**Publication Year** 2013

**Author(s)** Kleinfelder & Omni Environmental

**Title** Phase II Exectutive Summary: Raritan River Basin Nutrient TMDL Study

**Publication Type** Report

**Journal / Publisher** Kleinfelder & Omni Environmental

**Link** [Kleinfelder 2013.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\Kleinfelder%202013.pdf)

**Abstract** This study was undertaken to provide the scientific foundation to

understand the cause-and-effect relationships between pollutant loads

and observed water quality responses for a select set of related water

quality impairments in the Raritan River Basin. Defining these

relationships provides the Department with the defensible technical basis

to address total phosphorus (TP), pH, dissolved oxygen (DO), and total

suspended solids (TSS) impairments in streams and lakes within the study

area. This will include regulatory actions, implemented through NJPDES

permits, and non-regulatory actions involving regional and local partners,

targeted funding, and stewardship building.

**Publication Year** 2013

**Author(s)** Levinton, J, M Doall, and B Allam

**Title** Growth and Mortality Patterns of the eastern Oyster Crassotrea virginica

**Publication Type** Journal Article

**Journal / Publisher** Journal of Shellfish Research

**Link** [Levinton et al 2013.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Levinton%20et%20al%202013.pdf)

**Abstract** We monitored cage-based populations of the eastern oyster Crassostrea

virginica in coastal waters of New York Harbor in 2 phases of sampling, 1

with localities spread out over the New York–New Jersey Harbor area

(started 2008) and another with 3 localities within Jamaica Bay (started

2010), all impacted by high nitrogen input, low dissolved oxygen, but

over a water quality gradient. Patterns of growth, mortality, condition, and

disease were compared with a clean-water site in Shelter Island, NY,

sampled in parallel with both sampling phases. In both studies, oyster

mortality in the urban sites increased dramatically during and after the

second summer growth season. Mortality also increased at the same time

period at the cleanwater site, but to a much smaller degree. One instance

of high mortality in the Lower Hudson was caused by MSX; but,

otherwise, no known diseases were identified as the main cause of the

sudden mortality increases. Our results suggest that a general effect of

reduced water quality had a cumulative effect on the New York Harbor-

emplaced oysters, which culminated in high mortality, mainly at the end

of the second summer growing season. Despite the increased mortality,

other factors such as soft tissue growth and reproduction were not

reduced in the harbor sites relative to the clean-water control site. The

vulnerability of oysters grown in impacted waters may have to be factored

in attempts to restore oysters to impacted harbor waters.

**Publication Year** 2012

**Author(s)** Berry, K and S Cohen

**Title** 2010 New Jersey Integrated Water Quality Monitoring and Assessment

**Publication Type** Report

**Journal / Publisher** NJ Department of Environmental Protection

**Link** [NJDEP 2012.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\NJDEP%202012.pdf)

**Abstract** New Jersey is the fifth smallest and most densely populated state in the

Nation, with approximately 8.8 million people living within 7,500 square

miles of land area. New Jersey is also one of the most geologically and

hydrogeologically diverse states, with over 18,000 miles of rivers and

streams; over 50,000 acres of lakes, ponds, and reservoirs; 950,000 acres

of wetlands; 260 square miles of estuaries; 127 miles of coastline; and

over 450 square miles of ocean under its jurisdiction. The combination of

population density, diversity of natural resources, and a wide range of

industries and land uses, presents unique challenges to protecting New

Jersey’s water resources.

Water quality standards, monitoring, and assessment provide the

scientific foundation for the protection of New Jersey’s water resources

and implementation of the federal Clean Water Act and the New Jersey

Water Pollution Control Act. The 2010 Integrated Water Quality

Monitoring and Assessment Report (Integrated Report) describes the

overall quality of New Jersey’s surface waters based on data collected

between January 1, 2004 and December 31, 2008. This data is generated

by various different monitoring organizations and is then compiled and

evaluated by the Department to verify that the data meets the

Department’s data quality requirements. Data is then assessed using

scientific methods developed specifically for the applicable type of

parameter, use, and waterbody to determine compliance with New

Jersey’s surface water quality standards (SWQS).

The SWQS establish stream classifications and the designated uses for all

waters of the State. Designated uses include aquatic life support

(maintenance, migration, and propagation), recreation, fish consumption,

shellfish harvest for consumption, drinking water supply, industrial water

supply, and agricultural water supply. The Department assesses each

applicable designated use for all of the State’s 952 subwatersheds

(assessment units), to determine whether each subwatershed is “fully

supporting” the use, “not supporting” the use, or if insufficient

information is available to assess the use.

**Publication Year** 2012

**Author(s)** Burger, J, M Gochfeld, C Jeitner, M Donio, and T Pittfield

**Title** Lead (Pb) in Biota and Perceptions of Pb Exposure at a Recently

**Publication Type** Journal article

**Journal / Publisher** Journal of Toxicology and Environmental Health, Part A

**Link** [Burger et al 2012.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Burger%20et%20al%202012.pdf)

**Abstract** The Raritan Bay Slag Site (New Jersey) was designated a Superfund site in

2009 because the seawall, jetties, and sediment contained lead (Pb). Our

objective was to compare Pb and mercury (Hg) levels in biota and public

perceptions of exposure at the Superfund and reference sites. Samples

(algae, invertebrates, fish) were collected from the Raritan Bay Slag Site

and reference sites and analyzed for Pb and Hg. Waterfront users were

interviewed using a standard questionnaire. Levels of Pb in aquatic

organisms were compared to ecological and human health safety

standards. Lead levels were related to location, trophic level, and mobility.

Lead levels in biota were highest at the western side of the West Jetty.

Mean Pb levels were highest for algae (Fucus = 53,600 ± 6990 ng/g = ppb

[wet weight], Ulva = 23,900 ± 2430 ppb), intermediate for grass shrimp

(7270 ± 1300 ppb, 11,600 ± 3340 ppb), and lowest for fish (Atlantic

silversides 218 ± 44 ppb). Within species, Pb levels varied significantly

across the sampling sites. Lead levels in algae, sometimes ingested by

individuals, were sufficiently high to exceed human safety levels. Mercury

levels did not differ between the Superfund and reference sites. Despite

the fence and warnings, people (1) used the Superfund and reference

sites similarly, (2) had similar fish consumption rates, and (3) were not

concerned about Pb, although most individuals knew the metal was

present. The fish sampled posed no apparent risk for human consumers,

but the algae did.

**Publication Year** 2012

**Author(s)** Kratzer Environmental Services

**Title** Environmental Resource Inventory for the Borough of Highland Park,

**Publication Type** Report

**Journal / Publisher** Highland Park Environmental Commission

**Link** [Highland Park ERI 2012.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\Highland%20Park%20ERI%202012.pdf)

**Abstract** A Natural Resources Inventory (NRI) was commissioned by the Highland

Park Environmental Commission in 19921 with a grant from the New

Jersey Department of Environmental Protection and Energy, Office of

Environmental Services. In 2010 the Environmental Commission again

won a grant from ANJEC to generate an Environmental Resource Inventory

(ERI), which is equivalent to a NRI. An ERI is an objective set of data and

maps, which documents a town’s natural resources, biological resources,

cultural resources, and more. Thus, the ERI provides a “snapshot” of

Highland Park in 2011 and provides us the opportunity to identify

changes which have occurred over this eighteen-year period.

The technology to generate an ERI has also changed remarkably in these

18 years. Geographic Information Systems (GIS) are now the state of the

art for producing maps for ERIs in which multiple types of information

can be displayed on a single map. Large amounts of data are available

from county, state, and the federal government agencies and are included

in the ERI and maps. Internet references and literature references for data

sources are provided. This ERI has many digital photographs to document

the town and some of its historical resources. The Internet application

“Google Earth” has also provided additional images to make the ERI

accurate to December 2011.

The primary purpose of the ERI is to provide an objective data set (in one

volume) to borough elected officials, borough officials, and commissions

and boards so that they can make better, well-informed decisions on land

use and the environment. The ERI also will provide the Highland Park

resident with a great deal of information about the natural environment,

biological resources, historical resources, and the recreational

opportunities of Highland Park. The ERI also incorporates data from two

historical studies commissioned by the Environmental Commission:

“Stage 1A Reconnaissance Survey, Borough of Highland Park”, 1993 and

“Evaluation of Historical Significance – Livingston Manor District”, 1997,

which enhance the Historical Resources Section of the ERI.

**Publication Year** 2012

**Author(s)** Ravit, B, M Comi, D Mans, C Lynn, F Steimle, S Walsh, R Miskewitz, and S

**Title** Eastern Oysters (Crassostrea virginica) in the Hudson-Raritan Estuary:

**Publication Type** Journal article

**Journal / Publisher** Environmental Practice

**Link** [Ravit et al 2012.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Ravit%20et%20al%202012.pdf)

**Abstract** Once-extensive Eastern Oyster (Crassostrea virginica) reefs in the

Hudson-Raritan Estuary (HRE) were destroyed almost a century ago as a

result of human activities. However, because of improvements in water

quality, the potential exists to reintroduce this ecologically extinct species

to the ecosystem. For over a decade, New York/New Jersey Baykeeper has

conducted oyster restoration activities in support of target ecological

goals proposed in the HRE Comprehensive Restoration Plan (CRP). The

critical research question is whether existing conditions at a proposed

restoration site can actually support long-term Eastern Oyster survival. To

determine the feasibility of restoring this native species in Keyport

Harbor, New Jersey, juvenile oysters were placed in research field plots,

and survivorship and growth were monitored. Data from the first

reported oyster restoration research in the New Jersey (NJ) portion of the

HRE indicate that oysters could indeed be reintroduced into the

ecosystem. After 11 months in situ, research oyster survival rates as high

as 60% were observed. Qualitative tissue observations indicated female

oysters produced eggs that appeared normal and were ready for

spawning. Biodiversity of species collected from the field plots was two-

to threefold greater with adult research oysters present, suggesting that

oysters increased the density and abundance of other marine species.

Sediment deposition patterns indicated that the presence of oysters in

support structures may reduce the degree of topographic relief caused by

winter storm energies. The research ended abruptly on August 9, 2010,

when New Jersey’s Department of Environmental Protection rescinded

the project permit because of concerns that research oysters were

beginning to reach New Jersey’s market size of 2.5 inches. Although initial

data suggest that oysters can survive and reproduce in Raritan Bay and

the potential exists to achieve oyster restoration goals included in the

CRP, the project also highlights the current lack of agreement between

shellfishery regulators and restoration practitioners with respect to oyster

reintroduction in waters where shellfish harvesting is currently

prohibited. Different shellfish management approaches are used in New

England states (Massachusetts, Rhode Island, and Connecticut), where

local control is an important management tool, and in Chesapeake Bay

states (Maryland and Virginia), where federal involvement is relatively

high. Situated between these two distinct shellfish-producing regions,

New Jersey and New York have not supported aggressive reestablishment

of historic Eastern Oyster populations in the HRE, and unlike adjacent

states, have not developed long-term oyster aquaculture plans. The

reluctance to support oyster restoration is due to concerns related to

human health and ecological questions. Examples of best management

practices currently employed in neighboring states offer potential

solutions to address regulatory concerns and could form the basis for

developing a productive long-term strategy to reestablish Eastern Oysters

in the HRE.

**Publication Year** 2012

**Author(s)** Rossiter, WD

**Title** Impacts of Space, Abundance and Food Web Structure on Parasite Life

**Publication Type** Dissertation

**Journal / Publisher** Rutgers University - New Brunswick

**Link** [Rossiter 2012.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Rossiter%202012.pdf)

**Abstract** The search for fundamental patterns or rules by which parasites establish

and persist in free-living species is a rapidly expanding area of interest for

both parasitologists and ecologists. Though host-parasite interactions are

fairly well understood at the population level, little is known about

parasitism at the community level, nor why some free-living species

harbor many parasite taxa while others are seemingly resistant to parasite

establishment. The purpose of this dissertation was to explore several

species and community attributes that could be important to parasite

establishment and persistence in both a marine saltmarsh (Tuckerton, NJ)

and a freshwater riverine system (Raritan River, NJ). This study specifically

emphasized feeding interactions, abundance and spatial distributions of

free-living species and their respective helminth parasites. In Tuckerton

saltmarsh, I observed a strong spatial patterning in trematode infections

of the mudsnail, Ilyanassa obsoleta, and this pattern is strongly correlated

with habitat type and host quality. At the community level (along with

data from four previously published systems), trophically transmitted

parasites were found to utilize asymmetric predator-prey interactions, in

which predator hosts have many prey items and prey hosts have relatively

few predators. In a pristine site along the Raritan River high resolution

abundance data revealed that predator-prey interactions are spatially

constrained by habitat and that this pattern was even stronger for host-

host and parasite-host interactions. Finally, I found a decrease in

efficiency of biomass transfer up trophic levels across a perturbation

gradient in this river system. This pattern correlated with losses in both

free-living and parasite diversity. However, the relationship between these

factors and human impact was not linear, suggesting a threshold at which

community structure becomes less invasible by parasites. Collectively,

this study suggests that spatial context, in combination with community

structure, can greatly affect parasite establishment and persistence and

can be used to explain or predict which free-living species are more

hospitable hosts.

**Publication Year** 2012

**Author(s)** Tsipoura, N, M Allen, & J Kelly

**Title** Connecting People to Urban Wetlands: Preserving Biodiversity in the

**Publication Type** Report

**Journal / Publisher** N/A

**Link** [Tsipoura et al 2012.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\Tsipoura%20et%20al%202012.pdf)

**Abstract** New Jersey Audubon was been involved in surveys of urban habitats for

birds for the past 30 years. Richard Kane, former Vice-president of

Conservation, began conducting surveys and reporting on the

Meadowland's avifauna in 1975. In 1991, Rich Kane headed up a team of

NJAS staff that conducted the first year-long inventory of the Arthur Kill

and Raritan. Much of what we currently know about the seasonal

occurrences of avian species in the urban New Jersey wetlands is based

on this work. More recently, the NJAS’s Research and Monitoring

Department undertook and completed a two-year, systematic study of

avian abundance and distribution in the Meadowlands (2004-2006), an

avian study in the Gateway National Recreation Area (2006-2007), and a

survey of the Lower Raritan (2009).

Though this citizen science project we continued and expanded the 2009

surveys along the lower

Raritan River to provide baseline information on bird use throughout the

watershed. We also performed targeted searches for both new and

historically documented rare plant populations in

the lower and upper Raritan River watersheds, in hopes of updating

scarce information and bringing attention to the unique habitats that

remain amid significant urban sprawl. Results of this project will help set

site acquisition priorities, and direct management and restoration

activities related to reducing fragmentation and improving habitats for

wildlife. The project will also help to connect residents (citizen scientists

and community college students) to the remaining natural areas in this

largely urbanized watershed and the varied and interesting wildlife that

they support.

**Publication Year** 2011

**Author(s)** Bagheri, S

**Title** Nearshore Water Quality Estimation Using Atmospherically Corrected

**Publication Type** Journal article

**Journal / Publisher** Remote Sensing

**Link** [Bagheri 2011.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Bagheri%202011.pdf)

**Abstract** The objective of the research is to characterize the surface spectral

reflectance of the nearshore waters using atmospheric correction

code—Tafkaa for retrieval of the marine water constituent concentrations

from hyperspectral data. The study area is the nearshore waters of New

York/New Jersey considered as a valued ecological, economic and

recreational resource within the New York metropolitan area. Comparison

of the Airborne Visible Infrared Imaging Spectrometer (AVIRIS) measured

radiance and in situ reflectance measurement shows the effect of the

solar source and atmosphere in the total upwelling spectral radiance

measured by AVIRIS. Radiative transfer code, Tafkaa was applied to remove

the effects of the atmosphere and to generate accurate reflectance (R(0))

from the AVIRIS radiance for retrieving water quality parameters (i.e., total

chlorophyll). Chlorophyll estimation as index of phytoplankton

abundance was optimized using AVIRIS band ratio at 675 nm and 702 nm

resulting in a coefficient of determination of R2 = 0.98. Use of the

radiative transfer code in conjunction with bio optical model is the main

tool for using ocean color remote sensing as an operational tool for

monitoring of the key nearshore ecological communities of

phytoplankton important in global change studies.

