DELAWARE RIVER AND BAY

WATER QUALITY ASSESSMENT

2000 305(b) REPORT

DELAWARE RIVER BASIN COMMISSION

WEST TRENTON, NEW JERSEY

August 2000

DELAWARE RIVER AND BAY

WATER QUALITY ASSESSMENT

2 0 0 0 305(b) REPORT

This report was prepared by the Delaware River Basin Commission -- Carol R. Collier, Executive Director; Dr. Jeffrey P. Featherstone, Deputy Executive Director; Dr. Thomas J. Fikslin, Modeling and Monitoring Branch Head. Robert C. Kausch, Environmental Scientist, was the principal author.

August 2000

C O N T E N T S

INTRODUCTION 1

PART 1 SUMMARY / OVERVIEW

Support of Uses 2
Changes Since the 1998 305(b) Report 4
Cause and Source of Impairments 5
Programs to Correct Impairments 7
General Water Quality Trends 7
Monitoring / Special Concerns / Initiatives 8

PART 2 BACKGROUND

Purpose 10
Study Area Description 10
Water Uses and Standards 10
Water Pollution Control Program 10

PART 3 SURFACE WATER ASSESSMENT

Surface Water Monitoring Program 12
Changes in Assessment Methodology 12
Non-Tidal Delaware River (Zone 1) Assessment 14
Tidal Delaware River, Estuary/Bay (Zones 2-6) Assessment 16
Wetlands 18
Public Health and Aquatic Life Concerns 19
Fish/Shellfish Populations 19

PART 4 GROUNDWATER ASSESSMENT No changes have occurred in this section [see 1996 305(b) report].

INTRODUCTION

This report summarizes an assessment of the Delaware River's support of various uses during 1998 and 1999 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 and agriculture; swimming and recreation; and providing fish and shellfish that are safe for human consumption. The assessment primarily involved comparisons of a few key water quality parameters with DRBC water quality standards and stream quality objectives.

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 has an abbreviated format addressing just the changes in the support of uses and in the water quality monitoring and pollution control programs that have occurred since the last report [*Delaware River and Bay Water Quality Assessment, 1996-1997 305(b) Report*, August 1998]. The numerical data have been entered into EPA's assessment database. The electronically-filed data and this document constitute the commission's report under Section 305(b) of the Clean Water Act.

The degree of support -- full, full but threatened, partial, and none -- was determined by considering the number of times various water quality standards were violated. Following the above EPA guidelines, degree of support is determined as follows: when zero to 10% of the tests for a single parameter violate a standard or water quality objective, full support is indicated; exceedance in 10% to 25% of the tests reflects partial support; greater than 25% equals no support; and full support, but threatened occurs when there is an increasing trend in the mean for a parameter that provides full support. A water use is "impaired" wherever it is either partially supported or not supported. The quality of a water body is considered to be "good" when it provides full support or full support but threatened for a given use, according to EPA guidelines. Water quality is considered "fair" when a use is only partially supported and "poor" when a use is not supported.

In many cases, professional judgment was utilized when the data were insufficient or indeterminate. For water uses where the DRBC does not have specific water quality standards, the assessment considered the actions/judgments of the commission and other resource management agencies; for example, the assessment of fish and shellfish consumption was based on public notices issued by agencies of New Jersey, Pennsylvania, New York, and Delaware.

In an effort to be consistent with advisories issued by the basin states, this year's report considered statewide fish consumption advisories issued by New York and New Jersey. The New Jersey advisory calls for limited consumption of American eels and striped bass. The New York advisory covers all sportfish in the state's freshwaters.

The report also notes that despite the advisories, the striped bass population has experienced a remarkable recovery within the past decade, largely attributable to strict fish management measures and an improvement in overall water quality.

PART 1 SUMMARY/OVERVIEW

SUPPORT OF USES

Overall, the support of uses was highest in the non-tidal Delaware River where full support (or full support but threatened) was provided in the entire 206-mile-long reach for three uses -- agriculture, drinking water, and swimming. Aquatic life was fully supported in 99% of the reach, while fish consumption was only partially supported in this area, except for a small portion near Trenton that had no support.

In the 25 square miles of the tidal freshwater reach, three uses -- agriculture, swimming, and secondary contact -- were fully supported or fully supported but threatened. There was no support for aquatic life, drinking water (14 square miles), and fish consumption uses.

The estuary/bay provided full or full but threatened support for one use -- swimming. Aquatic life received full or full but threatened support in 97% of the 360 square miles that were assessed. Shellfishing was fully supported in 85% of the area, while fish consumption was only partially supported in 95% of the area and not supported in the remaining 5%.

Fish consumption was "impaired" (i.e., either partially supported, or not supported) throughout the entire length of the non-tidal river, in all 25 square miles of the tidal freshwater reach, and in 841 square miles of the estuary/bay.

Based on the percentage of the total miles or square miles providing full support for a given use, the order of support is as follows:

Agricultural	100%	
Secondary Contact	100%	
Swimming	97%	
Drinking Water	94%	
Shellfish	85%	
Aquatic Life	68%	
Fish Consumption	0%	(94% partial support and 6% no support)

Table 1 presents a summary of data by individual use for the 197-mile-long non-tidal Delaware River, extending from Hancock, N.Y. to Trenton, N.J. (DRBC Water Quality Management Zone 1), and a nine-mile-long section of the West Branch Delaware River -- a boundary water upstream of Hancock. Table 2 presents similar data for the 54-mile-long (25 square miles) tidal freshwater reach (Zones 2, 3,

PART 1 SUMMARY/OVERVIEW

and 4) which begins at Trenton and extends to Marcus Hook, Pa. Table 3 summarizes individual use support in the 79-mile-long (841 square miles) estuary/bay (Zones 5 and 6). The zones of support for each individual use are shown in maps at the end of the report.

Table 1. Individual Use Support Summary, 1998-1999

Water body: **DELAWARE RIVER (NON-TIDAL), ZONE 1**[a] (in miles)

Use	Size Assessed	Size Fully Supporting	Size Fully Supporting But Threatened	Size Partially Supporting	Size Not Supporting	Size Not Attainable
Aquatic Life	206	201	3	2	0	0
Fish Consumption	206	0	0	201	5	0
Shellfishing	*	*	*	*	*	*
Swimming	206	194	12	0	0	0
Secondary Contact[b]	*	*	*	*	*	*
Drinking Water	206	206	0	0	0	0
Agricultural	206	206	0	0	0	0

[a] includes nine miles of West Branch Delaware River

[b] not assessed since swimming is a higher use

Asterisk (*) = category not applicable

Zero (0) = category applicable, but size of waters in the category is zero

Table 2. Individual Use Support Summary, 1998-1999

Water body: **DELAWARE RIVER (TIDAL-FRESHWATER), ZONES 2, 3, 4** (in square miles)

Use	Size Assessed[1]	Size Fully Supporting	Size Fully Supporting But Threatened	Size Partially Supporting	Size Not Supporting	Size Not Attainable
Aquatic Life	25	0	0	0	25	0
Fish Consumption	25	0	0	0	25	0
Shellfishing	*	*	*	*	*	*
Swimming	10	10	0	0	0	0
Secondary Contact	15	15	0	0	0	0
Drinking Water	14	0	0	0	14	0
Agricultural	14	14	0	0	0	0

[1] The total area of Zone 2 (8 sq.miles), Zone 3 (6 sq.miles), and Zone 4 (11 sq.miles) = 25 square miles. These reaches do not include the tidal portions of tributaries.

