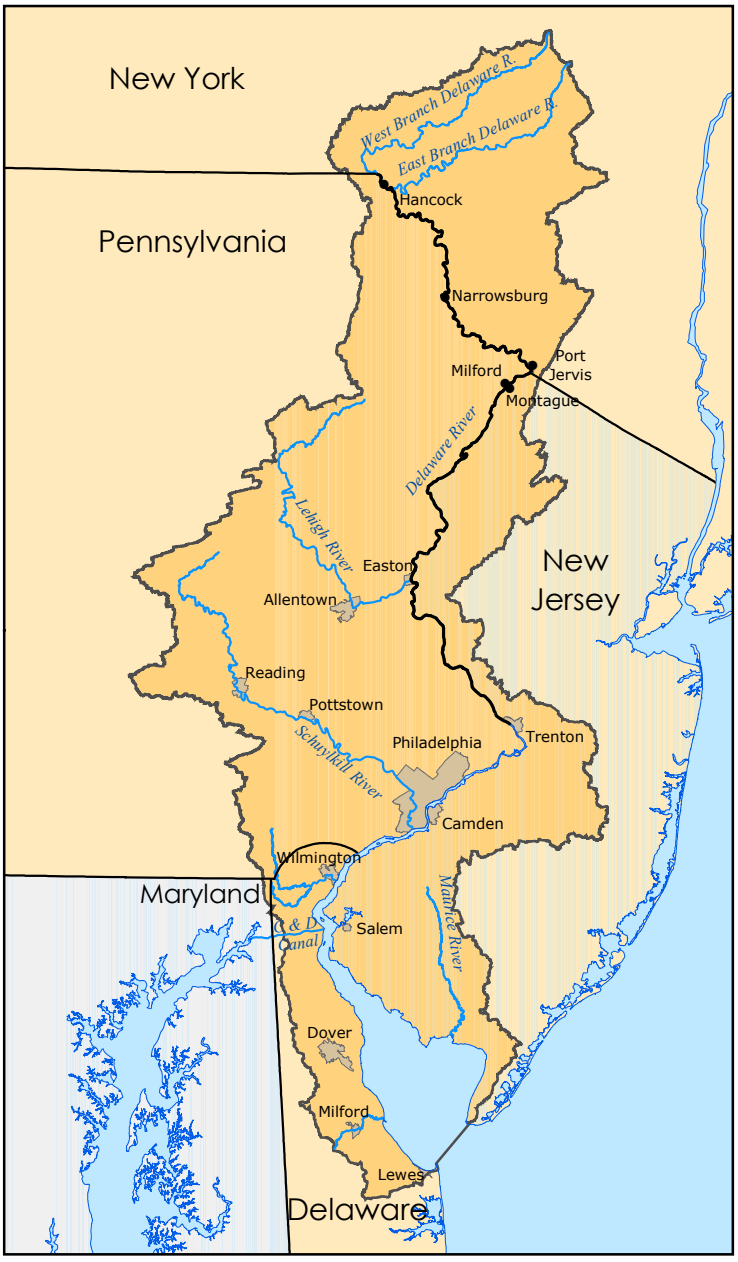
Delaware River Basin Commission

2002 305(b)
Water Quality Assessment Report



September 2002

(Revised April 2003)

Delaware River Basin Commission
DELAWARE · NEW JERSEY
PENNSYLVANIA · NEW YORK
UNITED STATES OF AMERICA

Delaware River Basin Commission
2002 305(b) Water Quality Assessment Report

Table of Contents

List of Tables

List of Figures

Introduction and Overview

This report provides an assessment of the Delaware River's support of various uses during 2000 and 2001 that are protected by the Delaware River Basin Commission's (DRBC) Water Quality Regulations, or by the federal Clean Water Act of 1972. The uses are: maintenance of aquatic life; providing a raw water source for human consumption; swimming and recreation; fish consumption; and shellfish consumption. The assessment primarily involves comparisons of several key water quality parameters with DRBC water quality standards and stream quality objectives. DRBC Water Quality Regulations also designate agricultural and industrial uses for the Delaware River. However, since these two uses would require less stringent water quality criteria than the other uses discussed, they were not assessed for this report.

In accordance with the U.S. Environmental Protection Agency's (EPA) *Guidelines for Preparation of the Comprehensive State Water Quality Assessments (305(b) Reports) and Electronic Updates* (September 1997), this report assesses designated use support in the mainstem and tidal portions of tributaries of the Delaware River Basin.

Assessed water bodies are categorized into one of four use support levels. These levels are based primarily upon the percentage of samples within a water body that meet the relevant water quality objectives. For criteria based upon seasonal or 30-day averages, the entire dataset for each assessed water body is judged to either be supporting or not supporting the designated use. In addition, in some cases where lack of data availability is an obstacle for making an informed assessment of the water body's use attainment, further study is recommended. The methodology used to make the assessments is presented in Part 3 of this report.

1. Summary

Table 1.1 shows the levels to which the assessed portions, or assessment units, of the Delaware River supported their designated uses during the 2000 and 2001 monitoring seasons. For the Aquatic Life, Drinking Water and Recreation uses, where sufficient data were available to assess those uses, full support was generally noted. Segments of the River (assessment units) that did not fully support the Aquatic Life use were Zones 1C and 1D (due to excesses of total dissolved solids), a small portion of Zone 1E (due to high pH), Zones 5A and part of 5B (due to chronic toxicity exceedences) and Zone 6A due to low dissolved oxygen.

Fish consumption was the most widely non-supported use. The assessment was based upon current State fish consumption advisories for the mainstem and tidal portions of the tributaries to the Delaware River.

Tables 1.2 and 1.3 provide a summary of the extent of use support for the different uses, in the different assessed segments of the Delaware River and Bay.

Table 1.4 provides an overview of causes and sources of pollutants or conditions that created the non-support of uses described in this report. The causes of the non-support are the chemical constituents, pollutants or conditions that created the criteria violations. The source is the activity that creates the condition or pollutant, or causes the pollutant to enter the stream. In many circumstances, professional judgment was utilized in surmising the most likely sources.

Table1.1: Overview of Use Support from 2002 305(b) Assessment

Designated Uses				
Assessment Unit	**Aquatic Life**	**Drinking Water**	**Recreation[b]**	**Fish Consumption[c]**
1A	Fully Supported	Fully Supported	Fully Supported	Partially Supported
1B	Fully Supported	Fully Supported	Fully Supported	Partially Supported
1C	Not Supported[a]	Fully Supported	Fully Supported	Partially Supported
1D	Not Supported[a]	Fully Supported	Fully Supported	Partially Supported
1E	Fully/Partially Supported[d]	Fully Supported	Fully Supported	Partially Supported
2	Fully Supported	Not Supported[e]	Fully Supported	Not Supported
3	Fully Supported	Not Supported[e]	Fully Supported	Not Supported
4	Fully Supported	NA	Fully Supported	Not Supported
5A	Partially Supported[f]	NA	Fully Supported	Not Supported
5B	Fully/Partially[f] Supported	NA	Fully Supported	Not Supported
5C	Fully Supported	NA	Fully Supported	Not Supported
6A	Partially Supported[g]	NA	Fully Supported	Partially Supported
6B	Fully Supported	NA	Fully Supported	Partially Supported
6C	Partially Supported[h]	NA	Fully Supported	Partially Supported

[a] due to total dissolved solids
[b] support based on geometric mean of entire dataset in each zone; insufficient data to perform 30-day geometric means
[c] based upon a compilation of State Fish Consumption Advisories
[d] due to high pH at Trenton, NJ
[e] as reported in the 2000 305(b) report, pending new data to determine if criteria for chlorinated organics are being violated
[f] due to chronic toxicity data. Zone 5b affected from river miles 70.0 – 63.0
[g] due to low dissolved oxygen
[h] based upon limited data, and possibly related to near-shore tributary effects
NA: drinking water use is not designated for Zones 4-6 of the Estuary

Table 1.2: Extent of Use Support of Designated Uses (Non-Tidal River)

Use	Size Assessed	Size Fully Supporting	Size Fully Supporting but Threatened	Size Partially Supporting	Size Not Supporting
Aquatic Life	197 mi.	124 mi.	0 mi.	2 mi.	71 mi.
Fish Consumption	197 mi.	0 mi.	0 mi.	193 mi.	4 mi.
Shellfishing	NA	NA	0 mi.	NA	NA
Primary Contact Recreation	197 mi.	197 mi.	0 mi.	0 mi.	0 mi.
Secondary Contact Recreation	NA	NA	0 mi.	NA	NA
Drinking Water	197 mi.	197 mi.	0 mi.	0 mi.	0 mi.

NA: These uses are not applicable in this portion of the Delaware River

Table 1.3: Extent of Use Support of Designated Uses (Estuary and Bay)

Use	Size Assessed	Size Fully Supporting	Size Fully Supporting but Threatened	Size Partially Supporting	Size Not Supporting
Aquatic Life	630 mi.^{2}	271 mi^2	0 mi.^{2}	359 mi.^{2}	0 mi.^{2}
Fish Consumption	783 mi^2	0mi.^{2}	0 mi.^{2}	717 mi.^{2}	66 mi.^{2}
Shellfishing	686 mi.^{2}	619 mi.^{2}	0 mi.^{2}	28 mi.^{2}	38.5 mi.^{2}
Primary Contact Recreation	609 mi.^{2}	609 mi.^{2}	0 mi.^{2}	0 mi.^{2}	0 mi.^{2}
Secondary Contact Recreation	21 mi.^{2}	21 mi.^{2}	0 mi.	0 mi.	0 mi.
Drinking Water	15 mi.^{2}	0 mi.	0 mi.	0 mi.	15 mi.^{2}

Note: Zone 2 = 8 square miles, Zone 3 = 7 square miles, Zone 4 = 17 square miles, Zone 5 = 65 square miles, Zone 6 = 686 square miles (total area is 783 square miles)

Table 1.4: Overview of Causes and Sources of Impairments

Assessment Unit	Use Not Fully Supported	Causes	Possible Sources
1A	Fish Consumption	Mercury	Some Industrial Point Sources, Nonpoint Sources including Air Deposition
1B	Fish Consumption	Mercury	Some Industrial Point Sources, Nonpoint Sources, Air Deposition
1C	Fish Consumption	Mercury	Some Industrial Point Sources, Nonpoint Sources, Air Deposition
1C	Aquatic Life	Total Dissolved Solids	Non-point Sources
1D	Fish Consumption	Mercury	Some Industrial Point Sources, Nonpoint Sources, Air Deposition
1D	Aquatic Life	Total Dissolved Solids	Non-point Sources
1E	Fish Consumption	Mercury, PCBs, Dioxins, Pesticides	Point Sources, Air Deposition, Non-point Sources
1E[a]	Aquatic Life	pH	Excessive plant growth during warm, low flow periods
2	Fish Consumption	Mercury, PCBs, Dioxins, Pesticides	Point Sources, Air Deposition, Non-point Sources
2	Drinking Water	Chlorinated Organics, PCBs	Industrial point and non-point sources, Superfund sites
3	Fish Consumption	Mercury, PCBs, Dioxins, Pesticides	Point Sources, Air Deposition, Non-point Sources
3	Drinking Water	Chlorinated Organics, PCBs	Industrial point and non-point sources, Superfund sites
4	Fish Consumption	Arsenic, Pesticides, Mercury, PCBs, Dioxins	Point Sources, Air Deposition, Non-point Sources
5A	Fish Consumption	Arsenic, Pesticides, Mercury, PCBs, Dioxins	Point Sources, Air Deposition, Non-point Sources
5A	Aquatic Life	Chronic Toxicity	Industrial point sources, municipal point sources, storm water runoff, Superfund sites
5B	Fish Consumption	Arsenic, Pesticides, Mercury, PCBs, Dioxins	Point Sources, Air Deposition, Non-point Sources
5B	Aquatic Life	Chronic Toxicity	Industrial point sources, municipal point sources, storm water runoff, Superfund sites
5C	Fish Consumption	Arsenic, Pesticides, Mercury, PCBs, Dioxins	Point Sources, Air Deposition, Non-point Sources
6	Fish Consumption	PCBs, Mercury, Dioxins	Industrial Point Sources, Air Deposition
6A	Aquatic Life	Low Dissolved Oxygen	Oxygen demanding pollutants
6C	Aquatic Life	Low Dissolved Oxygen	Oxygen demanding pollutants, excessive plant growth

[a] A two-mile reach of Zone 1E, upstream of a continuous water quality monitoring station at Trenton, NJ.

2. Background

This section gives an overview of the Delaware River Basin's water resources and other geographic statistics. A brief discussion of the various aspects of the Delaware River Basin Commission's (DRBC) water pollution control program is also provided, including how it relates to some other regulatory entities in the Basin. Finally, a description of some special issues of concern and recommendations for dealing with them is given.

2.1 An Overview of the Delaware River Basin

The Delaware is the longest un-dammed river east of the Mississippi, extending 330 miles from the confluence of its East and West branches at Hancock, N.Y. to the mouth of the Delaware Bay. The river is fed by 216 tributaries, the largest being the Schuylkill and Lehigh Rivers in Pennsylvania. In all, the basin contains approximately 13,500 square miles, draining parts of Pennsylvania (50.3 percent of the basin's total land area); New Jersey (23.3%); New York (18.5%); and Delaware (7.9%). See Figure 1 for a map of the Basin. Table 2.1 provides geographical statistics for the Delaware River Basin.

Over 17 million people rely on the waters of the Delaware River Basin for drinking and industrial use and the Delaware Bay is only a day's drive away for about 40 percent of the people living in the United States. Yet the basin drains only four-tenths of one percent of the total continental U.S. land area.

Three reaches of the Delaware River have been included in the National Wild and Scenic Rivers System. One section extends 73 miles from the confluence of the river's East and West branches at Hancock, N.Y. downstream to Milrift, PA; the second is a 40-mile stretch from just south of Port Jervis, NY downstream to the Delaware Water Gap near Stroudsburg, Pa. The Lower Delaware Wild and Scenic Rivers Act, signed into law on November 1, 2000, adds about 65 miles of the Delaware and selected tributaries to the national system, linking the Delaware Water Gap and Washington Crossing, PA, just upstream of Trenton, N.J. Currently, almost the entire non-tidal Delaware River (the portion north of the "fall line" at Trenton, New Jersey) is included in the National Wild and Scenic Rivers System. The Maurice River in New Jersey (a Delaware Bay tributary) and the White Clay Creek in Pennsylvania and Delaware (which flows into the Christina River, a tributary to the Delaware) also have been included in the national system.

The Delaware Bay and tidal reach of the Delaware River have been included in the National Estuary Program, a project set up to protect estuarine systems of national significance.

As a result of clean-up efforts in the Delaware River, shad and other fish species are increasing in number. A record number of juvenile shad were netted in the Delaware during 1996, a strong indication of exceptionally good spawning runs when these fish return to the river as adults. A recent study of Delaware River shad fishing placed a $3.2 million annual value on this fishery alone.

There are other economic benefits from the river. The Port of Philadelphia, for instance, generated $335 million in business revenue during 1997, according to the Philadelphia Regional Port Authority. State and local taxes from port transactions that year totaled $13 million and there were 3,622 jobs directly stemming from port activities.

The population of the Delaware River Basin increased by approximately 3.7 percent between 1990 and 2000, according to U.S. Census Bureau figures. Large growth spurts occurred in Pennsylvania's Pocono Mountain region and in the Philadelphia suburbs. The Basin's population rose by about 270,000 over the decade with the 1990 figure standing at roughly 7.31 million people. The basin provides water to approximately 10 million people who live outside of its boundaries.

Table 2.1: Delaware River Basin Geographic Statistics (approximate)

Total Basin Land Area (mi^2)[a]	12,700
Population (2000)	7.6 million
Major River Basins (HUC 8)[b]	13
River Miles (Named)[a]	9,080
Border (Shared) River Miles[a]	339
Square Miles of Public Lakes and Reservoirs[b]	140
Square Miles of Estuary/Bay[b]	783
Square Miles of Wetlands[b]	480

[a]DRBC GIS files

[b]National Hydrographic Dataset

2.2 Water Pollution Control Program

DRBC's water pollution control program is carried out through a series of interdependent steps and provides a rational approach to protecting and restoring water quality in the Basin. The waters of the Basin are protected for designated uses with water quality objectives that specify what levels of individual parameters are appropriate, based upon a review of the current scientific understanding about the needs of those uses. DRBC's monitoring programs provide a mechanism to evaluate how those water quality objectives are being met, and assessment of those monitored data provide the link to how well the designated uses are being protected. The identified impairment of interstate waters in the Basin leads to the development of TMDLs and the issuing of permits to reduce loading of pollutants in order to improve water quality to those levels that meet the objectives. In addition, DRBC has other layers of protection (see Special Protection Waters below) that aim to maintain existing water quality where it is better than the water quality objectives.

2.2.1 Watershed Approach

Because activities that affect the water quality of the Basin's many streams can individually or cumulatively impact the water quality of the main stem River, many of DRBC's regulations and programs are based on a watershed concept and focus on those interrelationships. The following are examples of how the Commission takes a multi-faceted approach to water quality regulation.

Special Protection Waters

Currently, portions of the Delaware River are designated by DRBC as "Special Protection Waters" (differentiated as either Outstanding Basin Waters or Significant Resource Waters) and have associated with them a variety of specific pollution prevention and reduction requirements. Designated reaches are comprised of (see Figure 2):

Outstanding Basin Waters

- The Upper Delaware Scenic and Recreational River from Hancock, NY to Milrift, NY (Delaware River between River Mile 330.7 and 258.4)
- Portions of intrastate tributaries located within the established boundary of the Upper Delaware Scenic and Recreational River Corridor
- The Middle Delaware Scenic and Recreational River from Milrift, NY to the Delaware Water Gap (Delaware River between River Miles 250.1 and 209.5)
- Portions of tributaries located within the established boundaries of the Delaware Water Gap National Recreation Area

Significant Resource Waters

- The Delaware River between River Miles from Milrift, NY to Milford, PA 258.4 and 250.1

Special Protection Waters regulations take a watershed approach to antidegradation of water quality. The regulations apply to the drainage area of the designated waters. Policies provide an up-front approach to reducing or eliminating new pollutant loadings, through requirements made in the docket (permit) review process, for the purpose of maintaining "Existing Water Quality" (EWQ) in designated waters. This is accomplished, in part, by looking at the cumulative impacts of point and nonpoint sources as they may affect the designated waters, either through direct discharge or through tributary loading. EWQ is defined (in DRBC Water Quality Regulations) as "the actual concentration of a water constituent at an in-stream site or sites, as determined through field measurements and laboratory analysis of data collected over a time period determined by the Commission to adequately reflect the natural range of the hydraulic and climatologic factors which affect water quality". Numerical criteria for Special Protection Waters EWQ are defined as "(a) an annual or seasonal mean of the available water quality data, (b) two-tailed upper and lower 95 percent confidence limits around the mean, and (c) the 10^{th} and 90^{th} percentiles of the dataset from which the mean was calculated." EWQ was defined for the above-mentioned portions of the River in 1992.

Estuary TMDLs

Total Maximum Daily Loads (TMDLs) to mitigate a variety of water quality issues in the Delaware River Estuary are either underway or planned. In addition, waste load allocations for certain pollutants are expected in the near term as well:

- By September 30, 2002, a TMDL for low dissolved oxygen is planned, if necessary
- By September 30, 2003, TMDLs for metals, PCBs, and DDT and its derivatives are expected
- By September 30, 2003, waste load allocations are expected for tetrachloroethylene (TCE) and 1,2 dichloroethane (PCE)
- By September 30, 2005, a TMDL for Fecal Coliform Bacteria is planned, if necessary

Estuary CBOD Allocations

DRBC allocates loading of carbonaceous biological oxygen demand (CBOD) among dischargers in the Delaware Estuary. Allowable loads are apportioned through the permit review process by utilizing steady-state modeling to estimate the cumulative impacts of discharges. As the assimilative capacity of a zone is reached, or when allocations existing at that time are no longer equitable, the capacity in the zone, minus a reserve, is reallocated among the waste dischargers in that zone.

Integrated Resource Planning

In 1998, DRBC amended its Southeast Pennsylvania Ground Water Protected Area (SPGWA) Regulations (adopted 1980) to include watershed-based ground water withdrawal limits for sub-basins that lie entirely or partially within the SPGWA. As required by the Regulations, those withdrawal limits may be revised by the Commission to be more protective of streams designated by the State of Pennsylvania as either "high quality" or "exceptional value", or "wild" or "scenic", or "pastoral", or to correspond to more stringent requirements in "integrated resource plans" adopted and implemented by all municipalities in the sub-basin. Integrated Resource Plans (IRPs) must assess water resources and existing uses of water; estimate future water demands and resource requirements; evaluate supply-side and demand-side alternatives to meet water withdrawal needs; assess options for wastewater discharge to subsurface formations and streams; consider storm water and floodplain management; assess the capacity of the sub-basin to meet present and future demands for withdrawal and non-withdrawal uses such as instream flows; identify potential conflicts and problems; incorporate public participation; and outline plans and programs including land use ordinances to resolve conflicts and meet needs. The development of IRPs helps focus and coordinate planning tools to consider the multiple uses of water resources and the interrelationships of water quality and quantity to meet various needs.

Comprehensive Planning Process

DRBC is currently heading a process to develop a "forward-looking" Comprehensive Plan for the Delaware River Basin. This plan outlines numerous mechanisms for protecting, preserving and enhancing the water resources of the Basin, on a watershed basis, through the development of goals, objectives and management strategies. The plan is multi-faceted in its approach and calls for the active involvement of a broad range of governmental and non-governmental entities in addition to DRBC.

The Plan includes such concepts as the integration of water resources considerations into land use planning and management, the development of analytical tools to evaluate water resources impacts of municipal land use plans, the preparation of all necessary TMDLs by the dates required by states, and the use of regulatory and non-regulatory approaches to maintaining and improving water quality where it is better than criteria.