**Publication Year** 2011

**Author(s)** Heyer, Gruel & Associates, PA

**Title** Edison , Middlesex County, New Jersey Environmental Resource Inventory

**Publication Type** Report

**Journal / Publisher** Edison Township Environmental Commission

**Link** [Edison ERI 2011.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\Edison%20ERI%202011.pdf)

**Abstract** The Environmental Resource Inventory (ERI) is an unbiased report of data

that describes the current state of the various environmental resources in

a community. It is a compilation of text and maps, and forms the baseline

documentation that the community can use to evaluate, and possibly

revise, planning documents, policy initiatives, and local ordinances to better

protect the remaining resources, and when possible, improve the state of

the natural environment.

The ERI is not a policy statement or a plan. Rather, it is an objective listing

of the resources in the community. It can be used as a tool for

Environmental Commissions, Planning Boards and Zoning Boards, as well

as by the Township administration and the public at large. The ERI can be

adopted as part of the Master Plan, or it can be combined with policy

statements and programs to create a Conservation Element for the Master

Plan. ERI’s are often the basis for resource protection ordinances in a

community, which are designed to protect the resources inventoried in

the ERI. Whether the ERI is part of a Conservation Element, or a separate

reference document, it is always seen as dynamic and revisable, as

circumstances on the ground evolve and change.

**Publication Year** 2011

**Author(s)** NJ Department of Environmental Protection

**Title** 2010 Annual Report of the Clean Water Enforcement Act

**Publication Type** Report

**Journal / Publisher** NJ Department of Environmental Protection

**Link** [NJDEP 2011.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\NJDEP%202011.pdf)

**Abstract** In 1972, Congress enacted the first comprehensive national clean water

legislation in response to growing public concern for serious and

widespread water pollution. The Clean Water Act (CWA) is the primary

federal law that protects our nation’s waters, including lakes, rivers,

aquifers and coastal areas.

The CWA established the basic structure for regulating discharges of

pollutants into the waters of the United States by making it unlawful for

any person to discharge any pollutant from a point source unless a

permit was obtained under its provisions. It also gave the United States

Environmental Protection Agency (EPA) the authority to implement

pollution control programs such as setting wastewater standards for

industry and to delegate the primary responsibility to issue permits for

discharges of pollutants and to enforce the permit system to individual

states.

In 1990, the New Jersey Legislature enacted substantial amendments to

the Water Pollution Control

Act (WPCA), commonly known as the Clean Water Enforcement Act

(CWEA), P.L. 1990, and c.28 which included the imposition of mandatory

minimum penalties for certain violations of the WPCA. The CWEA requires

the Department to prepare an annual report on the implementation of

the Act and enforcement actions which the Department and delegated

local agencies (DLAs) have taken during the preceding calendar year. The

statute also specifies the items that the report must contain. The

Department has been implementing the major provisions of the CWEA,

including the mandatory penalty scheme, since July 1, 1991; therefore the

information contained in this report enables the Department and the

Legislature to reflect on more than 20 years of implementation and

enforcement of the CWEA.

**Publication Year** 2010

**Author(s)** Cerucci, M, GK Jaligama, and RB Ambrose, Jr.

**Title** Comparison of the Monod and Droop Methods for Dynamic Water

**Publication Type** Journal article

**Journal / Publisher** Journal of Environmental Engineering ASCE

**Link** [Cerucci et al 2010.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Cerucci%20et%20al%202010.pdf)

**Abstract** The Monod method is widely used to model nutrient limitation and

primary productivity in water bodies. It offers a straightforward approach

to simulate the main processes governing eutrophication and it allows the

proper representation of many aquatic systems. The Monod method is

not able to represent the nutrient luxury uptake by algae, which consists

of the excess nutrient uptake during times of high nutrient availability in

the water column. The Droop method, which is also used to model

nutrient limitation and primary productivity, takes into account the luxury

uptake of nutrients. Because of the relative complexity of the Droop

method, it has not been systematically adopted for the simulation of large

stream networks. The Water Quality Analysis Simulation Program (WASP)

version 7.1 was updated to include nutrient luxury uptake for periphyton

growth. The objective of this paper is to present the new nutrient

limitation processes simulated by WASP 7.1 and to compare the

performance of the Droop and the Monod methods for a complex stream

network where periphyton is the main organism responsible for primary

productivity. Two applications of WASP 7.1 with the Droop and Monod

methods were developed for the Raritan River Basin in New Jersey. Water

quality parameters affecting the transport and fate of nutrients were

calibrated based on observed data collected for the Raritan River total

maximum daily load. The dissolved oxygen and nutrients simulated with

WASP 7.1, obtained with the Droop and Monod methods, were

compared at selected monitoring stations under different flows and

nutrient availability conditions. The comparison of the WASP 7.1

applications showed the importance of using the Droop method when

periphyton was the main organism responsible for primary productivity.

The data simulated with the Droop method resulted in good agreement

with the observed data for dissolved oxygen, ammonia-nitrogen, nitrate-

nitrogen, and dissolved orthophosphate at the selected stations. The

Monod method was not able to capture the diel dissolved oxygen

variation when nutrients were scarce, and it resulted in unrealistic diel

variations of nutrients at times of strong primary productivity at some

locations.

**Publication Year** 2010

**Author(s)** Dahl, SF, J Thiel, and B Allam

**Title** Field Performance and QPX Disease Progress in Cultured and Wild-Type

**Publication Type** Journal Article

**Journal / Publisher** Journal of Shellfish Research

**Link** [Dahl et al 2010.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Dahl%20et%20al%202010.pdf)

**Abstract** A field experiment was conducted to compare the performance of

different hard clam (Mercenaria mercenaria) strains in local clamming

waters of New York state. Experimental clams included a Mercenaria

mercenaria notata seed obtained from a Florida broodstock, and 2 New

York seed strains obtained from local hatcheries, including a cultured M.

mercenaria notata strain and a first-generation ‘‘wild-type’’ strain. Quahog

parasite unknown (QPX) was acquired by the Florida clams in less than

2mo of a July deployment of grow-out cages. Prior field studies

comparing susceptibility of northern and southern hard clam strains

observed QPX acquisition after clams had overwintered in the field,

raising the question that higher susceptibility observed in southern seed

clams could be a result of poor adaptation to winter water temperatures.

Our results show that the southern strain acquired QPX after the clams

had only been exposed to the warmest period of water temperatures for

this field site (22.3\_C on average), thus excluding poor acclimation to

winter temperatures as the main aggravating factor. In contrast, QPX was

not observed until the second summer in the cultured New York (M.

mercenaria notata) strain in which clam survival was high and infection

prevalence remained minimal. The New York ‘‘wild-type’’ clams displayed

good growth and did not acquire QPX at all, providing evidence for the

potential utilization of local wild broodstocks to enhance the resistance

of cultured strains. Histopathology observations offered further insights

to infection dynamics, with early, light infections almost exclusively

localized in mantle and gill tissues, clearly supporting the theory that

these organs (predominately the mantle) are sites of acquisition for QPX

infections.

**Publication Year** 2010

**Author(s)** FX Browne, Inc.

**Title** Hillsborough Township, Somerset County, NJ Natural Resources Inventory

**Publication Type** Report

**Journal / Publisher** Hillsborough Township Environmental Commission

**Link** [Hillsborough NRI 2010.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\Hillsborough%20NRI%202010.pdf)

**Abstract** Hillsborough Township contains a variety of natural resources that are

valuable to the community. Natural resources should be protected to the

greatest extent possible in order to maintain their ecological and

economic value to the Township. Resources can be protected by

conservation easements, the purchase of development rights, property

acquisition, public education, and by Township ordinances.

The purpose of this Natural Resource Inventory (NRI) is to identify,

describe and provide recommendations to preserve and manage the

natural resources of Hillsborough Township. The NRI is an important tool

for environmental commissions, planning boards, zoning boards of

adjustment as well as developers planners, engineers, and environmental

consultants. Readers can use the NRI as a tool to increase their

understanding of the Township’s natural systems, their limitations, and

opportunities for use; to help identify priority areas for open space,

historic, and farmland preservation; as a reference for developing

municipal ordinances; and as a guide in the site plan review process.

**Publication Year** 2010

**Author(s)** Kimbrough, KL, S Commey, DA Apeti, GG Lauenstein

**Title** Chemical Contamination Assessment of the Hudson-Raritan Estuary as a

**Publication Type** Journal article

**Journal / Publisher** Marine Pollution Bulletin

**Link** [Kimbrough et al 2010.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Kimbrough%20et%20al%202010.pdf)

**Abstract** The attack on the World Trade Center (WTC) resulted in the destruction of

buildings, and the release of tons of dust and debris into the

environment. As part of the effort to characterize the environmental

impact of the WTC collapse, Mussel Watch Program trace element

measurements from the Hudson–Raritan Estuary (HRE) were assessed for

the years before (1986–2001) and after (2001–2005) the attack. Trace

element measurements in the HRE were significantly higher than Mussel

Watch measurements taken elsewhere in the Nation. Post-attack trace

element measurements were not significantly different from pre-attack

measurements. The impacts of WTC collapse may have been obscured by

high ambient levels of trace elements in the HRE.

**Publication Year** 2010

**Author(s)** NJ Harbor Dischargers Group

**Title** The New Jersey Harbor Dischargers Group 2010 Water Quality Report

**Publication Type** Report

**Journal / Publisher** NJ Harbor Dischargers Group

**Link** [NJ Harbor Dischargers Group 2010.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\NJ%20Harbor%20Dischargers%20Group%202010.pdf)

**Abstract** The New Jersey Harbor Dischargers Group (NJHDG) is made up of nine

(9) sewerage agencies, representing eleven (11) wastewater treatment

plants in northeastern New Jersey. All of these plants discharge their

treated effluents into the New Jersey portion of the NY/NJ Harbor Estuary.

In 1992, these agencies agreed to collaborate and jointly fund and

perform various water quality studies in the region to add to the water

quality knowledge base for the Harbor. In 2003, the NJHDG began a Long-

Term Ambient Water Quality Monitoring Program for the waters in the

New Jersey portion of the NY/NJ Harbor Estuary, modeled after the

successful New York City Department of Environmental Protection

(NYCDEP) Harbor Survey. The Passaic Valley Sewerage Commission (PVSC)

had previously initiated a long-term ambient water quality monitoring

program of the Passaic River, Hackensack River, and Newark Bay in 2000,

and has taken the lead for the NJHDG monitoring program. Due to the

need for a Harbor-wide monitoring effort, the NJHDG decided to expand

upon PVSC’s original water quality monitoring program, with additional

resources and personnel to cover all of the NJ Harbor waters.

The main objective of the NJHDG Long-Term Ambient Water Quality

Monitoring Program is to develop a comprehensive database for

conventional chemical water quality parameters on the existing water

quality of the NY/NJ Harbor, by routinely and extensively sampling the

waters of the Passaic River, Hackensack River, Newark Bay, Arthur Kill,

Raritan River, Raritan Bay, and the Hudson River. To date, the NJHDG has

gathered six (6) years of high quality data from the NJ Harbor waters.

**Publication Year** 2010

**Author(s)** Zarnadze, A

**Title** Polybrominated Diphenyl Ethers in NY/NJ Harbor and Lower Delaware

**Publication Type** Dissertation

**Journal / Publisher** Rutgers University - New Brunswick

**Link** [Zarnadze 2010.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Zarnadze%202010.pdf)

**Abstract** Present dissertation is a compilation of several projects implemented at

the disarmament of Environmental Science of Rutgers University under

the supervision of Lisa A. Rodenburg. The goal of this work was to

describe the fate and transport of Polybrominated Diphenyl Ethers

(PBDEs) in North-East region of the United States. Chapter 1 of this

dissertation outlines background information on PBDEs, their occurrence

history and environmental and health problems associated with them.

Chapter 2 analyzes atmospheric (particle, gas and rain) levels of PBDEs in

NY/NJ Harbor. Atmospheric levels of BDEs in this region fall into the range

of the values reported by other studies in US and around the world.

Chapter 3 reveals high water column levels of PBDEs in Raritan Bay of

NY/NJ harbor (relative to other aquatic systems in US and around the

world) concluding that atmospheric deposition is not the main source of

BDEs in the NY/NJ Harbor. Dry particle and wet deposition fluxes, as well

as annual load of BDEs, are estimated in this chapter. Chapter 4 deals with

atmospheric levels of BDEs in lower Delaware River valley, obtained by

passive air sampling (PAS) methodology. This is the first study that

describes BDEs in this region.

Overall, atmospheric levels of BDEs are correlated with temperature but

mostly in gas phase rather than in particle phase. Overall, PBDE

concentrations do not show significant relationship with population

density. Although, some congeners (BDE 47) show stronger relationship

with population density at NY/NJ harbor and lower Delaware River valley,

than others (BDE 99 and BDE 209).

Gas-particle partitioning is important aspect of PBDE removal from the

environment and was investigated in this dissertation. Also, water column

partitioning between truly dissolved and particle phases was analyzed.

While heavy molecular weight congener BDE 209 was predominantly

found in particle (air) and particulate (water) phases, light congener BDE

47 was predominantly detected in gas (air) and truly dissolved (water)

phases, and therefore, being more inclined for long range transport in the

environment. As a result, unlike gas phase congeners, particle phase BDE

congeners show strong Penta-BDE (BDE 47 and BDE 99) and Deca-BDE

(BDE 209) commercial mixture signature at these regions.

**Publication Year** 2009

**Author(s)** Clarke Caton Hintz

**Title** Natural Resource Inventory, Franklin Township, Hunterdon County, New

**Publication Type** Report

**Journal / Publisher** Franklin Township Environmental Commission

**Link** [Franklin NRI 2009.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\Franklin%20NRI%202009.pdf)

**Abstract** The purpose of a Natural Resource Inventory (NRI), also known as an

Environmental Resource Inventory (ERI), is to document and describe the

natural resource characteristics and environmental features of a

community, utilizing text, maps and geographical information system

(GIS) data. The NRI identifies significant environmental resources and

provides guidance for the protection, preservation and conservation of

these resources. The document provides reference material for review of

applications that come before the Land Use Board, including

subdivisions, site plans and variances. It can also serve as a useful tool for

property owners in evaluating their property.

**Publication Year** 2009

**Author(s)** Du, S

**Title** Source Apportionment and Measurement of PCBs and POPs in NY/NJ Area

**Publication Type** Dissertation

**Journal / Publisher** Rutgers University - New Brunswick

**Link** [Du 2009.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Du%202009.pdf)

**Abstract** Investigating the source of Persistent Organic Pollutants in ambient air

and water is imperative in the development and implementation of Total

Maximum Daily Load (TMDL) process for the impaired water bodies.

Atmospheric deposition is an important process involved in the TMDL

modeling, therefore one objective of this thesis aims to achieve is how to

identify PCB source types and regions in air. The coupling of Positive

matrix factorization (PMF) model, which is use to apportion the

contributing sources, with potential source contribution function (PSCF)

model, which is used to locate the source regions, allowed the

identification of PCB sources in urban air in Camden, US. Four factors are

identified which are thought to represent sources such as volatilized

Aroclors and particle-phase PCBs. The PSCF model output for ΣPCBs and

the resolved factors suggests that the urban PCB signal is comprised of

multiple signals, some of which may come from discrete sources that can

be identified and remediated.

As an attempt to refine the atmospheric deposition modeling input,

passive sampling study is conducted to investigate the spatial extent of

the urban-impacted elevated atmospheric persistent organic pollutants

(POPs) including PCBs, PAHs, OCPs and BDEs by deploying passive

samplers at 32 sites across the Philadelphia –Camden area. This study

revealed two maxima for PCBs representative of urban (population

density driven) sources vs. industrial sources, highlighting the potential

role of densely populated urban centers as well as industrial areas as

sources of PCBs to the regional environment. PAHs and BDEs all showed

urban-rural gradients with maximum concentrations found in the urban

center. Some of OCPs showed urban-rural gradient, while others exhibited

either a relatively uniform concentration level across the sampling area or

a relatively random spatial distribution.