Asterisk (*) = category not applicable

Zero (0) = category applicable, but size of waters in the category is zero

PART 1 SUMMARY/OVERVIEW

Table 3. Individual Use Support Summary, 1998-1999

Water body: **DELAWARE ESTUARY/BAY, ZONES 5-6** (in square miles)

Use	Size Assessed[1]	Size Fully Supporting	Size Fully Supporting But Threatened	Size Partially Supporting	Size Not Supporting	Size Not Attainable
Aquatic Life	360	198	152	0	10	0
Fish Consumption	841	0	0	803	38	0
Shellfishing	679	579	0	38	62	0
Swimming	481	475	6	0	0	0
Secondary Contact[a]	*	*	*	*	*	*
Drinking Water	*	*	*	*	*	*
Agricultural	*	*	*	*	*	*

[1] The total area of Zone 5 (59 sq.miles) and Zone 6 (782 sq.miles) = 841 square miles. These reaches do not include the tidal portions of tributaries.

[a] not assessed since swimming is a higher use

Asterisk (*) = category not applicable

Zero (0) = category applicable, but size of waters in the category is zero

CHANGES SINCE THE 1998 305(b) REPORT

The most significant change in this report compared to the 1998 assessment is the finding that fish consumption was not fully supported anywhere in the Delaware River in 1998-1999. This finding is not the result of any new water quality data or fish tissue data indicating increases in the levels of hazardous chemicals during the study period. Rather, it is a result of applying existing statewide consumption advisories issued by New York and New Jersey for various freshwater species to the entire non-tidal portion of the Delaware River (Zone 1) for the first time. Previous assessments had concluded that "border" waters like the Delaware River did not fall under these statewide advisories. Since the species of concern and the chemicals are known to be widespread, it is warranted to now include the entire non-tidal river in the partial support category. State fishery biologists involved in the listing program concurred with this judgment. As stated in earlier 305(b) reports, it is obvious that differences in conclusions between assessments from different time periods may be unrelated to ambient water quality.

Aquatic life use support declined very slightly in Zone 1, with a drop from 204 miles to 201 miles providing full support. For swimming use, six miles were added to the full support but threatened category, while the drinking water use improved with four miles shifting from threatened to full support.

PART 1 SUMMARY/OVERVIEW

In the tidal freshwater reach (Zones 2, 3, and 4) swimming use improved slightly with a reduction in the levels of bacteria, while use for drinking water was determined to be unsupported based on further mathematical modeling of contaminants in upper Zone 2.

More areas of the estuary and bay (Zones 5 and 6) were monitored during the study period compared to the previous assessment. Aquatic life use support improved noticeably with higher oxygen levels resulting in 55% of the area assessed as providing full support compared to 19% in 1996-1997. The other uses received support similar to the levels recorded in the 1998 report.

CAUSE AND SOURCE OF IMPAIRMENTS

Table 4 lists the water bodies that had "impaired" uses -- i.e., uses for which the quality of the water provided no support or only partial support during 1998-1999. The probable cause or stress for the impairment is listed, as is the likely source.

PART 1 SUMMARY/OVERVIEW

Table 4. SUMMARY OF IMPAIRED USES *, 1998-1999

LOCATION	IMPAIRED USE	MILEAGE/AREA AFFECTED (RM = river mile)	CAUSE	SOURCE
Non-tidal river (Zone 1)	Consumption of fish (see below)	206 miles (see below)	(See below)	(See below)
	All sportfish	From Hancock, N.Y. (RM 330), plus 9 miles of the West Branch, to N.J.-N.Y. boundary (RM 254)	"General advisory" for contamination that may exist	Point and non-point sources
	Pickerel	From N.J.-N.Y. boundary (RM 254) to Trenton (RM 134)	Mercury	Point and non-point sources
	Striped bass and American eel	From N.J.-N.Y. boundary (RM 254) to Trenton (RM 134)	Either PCBs, dioxin or chlordane	Point and non-point sources
	White perch, channel catfish, American eel	Yardley (RM139) to Trenton (RM 134)	PCBs and chlordane	Point and non-point sources, including stormwater
Non-tidal river (Zone 1)	Aquatic life	2 miles at Trenton (RM 134)	High pH	Excessive plant growth during warm low flow periods
Tidal freshwater (Zones 2,3)	Drinking water	14 sq.mi.	1,2 - dichloroethane ("DCE") and tetrachloroethene ("PCE")	Point sources
Tidal freshwater (Zones 2-4)	Fish Consumption- (multi-species)	25 sq.mi.	Zones 2,3 -- chlordane, PCBs, mercury; Zone 4 – PCBs.	Point and non-point sources, including stormwater
Tidal freshwater (Zones 2-4)	Aquatic life	25 sq.mi.	Chronic toxicity	Point sources
Estuary/bay (upper Zone 5)	Aquatic life	10 sq.mi.	Chronic toxicity	Point sources
Estuary/bay (Zones 5-6)	Fish Consumption (multi-species)	841 sq.mi.	PCBs , arsenic (upper Zone 5), mercury, dioxin, chlorinated pesticides (dieldrin, DDT)	Point and non-point sources, including stormwater
Estuary/bay (Zone 6)	Shellfish Consumption	100 sq.mi.	Bacterial infestations	Point and non-point sources, including stormwater

*Uses that are partially supported or not supported

PART 1 SUMMARY/OVERVIEW

PROGRAMS TO CORRECT IMPAIRMENTS

The DRBC has developed innovative programs to address the impairments identified through monitoring programs. In the estuarine portion of the Delaware River, the commission continues to evaluate whether the assimilative capacity of the river for conventional and toxic pollutants has been exceeded. These evaluations can result in formal determinations by the commission (under DRBC Water Quality Regulations) authorizing the executive director to establish wasteload allocations for the pollutant. Such determinations were first made in March 1968 for carbonaceous BOD and most recently in January 2000 for two volatile organic chemicals and toxicity. Wasteload allocations issued by the executive director are referred to the appropriate National Pollution Discharge Elimination System permitting agency of the signatory parties for use in establishing effluent limitations and schedules of compliance.

The commission also is leading a cooperative effort with the states of Delaware, New Jersey, and Pennsylvania to determine the assimilative capacity of the estuary for bioaccumulative pollutants, such as PCBs and chlorinated pesticides. The effort also will provide the states with the necessary technical information and data to establish TMDLs for these pollutants in 2003.

In the upper basin, the DRBC established standards based upon "existing water quality" in December 1992. These standards are the basis for reviewing proposed projects by both the commission and the National Park Service. The commission is currently in the process of developing similar standards for the non-tidal river between Trenton, N.J. and the Delaware Water Gap.