2.2.2 Water Quality Standards Program

Water quality standards provide a description of water body uses to be protected as well as water quality objectives necessary to protect those uses. DRBC's water quality standards program derives its authority from Section 3.2 of the Delaware River Basin Compact (1961) which directs the Commission to adopt "a comprehensive plan…for the immediate and long range development and uses of the water resources of the basin" and to adopt "a water resources program, based upon the comprehensive plan, which shall include a systematic presentation of the quantity and quality of water resources needs of the area…"; and Section 5.2 which allows the Commission to "assume jurisdiction to control future pollution and abate existing pollution in the waters of the basin, whenever it determines…that the effectuation of the comprehensive plan so requires."

Designated Uses

Water uses are paramount in determining stream quality objectives, which, in turn, are the basis for determining discharge effluent quality requirements. Water quality standards require that all surface waters of the Basin be maintained in a safe and satisfactory condition for the following uses:

- Agricultural, industrial and public water supplies after reasonable treatment, except where natural salinity precludes such uses;
- Wildlife, fish and other aquatic life;
- Recreation;
- Navigation;
- Controlled and regulated waste assimilation to the extent that such use is compatible with other uses;
- Such other uses as may be provided by the Commission's Comprehensive Plan

Designated uses have been established specifically for the interstate zones of the Delaware River, as described in Tables 2.2 and 2.3. Figure 3 depicts the main-stem zones in the Basin and Table 2.4 shows the application of designated uses to specific zones. Zones 1A-E (assessed for this report) and Zones E, W1, W2, N1 and N2 (not assessed for this report) represent the non-tidal portions of the Delaware River. Zones 2-6 (assessed in this report) and C1-8 (not assessed in this report) represent the Estuary, or tidal portions of the River, including the tidal portions of the tributaries to the River.

Table 2.2: Main Stem, Shared Delaware River Zones

Zone	Location
1A	RM 330.7 - 289.9
1B	RM 289.9 - 254.75
1C	RM 254.75 - 217.0
1D	RM 217.0 - 183.66
1E	RM 183.66 - 133.4
2	RM 133.4 - 108.4
3	RM108.4 - 95.0
4	RM 95. 0 - 78.8
5	RM 78.8 - 48.2
6	RM 48.2 - 0.0

Note: Zones 1A to 1D (RM 209.5) are currently Special Protection Waters. 1D (from RM209.5) to 1E has been proposed as Special Protection Waters.

Table 2.3: Other Interstate Delaware River Zones (not assessed in this report)

Zone	Location
E	E. Branch to RM 330.7
W1	W. Branch to RM 330.7
W2	RM 1.8 on Sand Pond Ck. to RM 10.1 on W. Branch; Cat Hollow Bk. to RM 1.05 on Sand Pond Ck.; Sherman Ck. to RM 1.8 on Sand Pond Ck.; unnamed Sherman Ck. trib. to RM 1.6 on Sherman Ck.; Starboard Ck. to RM 1.81 on Sand Pond Ck.
N1	RM 0.5 on Neversink R. to RM 253.64
N2	Clove Bk. to RM 0.5 on Neversink R.; unnamed Clove Bk. trib. to RM 1.0 on Clove Bk.; unnamed trib. to Clove Bk. trib. to RM 0.7 on Clove Bk. trib.
C1	Source to RM 16.3 on Christina River
C2	W. Branch Christina R. to RM 25.7 on Christina R.; Persimmon Run to RM 0.8 on W. Branch Christina R.; E. Branch Christina R. to RM 30.2 on Christina R.
C3	White Clay Ck. to RM 14.7 at PA-DE line
C4	RM 14.7 on White Clay Ck. to RM 10.0 on Christina R.
C5	RM 13.4 on Red Clay Ck. to RM 12.6 at PA-DE line; W. Branch Red Clay Ck. to RM 13.4 on Red Clay Ck.
C6	RM 12.6 on Red Clay Ck. at PA-DE line to RM 2.6 on White Clay Ck.
C7	RM 20.0 on Brandywine Ck. to head of tide at RM 2.0 on Brandywine Ck.; W. Branch Brandywine Ck. to RM 20.0 on Brandywine Ck.
C8	Naaman Ck. to head of tide in DE

Table 2.4: Assignment of Designated Uses to the Mainstem Delaware River

Designated Uses	Applicable Zones
Agricultural water supplies	Zones 1,2 and 3
Industrial water supplies after reasonable treatment	All Zones
Maintenance and propagation of resident fish and other aquatic life	Zones 2 and 6
Maintenance and propagation of resident game fish and other aquatic life	Zone 1
Maintenance and propagation of shellfish	Zone 6
Maintenance and propagation of trout	Zone 1A
Maintenance of resident fish and other aquatic life	Zones 3-5
Navigation	Zones 2-6
Passage of anadromous fish	Zones 2-6
Propagation of resident fish	Zone 5 (RM 70.0-48.2)
Public water supplies after reasonable treatment	Zones 1,2 and 3
Recreation	Zones 1, 2, 4 (below RM 81.8), 5 and 6
Secondary contact recreation	Zones 3 and 4 (above RM 81.8)
Spawning and nursery habitat for anadromous fish	Zones 1A-1E
Wildlife	All Zones

Ambient Water Quality Standards

Sections 3.20, 3.30, and 3.40 of DRBC's Water Quality Regulations define the "Water Quality Objectives", or ambient water quality standards for the non-tidal river, tidal river and Basin ground water, respectively. Objectives are zone-based and define the water quality necessary to protect the designated uses in those zones. For the water quality assessments in Part 3, monitored data are compared against the zone standards for determining use attainment. Table 2.5 shows the water quality objectives for the non-tidal main stem and Table 2.6 shows the objectives for the tidal portions of the Delaware River main stem and tributaries.

Table 2.5: Water Quality Objectives for Non-tidal Delaware River Zones

Parameter	Zones																	
	1A	1B	1C	1D	1E	E	W1	W2	N1	N2	C1	C2	C3	C4	C5	C6	C7	C8
BACTERIA–FECAL COLIFORM--Not to exceed 200 per 100 ml as a geometric average; samples shall be taken at such frequency and location as to permit valid interpretation	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ALKALINITY--Not less than 20 mg/l					X													
DISSOLVED OXYGEN																		
Not less than 4.0 mg/l at any time		X	X	X	X				X		X	X		X		X	X	X
Not less than 5.0 mg/l at any time	X					X	X	X		X			X		X			
Not less than 7.0 mg/l in spawning areas whenever temperatures are suitable for trout spawning	X					X	X	X		X			X		X			
Minimum 24 hour average of 5.0 mg/l		X	X	X	X				X		X	X		X		X	X	X
Minimum 24 hour average of 6.0 mg/l	X					X	X	X		X			X		X			
PHENOLS --Not to exceed 0.005 mg/l unless due to natural conditions	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
PH																		
Between 6.0 and 8.5	X	X	X	X	X	X	X	X			X	X	X	X	X	X		X
Between 6.5 and 8.5									X	X							X	
RADIOACTIVITY--Alpha emitters not to exceed 3 pc/l (picocuries per liter); Beta emitters not to exceed 1000 pc/l	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SYNTHETIC DETERGENTS (Methylene Blue Active Substances (M.B.A.S.))--Not to exceed 0.5 mg/l	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 2.5 Continued

Parameter	Zones																	
	1A	1B	1C	1D	1E	E	W1	W2	N1	N2	C1	C2	C3	C4	C5	C6	C7	C8
TEMPERATURE																		
Not to exceed 5 degrees F (2.8 degrees C) rise above ambient temperature until stream temperature reaches 50 degrees F (10 degrees C)	X					X	X	X		X			X		X			
Not to exceed 2 degrees F (1.1 degrees C) rise above ambient temperature when stream temperature is between 50 degrees F (10 degrees C) and 58 degrees F (14.4 degrees C)	X					X	X	X		X			X		X			
Natural temperature will prevail above 58 degrees F (14.4 degrees C)	X					X	X	X		X			X		X			
Not to exceed 5 degrees F (2.8 degrees C) rise above ambient temperature until stream temperature reaches 87 degrees F (30.6 degrees C)		X	X	X	X				X		X	X		X		X	X	X
Natural temperature will prevail above 87 degrees F (30.6 degrees C)		X	X	X	X				X		X	X		X		X	X	X
TOTAL DISSOLVED SOLIDS--Not to exceed 133 percent of background, or 500 mg/l, whichever is less	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
TURBIDITY																		
Unless exceeded due to natural conditions: maximum 30 day average 10 units, maximum 150 units	X	X																
Not to exceed the natural background by 10 units, or a maximum of 25 units, whichever is less											X	X	X	X	X	X	X	
Unless exceeded due to natural conditions: maximum 30 day average 20 units, maximum 150 units			X	X														
Unless exceeded due to natural conditions: maximum 30 day average 30 units, maximum 150 units					X													
Increases not to be attributable to industrial waste discharges											X	X	X	X	X	X	X	
THRESHOLD ODOR NUMBER--Not to exceed 24 units at 60 degrees C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 2.6: Water Quality Objectives for the Tidal Delaware River Zones (Estuary)

Parameter	Zone				
	2	3	4	5	6
BACTERIA–FECAL COLIFORM					
Maximum geometric average 200 per 100 ml	**X**			**X**	**X**
Maximum geometric average 770 per 100 ml		**X**			
Above R.M. 81.8 maximum geometric average 770 per 100 ml			**X**		
Below R.M. 81.8 maximum geometric average 200 per 100 ml			**X**		
BACTERIA–ENTEROCOCCUS					
Maximum geometric average 33 per 100 ml	**X**				
Maximum geometric average 88 per 100 ml		**X**			
Above R.M. 81.8 maximum geometric average 88 per 100 ml			**X**		
Below R.M. 81.8 maximum geometric average 33 per 100 ml			**X**		
Maximum geometric average 35 per 100 ml				**X**	**X**
BACTERIA--COLIFORM, TOTAL--MPN (most probable number) not to exceed Federal shellfish standards in designated shellfish areas					**X**
ALKALINITY					
Maintain between 20-100 mg/l	**X**				
Maintain between 20-120 mg/l		**X**	**X**	**X**	**X**
DISSOLVED OXYGEN					
Not less than 5.0 mg/l at any time unless due to natural conditions					**X**
Minimum 24 hour average of 3.5 mg/l		**X**	**X**		
Minimum 24 hour average of 5.0 mg/l	**X**				
Minimum 24 hour average of 6.0 mg/l					**X**
Minimum 24 hour average concentration: At R.M. 78.8: 3.5 mg/l At R.M. 70.0: 4.5 mg/l At R.M. 59.5: 6.0 mg/l				**X**	
During the periods from April 1 to June 15 and September 16 to December 31, the dissolved oxygen shall not have a seasonal average less than 6.5 mg/l	**X**	**X**	**X**	**X**	

Table 2.6 Continued

Parameter	Zone				
	2	3	4	5	6
CHLORIDE					
Maximum 15-day average concentration of 50 mg/l	**X**				
Maximum 30-day average concentration of 180 mg/l at R.M. 98		**X**			
PHENOLS					
Not to exceed 0.005 mg/l unless due to natural conditions	**X**	**X**			
Maximum 0.02 mg/l, unless exceeded due to natural conditions			**X**		
Maximum 0.01 mg/l, unless exceeded due to natural conditions				**X**	**X**
PH --Between 6.5 and 8.5	**X**	**X**	**X**	**X**	**X**
HARDNESS					
Maximum 30 day average of 95 mg/l	**X**				
Maximum 30 day average of 150 mg/l		**X**			
RADIOACTIVITY					
Alpha emitters not to exceed 3 pc/l (picocuries per liter)	**X**	**X**	**X**	**X**	**X**
Beta emitters not to exceed 1000 pc/l	**X**	**X**	**X**	**X**	**X**
SODIUM–Maximum 30 day average concentration of 100 mg/l at R.M. 98		**X**			
SYNTHETIC DETERGENTS (Methylene Blue Active Substances (M.B.A.S.)					
Maximum 30 day average of 0.5 mg/l	**X**				
Maximum 30 day average of 1.0 mg/l		**X**	**X**	**X**	**X**

Table 2.6 Continued

Parameter	Zone				
	2	3	4	5	6
TEMPERATURE					
Shall not exceed 5 degrees F (2.8 degrees C) above the average 24-hour temperature gradient displayed during the 1961-66 period, or a maximum of 86 degrees F (30 degrees C), whichever is less	**X**	**X**	**X**		
Shall not be raised above ambient by more than: 1) 4 degrees F (2.2 degrees C) during September through May, nor 2) 1.5 degrees F (0.8 degrees C) during June through August;				**X**	**X**
The maximum temperatures shall not exceed 86 degrees F (30.0 degrees C)				**X**	
The maximum temperatures shall not exceed 85 degrees F (29.4 degrees C)					**X**
TOTAL DISSOLVED SOLIDS					
Not to exceed 133 percent of background, or 500 mg/l, whichever is less	**X**	**X**			
Not to exceed 133 percent of background			**X**		
TURBIDITY					
Unless exceeded due to natural conditions: maximum 30 day average 40 units, maximum 150 units	**X**	**X**	**X**	**X**	**X**
Unless exceeded due to natural conditions above R.M. 117.81 during the period May 30 to September 15, maximum 30 units	**X**				
THRESHOLD ODOR NUMBER --Not to exceed 24 units at 60 degrees C	**X**	**X**	**X**	**X**	**X**

Ambient Standards for Drinking Water Sources

Zones 1, 2 and 3 of the Delaware River are given the designated use of "public water supplies after reasonable treatment". It is the general policy of DRBC that all ground water of the Basin, as well as surface sources of drinking water, should not exceed maximum contaminant levels (MCL) given in the National Primary Drinking Water Standards. In Zones 2 and 3, there is additional definition of the permissible levels of specific toxicants in waters designated for both drinking water as well as fish consumption (due to the bioaccumulation of certain substances even at very low ambient levels). Appendix A includes tables from DRBC's Water Quality Regulations that show the toxics criteria for Zones 2 and 3.

Changes to Water Quality Standards

Ongoing Review of Water Quality Regulations

The last amendment of the Water Quality Regulations occurred in 1996. Currently, DRBC, through its Water Quality Advisory Committee, is developing recommendations to revise its standards under authority of Section 5.2 of the Compact which states that the Commission "may adopt and from time to time amend and repeal rules, regulations and standards" to control future pollution and abate existing pollution. A final, approved version of those rules, amended with any proposed changes, is not available at the time of this report and all water quality assessments presented here are based upon the Water Quality Regulations, as they existed during the 2000 and 2001 monitoring seasons.

Progress Toward Implementing Biocriteria

The Commission does not currently use biological criteria for 305(b) assessments or determinations of impairment, other than reports arising from fish-tissue toxics analyses and inference of aquatic life use support based upon water chemistry. Macroinvertebrate biocriteria were developed for DRBC's Special Protection Waters rules issued in 1992, and have been undergoing review as part of DRBC's anti-degradation policy.

With the launch of DRBC's Lower Delaware Monitoring Program in 1999, declaration of most of the non-tidal Delaware River as Wild and Scenic in 2000, and major efforts to update DRBC's comprehensive plan and water quality standards, there has been renewed interest in DRBC's biomonitoring program. Meetings with state and local partners resulted in the decision that DRBC should take a lead role in biological monitoring of the Delaware River, and near the mouth of select tributaries. With technical support and advice from NJDEP, PADEP, USGS, US EPA Region 3, the National Park Service, and the Academy of Natural Sciences, DRBC set out to define goals, objectives, and methods for improvement of its biological assessment program for the river.

DRBC investigated large-river methods and decided to wait for the issuance of EPA's large-rivers guidance before launching large-scale monitoring in difficult habitats such as pools, rapids, and upper-estuarine reaches. In 2001, DRBC initiated an annual benthic survey of wadeable riffle, run, and island margin habitats, to develop a benthic index of biological integrity for the non-tidal river. The annual August/September low-flow survey is narrowly defined to eliminate spatial and temporal variability, enabling site-to-site, reach-to-reach, and year-to-year comparison of results. By 2005, DRBC hopes to have enough data to create a low-flow B-IBI (benthic index of biotic integrity, a metric used to assess the quality of a macroinvertebrate community) for wadeable portions of the Delaware River.

There is current interest in monitoring other assemblages in order to gain a more complete picture of the ecological integrity of the Delaware River, and to measure progress toward objectives defined by the Commission's Comprehensive Plan. Methods under investigation would assess submerged aquatic vegetation, fish, mussels, plankton, invasive exotic species, and ecological characterization of over 50 unique microhabitats observed in the river. These investigations have been scheduled on a rotating basis as special studies.

2.2.3 Point Source Control Program

DRBC uses a variety of programs to regulate point source pollutant loadings that would impact the Delaware River. These consist of Docket Review, Special Protection Waters Regulations and Basin-wide minimum treatment standards and interstate cooperative agreements.

Section 3.8 of the Compact states that "No project having substantial effect on the water resources of the basin shall hereafter be undertaken by any person, corporation or governmental authority unless it shall have been first submitted to and approved by the Commission". All discharges to waters of the Basin with a design capacity greater than or equal to 50,000 gallons per day are subject to review by the Commission. In Special Protection Waters, the review threshold is 10,000 gallons per day. Projects are reviewed for potential impacts to the waters of the Basin and for consistency with the Comprehensive Plan, which consists of the statements of policies and programs that the Commission determines are necessary to govern the proper development and use of the River Basin *(DRBC Rules of Practice and Procedure, 1997)*.

DRBC also implements point source controls through its Special Protection Waters Regulations. All new or expanded discharges, for which DRBC has review authority, in Significant Resource Waters must undertake a non-discharge alternatives analysis and provide a Social and Economic Justification for a locally degrading discharge to be approved. In the case of Outstanding Basin Waters, no degrading discharge is permissible. The regulations state, "Point sources of pollutants discharged to Outstanding Basin Waters shall be treated as required and then dispersed in such a manner that complete mixing of effluent with the receiving stream is, for all practical intents and purposes, instantaneous."

Article 4 of DRBC's Water Quality Regulations identifies Basin-wide minimum treatment standards for wastewater discharges. These include:

- Removal of total suspended solids
- Minimum secondary treatment for biodegradable wastes
- BOD treatment requirements
- Disinfection requirements
- Color standards
- Dissolved substance standards
- pH standards
- Ammonia standards
- Temperature standards

DRBC maintains cooperative agreements with all four Basin States that provide that all NPDES permits for projects that lie within the Basin must comply with these DRBC standards as well as State standards.

2.2.4 Nonpoint Source Control Program

DRBC regulates non-point pollution as part of the anti-degradation requirements of Special Protection Waters. Under DRBC's Special Protection Water regulations, all new or expanded discharges to the drainage areas of Special Protection Waters must submit for approval a Non-point Source Pollution Control Plan with their application. The plan must control the new or increased non-point source loads generated within the portion of the project's service area that is also located within the drainage area of Special Protection Waters. The plans must document the Best Management Practices to be applied to the project site. Non-point pollution through runoff of developed areas in Special Protection Waters may not be susceptible to antidegradation constraints if they are associated with an existing, non-expanding facility, such as a wastewater treatment plant that is not expanding its service area.

2.2.5 Coordination With Other Agencies

The nature of DRBC's water quality management activities relies on interstate coordination and cooperation. For instance, the agency maintains agreements with all four Basin states regarding permit review, as previously described. Additionally, all new or amended regulations are ruled on by the Commission, which has representation by the four states and federal government. The SRMP and Estuary Boat Run also rely on cooperation between DRBC and other agencies. The Scenic Rivers Monitoring Program is a partnership between DRBC and the National Park Service, while the Boat Run uses data from Delaware Department of Natural Resources and Environmental Conservation's monitoring programs. See Part 3 for more information on these programs.

2.2.6 Special Concerns and Recommendations

- Data Availability – Working to ensure adequate data for assessing the water quality of the Delaware River and for implementing DRBC's many water quality management programs is an ongoing issue.
- Fish Consumption Advisory Consistency – There are discussions ongoing among the Basin States to find a mechanism for ensuring that fish consumption advisories are consistent between states that share common water bodies.
- Lower Delaware River – Efforts to define "Existing Water Quality" for this area are underway. In addition, this portion of the River potentially stands to be designated as Special Protection Waters by the DRBC, and subject to the regulatory approaches outlined in section 2.2.1 of this report.
- Maintaining Existing Water Quality – With growth and development pressures increasing in many parts of the Basin, preventing degradation of high quality waters is an important issue. A related issue is trying to identify the links between water quality issues in the main stem and the potential sources of pollution throughout the Basin.
- Identifying Natural Background Conditions – Attempting to better characterize natural conditions along the Delaware River continues to be an important topic of discussion, particularly as it applies to setting appropriate water quality goals for the River.

3. Surface Water Assessment

This section begins with a discussion of the monitoring programs utilized by DRBC and the data they provide. Those data can, among other purposes, be used to assess attainment of designated uses as described in section 2. Following this discussion are the actual assessments of use attainments for the years 2000 and 2001.

3.1 Current Monitoring Programs

The surface water quality monitoring program utilized by the Delaware River Basin Commission actually consists of three programs:

- The upper and middle non-tidal portions of the River (RM 330.7 to 209.5) are monitored through the *Scenic Rivers Monitoring Program*, a joint National Park Service and DRBC effort.
- The lower non-tidal portions (RM 209.5 to 133.4) are monitored through the *Lower Delaware Monitoring Program*.
- The Estuary, or tidal portion of the Delaware River (RM 133.4 to the mouth of the Delaware Bay), is monitored through the *Delaware River Boat Run Monitoring Program*.
- In addition, data obtained from other agencies, as available, are used to supplement data obtained through the above-mentioned monitoring efforts.

3.1.1 Overview of the Monitoring Programs and Program Goals

Scenic Rivers Monitoring Program (SRMP)

In 1984, The SRMP, a joint NPS/DRBC effort, began monitoring approximately a 121mile reach of the Delaware River, from RM 330.7 to RM 209.5, which contains two portions of the National Wild and Scenic Rivers System and numerous high quality tributaries that drain portions of New York, New Jersey and Pennsylvania.

