State of Narragansett Bay and Its Watershed
Overview

Photo: Ayla Fox

Did you know the Narragansett Bay watershed is... 60% in Massachusetts and 40% in Rhode Island?

Narragansett Bay and its watershed define the identity of Rhode Island and neighboring areas of Massachusetts. The millions of people who live, work, and visit here value the economic, recreational, and tourism benefits provided by the ecosystem. The Narragansett Bay Estuary Program and over 50 partners produced the 2017 *State of Narragansett Bay and Its Watershed* report to equip citizens, private-sector groups, scientists, and government agencies with information needed to sustain and enhance the socio-economic and ecological vitality of the bay and watershed for current and future generations.

✓ REDUCING POLLUTION FROM WASTEWATER TREATMENT FACILITIES
Public investments have successfully and dramatically reduced discharges of nitrogen, phosphorous, toxic pollutants, and pathogens into the bay and watershed.

◯ MITIGATING OTHER POLLUTION SOURCES
Stormwater runoff, faulty onsite wastewater systems, new chemical contaminants, and some historical contaminants continue to pose threats to the ecosystem and human health.

◯ PROTECTING NATURAL LANDS, PROTECTING WATER QUALITY
While many acres of natural lands have been protected to keep our waters clean and habitats healthy and resilient, extensive areas of ecological significance remain unprotected.

◯ ADAPTING TO CLIMATE CHANGE
Long-term changes in air and water temperatures, storm intensity, precipitation seasonality, and sea level rise require well-informed, local decision-making about how to manage the impacts on people, infrastructure, habitats, wildlife, and the economy.

To download the State of Narragansett Bay and Its Watershed, *go to* nbep.org/the-state-of-our-watershed.

Narragansett Bay and Its Watershed at a Glance

WATERSHED FACTS
- 1,705 square-mile watershed (~1,025 MA, ~680 RI)
- 105 cities and towns (71 MA, 34 RI)
- 3,578 miles of rivers and streams
- Highest elevation ~1,387 feet (near Worcester)

BAY FACTS
- 196 square miles
- 560 miles of shoreline (including islands)
- Up to 194 feet deep (near Newport)
- 67% of freshwater comes from the Blackstone and Taunton rivers

LANDSCAPE INDICATORS

- **1.95** million people (½ RI, ½ MA) (2010)
- **39%** forested (2011)
- **41%** of natural lands remain unprotected, and much of that land has high ecological integrity (2015)
- **35%** urban (2011)
- **14%** covered by pavement and buildings (2011)
- **37** wastewater treatment facilities (WWTFs) discharge to rivers and the bay
  - ◆ Between 2000 and 2015, nitrogen pollution decreased 55% and phosphorus pollution decreased 45% from the WWTFs
  - ◆ **62%** of population connected to WWTFs (2015)
  - ◆ **38%** of population relied on septic systems and cesspools (2015)

FRESHWATER ECOSYSTEM INDICATORS

- **13** freshwater fish species such as brook trout rely on cool, flowing waters
- Of **832** stream miles assessed by the states for *aquatic life*:
  - ◆ **450** miles were in acceptable condition
  - ◆ **162** miles impacted by nutrient enrichment and/or depleted oxygen
- Of **789** stream miles assessed by the states for *recreational use*:
  - ◆ **272** miles were in acceptable condition
  - ◆ **481** miles impacted by pathogens
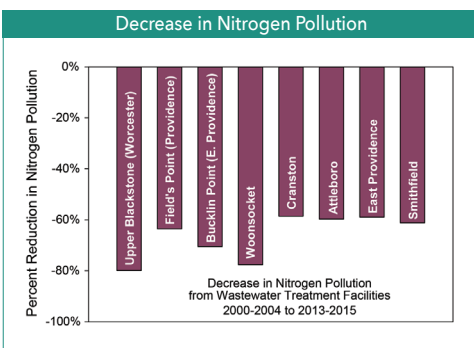
HUMAN HEALTH INDICATORS

- **37** licensed marine beaches (32 RI, 5 MA)
  - ◆ **14** high-concern beaches
  - ◆ **23** low-concern beaches
  - ◆ More closures at high-concern beaches than low-concern
- Shellfish harvesting areas for direct human consumption (2015):
  - ◆ **63%** approved (**3,711** newly opened acres in 2017)
  - ◆ **13%** conditionally approved
  - ◆ **24%** prohibited