GENERAL WATER QUALITY TRENDS

Based on the findings of a special 1999 study of the lower non-tidal reach (Zone 1), bacteria levels appear to have improved somewhat since the last special study in 1987. The Delaware River showed improvement in fecal coliform densities, though the 1999 drought may have affected the comparison. Very low levels were observed in most areas of the Delaware River. Bacteria populations were consistently higher in near-shore areas than in the main channel.

Since the methodology used in assessing support of uses has changed over time, the assessment reported in this and earlier 305(b) reports does not provide a meaningful basis for evaluating trends in the quality of the Delaware River. Water chemistry data, however, indicate that the (significant) improvements in conventional parameters that were achieved in the tidal river over the last 20 years, in general, have been maintained. The levels of toxins in water, sediment, and fish, especially in the tidal waters, continue to be high.

PART 1 SUMMARY/OVERVIEW

MONITORING / SPECIAL CONCERNS / INITIATIVES

The lower Delaware River (Delaware Water Gap, River Mile [RM] 212, to Trenton, RM 133) is proposed for designation as a National Wild and Scenic and Recreational River. The Lower Delaware River Management Plan, prepared by the Lower Delaware River Wild and Scenic River Study Task Force and the National Park Service in 1997, designated the DRBC as the lead agency for both monitoring and development of a water quality management plan for this reach.

The Lower Delaware Monitoring Program (LDMP) was an effort begun in 1998 by the DRBC and the Delaware Riverkeeper Network, under the auspices of the Delaware River Greenway Partnership. The LDMP is designed to develop a long-term data record of basic water quality information at 20 fixed river locations and 22 tributaries. The goal is for basic chemical and bacterial sampling to be conducted biweekly from May through September with concurrent studies of ecological and geomorphological components of the lower Delaware River corridor. Special, short-term intensive studies of particular aspects of river function will be performed as well. Other special topics of interest to the DRBC that are likely to be studied in detail over the coming five years include: development of a benthic macroinvertebrate index of biological integrity for the river; assessment of aquatic vegetation impacts on water quality; influences of channel geomorphology and stability; assessment of riparian communities; and description of exotic and invasive species along the river corridor. The 1999 program recommended that fecal coliform and enterococcus testing be added to the commission's lower Delaware monitoring network.

The Comprehensive Conservation and Management Plan (CCMP) for the Delaware Estuary was published in September 1996. The plan recommended that the DRBC augment its long-established center-of-channel water quality sampling program in which 18 stations from Fieldsboro, N.J. (RM 127) to Port Mahon, Del. (RM 35) were sampled for bacteria, heavy metals, nutrients, and conventional pollutants at a frequency of 15 times per year. The minimal plan in the CCMP suggested the addition of four new stations -- one upstream of Fieldsboro (near Trenton) and three between Port Mahon and the mouth of the Delaware Bay. In 1999, using discretionary funding, sampling was conducted at the three lower bay stations on five occasions. Beginning in 2000, all four stations will be monitored at a frequency of seven times per year, permitting an assessment of water quality over an additional 40 miles at the upper and lower reaches of the estuary (this represents an additional 150 square miles in Zone 6). The original 18 stations will be sampled 12 times per year.

The Delaware Estuary 1998 Monitoring Report (Santoro, DRBC, November 1999) recommended continued bacteriological monitoring in the channel and the addition of sampling in near-shore areas.

PART 1 SUMMARY/OVERVIEW

In 1999, monitoring of the ambient waters of the estuary for chronic toxicity was initiated at 12 stations between Pea Patch Island (RM 63.0) and Beverly (RM 115.0). Samples were collected at 0.6 of the water depth at three locations on a transect across the river at each station. The samples from all stations were tested with the fathead minnow *Pimephales promelas* and *Ceriodaphnia dubia*, while samples from the five stations in the lower estuary south of RM 81 also were tested with the marine species *Mysidopsis bahia* and the sheepshead minnow *Cyprinodon variegatus*. This sampling will be performed on a yearly basis as the commission evaluates the need to control chronic toxicity caused by the cumulative impact of effluents from NPDES dischargers. In addition to this sampling, phytoplankton toxicity studies have been proposed for the upper portion of the estuary to evaluate the influence of ambient toxicity on algal growth and photosynthesis.

PART 2 BACKGROUND

PURPOSE

No changes have occurred in this section [see 1994-1995 305(b) Report, June 1996].

STUDY AREA DESCRIPTION

No changes have occurred in this section [see 1994-1995 305(b) Report, June 1996].

WATER USES AND STANDARDS

The Delaware Estuary 1998 Monitoring Report (Santoro, DRBC, 1999) cited recent bacteriological data in recommending adoption of new, higher bacteriological standards. The report notes that lower mean levels for both enterococcus and fecal coliform bacteria support action by the DRBC to adopt a standard which is commensurate with the attainment of federal primary contact criteria in Zones 3 and 4.

The special Lower Delaware River 1999 study (Limbeck, DRBC, 2000) recommended that the commission revise its stream quality objectives for Zone 1 to include enterococcus, similar to the action taken for the estuary by DRBC Resolution No. 91-6. The study noted that enterococcus is a more sensitive measure of bacterial water quality than fecal coliform, and use of the enterococcus criterion would lead to a greater number of water bodies listed as impaired in 305(b) reports. The study also recommended that the upper limit of DRBC's pH standard (8.5) be changed to 9.0, making it consistent with federal criteria and state standards. These recommendations will be considered in the upcoming re-codification of the commission's Water Quality Regulations.

WATER POLLUTION CONTROL PROGRAM

The commission's water pollution control programs involve determining compliance with both effluent quality requirements and stream quality objectives (i.e., water quality standards) contained in Article 4 of the DRBC's Water Quality Regulations. The original requirements were adopted in 1967 with a focus on conventional pollutants, particularly carbonaceous biochemical oxygen demand (BOD). In 1968, procedures for allocating the assimilative capacity of the basin waters were adopted enabling the commission's executive director to issue wasteload allocations for pollutants in order to maintain stream quality objectives. With the enactment of the Federal Water Pollution Control Act Amendments of

1972 (the Clean Water Act), wasteload allocations issued by the executive director are referred to the permitting agencies of the signatory parties for use in establishing effluent limitations and schedules of compliance.

In 1992 and 1996, the commission made substantial changes to its regulations by adopting existing water quality criteria for high quality waters in the upper portion of the basin and adopting stream quality objectives for toxic pollutants in the tidal Delaware River (Zones 2 through 5). These revised standards form the basis for more recent actions to control pollution from both point and non-point sources.

The DRBC's Estuary Toxics Management Program developed a phased approach to addressing toxic pollutants. In the first phase, several volatile organics, chronic toxicity, and acute toxicity were the focus of concern due to their loadings from point source discharges. In January 2000, the commission determined that the assimilative capacity of the estuary for 1,2 -dichloroethane, tetrachloroethene, chronic toxicity, and acute toxicity had been exceeded. This determination allows wasteload allocations and other effluent requirements to be issued. In the next phase of this program, particulate-associated pollutants such as PCBs, chlorinated pesticides, and metals will be the focus of assessment.