The Delaware River Basin Commission and National Park Service (DRBC/NPS) Scenic Rivers Monitoring Program (SRMP) conducts water quality assessment activities in the northern portion of the Delaware River Basin from the lower reaches of the East and West Branches of the Delaware River downstream to the Delaware Water Gap (see Figure 4). Participating in the program are the Delaware River Basin Commission, the NPS Upper Delaware National Scenic and Recreational River (UDSRR), and the NPS Delaware Water Gap National Recreation Area (DWGNRA).

The monitoring program consists of three elements: baseline monitoring, ecosystem monitoring and special studies. The goals of the program are to:

- Assess whether existing water quality is measurably changing;
- Expand the scope of monitoring to provide an ecosystem monitoring strategy that complements baseline monitoring; and
- Provide scientific information for management decisions.

Lower Delaware Monitoring Program (LDMP)

In 1998, DRBC began monitoring to characterize water quality of the Lower Delaware River, extending from Trenton, NJ (RM 133.4) to the Delaware Water Gap (RM 209.5). See Figure 4 for a location map. The monitoring network was established because little data existed to characterize water quality in the reach, which has been included in the National Wild and Scenic Rivers system. The 1998 pilot study led to establishment of a fixed network for the year 2000, monitored bi-weekly through the May-September season for the purpose of defining existing water quality over a five-year period. The year 2000 results led to the 2001 program, the first

of a five-year effort to develop a water quality management strategy that protects and improves the water quality of the Lower Delaware region.

The monitoring program consists of two components: routine baseline monitoring, including water chemistry and physical parameters, and biological monitoring. The chemical/physical component has been established. The biological component is in development.

The Goals of the Program are to:

- Expand and augment baseline water quality, physical, and biological data collection efforts of various federal, state, local, and citizen monitoring agencies
- Allow statistical definition of existing water quality within five years, so that criteria may be established for development of an anti-degradation protection strategy for the Lower Delaware River corridor
- Enable reporting of water quality status and trends, biological response to natural and anthropogenic stressors, quantitative long and short-term changes to channel morphology of the river and its tributaries, and identification of key factors controlling maintenance and improvement of the ecological integrity of the river;
- Support determination of abatement priorities for point and non-point sources of pollution;
- Allow prioritization of tributaries for monitoring and watershed planning purposes;
- Expand ecological knowledge of the Lower Non-Tidal Delaware River; and
- Help to safeguard the health and safety of the river-using public.

Estuary Boat Run Program

The Boat Run Program monitors the tidal portion of the Delaware River from the head of tide at Trenton (RM133.4) to the mouth of the Delaware Bay, delineated as a line from Cape May, New Jersey to Lewes, Delaware. See Figure 5 for a graphical depiction of the monitored area.

The goals of the Program are to:

- Provide accurate, precise, and defensible estimates of the surface water quality of the Delaware Estuary
- Allow assessment of water quality standards compliance

3.1.2 Quality Assurance and Control

See Appendices B through D for information on quality assurance and control procedures for the Scenic Rivers Monitoring Program, Lower Delaware Monitoring Program, and Estuary Boat Run Program.

3.1.3 Networks and Programs

Scenic Rivers Monitoring Program

Design Methodology

The design of the Scenic Rivers Monitoring Program is based on:

- A fixed network of monitoring locations
- The number of samples that is needed for data comparison for reach-wide average assessments as well as Boundary Control Point assessments. Boundary Control Points refer to sampling locations, at the

mouths of tributaries that flow into the Delaware River, in order to determine their contributions of pollutant loads.

- The frequency of sampling is based on the ability to perform statistically valid assessments for showing measurable changes to existing water quality, using a 95 percent confidence interval about the average.
- The "redesign" of the program in 1995 was in part based on an analysis of past data and its applicability to performing statistically sound analyses.
- Protocols outlined in "Estimation of Pollutant Loads in Rivers and Streams: A Guidance Document for NPS Programs", Progress Report to EPA Region VIII, 1999, prepared under grant #998397-01-0.
- Other literature

Number and Location of Sites

See Appendix B for a listing of monitoring sites used in the Scenic Rivers Monitoring Program:

- Baseline Scenic Rivers Monitoring Sites
- Flow Measurement Monitoring Locations

Sampled Parameters and Sampling Methods

Detailed field and laboratory procedures are contained in the DRBC/NPS Cooperative Water Quality Monitoring Program Manual (1994). Table 3 in Appendix B Contains a summary of the parameters sampled in the 2000-2001 monitoring programs. Note in the table that not all parameters listed have been monitored during the 2000-2001 programs. Baseline Monitoring Locations are monitored monthly unless ice or safety considerations prevent sample collections.

Use of Reference Conditions

The Scenic Rivers Monitoring Program utilizes "boundary control points" to establish baseline reference conditions at the mouths of tributaries to the main stem Delaware River in this region. These monitoring locations are very useful in determining changes in water quality derived from inputs to the main stem from the adjoining watersheds. Boundary control point locations are listed in Table 1 in Appendix B as "Upper Delaware River Tributaries and Middle Delaware River Tributaries".

Biological Monitoring

Since the end of a 3-year macroinvertebrate study, biological monitoring of Upper Delaware and Middle Delaware tributaries is still being discussed. DRBC surveyed Delaware River macroinvertebrates from Hancock, NY, to Trenton, NJ, in August and September 2001. The ultimate purpose of this survey was to develop narrative and numeric biological criteria for reaches of the entire non-tidal Delaware River.

Fish Tissue Monitoring

During the 2001 monitoring season, one fish tissue sample was taken from the Middle Delaware River, at Montague, New Jersey, as part of a larger effort to sample fish tissue for toxicity. Seven fish were sampled, and included both White Perch and Channel Catfish. Parameters sampled for were PCB congeners, chlorinated pesticides, and metals. The results of this sampling effort are still pending. Other samples were taken from the Lower Delaware River and from the Delaware Estuary.

Lower Delaware Monitoring Program

Design Methodology

Delaware River Water Quality Monitoring Sites (9 bridges) were chosen based on accessibility; equidistance along the river corridor; physiographic regional location, coordination/comparison with other agencies; and location relative to major tributaries or known problem areas. In 2000, two monitoring sites were located at each bridge, one-third of the flow width in from each side of the flowing section. In 2001, three monitoring sites were located at each bridge, at one-quarter of the flow width in from the Pennsylvania side of the River, one-quarter of the flow width in from the New Jersey side of the River, and at center channel site. Composite samples were combined from these sites across the transect.

Tributary Water Chemistry Monitoring Sites (14) include tributaries selected for Lower Delaware Wild and Scenic Rivers (W&S) designation, PA High Quality (HQ) or Exceptional Value (EV) Waters, NJ Trout Maintenance (TM) or Trout Production (TP) Waters, or are streams which contribute a significant flow to the Delaware and are important hydrologic or pollutant loading influences. Some sites were chosen as comparison sites with other monitoring programs such as the Pennsylvania DEP's Water Quality Network (WQN) and New Jersey DEP's Ambient Surface Water network (ASW). Additional criteria for selection of a tributary included known problems, development pressure, and local interest or existence of a volunteer watershed group. Data are collected from other agencies to supplement DRBC's database for the Lower Delaware, and to verify the accuracy of each agency's data.

Number and Location of Sites

See Appendix C for a listing of the sites utilized in the Lower Delaware Monitoring Program:

- Continuous-Recording Water Quality and Flow Measurement Monitoring Locations
- Flow Monitoring Locations for Developing Flow-Rating Curves for Loadings
- Water Chemistry Monitoring Sites-Mainstem
- Water Chemistry Monitoring Sites-Tributary
- Sites Not Monitored in 2001-Established Sites for Establishing Existing Water Quality

For the 2000-2001 monitoring seasons, twenty-three long-term monitoring sites were sampled biweekly.

Sampled Parameters and Sampling Methods

Table 5 in Appendix C describes the parameters sampled for the Lower Delaware Monitoring Program in 2000 and 2001 as well as the methods and equipment used. Sampling consists of bi-monthly chemical/physical sampling at 9 bridges over the Delaware River and on 14 tributaries to the Delaware River between the Delaware Water Gap and Trenton, NJ. This results in 10 samples per site collected from 23 sites, from May through September.

Use of Reference Conditions

Table 6 in Appendix C lists ten Delaware River tributary sites that were not monitored in the 2000-2001 monitoring season but which were selected as boundary control points or reference sites for future monitoring. These locations are intended to establish "existing water quality" in the Lower Delaware River and thus will be used to indicate changes in water quality over time.

Biological Monitoring/Intensive Studies

During 1999 and 2000, DRBC staff met with monitoring counterparts representing the Pennsylvania DEP, New Jersey DEP, and the USGS National Water Quality Assessment (NAWQA) Delaware Basin Study Unit team

members. All agencies expressed the need for biological monitoring of the Delaware River, and expect DRBC to lead main stem Delaware River biological monitoring. A comprehensive biomonitoring program should include examination of multiple assemblages and communities, including fish, macroinvertebrates, periphyton, submerged aquatic macrophytes, and phyto- and zooplankton. Management priorities, lack of funds, and staff limitations have prevented implementation of such an effort.

However, with existing resources, certain activities have been undertaken to provide a biological monitoring component to Delaware River water quality monitoring. Complementary to DRBC's physical and chemical data gathering, macroinvertebrate monitoring provides a better rounded view of water quality conditions in the Delaware River, and should provide sufficient data for scientifically-based decisions regarding protective and preventive management of a known high-quality resource.

During the summer and fall of 2001, DRBC conducted reconnaissance of the river, basic macroinvertebrate collections, and methods investigations. This activity is expected to continue at least through 2005. By supplementing the traditional water chemistry monitoring with biological and geomorphologic investigations, DRBC intends to gather sufficient information to serve the following needs:

- Develop data sufficient to define Existing Water Quality; protect areas of known high water quality; and improve water quality in impaired areas of the Lower Non-Tidal Delaware River (76 miles). The current chemical monitoring component meets this need only partially. No quantitative biological criteria currently exist for the Lower Non-Tidal Delaware River or near-confluence tributary locations

- Implement Special Protection Waters regulations adopted in the early 1990's for the upper 121 miles of the Delaware River. As of 2001, the current chemistry-only monitoring program does not serve this need. No biological criteria were implemented, though they are a required component of measuring "existing water quality" for the Delaware River and tributary Boundary Control Points (see Section II on Special Protection Waters). A "bio-criteria" program was conducted by the Upper Delaware Scenic and Recreational River and the Delaware Water Gap National Recreation Area units of the National Park Service, in cooperation with the Academy of Natural Sciences in the mid-1990's. This study will provide direction for the development of Special Protection Waters bio-criteria by DRBC and NPS.

- Develop a Benthic Index of Biological Integrity (B-IBI) for the non-tidal Delaware River. This began in 2001 with an intensive 3-year macroinvertebrate survey of accessible river sites, targeting the richest-available habitats (riffles, runs, island margins). A B-IBI will be developed to quantify ecological integrity of the entire 200-mile non-tidal river. Further testing (years 2004-2005) of the most sensitive metrics for detecting 'measurable change' will be refined and incorporated into a B-IBI useful for protecting long-term ecological integrity of the river.

Fish Tissue Monitoring

Fish sampling during the 2000-2001 monitoring seasons occurred at two Lower Delaware River locations. The results of this sampling effort are pending and should provide insights into the condition of water quality as it relates to toxic substances.

Estuary Boat Run Program

Design Methodology

A maximum of 22 locations are sampled, most under slack tide conditions. Staff from Delaware DNREC, under contract with the Commission, perform the work. Samples are collected at a depth of three feet below the water surface at low, or high water slack as designated

Number and Location of Sites

See Appendix D for a listing of the monitoring sites utilized in the Estuary Boat Run Program:

Sampled Parameters and Sampling Methods

Table 1 in Appendix D outlines the parameter categories sampled as part of the Estuary Boat Run Program and the locations at which measurements are taken. Table 2 gives the methods used, and the reporting limits for the parameters sampled.

Sampling Frequency

Samples are collected with the frequency shown in Table 3 in Appendix D. Sampling is generally performed during March through November. High water slack runs are conducted about every third run. Air and water temperature as well as pH and Secchi disk are measured, as indicated in Table 2, at time of sampling.

The period of sampling for the Estuary and River stations is once per month during the months of March, June, July and October and twice per month for the months of April, May, August and September of each calendar year. The period of sampling for the Lower Bay Stations is once per month during the periods of March, April, May, July, Aug, September and October.

Toxics Monitoring

The Estuary Boat Run Program conducts water quality sampling for three heavy metals: Copper, Chromium and Zinc. In addition, special studies have been conducted for Lead as well.

Fish Tissue Monitoring

In years 2000 and 2001, fish tissue samples were collected from five locations in the Delaware Estuary for analysis of organic contaminants (PCBs, DDTs, HCHs, Chlordane-related compounds and pesticides) and trace metals. Sampling locations include Crosswicks Creek (RM 128.4), Tacony Palmyra Bridge (RM 107.9), Paulsboro (RM 87.9), Deepwater (RM 65.5) and The Chesapeake and Delaware Canal (RM 58.6). Fish tissue data are used to determine the ambient concentrations of key toxicants in water bodies by using conversion factors that account for the accumulation of those substances in fish tissue. They do not, however, account for bioaccumulation through the food chain. The water quality assessment presented in this section of the report utilizes these data for the purpose of determining drinking water use attainment.

3.1.4 Coordination and Collaboration with Other Programs

The three programs discussed in this section work in concert to provide complete longitudinal coverage of the shared, interstate waters of the Delaware River. However, there are a number of other sources of data utilized for assessment purposes.

As noted in Table 2 in Appendix B, flow measurement data from the USGS are utilized in the DRBC/NPS program. Relationships between other programs and the Scenic Rivers Monitoring Program include County, US Fish and Wildlife, watershed groups, and the USGS (NAWQA Program). If another monitoring program shows interest for integrating program operations with this program, such proposals would be considered favorably

DRBC has a contract with the Pennsylvania Department of Environmental Protection (PADEP) to provide monitoring information on the tidal portions of its tributaries to the Delaware River. Two sites on the Schuylkill and a site on each of Chester, Crum, Darby, Frankford, Neshaminy, Pennypack, Poquessing and

Ridley Creeks make up this network. Data from this monitoring is used in the assessments provided in this report.

Other data are provided by the Delaware Department of Natural Resources and Environmental Conservation (DNREC), from the General Assessment Monitoring component of their Surface Water Quality Monitoring Program.

3.1.5 Program Evaluations

Scenic Rivers Monitoring Program

Updates to Monitoring Strategy

In the 2001 monitoring season, chemical sampling has been modified to include a composite of three samples per bridge location, as opposed to two in the 2000 season. Samples are taken from the center of the bridge, and halfway from the center to the edge of the flow width.

The location of boundary control points in the Middle Delaware River (the Delaware Water Gap National Recreation Area) have been established at the NPS boundaries. Portions of the main stem and tributaries that fall within those boundaries are classified as Outstanding Basin Waters and regulations require no measurable change to existing water quality at the Park Service boundaries. Future monitoring will use these tributary boundary control point locations for this segment of the River.

Effectiveness in Meeting Program Objectives

The ability of the SRMP to assess the status of existing water quality for "measurable change" has been hampered by a lack of financial resources (for example, reduced federal funding, including Section 106 grant money) which has prevented laboratory analysis of water samples (except fecal coliform) since 1993. For the 2000-2001 monitoring program, data are available on temperature, dissolved oxygen, conductivity, pH and fecal coliform. A number of parameters, as listed in Appendix B, Table 3, have not been sampled for during this monitoring period. Some parameters are sampled for determining measurable change and to assist in making waste load allocations when reviewing permit applications for discharges. See Section 2 on Water Quality Standards.

With regard to providing scientific and technical input to management decisions, data collected are useful in making waste load allocations for dischargers to Special Protection Waters in the Basin, where antidegradation policies and more stringent point and non-point pollution control requirements exist. Decisions on how to permit new or expanded regulated discharges are based upon the expected effects on the existing water quality in these areas, and those expectations are driven by the data derived from the SRMP.

Changes Needed to Evaluate New Problems

Currently, an analysis by DRBC and NPS is underway to develop a new monitoring and data assessment protocol for better determining measurable change in the Upper and Middle Delaware River. This update is expected to include a change in monitoring frequency at boundary control points and for determining statistically valid changes to Existing Water Quality.

Additional Monitoring or Data Management Tools Needed

Financial resources remain a concern for the effectiveness of the Scenic Rivers Monitoring Program. As mentioned, not all parameters for which existing water quality has been established are routinely monitored. For

data management, currently there is interest in purchasing a STORET pre-processor to facilitate entry of monitoring data into that database.

Lower Delaware Monitoring Program

Changes to the Program

In 2001, the monitoring program has 9 fewer sites than it previously has had, 8 of which were on tributaries and 1 on the main stem of the river. Although the current tributary sites are located on the larger streams, some of the smaller streams that are no longer being monitored may be experiencing water quality degradation which will not show up in the River samples (due to dilution) until the streams become more severely degraded. This impedes the overall effectiveness of the program and would require additional funding in order to provide more comprehensive coverage.

Changes Needed to Evaluate New Problems

Better coordination with the States for monitoring and long-term water quality/quantity assessments at Boundary Control Points on the tributaries would provide a better evaluation of changes to "existing" water quality. Funding limitations continue to be a concern for maintaining an effective network that not only provides information on current conditions (for such reports as this one) but also would allow the program to meet its other objective of detecting changes to existing water quality.

Additional Monitoring or Data Management Tools Needed

Local municipalities would benefit by having available a locally-based stream model for illustrating present strengths and weaknesses in existing or potential ordinances for water quality/quantity protection. Examples include, the effects of mitigating storm water runoff and erosion, proper installation and maintenance of septic systems, pre and post-development ground and surface water evaluations, and protecting water quality and the aquatic ecosystem.

Of additional use would be the tools necessary to model the interaction of the stream and canal networks in the Lower Delaware region. This would allow for a better understanding of the locations, timing and magnitude of pollutant loadings and would help focus limited monitoring resources on identified data needs .

3.2 Plan for Achieving Comprehensive Assessment

Because DRBC's water quality use standards are currently based on chemical constituents and because DRBC's monitoring programs are primarily based upon fixed networks rather than a probabilistic or rotating basin design, comprehensive assessment could potentially rely on three conditions:

- Creating a denser network of monitoring locations (including the use of outside sources of data)
- Collecting sufficient data on all parameters for which there are standards
- Identifying sources of any mainstem river pollution that occurs through tributary loadings

A lack of resources has hampered the ability to implement some of these aspects of a more comprehensive monitoring program. As noted in the case of the SRMP, a number of parameters have not been monitored and in the LDMP, locations set aside as boundary control points have not been monitored. However, with a greater availability of resources, it would be more feasible to augment and enhance the programs to provide more comprehensive data coverage.

3.3 Assessment Methodology

3.3.1 Data Sources

The water quality assessments provided in this report are based upon data from the following sources:

- The NPS/DRBC Scenic Rivers Monitoring Program
- The Lower Delaware River Monitoring Program
- The Estuary Boat Run Program
- The Pennsylvania DEP Stream and Wastewater Treatment Plant Water Quality Monitoring
- The Delaware DNREC Surface Water Quality Monitoring Program
- The New Jersey DEP Ambient Surface Water Monitoring Network
- United States Geological Survey

In the Delaware Bay, three datasets were available for assessing water quality. Data from the Estuary Boat Run and New Jersey DEP provide coverage for the eastern and central portions of the Bay, respectively, while the Delaware DNREC data provide coverage for a strip along Delaware's coast. This leaves a fourth section of the Bay unassessed in this report (See Figure 6) because data are not available for this report from that portion of the Bay. See *Making Attainment Decisions* below for further discussion.

3.3.2 Associating Water Quality Objectives with Designated Uses

The ability to utilize the monitored data, available for the 2000-2001 monitoring seasons, for assessment purposes requires that the data be analyzed against current water quality objectives (or standards). Before this can be accomplished, it is necessary to establish which water quality objectives are necessary for the protection of each designated use. This is because the failure of a water body to meet its associated standards could cause that water body to be in non-attainment for one use or for several. Table 3.1 indicates which water quality objectives are responsible for protecting which designated uses, for the purpose of making the assessments.

Table 3.1: Application of Water Quality Objectives to Designated Uses

Aquatic Life Use	Recreation Use	Drinking Water Use
Dissolved Oxygen	Fecal Coliform Bacteria	Toxic Substances
PH	Enterococcus Bacteria	Total Dissolved Solids
Temperature		Turbidity
Alkalinity		Hardness
Total Dissolved Solids		Chloride
Chronic Toxicity		

3.3.3 Determining and Presenting the Extent of Use Attainment of Water Bodies

Making Attainment Decisions

Each assessed water body was placed into one of four categories, based upon how the data indicate the level of designated use attainment. Those categories are (for each designated use):

1. The water body is fully supporting its designated use;
2. The water body is fully supporting its designated use but the use is threatened;
3. The water body is partially supporting its designated use;
4. The water body is not supporting its designated use;

The following procedure is used to determine which category a particular water body belongs in, based upon the data collected for the 2000-2001 monitoring seasons:

1. Assessment units are chosen (water quality zones). Note the following (see Figure 7):
    - Zone 5 (RM 78.8 – RM 48.2, with an area of 65 square miles) was subdivided for assessment purposes into three assessment units based upon changes in dissolved oxygen standards within the Zone. The subdivisions are 5A (RM 78.8-RM70.0, with an area of 13 square miles or approximately 20% of the Zone), 5B (RM 70.0-RM59.5, with an area of 21 square miles or approximately 32% of the Zone) and 5C (RM59.5-RM48.2, with an area of 31 square miles or approximately 48% of the Zone).
    - Zone 6 (RM48.2-RM0.0) was subdivided for assessment purposes into three zones based upon the spatial extent of the three data sources available for the Bay. It was assumed that Estuary Boat Run data, collected from a series of points along a line through the Bay, could represent an area 2 miles on either side of that line. It was assumed that DNREC data, collected from the shallow near-shore edge of the Bay, could represent an area 0.5 miles out from the monitoring locations, and back to the shoreline. The NJDEP data, fairly evenly distributed over the eastern portion of the Bay, represents that area of the Bay. Total areas were calculated using Geographic Information System (GIS) analysis. Note the following:
        - Zone 6A, corresponding to NJ DEP data, comprises 282.9 square miles, or approximately 41% of the Zone.
        - Zone 6B, corresponding to Estuary Boat Run Data, comprises 199.2 square miles, or approximately 29% of the Zone.
        - Zone 6C, corresponding to DNREC data, comprises 50.6 square miles, or approximately 7% of the Zone.
        - The remaining 153.3 square miles, or approximately 22% of the Zone is unassessed in this report for all uses but fish consumption.