BAY ECOSYSTEM INDICATORS

- **Water clarity and dissolved oxygen** increase from north to south
- **Chlorophyll** decreases from north to south
- **Industrial contamination** has declined, but mercury still poses a human health threat
- **Seafloor habitats** improve in condition from north to south
- **3,321** acres of salt marsh (2010) and **479** acres of seagrasses (2016)
- **Summer migrant fish** (black sea bass, scup) have become more prevalent
- **Colder-water fish** (winter flounder) have declined

Map of Narragansett Bay watershed showing Massachusetts and Rhode Island, with cities including Worcester, Boston, Woonsocket, Brockton, Attleboro, Taunton, Providence, Warwick, Fall River, Newport. Rivers labeled Blackstone River, Taunton River, Pawtuxet River. Locations: Narragansett Bay, Sakonnet Point, Point Judith.

Reaping the Benefits of Successful Investments in Wastewater Pollution Reduction, Now We Face Challenges from Other Pollution Sources and Climate Change

Historically, population growth was the main factor affecting the condition of the Narragansett Bay watershed, as it led to severe pollution. Industrial operations released lead, chromium, and other contaminants; sewer systems discharged untreated sewage; and pavement and rooftops enabled rainwater to carry pollutants directly into waterways, rather than into soil where natural processes could remove or retain them. In recent decades, government agencies and private-sector partners have sharply reduced some contaminants, nutrient pollution, and harmful bacteria by upgrading wastewater treatment facilities and stormwater systems. Now the key challenges are to address other pollution sources and to support local adaptation to climate change, which is an increasingly dominant influence on the bay and watershed.

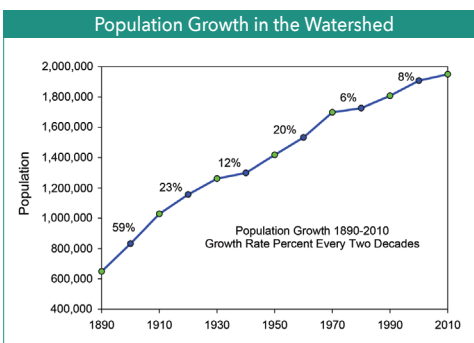## Improved Wastewater Treatment Has Cut Nutrient Pollution by More than Half

Public investments in wastewater treatment facilities have dramatically reduced the amount of nitrogen and phosphorous discharged into the bay and watershed. The reduction is important because excess nutrients can lead to low dissolved oxygen, affecting shellfish, fish, and other species. Scientists are investigating the effects of reduced nutrient pollution on these species and the ecosystem. It may take years for the changes to become apparent because of normal year-to-year variations from many influences.

Decrease in Nitrogen Pollution

Percent Reduction in Nitrogen Pollution

Upper Blackstone (Worcester), Field's Point (Providence), Bucklin Point (E. Providence), Woonsocket, Cranston, Attleboro, East Providence, Smithfield

Decrease in Nitrogen Pollution from Wastewater Treatment Facilities 2000-2004 to 2013-2015

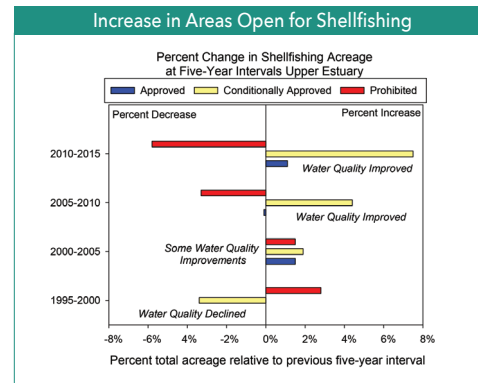## Population Growth and Urban Sprawl Degrade Bay and Watershed Conditions

The number of people living in the watershed continues to grow. Notably, recent population growth and land development have been concentrated in previously rural, forested areas. These new areas of "sprawl" contain large amounts of developed land per resident, compared to cities. As buildings and pavement replace forests and natural soils, stormwater flows more readily into rivers and the bay, carrying pollutants with it. Urbanization also demands sewage treatment. Bacteria, nutrients, and other pollutants from faulty septic systems and cesspools enter waterways via groundwater. The magnitude and extent of these impacts are largely unknown.