The commission also is completing the development of a new hydrodynamic and water quality model of the estuary for use in reallocations of carbonaceous BOD as well as allocations of nitrogenous BOD and bacteria. Final modifications to the model are expected to be completed in 2001. The model will then be used to evaluate the need for assimilative capacity and wasteload allocations for these conventional pollutants.

PART 3 SURFACE WATER ASSESSMENT

SURFACE WATER MONITORING PROGRAM

The following changes were made in the monitoring program outlined in the 1996 and 1998 305(b) reports:

- There was a substantial increase in monitoring of the non-tidal lower Delaware (Zone 1) between Columbia, N.J./Portland, Pa. (RM 207) and Trenton (RM 133). A total of 22 stations were each sampled for conventional parameters three to four times during the summer of 1999. Stations were located 3.3 miles apart on average. Only three stations in this reach were included in the 1998 305(b) report. A special survey of bacteria was performed in this reach as well and compared to the findings of a 1987 survey (see *The Lower Delaware Monitoring Program, 1999 Bacteria Survey of the Lower Delaware River and Inception of an Integrated Water Quality Monitoring Network*, Limbeck, DRBC, 2000).

- Bacteriological data collected by the state of New Jersey's shellfish program in 1998 were utilized in assessing the support for swimming on the New Jersey side of the bay.

- Water chemistry data taken by the state of Delaware at six locations in 1999 to monitor near-shore, shellfish waters were used to assess support for aquatic life on the Delaware side of the bay.

- The DRBC initiated monitoring at three, new lower bay stations between Port Mahon (RM 35) and the mouth of the Delaware Bay, namely Crossledge (RM 23), Joe Flogger Shoals (RM 16.5), and South Brown (RM 6.5). Each station was sampled five times during 1999.

CHANGES IN ASSESSMENT METHODOLOGY

One measure of the degree of support for aquatic life and swimming in the non-tidal Zone 1 in past 305(b) reports was the number of exceedances of 8.5 pH units, the DRBC maximum pH water quality objective. It was necessary to qualify those assessments since, as noted in the 1994, 1996, and 1998 reports, 9.0 pH units is now considered to be a more meaningful value. While the DRBC's stream quality objective remains the same, the number of pH determinations exceeding 9.0 pH units was used for this assessment. The DRBC will be considering changes to this objective in the planned re-codification of the standards.

Another change in the methodology used for this report was the dropping of pH and bacteria levels to assess the degree of support for drinking water supplies. Levels far above DRBC stream quality objectives for these parameters do not adversely affect operations in the modern water treatment facilities that utilize the Delaware River. The presence of toxins or unnaturally high levels of turbidity were used for this assessment.

DRBC's water quality standards list recreation (which includes swimming) as a water use to be protected in most of the Delaware River. There are only a handful of beaches, however, where swimming is a "heavy" use during the summer months, usually on weekends. Three beaches are located upstream of the Delaware Water Gap and several are located in Cape May County, N.J. It is at such locations that five bacteriological samples per month would be considered necessary to determine whether or not swimming would present a high risk for infections or illness. For all other locations, where swimming would be an occasional, low intensity activity, this assessment considered two samples per month to be sufficient. This follows guidance in EPA's *Ambient Water Quality Criteria for Bacteria-1986*. The maximum allowable bacteria criterion also was based on the degree of actual primary contact use. In addition, in a few tidal reaches, -- when six-to-eight samples were taken during mid-summer -- the percentage of samples exceeding 400 fecal coliform colonies was used as another criterion, as recommended in EPA's guidelines for preparation of 305(b) reports.

As noted in previous 305(b) reports, the assessment of support for swimming was often based merely on the number of individual samples that exceeded the water quality objective. Geometric means were often not calculated since the sampling frequency was less than five per month. These assessments, therefore, were very conservative.

In past reports, the support for secondary contact was assessed for the entire river. For this report it only was assessed for the 15 square miles in Zones 3 and 4 where secondary contact, rather than primary contact recreation, is the designated use.

An additional 290 square miles were assessed for support of swimming in Delaware Bay by using data obtained during bacteriological surveys of shellfish beds by the state of New Jersey.

The new, main channel monitoring stations in lower Zone 6 were each assumed to represent conditions in an open water circle with a radius of four miles, or an area of about 50 square miles, in accordance with EPA 305(b) guidance. Near-shore sites were considered to represent conditions in about a 3-square-mile area (radius = one mile).

PART 3 SURFACE WATER ASSESSMENT

NON-TIDAL DELAWARE RIVER (ZONE 1) ASSESSMENT

AQUATIC LIFE USE SUPPORT CHANGES: Three miles were moved from the full support category to full support but threatened, due to pH values exceeding 9.0 at Martins Creek (RM194), Eddyside Park (RM185), and Kingwood Access (RM163) on one of only three sampling events at each location in 1999. A one-mile reach at each location was placed in this category. Automatic monitoring indicated Trenton (RM134) experienced pH values above 9.0 frequently during the warm, low-flow conditions in the late fall of 1998 -- seven daily means exceeded 9.0 (9.1 and 9.2) while the daily mean pH for November 1998 was 9.0. By comparison, only three daily means were over 9.0 prior to November 1998 and none reached this level in the summer of 1999. However, the extended period of high values in the fall of 1998 warrants a change at Trenton from full support but threatened to partial support for two miles. In 1998-1999, 99% of Zone 1 provided full support (including threatened) for aquatic life use.

CHANGES IN THE SUPPORT OF SWIMMING: Based on a drop in fecal coliform levels throughout Zone 1 from the levels recorded in 1996-1997, two-mile-long reaches of the river at the Delaware Water Gap (RM 212) and at Trenton (RM134) were changed from full support but threatened to full support. In general, fecal coliform bacteria levels were low during the extended period of low-river flow caused by drought-warning conditions in 1999. In 1998, five stations -- West Branch (RM 331), Callicoon Access (RM 304), Cochecton (RM 299), Montague (RM 246), and Riegelsville (RM 175) -- recorded greater than 400 colonies per ml on more than 10% of the analyses. Two-mile-long reaches at these locations are listed as fully supporting but threatened for swimming. Except for a two-mile reach at Lumberville (RM 155) which continued full support but threatened, the remaining 194 miles (94%) of Zone 1 provided full support for primary contact recreation. There were no closings of swimming beaches due to water quality problems at Smithfield (RM 218), Milford (RM 246), or West End (RM 255) in 1998 or 1999. Riegelsville was the sole location in 1998 that experienced a geometric mean for five samples that exceeded the DRBC's maximum limit of 200. At Montague, measurements of enterococcus bacteria were recorded at 141 colonies (geometric mean) per 100 ml in mid-summer1999, far above the widely-accepted criteria of 33 colonies for this important indicator of fecal contamination. In assessing the degree of support for swimming, judgment was used in weighing the variable bacterial level, the location and timing of the monitoring, and the actual recreational uses in Zone 1.

