ENVIRONMENTAL RESOURCE INVENTORY

Updated 2022

Prepared by:
Bordentown City
Environmental Commission

DOCUMENT UPDATE LOG

Date	Contributors	Sections Updated
	Various BCEC members, community members, and City officials including:	All
	City Commissioner James Lynch	4.4.2 Sewerage
	Deputy Mayor Joe Myers	4.4.1 Water Supply & 4.4.4 Energy
	Tristan Harrison, Latini & Gleitz Planning	5.2 Regional Planning
	Margaret Peak, City Administrator	4.4.4 Energy
	Mary Ann Keifer, Bordentown City Cats	3.11.3 Feral Cats
	Fred Miller, Bordentown City Police	4.4.7 City Services
	Grace Archer, City Clerk	4.4.3 Stormwater & 4.3.2 Open Space
	Doug Johnson, Municipal & Water Engineer	4.4.3 Stormwater
July	Bob Erikson, Superintendent of Public Works	4.3.2 Open Space
2022	Joe Malone, Planning Board	4.3.2 Open Space

TABLE OF CONTENTS

FIGURES

1. INTRODUCTION

According to the Association of New Jersey Environmental Commissions, an Environmental Resources Inventory (or ERI), is "a compilation of text and visual information about the natural resource characteristics and environmental features of an area." The ERI is a report based upon factual information and provides a municipality with a baseline documentation for assessing environmental issues. It is an important planning tool for environmental commissions and planning boards. It is recommended that the ERI be adopted as part of the municipal master plan, specifically as part of the conservation element (which occurred in Bordentown City in 2006). The ERI is a living document, which should be updated periodically as new information becomes available and assessment techniques become more refined.

Two New Jersey state laws, the Environmental Commission Enabling Legislation (NJSA 40:56A) and the Municipal Land Use Law (NJSA 40:55D-1), give environmental commissions the authority and responsibility for conducting and maintaining ERIs.

An ERI includes text, maps, tables, photos and figures that describe and quantify the local environment. Basic ERI information, including such topics as location, topography, climate, soils, geology, hydrology, vegetation, wildlife and land use, serves as the foundation of the document. The inclusion of additional information such as air quality, transportation, historic resources, noise and regional relationships serves to create the most comprehensive report possible.

An ERI can be used in a variety of ways. In Bordentown City, the ERI can be a guide in the site plan review process; can help prioritize open space acquisition; can save tax dollars by helping to prevent costly environmental problems; can assist in the municipal land use planning process; can serve as a reference for municipal ordinances and best management practices; and can provide an educational resource for residents.

Hardcopies of the ERI are available at City Hall and the Bordentown Public Library, and a PDF version is available on the Bordentown City Environmental Commission (BCEC) website.

The ERI was initially begun by the BCEC in 2002 and completed in 2006. It was prepared and has been updated without the customary assistance of private consultants, at minimal cost to the City. BCEC members brought their expertise, passion and knowledge of the local environment to the project, and in the process gained a greater understanding of the local environment. This document represents a comprehensive review and update of the ERI prepared in 2006.

Though the natural environment and overall character of the town have changed relatively little, various new sources of information have become available and some recent occurrences have the potential to significantly affect for future development. Notably, in the 2020-2022 timeframe, the former Ocean Spray Cranberry factory property has been sold to a private owner and a portion of the former estate of Joseph Bonaparte (known as Point Breeze), owned by the Divine Word Missionaries since 1941, was purchased by the State of New Jersey, the City of Bordentown, and the D&R Greenway Land Trust (herein referred to collectively as Point Breeze Park).

The following sections summarize the findings of the ERI.

2. HISTORY

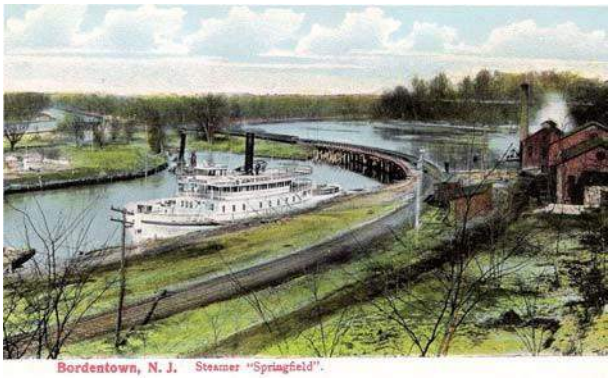
2.1 Historical Overview

The City of Bordentown encompasses an approximately one square mile area, on the bluffs of the Delaware River approximately 45 miles upstream from Philadelphia. With New York City 75 miles to the north, it is understandable that this small city became a colonial transportation hub. The City started its existence in 1682 with a log cabin on the riverbank and the name Farnsworth Landing. Settled by Quakers, the town was a trading point in colonial America. In 1717 a farmer from Freehold named Joseph Borden settled here, bought up a substantial part of the land and changed the town's name to Borden's Town. He started a packet line from Philadelphia to Bordentown, where travelers would stop to rest and then proceed on Borden's stage line to Perth Amboy, where they would make their connections to New York.

Many of the founding fathers of the country passed through Bordentown, which had become a bustling city of trade by the late 1700s. Francis Hopkinson, signer of the Declaration of Independence, lived in town. His son, Joseph, author of the song “Hail Columbia”, resided here as well. Thomas Paine, through his friendship with Col. Joseph Kirkbride, a veteran of the Revolutionary War, became enchanted with Bordentown and spent much time here, eventually buying a house in town. Bordentown's importance as a crossroads was not lost even on the British. The town was occupied by British forces on three separate occasions during the American Revolution, including in 1778 when two Continental frigates were burned and sunk in Crosswicks Creek as British troops attacked and briefly shelled the City.

Bordentown's historical significance did not end with the Colonial period, as it continued to play a major role in transportation. The first movement by steam on rails in the United States occurred in 1831 on the outskirts of town by the steam engine *John Bull* (now part of the Smithsonian Collection). Bordentown was an important stop on the railroad line between Philadelphia and New York. American Presidents and notables passed through town and some stayed, including Clara Barton, the founder of the Red Cross, who in 1852 established in Bordentown City the first successful free public school in New Jersey. The exiled King of Spain and Naples, Joseph Bonaparte, elder brother of Napoleon, also resided in Bordentown. Given the convenient location to cultural centers and the abundance of unspoiled property, Joseph Bonaparte purchased large tracts of land from Bordentown to Trenton, naming it “Point Breeze”, and built his mansion in Bordentown on the bluffs overlooking the Delaware River valley. Bonaparte brought a European influence to the town, spending 30 years here. While residing in Bordentown he hosted many important contemporary figures, including the Marquis de Lafayette, John Adams, Henry Clay and Noah Webster among others.

Mansion at Point Breeze, Park Street, circa early 1900s



Lock #1 And Locktender’s House, Delaware & Raritan Canal, Crosswicks Creek, circa early 1900s

Bordentown's location on the Delaware River, just south of the state capital of Trenton, made it an important river port. Shipbuilding and river trade were prosperous industries. The opening of the Delaware & Raritan Canal in 1834 also played a significant role in the town's growth. But throughout

these changes and commercial boom times, Bordentown remained small. The City was incorporated as a borough in 1849 and as a city in 1867. As the town has grown, the architecture has evolved as well. Buildings of Federal, Victorian, and Arts & Crafts styles, from bungalows to stately mansions, document the architecture of the 18th, 19th, and 20th centuries.

Today, much of the City's square mile is a designated Historic District, and numerous properties are on the State and National Historic Register.

2.2 Bordentown City Historic Sites

State and National Historic Register Designations

- Abbott Farm Historic District (NHL, ID#1654)
    - National Register: 12/8/1976 (National Register Reference #: 76001158)
    - State Register: 8/16/1979
- Bordentown Historic District (ID#750)
    - Location: Farnsworth, Second and Third Avenues; Crosswicks, Prince, Walnut, Burlington, Park and Spring streets.
    - National Register: 6/14/1982 (National Register Reference #: 82003264)
    - State Register: 7/7/1976
- Camden and Amboy Railroad Branch Line Historic District (ID#2969)
    - Location: Camden and Amboy Branch Line Right-of-way from Bordentown City to Adams Lane, North Brunswick, Middlesex County.
- Camden and Amboy Railroad Main Line Historic District (ID#2970) Location: Camden and Amboy Railroad right-of-way.
    - Extends through thirty-one municipalities in four counties.
- Crosswicks Creek Railroad Bridge (ID#3255)
    - Location: Camden and Amboy Railroad over Crosswicks Creek.

Thomas Paine Statue, Prince Street

Quaker Meeting House, circa 1750 (first floor), 1813 (second floor)

- Crosswicks Creek Site III (28-Bu-329) (ID#753)
    - National Register: 11/26/1990 (National Register Reference #: 87001795)
    - State Register: 8/31/1987
- Richard Watson Gilder house (ID#4283)
    - Location: Crosswicks Street.
- Francis Hopkinson House (NHL, ID#751)
    - Location: 101 Farnsworth Avenue.
    - National Register: 7/17/1971 (National Register Reference #: 71000496) State Register: 7/17/1971
- Point Breeze Historic District (ID#752)
    - Location: US Route 206 and Park Street.
- Richard Watson Gilder House, circa 1725
    - National Register: 8/10/1977 (National Register Reference #: 77000848) State Register: 10/22/1976

Francis Hopkinson House, circa 1750

Richard Watson Gilder House, circa 1725

2.3 Bordentown Timeline

The following represents a timeline of significant historical events occurring in Bordentown City.

1681 -- Thomas Farnsworth purchased 100 acres; later purchased an additional 448 acres, extending from Crosswicks to Blacks Creek, and the Delaware River to Newbold's Island.

1682 -- Bordentown founded by Thomas' son Samuel; called the settlement Farnsworth Landing.

1717 -- Joseph Borden acquires 50 acres, renaming the area Borden's Ferry.

1725 -- Iron forge built on Blacks Creek, location unknown.

1734 -- First stage line established from Burlington, through Bordentown, to New York.

1741 – First Quaker meeting house constructed.

1750 -- John Imlay built what is now known as the Francis Hopkinson House. It was later the home of Hopkinson, member of the Continental Congress, federal district judge, author, artist, and musician. He designed the Great Seal for the State of New Jersey.

1776 -- Bordentown occupied by 2,000 British and Hessian troops.

1778 -- British attack and destroy much of Bordentown.

1783-86 -- Thomas Paine lives in Bordentown.

1816 -- Joseph Bonaparte, King of Spain, purchases 1,000 acres in Bordentown at Point Breeze.

1830 -- Camden and Amboy Railroad incorporated. The following year, the John Bull locomotive has trial run.

1834 -- Delaware and Raritan Canal completed, connecting Bordentown and New Brunswick.

1849 -- Bordentown incorporated by New Jersey legislature.

1852-3 -- Clara Barton, founder of the American Red Cross, opened her free school, one of the first in NJ.

1872 -- The industrial revolution came to Bordentown with the establishment of a canning and mincemeat factory. This was followed two years later with a shirt manufacturer, shipyard, and in eight years, another shirt factory.

1886 -- African-American Rev. W. A. Rice established a private school, the Manual Training and Industrial School for Colored Youth, in a house on West Street; later moved to Walnut Street.

1898 -- Trenton Transportation Company began running trolleys from Trenton to Bordentown. They were replaced in 1932 with bus service.

1936 -- Hilltop Park renamed William R. Flynn Memorial Park. The newer park was the first Burlington County Works Progress Administration project completed.

1947 -- After several owners, Point Breeze becomes a seminary for the Divine Word Mission.

1976 -- Bordentown designated a Bicentennial Community.

2.4 Local Historic Designations:

Both the Farnsworth Avenue Business District and Thompson Street are designated historic districts as part of the Bordentown City Historic Preservation Ordinance. Any development, redevelopment or rehabilitation of structures within these zones is subject to review by the Historic Preservation Officer. In order to preserve and protect the historic architectural resources, exterior building facades in these areas must adhere to historically correct designs, patterns and colors.

Streetscape on Thompson Street

3. THE NATURAL ENVIRONMENT

3.1 Location

Bordentown City is located on the western edge of central New Jersey, just southeast of Trenton, along a bend in the Delaware River, where the flow direction shifts from southeast to southwest. It is in the northernmost corner of Burlington County, and is bordered by:

- Mile Hollow Run (and Bordentown Township) to the northeast;
- Bordentown Township to the east and south;
- Blacks Creek (and Bordentown Township) to the southwest;
- The Delaware River (and Pennsylvania) to the west;
- Crosswicks Creek (and Hamilton Township, Mercer County) to the northwest.