Population Growth in the Watershed

Population

Population Growth 1890-2010 Growth Rate Percent Every Two Decades

59%, 23%, 12%, 20%, 6%, 8%

Increase in Shellfish Harvesting Areas in the Upper Estuary Reflects Reduced Pathogens
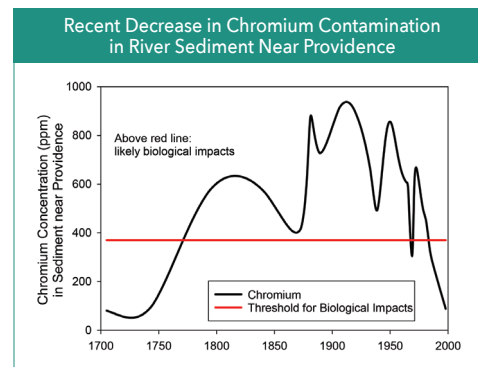
To protect human health, state agencies regulate where shellfish can be harvested. Pathogenic bacteria can enter the bay in stormwater runoff and, during large rainstorms, may also come from overflowing sewer systems that lack capacity to handle both sewage and stormwater. In the last two decades, upper estuary water quality has improved. In 2005, acreage open for shellfishing began to increase, reflecting reduced pollution from combined sewer overflows in Providence and Fall River.

Increase in Areas Open for Shellfishing

Percent Change in Shellfishing Acreage at Five-Year Intervals Upper Estuary

Approved | Conditionally Approved | Prohibited

Percent Decrease | Percent Increase

2010-2015 — Water Quality Improved
2005-2010 — Water Quality Improved
2000-2005 — Some Water Quality Improvements
1995-2000 — Water Quality Declined

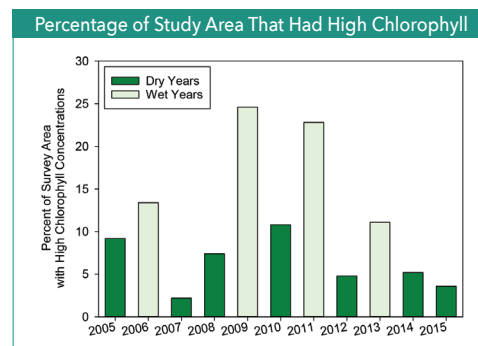Percent total acreage relative to previous five-year interval

While Some Contaminants Have Declined, Old and New Contaminants Pose Threats

Lead, chromium, and some other legacy pollutants have declined greatly in the bay, but mercury continues to pose a public health risk through consumption of locally caught fish. In addition, new types of chemical contaminants from personal care products, pharmaceuticals, and industrial practices are entering the watershed with unknown impacts.

Recent Decrease in Chromium Contamination in River Sediment Near Providence

Chromium Concentration (ppm) in Sediment near Providence

Above red line: likely biological impacts

Chromium
Threshold for Biological Impacts

Annual Changes in Bay Conditions Mask Long-term Trends

Bay water conditions vary greatly among years because of precipitation, temperature, and other influences. As an example, this graph shows dramatic year-to-year changes in chlorophyll, an indicator of phytoplankton abundance. Such changes are normal, but they make it challenging to identify long-term trends that may result from climate change or reductions in nutrient pollution. Comprehensive data collection over many years is needed to see those changes.

Percentage of Study Area That Had High Chlorophyll

Percent of Survey Area with High Chlorophyll Concentrations

Dry Years | Wet Years

2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015

Measurements Show that Climate Conditions Are Changing in the Narragansett Bay Watershed

Many people think of climate change as something in the distant future, but big changes are happening already in the Narragansett Bay watershed–with more to come. While it is true that Earth's climate has changed in the past, the changes under way now are extremely rapid and their pace is projected to increase. Decades of scientific data show that local air and water temperatures have warmed, rainfall has increased in volume and intensity, sea level has risen, and cold-water fish such as winter flounder have declined. Climate models tailored for this region show that changes will continue, potentially affecting developed lands and infrastructure such as roads and wastewater facilities, altering ecological food webs and abundance of natural resources such as seafood, and impairing the resiliency of salt marshes, seagrass beds, and other habitats.