In order to corroborate the loading estimate used in the development of

TMDL, PMF model is also used to apportion the source of PCBs in

Delaware River and NY/NJ Harbor Estuary. The analysis of ambient water

either generally corroborates the PCB loading estimate used in the water

quality model or identified factors associated with top loading categories

in previous mass balance study.

**Publication Year** 2009

**Author(s)** Kim, IY

**Title** The Sorption, Biotransformation, and Detection of Hormones in the

**Publication Type** Dissertation

**Journal / Publisher** Rutgers University - New Brunswick

**Link** [Kim 2009.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Kim%202009.pdf)

**Abstract** In this dissertation, the sorption, biotransformation, and presence in the

environment of five hormones, 17β-estradiol, 17α-ethinylestradiol,

estrone, androstenedione, and testosterone, were chosen for study.

Sorption to various soils and sediments appears to assume non-linear

characteristics, with n values in the Freundlich isotherm model falling

below unity as well as there being a tendency for log KOC values to

increase as the amount of sorbate decreases. As for inter-soil sorption

comparisons, there appeared to be no obvious correlation between the

sorption capacity of the hormones and the quantity of organic carbon of

the soil, which suggests site-specific interactions between the functional

groups of the hormones and the complex surfaces of the soils/sediments

employed.

Biotransformation studies of three of the hormones to river sediments

reveal that the rate of reaction increased in the order of 17α-

ethinylestradiol < 17β-estradiol < testosterone. The synthetic hormone

used in the birth control pills, 17α-ethinylestradiol, was relatively

recalcitrant compared to the two natural hormones. When the hormone

biotransformation data was compared to the sorbent characteristics of

the same select hormones on the same sediments, it was found in general

that sediments with lower organic carbon content yielded longer lag

times for both female and male hormones.

The field samples of various sewage treatment plant effluent and river

waters of central and northern New Jersey for hormones yielded frequent

detections. At least one hormone was detected at all 9 sampling locations

in central and northern New Jersey. Androstenedione and estrone were

the most frequently detected and found at the highest concentrations.

Hormones were detected at levels known to either induce vitellogenin

production or have pheromonal effects in fish. The low levels of

unconjugated hormone at the combined sewer overflow were most likely

due to the lack of deconjugation in the freshly discharged sewage/rain

water mixture.

**Publication Year** 2009

**Author(s)** Kraeuter, JN, G Flimlin, MJ Kennish, R Macaluso, and J Viggiano

**Title** Sustainability of Northern Quahogs (= Hard Clams) Mercenaria

**Publication Type** Journal article

**Journal / Publisher** Journal of Shellfish Research

**Link** [Kraeuter et al 2009.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Kraeuter%20et%20al%202009.pdf)

**Abstract** In 2000, the northern quahog (=hard clams) Mercenaria mercenaria

population was surveyed in Raritan Bay with the purpose of determining

sustainable harvest levels. To complement this population survey, we

determined the size-at-age structure and experimentally determined

mortality rate and size specific growth of adult clams. Clams of a range of

sizes, obtained from the sampling program, were measured, cleaned, and

aged by counting growth rings in sectioned shells. Experimental plots

were established in the low intertidal zone at two sites in the

Raritan/Sandy Hook Bay system. Marked clams of five sizes were planted

in three seasons and harvested quarterly. Experimental estimates of

mortality and survival were based on collected live and dead individuals

and are thus conservative because they do not address the numbers

missing. Some of the clams from both sites were removed from the area

by predators. Estimated mortality for individuals >25 mm by

instantaneous rate yielded a mean of 0.0176. Integrating the size specific

information with the size-frequency distribution from field survey yielded

an average instantaneous mortality rate of 0.0187. Growth, based on the

difference between the mean size planted and the mean size of the same

size class retrieved was analyzed with a general ANOVA, and exhibited

typical seasonal growth. The smallest size individuals grew faster than

larger individuals. Survey data indicated an increasing clam population

and increasing harvests. The survey mortality estimates, based on box

counts, seem to overestimate losses. Our experimental work suggests

adult mortality rates of nearly 2%, but loss of individuals from the plots

made computation of exact mortality rates difficult, and 2% probably

underestimates adult natural mortality rates. The results indicate that

current levels of fishing mortality are sustainable with 3% natural adult

mortality, but a natural adult mortality rate just above 5% would reduce

the population growth to near zero. This information is important,

because there has been interest in establishing additional depuration

facilities to take advantage of the clam population and put more people to

work. To sustain current levels of harvest, it will be essential to increase

population level monitoring activities over time to assure the population

is not being over harvested because of slight changes in recruitment or

mortality rates.

**Publication Year** 2009

**Author(s)** Liu, Q, B Allam, and JL Collier

**Title** Quantitative Real-Time PCR Assay for QPX (Thraustochytriidae), a Parasite

**Publication Type** Journal Article

**Journal / Publisher** Applied and Environmental Microbiology

**Link** [Liu et al 2009.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Liu%20et%20al%202009.pdf)

**Abstract** We developed a real-time quantitative PCR (qPCR) assay targeting the

rRNA internal transcribed spacer region of the hard clam pathogen QPX.

The qPCR assay was more sensitive than was histology in detecting clams

with light QPX infections. QPX was detected in 4 of 43 sediment samples

but in none of 40 seawater samples.

**Publication Year** 2009

**Author(s)** Money, ES, GP Carter, and ML Serre

**Title** Modern Space/Time Geostatistics Using River Distances: Data Integration

**Publication Type** Journal article

**Journal / Publisher** Environmental Science and Technology

**Link** [Money et al 2009a.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Money%20et%20al%202009a.pdf)

**Abstract** Escherichia coli (E. coli) is a widely used indicator of fecal contamination

in water bodies. External contact and subsequent ingestion of bacteria

coming from fecal contamination can lead to harmful health effects. Since

E. coli data are sometimes limited, the objective of this study is to use

secondary information in the form of turbidity to improve the

assessment of E. coli at unmonitored locations. We obtained all E. coli

and turbidity monitoring data available from existing monitoring networks

for the 2000-2006 time period for the Raritan River Basin, New Jersey.

Using collocated measurements, we developed a predictive model of E.

coli from turbidity data. Using this model, soft data are constructed for E.

coli given turbidity measurements at 739 space/time locations where only

turbidity was measured. Finally, the Bayesian Maximum Entropy (BME)

method of modern space/time geostatistics was used for the data

integration of monitored and predicted E. coli data to produce maps

showing E. coli concentration estimated daily across the river basin. The

addition of soft data in conjunction with the use of river distances

reduced estimation error by about 30%. Furthermore, based on these

maps, up to 35% of river miles in the Raritan Basin had a probability of E.

coli impairment greater than 90% on the most polluted day of the study

period.

**Publication Year** 2009

**Author(s)** Money, ES, GP Carter, and ML Serre

**Title** Using River Distances in the Space/Time Estimation of Dissolved Oxygen

**Publication Type** Journal article

**Journal / Publisher** Water Research

**Link** [Money et al 2009b.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Money%20et%20al%202009b.pdf)

**Abstract** Understanding surface water quality is a critical step towards protecting

human health and ecological stability. Because of resource deficiencies

and the large number of river miles needing assessment, there is a need

for a methodology that can accurately depict river water quality where

data do not exist. The objective of this research is to implement a

methodology that incorporates a river metric into the space/time analysis

of dissolved oxygen data for two impaired river basins. An efficient

algorithm is developed to calculate river distances within the BMElib

statistical package for space/time geostatistics. We find that using a river

distance in a space/time context leads to an appreciable 10% reduction in

the overall estimation error, and results in maps of DO that are more

realistic than those obtained using a Euclidean distance. As a result river

distance is used in the subsequent non-attainment assessment of DO for

two impaired river basins in New Jersey.

**Publication Year** 2009

**Author(s)** Numerous State, Federal, & Regional Agencies

**Title** Hudson-Raritan Estuary Comprehensive Restoration Plan

**Publication Type** Report

**Journal / Publisher** NY-NJ Harbor Estuary Program

**Link** [Hudson-Raritan CRP 2009.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\Hudson-Raritan%20CRP%202009.pdf)

**Abstract** The Comprehensive Restoration Plan (CRP) for the Hudson-Raritan

Estuary (HRE) is a master plan to guide ecosystem restoration efforts

throughout the estuary. It is intended to be used by all stakeholders

(environmental and community groups, government agencies, and

others), thus allowing the whole region to work towards a series of

common restoration goals providing benefits to the estuary.

This effort was initiated in 1988, when Congress recognized the New

York-New Jersey Harbor as an estuary of national importance and

accepted it into the National Estuary Program (NEP).

Following this designation, the Harbor Estuary Program (HEP) completed

a Comprehensive Conservation and Management Plan (CCMP) in March

of 1996. Included among the CCMP’s recommendations was the

development of a comprehensive strategy for habitat protection and

restoration. The US Army Corps of Engineers (USACE), in partnership with

their non-Federal sponsor, The Port Authority of New York & New Jersey,

joined the process of developing the strategy in 1999 with the initiation

of the HRE Ecosystem Restoration Feasibility Study.

**Publication Year** 2008

**Author(s)** Cerucci, M and GK Jaligama

**Title** Hydrologic and Water Quality Integration Tool: HydroWAMIT

**Publication Type** Journal article

**Journal / Publisher** Journal of Environmental Engineering ASCE

**Link** [Cerucci & Jaligama 2008.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Cerucci%20&%20Jaligama%202008.pdf)

**Abstract** A spatially distributed and continuous hydrologic model focusing on

total maximum daily load (TMDL) projects was developed. Hydrologic

models frequently used for TMDLs such as the hydrologic simulation

program—FORTRAN (HSPF), soil and water assessment tool (SWAT), and

generalized watershed loading function (GWLF) differ considerably in

terms of spatial resolution, simulated processes, and linkage flexibility to

external water quality models. The requirement of using an external water

quality model for simulating specific processes is not uncommon. In

addition, the scale of the watershed and water quality modeling, and the

need for a robust and cost-effective modeling framework justify the

development of alternative watershed modeling tools for TMDLs. The

hydrologic and water quality integration tool (HydroWAMIT) is a spatially

distributed and continuous time model that incorporates some of the

features of GWLF and HSPF to provide a robust modeling structure for

TMDL projects. HydroWAMIT operates within the WAMIT structure,

developed by Omni Environmental LLC for the Passaic River TMDL in N.J.

HydroWAMIT is divided into some basic components: the hydrologic

component, responsible for the simulation of surface flow and baseflow

from subwatersheds; the nonpoint source (NPS) component, responsible

for the calculation of the subwatershed NPS loads; and the linkage

component, responsible for linking the flows and loads from

HydroWAMIT to the water quality analysis simulation program (WASP).

HydroWAMIT operates with the diffusion analogy flow model for flow

routing. HydroWAMIT provides surface runoff, baseflow and associated

loads as outputs for a daily timestep, and is relatively easy to calibrate

compared to hydrologic models like HSPF. HydroWAMIT assumes that the

soil profile is divided into saturated and unsaturated layers. The water

available in the unsaturated layer directly affects the surface runoff from

pervious areas. Surface runoff from impervious areas is calculated

separately according to precipitation and the impervious fractions of the

watershed. Baseflow is given by a linear function of the available water in

the saturated zone. The utility of HydroWAMIT is illustrated for the North

Branch and South Branch Raritan River Watershed (NSBRW) in New

Jersey. The model was calibrated, validated, and linked to the WASP. The

NPS component was tested for total dissolved solids. Available weather

data and point-source discharges were used to prepare the

meteorological and flow inputs for the model. Digital land use, soil type

datasets, and digital elevation models were used for determining input

data parameters and model segmentation. HydroWAMIT was successfully

calibrated and validated for monthly and daily flows for the NSBRW

outlet. The model statistics obtained using HydroWAMIT are comparable

with statistics of HSPF and SWAT applications for medium and large

drainage areas. The results show that HydroWAMIT is a feasible alternative

to HSPF and SWAT, especially for large-scale TMDLs that require

particular processes for water quality simulation and minor hydrologic

model calibration effort.

**Publication Year** 2008

**Author(s)** NJ Department of Environmental Protection

**Title** Routine Monitoring Program for Toxics in Fish - Year 3: raritan River Region

**Publication Type** Report

**Journal / Publisher** NJDEP

**Link** [NJDEP 2008.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\NJDEP%202008.pdf)

**Abstract** This New Jersey Department of Environmental Protection (NJDEP)

monitoring program is the third year of a five-year program that builds

upon prior fish contamination research. The program, conducted by the

NJDEP’s Division of Science, Research and Technology (DSRT), focuses on

collection of fish species currently under fish consumption advisories

due to chemical contamination, and to assess the status and trends of

these contaminants in the state’s aquatic systems. This year 3 program

primarily examined the entire Raritan River Region. Samples were collected

in 2006-07. In general, only a few of the samples exceeded high action

levels (e.g., FDA Action Levels for mercury, PCBs, DDX and chlordane).

However, the majority of samples did exceed various risk-based (human

health) thresholds (utilized by the State) and in many cases, the individual

specimens exceeded thresholds for several contaminants. Some sites,

notably New Market Pond and the Bound Brook downstream of New

Market Pond (several fish species) and Raritan Bay and South River (blue

crab hepatopancreas tissue) had high concentrations of a variety of

chemical contaminants. Low concentrations of contaminants were found

in samples of summer flounder from Sandy Hook Bay and weakfish from

Manahawkin Bay. Comparable samples of similar size species from the

same sites collected in 1992 and 2006 DSRT studies revealed mercury

concentrations generally similar between the two years. However, lower

concentrations were seen in 2006 northern pike from Spruce Run

Reservoir and largemouth bass from Carnegie Lake when compared to

1992. The patterns of contaminant concentrations in fish reflect

individual fish characteristics such as size (typically higher in larger, older

fish), trophic level (high mercury in top predators) and lipid content (for

organic contaminants). Sample site differences, indicative of current or

past point sources (e.g., New Market Pond) and regional differences also

affect contaminant biogeochemistry. The data generated through the

Routine Monitoring Program are used by NJDEP and NJDHSS to develop

various fish consumption

advisories for the fish consuming public.

**Publication Year** 2008

**Author(s)** Smith, LM

**Title** Land-Atmosphere Exchange of Mercury in Temperate Wetlands

**Publication Type** Dissertation

**Journal / Publisher** Rutgers University - New Brunswick

**Link** [Smith 2008.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Smith%202008.pdf)

**Abstract** Gaseous elemental mercury (Hg0) cycling in temperate wetlands was

evaluated by performing an atmospheric deposition study in addition to

in situ micrometeorological and laboratory dynamic flux chamber

experiments examining New Jersey salt marsh sediments.

Mercury wet deposition was measured at an urban/suburban site in

eastern central New Jersey (New Brunswick) and at a rural site in

northwestern New Jersey (Belvidere). Volume-weighted mean mercury

concentrations in precipitation were greater in New Brunswick (11 ng L-1)

than Belvidere (8.6 ng L-1) and exhibited seasonality with highest

concentrations in the summer. Over a seven year period (1999-

2002 from Zhuang 2004, plus 2003-2006 from this study), mercury

concentrations in New Brunswick precipitation decreased at a rate of 0.2

μg m-2 y-1, while over a three year period (2002-2005) in Belvidere,

mercury concentrations were constant. Annual wet deposition fluxes for

New Brunswick and Belvidere were 12 and 11 μg m-2 y-1 respectively,

similar to previous estimates for New Jersey. No patterns were observed

between Hg and other analyzed trace metals. Meteorological conditions

also did not correlate, indicating local and regional sources.

In situ estimates of sediment-air mercury volatilization fluxes were an

order of magnitude higher at the Secaucus High School Marsh (-375 to

+677 ng m-2 h-1) than at the Great Bay estuary (-34 to +81 ng m-2 h-1).