SUPPORT OF FISH CONSUMPTION CHANGES: In 1998, based upon new monitoring data, the Pennsylvania Department of Environmental Protection (PADEP) rescinded an advisory against consumption of American eel taken in the Callicoon (RM

304) access area, removing three miles from the not supporting category. Of greater significance is the assessment's judgment that the special statewide advisories which New Jersey Department of Environmental Protection (DEP) and the New York Department of Health have had in effect for a number of years for all freshwater bodies within their boundaries should be applied to the entire Delaware River. In the past, an assessment of partial support was only applied to the Phillipsburg, N.J. to Trenton N.J. reach in response to New Jersey's statewide consumption advisory for pickerel due to mercury contamination. The upper-most boundary for this advisory is now extended to the New Jersey – New York border. New Jersey's statewide consumption advisories for striped bass and American eel due to high levels of PCBs, dioxin or chlordane also apply to this reach, according to NJDEP. New York's general advisory for sportfish in freshwaters applies to the river upstream of the New Jersey boundary, extending to Hancock, N.Y. (including nine miles of the interstate West Branch Delaware River.) The result is 201 miles of Zone 1 that were assessed in the 1998 305(b) report as providing full support for fish consumption are now judged to have provided partial support in 1998-1999. This change is not based on any new monitoring data obtained since the 1998 305(b) report.

DRINKING WATER USE SUPPORT CHANGES: A four-mile reach at Trenton was moved from full support but threatened to full support with the elimination of river pH and bacteria levels as criteria for assessing support of drinking water use. High discharge levels during mid-September 1999 generated by Hurricane Floyd caused both high turbidity and color levels in the raw water for the Easton, Pa. water treatment plant. These conditions persisted for five days. Consumers were notified in accordance with federal regulations. Color levels were high again in the raw water supply at the end of November. Treatment plant staff are investigating the cause/source of the color.

SUPPORT OF USES IN THE "EXISTING QUALITY" SPECIAL PROTECTION WATERS SEGMENTS: The mean dissolved oxygen level at Cochecton Bridge (RM 298) for nine occasions in May-September 1999 was 8.93. This is very close to the minimum level of 8.9 mg/l that has been defined as "existing quality" by the DRBC Special Protection Waters Regulations for the entire Upper Delaware Scenic and Recreational River reach (from RM 330.7 to RM 258.4). The regulations would be violated whenever the mean dissolved oxygen level for the May-September period falls below 8.9 over the entire reach. Before conclusions can be made about the potential for oxygen levels to drop below "existing quality" at a particular location in the Special Protection Waters, additional sampling would be necessary over an extended period, along with an analysis of flow, temperature, and oxygen levels throughout the entire zone.

PART 3 SURFACE WATER ASSESSMENT

TIDAL DELAWARE RIVER, ESTUARY/BAY (ZONES 2-6) ASSESSMENT

AQUATIC LIFE USE SUPPORT CHANGES: The only changes in this category occurred in Zones 5 and 6. There was a general increase in dissolved oxygen levels in these zones, especially in 1998, resulting in 29 square miles in the middle of Zone 5 -- Cherry Island (RM 71), New Castle (RM 66) and Pea Patch Island (RM 61) -- moving from partial support to full support of aquatic life. Twenty square miles in lower Zone 5 were raised from partial support to full support but threatened based on monitoring at Reedy Island (RM 55) and Liston Point (RM 49). Over two years, 22% of the grab samples at these sites were slightly less than 6.0 mg/l (the water quality objective based on daily mean levels). None, however, were less than 5.4 mg/l, significantly above the "minimum at anytime objective" of 5.0 mg/l. The lowest daily mean at the Reedy Island automatic monitor in 1998 was 6.2, much higher than levels in 1994-1997. ("Provisional" data from the monitor in 1999 were unreliable).

Thirty-six square miles of upper Zone 6 around Smyrna (RM 44) dropped from full support to full support but threatened due to slightly lower dissolved oxygen levels, mostly in 1999. This reach abuts 96 square miles classified as full but threatened support for aquatic life use in 1996-1997 and was unchanged in 1998-1999. Twenty-one percent of the grab samples in the combined reach, mostly around Ship John Light (RM 37) and Port Mahon (RM 35), were less than 6.0 mg/l (the water quality objective based on daily mean levels), 7% of 86 samples were less than 5.0 mg/l (the “minimum at anytime objective”), and 3% were less than 4.0 mg/l.

Based on limited monitoring during 1999 at the three, new lower bay stations, 150 square miles along the mid-line of lower Delaware Bay were judged to provide full support for aquatic life. Nineteen square miles along the Delaware coastline fully supported aquatic life in 1999 based on a few oxygen and pH samples from six locations (there was insufficient data for these sites in 1998).

CHANGES IN SUPPORT OF SWIMMING (and Secondary Contact): In Zone 2, 8 square miles changed from full support but threatened to full support of swimming due to lower levels of both enterococcus and fecal coliform bacteria. The decision was based primarily on data collected during the warmer months with a sampling frequency of at least two per month. This was considered adequate due to the very low incidence of swimming in the tidal Delaware River. The geometric means of the data did not exceed DRBC’s stream water quality objectives in 1998 or 1999, nor did individual samples exceed EPA’s recommended single sample limit for enterococcus or the equivalent criteria for fecal coliform. Secondary contact was only assessed in Zones 3 (6 square miles) and 4 (9 square miles) where it is the designated use. In past 305(b) reports, this

use was assessed for the entire river and bay. The use continues to be fully supported in the designated areas. The area of full support is now listed as 15 square miles in Zones 2 through 4, as opposed to 23 square miles in the past. The use is cited as "not applicable" for assessment in Zones 5 and 6, whereas in the past it was cited as fully supported in 191 square miles.

The assessment presented above is limited to the main stem tidal Delaware River and does not include the tidal portions of the tributaries to Zones 2, 3, and 4 that are part of these estuary zones under DRBC regulations. This is consistent with previous reports. Water quality data are collected in the tidal portion of nine tributaries by the PADEP under contract with DRBC. In Zone 2, the available data indicate that the standard for primary contact recreation is not being achieved in the Pennypack and Poquessing Creeks, while regular exceedances of the Zone 2 standard of 200 fecal coliform colonies per 100 ml occur in the Neshaminy Creek. No data are available for the tidal portions of tributaries to Zone 2 in New Jersey to assess suitability for primary contact recreation. In Zones 3 and 4, the available data indicate that the standard for secondary contact recreation is not being achieved in the Frankford, Ridley, and Chester Creeks, and that exceedances of the 770 fecal coliform colonies per 100 ml secondary contact standard occur regularly in Crum and Darby Creeks.