Warmer Water and Air Temperatures

Bay water and air temperatures have increased by 3°F since 1960 and air temperature is projected to increase another 5 to 10°F by 2100. Studies

show that warming will become faster, causing ecosystem impacts such as increases in warm-water fish and decreases in cold-water fish, and potentially affecting public health concerns such as bacterial contamination of shellfish beds.
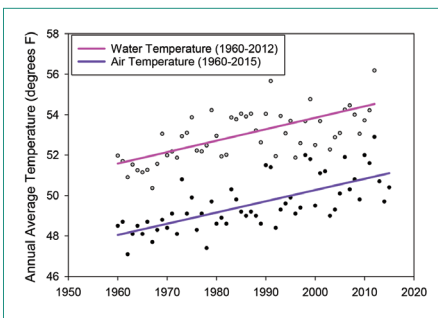
Increasing Amounts of Precipitation

Annual precipitation in the region has increased by two inches since 1950

(black line). Projections under different scenarios of greenhouse gas emissions (red and blue lines) show further increases in precipitation. The more intense rainfall may increase flooding to low-lying areas and threaten existing infrastructure.
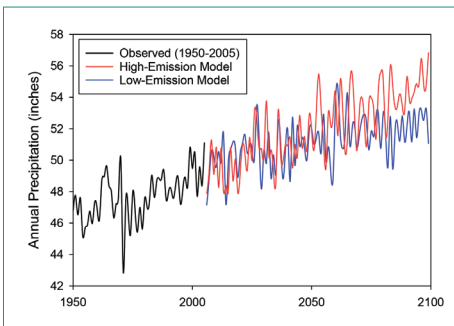
Rising Sea Level

Measurements (black line) show that sea level rose by nine inches from 1930 to 2017 at Newport. Models of different greenhouse gas emissions scenarios (colored lines) indicate that it could rise as much as another nine

or even eleven feet by 2100, drowning salt marshes (up to 87% loss), flooding developed lands, and causing other impacts. Already, some roads and other infrastructure in low-lying, coastal areas are inundated during extreme high tides.
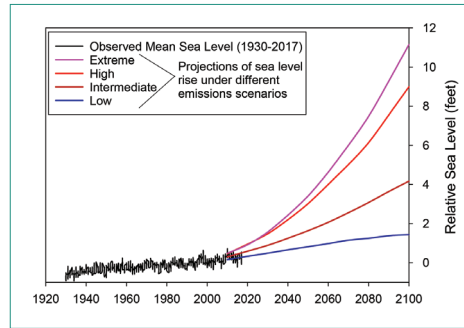
Changes in the Bay's Fish Community

Since the 1980s, warmer-water species such as scup and black sea bass

have displaced cooler-water species such as winter flounder and red hake, partly due to increasing temperatures and predation. These changes affect the bay's food web and the fishing industry.
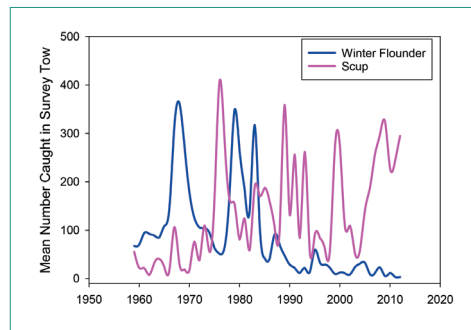
Scientific Information for Local Decision-Making Toward Climate Adaptation

Climate change presents on-the-ground challenges for the people of the Narragansett Bay watershed, and it has a bearing on many decisions being made today. Information in the *State of Narragansett Bay and Its Watershed* can be used to support decision-making related to infrastructure, public health, land development, habitat conservation, and other issues. Enhanced research and monitoring by public- and private-sector partners are needed to provide vital information for management and policy decision-making.

The State of Narragansett Bay and Its Watershed *report was made possible through the collaboration of many individuals and institutional partners. Please see acknowledgments at* nbep.org/the-state-of-our-watershed.

NARRAGANSETT BAY ESTUARY PROGRAM

EPA

NEIWPCC
New England Interstate Water Pollution Control Commission