Mercury volatilization fluxes were positively correlated with solar

radiation at the Great Bay estuary but only on one out of six sampling

days in Secaucus, potentially a result of tides. Areally averaged annual

mercury emissions from Secaucus (0.06 kg y-1) are much lower than

those from industrial sources in New Jersey, but preliminary scaling up of

mercury emissions estimated for the much larger Great Bay estuary (13 kg

y-1) indicate that it is comparable to minor industrial sources in the

State.

Laboratory flux chamber experiments showed that photochemistry is

more important in sediment-air mercury volatilization than other

physicochemical sediment characteristics. In the light, mercury flux from

sediments was up to 50 times larger than in the dark, with the greatest

emissions observed during visible + UV treatments, as observed in the

natural environment.

**Publication Year** 2008

**Author(s)** Zarnadze, A and LA Rodenburg

**Title** Water-Column Concentrations and Partitioning of Polybrominated

**Publication Type** Journal article

**Journal / Publisher** Environmental Toxicology and Chemistry

**Link** [Zarnadze & Rodenberg 2008.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Zarnadze%20&%20Rodenberg%202008.pdf)

**Abstract** Despite the emerging concern regarding polybrominated diphenyl ethers

(BDEs), very few measurements of BDE concentrations in ambient water

have been published. In the present study, BDEs were measured in water

samples from the New York/New Jersey Harbor (USA). Samples were taken

in Raritan Bay west of Sandy Hook during four intensive sampling

campaigns in 2000 and 2001. Congeners 17, 47, 99, 100, 153, 154, 183,

and 209 were detected. Total BDE (∑BDE) concentrations (average +

standard deviation) were 175 + 75 ng/g in the particle phase and 110 + 72

pg/L in the apparent dissolved phase. The decacongener, BDE 209,

constituted 85 and 9% of ∑BDEs in the particle and apparent dissolved

phases, respectively. The ∑BDE levels are significantly higher than those

measured in Lake Ontario, USA, and in The Netherlands, but they are

similar to concentrations measured in Lake Michigan and San Francisco

Bay (both USA). Calculated values of the organic carbon–water partition

coefficient (KOC) were strongly correlated with literature values of the

octanol–water partition coefficient (KOW). The data suggest that sorption

of BDEs to colloids is important in this system, although quantifying the

extent of colloid sorption is difficult.

**Publication Year** 2007

**Author(s)** Bain, M, J Lodge, D Suszkowski, and M Matuszeski

**Title** Target Ecosystem Characteristics for the Hudson Raritan Estuary

**Publication Type** Report

**Journal / Publisher** Hudson River Foundation

**Link** [Bain et al 2007.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\Bain%20et%20al%202007.pdf)

**Abstract** The Hudson-Raritan Estuary (HRE) environmental restoration program

was authorized by the U.S. Congress in 1999, and developed as an effort

of an array of agencies and organizations to enhance port facilities, the

regional economy, and the New York/ New Jersey Harbor environment.

However, progress has been slowed by the lack of an ecosystem-scale

restoration approach, a program goal, clear objectives, a method for

selecting specific projects, and the capability to report progress.

Therefore, the HRE program asked an interdisciplinary expert team to

develop an ecosystem context for restoration, a system scale plan to

frame specific projects, measurable objectives, and a means to track

program performance. This report presents a holistic plan based on

scientific knowledge and designed to guide the HRE agencies and

organizations identifying site-specific projects and making a detailed

restoration agenda. This report also describes and justifies an approach

to ecosystem restoration, includes public interests, synthesizes

information from agency programs and scientists, and establishes a

framework for relevance and public information.

**Publication Year** 2007

**Author(s)** Bass, CS

**Title** Parasite Communities and Effects on Mummichog (Fundulus

**Publication Type** Dissertation

**Journal / Publisher** Rutgers University - New Brunswick

**Link** [Bass 2007.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Bass%202007.pdf)

**Abstract** Fundulus heteroclitus, the killifish or the mummichog, is commonly

found in estuarine waters. Fundulus spp. have played important roles in

advancing our understanding of different aspects in biology such as

physiology, behavior, and genetics due to their hardiness and distribution

and abundance. Because parasites are so ubiquitous and can affect host

physiology, behavior, and ultimately ecology, it is important to know how

parasites are distributed among host populations and which populations

are more susceptible to infection. A baseline survey was conducted over

two-years, examining the parasite communities of 280 F. heteroclitus

(138 males, 142 females) from seven sites throughout New Jersey and

New York in early and late season collections. The gills, digestive tract,

liver, body cavity and swim bladder were examined and all macroparasites

were recorded. Parasite communities varied spatially over site and habitat,

and temporally by year and season. Host sex did not play a significant

role. Salinity appeared to play a large part in structuring communities as

did site disturbance (e.g., restoration). Heavy gill infections (>2,000

parasites) were found in fish from a restored site during the baseline

survey so a more focused investigation of F. heteroclitus gills ensued.

Using fish from three restored and three unrestored sites from the

Hackensack Meadowlands, behavior, physiology, anatomy and gill

parasite abundance were examined. Fish from restored sites had the

greatest number of digenean trematode metacercariae gill infections

(Ascocotyle phagicola diminuta and Echinochasmus schwartzi) compared

to fish from unrestored sites. Heavily parasitized individuals spent more

time at the water’s surface and exhibited more conspicuous behaviors,

which could enhance trophic transmission. Heavily parasitized fish also

had greater stamina, lower respiration rates, larger red blood cells and

greater blood volume. They also induced gill tissue growth, forming

additional branches as a response to the metacercariae, probably as a way

to compensate for reduced oxygen extraction. This study has shown that

parasite-host relationships are highly dynamic interactions and that

heavy gill infections with digenean trematode metacercariae can

significantly shape host’s physiology, behavior and anatomy.

**Publication Year** 2007

**Author(s)** HydroQual & CARP

**Title** A Model for the Evaluation and Management of Contaminants of Concern

**Publication Type** Report

**Journal / Publisher** Contaminant Assessment & Reduction Project

**Link** [CARP Model 2007 Contaminant.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\CARP%20Model%202007%20Contaminant.pdf)

**Abstract** N/A

**Publication Year** 2007

**Author(s)** Hydroqual & CARP

**Title** A Model for the Evaluation and Management of Contaminants of Concern

**Publication Type** Report

**Journal / Publisher** Contaminant Assessment & Reduction Project

**Link** [CARP Model 2007 Hydrodynamics.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\CARP%20Model%202007%20Hydrodynamics.pdf)

**Abstract** N/A

**Publication Year** 2007

**Author(s)** Hydroqual & CARP

**Title** A Model for the Evaluation and Management of Contaminants of Concern

**Publication Type** Report

**Journal / Publisher** Contaminant Assessment & Reduction Project

**Link** [CARP Model 2007 Sediment.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\CARP%20Model%202007%20Sediment.pdf)

**Abstract** N/A

**Publication Year** 2007

**Author(s)** Lathrop, RG, DL Tulloch, and C Hatfield

**Title** Consequences of Land Use Change in the New York-New Jersey

**Publication Type** Journal Article

**Journal / Publisher** Landscape and Urban Planning

**Link** [Lathrop et al 2007.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Lathrop%20et%20al%202007.pdf)

**Abstract** The New York–New Jersey Highlands, a 600,000 ha area of forested

uplands, provide vital environmental services to the growing New York

City, USA metropolitan region. Urban development and associated land

use/land cover change threaten to impair the Highland’s natural resource

values.

In response, the USDA Forest Service, in collaboration with Rutgers

University, the U.S. Geological Survey, and the Regional Plan Association,

undertook a regional study of the NY–NJ Highlands to characterize the

resources at stake and assess the implications of continued land use

change. This paper will focus on the Highlands as a case study on the

application of landscape-scale indicators to assess the potential impacts

of future land use change. A three-pronged approach was adopted: (1)

land use/land cover change mapping to assess past changes, (2) build-

out modeling to project possible future land use change, and (3)

landscape-scale indicators of forest and watershed condition. The

coupled build-out and landscape indicator analysis served as a planning

tool to assess the potential impacts to forest and watershed integrity

based on two different scenarios of future development.

**Publication Year** 2007

**Author(s)** Lauenstein, GG and KL Kimbrough

**Title** Chemical Contamination of the Hudson-Raritan Estuary as a Result of the

**Publication Type** Journal article

**Journal / Publisher** Marine Pollution Bulletin

**Link** [Lauenstein & Kimbrough 2007.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Lauenstein%20&%20Kimbrough%202007.pdf)

**Abstract** The September 11, 2001 attack on the World Trade Center (WTC) resulted

in a massive plume of dust and smoke that blanketed lower Manhattan

and part of the Hudson-Raritan Estuary (HRE). The NOAA National Status

and Trends Mussel Watch Program has long-term monitoring sites in the

area and thus had an opportunity to assess the effect of the WTC attack

on PAH and PCB contamination of the surrounding estuary. Seven

additional sites were added in the Upper HRE to attain higher sampling

resolution for comparison with regularly sampled Mussel Watch Project

HRE sites. Elevated background levels of PCBs and PAHs in mussel tissue

and sediments were high enough before the WTC attack that

concentrations were not measurably changed by WTC derived

contaminant input.

**Publication Year** 2007

**Author(s)** Obropta, CC and GM Rusciano

**Title** Erratum: Addressing Total Phosphorus Impairments with Water Quality

**Publication Type** Journal article

**Journal / Publisher** Journal of the American Water Resources Association

**Link** [Obropta & Rusciano 2007.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Obropta%20&%20Rusciano%202007.pdf)

**Abstract** N/A

**Publication Year** 2007

**Author(s)** Rodriguez, W, PV August, Y Wang, JF Paul, A Gold, and N Rubinstein

**Title** Empirical Relationships Between Land Use/Cover and Estuarine Condition

**Publication Type** Journal article

**Journal / Publisher** Landscape Ecology

**Link** [Rodriguez et al 2007.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Rodriguez%20et%20al%202007.pdf)

**Abstract** Land–water interactions were examined in three regions in the Virginian

Biogeographic Province; the southern shore of Cape Cod, Massachusetts;

the Hudson/Raritan region of New York; and the eastern shore of the

Delmarva (Delaware/Maryland/Virginia) Peninsula. Cumulative

distribution functions were used to evaluate similarity in environmental

condition among estuaries. Spatial-setting variables (location in a river,

coastal lagoon, or in open waters) were associated with variation for some

measures of estuarine condition. Patterns of coastal urban and

agriculture gradients were measured and their relationship with indicators

of estuarine condition was modeled statistically. When estuaries were

pooled, the highest variation explained by spatial-setting variables was

found for dissolved oxygen (DO, R2 = 0.44) and salinity (R2 = 0.58), with

DO decreasing in river locations and salinity decreasing with rainfall and

sampling locations near rivers. The explanatory power for the other

indicator variables was low and varied from 6% to 27%. Rainfall explained

some of the variation (R2 = 0.23) in total suspended solids. Moderate

(0.4 < | r | < 0.7) to strong (| r | > 0.7) linear associations were found

between total urban area and measures of estuarine condition. Within

regions, total urban area was positively associated with Silver (r = 0.59),

Cadmium (r = 0.65), and Mercury (r = 0.47) in Cape Cod, and inversely

related to DO (r = –0.65) in the Hudson/Raritan region. No associations

were found in the Delmarva Peninsula study area. Total area of agriculture

showed a moderate association with Arsenic in Cape Cod, but no other

associations were found in the other two regions. Our analyses show a

measurable impact of urban land use on coastal ecosystem condition

over large areas of the northeastern United States. This pattern was most

evident when many different landscapes were considered simultaneously.

The relationship between urban development and estuarine condition

were weaker within the individual regions studied. The use of land

use/cover models for predicting estuarine condition is a challenging task

that warrants enhancements in the type, quantity, and quality of data to

improve our ability to discern relationships between anthropogenic

activities on land and the condition of coastal environments.

**Publication Year** 2007

**Author(s)** Stevens Institute of Technology

**Title** Ambient Monitoring of Water Quality within Major Tributaries & the

**Publication Type** Report

**Journal / Publisher** Stevens Institute of Technology

**Link** [Stevens Institute 2007.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\Stevens%20Institute%202007.pdf)

**Abstract** The presence of toxic chemicals in the water and sediments of New York-

New Jersey Harbor has resulted in reduced water quality, fisheries

restrictions/advisories, reproductive impairments in some species, and

general adverse impacts to the estuarine and coastal ecosystems. In

addition, problems associated with the management of contaminated

dredged material have resulted in uncertainty regarding planned

construction and future maintenance of the maritime infrastructure that

supports shipping in the harbor.

The New Jersey Toxics Reduction Workplan for NY-NJ Harbor (NJTRWP)

includes a series of studies designed to provide the NJ Department of

Environmental Protection with the information it needs to identify

sources of the toxic chemicals of concern, and to prioritize these sources

for appropriate action. The primary goal of the water quality components

of NJTRWP Studies I-D and I-E (undertaken by Stevens Institute of

Technology) is to determine the relative importance of the discharges of

selected organic and inorganic toxic contaminants originating within the

watersheds of the major New Jersey tributaries to the harbor.

Study I-D of the NJTRWP involved the collection and analysis of water

samples in the tidal portions of the major New Jersey tributaries to the

harbor – the Passaic, Hackensack, Elizabeth, Rahway, and Raritan Rivers.

Sampling was also undertaken in the estuarine areas of Newark Bay, the

Arthur Kill, and the Kill van Kull under NJTRWP Study I-E. State-of-the-art

sampling and analytical procedures were used to determine the

concentrations of metals (Cd, Pb, Hg, and methyl-Hg), PCBs,

dioxins/furans, pesticides, and PAHs in the water column. Sampling was

conducted from June 2000 to May 2002 at ten (10) fixed sampling sites

located on the banks of the tributary rivers, and five (5) ship-board

locations in the estuarine areas of the harbor. Sampling targeted defined

dry weather/low river flow and wet weather/high river flow hydrologic

conditions in the tributaries. This is by far the most comprehensive

sampling for toxic contaminants ever to occur in this economically

important and complex estuarine system.

**Publication Year** 2007

**Author(s)** US Geological Survey

**Title** Concentrations and Loads of Organic Compounds and Trace Elements in

**Publication Type** Report

**Journal / Publisher** USGS

**Link** [USGS 2007.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\USGS%202007.pdf)

**Abstract** A study was undertaken to determine the concentrations and loads of

sediment and chemicals delivered to Newark and Raritan Bays by five

major tributaries: the Raritan, Passaic, Rahway, Elizabeth, and Hackensack

Rivers. This study was initiated by the State of New Jersey as Study I-C of

the New Jersey Toxics Reduction Workplan for the New York-New Jersey

Harbor, working under the NY-NJ Harbor Estuary Program (HEP)

Contaminant Assessment and Reduction Program (CARP). The CARP is a

comprehensive effort to evaluate the levels and sources of toxic

contaminants to the tributaries and estuarine areas of the NY-NJ Harbor,

including Newark and Raritan Bays. The Raritan and Passaic Rivers are

large rivers (mean daily discharges of 1,189 and 1,132 cubic feet per

second (ft3/s), respectively), that drain large, mixed rural/urban basins.

The Elizabeth and Rahway Rivers are small rivers (mean daily discharges of

25.9 and 49.1 ft3/s, respectively) that drain small, highly urbanized and

industrialized basins. The Hackensack River drains a small, mixed

rural/urban basin, and

its flow is highly controlled by an upstream reservoir (mean daily

discharge of 90.4 ft3/s). These rivers flow into urbanized estuaries and

ultimately, to the Atlantic Ocean.

**Publication Year** 2006

**Author(s)** Dimou, KN, TL Su, RI Hires, and R Miskewitz

**Title** Distribution of Polychlorinated Biphenyls in the Newark Bay Estuary

**Publication Type** Journal article

**Journal / Publisher** Journal of Hazardous Materials

**Link** [Dimou et al 2006.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Dimou%20et%20al%202006.pdf)

**Abstract** As part of the NJ Toxics Reduction Workplan for NY/NJ Harbor, ambient

water samples were collected at 15 locations along the tidal portions of

the Hackensack, Passaic, Raritan, Rahway and Elizabeth Rivers, and in

Newark Bay, the Arthur Kill, and Kill van Kull. A Trace Organics Platform

Sampler was used to collect a total of 73 dissolved phase and 73

suspended sediment phase samples between June 2000 and May 2002.