3.2 Physiography

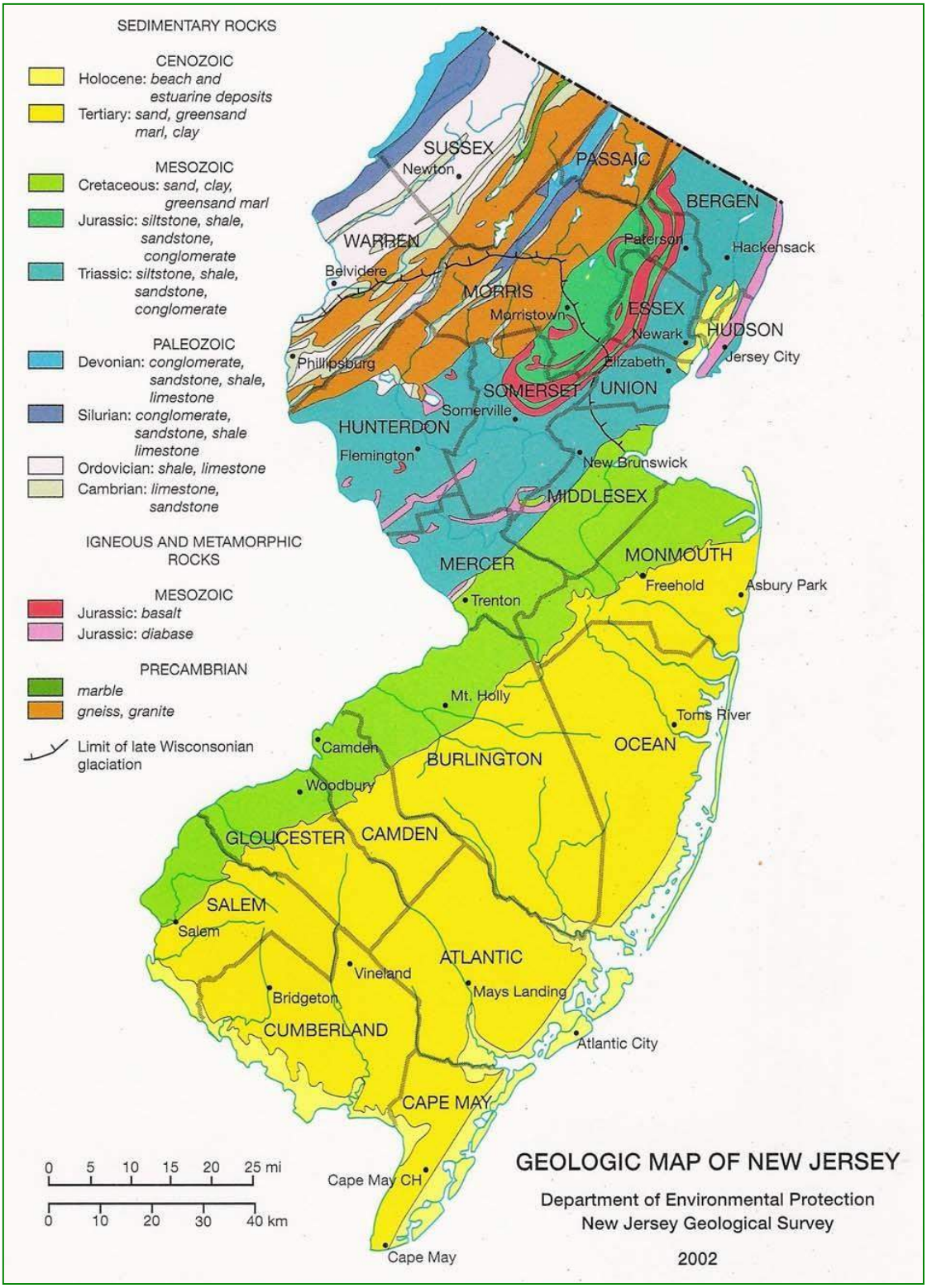
New Jersey can be divided into four major geomorphic or physiographic provinces, each characterized by rocks (or sediments) of similar type, origin, and age, similar landscapes, and a general northeast/southwest trend. (See the Geologic Map of New Jersey on page 3.) Bordentown City is part of the Coastal Plain, which covers 3/5 of the area of the state, southeast of a line from Trenton to Carteret. It is a broad, flat to gently undulating, low-lying area, composed of a wedge of unconsolidated sediments gently dipping southeastward. This wedge also thickens to the southeast, from 50 to 150 feet along the Delaware River, to 4,500 feet at Atlantic City, to 40,000 feet thick 50 miles offshore. Coastal plain sediments include deltaic and marine deposits of Cretaceous to Tertiary age (145 to 1.75 million years ago), resulting from fluctuating sea level; a thin veneer of fluvial sands and gravels of Pliocene and Miocene age (23 to 1.75 million years ago); and alluvial, beach, swamp, eolian, and tidal marsh deposits from the Quaternary Period (the last 1.75 million years).

Bordentown City is located in the Inner Coastal Plain subprovince, characterized by higher elevations, more local topographic relief, and generally finer textured deposits than found in the Outer Coastal Plain.

3.3 Topography

Most of Bordentown City is situated on a terrace elevated approximately 50 feet above the adjacent Delaware River. The land on the terrace is nearly level to gently sloping with elevations between approximately 50 and 100 feet above sea level. The land drops toward tidal marshes along Crosswicks Creek and Blacks Creek as well as the Delaware River, located at less than 10 feet above sea level, forming steep bluffs. The channels of second and higher order streams, Thorntown Creek, Mile Hollow Run, Love Bridge Run, and Blacks Creek, are also incised into the terraced area forming steep slopes along the valley walls.

Regional Map



Geologic Map of New Jersey

3.4 Climate

The global weather patterns that take place based upon the Earth's rotation, tilt and land/water distribution are the factors responsible for our climates. Climates are the common weather conditions usually found in a particular location. While the weather fluctuates daily at any particular place, over time, the same kind of weather will reoccur. This recurring weather pattern for each area is known as the climate for that locale.

German climatologist, Wladimir Köppen, separated the world's climates into several major groupings. The Eastern United States falls under the classification Moist Subtropical Mid-Latitude Climate, a general temperature profile based on latitude. This climate generally has warm and humid summers with mild winters. It extends from 30° to 50° latitude mainly on the eastern and western borders of most continents. During the winter, the chief weather element is the mid-latitude cyclone. Convective thunderstorms are prevalent during the summer months.

3.4.1 The Climate of New Jersey

The Garden State is located about halfway between the Equator and the North Pole, on the eastern coast of the United States. This geographic placement results in the state being influenced by hot, dry, wet, and cold airstreams, leading to daily weather that is highly variable.

New Jersey is 166 miles long from north to south, and 65 miles at its greatest width. While this may not seem very large, there is a marked difference in climate between Cape May in the south and the Kittatinny Mountains in the northwest.

The dominant feature of the atmospheric circulation over North America is the broad, undulating flow of air from west to east across the middle latitudes of the continent. These "prevailing westerlies" shift north and south and change in strength during the course of the year, exercising a major influence on the weather throughout New Jersey.

Some general observations about the temperature and precipitation in New Jersey include:

- Average yearly precipitation ranges from 40 inches along the southeast coast to 51 inches in north-central parts of the state. Many areas average between 43 and 47 inches.
- Most areas receive 25 to 30 thunderstorms annually, with fewer storms near the coast than farther inland. Approximately five tornadoes occur across the state each year.
- Measurable precipitation falls on approximately 120 days. Fall months are usually the driest, with an average of eight days with measurable precipitation. Other seasons average between 9 and 12 days per month of precipitation.
- Average number of freeze-free days varies from 163 in the northern Highlands, 179 in the central and southern interior, and 217 along the seacoast.
- Snow may fall from about mid-October to the end of April in the Highlands and from about mid November to mid-April in southern counties.
- All New Jersey weather stations have registered temperature readings of 100 degrees F or higher and have records of 0 degrees F or below.

Although New Jersey is one of the smallest states in the Union, with a land area of 7,836 square miles, it has five distinct climate regions. The geology, distance from the Atlantic Ocean, and prevailing atmospheric flow patterns create distinct variations in the daily weather between each of the regions.

Bordentown City falls within what is known as the Central Zone, closely bordered by the Pine Barrens region.

3.4.1.1 Central Zone

The Central Zone has a northeast to southwest orientation, running from New York Harbor and the Lower Hudson River to the great bend of the Delaware River in the vicinity of Trenton. This region has many urban locations, and the concentration of buildings and paved surfaces serve to retain more heat, thus affecting local temperatures. Due to the concrete, brick and asphalt, the observed nighttime temperatures in heavily developed parts of the zone are often warmer than nearby suburban and rural areas. This phenomenon is commonly referred to as a "heat island" effect.

The northern edge of the Central Zone is often the boundary between freezing and non-freezing precipitation during the winter. Areas to the south of the Central Zone tend to have nearly twice as many days with temperatures above 90 degrees F than the 15-20 commonly observed in the central portion of the state.

3.4.1.2 Pine Barrens Zone

Scrub pine and oak forests pervade the interior southern portion of New Jersey, hence the name, Pine Barrens. Sandy soils, which are porous and not very fertile, have a major impact on this region's climate. On clear nights, solar radiation absorbed during the day is rapidly radiated back into space, resulting in surprisingly low minimum temperatures.

The porous soil allows any precipitation to quickly infiltrate and leave surfaces rather dry. Drier conditions allow for a wider range between the daily maximum and minimum temperatures and make the area vulnerable to forest fires.

3.4.2 Local Statistical Information

Statistical analysis of climatic data generates descriptive information, which reflects the average atmospheric conditions at a location, as well as generating probabilities that extreme events will occur.

The Office of the New Jersey State Climatologist of Rutgers University, as well as the National Weather Service, collects information on climate data in New Jersey through the operation of individual weather stations located throughout the state.

Measurements of temperature, precipitation, frost points and snowfall are some of statistical climatic data relevant to our locale. While there are no weather stations located in Bordentown City, pertinent data is collected from the nearest weather stations operating in Hightstown, Trenton and Pemberton, New Jersey.

Temperature readings are collected daily and monthly. The average, or mean temperature, reflects the average of a series of temperatures taken over a period of time. Maximum temperature indicates the highest temperature during a specified time period, while the average maximum temperature reflects the average of the maximum readings over the specified time period. Similarly, minimum temperatures indicate the lowest temperature during a specified time period, and the average minimum temperature reflects the average of the minimum readings.

Precipitation is measured on a daily and monthly basis in New Jersey. Precipitation refers to all forms of water - liquid or solid - that fall from the atmosphere and reach the ground. Precipitation includes, but is not limited to, rain, drizzle, snow, hail, sleet, and ice crystals. Precipitation does not include dew.

The average precipitation refers to the average number of inches for a given time period.

Climate normals for the Trenton, New Jersey climate station for the 1981 to 2011 period are presented in the following table.

Month	Minimum Temperature (deg F)	Maximum Temperature (deg F)	Average Temperature (deg F)
JAN	23.2	39	31.1
FEB	25.8	42.2	34
MAR	31.9	50.9	41.4
APR	41	61.4	51.2
MAY	50.5	71.8	61.1
JUN	60.3	80.8	70.5
JUL	66	85.3	75.7
AUG	64.2	83.6	73.9
SEP	56.4	76.1	66.2
OCT	44.2	65	54.6
NOV	36.9	54.5	45.7
DEC	27.6	43.1	35.3

Mean, median, minimum and maximum values of total monthly precipitation for the Trenton, New Jersey climate station from the period from 1865 to 2019 are presented in the table below.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	3.19	2.99	3.77	3.44	3.66	3.78	4.62	4.78	3.78	3.25	3.20	3.39	43.7
Median	3.12	2.68	3.76	2.91	3.57	3.46	4.31	4.08	3.38	3.08	2.83	3.21	43.27
Min	0.22	0.63	0.09	0.83	0.25	0.06	0.37	0.47	0.19	0.05	0.31	0.19	28.79
Max	8.99	6.25	8.86	10.32	10.75	10.16	15.12	15.69	11.22	11.21	8.24	7.54	66.65

3.4.3 Climate Change

The National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information State Climate Summaries for New Jersey 2022 (https://statesummaries.ncics.org/chapter/nj/ accessed July 19, 2022) provides a summary of the present state of climate change as well as predicted future changes. The report indicates that annual temperatures in New Jersey have increased by more than 3.5 degrees Fahrenheit since the beginning of the 20th century. Recent temperature changes have included ten of the ten hottest calendar years on record occurring since 1990, increased numbers of very hot days and warm nights, and decreases in the number of extremely cold days. Precipitation across the state has also increased with the number of extreme events being above average and annual precipitation being about 3.7 inches above average over the last 16 years. Winter and spring precipitation as well as extreme precipitation events are predicted to continue to increase in the 21st century. Global sea level has risen approximately 8 inches since 1880 and is predicted to rise another 1 to four feet by 2100. Sea level has risen approximately 1.6 inches per decade based on historical observations at Atlantic City, twice the global rate.