2. In each assessment unit, the level of each water quality parameter, for which a standard and sufficient available data exist, is compared against the standard prescribed, such that every monitored sample for that parameter either "passes" or "fails" the standard.

3. The percentages of samples in an assessment unit that "fail" a standard determines the level of use support, depending on which uses are associated with the given parameter, such that:
    - Less than or equal to 10% failing samples equates to the Full Support of the use
    - 10% - 25% failing samples equates to Partial Support
    - Greater than 25% failing samples equates to a Not Supported assessment
    - Where a use is supported but there is a documented declining trend in water quality, which indicates that a use will likely not be supported in the near future, the water body is assessed as Fully Supporting but Threatened.

4. For criteria based upon 30-day or seasonal averages, the entire dataset either passes or fails based upon meeting or not meeting those criteria.

3.4 Delaware River and Bay Surface Water Quality Assessment for Years 2000 and 2001

The following section of the report presents the results of assessing the Delaware River and the tidal portions of its tributaries.

3.4.1 Assessment of Designated Uses for Surface Waters

Aquatic Life Designated Use

The water quality parameters used in this assessment of the Aquatic Life Designated Use are pH, Temperature, Dissolved Oxygen, Alkalinity and Total Dissolved Solids or TDS (Ambient water quality should not exceed 133% of background levels for this use), and Chronic Toxicity data which were collected in Water Quality Zones 2-5. DRBC standards include temperature criteria for all portions of the River; however only in Zones 2, 3 and 4 do ambient criteria exist. In other portions of the River, criteria are based upon the regulation of temperature increases, caused by effluent discharges, above background conditions. Those background conditions are not defined in Zones 1, 5 and 6. However, work is ongoing to address this issue.

Table 3.2 shows the level of aquatic life use attainment for the various segments of the main stem Delaware River. Figure 8 depicts the same information.

Table 3.2: Aquatic Life Designated Use Assessment Years 2000-2001

River Zone	DO Criteria Met	pH Criteria Met	Temp. Criteria Met	Alkalinity Criteria Met	TDS Criteria Met	Chronic Toxicity Criteria Met	Use Support Level
1A	Yes	Yes	NA	NA	Yes	NA	Full Support
1B	Yes	Yes	NA	NA	Yes	NA	Full Support
1C	Yes	Yes	NA	NA	No	NA	Not Supported
1D	Yes	Yes	NA	NA	No	NA	Not Supported
1E	Yes	Yes/No[d]	NA	NA	Yes	NA	Full/Partial Support
2	Yes	Yes	No Data[e]	Yes	Yes	Yes	Full Support
3	Yes	Yes	Yes	Yes	Yes	Yes	Full Support
4	Yes	Yes	Yes	Yes	Yes	Yes	Full Support
5a[a]	Yes	Yes	Yes	Yes	NA	No	Partial Support
5b	Yes	Yes	Yes	Yes	NA	Yes/No[f]	Full/Partial Support
5c	Yes	Yes	Yes	Yes	NA	Yes	Full Support
6a[b]	No	No Data	Yes	No Data	NA	No Data	Partial Support
6b	Yes	Yes	Yes	Yes	NA	No Data	Full Support
6c	No[c]	Yes	Yes	Yes	NA	No Data	Partial Support

NA: No ambient criteria available for these zones
[a] The division of Zone 5 is based on differing dissolved oxygen criteria within that zone
[b] Zone 6 is divided into three assessed sections based upon the spatial nature of available data
[c] see narrative on data availability and possible tributary effects
[d] Due to high pH at Trenton
[e] No continuous temperature data available for this zone
[f] Zone 5b affected from river miles 70.0 – 63.0

The Aquatic Life designated use was assessed along the length of the Delaware River from Hancock, NY to the bottom of Zone 1 (197 miles), in Zones 2-5 of the Delaware Estuary (97 square miles), and in the assessed portion of the Delaware Bay (533 square miles).

Non-Tidal River

The use was fully supported in Zones 1A and 1B in the non-tidal river (76 miles, or 38.6% of the non-tidal river). Full Support status was also indicated in Zone 1E (48 miles, or 24.4%), with the exception of two miles (1.0%) which was assessed as being in Partial Support. The use was not supported in Zones 1C and 1D of the River (71 miles, or 36.0%).

In Zones 1C and 1D, total dissolved solids were the cause of the impairment. All samples exceeded 133% of background levels of TDS in 1C. In 1D, 19 out of 51 samples (37%) exceeded 133% of background levels.

In Zone 1E, continuous monitoring at the USGS station (RM 134.5) indicated 13% of samples violated the upper pH criterion of 8.5. Seasonal monitoring (Lower Delaware Monitoring Program) found less than 10% violations in the samples taken, indicating Full Support with regard to pH. For this reason, the zone is assessed as Fully Supporting the Aquatic Life use except for a two-mile reach of the Delaware River above Trenton being

assessed as Partially Supporting the Aquatic Life use. In the course of monitoring the Lower Delaware River, during the monitoring seasons of 2000-2001, there have been sightings of persistent and excessive submerged aquatic vegetation growth in the vicinity of the USGS continuous monitoring station at Trenton, NJ. The River becomes particularly shallow in this area, exposing much of the bed to sunlight and it is possible, if not likely, that this has created the high pH values measured.

Estuary

The use was fully supported in Zones 2, 3, 4, 5c, and a 9-square-mile portion of 5b (72 square miles in total, or 74% of the Estuary, excluding the Bay) and Zone 6b (199 square miles, or 37% of the assessed portion of the Bay). Zones 5a and 12 square miles of 5b (25 square miles in total, or 26% of the Estuary, excluding the Bay), along with Zone 6c (51 square miles, or 9.5% of the assessed portion of the Bay) was assessed as being in Partial Support.

In Zones 3 and 4, the seasonal component of the dissolved oxygen criteria (September 16 through December 31, seasonal average not less than 6.5) was violated with an average of 6.2, calculated from the two years of data. However, data from only four of that season's dates were available in each year (the same dates each year), and no December data were collected (December, with colder water temperatures, would tend to show higher dissolved oxygen levels). All other dissolved oxygen criteria were met for this zone, using both seasonal and continuous (Ben Franklin Bridge USGS monitor at RM 100.2) monitoring data. Zones 3 and 4 are assessed as Fully Supporting the Aquatic Life designated use.

In all of Zone 5a (river miles 78.8 to 70) and part of Zone 5b from river miles 70.0 to 63.0, or 25 square miles in total, chronic toxicity data, associated with DRBC sponsored testing of ambient water, suggest that the Delaware River is partially supporting the Aquatic Life use. This conclusion is based on toxicity effects observed in *Mysid* or *Ceriodaphnia,* each test year, from samples collected one time each test year.

In Zone 6b (corresponding to Estuary Boat Run data), the Aquatic Life designated use was assessed as "Full Support" based upon the available data. In Zone 6A (corresponding to the NJ DEP data), low dissolved oxygen, as compared to the absolute minimum criterion of 5.0 mg/L, occurred in approximately 12 percent of the samples analyzed. This corresponds to a Partial Support designation for that portion of the Bay (283 square miles, or 53 percent of the assessed area). Zone 6c (corresponding to the Delaware DNREC Surface Water Quality Monitoring Program) was assessed as partially supporting the use. In that zone, 17% of samples failed the dissolved oxygen criterion of a minimum 5.0 mg/L. Based upon available information, it appears that tributary effects may be causing this condition. It should also be noted that data from only four dates (the same dates in each of two years) were represented in this data set. This may not provide adequate temporal coverage to give a reliable seasonal average. A greater temporal seasonal coverage of data, throughout the seasonal time periods indicated in the water quality standards, would be helpful.

The fourth section of Zone 6 (153 of 687 square miles), presented as "unassessed" in this report, is most likely Fully Supporting the Aquatic Life designated use, based upon the Fully Supporting assessments upstream, and in Zones 6a and 6b. However, more data are needed to confirm this.

Fish Consumption Designated Use

The assessment of Fish Consumption is not based on zones, but rather is based upon the presence of fish consumption advisories for the main stem Delaware River and the tidal portions of its tributaries. Table 3.3 below indicates the portions of the River for which such advisories exist. Figure 9 shows how those advisories translate into use support for fish consumption in the Delaware River.

Where no advisories are in effect, the water body is in Full Support. Where restrictions exist on the amount of fish consumed in a given time period, or consumption advisories exist for susceptible populations, the water body is in Partial Support. Where consumption bans exist for the general population, for at least one fish species, the water body is Not Supporting its designated use. Note that currently, New Jersey's fish consumption advisories defer to those of Pennsylvania and Delaware. However, New Jersey is in the process of developing a new methodology for making these advisories, which may result in differences with the advisories of Pennsylvania and Delaware.

Table 3.3: Fish Consumption Advisories for the Delaware River

Issuing State	From RM	To RM	Location	Species	Restrictions	High Risk Restrictions	Contaminant
PA[a]	PA/NY Line on West Branch	137.60	Source to Yardley	American Eel	2 meals/month		Mercury
PA	137.6	78.74	Yardley to PA/DE line[b]	American Eel	Do Not Eat		PCBs
				White Perch, Striped Bass, Carp	1 meal/month		PCBs
				Channel Catfish	6 meals/year		PCBs
				Smallmouth Bass	2 meals/month		Mercury
PA	330.71-7.7	330.71	West Branch Delaware River-PA section	Brown Trout	2 meals/month		Mercury
NY[d]	330.71	253.6	Statewide (i.e., NY portion of mainstem Delaware River)	All Species	no more than 1/2 lb/week	do not eat[c]	Various
DE[e]	78.74	58.90	Delaware State Line to C&D Canal	All Finfish	do not eat		PCBs, Arsenic, Dioxin, Mercury, Chlorinated Pesticides
DE	58.90	0.00	C&D Canal to mouth of Delaware Bay	Striped Bass, Channel Catfish, White Catfish, American Eel, White Perch	no more than 1 8-oz. meal/year		PCBs, Mercury, Dioxin
DE			Red Lion Creek, Rt. 13 to Delaware R.	All Finfish	no more than 3 8-oz. meals/year		PCBs, Dioxin
DE			Tidal Brandywine R., mouth to Baynard Blvd.	All Finfish	do not eat		PCBs
DE			Tidal Christina R., mouth to Smalley's Dam	All Finfish	do not eat		PCBs, Dieldrin
DE			Tidal White Clay Creek, mouth to Route 4	All Finfish	do not eat		PCBs
DE			C&D Canal, entire Canal in DE	All Finfish	do not eat		PCBs
DE			Shellpot Creek, Rt.13 to Delaware River	All Finfish	do not eat		PCBs, Chlordane
DE			Appoquinimink River, Tidal Portions	All Finfish	no more than 1 8-oz. meal/year		PCBs, Dioxin
DE			Drawyers Creek, Tidal Portions	All Finfish	no more than 1 8-oz. meal/year		PCBs, DDT
NJ[g]	184.6	131.96	Easton to Trenton	Bass	No restrictions	1 meal/month	Mercury
				Pickerel	1 meal/week	1 meal/month	

Issuing State	From RM	To RM	Location	Species	Restrictions	High Risk Restrictions	Contaminant
NJ	131.96	100.12	Trenton to Camden	Bass	No restrictions	1 meal/week	Mercury
				Pickerel	1 meal/week	1 meal/month	
NJ	137.6	78.74	Delaware River, Yardley, PA to PA/DE border, including tributaries to head of tide	American Eel	do not eat	do not eat[f]	see note g below
NJ				Striped Bass	no more than one meal/month	no more than one meal/month	see note g below
NJ				Channel Catfish	no more than one meal/2months	no more than one meal/2months	see note g below
NJ	78.74	58.90	Delaware River, DE/PA line to C&D Canal	All Finfish	do not eat	do not eat	see note g below
NJ	58.9	0.00	Delaware River, C&D Canal to mouth of Delaware Bay	Striped Bass, Channel Catfish, White Catfish, American Eel, White Perch	no more than one 8-oz. meal per year	no more than one 8-oz. meal per year	see note g below

[a] Commonwealth of Pennsylvania Fish Consumption Advisories-2002, Organic Contaminants

[b] Including all tributaries to head of tide on PA side

[c] in NY, high risk individuals are women of childbearing age, infants and children under 15

[d] NYS DEC Health Advisories for Fish Consumption

[e] Delaware Division of Fish and Wildlife, Fish Health Advisories as of February, 2002

[f] in NJ, high risk individuals include infants, children under 15, pregnant women, nursing mothers and women of childbearing age.

[g] From NJ's 11/99 revision of Fish and Crab Consumption Advisories based on PCBs, Dioxin or Chlordane Contamination (includes listing of PA/DE advisories)

In total, all 197 miles of the mainstem Delaware River, all 97 square miles of the Estuary and 686 square miles of the Bay were assessed for fish consumption.

Shellfish Consumption Designated Use

DRBC classifies only Zone 6 for the shellfish consumption use. In Zone 6, a criterion is set such that Total Coliform (Most Probable Number, or MPN) is not to exceed federal shellfish standards in designated shellfish areas. Because both the states of Delaware and New Jersey monitor and assess water quality for suitability for shell fishing based upon the same set of federal guidelines, the reader is referred to the most recent water quality assessment reports of those states for an assessment of the shellfish consumption use.

The State of Delaware classifies its designated shellfish waters as falling into the following categories; Approved, Seasonally Approved, Prohibited Shellfish Harvesting and Resource Protection Area, or Prohibited. New Jersey classifies shellfish waters as falling into the following categories; Unrestricted, Special Restricted, Seasonal, and Prohibited (either due to water quality or to administrative closures).

DRBC classifies only Zone 6 for the shellfish consumption use. For this assessment, Approved waters were considered to be in Full Support of the use, Prohibited waters were considered to be Not Supporting the use, and all other provisionally approved waters were considered to be in Partial Support of the use. Figure 10 indicates the use support for shellfishing in Zone 6. In total, 619.2 square miles (90% of Zone 6) were in Full Support, 28.2 square miles (4% of Zone 6) were in Partial Support, and 38.5 square miles (6% of Zone 6) were Not Supporting the use. For Shellfish Consumption, the entirety of Zone 6 (686 square miles) was assessed.

It is important to note that both the States of Delaware and New Jersey do not list all prohibited or provisionally approved waters as impaired waters, as not all restrictions on shellfish harvesting are due to water quality issues. According to DNREC, there were no closures of shellfishing waters during the 2000-2001 seasons due to water quality concerns. Please see Delaware's 2002 305(b) report and New Jersey's 2002 Integrated Water Bodies List for more information.

Recreational Designated Use

The determination of Recreational Use support in this assessment is based upon bacterial data. DRBC standards for bacteria are based upon a geometric mean such that, for areas where Fecal Coliform bacteria are used as indicators, a maximum geometric mean of 200 colonies per 100 ml is permitted. Some exceptions to this criterion are present in the standards, however. In Zone 3 and Zone 4 (above RM 81.8) the limit is 770 colonies per 100 ml and secondary contact recreation is the designated use. In sections of the River where Enterococcus is another indicator (Zones 2-6), a maximum geometric mean of 33 colonies per 100 ml is the criterion for primary contact recreation in fresh waters. In marine waters (Zones 5 and 6), the Enterococcus criterion is 35 colonies per 100 ml for primary contact recreation. Secondary contact recreation in fresh waters requires no more than 88 colonies per 100ml.

Fecal Coliform samples should be taken at such a frequency and location as to permit valid interpretation. In a review of the available data used for this report, it is uncommon for there to be at least five samples (sampling dates) represented in any 30-day period. Since spikes in Fecal Coliform concentrations are likely to be event-driven (high flow events would tend to increase levels of these bacteria in the streams), it seems inappropriate to analyze the data based on 30-day periods, when only one or two days may be represented. Therefore, for this analysis, geometric means of the entire dataset in each zone were calculated, based upon the available data.

Overall, it would be helpful to have more frequent bacteriological testing to facilitate the assessment process. Table 3.4 shows the level of use support in the mainstem of the River. Figure 11 shows graphically the same information.

Table 3.4: Recreation Designated Use Assessment Years 2000-2001

River Zone	Fecal Coliform Standard Met	Enterococcus Standard Met	Use Support Level[e]
1A	Yes	NA[d]	Full Support
1B	Yes	NA[d]	Full Support
1C	Yes	NA[d]	Full Support
1D	Yes	NA[d]	Full Support
1E	Yes	NA[d]	Full Support
2	Yes	Yes	Full Support
3	Yes	Yes	Full Support
4	Yes	Yes	Full Support
5a[a]	Yes	Yes	Full Support
5b	Yes	Yes	Full Support
5c	Yes	Yes	Full Support
6a[b]	Yes	Yes	Full Support
6b	Yes	Yes	Full Support
6c	NA[c]	Yes	Full Support

[a] The division of Zone 5 is based on differing dissolved oxygen criteria within that zone
[b] Zone 6 is divided into three assessed sections based upon the spatial nature of available data
NA[c]: No data available for this zone
NA[d]: No criteria for this parameter in these zones
[e] Based upon geometric mean of entire monitoring season dataset in each zone; insufficient data to perform 30-day geometric means

The Recreation use designation was assessed along the length of the Delaware River from Hancock, NY to the bottom of Zone 1 (197 miles), in Zones 2-5 of the Delaware Estuary (97 square miles), and in the assessed portion of the Delaware Bay (533 square miles).

Non-Tidal River
The use was fully supported in all non-tidal zones (197 miles, or 100% of the non-tidal river).

Estuary
The use was fully supported in all Estuary zones (97 square miles, or 100% of the Estuary, excluding the Bay) and in the assessed portion of the Bay (533 assessed square miles).

Drinking Water Designated Use

The assessment of the Drinking Water designated use, in this assessment, is based upon levels of toxic substances, Total Dissolved Solids or TDS (secondary drinking water standards, or maximum of 500 mg/L applies for this use), Turbidity, Hardness and Chlorides. Zones 1A-E, 2 and 3 are designated for drinking water use, or a total of 197 main stem river miles and 14 square miles of Estuary.

Historical monitoring data show that levels of PCBs, 1,2 Dichloroethane (DCE) and Tetrachloroethene (PCE) exceed drinking water criteria in Zones 2 and 3 of the Delaware River. There is currently a TMDL being developed for PCBs. Further, a 2000 DRBC resolution was passed by the Commissioners that noted that wasteload allocations were necessary in Zones 2 and 3, for DCE and PCE, in order to maintain the stream quality objectives. One year of discharge monitoring for these substances has occurred. Monitoring is underway to determine if the assimilative capacity of the Delaware River has in fact been exceeded for DCE and PCE. Modeling of the River has indicated that this is the case.

Table 3.5 and Figure 12 show the level of drinking water use attainment for the various segments of the main stem Delaware River based upon an analysis of the parameters mentioned above. Note that Alkalinity, Chlorides, and Hardness criteria are not set for Zones 1A-E in the River. Note that for Turbidity, which carries a "30-day average" criterion as well as a maximum value criterion, averages were calculated for the entire dataset. This was because the temporal nature of the data was not sufficient to calculate 30-day averages that would be useful for this analysis. It is recommended that, in the future, turbidity be measured with a greater frequency to improve assessment of the Drinking Water designated use.

Table 3.5: Drinking Water Designated Use Years 2000-2001

River Zone	Toxics Criteria Met	TDS Criteria Met (500 mg/L)	Turbidity Criteria Met	Hardness Criteria Met	Chloride Criteria Met	Use Support Level
1A	NA	Yes	Yes	NA	NA	Full Support
1B	NA	Yes	Yes	NA	NA	Full Support
1C	NA	Yes	Yes	NA	NA	Full Support
1D	NA	Yes	Yes	NA	NA	Full Support
1E	NA	Yes	Yes	NA	NA	Full Support
2	No	Yes	Yes	Yes	Yes	Not Supporting
3	No	Yes	Yes	Yes	Yes	Not Supporting

NA: No ambient criteria for these parameters in these zones

The Drinking Water designated use was assessed along the length of the Delaware River from Hancock, NY (RM 330.7) down to the bottom of Zone 1 (197 miles) and in Zones 2 and 3 (14 square miles). This is equal to 100% of the main stem River and Estuary that are designated for that use.

Non-Tidal River

In Zones 1A-E, use support was based upon Turbidity and Total Dissolved Solids data. The use was fully supported in all Zones (197 river miles, or 100% of the designated non-tidal river mileage). It would be helpful, for the 2004 305(b) report, if additional data would be collected and utilized, including toxics data.

Estuary

In Zones 2 and 3 (15 square miles, or 100% of the designated area in the Estuary) the drinking water use was assessed as Not Supported. Monitoring is underway to determine if the assimilative capacity of Zones 2 and 3 has in fact been exceeded for DCE and PCE, as modeling of the system indicates. A TMDL for PCBs is in place for this portion of the River. The 2000 305(b) report (1998-1999 assessed) indicated non-support in these zones, and this assessment continues that characterization, until further data are collected and analyzed.

4. Ground Water Assessment

As described in Part 2, it is the general policy of DRBC that all ground water of the Basin, as well as surface sources of drinking water, should not exceed maximum contaminant levels (MCL) given in the National Primary Drinking Water Standards. Because this report focuses on the mainstem of the Delaware River, the reader is directed to the 2002 water quality assessment reports of each of the four Delaware River Basin States for an update on groundwater quality management programs and any ground water-related issues.