These samples were analyzed for spatial and wet versus dry weather

trends in the 114 polychlorinated biphenyls (PCBs; modified USEPA

Method 1668A). Mean total PCB concentrations at the sampling

locations ranged between 3.45 and 56 ng/L. PCB homolog groups

distribution patterns at the sampling locations are presented.

**Publication Year** 2006

**Author(s)** Obropta, CC and GM Rusciano

**Title** Addressing Total Phosphorus Impairments with Water Quality Trading

**Publication Type** Journal article

**Journal / Publisher** Journal of the American Water Resources Association

**Link** [Obropta & Rusciano 2006.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Obropta%20&%20Rusciano%202006.pdf)

**Abstract** Water quality trading is a voluntary economic process that provides an

opportunity for dischargers to reduce the costs associated with meeting a

discharge limitation. Trading can provide a cost effective solution for

point sources (i.e., wastewater treatment plants) to meet strict effluent

limitations set in response to total maximum daily loads (TMDLs). A

successful trading program often depends on first determining the

trading suitability of a pollutant for a particular watershed. A simple

technical approach has been developed to identify subwatersheds within

the Raritan River Basin, New Jersey, where water quality trading could

provide a cost effective and scientifically feasible method for addressing

total phosphorus impairments. The methodology presented will serve as a

model to conduct similar analyses in other watersheds. The Raritan River

Basin was divided into 12 subwatershed-based study areas. Point-

nonpoint source trading opportunities were examined for each study area

by examining the point and nonpoint source total phosphorus loading

to impaired water bodies. Of the 12 subwatersheds examined, four had a

high potential for implementing a successful trading program. Since

instream phosphorus concentrations are closely related to soil erosion,

an additional analysis was performed to examine soil erodibility.

Recommendations are presented for conducting an economic analysis

following the feasibility study.

**Publication Year** 2006

**Author(s)** Totten, LA & A Zarnadze

**Title** Measurement of Poly-Brominated Diphenyl Ethers (PBDEs) in the Air and

**Publication Type** Report

**Journal / Publisher** Rutgers University

**Link** [Totten & Zarnadze 2006.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\Totten%20&%20Zarnadze%202006.pdf)

**Abstract** In this study, Polybrominated Diphenyl Ethers (BDEs) were measured in

atmospheric and water samples collected as part of two projects: the New

Jersey Atmospheric Deposition Network (NJADN), and a previous grant

from the Hudson River Foundation (HRF 004/99A) designed to measure

exchange of polychlorinated biphenyls (PCBs) between air, water, and

phytoplankton.

**Publication Year** 2006

**Author(s)** US Geological Survey

**Title** Organic Compounds, Trace Elements, Suspended Sediment, and Field

**Publication Type** Report

**Journal / Publisher** USGS

**Link** [USGS 2006.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\USGS%202006.pdf)

**Abstract** Concentrations of suspended sediment, particulate and dissolved organic

carbon, trace elements, and organic compounds were measured in

samples from the heads-of-tide of the five tributaries to the Newark and

Raritan Bays during June 2000 to June 2003. The samples were collected

as part of the New Jersey Department of Environmental Protection Toxics

Reduction Workplan/Contaminant Assessment Reduction Program.

Samples of streamwater were collected at water-quality sampling stations

constructed near U.S. Geological Survey gaging stations on the Raritan,

Passaic, Hackensack, Rahway, and Elizabeth Rivers. Sampling was

conducted during base-flow conditions and storms. Constituent

concentrations were measured to determine the water quality and to

calculate the load of sediment and contaminants contributed to the bays

from upstream sources.

Water samples were analyzed for suspended sediment, dissolved organic

carbon, particulate organic carbon, and specific conductance. Samples of

suspended sediment and water were analyzed for 98 distinct

polychlorinated biphenyl congeners, 7 dioxins, 10 furans, 27 pesticides,

26 polycyclic aromatic hydrocarbons, and the trace elements cadmium,

lead, mercury, and methyl-mercury. Measurements of ultra-low

concentrations of organic compounds in sediment and water were

obtained by collecting 1 to 3 grams of suspended sediment on glass fiber

filters and by passing at least 20 liters of filtered water through XAD-2

resin. The extracted sediment and XAD-2 resin were analyzed for organic

compounds by high- and low-resolution gas chromatography mass-

spectrometry that uses isotope dilution procedures. Trace elements in

filtered and unfiltered samples were analyzed for cadmium, lead, mercury,

and methyl-mercury by inductively coupled charged plasma and mass-

spectrometry.

All constituent concentrations are raw data. Interpretation of the data will

be completed in the second phase of the study.

**Publication Year** 2005

**Author(s)** Bagheri, S, S Peters, and T Yu

**Title** Retrieval of Marine Water Constituents from AVIRIS Data in the

**Publication Type** Journal article

**Journal / Publisher** International Journal of Remote Sensing

**Link** [Bagheri et al 2005.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Bagheri%20et%20al%202005.pdf)

**Abstract** This paper reports on the validation of bio-optical models in estuarine

and nearshore (case 2) waters of New Jersey–New York to retrieve

accurate water leaving radiance spectra and chlorophyll concentration

from the NASA Airborne Visible Infrared Imaging Spectrometer (AVIRIS)

data complemented with in situ measurements. The study

area—Hudson/Raritan Estuary—is a complex estuarine system where tidal

and wind-driven currents are modified by freshwater discharges from the

Hudson, Raritan, Hackensack, and Passaic rivers. Over the last century

the estuarine water quality has degraded, in part due to eutrophication,

which has disrupted the pre-existing natural balance, resulting in

phytoplankton blooms of both increased frequency and intensity,

increasing oxygen demand and leading to episodes of hypoxia. During

1999–2001 data acquisitions by NASA AVIRIS field measurements were

obtained to establish hydrological optical properties of the

Hudson/Raritan Estuary: (1) concurrent above- and below-surface

spectral irradiance; (2) sampling for laboratory determination of inherent

optical properties; and (3) concentrations of optically-important water

quality parameters. We used a bio-optical model based on Gordon et al.

to predict the sub-surface irradiance reflectance from optically important

water constituents. Modelling of reflectance is a prerequisite for

processing remote sensing data to desired thematic maps for input into

the geographical information system (GIS) for use as a management tool

in water quality assessment. A Radiative Transfer Code—MODTRAN-

4—was applied to remove the effects of the atmosphere so as to infer the

water leaving radiance from the AVIRS data. The results of this procedure

were not satisfactory, therefore an alternative approach was tested to

directly correct the AVIRIS image using modelled spectra based on

measured optical characteristics. The atmospherically corrected AVIRIS

ratio image was used to calculate a thematic map of water quality

parameters (i.e. chlorophyll-a) concentration, which subsequently were

integrated into a GIS for management of water quality purposes.

**Publication Year** 2005

**Author(s)** Paulson, AJ

**Title** Tracing Water and Suspended Matter in Raritan and Lower New York Bays

**Publication Type** Journal article

**Journal / Publisher** Marine Chemistry

**Link** [Paulson 2005.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Paulson%202005.pdf)

**Abstract** Geochemical tracers were used to examine the mixing of water and

particles in Lower New York and Raritan Bays in August 1999 during low-

flow conditions. Four brackish water masses (20VS V28) originating in the

Raritan and Shrewsbury Rivers, Arthur Kill, and Upper New York Bay were

characterized by their dissolved metals concentrations. The mixing lines

of dissolved Cu, Ni, and Pb in Lower New York Bay were similar to those in

Upper New York Bay, the source of most of the freshwater to the system.

Dissolved Cd and Mn seemed to have been removed by particles in

several regions of the study. Dissolved Cu, Ni and Pb in the Raritan River

fell below the mixing lines of the Lower New York Bay. In contrast, the

concentrations of dissolved Co and Mn in the Raritan River were

distinctly higher than those in the Lower New York Bay, while dissolved Cu

and Ni were elevated in the Arthur Kill. A plot of dissolved Co versus

dissolved Ni clearly differentiated among three water masses: (1) Upper

and Lower New York Bays and Sandy Hood Bay, (2) the Raritan River, and

(3) Arthur Kill–Raritan Bay–Shrewsbury River.

The concentrations of 22 elements also were measured in the suspended

matter of Raritan and Lower New York Bays and brackish water sources.

The elemental composition of the suspended matter in surface and

bottom waters was correlated with Fe concentrations, which ranged

between 50 and 900 μmol/g. Statistical differences among the

geographical regions were detected in the relationships of Ti, Ni, Co, As,

and U with Fe, with particulate As being an especially strong geochemical

indicator of Raritan River particles. The geochemical signatures of Lower

New York Bay particles were similar to those of Upper New York Bay. The

geochemical signatures of Raritan River particles were distinctly different

than those of the Upper New York Bay, but the influence of Raritan River

particles appeared to be limited to only inner Raritan Bay. This study

illustrates the utility of trace elements for characterization of physical

processes in complex estuaries.

**Publication Year** 2004

**Author(s)** Stehlik, LL, RA Pikanowski, and DG McMillan

**Title** The Hudson-Raritan Estuary as a Crossroads for Distribution of Blue

**Publication Type** Journal Article

**Journal / Publisher** Fishery Bulletin

**Link** [Stehlik et al 2004.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Stehlik%20et%20al%202004.pdf)

**Abstract** Blue (Callinectes sapidus) (Portunidae), lady (Ovalipes ocellatus)

(Portunidae), and Atlantic rock (Cancer irroratus) (Cancridae) crabs

inhabit estuaries on the northeast United States coast for parts or all of

their life cycles. Their distributions overlap or cross during certain

seasons. During a 1991-94 monthly otter trawl survey in the Hudson-

Raritan Estuary between New York and New Jersey, blue and

lady crabs were collected in warmer months and Atlantic rock crabs in

colder months. Sex ratios, male:

female, of mature crabs were 1:2.0 for blue crabs, 1:3.1 for lady crabs,

and 21.4:1 for Atlantic rock crabs.

Crabs, 1286 in total, were subsampled for dietary analysis, and the

dominant prey taxa for all crabs, by volume of foregut contents, were

mollusks and crustaceans. The proportion of amphipods and shrimp in

diets decreased as crab size increased. Trophic niche breadth was widest

for blue crabs, narrower for lady crabs, and narrowest for Atlantic rock

crabs. Trophic overlap was lowest between lady crabs and Atlantic rock

crabs, mainly because of frequent consumption of the dwarf surfclam

(Mulinia

lateralis) by the former and the blue mussel (Mytilus edulis) by the latter.

The result of cluster analysis showed that size class and location of

capture of predators in the estuary were more influential on diet than the

species or sex of the predators.

**Publication Year** 2004

**Author(s)** Zimmer, BJ

**Title** Raritan and Sandy Hook Bays Sanitary Survey Report (1997-2000)

**Publication Type** Report

**Journal / Publisher** NJ Department of Environmental Protection

**Link** [Zimmer 2004.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\Zimmer%202004.pdf)

**Abstract** This report is a Sanitary Survey of the Raritan and Sandy Hook Bays. A

Sanitary Survey is completed every 12 years for each designated growing

area, when there have been significant changes in the area, or if an

upgrade in classification is proposed. The report addresses a request

from the shellfish industry to review the water quality of the Prohibited

waters at the eastern and western portions of the area. A classification

upgrade (Prohibited to Special Restricted) would allow the shellfish

resources to be utilized under the special permit program for depuration

and relay.

Sampling results (1997-2000) indicate that the total coliform bacterial

water quality of the shellfish growing waters of the Raritan and Sandy

Hook Bays has improved slightly since the last Sanitary Survey report that

covered sampling results from 1994-1996. This improvement is part of a

continuing trend in water quality improvement in this area. There appears

to be an overall improvement in bacterial water quality in the Sandy Hook

Bay.

This report includes an evaluation of tissue samples analyzed for a suite

of toxicants, including heavy metals and organic compounds. An

evaluation of the potential impacts from the Middlesex County Utilities

Authority discharge, located in the western section of Raritan Bay, is also

included. Based on these data, an upgrade was implemented for a

triangular area to the west of Sandy Hook (known as Flynn’s Knoll) as well

as a smaller area to the west of Conaskonk Point. The total area upgraded

(from Prohibited to Special Restricted) is approximately 5714 acres.

**Publication Year** 2003

**Author(s)** Adams, D and S Benyi

**Title** Sediment Quality of the NY/NJ Harbor System: A 5-Year Revisit

**Publication Type** Report

**Journal / Publisher** US Environmental Protection Agency

**Link** [EPA 2003.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\EPA%202003.pdf)

**Abstract** The Comprehensive Conservation and Management Plan (CCMP) for the

NY/NJ Harbor requires specific management actions to maintain and

restore the Harbor environment. It also specifies that the progress of

these management actions on the improvement of sediment quality and

biological condition in the Harbor be measured. To do this requires

initially establishing a baseline of condition of the Harbor sediment that is

objective and of known statistical confidence. The next logical step is to

periodically determine whether conditions have improved, declined or

remained the same from the baseline. Existing studies either were

conducted in a biased manner, did not cover all portions of the Harbor or

did not concurrently collect the biological and chemical information to

do be able to provide the baseline or subsequent trend assessment.

A previous investigation (Adams et al., 1998) provided a baseline of the

areal extent of chemical contamination and biological effects in the NY/NJ

Harbor system. That investigation, done in 1993 and 1994, also defined

the extent of specific biological effects, such as degraded benthic

macroinvertebrate communities and amphipod toxicity, and determined

that these effects were

associated with specific contaminants found in the sediments of the

Harbor.

To begin to define trends in sediment quality and biological health of the

Harbor, EPA-Region 2 conducted a followup investigation in 1998. The

design, parameters measured, and methods were identical to, or

comparable to, the 1993/1994 investigation. Synoptic measurements of

benthic macroinvertebrate assemblages, sediment toxicity and sediment

chemical concentrations were collected in four sub-basins of the Harbor,

encompassing 28 sampling stations in each subbasin. Surficial sediment

contaminant concentrations, sediment toxicity (Ampelisca abdita) and

benthic macrofaunal community structure were measured at each station.

**Publication Year** 2003

**Author(s)** Dobosiewicz, JF

**Title** An Assessment of Spatial Variability in Water Level Observations and

**Publication Type** Dissertation

**Journal / Publisher** Rutgers University - New Brunswick

**Link** [Dobosiewicz 2003.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Dobosiewicz%202003.pdf)

**Abstract** Coastal flooding is an integral part of the development of natural

estuarine ecosystems but also threatens human populations living along

estuarine shores. A study was conducted on the Raritan Bay, New Jersey

shore to determine the spatial variability of elevated water levels from

coastal storms and the physical controls on susceptibility to inundation.

Raritan Bay is used as a study site because it is a developed estuary with a

high population density and a variety of flood mitigation strategies in

place. Water levels are identified from wrack (debris) lines on field profiles

200 m apart over 10 km of shoreline for five storms. Elevations on the

field profile are referenced to a standard datum for comparison

throughout the study area. The greatest spatial variability o f water levels

between sites from the observed storms was 1.7 m. Variability in water

levels at the same site for different storms is used to evaluate site-specific

relationships between shoreline characteristics and storm conditions.

Fourteen onshore variables are determined from the field profiles and

include natural and human-altered geomorphic features. Thirty-three

offshore variables, including bathymetry and fetch, are determined or

calculated from data derived from digital nautical charts. Fifteen of the

variables are significantly correlated to water levels, with only one variable,

the maximum elevation of the profile, correlated to all five storms.