GIS map 07 depicts Federal Emergency Management Agency (FEMA) flood zones for Bordentown City. These are areas vulnerable to more severe or more frequent flooding under the predicted sea level rise scenarios. The City's Comprehensive Master Plan adopted by the planning board on June 29, 2021 (https://cityofbordentown.com/wp-content/uploads/BORDENTOWN-COMPREHENSIVE-PLAN-Adopted-June-29-2021-w-Appendices.pdf accessed on July 19, 2022) provides further analysis of potential climate change impacts and the NJDEP New Jersey Scientific Report on Climate Change (https://dspace.njstatelib.org/xmlui/bitstream/handle/10929/68415/nj-scientific-report-2020.pdf?sequence=1&isAllowed=y accessed on July 19, 2022) provides a detailed analysis of the current state of knowledge about the effects of climate change on New Jersey's environment.

3.5 Air Quality

The air quality of Bordentown City is greatly impacted by its location in the urban expanse of the Northeastern corridor of the United States. Exposure to air toxincs is a widespread problem that occurs throughout the entire state of New Jersey. These pollutants come from a wide variety of sources, including traditional industrial and utility sources, smaller manufacturing and commercial sources, mobile sources, residential activities and construction equipment. Sources of air toxics are generally categorized as point, nonpoint, and mobile (on-road and non-road) sources.

Point Sources: For the purposes of the 2014 National Air Toxics Assessment (NATA), a point source is a stationary facility or process whose location could be identified with latitude and longitude coordinates. Point sources include large facilities that emit a significant amount of air pollution during manufacturing, power generation, heating, incineration, or other such activity. They also include smaller facilities including those that are required to report their emissions under the federal Toxic Release Inventory program and the state's Community Right-To-Know program.

Nonpoint/Area Sources: These are small stationary sources of air pollution which by themselves may not emit very much, but when their emissions are added together, they account for a significant portion of the total emissions of air toxics. They are also referred to as area sources and are generally too small or too numerous to be inventoried individually. The following are grouped under nonpoint sources in NATA:

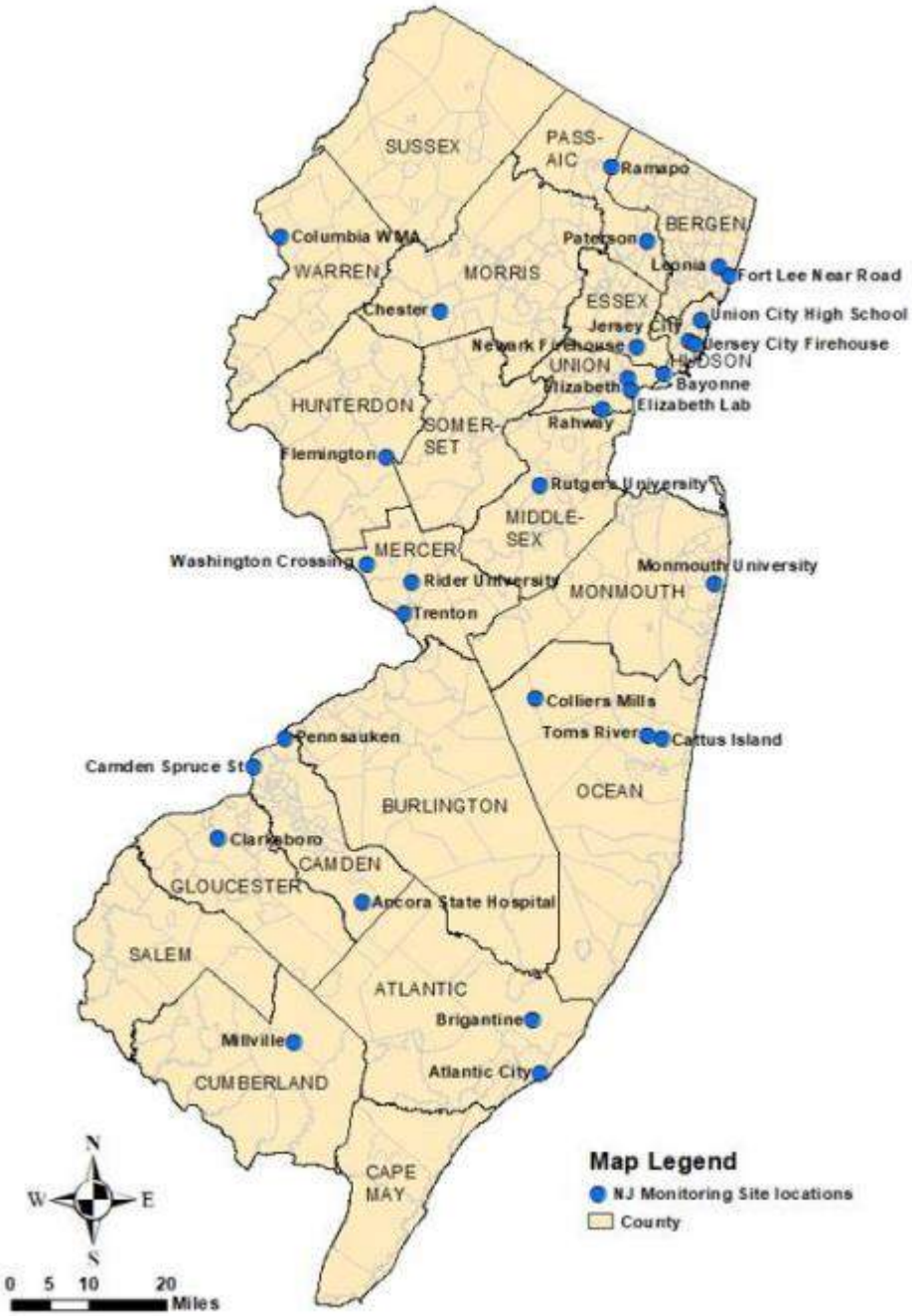
- Consumer products, including personal care products, household products, adhesives and sealants, automotive products, and coatings such as paints
- Residential heating and fuel use
- Pesticide use
- Gasoline stations
- Dry cleaners
- Institutional and commercial heating

Mobile Sources: are divided into two categories:

- On-road mobile sources are vehicles found on roads and highways, including cars, trucks, buses, and motorcycles.
- Non-road mobile sources include aircraft, trains, lawnmowers, boats, dirt bikes, construction vehicles, farm equipment, leaf blowers, and more.

The 2020 New Jersey Air Quality Report, the latest currently available, indicates that air quality is monitored at 31 sites as shown on the map below. Note that The former monitoring site in Burlington was shut down in 2009 and no sites remain in Burlington County[1].

[1] https://nj.gov/dep/airmon/pdf/2020-nj-aq-report.pdf accessed on July 18, 2022
https://www.nj.gov/dep/airmon/pdf/archive/2010%20Air%20Quality%20Report.pdf accessed on July 18, 2022

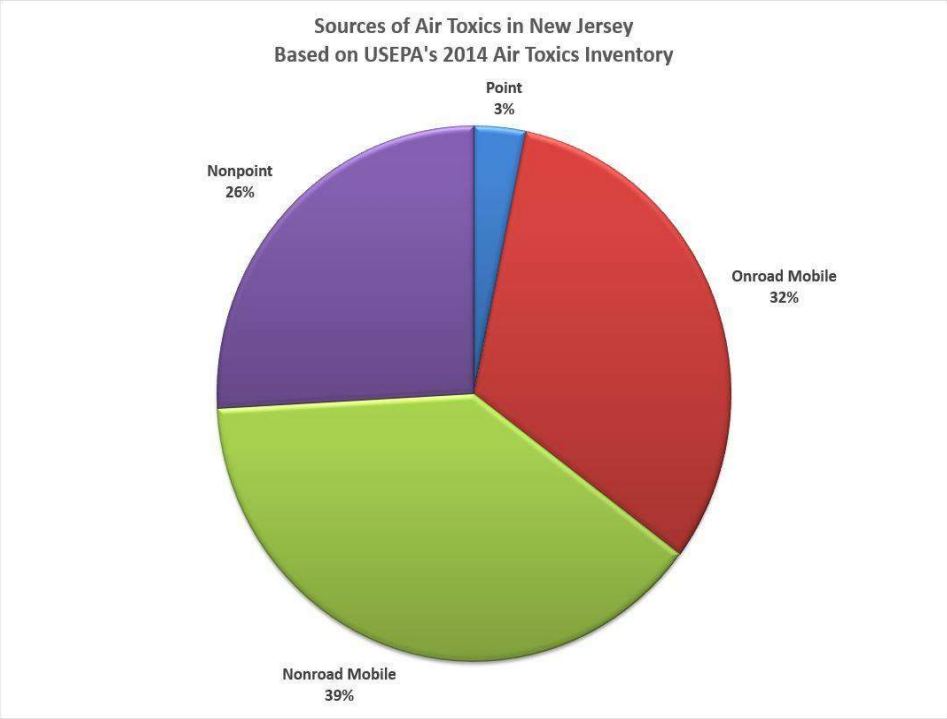


3.5.1 The National Air Toxics Emissions Inventory[2]

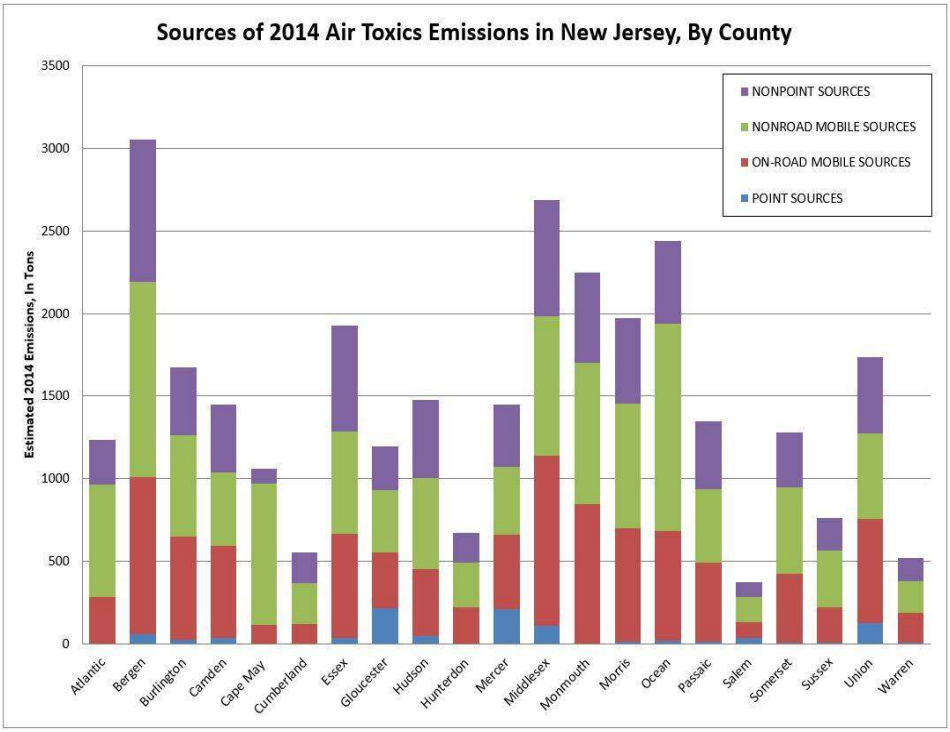
As part of the NATA process, USEPA prepares a comprehensive list of air toxics emissions for the entire country. This emissions inventory is reviewed and revised by each state before being finalized by USEPA. As shown in the pie chart

[2] https://www.nj.gov/dep/airtoxics/sourceso14.htm accessed on July 18, 2022

below, mobile sources are the largest contributors of air toxics emissions in New Jersey, with on-road mobile sources accounting for 37%, and non-road mobile sources contributing 31%. Nonpoint/area sources represent 29% of the inventory. The remaining 3% of the inventory is attributable to point sources.



When the emissions estimates are broken down by county, it is evident that the areas with the largest air toxic emissions are generally those with the largest population in the smallest space. This is directly related to high levels of vehicle use, solvent use, and other population-related types of activities in those counties. In the chart below, Burlington County ranks 8th highest for total estimated air toxic emissions among the 21 counties in New Jersey.