Some general ground water issues that are occurring in the Basin, as of the writing of this report are as follows:

- Superfund sites - A number of these sites exist in the Basin and contribute to localized groundwater contamination. Remediation activities are ongoing throughout the Basin.
- Mercury - Natural sources exist in some geologic formations in the Basin. More importantly, air deposition of mercury from combustion activities is an issue.
- Saltwater intrusion - In areas near the Delaware Bay, pumping of groundwater leads to migration of saltwater into the aquifers that supply water for drinking and other needs.
- Naturally occurring substances - Some areas have naturally high levels (due to local geology) of radioactivity, arsenic and other substances that may require additional treatment or preclude them from serving as drinking water sources

Appendix A
DRBC Water Quality Standards for Drinking Water Sources

Table A1: Maximum Contaminant Levels to be Applied as Human Health Stream Quality Objectives in Zones 2 and 3 of the Delaware River Estuary

Parameter	Maximum Contaminant Level (µg/l)
Antimony	6
Arsenic	50
Barium	2.0 mg/l
Cadmium	5
Chromium (total)	100
Nickel	100
Selenium	50
1,2 - trans - Dichloroethene	100
1,2 - Dichloropropane	5
Ethylbenzene	700
gamma - BHC (Lindane)	0.2
1,2,4 - Trichlorobenzene	70
Total Trihalomethanes	100

Table A2: Stream Quality Objectives for Carcinogens for The Delaware River Estuary

PARAMETER	EPA CLASS.	FRESHWATER OBJECTIVES (µg/l)		MARINE OBJECTIVES (µg/l)
		FISH & WATER INGESTION (Zones 2&3)	FISH INGESTION ONLY	FISH INGESTION ONLY
Beryllium	B2	0.00767	0.132	0.0232
Aldrin	B2	0.00189	0.0226	0.00397
alpha - BHC	B2	0.00391	0.0132	0.00231
Chlordane	B2	0.000575	0.000588	0.000104
DDT	B2	0.000588	0.000591	0.000104
DDE	B2	0.00554	0.00585	0.00103
DDD	B2	0.00423	0.00436	0.000765
Dieldrin	B2	0.000135	0.000144	0.0000253

PARAMETER	EPA CLASS.	FRESHWATER OBJECTIVES (µg/l)		MARINE OBJECTIVES (µg/l)
		FISH & WATER INGESTION (Zones 2&3)	FISH INGESTION ONLY	FISH INGESTION ONLY
Heptachlor	B2	0.000208	0.000214	0.0000375
Heptachlor epoxide	B2	0.000198	0.000208	0.0000366
PCBs (Total)	B2	0.0000444	0.0000448	0.0000079
Toxaphene	B2	0.000730	0.000747	0.000131
Acrylonitrile	B1	0.0591	0.665	0.117
Benzene	A	1.19	71.3	12.5
Bromoform	B2	4.31	164.0	28.9
Bromodichloromethane	B2	0.559	55.7	9.78
Carbon tetrachloride	B2	0.254	4.42	0.776
Chlorodibromomethane	C	0.411	27.8	4.88
Chloroform	B2	5.67	471.0	82.7
1,2 - Dichloroethane	B2	0.383	98.6	17.3
1,1 - Dichloroethene	C	0.0573	3.20	0.562
1,3 - Dichloropropene	B2	87.0	14.1	2.48
Methylene chloride	B2	4.65	1,580	277
Tetrachloroethene	B2	0.80	8.85	1.55
1,1,1,2 - Tetrachloroethane	C	1.29	29.3	5.15
1,1,2,2 - Tetrachloroethane	C	0.172	10.8	1.89
1,1,2 - Trichloroethane	C	0.605	41.6	7.31
Trichloroethene	B2	2.70	80.7	14.2
Vinyl chloride	A	2.00	525.0	92.9
Benzidine	A	0.000118	0.000535	0.000094
3,3 - Dichlorobenzidine	B2	0.0386	0.0767	0.0135
PAHs				
Benz[a]anthracene	B2	0.00171	0.00177	0.00031
Benzo[b]fluoranthene	B2	0.000455	0.000460	0.000081

PARAMETER	EPA CLASS.	FRESHWATER OBJECTIVES (µg/l)		MARINE OBJECTIVES (µg/l)
		FISH & WATER INGESTION (Zones 2&3)	FISH INGESTION ONLY	FISH INGESTION ONLY
Benzo[k]fluoranthene	B2	0.000280	0.000282	0.000049
Benzo[a]pyrene	B2	0.0000644	0.0000653	0.0000115
Chrysene	B2	0.0214	0.0224	0.00394
Dibenz[a,h]anthracene	B2	0.0000552	0.0000559	0.0000098
Indeno[1,2,3-cd]pyrene	B2	0.0000576	0.0000576	0.0000101
Bis (2-chloroethyl) ether	B2	0.0311	1.42	0.249
Bis (2-ethylhexyl) phthalate	B2	1.76	5.92	1.04
Dinitrotoluene mixture (2,4 & 2,6)	B2	17.3	1420	249
1,2 - Diphenylhydrazine	B2	0.0405	0.541	0.095
Hexachlorobenzene	B2	0.000748	0.000775	0.000136
Hexachlorobutadiene	C	0.445	49.7	8.72
Hexachloroethane	C	1.95	8.85	1.56
Isophorone	C	36.3	2590	455
N-Nitrosodi-N-methylamine	B2	0.000686	8.12	1.43
N-Nitrosodi-N-phenylamine	B2	4.95	16.2	2.84
N-Nitrosodi-N-propylamine	B2	0.00498	1.51	0.265
Pentachlorophenol	B2	0.282	8.16	1.43
2,4,6 - Trichlorophenol	B2	2.14	6.53	1.15
Dioxin (2,3,7,8 - TCDD)	-	1.3×10^{-8}	1.4×10^{-8}	2.4×10^{-9}

Table A3: Stream Quality Objectives for Systemic Toxicants for the Delaware River Estuary.

PARAMETER	EPA CLASS.	FRESHWATER OBJECTIVES (µg/l)		MARINE OBJECTIVES (µg/l)
		FISH & WATER INGESTION (Zones 2 and 3)	FISH INGESTION ONLY	FISH INGESTION ONLY
Antimony		14.0	4,310	757
Arsenic	A	9.19	73.4	12.9
Beryllium	B2	165	2,830	498
Cadmium		14.5	84.1	14.8
Chromium (Trivalent)		33,000	673,000	118,000
Hexavalent chromium	A	166	3,370	591
Mercury	D	0.144	0.144	0.144
Nickel		607	4,580	805
Selenium	D	100	2,020	355
Silver	D	175	108,000	18,900
Thallium		1.70	6.20	1.10
Zinc		9110	68700	12100
Aldrin	B2	0.96	11.5	2.03
gamma - BHC (Lindane)		7.38	24.9	4.37
Chlordane	B2	0.0448	0.0458	0.00805
DDT	B2	0.100	0.100	0.0176
Dieldrin	B2	0.108	0.115	0.020
Endosulfan		111	239	42.0
Endrin	D	0.755	0.814	0.143
Heptachlor	B2	0.337	0.344	0.060
Heptachlor epoxide	B2	0.0234	0.0246	0.00433
Total PCBs	B2	0.00839	0.00849	0.00149
Acrolein		320	780	137
Ethylbenzene		3,120	28,700	5,050

PARAMETER	EPA CLASS.	FRESHWATER OBJECTIVES (µg/l)		MARINE OBJECTIVES (µg/l)
		FISH & WATER INGESTION (Zones 2 and 3)	FISH INGESTION ONLY	FISH INGESTION ONLY
Bromoform	B2	682	25,900	4,560
Bromodichloromethane	B2	693	69,000	12,100
Dibromochloromethane	C	690	46,600	8,190
Carbon tetrachloride	B2	23.1	402	70.6
Chloroform	B2	346	28,700	5,050
Chlorobenzene	D	677	20,900	3,670
1,1 - Dichloroethene	C	309	17,300	3,040
1,2 - trans - Dichloroethene		696	136,000	23,900
1,3 - Dichloropropene	B2	10.4	1,690	297
Methyl bromide		49.0	N/A	N/A
Methylene chloride	B2	2,090	710,000	125,000
1,1,2 - Trichloroethane	C	138	9,490	1,670
Tetrachloroethene		318	3,520	618
1,1,1,2 - Tetrachloroethane	C	1,000	22,400	3,940
Toluene		6,760	201,000	35,400
Acenaphthene		1,180	2,670	469
Anthracene	D	4,110	6,760	1,190
Benzidine	A	81.8	369	64.9
Bis (2-chloroisopropyl) ether		1,390	174,000	30,600
Bis (2-ethylhexyl) phthalate	B2	492	1,660	291
Butylbenzl phthalate	C	298	520	91.4
Diethyl phthalate	D	22,600	118,000	20,700
Dimethyl phthalate	D	313,000	2,990,000	526,000
Dibutyl phthalate	D	2,710	12,100	2,130
1,2 - Dichlorobenzene	D	2,670	17,400	3,060

PARAMETER	EPA CLASS.	FRESHWATER OBJECTIVES (µg/l)		MARINE OBJECTIVES (µg/l)
		FISH & WATER INGESTION (Zones 2 and 3)	FISH INGESTION ONLY	FISH INGESTION ONLY
1,3 - Dichlorobenzene	D	414	3,510	617
1,4 - Dichlorobenzene		419	3,870	677
2,4 - Dinitrotoluene		69.2	5670	996
Fluoranthene		296	375	65.8
Fluorene	D	730	1,530	268
Hexachlorobenzene	B2	0.958	0.991	0.174
Hexachlorobutadiene	C	69.4	7,750	1,360
Hexachlorocyclopentadiene		242	17,400	3,050
Hexachloroethane	C	27.3	124	21.7
Isophorone	C	6,900	492,000	86,400
Nitrobenzene	D	17.3	1,860	327
Pyrene	D	228	291	51.1
1,2,4 - Trichlorobenzene	D	255	945	166
2 - Chlorophenol		122	402	70.6
2,4 - Dichlorophenol		92.7	794	139
2,4 - Dimethylphenol		536	2,300	403
2,4 - Dinitrophenol		70	14,300	2,500
Pentachlorophenol	B2	1,010	29,400	5,160
Phenol		20,900	4,620,000	811,000

Appendix B
Scenic Rivers Monitoring Program
Site Information and Quality Assurance and Control

Table B1: Locations for Baseline Scenic Rivers Monitoring (43 Sites)

UPPER DELAWARE RIVER MONITORING LOCATIONS (9)	
Buckingham Access Area (2001)	Ten-Mile River NYSDEC Access Area
Lordville Bridge	Barryville Bridge
Callicoon Bridge	Pond Eddy Bridge
Callicoon NYSDEC Access Area	Millrift
Cochecton Bridge	
MIDDLE DELAWARE RIVER MONITORING LOCATIONS (7)	
Port Jervis	Bushkill Access
Northern DEWA boundary	Smithfield Beach
Milford Beach	Delaware Water Gap
Dingmans Access	
UPPER DELAWARE TRIBUTARIES (14)	
West Branch Delaware	Masthope Creek
East Branch Delaware	Beaver Brook
Equinunk Creek	Lackawaxen River
Little Equinunk Creek	Halfway Brook
Callicoon Creek	Shohola Creek
Calkins Creek	Mongaup River
Ten Mile River	Shingle Kill
MIDDLE DELAWARE TRIBUTARIES (13)	
Neversink River	Flat Brook
Vandermark Creek	Little Flat Brook
Shimers Brook	Van Campens Brook
Sawkill Creek	Shawnee Creek
Raymondskill Creek	Brodhead Creek
Bushkill Creek	Cherry Creek
Little Bushkill	

Table B2: Flow Measurement Monitoring Locations

LOCATION	**AGENCY**	**TYPE**
DELAWARE RIVER FLOW MONITORING LOCATIONS		
Callicoon Access Area	U.S.G.S.	Continuous
North of Lackawaxen	U.S.G.S.	Continuous
Port Jervis	U.S.G.S.	Continuous
Milford	U.S.G.S.	Continuous
Tocks Island	U.S.G.S.	Discontinued
UPPER DELAWARE TRIBUTARY FLOW MONITORING LOCATIONS		
West Branch Delaware	U.S.G.S.	Continuous
East Branch Delaware	U.S.G.S.	Continuous
Equinunk Creek	DRBC/NPS	Instantaneous
Little Equinunk Creek	DRBC/NPS	Instantaneous
Calkins Creek	DRBC/NPS	Instantaneous
Callicoon Creek	DRBC/NPS	Instantaneous
Tenmile River	DRBC/NPS	Instantaneous
Masthope Creek	DRBC/NPS	Instantaneous
Beaver Brook	DRBC/NPS	Instantaneous
Halfway Brook	DRBC/NPS	Instantaneous
Shohola Creek	DRBC/NPS	Instantaneous
Shingle Kill	DRBC/NPS	Instantaneous

Table B2 continued

MIDDLE DELAWARE TRIBUTARY FLOW MONITORING LOCATIONS		
Neversink River	U.S.G.S.	Continuous
Cummins Creek	DRBC/NPS	Instantaneous
Vandermark Creek	DRBC/NPS	Instantaneous
Shimers Brook	DRBC/NPS	Instantaneous
Sawkill Creek	DRBC/NPS	Instantaneous
Raymondskill Creek	DRBC/NPS	Instantaneous
Dingmans Creek	DRBC/NPS	Instantaneous
Hornbecks Creek	DRBC/NPS	Instantaneous
Toms Creek	DRBC/NPS	Instantaneous
Saw Creek	DRBC/NPS	Instantaneous
Little Bushkill Creek	DRBC/NPS	Instantaneous
Bushkill Creek	U.S.G.S.	Continuous
Flat Brook	U.S.G.S.	Continuous
Little Flat Brook	DRBC/NPS	Instantaneous
Big Flat Brook	DRBC/NPS	Instantaneous
Van Campens Brook	DRBC/NPS	Instantaneous
Shawnee Creek	DRBC/NPS	Instantaneous
Marshalls Creek	DRBC/NPS	Instantaneous
Brodhead Creek	U.S.G.S.	Continuous
Adams Creek	DRBC/NPS	Instantaneous
Dunnfield Creek	DRBC/NPS	Instantaneous
Slateford Creek	DRBC/NPS	Instantaneous
Cherry Creek	DRBC/NPS	Instantaneous

Table B3: Parameters for Scenic Rivers Monitoring Program

Parameter	Standard Methods – Number	Equipment	Min – Max	Accuracy(±)
BASELINE PARAMETERS - MONTHLY SAMPLING FREQUENCY				
Flow	See TABLE B2 for locations	Pygmy meter	0.07-3.00 fps	
Air temperature	2550 – thermometric	Thermometer	-10-110 °C	1 °C
Water temperature	2550 – thermometric	Thermometer	-10-110 °C	1 °C
		Thermistor probe (DO meter)	-5-45 °C	0.7 °C
		Thermistor probe (conductivity meter)	-2-50 °C	0.6 °C
Dissolved oxygen	4500-O C. - azide modification of Winkler titration method	Kit	0-20 mg/l	20-60 µg/l
	4500-O G. – membrane electrode	Meter	0-20 mg/l	1 % of scale
Specific conductance	2510 - platinum electrode conductivity cell	Meter	0-19,999 µmhos /cm	2 µmhos/cm
PH	4500-H+	Oakton pH meter	4-10 units	0.25 units
Turbidity	2130 B. Nephelometric	LaMotte colorimeter	5-400 NTU	.1-10 NTU
Fecal coliform	9222 D. m-FC media	Membrane filtration	> 0 colonies/100 ml	NA
Total Suspended Solids	2540 D. TSS dried at 103-105°C	Glass fiber filter system, oven, dessicator, analytical balance to 0.1 mg	2.5 -200 mg residue weight	5% of avg. weight 2.8 mg/L SD

Table B3 continued

Parameters **Not** Analyzed in 2000 and 2001 Programs *Some were used to define existing water quality in DRBC's Special Protection Waters rules, others form the basis of DRBC's Stream Quality Objectives for Zones 1A, 1B, 1C, and 1D of the Delaware River. Resource constraintsduring the 2000 and 2001 monitoring seasons prevented assessment of these against water quality standards and Special Protection Waters stream quality targets.*	
Alkalinity	2320 B. Titration. No criteria for this parameter. Deemed useful, but not funded.
Ammonia N	4500-NH3 F. Phenate Method. Special Protection Waters rules define existing water quality for this parameter. Replacement equipment has not been funded.
Biocriteria: Macroinvertebrate Shannon Diversity	Special Protection Waters rules defined existing water quality using this benthic macroinvertebrate metric as a numeric standard. Methods under development to assess this parameter's sensitivity to "measurable change", no resources allocated.
Biocriteria: Macroinvertebrate Equitability	Special Protection Waters rules defined existing water quality using this benthic macroinvertebrate metric as a numeric standard. Methods under development to assess this parameter's sensitivity to "measurable change", no resources allocated.
Biocriteria: Macroinvertebrate EPT Richness	Special Protection Waters rules defined existing water quality using this benthic macroinvertebrate metric as a numeric standard. Methods under development to assess this parameter's sensitivity to "measurable change", no resources allocated.
BOD5	5210 B. 5-Day BOD Test. Special Protection Waters rules define existing water quality for this parameter. Analysis of this parameter is not funded.
Hardness	2340 B. Calculation or 2340C – EDTA Titrimetric. Special Protection Waters rules define existing water quality for this parameter. Analysis of this parameter is not funded.
Nitrate+nitrite N	4500-NO3. No method decided. Special Protection Waters rules defined existing water quality for this parameter. Staff are averse to Cadmium Reduction method due to health and cost concerns regarding waste disposal. Alternative Zinc Reduction method not approved by U.S. EPA. Replacement equipment is not funded.
Ortho-phosphate	4500-P E. Ascorbic acid reduction. Special Protection Waters rules define existing water quality for this parameter. Replacement equipment has not been funded.
Total Dissolved Solids	2540 C. TDS dried at 180 °C. Special Protection Waters rules define existing water quality for this parameter. Analysis of this parameter is not funded.
Total Kjeldahl Nitrogen	4500-Norg A. Macro-Kjeldahl. . Special Protection Waters rules define existing water quality for this parameter. Analysis of this parameter is not funded.

DRBC BIOMONITORING – Macroinvertebrates and habitat for tributaries and Delaware River.	
Habitat Assessment (wadeable tributaries)	RBP 2nd Edition 1999, Habitat Protocols for High Gradient Streams (tributaries). Sampled as needed.
Habitat Assessment (Delaware River – special project)	USGS NAWQA Protocols (Fitzpatrick et al. 1998) in Delaware River OR Adaptation of RBP Habitat (2nd Ed., Barbour et al. 1999) to Delaware River. This is used to identify & quantify extent of riverine microhabitats for macroinvertebrates.
Macroinvertebrates (Rapid Assessment in Tributaries)	Indicator-organism field-level assessment w/ 10 point scoring system. Adapted from NYSDEC screening procedure developed by Bode et al. 1996. Assess 100 m reach upstream of fixed water quality sampling site. Sample as needed. If score < 5, call state for further investigation.
Macroinvertebrates (Delaware River Metric Development)	Best habitat (riffle, run, or island head), 33 sites, 3 replicates, 200-organism subsample of Delaware River from East & West Branches to Trenton, NJ. Index period is August-September, flow must be less than 6,000 cfs @ Trenton for access. Sampled annually.

Quality Assurance and Control

The data collection quality objectives of the SRMP are:

- To accurately describe the water quality conditions in the study area. The water quality parameters should be sufficient to:

1. define and evaluate the quality of the waters within the Scenic Rivers region;
2. determine if numerical standards of Special Protection Waters are maintained
3. categorize tributaries and river locations as point source or non-point source-impacted;
4. support management actions such as follow-up monitoring and directing intensive surveys by state enforcement agencies;
5. determine if water quality meets or exceeds primary contact recreation standards.

- To obtain data so that sound, scientifically-based management decisions involving the ecosystem can be made. The level of precision and accuracy should be sufficient to characterize:

1. the chemical, biological, and physical characteristics of the ecosystem;
2. the aquatic and riparian habitats of the ecosystem;
3. the natural variability of the biological communities of each habitat;
4. the sensitivity of biological communities to natural and anthropogenic impacts;
5. the interrelationship of chemical, physical, and biological components; and
6. measures of the ecosystem's general integrity and health.

Quality Assurance Practices and Procedures

Attainment of quality assurance objectives is achieved by maintaining a running check of precision and accuracy of analyses throughout the sampling program. Instrument variations are controlled by calibration of equipment and use of standard solutions. These are recorded on Calibration Quality Assurance forms.

SRMP staff is required to maintain a daily log of activities. Separate notebooks are also kept for each individual program element. These notebooks are used to record observations, describe sampling station locations, and to present results. The SRMP has also developed three data record/analyses sheets for recording results. These are used routinely for water quality, flow and macroinvertebrate/habitat.

Separate notebooks are also maintained for all quality control checks for bacteriological samples. Examples of information recorded include tests using sample blanks, parallel tests (external and internal) and replicate samples. QA report forms have been developed for use by the SRMP staff for their monthly and other QA reporting activities.

Sample Custody

Samples are generally in the custody of the same individuals from initial collection through analysis and recording of data. One individual has designated responsibility for record-keeping, which includes the preparation of sample labels, laboratory logging procedures and the maintenance of reports as described above. In cases where a laboratory is contracted for analyses (e.g., the Academy of Natural Sciences contracted from 1995-1997), sample custody procedures of the contract lab are followed by the sampling personnel.

Performance and System Audits

Before the initiation of the SRMP, the DRBC/NPS Co-Managers should prepare the program by checking all equipment, making repairs, and by purchasing equipment and chemicals. This activity is coordinated and shared with National Park Service lab personnel. A Co-manager or QA Officer from both DRBC and NPS performs training and field/laboratory audits prior to and during the monitoring season, checking sampling and analytical methods for proper quality controls and other activities related to program administration.