Correlated variables were categorized into five susceptibility classes and

combined to produce two susceptibility indices using a Geographic

Information System (GIS). The first index uses onshore and offshore

variables to determine susceptibility to actual inundation. The second

index uses only offshore variables to determine susceptibility to potential

inundation. Water levels are highest where hard, vertical shore protection

projects exist, suggesting that these structures increase water levels and

susceptibility to actual inundation of human structures landward of

them. Marshes and nourished beaches reduce water levels and

susceptibility to actual inundation of human structures landward of

them. Site-specific coastal data analysis and the use of GIS are consistent

with modem research objectives to develop and enhance digital coastal

databases and advance current flood mitigation based on single flood

elevations for entire shorelines.

**Publication Year** 2003

**Author(s)** Kwak, JH

**Title** Monitoring Natural Endocrine Disruptors in Water and Pesticides in

**Publication Type** Dissertation

**Journal / Publisher** Rutgers University - New Brunswick

**Link** [Kwak 2003.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Kwak%202003.pdf)

**Abstract** To determine the presence of sterols, suspected endocrine disruptors, in

drinking and river water, a sensitive analytical method was developed.

Sterols were extracted by solid-phase extraction (Clg disk) and determined

by gas chromatography/ion trap mass spectrometry. Sterols were

silylated to improve sensitivity and chromatography. The sensitivity was

10 parts per trillion (ng/L) and the recovery of cholesterol-^ from 1 L

water (spiked at 0.5 ppb) was 93.1 ± 20.6%. Of 126 well water samples

analyzed, 41 contained at least one of the following phytosterols:

brassicasterol, 22-dehydrocholesterol, campesterol, stigmasterol, P-

sitosterol and fucosterol, in concentrations ranging from 3 ng/L to 6.8

pg/L. Only 2 contained coprostanol (13 ng/L and 3.5 ng/L). No sterols

were found in tap water. All river waters analyzed, contained cholesterol,

coprostanol and phytosterols, in concentrations ranging from 3 ng/L to 2

pg/L.

In addition, another analytical method was developed to determine the

concentrations of sterols in meat samples. Campesterol and sitosterol

were detected in all samples analyzed, in the range of 65 - 448 ng/g and

17 - 2,222 ng/g meat, respectively. Except in chicken, coprostanol was

found in all samples, ranging from 87 to 607 ng/g meat.

Commercially available sterols (cholesterol, campesterol, stigmasterol and

sitosterol) and a river water extract were tested for endocrine disruption.

They were positive for the test.

To determine the concentration of pesticides in conventional processed

foods, analytical methods were developed. Pesticides were extracted with

acetonitrile/water, cleaned up by liquid-liquid extractions and solid phase

extractions, and analyzed by gas chromatography/mass spectrometry

(GC/MS) and liquid chromatography/mass spectrometry (LC/MS). In

GC/MS analysis, 65 percent of pesticides spiked in cereal at 100 ppb

showed recoveries of 70-130%. Limits of detection in most pesticides

ranged from less than 1 to 10 ppb. Some carbamate insecticides and

phenylurea herbicides were monitored by LC/MS since they were

thermally degraded during GC analysis. Methomyl, monuron, neburon

and siduron had good recoveries, ranging from 70 to 121%. Methomyl,

siduron and thiodicarb could be detected at less than 15 ppb, and others

at less than 75 ppb in toasted oats. No pesticides were detected in 20

conventional cereals.

**Publication Year** 2003

**Author(s)** Marhaba, TF, K Bengraine, Y Pu, and J Arago

**Title** Spectral Fluorescence and Signatures and Partial Least Squares

**Publication Type** Journal article

**Journal / Publisher** Journal of Hazardous Waste Materials

**Link** [Marhaba et al 2003.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Marhaba%20et%20al%202003.pdf)

**Abstract** Spectro-fluorescence signature (SFS) of water samples contains

information that may be used to quantify dissolved organic carbon (DOC)

if combined with multivariate analyses. A model was built through SFS

and partial least squared (PLS) regression. The SFSs of 219 samples of

natural water along the Raritan River and Millstone River watersheds

located in central New Jersey, and their corresponding DOC

concentrations were used to build the model. Calibration, full cross-

validation, and prediction performances of various models were

statistically compared before optimal model selection. The final selected

model, tested on the Passaic River watershed in northern New Jersey,

provided a bias of 0.028 mg/l and a root mean squared error of

prediction (RMSEP) of 0.35 mg/l. Linked to PLS, SFS can be a quality and

cost effective method to perform on-line rapid DOC measurements.

**Publication Year** 2002

**Author(s)** Bagheri, S, M Rijkeboer, and HJ Gons

**Title** Inherent and Apparent Optical Measurements in the Hudson/Raritan

**Publication Type** Journal Article

**Journal / Publisher** Aquatic Ecology

**Link** [Bagheri et al 2002.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Bagheri%20et%20al%202002.pdf)

**Abstract** During an August, 1999 field campaign, measurements were made to

establish hydrologic optical properties of the Hudson/Raritan Estuary

(New York-New Jersey): 1) concurrent above-and below-surface spectral

irradiance; 2) sampling for laboratory determination of inherent optical

properties; and 3) concentrations of optically-important water quality

parameters. We used a bio optical model based on Gordon et al. (1975)

to predict the subsurface irradiance reflectance from optically important

water constituents. This model was then validated with the measured

reflectance spectra from the field spectroradiometers. Modeling of

reflectance is a prerequisite for processing remote sensing data to desired

thematic maps. These are key input to the geographic information system

(GIS) used to manage the water quality condition of the estuary.

**Publication Year** 2002

**Author(s)** Fan, CW

**Title** Bioaccumulation and Air-Water Exchange of the PAH Phenanthrene in

**Publication Type** Dissertation

**Journal / Publisher** Rutgers University - New Brunswick

**Link** [Fan 2002.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Fan%202002.pdf)

**Abstract** In order to improve the understanding of the interactions between

bioaccumulation in phytoplankton and air-water exchange of polycyclic

aromatic hydrocarbons (PAHs) in the NY/NJ Hudson River Harbor

Estuary, the accumulation kinetics of the common PAH phenanthrene

was studied in two species of coastal diatoms, Thalassiosira wcissflogii

and T. pseudonana, using a two-compartment kinetics bioaccumulation

model. This model coupled with air-water exchange and sedimentation

processes was then applied to field data from Raritan Bay, collected

during four cruises from April 2000 to April 2001.

The bioaccumulation kinetics parameters of phenanthrene in the two

species of coastal diatoms were measured in laboratory experiments

using I4C-labeled phenanthrene. The accumulation of phenanthrene in

these diatoms follows a two compartment mechanism, which includes

fast surface sorption and subsequent accumulation into the cell’s

interior.

Field measurements of dissolved and particulate phenanthrene

concentrations in Raritan Bay suggest the presence of a particulate phase

(possible soot particles) to which PAHs sorbed more strongly compared

to organic carbon. Using an extended soot carbon-partitioning equation,

a small fraction (5-10%) of particulate phenanthrene was estimated to be

associated with organic carbon in the suspended particle phase,

suggesting the predominance of the soot-like phase for PAHs, such as

phenanthrene, methylphenanthrenes, and pyrene in Raritan Bay.

A dynamic model that coupled air-water exchange and phytoplankton

accumulation of phenanthrene was applied to field data from Raritan Bay,

New Jersey, to investigate the mutual interactions of the two processes.

Annual dynamic simulations show that using a monthly collected

database from a nearby shore site (Sandy Hook, New Jersey) for gas phase

concentrations of phenanthrene as input provides a better prediction of

dissolved phase concentrations than seasonal over-water measurements.

This modeling results suggest that processes such as horizontal air and

water movements may maintain disequilibria between air, water, and

suspended particles phases for hydrophobic organic pollutants.

**Publication Year** 2002

**Author(s)** Komada, T

**Title** Sorptive Dynamics and Fluorescence Properties of Organic Carbon within

**Publication Type** Dissertation

**Journal / Publisher** Rutgers University - New Brunswick

**Link** [Komada 2002.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Komada%202002.pdf)

**Abstract** Sorptive behavior and fluorescence characteristics of organic carbon (OC)

were examined in Hudson River Estuary and Inner New York Bight

sediments, with the overall goal of understanding the nature and

biogeochemical role of the fraction of particulate OC (POC) that readily

exchanges with dissolved OC (DOC). In two studies, the significance of

sorption and fundamental properties of the readily-exchangeable POC

fraction were investigated under laboratory conditions simulating bottom

resuspension. In the third study, the role of sorption in controlling pore-

water DOC cycling was evaluated within the sediment column.

In order to simulate resuspension, surface sediments were dispersed in

bottom water from the same locations for 30 seconds to 2 hours. After

resuspension, DOC concentration generally exceeded the value predicted

by conservative mixing of pore and bottom waters, indicating net release

of OC from POC. Regression analyses between the amount of OC released

and the POC content of sediment density fractionates suggest that < 0.3

% of the mineral-bound POC pool may be readily releasable into solution

across the estuarine gradient.

In the second study, chemical characteristics of the OC released into

solution during the resuspension experiments were explored through

excitation-emission matrix (EEM) fluorescence spectroscopy. Examination

of EEMs revealed that relative to values predicted by conservative mixing,

resuspension resulted in: (1) more intense humic-like fluorescence; and

(2) proportionally greater fluorescence in the longer wavelength region of

the electromagnetic spectrum. Trends in the literature data strongly

suggest fluorophores that emit at longer wavelengths to be increasingly

degraded. The data therefore imply that resuspension results in net

release of degraded, mineral-bound organic matter from the sediment

matrix into solution.

In order to evaluate the significance of sorptive processes within the

sediment column, a diagenetic model was applied to DOC profiles

determined within the study area. OC was assumed to undergo linear

equilibrium adsorption, with a coefficient that was estimated from the

results of the first study. Model calculations show that sorption is

unlikely to be a major factor controlling pore-water DOC accumulation

patterns. Rather, redox-dependent microbial processes and sediment

mixing most often dominate DOC cycling within the benthos.

**Publication Year** 2001

**Author(s)** Eisenreich, SJ

**Title** Atmospheric Deposition of PCBs, PAHs, Trace Metals and Nitrogen to the

**Publication Type** Report

**Journal / Publisher** NJ Atmospheric Deposition Network

**Link** [Eisenreich 2001.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\Eisenreich%202001.pdf)

**Abstract** The first estimates of atmospheric deposition fluxes of PCBs and PAHs to

the NY/NJ Hudson Estuary are presented. As part of the New Jersey

Atmospheric Deposition Network, concentrations of PCBs and PAHs were

measured at three sites near the estuary in air, aerosol, and precipitation

at regular intervals from October, 1997 through December, 1999.

Atmospheric deposition fluxes (combined gas absorption, dry particle

deposition, and wet deposition) at the three sites ranged from 7.3-40

ug/m2/y for total PCBs and from 1400-6400 ug/m2/y for the sum of 36

individual PAHs. These depositional fluxes are at least 2-10 times those

estimated for Great Waters similarly adjacent to urban areas, such as the

Chesapeake Bay and Lake Michigan. Such high depositional fluxes are due

the to location of the Harbor Estuary, within the urban/industrial complex

of northern New Jersey and New York City. Inputs of PCBs to the estuary

from the Hudson River and from wastewater treatlnent plants are 8-18

times atmospheric inputs. In addition, volatilization of PCBs from the

estuary exceeds atmospheric deposition by at least an order of

magnitude.

**Publication Year** 2001

**Author(s)** NY/NJ Harbor Estuary Program

**Title** New York/New Jersey Harbor Estuary Program Habitat Workgroup 2001

**Publication Type** Report

**Journal / Publisher** NY/NJ Harbor Estuary Program

**Link** [HEP Habitat Status Report 2001.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\HEP%20Habitat%20Status%20Report%202001.pdf)

**Abstract** The New York/New Jersey Harbor Estuary Program (HEP) was formed to

protect the harbor's watersheds and to restore a healthy and productive

ecosystem to full beneficial uses. A dynamic system covering 42,128

square kilometers, the New York/New Jersey Harbor Estuary and Bight

extend from the limits of tidal influence to the harbor transect. The area

supports a diverse biotic assemblage within a sprawling urban landscape.

HEP, one of 28 National Estuary Programs established under Section 320

of the Clean Water Act, is a unique regional partnership of citizens,

scientists, and federal, state, interstate, and local agencies. The HEP

Comprehensive Conservation and Management Plan (CCMP) serves as a

blueprint for the management of the harbor and bight. It includes long-

term strategies and intermediate actions designed to protect, restore, and

enhance habitat. It offers guidance for development of management

strategies to prevent pollution and reduce toxins, pathogens, nutrients,

and floatable debris. The U.S. Environmental Protection Agency (EPA)

approved the CCMP in March 1997. The EPA Region II Administrator and

the Governors of New York and New Jersey signed it in August 1997.

This report is a celebration of the environmental achievements of the

participants in the Harbor Estuary Program: government agencies,

conservation organizations, and individuals.

It is also a warning. Despite our best efforts, bulldozers are poised to

develop many of the region's natural lands. Cumulative urban impacts -

including channelization, sediment deposition, relative sea level rise, and

nutrient loading- have taken their toll, eroding marshes in Jamaica Bay and

the Arthur Kill. These ecosystems serve as reminders of our natural

legacy. They protect the economic interests of our neighborhoods with

their ability to absorb flood flows from catastrophic weather events and

bioremediate contaminants. They reduce the sediment and nutrient

burdens of the NY /NJ Harbor - while supporting remarkable wildlife

populations.

**Publication Year** 2001

**Author(s)** Paul, RW

**Title** Geographical Signatures of Middle Atlantic Estuaries: Historical Layers

**Publication Type** Journal article

**Journal / Publisher** Estuaries

**Link** [Paul 2001.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Paul%202001.pdf)

**Abstract** Estuaries of the middle Atlantic region can be characterized and viewed

broadly against the backdrop of their geomorphologic features. While

geomorphology is literally at the base of every estuary, these features do

not necessarily yield regional signatures. A conceptual model, with

layering in time and space, is proposed as an alternative to simplistic

geomorphologic characterization. Humans have altered virtually every

physical, chemical, and biological feature of middle Atlantic estuaries. A

basic model premise is that middle Atlantic estuaries have a base of

fundamental geomorphology features. Layered, in GIS fashion, on this

base are the estuaries’ components: climate, nutrients, watershed soils

and vegetation, producers, and consumers. These components have been

so strongly influenced by humans in time and space that the signature is

anthropogenic. As a consequence, best management practices, stock

assessment, and restoration have replaced concepts such as ecosystem

integrity and stability. The focus of the layered model is the Chesapeake

Bay watershed, and although middle Atlantic estuaries differ along

climatic and latitudinal gradients, all reflect the detrimental effects of a

massive human presence. The ability or inability of middle Atlantic

estuaries to absorb human perturbation over the last 10,000 years gives

them their signatures. From the Hudson-Raritan to the Pamlico-Albemarle

estuaries, we have made some progress in curbing our impacts. Nearly

everything we do affects our estuaries, and our actions are proportional

to the number of humans living in the watersheds. Continued population

growth on our coasts and many years of abuse may be irreversible as our

estuaries lose their ability to be self-regulating, biological systems.

**Publication Year** 2000

**Author(s)** Gons, HJ, M Rijkeboer, S Bagheri, and KG Ruddick

**Title** Optical Teledetection of Chlorophylla in Estuarine and Coastal Waters

**Publication Type** Journal Article

**Journal / Publisher** Environmental Science and Technology

**Link** [Gons et al 2000.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Gons%20et%20al%202000.pdf)

**Abstract** A hand-held spectroradiometer was used for above-water determination

of subsurface spectral irradiance reflectance in the Scheldt Estuary

(Belgium/The Netherlands), the North Sea off the Belgian coast, and the

Hudson/Raritan Estuary (New York/New Jersey). On the North Sea the

measurement conditions were adverse, and elsewhere broken cloud

caused considerable spectral variation. Despite

this variation the retrieval of chlorophyll a (Chl-a) from three reflectance

spectra at all sampling stations was stable. The algorithm calibrated for

the freshwater IJssel Lagoon (The Netherlands) proved to be applicable to

these estuarine and coastal waters (N = 30; standard error of estimate = 7

mg m-3 for corrected Chl-a ranging from 1 to 93 mg m-3).