3.5.2 Federal Clean Air Act Criteria Pollutants[3]

The Federal Clean Air Act requires the United States Environmental Protection Agency (USEPA) to set National Ambient Air Quality Standards (NAAQS) for six common air pollutants. These commonly found air pollutants also known as "criteria pollutants" are particle pollution or particulate matter (PM), ground-level ozone, carbon monoxide (CO), sulfur dioxide (SO2), nitrogen dioxide (NO2), and lead. These pollutants can harm your health, the environment, and cause property damage. The USEPA calls these pollutants "criteria" air pollutants because it regulates them by developing human health-based and/or environmentally-based criteria (science-based guidelines) for setting permissible levels. If the NAAQS for a pollutant is exceeded, adverse effects on human health may occur. Areas of the country where air pollution levels persistently exceed the standards may be designated by the USEPA as non-attainment areas.

Statewide, New Jersey has been designated by USEPA with a non-attainment status for ozone, and an unclassifiable status (meaning not enough information is available to make a determination) for PM(2.5), SO2, NO2, and lead.

Bordentown City is located in the Southern New Jersey- Pennsylvania-Delaware-Maryland, NJ-PA-DE-MD non-attainment area for failing to meet the national ambient air quality standard for the air pollutant Ozone.

Ozone can be formed when a mixture of oxygen and nitrogen dioxide is exposed to bright light. Such mixtures occur in the polluted air of large cities. On sunny days where nitrogen dioxide pollution from traffic is high, the concentration of ozone in the air can reach levels that are dangerous for plants, animals, and people.

[3] https://www.nj.gov/dep/baqp/aas.html accessed on July 18, 2022

3.5.3 NATA Modeled Air Concentrations

As part of the NATA, USEPA models ambient concentrations of contaminants in air throughout the country. NJDEP compares the estimated NATA air concentrations to their chemical-specific New Jersey health benchmarks. The latest available risk assessment for Burlington County is from 2014[4]. The results indicate that in Burlington County concentrations are predicted to present a health risk for 1,3-butadiene, acetaldehyde, benzene, carbon tetrachloride, diesel particulate matter, formaldehyde, and naphthalene.

3.5.4 Air Quality Index[5]

The USEPA monitors air quality through the use of the Air Quality Index (AQI). The AQI is an index for reporting daily air quality. It reports how clean or polluted the air is, and what associated health concerns people should be aware of. The EPA uses the AQI for five major air pollutants regulated by the Clean Air Act: ground-level ozone, particulate matter, carbon monoxide, sulfur dioxide, and nitrogen dioxide. For each of these pollutants, the EPA has established national air quality standards to protect against harmful health effects.

An AQI value of 100 generally corresponds to the national air quality standard for the pollutant, which is the level EPA has set to protect public health. So, AQI values below 100 are generally thought of as satisfactory. When AQI values are above 100, air quality is considered to be unhealthy—at first for certain sensitive groups of people, then for everyone as AQI values get higher.

The EPA has divided the AQI scale into six categories, shown below:

Air Quality Index (AQI) Values	Levels of Health Concern
When the AQI is in this range:	...air quality conditions are:
0 to 50	Good
51 to 100	Moderate
101 to 150	Unhealthy for Sensitive Groups
151 to 200	Unhealthy
201 to 300	Very Unhealthy
301 to 500	Hazardous

AQI values can vary significantly from one season to another. In winter, for example, carbon monoxide is likely to be the pollutant with the highest AQI values in some areas, because cold weather makes it difficult for car emission

[4] https://www.nj.gov/dep/airtoxics/nataest14.htm accessed on July 18, 2022

[5] https://www.airnow.gov/state/?name=new-jersey accessed on July 18, 2022

control systems to operate effectively. In summer, ozone is the most significant air pollutant in many communities, since it forms in the presence of heat and sunlight. AQI values also can vary depending on the time of day. For example, ozone levels often peak in the afternoon, while carbon monoxide is usually a problem during morning or evening rush hours.

Current and predicted AQI values are available at www.airnow.gov.

2020 AQI Summary Pertinent to Bordentown

Not all air quality monitoring stations in New Jersey are used for calculation of AQI, and not all stations that are used to calculate AQI measure all five major air pollutants. The nearest AQI monitoring stations are Rider University (measures ozone and PM), Colliers Mills (measures ozone), Rutgers University (measures ozone and PM), Flemington (measures ozone and PM), and Camden Spruce St. (measures all five parameters). The latest New Jersey Air Quality Monitoring Report from 2020, indicates that statewide, there were 5 days when ozone exceeded the "Unhealthy for Sensitive Groups" (USG) threshold, and 1 day when PM2.5 exceeded the USG threshold.

Of the monitoring stations near Bordentown City, three USG threshold exceedances occurred in 2020 at Rider University for ozone, and one occurred at Rutgers University for ozone.

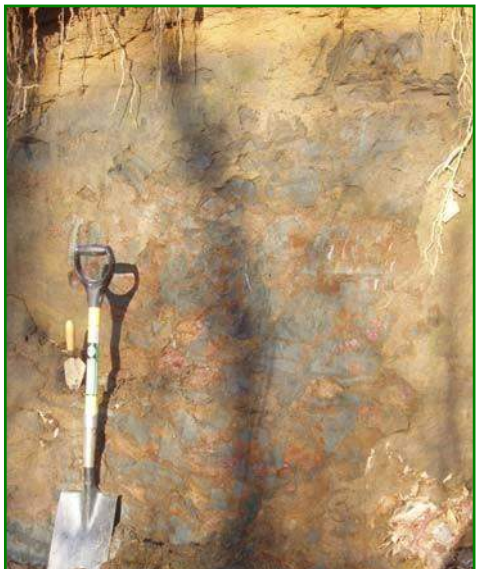
3.6 Geology

The New Jersey Coastal Plain is composed of a wedge of sediments dipping and thickening toward the east. The geologic formations comprising the older basal beds beneath Bordentown City were deposited 70 to 100 million years ago, during the Upper Cretaceous Period. These deposits are part of a coastal plain aquifer system extending along the East Coast of the United States used to supply drinking water. Though these formations are often referred to as the "bedrock geology" of the Coastal Plain, because they are substantially older and more widespread than the overlying surficial sediments, they are not actually rock, but rather unconsolidated sediments. The true bedrock is much older crystalline rock, which occurs approximately 350 feet below ground surface in the area of the city, below the coastal plain formations. In general, the coastal plain formations are exposed at the ground surface according to age (younger to older) from east to west as shown in GIS Map 1.

3.6.1 Coastal Plain Geologic Formations

The *Potomac Formation* approaches the ground surface in the northwestern-most portions of the city in the Delaware River channel at the mouths of Blacks and Thorntown Creeks, and Mile Hollow Run and is overlain by recent alluvial/tidal marsh deposits. The Potomac Formation was historically identified as the Raritan Formation in this area, however, recent research indicates that the Raritan Formation, though present between the Potomac Formation and the overlying Magothy Formation in areas to the northeast, is not present in the Bordentown area. The Potomac formation serves as the water source for Bordentown City and Township and is referred to as the middle aquifer of the Potomac-Raritan-Magothy (PRM) aquifer system in this area. Near Bordentown the *Potomac Formation* consists largely of thick beds of light-colored sands and massive to thick-bedded variegated (red, white, yellow) silty clays, although exposures are rare because of the widespread cover of surficial sediments. It is the basal unit of the Coastal Plain, in this area overlying basement rocks of Early Paleozoic age (439-570 million years ago). The Potomac represents a wide variety of depositional environments, from continental to marine, although in the Bordentown area this unit is generally lacking in fossils.

The *Magothy Formation* overlies the Potomac and forms the substratum along the western edge of the city, Blacks Creek, Thorntown Creek, and Mile Hollow Run. Throughout most of New Jersey, the Magothy consists of sand, silt, and clay deposited in tidally influenced shallow shelf and estuarine environments. In the Bordentown area it is about 30 to 50 feet thick, consisting of dark clays and light colored cross-bedded sands that are well exposed in the striking bluffs along the Delaware River and Crosswicks Creek, and along Mile Hollow Run. The Magothy serves as the upper aquifer in the PRM drinking water aquifer system.



Merchantville Formation, Blacks Creek

The *Merchantville Formation* overlies the Magothy and occurs at or near the ground surface throughout most of Bordentown City. In many places it is overlain by thin surficial terrace deposits, but it outcrops along stream and river valleys and in topographically higher areas along the eastern side of the city. The Merchantville consists of a black, glauconitic micaceous clay and silty clay, with a massive structure and greasy appearance, that "weathers to a coherent brown earth" (Wolfe, 1977). In the Bordentown area it is thicker bedded and more glauconitic than further east. The best exposures of the Merchantville are in the tributaries on the west side of Blacks Creek (Owens and Minard, 1964). It is a marine shelf deposit, about 50 feet thick, formed during the first advance of the sea onto the coastal plain during the Cretaceous, and is the oldest glauconitic unit to outcrop in New Jersey. A diverse assemblage of casts and molds of marine fossils such as ammonites and mollusks are common.

The Merchantville Formation is part of a greensand belt, which stretch across the inner coastal plain from Monmouth to Salem Counties. Greensand deposits contain the mineral glauconite, a dioctahedral iron-rich layer silicate similar to illite, commonly found as a green to black pellet of micaceous clay. Glauconite was formed in an offshore marine environment during the Tertiary and Cretaceous periods, 45 to 85 million years ago. Greensand deposits often contain phosphorus and calcium carbonate, high amounts of some trace elements, and in some cases pyrite, which can create extremely acid, or "poison marl," conditions.

Glauconite-bearing soils are among the best agricultural soils in the state, and greensand has been used as a soil amendment in NJ since the 1760's.

Although once considered a valuable potash source, its real benefit is to soil physical properties, through increased water and nutrient holding capacity.

Greensand use peaked in the late 1800's, when up to 1 million tons were dug per year, with application rates of 20 to 50 tons per acre. As late as 1923 there were still about 80 active greensand pits in New Jersey, but with the advent of chemical fertilizers, the industry faded. Glauconite has found other uses through the years as a binding additive for brick making, in the production of green glass, and as a water softener.

Glauconite is still used in water treatment, and the only remaining commercial greensand producer in the US is the Inversand Corporation in Sewell, Gloucester County. Manganese-coated greensand is used by the Bordentown water treatment plant to remove iron, manganese, and hydrogen sulfides from groundwater. Inversand also supplies a Pennsylvania company, Fertrell, which markets a greensand soil conditioner. The Sewell pit, like most greensand deposits, has also been an extremely valuable site for Cretaceous and Tertiary fossils.

A small area of the *Woodbury Formation* clay overlies the Merchantville at the eastern edge of town, near the intersection of Crosswicks Street with Route 130. Being near its western extent here, it is likely only a few feet in

thickness. It is a massive, dark gray, micaceous clayey silt, with more clay and less glauconite than the underlying Merchantville. Small particles of pyrite, an iron sulfide mineral, are locally abundant, and upon oxidation can create extremely acid conditions. The Woodbury is interpreted as a marine inner shelf deposit. The fine textured material is commonly used as landfill liner due to its slow permeability, and the formation is famous for producing (in Haddonfield in the 1860's) the bones of *Hadrosaurus foulkii*, the first dinosaur skeleton to be mounted and displayed publicly.

Outcrops of these older formations may be seen in cutbanks along streams, or material can be exposed during excavations. In many areas, these deposits are covered by younger, surficial materials.

3.6.2 Surficial Deposits

Geological materials at the ground surface generally consist of exposed areas of the coastal plain formations along incised channel banks, Pliocene aged Pennsauken Formation materials, and younger Pleistocene aged deposits identified by Stanford (2014) as Upper and Lower Stream-Terrace deposits, younger still Pleistocene aged Lower Postglacial Terrace deposits, and modern Alluvium and Tidal-Marsh and Estuarine deposits. Bordentown City's surficial geology is shown on GIS Map 2.

Prior to the most recent glaciation of New Jersey, during the Pliocene Period, the Pennsauken Formation was deposited on the floodplain of a large river flowing southwesterly from the New York City are to the Delmarva Peninsula. The Pennsauken Formation once covered the entire area of Bordentown City but was subsequently eroded from the western portions of the City such that it remains only in the highest elevation areas the east. The Pennsauken Formation is generally composed of yellow or reddish yellow fluvial sand and gravel consisting of primarily quarts with some felspar, mica, and glauconite. This formation occurs at thicknesses of up to 80 feet above the underlying coastal plain formations.