Field audits evaluate sampling technique, sample handling, and preservation to insure representative results. Personnel safety measures are highlighted. Laboratory audits review analytical techniques, sample preparation, and data reporting procedures. Also, laboratory cleanliness and safety are emphasized.

Corrective Actions

Corrective actions are initiated during routine internal and external quality control checks. The Quality Assurance Officer orders corrective actions after consultation with the program co-managers when periodic quality assurance inspections turn up unacceptable variations in data sets obtained during implementation of quality control procedures. If the problems noted by the Quality Assurance Officer are not corrected to his/her satisfaction, a memo report is prepared by the Quality Assurance Officer and sent to each Co-manager.

Quality Assurance Records to Management

The SRMP uses a reporting procedure by which the co-managers prepare quarterly reports to the Quality Assurance Officer before his inspection and institution of performance and system audits. The reports present the results of internal and external quality checks, corrective actions taken and other information such as timing of critical steps in bacterial analyses, sterilization steps taken, incubator temperature monitoring results, etc. The reporting procedures consist of the submittal of logbooks and filling out forms.

Data Storage, Management and Sharing

Data are entered into STORET by DRBC staff as soon as practical after internal review. Dissolved oxygen concentrations and water temperatures are used to calculate percent dissolved oxygen saturation.

Appendix C
Lower Delaware Monitoring Program
Site Information and Quality Assurance and Control

Table C1: Continuous-Recording Water Quality and Flow Measurement Monitoring Locations, Delaware Water Gap to Trenton

Location		Agency	Type
01443280	East Branch Paulins Kill nr Lafayette, NJ	USGS	Continuous
01443500	Paulins Kill at Blairstown, NJ	USGS	Continuous
01443900	Yards Creek nr Blairstown, NJ	USGS	Continuous
01445500	Pequest River at Pequest, NJ	USGS	Continuous
01446500	Delaware R. at Belvidere, NJ	USGS	Continuous**
01447500	Lehigh R. at Stoddartsville, PA	USGS	Continuous**
01447800	Lehigh R blw FE Walter Resv nr White Haven, PA	USGS	Continuous**
01449000	Lehigh R at Lehighton, PA	USGS	Continuous**
01451000	Lehigh R at Walnutport, PA	USGS	Continuous**
01453000	Lehigh R at Bethlehem, PA	USGS	Continuous**
01454700	Lehigh R at Glendon, PA	USGS	Continuous**
01457500	Delaware R. at Riegelsville, NJ	USGS	Continuous**
01457000	Musconetcong River nr Bloomsbury, NJ	USGS	Continuous
01460200	Delaware R. at Point Pleasant, PA (QW Site Only)	USGS	DO, pH, Temp, Cond.
01459500	Tohickon Cr nr Pipersville, PA	USGS	Continuous**
01463620	Assunpink Creek nr Clarksville, NJ	USGS	Continuous
01464000	Assunpink Creek @ Trenton, NJ	USGS	Continuous
01463500	Delaware R. at Trenton, NJ	USGS	Continuous**

** denotes availability of current data on worldwide web at http://waterdata.usgs.gov/nwis-w/

Table C2: DRBC Flow Monitoring - Develop Flow Rating Curves for Loadings (10 Creeks)

Pidcock Creek at Bowmans Hill Wildflower Preserve, Bucks Co, PA	DRBC	Instantaneous
Wickecheoke Creek at Rt 29 nr Prahls Mill, Hunterdon Co, NJ	DRBC	Instantaneous
Lockatong Creek at Rosemont-Raven Rock Rd, Hunterdon Co, NJ	DRBC	Instantaneous
Paunacussing Creek near Rt 32, Bucks Co, PA	DRBC	Instantaneous
Tinicum Creek near Rt 32, Bucks Co, PA	DRBC	Instantaneous
Tohickon Creek above Rt 32, Bucks Co, PA (relate to upstr USGS gage)	DRBC	Instantaneous
Nishisakawick Creek, Hunterdon Co, NJ	DRBC	Instantaneous
Cooks Creek above Red Bridge Rd, Bucks Co, PA	DRBC	Instantaneous
Pohatcong Creek above River Rd, Warren Co, NJ	DRBC	Instantaneous
Bushkill Creek above Rt 611, Northampton Co, PA	DRBC	Instantaneous

Table C3: Delaware River Water Chemistry Monitoring Sites

Delaware River Bridge	River Mile	Site # (composite, NJ side, PA side)
Calhoun Street Bridge	134.34	DRBCNJPAC01, DRBCNJ0001, DRBCPA0001
Washington Crossing Bridge	141.80	DRBCNJPAC02, DRBCNJ0004, DRBCPA0006
Lambertville/New Hope Bridge	148.70	DRBCNJPAC11, DRBCNJ0009, DRBCPA0010
Stockton Bridge (not monitored 2001)	151.90	DRBCNJPAC03, DRBCNJ0011, DRBCPA0012
Raven Rock/Lumberville Foot Bridge, Bulls Isl.	155.40	DRBCNJPAC04, DRBCNJ0014, DRBCPA0013

Table C3 continued

Delaware River Bridge	River Mile	Site # (composite, NJ side, PA side)
Frenchtown/Uhlerstown Bridge (closed 2001)	164.30	DRBCNJPAC05, DRBCNJ0021, DRBCPA0018
Milford/Upper Black Eddy Bridge	167.70	DRBCNJPAC06, DRBCNJ0024, DRBCPA0019
Riegelsville Bridge	174.80	DRBCNJPAC07, DRBCNJ0026, DRBCPA0023
Easton/Phillipsburg Bridge, Northampton St.	183.80	DRBCNJPAC08, DRBCNJ0029, DRBCPA0027
Belvidere/Riverton Bridge	197.80	DRBCNJPAC09, DRBCNJ0034, DRBCPA0033
Columbia/Portland Foot Bridge	207.40	DRBCNJPAC10, DRBCNJ0037, DRBCPA0036

Table C4: Tributary Water Chemistry Monitoring Sites

Tributary	Mile	Reason for Selection 2001	Site No.
Pidcock Cr, PA	146.3	Good quality, potential reference site	DRBCPA0008
Wickecheoke Cr, NJ	152.5	W&S, TM, development	DRBCNJ0012
Lockatong Cr, NJ	154.0	W&S, TM, development	DRBCNJ0013
Paunacussing Cr, PA	155.6	W&S, HQ, watershed group	DRBCPA0016
Tohickon Cr, PA 157.0	W&S	EV, regulated, major tributary	DRBCPA0015
Tinicum Cr, PA	161.6	W&S, EV	DRBCPA0017
Nishisakawick Cr, NJ	164.1	ASW	DRBCNJ0020
Cooks Cr, PA	173.7	W&S, EV, infrequent samples, watershed group	DRBCPA0021
Musconetcong R., NJ	174.6	ASW, TM, major tributary, watershed group	DRBCNJ0025
Pohatcong Cr, NJ	177.4	TP, reservoir effects, development, watershed group	DRBCNJ0027
Lehigh River, PA	183.66	WQN, regulated, major tributary, watershed groups	DRBCPA0026
Bushkill Cr, PA	184.1	EV (pt), known problems, watershed group	DRBCPA0028
Pequest River, NJ	197.8	ASW, TM, major tributary, watershed group	DRBCNJ0032
Paulins Kill, NJ	207.0	W&S, TM, ASW, major tributary	DRBCNJ0036

Table C5: Lower Delaware Monitoring Program Sampled Parameters and Procedures

Parameter	Standard Methods Procedure	Equipment	Min – Max	Accuracy(±)
COLLECTED AND ANALYZED BY DRBC:				
Flow Discharge	See TABLE 2 for locations	Pygmy meter	0.07-3.00 fps	
Gage Height	N/A	Surveyor's Tape	N/A	0.01 ft
Air temperature	2550 – thermometric	Thermometer	-10-110 °C	1 °C
Water temperature	2550 – thermometric	Thermometer	-10-110 °C	1 °C
		Probe (DO meter)	-5-45 °C	0.7 °C
		Probe (cond. meter)	-2-50 °C	0.6 °C
Dissolved oxygen	4500-O C. - azide modification of Winkler titration method	Pre-prepared Hach kit	0-20 mg/l	20-60 µg/l
	4500-O G. – membrane electrode	YSI Meter	0-20 mg/l	1% of scale
Specific conductance	2510 B. Laboratory Method (platinum electrode cond. cell)	YSI Meter	0-19,999 µmhos /cm	2 µmhos/cm
PH	4500-H+	Oakton pH Testr 2	4-10 units	0.25 units
PH	4500-H+	IQ 120 pH meter	2-12 pH	±0.1 units
COLLECTED BY DRBC: Contract with NJ Analytical Labs for analyses (LRL is Lower Reporting Limit)				
Hardness (Total)	EPA 130	1 mg/l CaCO3 LRL	7 d hold time	±1 mg/l
Chloride	EPA 325.3	1 mg/l LRL	7 d hold time	±1 mg/l
Alkalinity, Total	EPA 310	1 mg/l CaCO3 LRL	24 hr hold time	±1 mg/l
Turbidity (NTU)	EPA 180.1	5 NTU LRL	24 hr hold time	±1 units
Enterococcus	9230 C. mE agar enterococci MF	>0 /100ml LRL	6 hr hold time	NA
Fecal coliform	9222 D. m-FC media (MF)	>0 /100ml LRL	6 hr hold time	NA
Nitrate+Nitrite	EPA 353.2, 353.3	0.05 mg/l as N LRL	7 d hold time	0.05 mg/l
Chlorophyll a	SM 10200 H.	0.001 mg/m3 LRL	24 hr hold time	0.001 mg/m3
Ammonia N	EPA 350	0.1 mg/l NH3 as N LRL	7 d hold time	0.1 mg/l NH3 as N
Total Phosphorus	EPA 365.1	0.005 mg/l PO4 as P LRL	7 d hold time	0.005 mg/l PO4 as P
Total Kjeldahl Nitrogen	EPA 351.2	0.1 mg/l TKN LRL	7 d hold time	0.1 mg/l TKN
Orthophosphate P	EPA 365.1	0.005 mg/l PO4 as P LRL	24 hr hold time	0.005 mg/l PO4 as P
Total Suspended Solids	EPA 160.2	4 mg/l LRL	24 hr hold time	4 mg/l

W&S=Wild and Scenic, TM=Trout Maintenance, HQ = High Quality Waters, EV = Exceptional Value Waters, ASW = Ambient Surface Water Network (NJDEP)

Table C6: Sites Not Monitored in 2001, Established for Definition of Existing Water Quality

Tributary	Mile	Reason for Exclusion 2001	Site No.
Assunpink Creek, NJ	133.8	Lack of funds, NJDEP monitors (303D listed)	DRBCNJ1338
Buck/Brock Cr, PA	138.0	Lack of funds, not major tributary	DRBCPA0002
Jacobs Cr, NJ	140.5	Lack of funds, not major tributary	DRBCNJ0003
Aquetong Cr, PA	148.5	Lack of funds, not major tributary (PA HQ stream)	DRBCPA0009
Alexaukin Creek, NJ	149.5	Lack of funds	DRBCNJ0010
Hakihokake Cr, NJ	167.2	Lack of funds, not major tributary (NJ TM waters)	DRBCNJ0023
Fry's Run, PA	176.6	Lack of funds, not major tributary (PA HQ stream)	DRBCPA0024
Lopatcong Cr, NJ	182.0	Lack of funds, not major tributary (NJ TP waters)	DRBCNJ0028
Martins Cr, PA	190.58	Lack of funds, not major tributary	DRBCPA0031
Buckhorn Cr, NJ	192.9	Lack of funds, not major tributary (NJ TP waters)	DRBCNJ0030

Quality Assurance and Control

The QA Objectives of the Lower Delaware Monitoring Program are:

- To accurately describe the water quality and related biological conditions in the study area. The water quality parameters should be sufficient to:

1. Define and assess existing water quality and quantity
2. Evaluate the quality of the waters within the Lower Delaware River region;
3. Categorize tributaries and river locations as point source or non-point source impacted;
4. Rank tributaries and river locations for water quality management actions including follow-up monitoring and intensive surveys by state enforcement agencies;
5. Identify whether water quality meets or exceeds standards related to designated uses; and,
6. Ascertain relative water quality impact on the biological resources of the study area.

Quality Assurance Practices and Procedures

Attainment of quality assurance objectives are achieved by maintaining a running check of precision and accuracy of analyses throughout the sampling program. Before the start of the program, the quality assurance officer and program manager conducted a laboratory audit. During the monitoring season, field sampling protocol audits are conducted monthly. Instrument variations are controlled by calibration of equipment and use of standard solutions. Comparability of data sets is determined by examining data using the Student t-test. All problems are immediately reported to both the program manager and the quality assurance officer, a report is prepared in the form of a DRBC memorandum, and resolution is sought before continuation of the task.

Reports and Forms

The program staff is required to maintain a log of activities. Notebooks and common computer files accessible to all study participants are used to record observations (weather, etc.), to describe sampling station locations, and to present results. Several data record/analyses sheets were developed or adopted from the SRMP and other agencies for recording results. These are used routinely for water quality, flow, habitat, macroinvertebrate, and stream channel condition studies (See Exhibits 2,3 and 4). QA reporting forms have been developed for use by staff for QA recording activities. All forms contained in the Rapid Bioassessment Protocols (Barbour et. al 1999) and USGS NAWQA Protocols (Cuffney et. al 1993; Fitzpatrick et. al 1998) are copied directly from those documents for field use.

Sample Custody

All samples will be logged according to chain of custody procedures. The program manager is responsible for record-keeping, including preparation of sample labels, laboratory logging procedures and maintenance of reports as described above. In cases where a laboratory is contracted for analyses, field personnel follow the contract laboratory's sample custody procedures

Performance and System Audits

Before the initiation of the sampling season, the manager prepares the program by checking all equipment, making repairs, and by purchasing equipment and chemicals. The QA Officer performs an audit of the contract laboratory prior to commencement of the program. The program manager and/or the QA officer observe field and lab procedures, checking data including quality control checks and other activities related to program administration.

The program manager and/or the QA officer will conduct field audits to evaluate sampling technique, sample handling, and preservation to insure representative results. Personnel safety measures are highlighted, and all

relevant personnel are required to read and understand the DRBC Field Safety Manual. The laboratory audits review analytical, sample preparation, and data reporting procedures. Also, laboratory cleanliness and safety are emphasized. DRBC's laboratory must comply with the New Jersey Right-to-Know Act, and all chemical materials must be properly stored and labeled.

Quality Assurance Records to Management

The Project Manager reports to the Quality Assurance Officer for inspection and application of performance and system audits. Reports will present the results of internal and external quality checks, corrective actions taken, and analytical results. The reporting procedures will consist of the submittal of logbooks.

Appendix D
Delaware Estuary Boat Run Program
Site Information and Quality Assurance and Control

Table D1: Sampling Stations Parameter Categories for the Estuary Boat Run Program

STATION	RIVER MILE	SAMPLING STATIONS FOR PARAMETER CATEGORIES			
		ROUTINE, BACTERIAL & RADIOACTIVITY	HEAVY METALS	ALGAL & ORGANIC CARBON	OXYGEN DEMAND
South Brown Shoal[1]	6.5	■	■	■	
South of Joe Flogger Shoal[1]	16.5	■	■	■	
Elbow of Crossledge Shoal[1]	22.75	■	■	■	
Mahon River	31.0	■		■	■
Ship John Light	36.6	■			
Smyrna River	44.0	■			
Liston Point–Buoy 8L	48.2	■			
Reedy Island	54.9	■			
Pea Patch Island	60.6	■	■		
New Castle	66.0	■			
Cherry Island	71.0	■	■	■	■
Oldmans Point	74.9	■			
Marcus Hook	78.1	■	■		
Eddystone, PA	84.0	■	■		
Paulsboro, NJ	87.9	■	■		
Navy Yard	93.2	■	■	■	■
Benjamin Franklin Bridge	100.2	■	■		
Betsy Ross Bridge	104.75	■	■		
Torresdale	110.7	■	■		
Burlington Bristol Bridge	117.8	■	■		
Florence Bend		■		■	■
Trenton (Biles Channel)		■	■	■	■

TABLE D2: METHODS OF ANALYSIS FOR PARAMETERS

CATEGORY OF PARAMETERS	PARAMETER	METHOD REFERENCE	REPORTING LIMIT
ROUTINE	ACIDITY	EPA 305.1/STDMTD 18TH ed. 2310B	1.0 mg/L
	ALKALINITY	EPA 310.1/STDMTD 18TH ed. 2320B	1.0 mg/L
	CHLORIDE	EPA 325.2/STDMTD 18TH ed. 4500-Cl	1.0 mg/L
	DISSOLVED OXYGEN	EPA 360.1/360.2/STDMTD 18TH ed. 4500-O	0.1 mg/L
	PERCENT SATURATION	CALCULATED	1%
	HARDNESS	EPA 130.2	1.0 mg/L
	pH	EPA 150.1	0.1 unit
	DISSOLVED ORTHOPHOSPHATE	EPA 365.1/STDMTD 18TH ed. 4500-P F	0.005 mg/L
	PHOSPHOROUS: TOTAL	EPA 365.1/STDMTD 18TH ED. 4500-P F	0.005 mg/L
	SODIUM	EPA 200.7	5000 ug/L
	SPECIFIC CONDUCTANCE	EPA 120.1	1.0 uS/cm
	TEMPERATURE, AIR & WATER	EPA 170.1/STDMTD 18TH ED. 2550B	N/A
	SUSPENDED SOLIDS, TOTAL & VOLATILE	EPA 160.2- .4/STDMTD 18TH ed. 2540	1.0 mg/L
	TURBIDITY	EPA 180.1	1.0 FTU
	NH_3-N	EPA 350.1/STDMTD 18TH ed. 4500-N	0.005 mg/L
	NO_2-N	EPA 354.1/ STDMTD 18TH ed. 4500-N	0.005 mg/L
	NO_3-N	EPA 353.2, 354.1/ STDMTD 18TH ed. 4500-N	0.005 mg/L
	TOTAL KJELDAHL-N	EPA 351.2	0.05 mg/L
BACTERIAL	E. COLI	EPA 1103.1	N/A
	ENTEROCOCCUS	EPA 1106.1/STDMTD 18TH ed. 9230C	N/A
	FECAL COLIFORM (MTEC)	EPA 825	N/A
ALGAL	CHLOROPHYLL A	(1) STDMTD 18TH ed. 10200H	1.0 ug/L
	PHEOPHYTIN	STDMTD 18TH ed. 10200H	1.0 ug/L
	SILICA	STDMTD 4500-Si E/D	1.0 mg/L
	PRODUCTIVITY, CARBON 14 METHOD	Procedure Developed by University of Delaware	uMC
	SECCHI DISK	N/A	N/A
	LIGHT TRANSMISSION	(2)	0.01 uM

TABLE D2 continued

CATEGORY OF PARAMETERS	PARAMETER	METHOD REFERENCE	REPORTING LIMIT
HEAVY METALS	COPPER, DISSOLVED	EPA 200.7	5 ug/L
	COPPER, TOTAL	EPA 200.7	5 ug/L
	CHROMIUM, HEXAVALENT	STDMTD 18TH ed. 3500-CR	5 ug/L
	ZINC, DISSOLVED	EPA 200.7	10 ug/L
	ZINC, TOTAL	EPA 200.7	10 ug/L
RADIOACTIVITY	ALPHA EMITTERS	(3) EPA 900.0	5 pCi/L
	BETA EMITTERS	(3) EPA 900.0	5 pCi/L
	TRITIUM	(3) EPA 906.0	500 pCi/L
ORGANIC CARBON	DISSOLVED	EPA 415.1/STDMTD 18TH ed. 5310-B	1 mg/L
	TOTAL	EPA 415.1/ STDMTD 18TH ed. 5310-B	1 mg/L
OXYGEN DEMAND	ULTIMATE (60 DAY), DISSOLVED	EPA 405.1/STDMTD 5210-B	2.4 mg/L
	ULTIMATE (60 DAY), TOTAL	EPA 405.1/STDMTD 5210-B	2.4 mg/L

1.For Chlorophyll A, one split sample, for analysis at another laboratory selected by DNREC, was conducted.
2.Light transmission to be conducted as practical to obtain correlation with Secchi Disk readings.
3.Radioactivity analyses outsourced. All laboratory materials provided by the outsourced lab were provided to DRBC.

Table D3: Frequency of Sampling by Parameter Category for the Estuary Boat Run Program

CATEGORY OF PARAMETERS	PARAMETER	FREQUENCY
ROUTINE	ACIDITY	TWO TIMES MONTHLY (1) FOR APRIL, MAY, AUG., & SEPT. & ONCE MONTHLY FOR OCT., MAR., JUNE, JULY & OCT. & ONCE MONTHLY FOR MAR, APRIL, MAY, JULY, AUG., SEPT. & OCT, FOR THE LOWER BAY STATIONS
	ALKALINITY	
	CHLORIDE	
	DISSOLVED OXYGEN	
	HARDNESS	
	pH	
	PHOSPHOROUS: DISSOLVED ORTHOPHOSPHATE & TOTAL	
	SODIUM [1]	
	SPECIFIC CONDUCTANCE	
	TEMPERATURE, AIR & WATER	
	TOTAL SUSPENDED SOLIDS AND DISSOLVED SOLIDS	
	TURBIDITY	
	NH3-N, NO2-N, NO3-N & TOTAL KJELDAHL -N	
BACTERIAL	E. COLI	
	ENTEROCOCCUS	
	FECAL COLIFORM (MTEC)	
ALGAL	CHLOROPHYLL A	
	PHEOPHYTIN A	
	SILICA	
	PRODUCTIVITY, CARBON 14 METHOD	
	SECCHI DISK & LIGHT TRANSMISSION	
HEAVY METALS	COPPER, DISSOLVED & TOTAL	MONTHLY & 7 times per year for Lower Bay Stations
	CHROMIUM, HEXAVALENT	
	ZINC, DISSOLVED & TOTAL	
RADIOACTIVITY	ALPHA EMITTERS	ANNUALLY
	BETA EMITTERS	
	TRITIUM	
ORGANIC CARBON	DISSOLVED	QUARTERLY[2]
	TOTAL	
ULTIMATE OXYGEN DEMAND		

[1] Analyses of sodium are required only for stations above R. M. 78
[2] Not Required for Lower Bay Stations

Quality Assurance and Control

Special Training / Certification

Sample collection is performed by personnel who have experience in the collection of samples for chemical and physical analysis. All members of the sampling team must review and be familiar with the Sampling and Analysis Plan (SAP), the Quality Assurance Project Plan (QAPP), and the references to these documents.