**Publication Year** 2000

**Author(s)** Lohmann, R, E Nelson, SJ Eisenreich, and KC Jones

**Title** Evidence for Dynamic Air-Water Exchange of PCDD/Fs: A Study in the

**Publication Type** Journal article

**Journal / Publisher** Environmental Science and Technology

**Link** [Lohmann et al 2000.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Lohmann%20et%20al%202000.pdf)

**Abstract** The first detailed evidence for dynamic air-water exchange of

polychlorinated dibenzo-p-dioxins and furans (PCDD/Fs) is presented.

Samples of air (340-380 m3) and water (33-60 L) were taken

simultaneously during July 1998 at two sites in the lower Hudson River

Estuary, NY. The atmospheric gas and particulate phases and the aqueous

dissolved and particulate phases were analyzed for di- to octa-CDD/Fs. All

the homologue groups were routinely detected by HRGC-HRMS, with

detection limits for the homologue groups ~1 pg/sample. Cl2DDs, OCDD,

and Cl2DFs were the most abundant homologues in the water, and the

Cl2DDs were the most abundant in the air (4.3-7.6 pg/m3). The Cl2DD/Fs

and Cl7/8DD/Fs were 25-53% and 78-99% associated with the water

particulate phase, respectively. The likelihood of sampling artifacts

influencing the apparent dissolved/particulate partitioning of the higher

chlorinated congeners is discussed. Water concentrations were constant

over the sampling period, while atmospheric concentrations varied with

air mass origin. The fugacity ratios between the dissolved phase in water

and the gas phase in air were usually >1, implying a net volatilization flux.

Evidence for outgassing of the lower chlorinated homologues, obtained

by the simultaneous measurement of air over adjacent land and water,

provided further support for the outgassing of the lower chlorinated

homologues from the water body.

**Publication Year** 2000

**Author(s)** O'Shea, ML and TM Brosnan

**Title** Trends in Indicators of Eutrophication in Western Long Island Sound and

**Publication Type** Journal Article

**Journal / Publisher** Estuaries

**Link** [O'Shea & Brosnan 2000.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\O'Shea%20&%20Brosnan%202000.pdf)

**Abstract** Significant improvements in water quality have been observed for several

decades throughout much of the Hudson-Raritan Estuary, primarily as a

result of regional abatement of municipal and industrial discharges. These

improvements include area-wide, order-of-magnitude reductions in

ambient coliform concentrations and significant increases in dissolved

oxygen (DO) concentrations. In contrast to these improvements, DO in

bottom waters of the western Long Island Sound (WLIS) appears to have

decreased in the last two decades. Although there is no consensus as to

why hypoxia in WLIS may have recently become more severe, several

related hypotheses have been suggested, including an increase in

eutrophication, increased density stratification, and changes in

wastewater loads. To determine if eutrophication has increased in WLIS,

trends in several indicators of eutrophication were examined from a long-

term water quality data set. Since the mid-1980s surface DO

supersaturation has increased, bottom minimum DO has decreased, and

vertical DO stratification has increased in WLIS. Other areas of the

Hudson-Raritan Estuary, such as Jamaica Bay and Raritan Bay, exhibit

similar evidence of declining water quality and may be experiencing

increasing eutrophication. Temporal changes in vertical density

stratification indicate that surface to bottom temperature differences

have increased to a greater extent and have had a more significant impact

on bottom DO depletion in WLIS than in the shallower Jamaica Bay and

Raritan Bay. Additional factors contributing to the observed decline in

water quality include recent changes in wastewater loads and possible

increases in upstream and nonpoint source loads.

**Publication Year** 2000

**Author(s)** Robinson, DA

**Title** Hurrican Floyd Rainfall in New Jersey

**Publication Type** Journal Article

**Journal / Publisher** American Meteorological Society

**Link** [Robinson 2000.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Robinson%202000.pdf)

**Abstract** N/A

**Publication Year** 2000

**Author(s)** Thursby, GB, EA Stern, KJ Scott, and J Heltshe

**Title** Survey of Toxicity in Ambient Waters of the Hudson/Raritan Estuary, USA:

**Publication Type** Journal Article

**Journal / Publisher** Environmental Toxicity

**Link** [Thursby et al 2000.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Thursby%20et%20al%202000.pdf)

**Abstract** This study was part of a characterization of the nature and severity of

water-quality problems in the Hudson/Raritan Estuary in New York State

and New Jersey, USA. The toxicity of ambient water was measured at 51

stations in the estuary by using standard tests with the sea urchin Arbacia

punctulata and the marine red alga Champia parvula. Toxicity

identification evaluations on samples from two stations suggested that

cationic metals were the source of the observed toxicity. Overall results

showed that toxicity could vary as much on the small scale, i.e., with

depth and tide at a single site, as over several stations within a given

subarea of the estuary. Thus, knowing about small-scale variations in

toxicity is essential to understanding the significance of the variations

from different areas or different sampling events.

**Publication Year** 1998

**Author(s)** Cantillo, AY

**Title** Comparison of Results of Mussel Watch Programs of the United States

**Publication Type** Journal article

**Journal / Publisher** Marine Pollution Bulletin

**Link** [Cantillo 1998.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Cantillo%201998.pdf)

**Abstract** As part of the Global Ocean Observing System (GOOS), the National

Oceanic and Atmospheric Administration (NOAA) National Status and

Trends (NS&T) Program compiled the World Mussel Watch

(WMW) data base with results from the analyses of marine or estuarine

mussels or oysters as far back in time as possible. Here we compare

WMW data with results from two long-term Mussel Watch Programs, the

Reseau National d'Observation de la Qualite du Mulieu Marin (RNO)

Mussel Watch in France and NS&T Program in the United States. The

medians and 85th percentiles for Cr, Ni, Cu, Zn, As, Se, Ag, Cd, Hg and Pb

in mussels and oysters were calculated for the WMW, NS&T and RNO

Mussel Watch programs. While there was generally good agreement for

medians among all three data sets, the upper ends of the WMW

concentrations tend to be higher than their NS&T and RNO counterparts.

This probably reflects the fact that the latter two programs emphasize

collection of mollusks at representative sites rather than within small

areas of extreme contamination such as near waste discharges.

**Publication Year** 1997

**Author(s)** Dobosiewicz, JF

**Title** A Spatial Analysis of Storm Caused Water Levels in an Urban Estuary,

**Publication Type** Journal Article

**Journal / Publisher** Middle States Geographer

**Link** [Dobosiewicz 1997.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Dobosiewicz%201997.pdf)

**Abstract** The spatial variability ofcoastalflooding along the New Jersey shoreline of

Raritan Bay, an urban estuary, is determined using linear regression

analysis. Water levels from six tide gages, installed in 1976 and 1977, are

correlated to a tide gage at Sandy Hook, NJ. Peak water levels for the most

severe storm in the past 30 years, occurring December 11-13, 1992, are

derived at the six gage locations from the actual water level at Sandy Hook

and regression equations. Storm surge is determined by subtracting the

predicted tides from the derived water levels. Predicted tides in Raritan

Bay increase westward from Sandy Hook by 1% to 9%. The statistically

derived water levels and storm surge for the December 1992 storm do

not follow a trend of steady increase westward. An embayment in the

middle of the bay and sheltered from northeast winds has the highest

derived water level, 1.82 m above mean high water, and storm surge, 1.54

m. Consequently, flood mitigation strategies must consider both broad

and local scale factors and the site-specific nature of the variables that

contribute to peak water levels throughout the bay.

**Publication Year** 1996

**Author(s)** Peven, CS, AD Uhler, RE Hillman, and WG Steinhauer

**Title** Concentrations of Organic Contaminants in Mytilus edulis from the

**Publication Type** Journal Article

**Journal / Publisher** The Science of the Total Environment

**Link** [Peven et al 1996.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Peven%20et%20al%201996.pdf)

**Abstract** In this paper, we present the findings of 2-, 3-, 4-, and 5-ring polynuclear

aromatic hydrocarbons (PAH), selected polychlorinated biphenyl (PCB)

congeners, the pesticide DDT and its degradation products, and the

marine paint antifouling agent tributyltin (TBT), in the tissues of Mytilus

edulis collected from 10 sites in the Hudson-Raritan Estuary and 10 sites

in Long Island Sound. In the estuary, contaminant concentrations were

highest in the Upper Bay, and systematicallyd ecreasedm oving south and

east into the New York Bight. Near equal distributions of tetra-, penta-,

and hexa-chlorinated PCBs in the Upper Bay systematically shifted to a

composition dominated by more

heavily chlorinated PCBs in the New York Bight. In Long Island Sound,

contaminant concentrations were highest in the heavily populated

southwest region of the Sound, while the lowest bivalve contaminant

levels were observed near the eastern-most tip of Long Island. PAH

distributions generally were reminiscent of complex mixtures of

combustionp roducts and refined fuel products. PCB congenerd

istributions exhibited similar changesin composition as those observed in

the Hudson-Raritan Estuary.

**Publication Year** 1996

**Author(s)** Wolfe, DA, ER Long, and GB Thursby

**Title** Sediment Toxicity in the Hudson-Raritan Estuary: Distribution and

**Publication Type** Journal article

**Journal / Publisher** Estuaries

**Link** [Wolfe et al 1996.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Wolfe%20et%20al%201996.pdf)

**Abstract** The Hudson-Raritan Estuary is one of several United States coastal areas

where chemical data have suggested a potential for contaminant-related

biological effects, and multiyear intensive bioeffects surveys have been

conducted by the National Oceanic and Atmospheric Administration. The

severity and spatial patterns in sediment toxicity were determined in an

estuary-wide survey during spring 1991 using amphipods, bivalve larvae,

and luminescent bacteria as test organisms. Spatial patterns in toxicity

corresponded to the distributions of a number of toxic chemicals in the

sediments. Areas that exhibited the greatest sediment toxicity included

the upper East River, Arthur Kill, Newark Bay, and Sandy Hook Bay. The

lower Hudson River adjacent to Manhattan Island, upper New York

Harbor, lower New York Harbor off Staten Island, and parts of western

Raritan Bay generally showed lower toxicity. Supporting chemical analyses

of the sediments, including acid-volatile sulfide and simultaneously-

extracted metals, suggested that metals were generally not the cause of

the observed toxicity, with the possible exception of mercury. Among all

contaminants analyzed, toxicity was most strongly associated with

polynuclear aromatic hydrocarbons, which were substantially more

concentrated in toxic samples than in nontoxic samples, and which

frequently exceeded sediment quality criteria.

**Publication Year** 1995

**Author(s)** Louis Berger & Associates, Inc.

**Title** Water Quality Survey and Assessment for the Township of Piscataway

**Publication Type** Report

**Journal / Publisher** Louis Berger & Associates, Inc.

**Link** [Louis Berger 1995.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\Louis%20Berger%201995.pdf)

**Abstract** The objectives of this report have been to: 1)summarize the flow

characteristics of selected waterbodies within the Township of Piscataway

(Raritan River, Bound Brook, Ambrose Brook, Doty's Brook); 2) develop a

volunteer water quality sampling plan for New Market Pond; 3) research

available data regarding the water quality and aquatic ecosystem of the

Raritan Riber; and 4) preapre a water quality profile report of the Raritan

River and New Market Pond. Only secondary source data were used. A

digitized map of stream flow characteristics within the township is also

provided.

Numerous written sources were used for this report, in addition to

personal communications with local, state, and federal agencies. A list of

references used and agencies contacted are provided. The appendices

contain correspondence and other data refered to in the body of the text.

**Publication Year** 1994

**Author(s)** Cai Z, DE Giblin, VM Sadagopa Ramanujam, and ML Gross

**Title** Mass-Profile Monitoring in Trace Analysis: Identification of

**Publication Type** Journal Article

**Journal / Publisher** Environmental Science and Technology

**Link** [Cai et al 1994b.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Cai%20et%20al%201994b.pdf)

**Abstract** Tetra- and pentachlorodibenzothiophenes (TCDT and P&DT) and the

sulfur analogues of tetra- and pentachlorodibenzofurans (TCDF and

P5CDF) were identified along with polychlorodibenzo-p-dioxins and

dibenzofurans (PCDD/Fs) in tissues of crabs collected from the

Newark/Raritan Bay system. The use of mass-profile monitoring of

selected ions in capillary gas chromatography/highresolution mass

spectrometry (GC/HRMS) resulted in a preliminary identification of an

isomer of TCDT and of P&DT. Confirmation for this identification was

accomplished by high-resolution peak matching and by acquiring a full

spectrum by GUMS. The accurate masses of three molecular ions, the full

electron ionization (EI) mass spectrum, and the chromatographic

retention time are all consistent with those of a 2,4,6,8-TCDT standard.

Levels of 2,4,6,8-TCDT in the crab tissues are more than 5-10 times those

of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD); the highest level (12 ppb)

occurring in the hepatopancreas tissue of crabs taken from Newark Bay.

A good correlation was found between the levels of 2,3,7,8-TCDD and

2,4,6,8-TCDT (r2 = 0.98) in the samples collected from four stations in

the area, suggesting common sources of 2,4,6,8-TCDT and 2,3,7,8-TCDD.

**Publication Year** 1994

**Author(s)** Cai, Z, VM Sadagopa-Ramanujam, ML Gross, A Cristini, and RK Tucker

**Title** Levels of Polchlorodibenzo-p-dioxins and Dibenzofurans in Crab Tissues

**Publication Type** Journal article

**Journal / Publisher** Environmental Science and Technology

**Link** [Cai et al 1994.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Cai%20et%20al%201994.pdf)

**Abstract** Hepatopancreas and muscle tissues of crabs collected from the

Newark/Raritan Bay system, New Jersey, were analyzed for

polychlorodibenzo-p-dioxins and dibenzofurans (PCDD/Fs) by using

capillary gas chromatography/high-resolution mass spectrometry

(GC/HRMS) in the selected ion-monitoring, mass-profile mode. All

Hepatopancreas tissue samples were found to be contaminated with

PCDD/Fs. Samples collected proximate to a former chemical

manufacturing plant located on the Passaic River have the highest levels.

The concentrations of PCDD/Fs decrease in animals taken at increasingly

more remote sites from the alleged point source. The levels (up to 1 ppb)

of 2,3,7,8-tetrachlorodibenzo-p-diox(i2n, 3,7,8TCDD) in hepatopancreas

tissues of the crabs taken from Newark Bay are elevated by a factor of 5-

10 times those of samples from Raritan Bay. Even the muscle samples

from animals taken from Newark Bay have detectable levels of 2,3,7,8-

TCDD, whereas those from Raritan Bay have "no detectable" levels of

2,3,7,8-TCDD (detection limit 0.5-1.0 ppt). The levels of

2,3,7,8substituted pentachloro- and hexachlorodibenzofurans are

approximate 10 times lower. No other PCDD/Fs were detected at a

detection limit range of 5-45 ppt.

**Publication Year** 1994

**Author(s)** US Environmental Protection Agency

**Title** Total Maximum Daily Loads (TMDLs) for Copper, Mercury, Nickel and

**Publication Type** Report

**Journal / Publisher** US Environmental Protection Agency

**Link** [EPA 1994.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\EPA%201994.pdf)

**Abstract** In June 1990, the U.S. Environmental Protection Agency (EPA) approved

the listing of New York-New

Jersey Harbor, by the States of New York and New Jersey, under Section

304(I)(1)(B) ("the short list") of the Clean Water Act. As a result of this

listing, the States of New York and New Jersey and EPA agreed to

cooperatively develop the Individual Control Strategies (ICSs) for

dischargers of copper and

mercury to the Harbor waters. Effluent limits included in ICSs must be

consistent with waste load

allocations (WLAs) and Total Maximum Daily Loads (TMDLs) established

for the waterbody. In order to

develop a unified TMDL approach for these interstate waters, a TMDL

Workgroup was formed under the auspices of the New York-New Jersey

Harbor Estuary (HEP) Program. The Workgroup consisted of the States of

New York and New Jersey, citizens representatives, municipal dischargers,

and other members of the various HEP workgroups. The tasks of the

Workgroup were to: review currently enforceable water quality standards,

choose an applicable set of numeric standards to be applied Harbor-wide,

develop a uniform TMDL/WLA approach, and implement water quality-

based effluent limits, where necessary, in a uniform manner.