Later, during the Illinoian glaciation, which occurred during the Pleistocene Period, sea level dropped causing the local streams to incise into the Pennsauken Formation. During a period of stable baselevel, large terraces were deposited, including the Upper Terrace deposit, which covers the majority of Bordentown City. The Upper Stream-Terrace deposits consist primarily of brownish and yellowish sand with minor silt and pebble gravel. The sand consists primarily of quartz with some glauconite, minor mica and trace feldspar. Thickness of this deposit is generally less than 20 feet, but up to 50 feet overlying the coastal plain formations.

During the late Pleistocene, as the glacial ice front receded from northern New Jersey and the land became reforested, the streams and rivers in the Bordentown area became starved for sediment and again incised into the surficial sediments. In Bordentown City, the Upper Stream-Terrace deposits were eroded along the creeks, further deepening those valleys and leaving small areas of Lower Stream-Terrace deposits along the lower channel banks of Blacks Creek, Thorntown Creek, and Mile Hollow Run, near where they enter the Delaware River. The Lower Stream-Terrace Deposits generally consist of brownish and yellowish sands with some minor silt and pebble gravel. This deposit is generally 5 to 15 feet in thickness above the coastal plain deposits.

Following the last north American glaciation, sea levels rose and during the Holocene period Alluvium had been deposited along active stream channels and Tidal-Marsh and Estuarine deposits have been deposited at the mouths of these channels where they meet the Delaware River.

3.7 Soils

Soils perform essential functions in maintaining environmental health and quality, including:

- Sustaining biological activity, diversity, and productivity;
- Regulating and partitioning water and solute flow;

- Filtering, buffering, degrading, immobilizing and detoxifying organic & inorganic materials;
- Storing and cycling nutrients and other elements;
- Providing support for socioeconomic structures.

As soils vary in their physical, chemical, and mineralogical properties, their capability to perform these important functions also varies. Soils can also be degraded, e.g., through erosion, contamination, and compaction, which can affect their ability to function. Knowledge of soil distribution patterns and soil properties can help to put our soils to their best use and keep them functioning optimally.

In general, soils of the coastal plain are formed in unconsolidated deposits of sand, silt, clay, and gravel, predominantly of fluvial and marine origin. Soil types are mapped by the National Cooperative Soil Survey and are available via the Soil Survey Geographic (SSURGO) Database (see GIS Map 3). Five soil series and seven miscellaneous areas were originally mapped in Bordentown City. Soils in a series generally have the same sequence of horizons, have the same drainage class, are formed from the same type of parent material, and have similar physical and chemical properties. Soil series are further separated by surface texture, substratum, and slope into phases which serve as mapping units. Soil series and their substratum phases mapped in Bordentown can be differentiated as follows:

Table 1: Soils in Bordentown City

Texture & Mineralogy	**Drainage Class**	
	Well-drained	Moderately well-drained
moderately coarse, low glauconite	***Freehold***	***Holmdel***
moderately coarse, low glauconite, heavy substratum	***Freehold clayey substratum***	
thick sandy surface, moderately coarse subsoil, low glauconite	***Tinton***	
heavy subsoil, low glauconite		***Keyport***
moderately coarse, no glauconite,	***Sassafras***	
moderately coarse, no glauconite, heavy substratum	***Sassafras clayey substratum***	

Two soil series (and two map units) make up most of the area of residential Bordentown City: Sassafras fine sandy loam, clayey substratum, 0 to 2 percent slopes (SaekA); and Freehold fine sandy loam, clayey substratum, 2 to 5 percent slopes (FrmkB). The approximate acreage and proportional extent of the soils and miscellaneous areas mapped in Bordentown City are listed in Table 2. The limitations for these soils for some community development and recreational uses are given in Table 3.

Table 2. Approximate acreage and proportional extent of the soils and miscellaneous areas in Bordentown City

Symbol	Map unit	Acres	Percent
FmhAt	Fluvaquents, loamy, 0 to 3 percent slopes, frequently flooded	8.0	1.4%
FrmA	Freehold fine sandy loam, 0 to 2 percent slopes	6.0	1.0%
FrmB	Freehold fine sandy loam, 2 to 5 percent slopes	23.0	3.9%
FrmC	Freehold fine sandy loam, 5 to 10 percent slopes	8.0	1.4%
FrmkB	Freehold fine sandy loam, clayey substratum, 2 to 5 percent slopes	105.0	17.9%
HodA	Holmdel fine sandy loam, 0 to 2 percent slopes	4.0	0.7%
KeoC	Keyport loam, 5 to 10 percent slopes	43.0	7.3%
KeoD	Keyport loam, 10 to 15 percent slopes	50.0	8.5%
KeoE	Keyport loam, 15 to 25 percent slopes	11.0	1.9%
MamnAv	Mannington-Nanticoke complex, 0 to 1 percent slopes, very frequently flooded	35.0	6.0%
MbaAt	Marsh, fresh water, 0 to 2 percent slopes, frequently flooded	1.0	0.2%
PHG	Pits, sand and gravel	1.0	0.2%
SaeB	Sassafras fine sandy loam, 2 to 5 percent slopes	1.0	0.2%
SaekA	Sassafras fine sandy loam, clayey substratum, 0 to 2 percent slopes	210.0	35.8%
ThfC	Tinton sand, 5 to 10 percent slopes	13.0	2.2%
UddfB	Udorthents, dredged fine material, 0 to 8 percent slopes	7.0	1.2%
UdrB	Udorthents, refuse substratum, 0 to 8 percent slopes	1.0	0.2%
URCLAB	Urban land, clayey substratum, 0 to 8 percent slopes	16.0	2.7%

Table 3. Soil limitations for some community development and recreational uses.

Map unit	Dwellings with basements	Local roads & streets	Playgrounds	Paths & trails
FrmA	slight	moderate (frost action)	slight	slight
FrmB	slight	moderate (frost action)	moderate (slope)	slight
FrmC	slight	moderate (frost action, slope)	severe (slope)	slight
FrmkB	moderate (wetness)	moderate (frost action)	moderate (slope)	slight
HodA	severe (wetness)	severe (frost action)	moderate (wetness)	moderate (wetness)
KeoC	severe (wetness)	severe (frost action)	severe (slope)	moderate (wetness)
KeoD	severe (wetness)	severe (frost action)	severe (slope)	moderate (wetness)
KeoE	severe (wetness, slope)	severe (frost action)	severe (slope)	moderate (wetness, slope)
SaeB	slight	moderate (frost action)	slight	slight
SaekA	moderate (wetness)	(moderate (frost action)	slight	slight
ThfC	moderate (slope)	moderate (slope)	severe (slope, sandy surface)	severe (sandy surface)

Sassafras soils are moderately coarse-textured with little or no glauconite. Permeability and available water capacity are moderate. Soil reaction is extremely acid to strongly acid, unless limed. These soils have formed in old stream deposits, and are generally associated with the Pensauken formation. The subsoil has distinctly more clay than the surface layer, and these soils are well drained, i.e., the water table is below 40 inches during most or all of the growing season. Nearly all of the Sassafras soil in the inner Coastal Plain was once farmland, but now much of it has been developed for residential and commercial use. Hydrologic Soil Group is B.

Sassafras Soil, Railroad Avenue

Sassafras fine sandy loam, clayey substratum, 0 to 2 percent slopes (SaekA) is the predominant soil mapped in the residential portion of Bordentown City. In this area, the clayey substratum is generally part of the Merchantville formation and often contains glauconite, with textures ranging from heavy silty clay loam to silty clay to clay. This layer has slow permeability, and water perches on it, or moves laterally, after heavy rains. This zone is normally found at a depth of 40 to 60 inches, but in some areas in Bordentown City it is only 30 inches or so from the surface. Because of the substratum, this soil has severe limitations for septic systems.

There is a small section of Sassafras soil without the clayey substratum. *Sassafras fine sandy loam, 2 to 5 percent slopes* (SaeB) is found along the eastern edge of the City, in a residential section just east of Route 130 and north of Route 528. It is essentially the same soil as above, except the substratum in this phase has moderate permeability.

Freehold soils are similar to Sassafras, but contain 2 to 10 percent (by volume) of glauconite in the solum. This increases water and nutrient holding capacity; as a result Freehold soils rank among the best agricultural soils in the state. They are well drained, with moderate or moderately slow permeability, and a moderately high or high available water capacity. Soil reaction is extremely acid to strongly acid, unless limed. Hydrologic Soil Group is B.

Freehold fine sandy loam, clayey substratum, 2 to 5 percent slopes (FrmkB) is mapped in the northeastern portion of residential Bordentown City. These soils have the slowly permeable substratum similar to the above Sassafras: a thick, dark gray deposit that is part of the Merchantville formation.

Freehold soils without the clayey substratum are found in the northwestern part of the City. Most of the area mapped as *Freehold fine sandy loam, 0 to 2 percent slopes* (FrmA) is occupied by the Park Street Apartments, with *Freehold fine sandy loam, 2 to 5 percent slopes* (FrmB) covering much of the landscaped open space (lawn area) of Point Breeze Park.

Freehold fine sandy loam, 5 to 10 percent slopes (FrmC) comprises a wooded area along Mile Hollow Run.

Keyport soils have a moderately fine or fine-textured subsoil, with varying amounts of glauconite. They have a high available water content and slow permeability. These soils are moderately well drained, i.e., they have a water table between 18 and 40 inches for a significant period of time during the growing season. Soil reaction is extremely acid to strongly acid, unless limed. Hydrologic Soil Group is C. In Bordentown City, Keyport soils are found on steep slopes where streams have exposed the marine clay beds of the Merchantville and Magothy formations.

Keyport loam, 5 to 10 percent slopes (KeoC), is found along Blacks and Thorntown Creeks.

Keyport loam, 10 to 15 percent slopes (KeoD) is also found along Blacks and Thorntown Creeks. *Keyport loam, 15 to 25 percent slopes* (KeoE) is found on the exposed bluffs of the Magothy Formation along Crosswicks Creek.

Holmdel soils are moderately well drained, moderately coarse-textured, with 2-10% glauconite in the solum. They have a moderately high or high available water capacity, and a moderate or moderately slow permeability. Soil reaction is extremely acid to strongly acid, unless limed. Hydrologic Soil Group is C. *Holmdel fine sandy loam, 0 to 2 percent slopes* (HodA) is mapped on the northern edge of city, a wooded area along Mile Hollow Run.

Tinton soils are well drained with a thick sandy surface layer over a moderately coarse-textured subsoil containing 2-10% glauconite. They have a low or very low available water content, and a moderately rapid permeability. Soil reaction is extremely acid to strongly acid, unless limed. Hydrologic Soil Group is A. *Tinton sand, 5 to 10 percent slopes* (ThfC) is also mapped on the northern edge of the City, in a woodland area along Mile Hollow Run.

Miscellaneous areas have little or no natural soil, are difficult to access for orderly examination, or for other reasons, are difficult to classify. They can be characterized by disturbance, recent deposition, or highly variable composition. Four of the seven original miscellaneous areas mapped in Bordentown City have since been reclassified to higher level.

Miscellaneous areas found in Bordentown City include:

Fluvaquents, loamy, frequently flooded (Fmht), formerly *Alluvial land, loamy*, consist of stream deposits in areas adjacent to meandering perennial streams that are subject to frequent stream overflow. Drainage class can range from moderately well drained to very poorly drained, and soil textures can vary, but a sandy loam surface is common. Fluvaquents, or alluvial land, can be found in the Blacks and Thorntown Creek floodplains, generally adjacent to tidal marsh areas.

Udorthents, dredged fine material (Udmf), formerly *Made land, dredged fine materia*l, consist of those areas filled with fine material dredged from the Delaware River, mostly derived from the thick clay beds of the Magothy formation. The Bordentown Beach area is composed of dredged material.

Udorthents, refuse substratum (Udz), formerly *Made land, sanitary fill*, consist of small areas of rubbish disposal, covered with variable amounts of soil. A small delineation is found in the northern part of the City on Point Breeze Park.

Tidal Marsh, Blacks Creek, west of Oliver St.

Mannington-Nanticoke complex, very frequently flooded (Mamnv), formerly *Tidal marsh*, are those areas of freshwater tidal marsh wetlands along the Delaware River and its tributaries which are flooded twice daily. These are very productive, diverse ecosystems that serve as feeding and breeding areas for birds, mammals, and crustaceans, and are important in flood control and in filtering storm water and runoff before entering surface waters. The soils are generally high in organic matter and clay, which gives them an appreciable adsorptive capacity, and are anaerobic, except for a thin surface layer. Soil reaction is generally close to neutral. More recent Soil Surveys use the Mannington and Nanticoke series for these marshes. Areas of Tidal marsh in Bordentown City are found along Blacks and Crosswicks Creeks.