Sample analysis must be performed by personnel who have experience in the analysis of environmental samples. All members of the analytical team must review and be familiar with the QAPP, the laboratory Standard Operating Procedures (SOPs) and the references to these documents.

Quality Control

The minimum requirements consist of an initial demonstration of laboratory capability, analysis of samples spiked with labeled compounds or analysis of quality control samples to evaluate and document data quality, and analysis of standards and blanks as tests of continued performance. Laboratory performance is compared to established performance criteria to determine if the results of analyses meet the performance characteristics of the methods.

Documents and Records

The Project Manager will be responsible for maintaining all documents and records associated with this project. Documents and records associated with this project will be kept and maintained in the project file at the Delaware River Basin Commission (DRBC) offices in West Trenton, New Jersey. Records will be maintained for a minimum of 5 years after completion of sampling and analysis.

Standard Data Reporting Format

The Standard Data Reporting Format requires a signed paper copy of all data along with the supporting quality control information. An electronic data deliverable (EDD) is required of the laboratory.

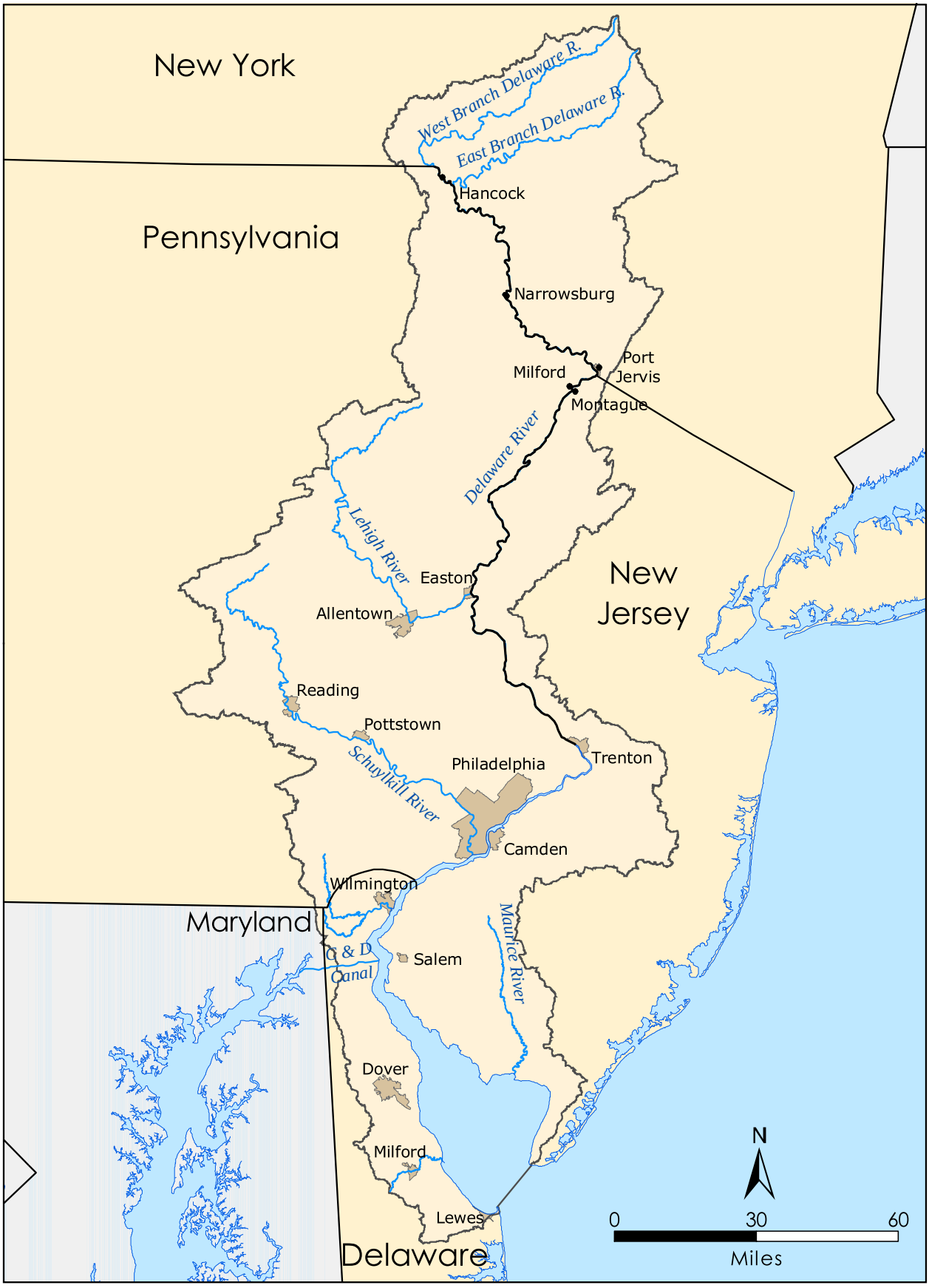
Field data included in the EDD is taken from the field log books/sheets and submitted in a form specified by DRBC. Laboratory Reports are structured to clearly present all of the items required by the contract. The report shall be organized as follows:

Data is reported by sample or by test. Pertinent information includes, at a minimum, field sample identification, laboratory sample number, date the sample was collected, date the sample was received at the laboratory, date the sample was extracted / prepared, date the sample was analyzed, extraction / preparation / cleanup / analysis procedure(s) used, laboratory preparation batch number(s), dilution factors, all analytes tested for and their associated reporting limits, matrix, units, and sample description including preservation. Any other factors that could affect the sample results are also noted.

Any other information that is pertinent to the samples is also reported. This includes copies of original chain-of-custody forms, copies of any telephone conversation record sheets, and copies of any other forms. The Laboratory shall maintain on file all of the supporting data and documentation for these samples. The Laboratory shall provide, upon request, copies of raw data as the DRBC deems necessary for specific methods and samples.

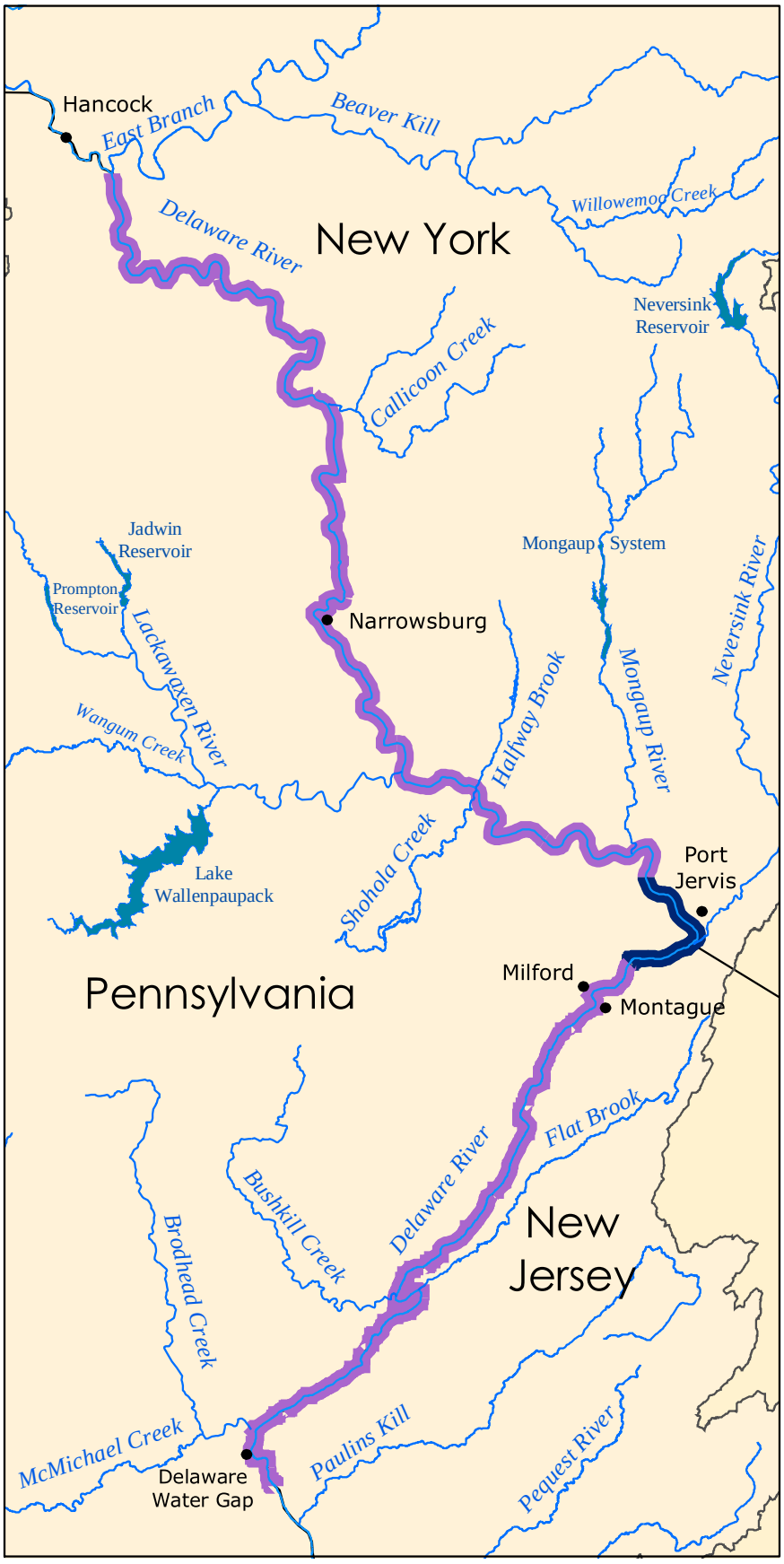
Sample method and associated quality control information shall be reported in a standard format as a complete packet representing a batch of samples. The method quality control information should be presented as in a standard order following the sample data results. The laboratory should maintain the standard order of reporting to the maximum extent possible.

