres). In the *Illinois Integrated Water Quality Report and Section 303(d) List-2006*, North Fork Vermilion River segment BPG-05 was listed for nitrates, while BPG-09 was listed for total fecal coliform. Lake Vermilion was listed for nitrates, TSS, and aquatic algae. During TMDL development, we determined the lake is also impaired for total phosphorus. The Clean Water Act and USEPA regulations require that states develop TMDLs for waters on the Section 303(d) List. Illinois EPA is currently developing TMDLs for pollutants that have numeric water quality standards. The Illinois EPA contracted with Tetra Tech EM, Inc. to prepare a TMDL report for the North Fork Vermilion River watershed.

Public Meetings

Public meetings were held in the City of Danville on December 14, 2005, and in the Village of Rossville on August 16, 2006. The Illinois EPA provided public notice for the August 16, 2006 meeting by placing display ads in the Danville Commercial News. This notice gave the date, time, location, and purpose of the meeting. The notice also provided references to obtain additional information about this specific site, the TMDL program and other related issues. Approximately 338 individuals and organizations were also sent the public notice by first class mail. The draft TMDL Report was available for review on the Agency's web page at http://www.epa.state.il.us/public-notices. Hardcopies were available upon request.

The Stage 3 public meeting started at 6:00 p.m. on Wednesday, August 16, 2006. It was attended by approximately 15 people and concluded at 7:30 p.m. with the meeting record remaining open until midnight, August 30, 2006.

Questions and Comments

1. What are the point sources of concern in this watershed?

   Response: Discussion of the point sources in the watershed are presented in Section 5.2 of the draft report.

2. Is IEPA looking at the BPG10 segment?

   Response: While segment BPG-10 is listed as impaired, the cause of impairment is total nitrogen, which does not have a numeric water quality standard. Illinois EPA is currently developing TMDLs for pollutants with numeric water quality standards. Therefore, this report does not specifically address this segment. However, TMDLs are developed for downstream segment BPG-05 and Lake Vermilion for nitrates. A watershed-based implementation plan that addresses nitrates could potentially improve the total nitrogen impairment for segment BPG-10.

3. What is the source(s) of fecal coliform between the Village of Alvin and Lake Vermilion?

   Response: The Bismarck Community Unit School discharges below Alvin. Other sources would include nonpoint sources. A discussion of nonpoint sources in the watershed is found in Section 5.1 in the draft report.

4. Is the IEPA going to address where the fecal coliform is coming from?

   Response: Section 5 of the draft report discusses general sources for the pollutants of concern. As stated in the report, there are very little data available from the point sources for the pollutants of concern (total fecal coliform, total phosphorus, and nitrate). The implementation plan will detail additional monitoring that would be necessary to quantify the nonpoint source contributions.

5. Are failing septic systems something that should be addressed in the implementation phase?

   Response: Yes, septic systems will be addressed in the implementation plan.

6. Can the fecal coliform be distinguished between animal and human?

   Response: Laboratory analysis of the DNA of the fecal material can be used to distinguish between human and animal species. DNA analysis of this type is expensive, and Illinois EPA currently does not perform this analysis. This analysis could be utilized in the monitoring component of the implementation plan.

7. What percentage of nitrogen reduction are we shooting for--the entire percentage or would a portion of that percentage be good enough?

   Response: The model indicated that a 33% reduction is necessary to meet the water quality standards for nitrates in the lake, and an 18-43% reduction in North Fork Vermilion segment BPG-05. These reductions are based on historic water quality data and flows. The implementation plan will use an adaptive management approach. This means that as practices are implemented in the watershed, further monitoring should be conducted to gauge the results of those practices, until water quality standards are met for the long term.

8. Are point sources contributing to the nitrate?

   Response: While the point sources may contribute nitrates, they are not believed to be the main contributor. The load duration curve (Figure 6-2) showed that the water quality standard for nitrates was only violated once during low flow conditions. Point sources typically have the largest impact on water quality during low flow. Therefore, the nitrate loads appear to be largely driven by nonpoint sources during wet-weather events.

9. In order to solve the problem, will this be on a voluntary basis or will there be a mandate?

   Response: Illinois EPA only has the authority to regulate NPDES permits held by the point sources. Any Best Management Practice recommended for nonpoint sources in the implementation plan will be strictly voluntary.

10. Why was the total nitrogen data modeled only for 2000 and 2001 data?

    Response: Total Nitrogen (or Nitrate) concentrations were only simulated for years 2000 and 2001 because the measured concentrations at the tributary and at the lake on the same date are available for the two years. The report has been revised accordingly.