The bacteriological data acquired by the state of New Jersey during 1998 in the course of routinely monitoring that state's Delaware Bay shellfish beds were assessed to determine the degree of support for swimming. More than 1,000 samples were collected at 142 stations. The frequency of the sampling was approximately one sample per month, which was judged as marginal, or barely acceptable, to assess support for swimming, primarily because the area is subject to infrequent swimming and probably more of an incidental nature. In addition, many of the stations are some distance from the shore and in deeper water. It was determined that 290 square miles in Zone 6 provided full support, while 6 square miles near the mouth of the Maurice River (Zone 6) provided full but threatened support. In the latter case, the geometric mean of fecal coliform levels at three stations exceeded Zone 6 water quality objectives. More frequent sampling, especially during the warmer months, would be needed before these judgments could be made with full confidence. This is the first time these waters have been assessed for support of swimming and reported in the DRBC's 305(b) report. There were no closures of Cape May County's swimming beaches on Delaware Bay due to high bacteria levels during 1998-1999.

SHELLFISHING SUPPORT CHANGES: In 1998, the state of New Jersey shifted approximately 3 square miles of shellfish-producing waters in the Maurice River Cove and Dividing Creek area from the approved for harvesting category to the seasonal

restricted category. This corresponds to a shift of 3 square miles from full to partial support since the 1998 305(b) report. There were no changes in 1999. There were no changes in the state of Delaware's delineation of shellfish harvest waters during 1998-1999.

DRINKING WATER SUPPORT: Further modeling of the distribution of certain chemicals that have been detected in the Delaware River at levels harmful to humans resulted in the DRBC's designation in January 2000 that the assimilative capacity of Zones 2 and 3 has been exceeded for DCE and PCE. This action requires that the upper 6 square miles of Zone 2 be changed from full support of drinking water use to no support, resulting in the entire 14 square miles of Zones 2 and 3 that are designated for drinking water use to be categorized under no support. There was no new monitoring data in 1998–1999 that led to this reclassification; rather it was an on-going assessment using mathematical modeling. The evaluation was based solely on the quality of the river water; it did not consider the quality of the water that is supplied to consumers following treatment in the water supply facilities in Zone 2 that draw from the Delaware River.

The support for AGRICULTURAL SUPPLY in the tidal Delaware River, estuary and bay (Zones 2 - 6) in 1998 and 1999 was unchanged from the degree of support that existed in 1996 and 1997, as summarized in the 1998 305(b) report.

FISH CONSUMPTION: The areas designated by advisories recommending either limited consumption or no consumption of fish during 1996 and 1997 were unchanged in 1999; however, more fish species and/or consumption recommendations were affected. In the case of the upper half of Zone 5, Delaware applied the no consumption advisory to <u>all</u> finfish species. In lower Zone 5 and Zone 6, the advisory to restrict consumption was applied to American eel and white perch. The advisory to restrict consumption was changed from no more than five, eight-ounce meals per year to no more than one, eight-ounce meal per year. This change was based on the use of a new EPA cancer/ dose-response assessment.

<u>WETLANDS</u>

No changes have occurred in this section [see 1994-1995 305(b) Report, June 1996].

PART 3 SURFACE WATER ASSESSMENT

PUBLIC HEALTH AND AQUATIC LIFE CONCERNS

Bacteria samples collected in 1998 during the DRBC boat run program suggest that average levels of fecal coliform bacteria are below the primary contact standard in the main channel of the river. However, plots of combined data sets for tributaries to the Delaware Estuary suggest continued input of fecal coliform from tributaries to the estuary around Philadelphia, Camden, and Wilmington, especially during and after rainfall events.

Levels of enterococcus bacteria also were evaluated during the 1998–1999 DRBC Boat Run. In the areas of Zone 3 and Zone 4, the mean level of enterococcus was considerably below both the DRBC standard for secondary contact recreation and the federal requirement for primary contact recreation in saline waters. The remaining DRBC zones utilize the federal criteria of 200 fecal coliform colonies/100ml.

Monitoring of the level of contaminants in the tissues of resident fish collected from the estuary continued in 1998. Filet samples were obtained from white perch and channel catfish collected at five locations in the estuary. These five locations have been sampled every one to two years since 1990. The results indicated that PCB levels in white perch have not decreased, while channel catfish were found to have higher levels of contamination (up to 1700 ppb). Peak tissue concentrations continue to occur in Zones 3 and 4 of the estuary. Samples also were collected from American shad adults and juveniles to determine contamination levels in this anadromous species for the first time. PCB levels in the filet samples from adult shad collected in the bay, tidal river, and lower non-tidal river indicated levels between 100 and 200 ppb. Low levels of PCBs were found in young-of-the-year shad collected in the fall above the Delaware Water Gap, with increasing concentrations found in specimens collected downstream. Specimens collected at Trenton in the tidal portion of the river had a concentration of approximately 800 ppb.

FISH/SHELLFISH POPULATIONS

In 1998, an estimated 392,700 adult American shad passed Lambertville, N.J./New Hope, Pa. (RM 149) during their annual spawning migration up the Delaware River. That was a decrease of 25% from the 524,300 shad recorded in 1996. In 1999, only 24,700 shad were counted by the New Jersey Bureau of Freshwater Fisheries' hydro-acoustic monitor at Lambertville, a 94% decrease from 1998. Fishery managers do not know the reason for the dramatic decline in the shad run, but speculate that the entire North Atlantic population is being reduced while they are in their oceanic habitat. There has been no speculation that conventional water quality constituents in the Delaware River are a factor in the decline. In fact, shad have been declining

in neighboring river systems prior to the drop in the Delaware River population. Excluded in the Lambertville count are the shad that have not entered the non-tidal reach, choosing instead to use the tidal river and certain tidal tributaries for spawning, primarily Crosswicks, Rancocas, Big Timber, and Raccoon Creeks. During 2000, fishery managers are expanding the range of shad monitoring programs to include the tidal river and are re-examining current monitoring techniques. Preliminary reports for 2000 indicate a rebound in the Delaware River shad run to the range of the 1998 numbers.