Figure 1
Map of the Delaware River Basin



Source: DRBC 2002 305(b) Report

Figure 2
Special Protection Waters of the Delaware River Basin



Outstanding Basin Waters

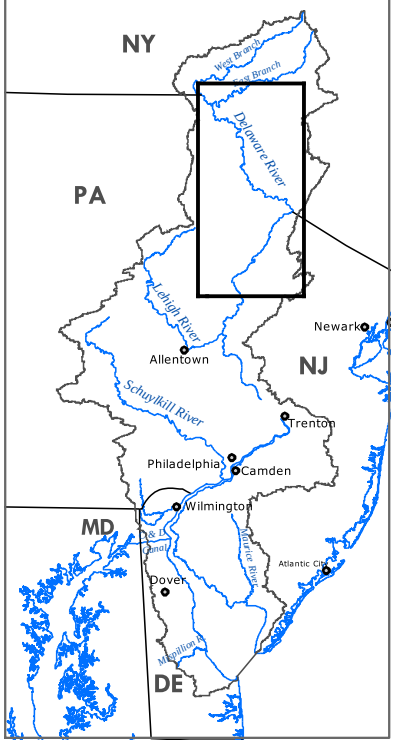
Significant Resource Waters

N

0 10 20

Miles

Location Map



Source: DRBC 2002 305(b) Report

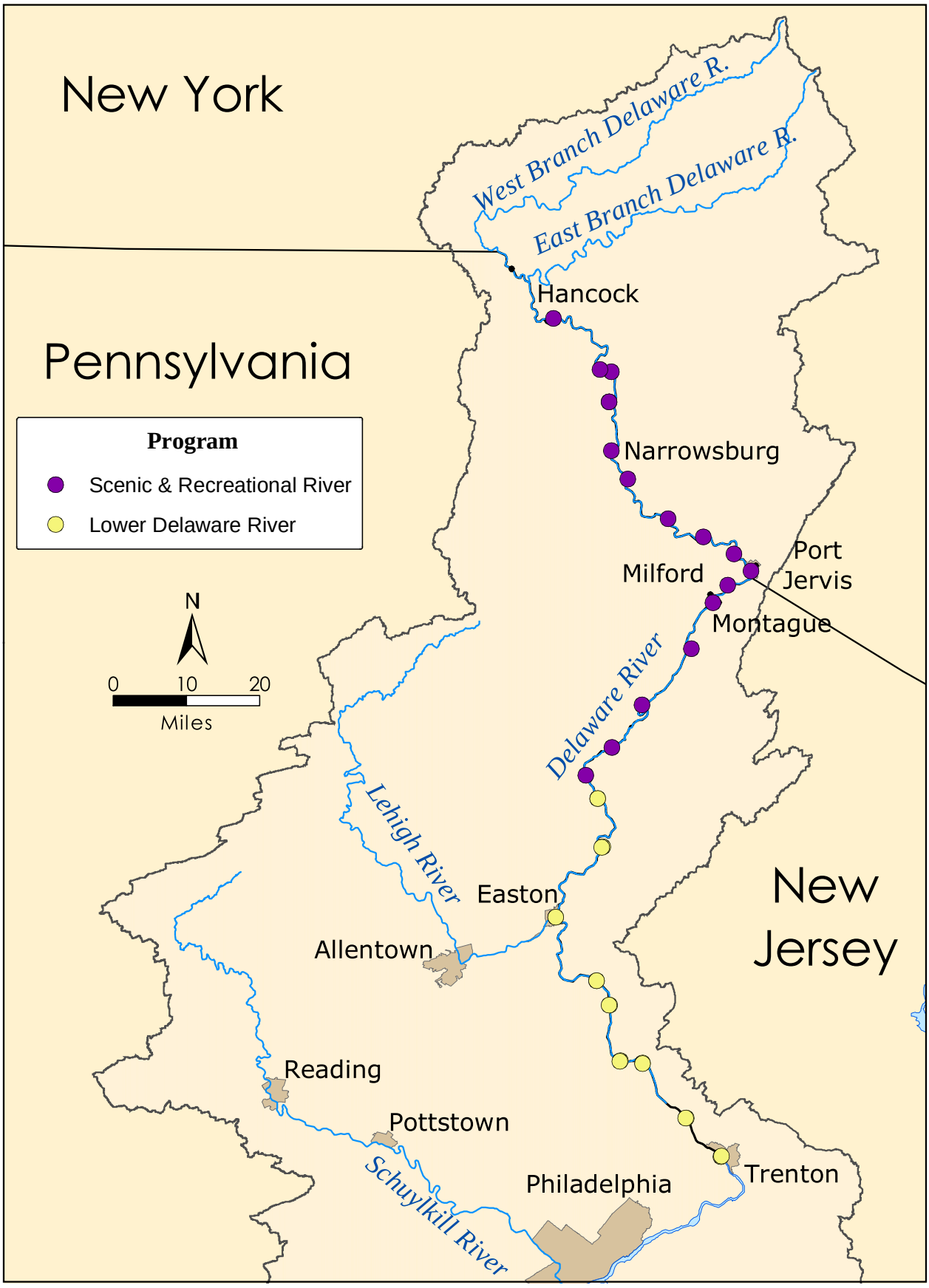
Figure 3

DRBC Main Stem Water Quality Zones

Source: DRBC 2002 305(b) Report

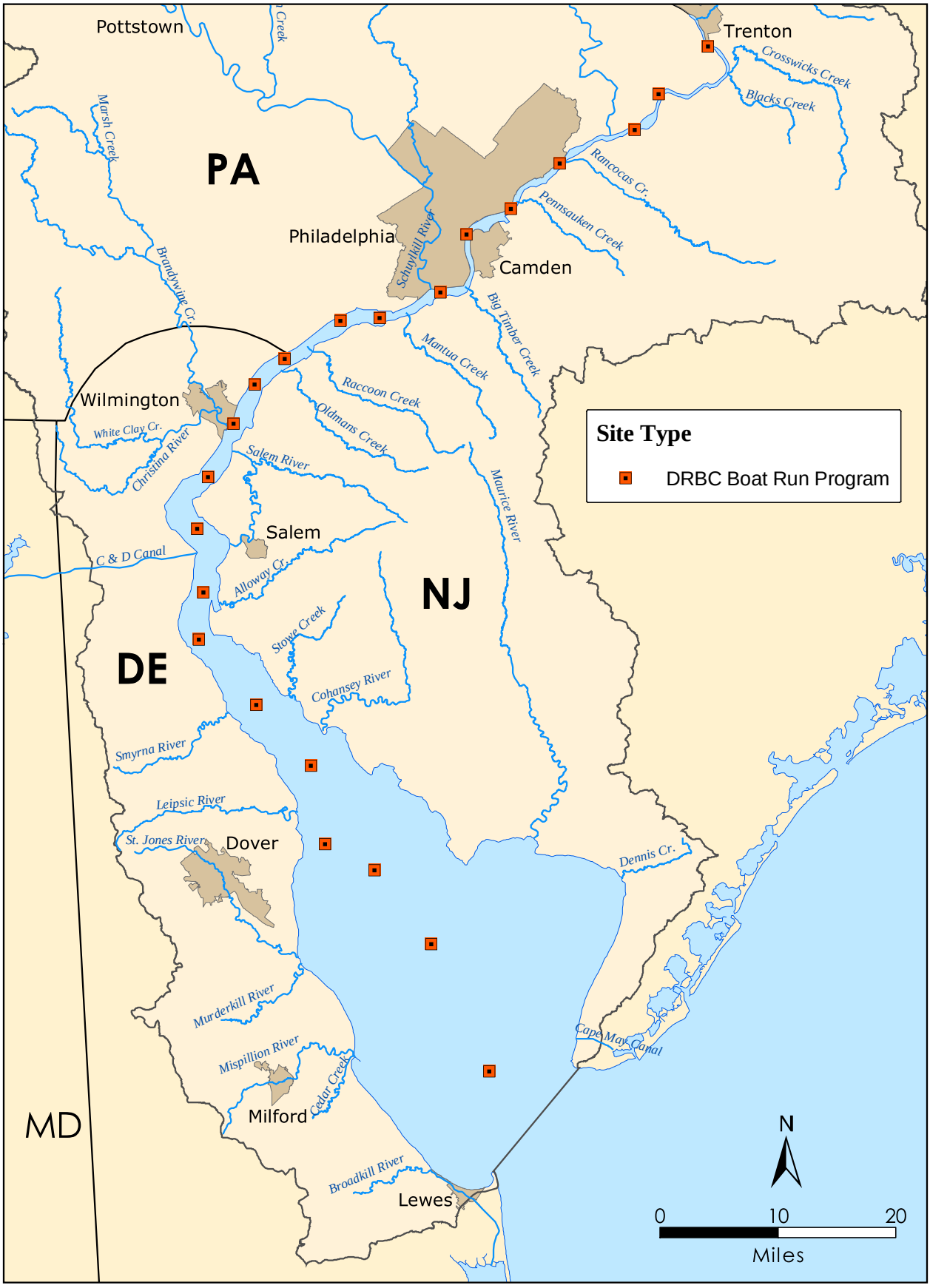
Figure 4

Scenic Rivers and Lower Delaware River Monitoring Programs



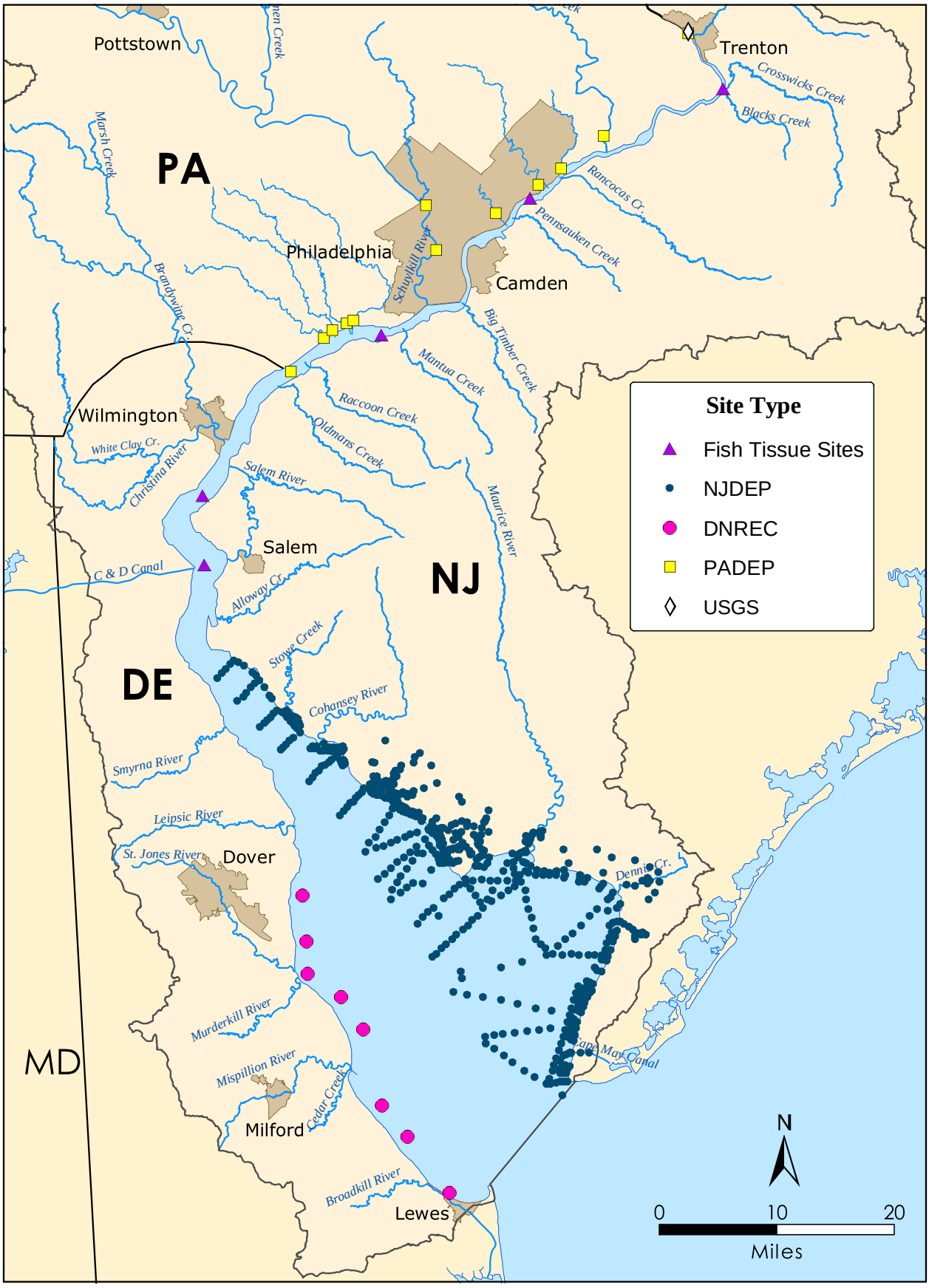
Source: DRBC 2002 305(b) Report

Figure 5
Estuary Boat Run Monitoring Program



Source: DRBC 2002 305(b) Report

Figure 6
Monitoring Locations for Supplemental Data in the Delaware Estuary



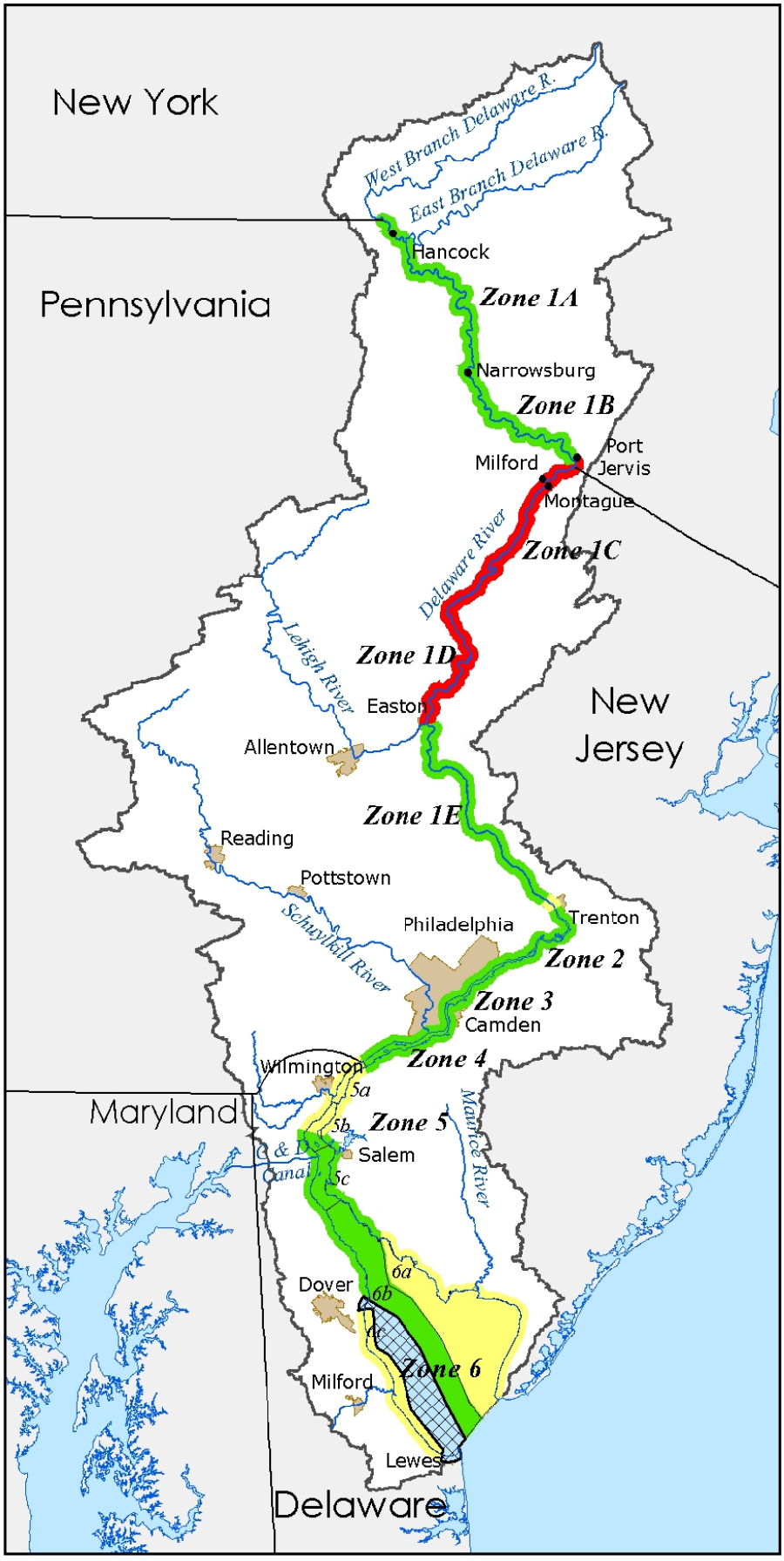
Source: DRBC 2002 305(b) Report

Figure 7

2002 305(b) Assessment Units

Source: DRBC 2002 305(b) Report

Figure 8



Aquatic Life Use Support 2000-2001

- Full Support
- Partial Support
- No Support*
- Not Assessed

** Due to total dissolved solids.*

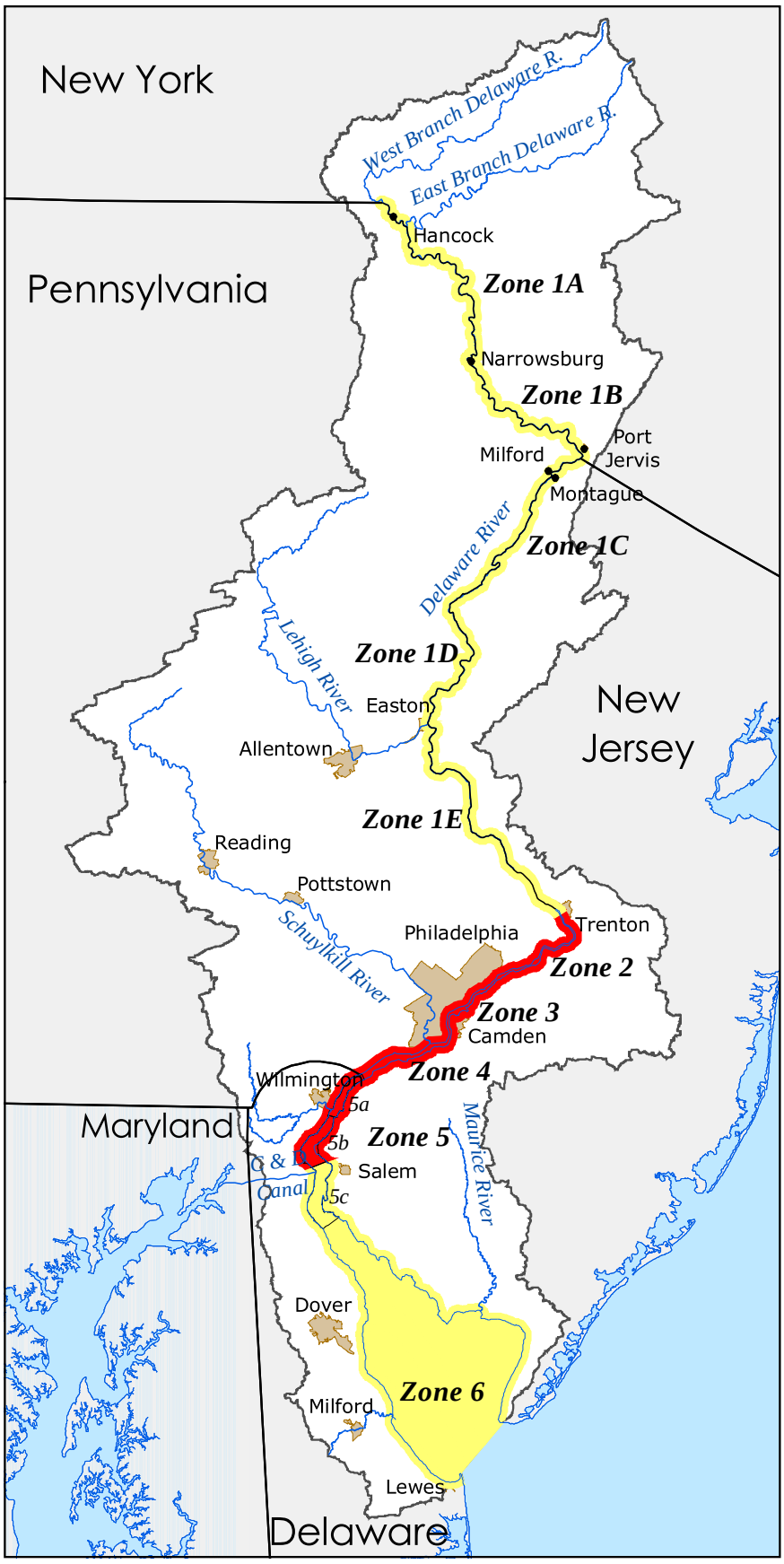
Source: DRBC 2002 305(b) Report

N

0 30 60

Miles

Figure 9



Fish Consumption Use Support 2000 - 2001

- Full Support
- Partial Support
- No Support

Based upon State fish consumption advisories.

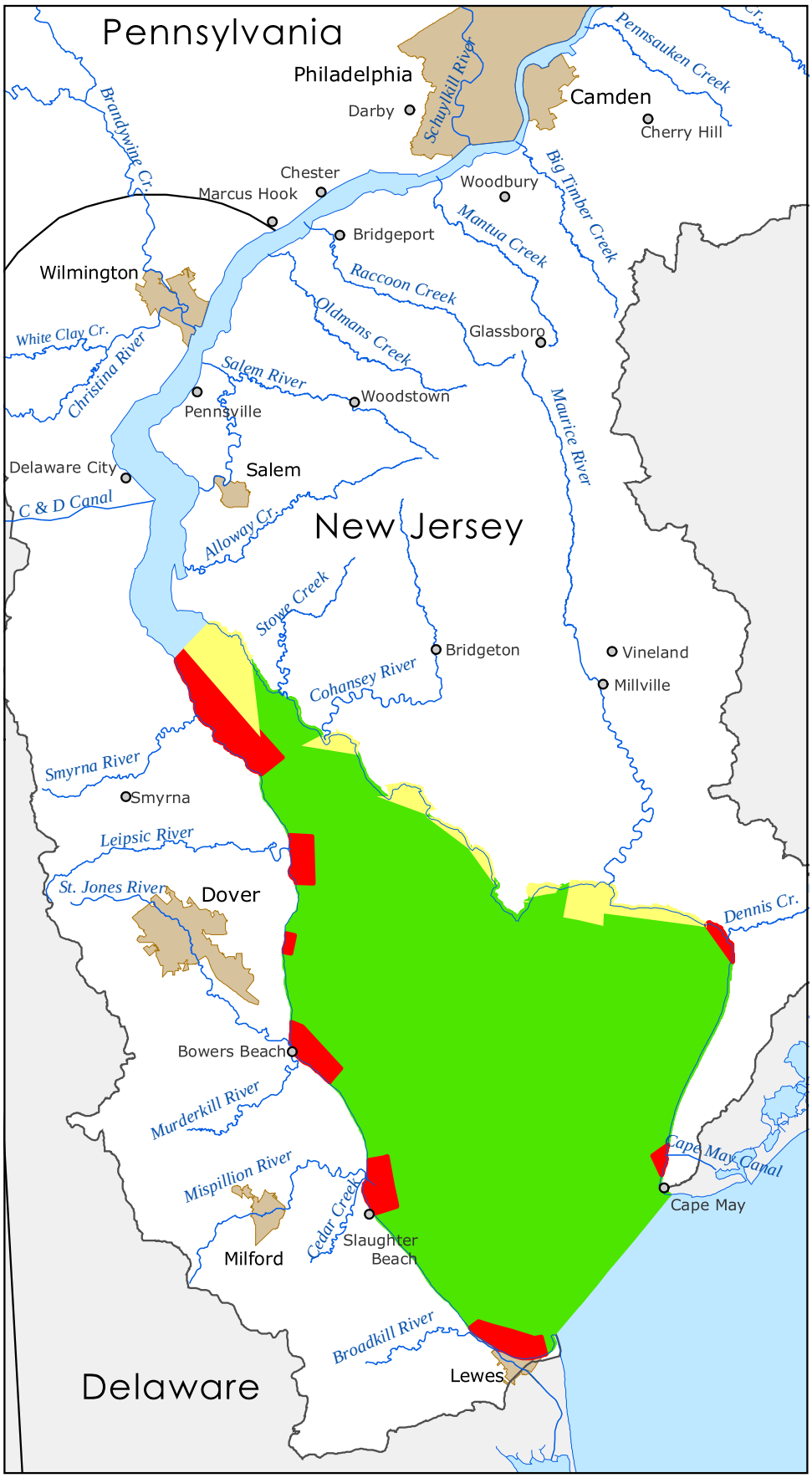
Source: DRBC 2002 305(b) Report

N

0 30 60

Miles

Figure 10



Shellfish Use Support 2000 - 2001

Full Support

Partial Support

No Support

Based upon State designations of harvestable shellfish areas.

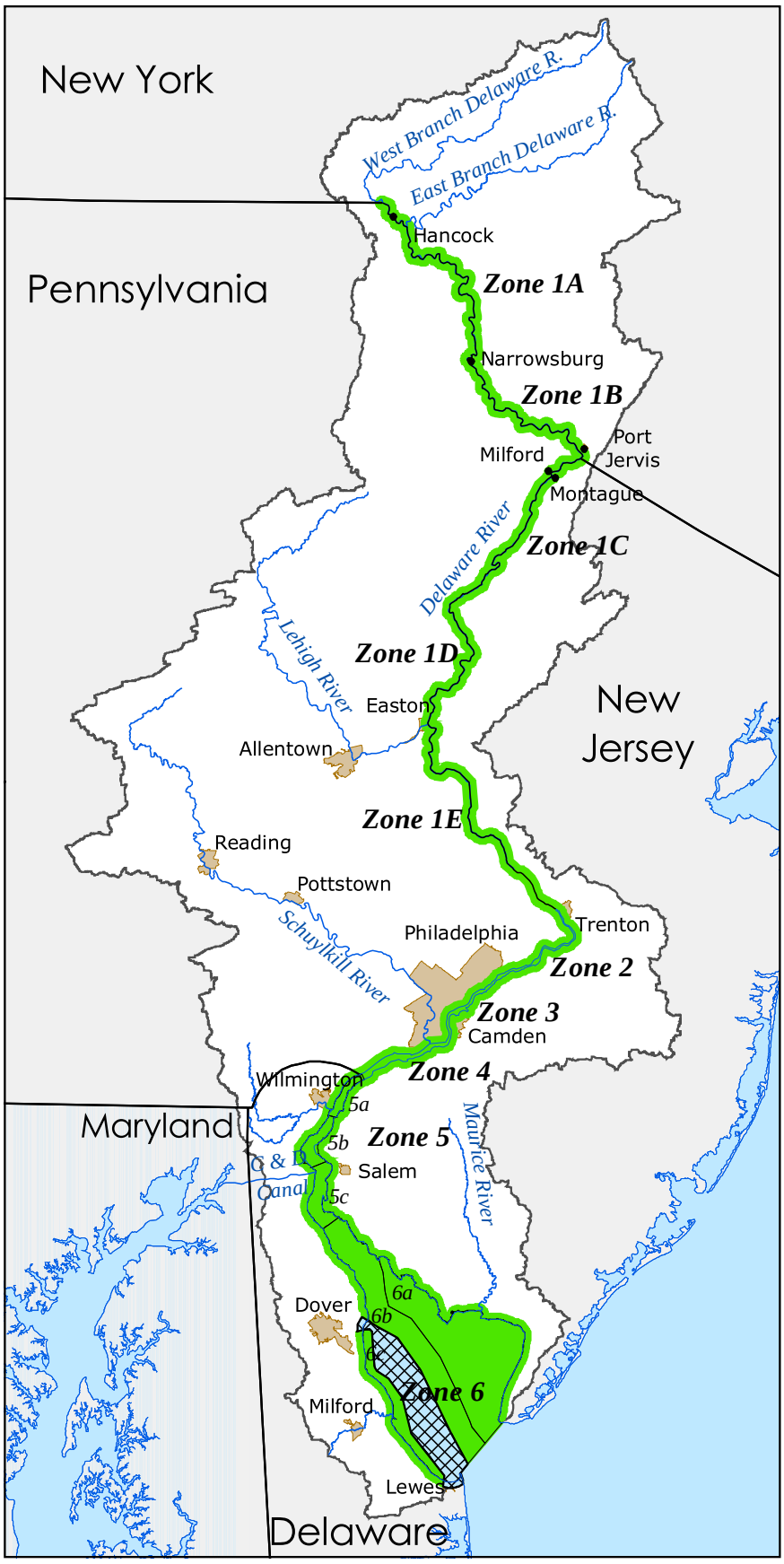
Source: DRBC 2002 305(b) report

N

0 5 10 15

Miles

Figure 11



Recreation Use Support 2000 - 2001

- Full Support
- Partial Support
- No Support
- Not Assessed

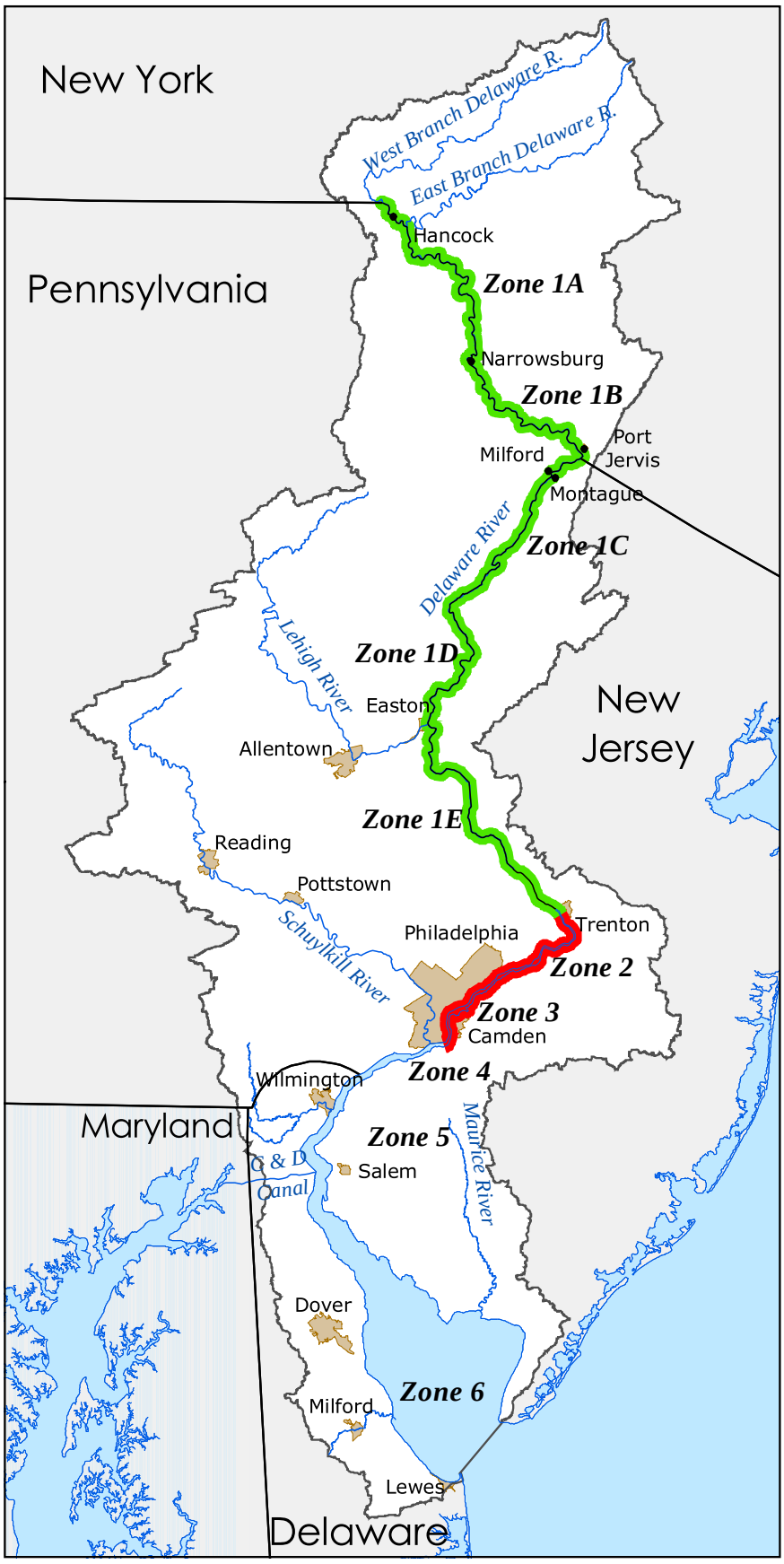
Source: DRBC 2002 305(b) Report

N

0 30 60

Miles

Figure 12



Drinking Water Use Support 2000 - 2001

- Full Support
- Partial Support
- No Support

Reflects ambient water data and assessment; not finished drinking water quality.

Source: DRBC 2002 305(b) Report

N

0 30 60

Miles