In addition to the original 304(I) listed metals of mercury and copper, the

Workgroup, after review of all available Harbor specific metals data,

identified six additional metals of concern: arsenic, silver, lead, cadmium,

nickel and zinc. In 1991 and 1992 ambient and source data were

collected and analyzed using trace metal clean techniques. Sampling

stations were located throughout the Harbor complex and included both

New York and New Jersey tributaries. The results of these surveys

indicated significantly lower metal concentrations as compared to

historical data. The differences were attributed, in large part, to sample

contamination and differing laboratory procedures used in collecting the

historical data. For additional information regarding data collected during

the Harbor monitoring surveys, refer to references 1-5. The monitoring

studies for the Harbor were funded by EPA and the New York City

Department of Environmental Protection.

Data collected during these surveys indicated that of the eight metals

identified by the Workgroup, only four metals exceeded or potentially

exceeded ambient water quality criteria: copper, mercury, nickel and lead.

Since these four metals are water quality-limiting, TMDLs are required.

**Publication Year** 1988

**Author(s)** Mahoney, JB, D Hollomon, and R Waldhauer

**Title** Is the Lower Hudson-Raritan Estuary a Suitable Habitat for Gonyaulax

**Publication Type** Journal Article

**Journal / Publisher** Marine Ecology - Progress Series

**Link** [Mahoney et al 1988.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Mahoney%20et%20al%201988.pdf)

**Abstract** The toxic dinoflagellate Gonyaulax tarnarensis Lebour [= Protogonyaulax

tamarensis (Lebour emend. Taylor) Taylor = Alexandrium tamarense

(Lebour) Balech] has not been identified in the lower Hudson-Raritan

estuary, a characteristically hypertrophic, contaminated system but is

widespread and sometimes abundant in nearby Long Island, New York

waters. Our hypothesis is that anthropogenic contaminants can be

important regulators of G. tamarensis in the Hudson-Raritan estuary. To

address this, we conducted a series of bioassays of water collected from

2 locales in Lower New York Bay during July through September, the usual

period of flagellate maxima. In the assays. G. tamarensjs growth regulation

by nitrogen, phosphorus and vitamins was relatively unimportant, less

important than that of one or more components of a metals mix.

Nitrogen had a primary limiting role or shared primary importance with

other enrichments in just 7 and 18% of the assays, respectively;

phosphorus and vitamins were less limiting. Growth inhibition in the

assays, which could be relieved by chelation and/or treatment of the

water with activated carbon, was prevalent. Assuming the persistence of

similar chemical water quality in Lower New York Bay, the results suggest

that, although nutrient limitation of G. tamarensis would be improbable,

this habitat would not be generally favorable. However, because the

dinoflagellate grew relatively well in the unenriched, untreated bay water in

20 O/O of the assays, and at least survived in most of the remainder, the

chemical water quality does not appear to exclude it. We conclude that G.

tamarensis is unlikely to become a principal resident phytoplankter in the

bay, assuming its introduction, but it may be able to establish itself

temporarily

when water quality is favorable for the species.

**Publication Year** 1986

**Author(s)** Ayres, RU and SR Rod

**Title** Patterns of Pollution in the Hudson-Raritan Basin

**Publication Type** Journal article

**Journal / Publisher** Environment

**Link** [Ayres & Rod 1986.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Ayres%20&%20Rod%201986.pdf)

**Abstract** N/A

**Publication Year** 1985

**Author(s)** Oey, LY, GL Mellor, and RI Hires

**Title** A Three-Dimensional Simulation of Hudson-Raritan Estuary. Part I:

**Publication Type** Journal article

**Journal / Publisher** Journal of Physical Oceanography

**Link** [Oey et al 1985a.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Oey%20et%20al%201985a.pdf)

**Abstract** A time-dependent, three-dimensional, finite difference simulation of the

Hudson-Raritan estuary is presented. The calculation covers July-

September 1980. The model estuary is forced by time-dependent

observed winds, tidal elevation at open boundaries, and river and sewage

discharges. Turbulence mixing coefficients in the estuary are calculated

according to a second-moment, turbulence-closure submodel. Horizontal

diffusivities are zero in the simulation and small-scale eddies produced

by the interaction of unsteady three-dimensional velocity and salinity

fields with coastline and bottom bathymetry were resolved by the model.

These eddies are important physical elements in shear dispersion

processes in an estuary.

Model results show unstably stratified water columns produced by

advection of waters of different densities. These instabilities produce

intense mixing with vertical eddy diffusivities reaching 2-3 times their

neutral values. They occur most frequently at slack currents, during initial

stages of flooding currents and also during upestuary wind events. These

three-dimensional, time-dependent solutions extend previous analytical

model results and are consistent with observations in partially mixed and

well mixed estuaries.

Model results show large subtidal response of velocity and salinity fields

to wind forcing. Wind forcing modifies the density-induced flows m deep

channels in the estuary and also the horizontal circulation in Raritan Bay

where the average water depth is less than 5 m and tidal currents are weak.

**Publication Year** 1985

**Author(s)** Oey, LY, GL Mellor, and RI Hires

**Title** A Three-Dimensional Simulation of Hudson-Raritan Estuary. Part II:

**Publication Type** Journal article

**Journal / Publisher** Journal of Physical Oceanography

**Link** [Oey et al 1985b.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Oey%20et%20al%201985b.pdf)

**Abstract** Results from a time-dependent, three-dimensional numerical simulation

of the Hudson-Raritan estuary are compared with observations. The

comparison includes: I) instantaneous salinity contours across a transect

in the estuary; 2) amplitudes and phases of tidal constituents at four tide

gauge and five current meter stations; 3) mean currents at nine meter

locations, and mean salinity in the Hudson River; 4) kinetic energy

spectra; and 5) response to wind forcing of subtidal current at an

observational station near the mouth of the estuary.

Observations confirm the model's prediction of existence of density

advection instabilities induced by differential advection of the three-

dimensional density field. These instabilities produce intense vertical

mixing and should significantly modify dispersion processes in the

estuary. Effects of neap-spring tides on vertical stratifications are also

simulated by the model. Simulated M2 phases at three tide gauge stations

show improvement over the M2 phases obtained from a two-

dimensional, vertically integrated tidal model. The improvement is

presumably due to bottom boundary layer resolution and, therefore,

improved representation of bottom friction in the three-dimensional

model. Simulated (instantaneous and mean) currents compare reasonably

well with observations, except at narrow channel regions where the

model's resolution is inadequate. Simulated "density-induced" mean

currents are weaker than those observed, a discrepancy attributed to

neglect of temperature variations in the model. Horizontal diffusion

coefficients are null in this model. The burden of horizontal dispersion is

generally handled well by the model's adequate resolution of small-scale

advective processes, as suggested by the model's correct simulation of

the k-3 transfer spectrum law at high wave number k. In narrow rivers that

are modeled two-dimensionally (x, z), the estimate of the horizontal

dispersion due to vertical variabilities in velocity and salinity appears to be

correct; however, mixing by lateral variability is absent so that the saline

intrusion is somewhat underpredicted. At the mouth of the estuary,

simulated subtidal current responses to wind forcing generally agree with

observed responses. The response is partly barotropic, which is a result

of balance between bottom friction, sea level setup from the adjacent

continental shelf and wind stress, modified by local vertical velocity

shears and baroclinic responses.

**Publication Year** 1985

**Author(s)** Oey, LY, GL Mellor, and RI Hires

**Title** A Three-Dimensional Simulation of Hudson-Raritan Estuary. Part III: Salt

**Publication Type** Journal article

**Journal / Publisher** Journal of Physical Oceanography

**Link** [Oey et al 1985c.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Oey%20et%20al%201985c.pdf)

**Abstract** Salt fluxes and volume transports in an estuary vary considerably over

subtidal time scales of a few days to weeks in response to wind and neap-

spring tidal forcings. Results from a numerical simulation of the Hudson-

Raritan estuary are used to study subtidal variations of salt fluxes and the

physical mechanisms for salt balance in the estuary. Simulated salt fluxes

are compared with available observations. Observations support the

model's finding that analysis of volume and salt fluxes based on short-

length data records (<30 days) can lead to misleading conclusions.

"Tidal trapping" effects due to coastline irregularities contribute most to

the salt balance at the Sandy Hook-Rockaway Point transect and at the

Narrows. A two-week observational record is analyzed to support this

finding. Simulated subtidal variation of the tidal trapping term at the

Sandy Hook-Rockaway Point transect compares well with that observed.

In Raritan Bay, where tidal currents are weak and effects of winds are

significant, contributions to salt balance from vertical velocity and salinity

gradients are comparable to transverse contributions. This occurs

despite the fact that surface-to-bottom salinity differences during the

simulation period-a period of low freshwater flow-never exceed 0.5%o

throughout most regions of the bay. A two-dimensional, depth-integrated

xy-t model, in which the horizontal dispersion coefficients are modeled

empirically, may not perform well in this case.

**Publication Year** 1979

**Author(s)** Frey, RJ and JA Quinn

**Title** Forest Development in Relation to Topography and Soils on a Floodplain

**Publication Type** Journal article

**Journal / Publisher** Bulletin of the Torrey Botanical Club

**Link** [Frye & Quinn 1979.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Frye%20&%20Quinn%201979.pdf)

**Abstract** The woody vegetation of a previously studied 60-year-old successional

forest on a floodplain of the Raritan River in New Jersey was analyzed for

rate of forest development in relation to site characteristics.

Environmental factors including texture, chemical characteristics, and

moisture of the surface 15 cm of soil; soil horizonation; depth of the

water table; and frequency of flooding were analyzed along an elevaitonal

gradient. A rather abrupt change in soil texture and chemical

characteristics, especially exchangeable cations, occurred at

approximately 3.35 m above mean sea level. Corresponding to this

textural and chemical discontinuity was a change in the depth to water

table. Comparisons of woody species composition above and below 3.35

m showed consitent differences, with the higher area having greater

species richness, species diversity (H'), equitability (J'), basal area of trees,

and total cover of shrubs. Comparisons of the rate of forest

development on the high area of the floodplain with that of mearby

upland sites indicated that development occurs more rapidly on the

floodplain. With respect to trees (> 2.54 cm dbh), at stages of

apprximately 21 to 25, 40, and 60 years, the floodplain showed greater

species diversity, equitability, basal area, mean stem diameter, and tree

height. The floodplain study area passed from a thicket to a structurally

complex forest stage between 40 and 60 years in development.

**Publication Year** 1978

**Author(s)** Jeffries, HP

**Title** Environmental Characteristics of Raritan Bay, A Polluted Estuary

**Publication Type** Journal article

**Journal / Publisher** Limnology and Oceanography

**Link** [Jeffries 1978.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Jeffries%201978.pdf)

**Abstract** Temperature, salinity, dissolved O2, PO4-P, and NO3-N in Raritan Bay, N.J.

were determined over a 16-month period. Each reflects the circulation

pattern in which sea water floods along the northern shore, enters a

region of mixing with river discharge in the head of the bay, and then ebbs

out along the southern shore.

At the mouth of the bay, salinity was higher on the northern than on the

southern side. The mean annual monthly difference at the surface was

1.27 ppt; departures from the mean were related to river flow.

Surface and bottom dissolved O2 content were minimal in August and

highest during winter. Low concentrations occurred in the Raritan River,

especially during the summer preceding operation of a trunk sewer.

The primary source of NO3-N was outflow from the Raritan River. Prior to

operation of a trunk sewer, the river may have discharged significant

quantities of PO4-P into the bay.

Throughout spring and summer, PO4 concentrations rose and NO3

decreased. It is postulated that the resultant low N:P ratio was partially

due to an efficient nutrient regeneration mechanism that favored the rate

of P renewal.

A combination of rich nutrient supplies arising from natural and domestic

sources, plus a sluggish circulation, efficient nutrient regeneration

mechanism, and scarcity of macroscopic algae combine to form an

estuarine environment capable of supporting extremely dense plankton

populations.

**Publication Year** 1975

**Author(s)** Dean, D

**Title** Raritan Bay Macrobenthos Survey, 1957-1960

**Publication Type** Report

**Journal / Publisher** NOAA?NMFS

**Link** [Dean 1975.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\Reports\Dean%201975.pdf)

**Abstract** This paper describes a quantitative and qualitative census of benthic

macrofauna from Raritan Bay and Lower Bay during the summers of 1957

to 1960, prior to and following the operation of a sewer outfall

at the head of Raritan Bay. A total of 193 stations were sampled yielding

127 taxa that were identified

to genus or species. Polychaetes, molluscs, and crustaceans accounted

for 86% of the taxa. Most prevalent species were the soft-shell clam, Mya

arenana, the polychaetes, Nereis succinea and Polydora ligni, the

amphipod, Ampelisca sp., and the gastropod, Nassarius obsoletus. Three

types of species dlstribution were found, viz., those found only in Raritan

Bay, those only in Lower Bay, and those common to both bays. Of the 10

stations sampled in Raritan Bay for four consecutive years, by the

summer of 1960 one had the same number of species in quantitative

samples as in 1957, four stations averaged a 30% decrease, and six

stations averaged a 96% increase.

**Publication Year** 1964

**Author(s)** Dean, D and HH Haskin

**Title** Benthic Repopulation of the Raritan River Estuary Following Pollution

**Publication Type** Journal article

**Journal / Publisher** Limnology and Oceanography

**Link** [Dean and Haskin 1964.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Dean%20and%20Haskin%201964.pdf)

**Abstract** A total of 69 samples of benthic animals was taken in the lower 20 km of

the Raritan River estuary from 1957 to 1960. During 1957, under heavily

polluted conditions, no freshwater species were discovered. Of the I7

marine species found, the barnacle Balanus improvisus extended 8.5 km

above the river mouth; the remaining species were confined to the

seaward 4.6 km of the river.

In January 1958, a trunk sewer system began operation in the lower

Raritan Valley, and pollution was abated in the river. Rapid repopulation

of the estuary occurred. The sequence and numbers of freshwater and

marine species invading the estuary and colonizing the bottom sediments

were followed in the samples of 1958, 1959, and 1960.

The most obvious change in 1958 was the distribution and density of

Balanus improvisus. These barnacles coated all firm substrata in the

previously uninhabited section, extending upriver to the limit of salt

penetration. The 12 stations sampled in both 1958 and 1959 yielded 6

freshwater and 21 marine species in 1958 and 8 freshwater and 28

marine species in 1959. In 1960, freshwater species continued to

increase, but there was a slight decrease in the number of marine species.

Dominant components of the freshwater fauna were the oligochaetes

Limnodrilus spp., the leech Erpobdella punctata, and the bivalve

Sphaerium sp. A density of 7,102 organisms/m2 was found at one of the

freshwater stations in 1960.

Marine species that invaded the river following pollution abatement are

placed in five groups -three of pioneers, one of secondary invaders, and

one of progressive penetrators on the basis of their year of arrival,

penetration, and length of stay.

By the end of the study, biotic recovery had so progressed that a plot of

the quantitative distribution of species illustrated the classic V-shaped

curve for estuaries. A similarly shaped curve was obtained for the

distribution of population densities.

**Publication Year** 1958

**Author(s)** Wistendahl, WA

**Title** The Flood Plain of the Raritan River, New Jersey

**Publication Type** Journal Article

**Journal / Publisher** Ecological Monographs

**Link** [Wistendahl 1958.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Wistendahl%201958.pdf)

**Abstract** N/A

**Publication Year** 1955

**Author(s)** Buell, MF and WA Wistendahl

**Title** Flood Plain Forests of the Raritan River

**Publication Type** Journal Article

**Journal / Publisher** Bulletin of the Torrey Botanical Club

**Link** [Buell & Wistendahl 1955.pdf](file:///C:\My%20Documents\Water%20Resources%20Program\Projects\EPA_Raritan_River_Project\08_Data\Buell%20&%20Wistendahl%201955.pdf)

**Abstract** N/A