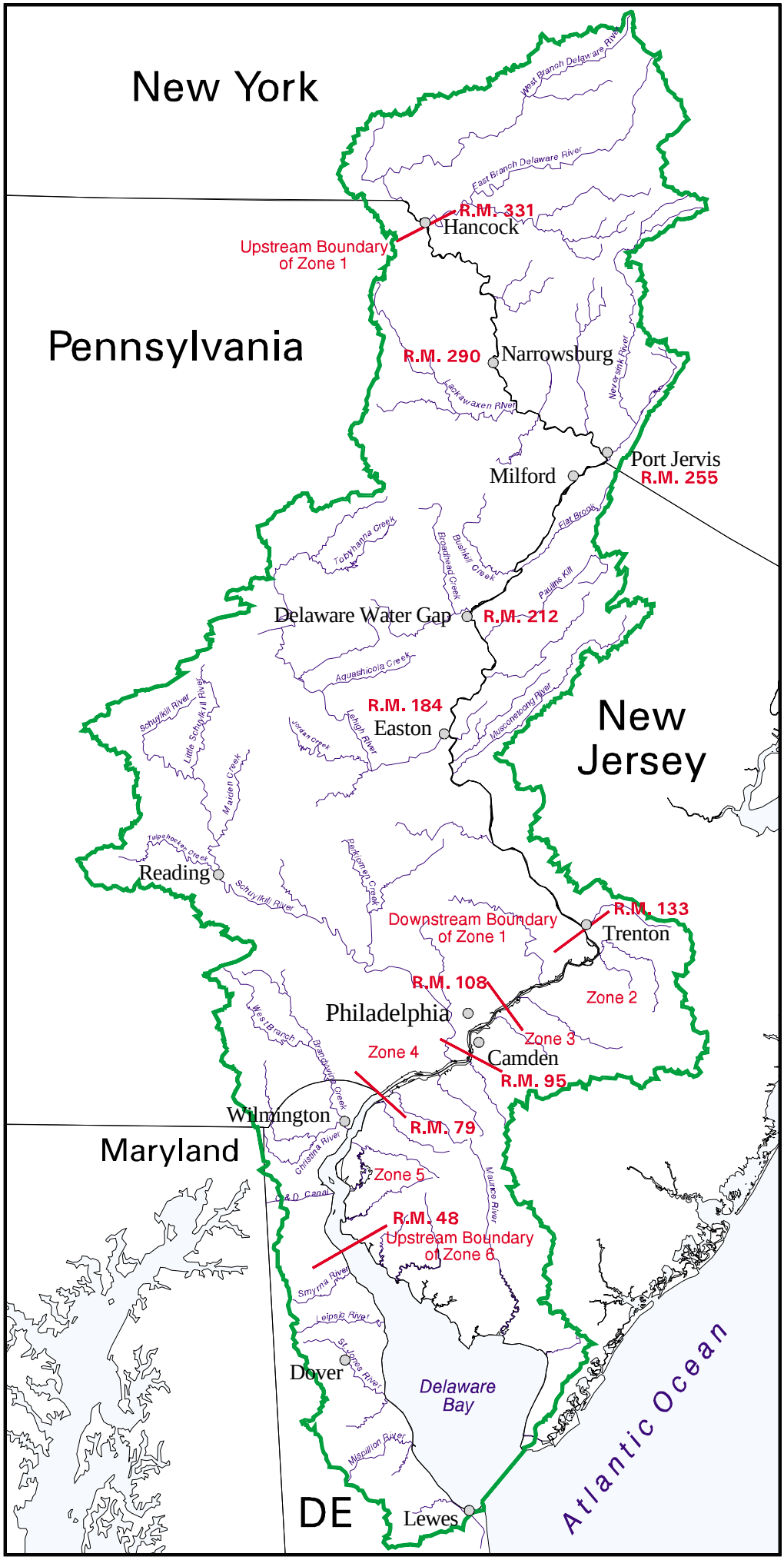
Juvenile American shad are monitored annually by the New Jersey Bureau of Freshwater Fisheries during the out-migration of the young-of-year from the Delaware River. The 1998 effort yielded just 62 juvenile shad per seine haul, an all-time low. According to state fishery managers the 1998 adult run was sufficient to have produced a collection of 224 shad juveniles per seine haul. Possible reasons for the decline, according to the managers, include in-the-river "problems" such as the patterns of river flow and water temperature, as well as predation. In 1999, an average of 172 were collected in each haul. The average for the 20-year period of record is 216 per haul.

The Delaware River striped bass population has experienced a remarkable recovery within the last decade, largely attributable to strict fishery management measures and improvements in water quality. Young-of-year recruitment surveys in the estuary and tidal river (Zones 2-5) conducted by the New Jersey DEP's Bureau of Marine Fisheries, reflect the increase in the striped bass population. In 1999, 932 young were taken during 192 seine hauls for a geometric mean of 1.9, the second highest recorded over the last 20 years. The 1998 value of 1.31 is the fifth highest.

Surveys by the state of Delaware in October 1999 found 50% of the oysters in Delaware's natural beds to be dead, due primarily to infestations of the parasitic protozoan, DERMO. Summertime drought conditions were cited as the cause of the warm, high-salinity waters in which DERMO thrives.

PART 4 GROUNDWATER ASSESSMENT

No changes have occurred in this section [see 1996 305(b) Report].



Water Quality Management Zones

LEGEND

- Water Quality Zone Boundary
- Delaware River Basin Boundary
- State Boundary
- Major Rivers
- R.M. River Mile

N

0 5 10 15 20 25
MILES

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

Delaware River Support of Water Uses 1998 - 1999

Data Source:
2000 305(b) Report

Agricultural Water Supply

LEGEND

Degree of Support

- Full Support
- Full Support, but Threatened
- Partial Support
- No Support
- Not Assessed

Locations Approximate

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

Delaware River Support of Water Uses 1998 - 1999

Data Source:
2000 305(b) Report

Aquatic Life

LEGEND

Degree of Support

- Full Support
- Full Support, but Threatened
- Partial Support
- No Support
- Not Assessed

Locations Approximate

N

0 5 10 15 20 25
MILES

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

Delaware River Support of Water Uses 1998 - 1999

Data Source:
2000 305(b) Report

Drinking Water Supply

LEGEND

Degree of Support

- Full Support
- Full Support, but Threatened
- Partial Support
- No Support
- Not Assessed