Pits, sand and gravel (PHG) are excavation sites for sand or gravel, ranging from 4 to 20 feet deep. A small delineation is found in the northern part of the City on Point Breeze Park.

Urban land, sandy (USD) consists of cut and fill areas developed for commercial, residential, or industrial use, now covered with a high proportion of impervious surface. This area is occupied by Ocean Spray facilities.

Urban land, clayey substratum (USF) consists of cut areas where the heavy clay sediments of the Merchantville formation had been exposed, and are now covered with a high proportion of impervious surface. In Bordentown City, this area is along Routes 206/130 near the intersection with Route 528.

Bordentown Beach/Boat Ramp area (Udorthents, dredged fine material)

Tidal marsh, mouth of Thorntown Creek (Mannington- Nanticoke complex, frequently flooded)

3.8 Steep Slopes

Slopes serve important natural, aesthetic and planning functions, such as abating noise, light or air pollution; buffering wind, rain and snow; providing a pleasing, distinctive setting; and acting as visual barriers between different development zones. Vegetated hillsides can serve as buffer areas that absorb the force of wind-driven rain and snow. They provide harmonious settings for human communities.

And they can help offset some noxious effects of human activity--diminishing air, light and noise pollution.

The natural stability of slopes is determined by:

- steepness (described as a percentage based on the amount of rise over a certain distance-a 10 percent slope rises one foot over a 10 foot distance);
- length;
- subsurface geology;
- soil characteristics, such as erodibility, compactibility, percolation rate, water retention capacity, fertility;
- amount and type of vegetative cover;
- climate (precipitation, wind, freezing and thawing).

Slope can be a major constraint on land use. Areas with slopes as low as 5 percent are unsuitable for athletic fields and playgrounds; 10 to 15 percent can be restrictive for roads and streets, and those over 15 percent are problematic

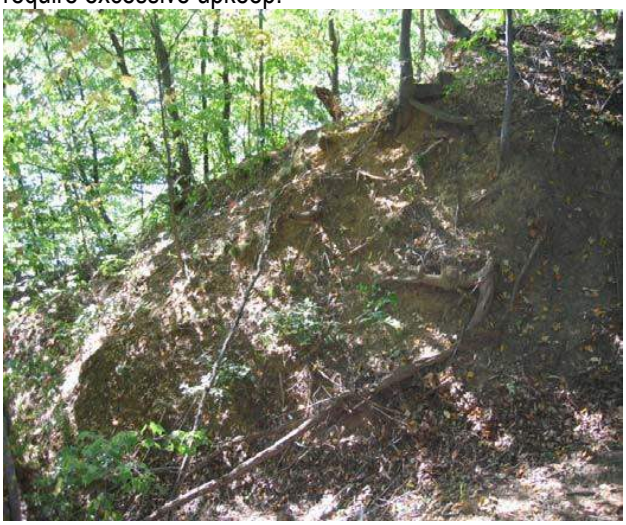
for dwellings. Removal of vegetation in areas with over 10% slope can result in severe erosion and mass movement of soil materials. In addition to the loss of valuable soil material, erosion also creates a water pollution problem. Local ordinances are common in New Jersey which limit development in areas with slopes greater than 15 or 25%.

3.8.1 The Results of Disturbing Slopes

Disturbing the plant life, drainage patterns, topography or soils of slopes often increases the amount and speed of runoff and can cause erosion, soil creep, slumping (sections of soil shifting down and outward on the slope), and landslides. When a hillside is cleared, the usual result is more and faster runoff, especially when grading has smoothed a slope's natural roughness. Leaves and branches no longer shield the soil from wind and rain; roots no longer hold the soil in place; and the smoother slope allows the runoff to travel faster, thus increasing erosion and decreasing groundwater recharge. These problems become progressively worse on steeper slopes.

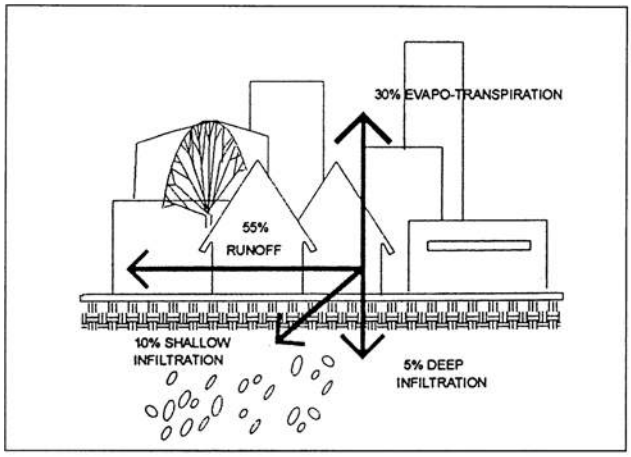
Runoff carries eroded sediments to lowland areas, to wetlands, ponds and streams, where the resulting turbidity and siltation can damage or destroy aquatic life and disrupt the ability of wetlands to filter and purify water. This combination of increased runoff and stream siltation affects the ability of streams and wetlands to retain water, changing the pattern and rate of the water's rise and fall and causing increased flooding.

Changing topography by excavating or grading the foot of a slope or cutting into the face of a hillside often promotes instability and erosion. Erosion, slippage or excessive runoff may also result when existing soils are replaced with soils more suited for septics or lawns. Soils on ridgelines and steep slopes often are thin and susceptible to wind and water erosion. Only specialized vegetation thrives in these conditions; conventional landscaping usually does not and may require excessive upkeep.

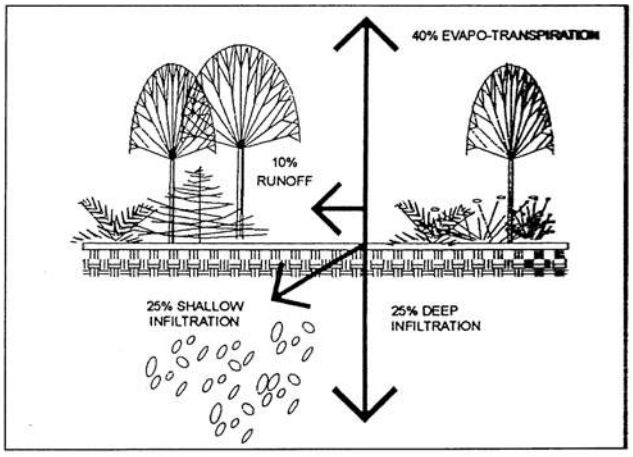


Steep, eroding slope, Mile Hollow Run

Steep, eroding slope, Thorntown Creek



Water Infiltration with 75-100% Impervious Surface



Water Infiltration with Natural Groundcover

In any case, even a brief denuding of ridgelines and steep slopes can cause soil losses that will discourage any regrowth of plant life and habitat.

Dramatic runoff problems often result when slopes are covered with impervious surfaces, such as buildings, roads, driveways and parking lots. Since water can't percolate into the soil, it runs off the site, picking up speed as it travels across these smoother surfaces. Eroding surrounding soils, this high velocity runoff carries increased amounts of silt into nearby surface waters. Excessive runoff sometimes also results in flooded or icy conditions in parking lots and roads.

In addition to the obvious problems of runoff, erosion and landslides, altering the soils or vegetation on slopes may also reduce the percolation of water into the soil and disrupt the recharge of groundwater and aquifers. Aquifers in areas of steep bedrock, like parts of northern New Jersey, do not contain much water. Poorly designed or excessive development that disrupts aquifer recharge while increasing the demand for water for human consumption can result in periodic or permanent water shortages.

Aquifers can also be damaged by the heavy road salting typical in hilly areas and from septic installation on slopes, where soils are thin or otherwise unsuitable for leach fields. In such areas, septic effluent may seep out on the face of the hillside.

Grading hillsides and ridgelines sometimes alters drainage divides, sending more runoff in one direction and less in another. Clearing and grading may even alter the local climate, changing the path and severity of wind, precipitation, noise and pollution.

Local regulations can address some of these problems, but designing, building and maintaining development on steep slopes will inevitably mean higher costs for the developer and for the municipality. Problems often come to light after construction is finished and the developer is gone. Then the municipality may be stuck with burdensome costs for stormwater management, septic failures, sewering, winter storm maintenance, construction of public water systems, or fire and emergency services.

3.8.2 Steep Slopes in Bordentown City

In general, landscapes of the Coastal Plain exhibit less relief than those in North Jersey. Unlike areas of exposed bedrock, the highly erosive nature of unconsolidated sandy sediments precludes the formation of steep slopes.

According to the Soil Survey (GIS Map 3), slopes in most of residential Bordentown City are characterized by nearly level A (0 to 2%) and gently sloping B (2 to 5%) classes, where Sassafras and Freehold soils are underlain by the clayey substratum of the Merchantville formation. Strongly sloping (5 to 10%) Tinton and Freehold soils are found in wooded areas along Mile Hollow Run, above the Magothy formation. The steepest slopes in the City are along streams where the clayey substratum has been exposed, and, due to the cohesive forces of the clay, can hold the banks together to resist erosion. Strongly sloping (5 to 10%) and very strongly sloping (10 to 15%) Keyport soils are found along Thorntown Creek in both the Magothy and Merchantville formations, and along Blacks Creek and Love Bridge Run in the Magothy.

Keyport soils along Crosswicks Creek are even steeper (15 to 25%), with slope in some areas reaching 50% or more, highlighting the cross-bedded strata of the Magothy.

Steep slope, Crosswicks Creek

3.9 Hydrology

The continuous movement of water between the atmosphere and the earth's surface, and beneath the surface, is called the hydrologic cycle. Water from the earth's surface is evaporated into the atmosphere, where it condenses and falls back as precipitation. A small part of this precipitation is intercepted by vegetative cover and lost through evaporation. The water that reaches the soil can be wholly or partly absorbed in the process of infiltration. The rate of infiltration is affected by rainfall intensity, soil conditions, vegetative cover, and the slope of the land. Water that infiltrates is available for plant growth, evaporation, or further movement down through the soil profile. Some of the water taken up by plants is released back into the atmosphere as transpiration. When water is delivered to the surface faster than it can be absorbed, it will move over the surface as runoff. Runoff can erode soil, and can carry this material, along with other dissolved and suspended constituents it accumulates from the soil surface, as non-point source pollution into surface water. Increases in the amount of impervious surface from development result in an increase in the volume of stormwater runoff. Unless control measures are in place, this can bring about downstream flooding, streambank erosion, and severe alteration of drainage patterns.

3.9.1 Groundwater

The Coastal Plain deposits of New Jersey can be classified into a sequence of aquifers and confining units based on the porosity and permeability of the sediments. The Coastal Plain is one of seven aquifer systems in New Jersey given Sole Source designation, i.e., it is an aquifer which contributes more than 50 percent of the drinking water to a specific area, and the water would be impossible to replace if contaminated. The Coastal Plain aquifers in New Jersey supply potable water for more than 3.5 million people.

The Magothy, Raritan, and Potomac geological Formations together make up the upper, middle, and lower aquifers that form the Potomac-Raritan-Magothy (PRM) aquifer system. The PRM is one of the most productive and heavily pumped aquifers of the Coastal Plain. The three formations vary regionally in composition and are separated by two confining beds. Recent investigations (Volkert and Stanford, 2018) indicate that the Raritan Formation and confining beds are not present beneath the city. The Magothy (upper aquifer) and Potomac (lower aquifer) Formations of the PRM aquifer system serve as the drinking water source for Bordentown City.

Historically, higher topographic elevations along the north central edge of the Coastal Plain served as recharge areas for the PRM aquifer system, and the outcrop areas of PRM formations along the Delaware River served as discharge

areas. However, extraction of ground water for municipal water supplies have lowered water levels in the aquifer, reversing the flow of ground water, and induced recharge from the Delaware River. This can potentially affect water quality in the PRM aquifer.

Groundwater recharge, including recharge to both aquifers and non-aquifers, has been estimated by NJDEP as depicted on GIS Map 4. Estimated recharge is highest in Area B, which generally encompasses relatively flat areas underlain by sandy soils and with relatively low coverage by impervious surfaces. Recharge in this area is estimated as 11 to 15 inches per year. Estimated recharge is lower in areas with more impervious land cover, steep slopes, high water table (streams, rivers, and wetlands) and areas underlain by low permeability clay.