Locations Approximate

N

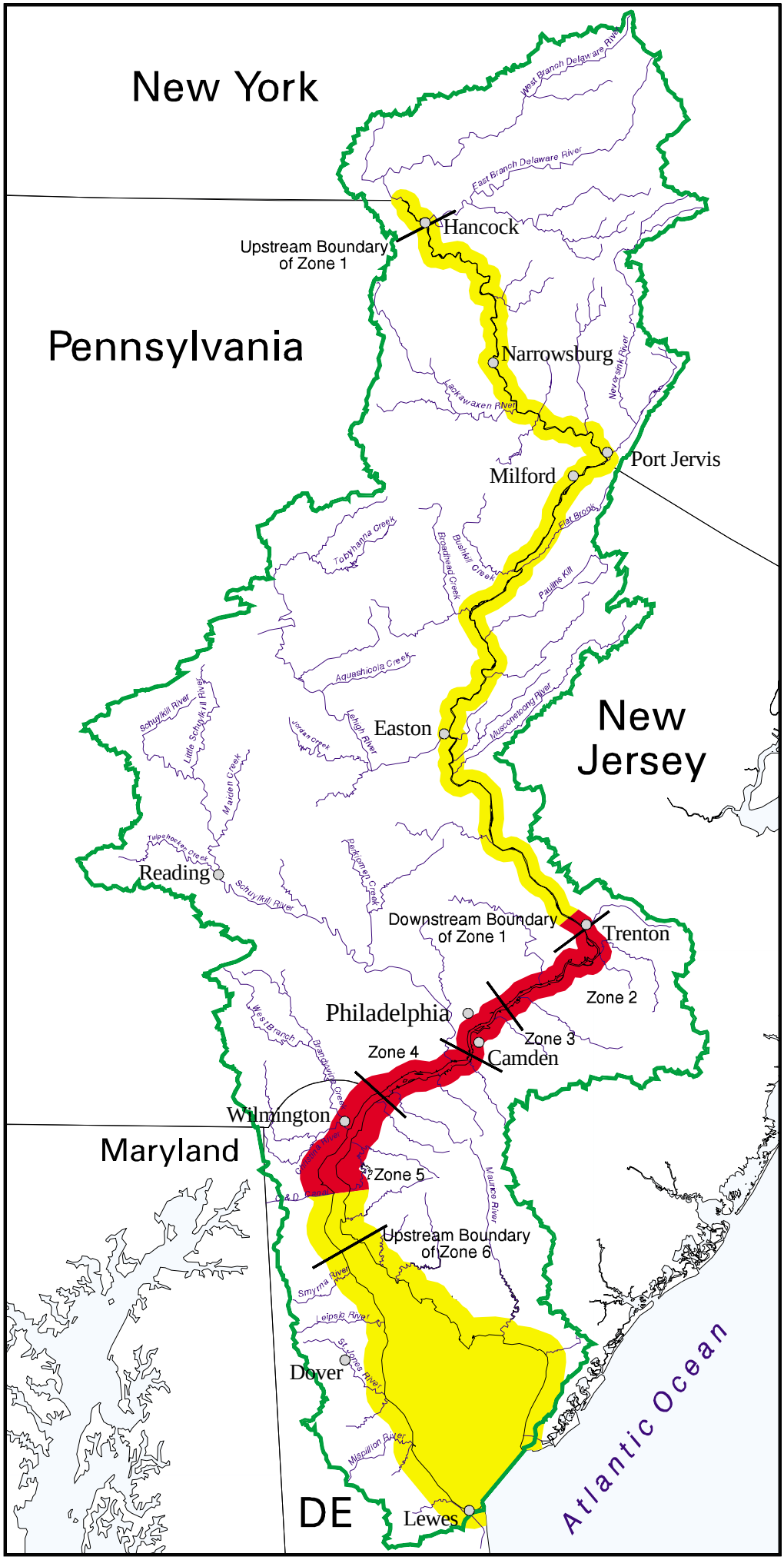
0 5 10 15 20 25
MILES

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

Delaware River Support of Water Uses 1998 - 1999

Data Source:
2000 305(b) Report

Fish Consumption



LEGEND

Degree of Support

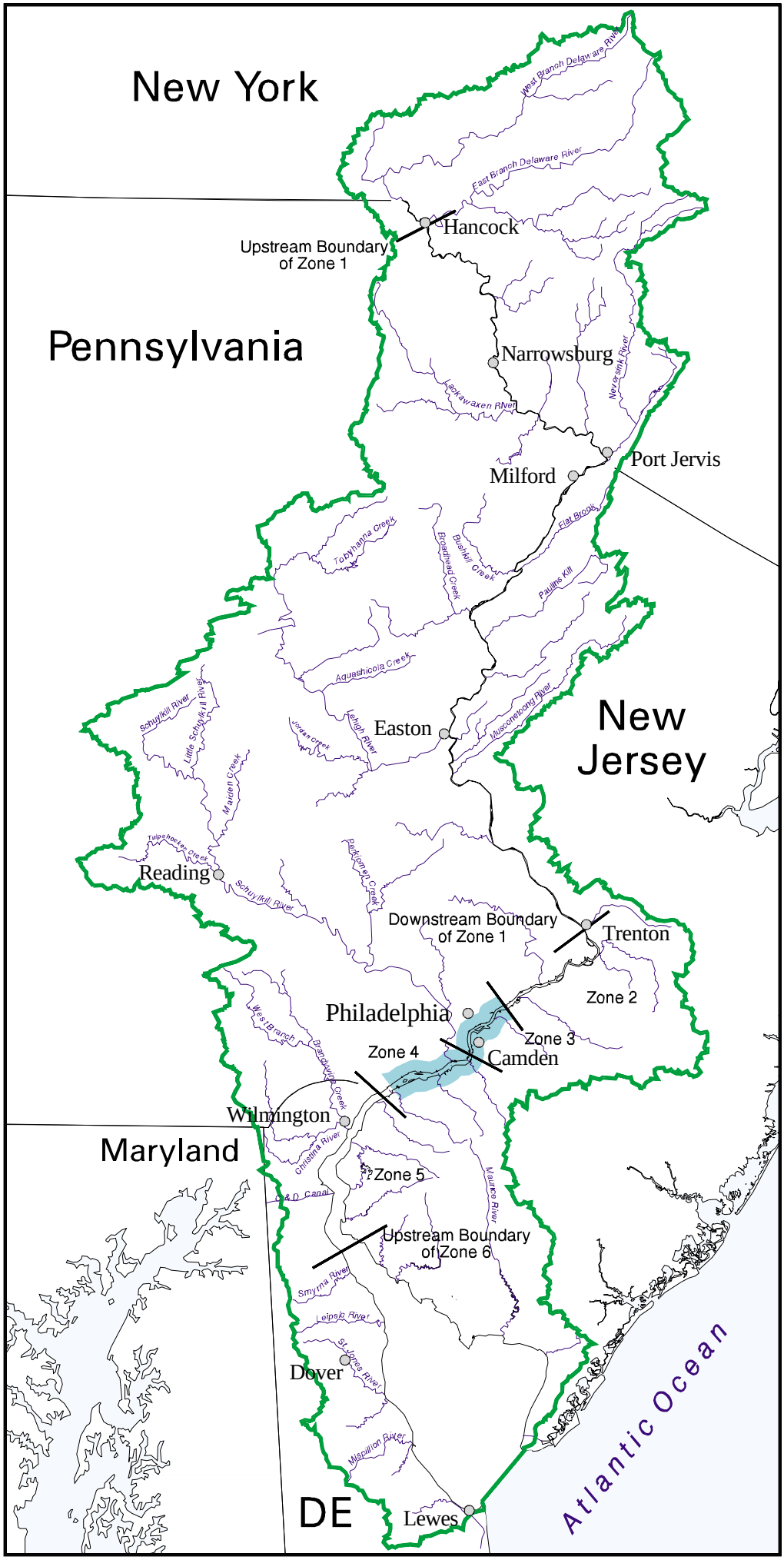
- Full Support
- Full Support, but Threatened
- Partial Support
- No Support
- Not Assessed

Locations Approximate

N

0 5 10 15 20 25
MILES

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



Delaware River Support of Water Uses 1998 - 1999

Data Source:
2000 305(b) Report

Secondary Contact

LEGEND

Degree of Support

- Full Support
- Full Support, but Threatened
- Partial Support
- No Support
- Not Assessed

Locations Approximate

N

0 5 10 15 20 25
MILES

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

Delaware River Support of Water Uses 1998 - 1999

Data Source:
2000 305(b) Report

Shellfish Consumption

LEGEND

Degree of Support

- Full Support
- Full Support, but Threatened
- Partial Support
- No Support
- Not Assessed

Locations Approximate

N

0 5 10 15 20 25
MILES

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

Delaware River Support of Water Uses 1998 - 1999

Data Source:
2000 305(b) Report

Swimming

LEGEND

Degree of Support

- Full Support
- Full Support, but Threatened
- Partial Support
- No Support
- Not Assessed

Locations Approximate

N

0 5 10 15 20 25
MILES

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