3.9.1.1 Groundwater Quality

Groundwater in the PRM aquifer is generally of good chemical quality, low in dissolved solids, except for local hardness and high concentrations of iron and manganese. All chloride concentrations in Burlington County are less than 20 parts per million, as the saltwater front in the Delaware River does not extend beyond Camden. However, a potential source of contamination is the infiltration of pollutants with river water. In general, outcrop areas are susceptible to contamination, especially when the water table is high, and the soil is sandy and low in organic matter. Formations of the Coastal Plain are hydrologically interconnected such that they respond collectively as an interrelated aquifer system.

The NJDEP has performed source water assessment of each source of public drinking water and determined the susceptibility to contamination for each source for eight contaminants. The factors affecting water quality were separated into two categories: *sensitivity factors*, including well type and depth, soil organic matter and clay content, which assess how sensitive the water source is to contamination; and *intensity factors* such as land use, non-point and point sources, which assesses how frequently contaminants are used near the source. The susceptibility rating does not determine if a water source is actually contaminated.

Bordentown City's water supply is drawn from four unconfined wells along the north bank of Crosswicks Creek just east of Route 206 in Hamilton Township, Mercer County. Most of the source, or recharge, area for these wells is located northeast of the wells in Mercer County, a predominantly residential area. The aquifer lies beneath the Magothy formation in much of the recharge area, and in some sections the Merchantville as well.

NJDEP conducted a Source Water Assessment Program (SWAP) in 2004 to assess risk to public water supplies. It should be noted that two of the four Bordentown Water Department wells, Well #2 and Well #5 have been replaced since the SWAP was conducted, however, the results are likely still representative of overall risk to the water system. Many of the ratings reflect the dominant land use (urban) of the recharge area. All four wells are rated as highly susceptible to contamination by nutrients and volatile organic compounds, and low to pesticides.

The following table indicates contamination risk from different sources and the number of wells potentially at risk: :

Pathogens	Nutrients	Pesticides	VOCs*	Inorganics	Radionuclides	Radon	DBP**
4 M	4H	4L	4H	1H; 3M	2H; 2M	4M	3H; 1M

Ratings: L=low; M=medium; H=high

*Volatile Organic Compounds: solvents, degreasers, and gasoline components.

**Disinfection Byproduct Precursors: byproducts of the reaction between disinfectants (e.g., chlorine) and dissolved organic materials.

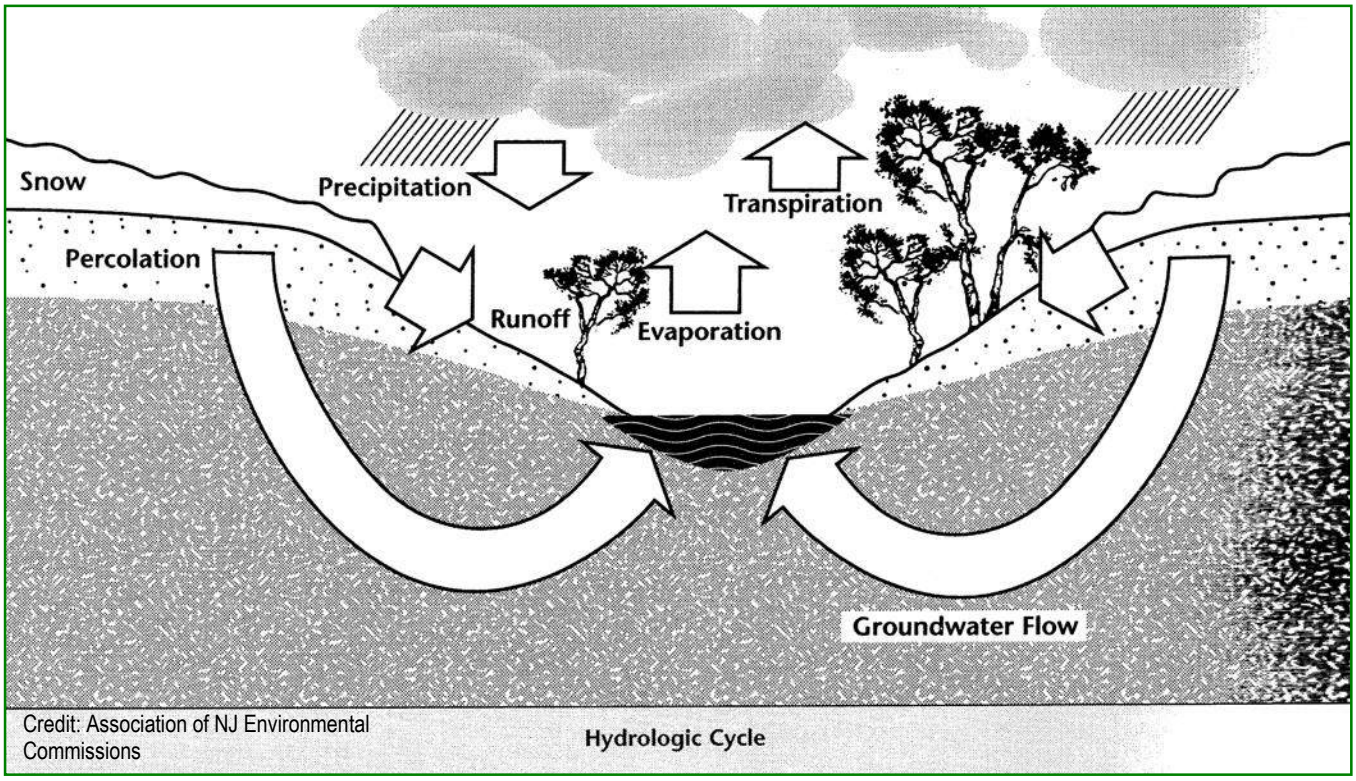
3.9.2 Surface Water

Surface water includes water visible on land including lakes, ponds, rivers, streams, bogs, wetlands, bays and oceans. Although a predominately urbanized municipality, Bordentown City contains a variety of surface water, the majority of which is freshwater wetlands (including tidal areas), wetlands and marshy areas, as well as waterways ranging from seasonal streams to major rivers. The major water bodies include Crosswicks Creek, forming the northwestern boundary of the City; Blacks Creek, which forms the southwestern boundary of the City; Mile Hollow Run, a stream that forms the northeastern boundary; Thorntown Creek, which intersects the City at a roughly east to west direction; and Love Bridge Run, a seasonal stream that loosely follows a portion of the southern boundary of the City. A small portion of the Delaware River channel, where it meets the mouth of Crosswicks Creek, lies adjacent to the City boundary. Wetlands include large areas associated with the Blacks Creek channel and the mouth of Thorntown Creek (partially due to a vestigial dike built by Joseph Bonaparte to create an artificial lake on the adjacent Point Breeze estate in the 1820s), as well as other smaller areas.

Bordentown City is within *Watershed Management Area (WMA) #20 (Assiscunk, Crosswicks, and Doctors Creeks)*, one of 20 watersheds designated by the NJ Department of Environmental Protection (NJDEP) in the state. A watershed, or drainage basin, is an area that includes all the land over which water flows to reach a body of water. Within WMA 20, Bordentown City lies within three sub-watersheds as depicted on GIS Map 5:

- 20DA01, Duck Creek and UDRV to Assunpink Creek, a small area at the mouth of Crosswicks Creek, corresponding roughly to the “Bordentown Beach” area;
- 20BC02, Crosswicks Creek(below Doctors Creek), extending from an east-west line just south of Thorntown Creek all the way to the northern border; and
- 20CA03, Blacks Creek (below Bacons Run), extending roughly from Farnsworth Avenue to the southern border.

Mouth of Thorntown Creek, emptying into Crosswicks Creek (B-2 watershed), low tide



3.9.2.1 Surface Waters in Bordentown City

All surface water within Bordentown City ultimately drains to the **Delaware River**, which flows in a southeasterly direction just north of the City. According to the Delaware Riverkeeper, "The Delaware River is the last major free flowing river on the East Coast. Originating in the Catskill Mountains of New York, the East and West branches of the Delaware River meet in Hancock, New York and form the main stem of the river. The River flows a total of 375 miles from the Catskills to the sea. Its watershed includes 12,765 square miles in portions of four states -- New York, New Jersey, Pennsylvania, and Delaware -- and is home to nearly 6 million people." Although technically not within

Delaware River, looking south from I-295 bridge

Delaware River, looking north from I-295 bridge

Bordentown City's borders, the Delaware River meets the mouth of Crosswicks Creek at the northwestern border of the City.

NJDEP assigns Surface Water Quality Standards based on a designated use classification applied to each water body in the state. All streams in in the city are designated as "FW2-NT", thus the SWQS for FW2-NT waters found in New Jersey Administrative Code (N.J.A.C.) 7:9B apply.

Crosswicks Creek is 25 miles long and drains an area of 146 square miles to the Delaware River at Bordentown City. It drains sections of Ocean, Burlington, Monmouth and Mercer counties. The creek forms the northwestern boundary of Bordentown City, from Mile Hollow Run at the northernmost edge, running south to the intersection with Blacks Creek and the Delaware River. It is tidal for the entire portion within Bordentown City (and as far as Crosswicks Mill Dam), exhibiting water level changes of as much as eight (8) feet.

Crosswicks Creek, low tide, looking upstream (north) from mouth of Thorntown Creek

Looking south towards RiverLINE bridge

Looking south from Mile Hollow Run

Blacks Creek, forming the western boundary of the City (with minor exceptions due to manmade redirection of the channel during I-295 construction), originates in Mansfield and North Hanover Townships, and enters Bordentown City via channelized construction below Route 130 a quarter mile south of Farnsworth Avenue. It is a tidal freshwater stream up to approximately Route 206, where the tidal influence ceases. Blacks Creek is generally navigable by watercraft to Route 130. Stormwater from the area of Bordentown City south of Crosswicks Street drains into storm drains leading to Blacks Creek, which empties into the Delaware River. Steep slopes characterize the southwestern portion of Blacks Creek, on the Township side, just below the Route 130 bridge. Further downstream, there is an artificial oxbow lake that was created just above the railroad bridge on Blacks Creek by I-295.

Blacks Creek, looking north from Burlington Street bridge, low tide

Thorntown Creek begins in Mansfield Township, traverses Bordentown Township, and enters the City beneath Route 206 behind Gilder Field. It continues in a roughly east/west direction and is characterized by a broad flood plain. A manmade pond was constructed in the early part of the 20th century just north of Elizabeth Street, and was used for recreational purposes (skating in the winter, swimming in the summer) by City residents. The dam has since deteriorated. As it approaches Crosswicks Creek, the area around the mouth of Thorntown Creek exhibits progressively steep bluffs, exceedingly rare for the portion of the Delaware River Estuary between Trenton and the Delaware Bay. Thorntown Creek exhibits tidal influence for approximately a quarter mile upstream from its mouth at Crosswicks Creek. Stormwater from the area generally north of Crosswicks Street empties into Thorntown Creek, which drains to Crosswicks Creek, and then into the Delaware River.

Thorntown Creek, high tide, near Crosswicks Creek

Mouth of Thorntown Creek, looking towards Crosswicks Creek

Mouth of Thorntown Creek, low tide

Mile Hollow Run, west of Route 206

Mile Hollow Run, a shallow stream that forms the northeastern boundary between the City and Township, enters the City at the intersection of Route 206 and Park Street. It exhibits a tidal influence where it enters Crosswicks Creek. The mouth of Mile Hollow Run is characterized by extremely steep slopes comprised of eroded soils. This area is known locally as "Jumbo" and was used in the past as a recreational bathing beach.

Mouth of Mile Hollow Run

Mile Hollow Run emptying into Crosswicks

Love Bridge Run is an intermittent stream (prone to drying up during the summer months or during periods of long drought) that drains the south-southeastern portion of the City. It springs from a wooded area between West Chestnut Street and Route 130, flows underneath Farnsworth Avenue, and parallels Mill Street down into the flood plain of Blacks Creek, a marshy tidal area at the southwest corner of Bordentown City. Love Bridge Run is characterized by increasingly steep slopes as it progresses towards Blacks Creek. Residential development occurs immediately adjacent to both banks along most of the stream corridor. Love Bridge Run is subject to tidal activity at the marshy mouth where it empties into Blacks Creek.

Love Bridge Run, summer flow, behind East Chestnut Street

Ridgeway Brook is an intermittent stream that drains the area between the freight railroad tracks along Park Street and the self-storage facility on Rt. 206. The stream rises behind the Landon Drive neighborhood, flows in a north-northeasterly direction paralleling the railroad tracks, and enters Mile Hollow Run in a channelized culvert under Rt. 206/Park Street intersection. *(Ridgeway Brook does not appear on maps for Bordentown City. The existence of this stream was (re) discovered in 2004, and since it was unnamed, the name "Ridgeway Brook" was chosen for the local topography where it is found.)*

Ridgeway Brook, between Park Street and Route 206 (Route 206 in the background)

3.9.3 Wetlands

Traditionally, bogs and swamps were considered unnecessary by-products of oceans, rivers and streams--at worst, symbols of death and decay, sources of methane, breeding grounds for noxious odors and mosquitoes; at best, they were considered a nuisance. If unusable by humans, wetlands were commonly assumed to be worthless to nature. In New Jersey and throughout the United States, laws and regulations often encouraged developers to fill in wetlands and make them "useful."

Freshwater wetlands adjacent to Crosswicks Creek (note skunk cabbage, a wetlands indicator species)

Now we have learned how important wetlands are:

- By filtering sediment and pollutants from the water flowing through them, wetlands protect water quality.
- During periods of heavy rainfall, wetlands act as a natural flood-control device.
- Wetlands provide habitat for many species of birds, mammals, reptiles, amphibians and fish and a rich diversity of plant life. Nearly half New Jersey's threatened or endangered species live in freshwater or coastal area wetlands.
- Wetlands help regulate the water level in streams and rivers by retaining water during wet periods and releasing it during dry periods. They help stabilize the water table by holding surface water and letting it seep into the groundwater supply.
- Wetlands along a shoreline or stream bank help stabilize the land, buffering it from erosion.
- Draining wetlands for urban development results in greater runoff and probability of flooding as well as the destruction of wildlife habitat.

Wetlands are not wastelands. They are useful, both to nature and to people. Especially since we have destroyed about half our natural wetlands, we must preserve what remains if we want to maintain a healthy environment.

Defining Wetlands

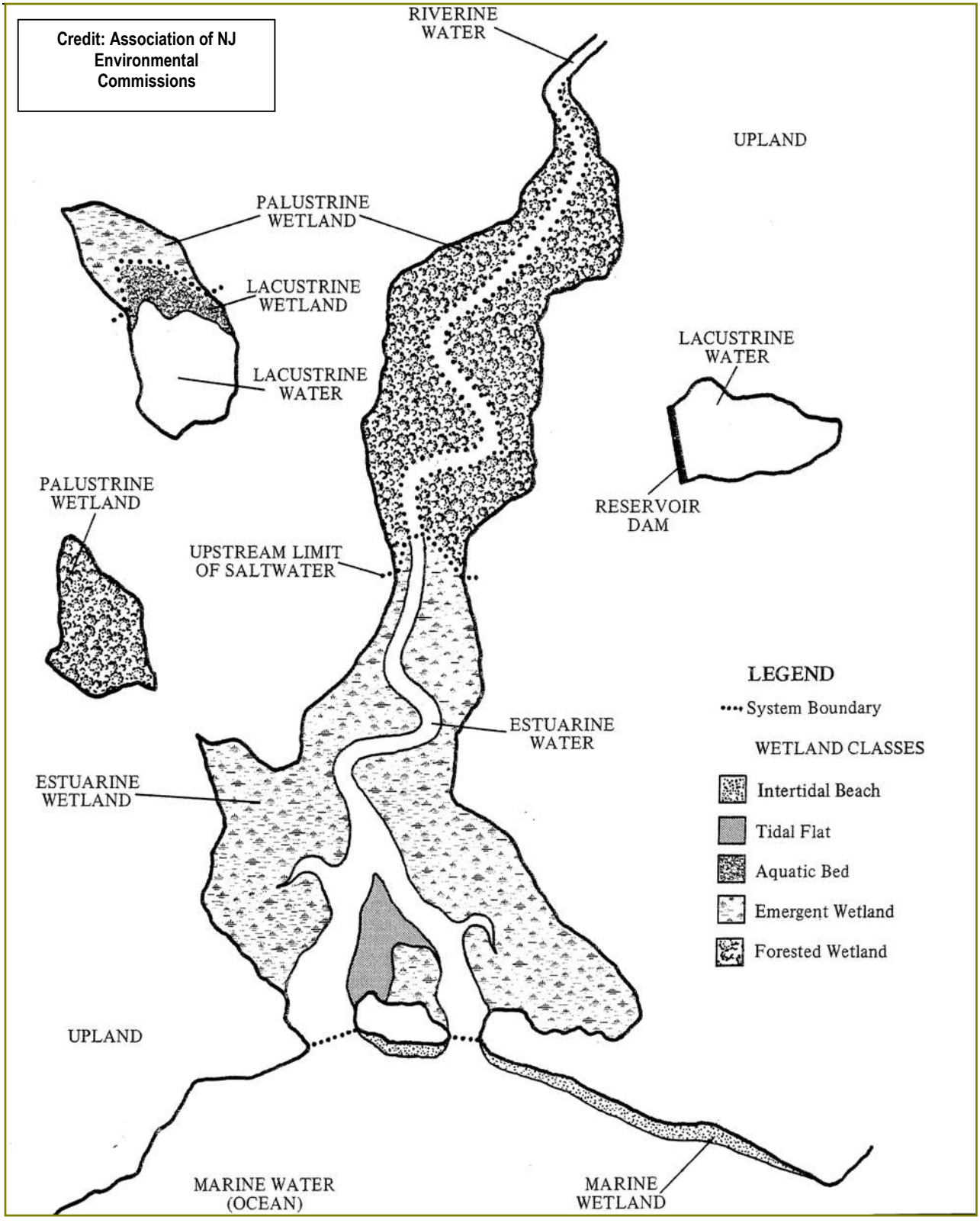
Wetlands are neither dry land nor water bodies, but rather the transition from one to the other. Wetlands are saturated with water or covered by shallow water at least part of each year, or part of most years. Wetlands tend to evolve through natural or human activity, emerging as dry land or submerging under rising water levels.

The 1987 New Jersey Freshwater Wetlands Protection Act (N.J.S.A. 13:9B-1 et seq.) officially defines a wetland: "An area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation..."

A general definition of wetlands, presented by the U.S. Fish and Wildlife Service and in use since 1956, says: “The term...wetlands refers to lowlands covered with shallow and sometimes temporary or intermittent waters. They are referred to by such names as marshes, swamps, bogs, wet meadows...Shallow lakes and ponds, usually with emergent vegetation as a conspicuous feature, are included in the definition, but the permanent waters of streams, reservoirs and deep lakes are not included.”

Wetlands ecosystems are important for a variety of reasons. They are often described as “the kidneys of the landscape.” Wetlands may benefit the local environment in many ways. They can filter pollutants from water, prevent floods, recharge aquifers and protect shorelines from erosion. They also provide habitat for a wide variety of flora and fauna.

Wetlands may include three main features: the presence of water; unique soils differing from adjacent upland soils; and supportive of vegetation that is adapted to wet conditions. In addition, wetlands often occur at the boundary between deep water and uplands; they may vary in both size and location; and while water may be present for extended periods of time, the depth of water and length of time a wetland is covered by water may very according to season and region.



Wetland Classes

Wetlands Classification

Wetlands can be classified with the U.S. Fish and Wildlife Service hierarchical classification, or Cowardin system, based on plants, soils, and frequency of flooding. The highest level of classification is a system, a broad category sharing similar hydrology, geomorphology, chemistry, and biology. Most of the wetlands in Bordentown City are classified as palustrine, which includes all non-tidal wetlands dominated by trees, shrubs, persistent emergents, and all such wetlands in freshwater tidal areas.

The *class* of a particular wetland describes the general appearance of the ecosystem, generally in terms of the dominant vegetation.

Three wetland classes are identified in Bordentown City, as follows:

Herbaceous Wetland, characterized by erect, rooted, herbaceous aquatic plants;
Freshwater Tidal Wetland, characterized by nonpersistent emergent plants in low areas and persistent emergent at higher elevations;
Deciduous Wooded Wetland, predominantly woody vegetation 20 feet or taller in height.

GIS Map 6 shows the wetland classification of Bordentown City:

Blacks Creek tidal marsh

3.9.3.1 Abbott Marshland

A freshwater tidal marsh is an area that experiences significant tidal fluctuations, but is beyond the reach of saltwater movement. Freshwater tidal marshes are highly diverse, extremely productive areas which can actually rival the tropical rainforests in the amount of plant material produced each year.

The tidal marshes in Bordentown City are part of the Hamilton-Trenton Marsh system, a 1,250 acre wetland-upland complex which includes the northernmost section of freshwater tidal marsh on the Delaware River. As of March 2003, species inventories in the complex have identified 850 species of plants, including 28 endangered/threatened/rare for

Thorntown Creek tidal marsh

New Jersey; 28 species of butterflies, including 1 rare for the region; 60 species of fish, including 1 endangered; 23 amphibians and reptiles; 237 species of birds, 100 nesting species; and 19 species of mammals (Leck, 2004).

In addition to its ecological value for primary production and habitat diversity, the marsh functions as a buffer between the suburban and freshwater environments, helping to prevent flooding and filtering and absorbing nonpoint source pollutants to protect water quality. It provides both recreational opportunities (hiking, canoeing, birding, fishing, and hunting) as well as educational opportunities; it's a great field trip site for students of all ages; and the over 50 research papers on the Hamilton-Trenton Marshes have substantially increased worldwide understanding of freshwater tidal marsh ecology. The area is also historically significant as the stomping ground of noted naturalists Charles Conrad Abbott and Charles Lucien Bonaparte, and archeologically important as a Woodland Indian site.

3.9.4 Impacts of Development

Important land uses within WMA 20 include agricultural, forested, residential/commercial development and military installations. Development and agricultural runoff in Bordentown Township and Chesterfield Township contributes significantly to the degradation of water quality in the waterways within Bordentown City limits. Runoff from agriculture, lawn care chemicals, pet waste, and automotive fluids all find their way to the waterways that flow through Bordentown City.

How Does Urbanization Change a Watershed?

Urbanization (or development) has a great effect on local water resources. It changes how water flows in the watershed and what flows in the water. Both surface and ground water are changed. As a watershed becomes developed, trees, shrubs and other plants are replaced with impervious surfaces (roads, rooftops, parking lots and other hard surfaces that do not allow stormwater to soak into the ground).

Without the plants to store and slow the flow of stormwater, the rate of stormwater runoff is increased. Less stormwater is able to soak into the ground because sidewalks, roads, parking lots and rooftops block this infiltration. This means a greater volume of water reaches the waterway faster and less of that water is able to infiltrate to ground water. This, in turn, leads to more flooding after storms, but reduced flow in streams and rivers during dry periods. The reduced

Blacks Creek, looking south from Burlington Street bridge, March 2005 Flood

Bordentown Beach/Boat Ramp area, March 2005 Flood

amount of infiltrating water can lower ground water levels, which in turn can stress local waterways that depend on steadier flows of water.

In the stream, more erosion of stream banks and scouring of channels will occur due to volume increase. This degrades habitat for plant and animal life that depend on clear water. Sediment from eroded stream banks clogs the gills of fish and blocks light needed for plants. The sediment settles to fill in stream channels, lakes and reservoirs. This also increases flooding as well as the need for dredging to clear streams or lakes for boating and habitat.

GIS Map 7 indicates the potential flood hazard areas of Bordentown City.

In addition to the high flows caused by urbanization, the increased runoff also contains increased contaminants. These include litter, cigarette butts and other debris from sidewalks and streets, motor oil poured into storm sewers, heavy metals from brake linings, settled air pollutants from car exhaust and pesticides and fertilizers from lawn care. These contaminants reach local waterways quickly after a storm.

3.9.5 Surface Water Quality

The USEPA How's My Waterway website[6] provides information about the quality of surface water in the Blacks Creek (below Bacons Run), Crosswicks Creek (below Doctors Creek), and Duck Creek and Upper Delaware River Valley watersheds. The following sections describe the available information for each of these watersheds.

[6] https://mywaterway.epa.gov/ accessed on July 18, 2022

3.9.5.1 Blacks Creek

The general condition of Blacks Creek is listed as "impaired". The condition with respect to uses for drinking water, aquatic life, fish and shellfish consumption, and swimming and boating are all listed as "impaired". Specific issues listed consist of:

- Bacteria and other microbes;
- Degraded aquatic life;
- Murky water;
- Nitrogen and/or phosphorus;
- PCBs; and
- Salts.

3.9.5.2 Crosswicks Creek

The general condition of Crosswicks Creek is listed as "impaired". The condition with respect to uses for drinking water, aquatic life, fish and shellfish consumption, and swimming and boating are all listed as "impaired". Specific issues listed consist of:

- Bacteria and other microbes;
- Degraded aquatic life;
- Metals;
- Murky water;
- Nitrogen and/or phosphorus; and
- PCBs.

3.9.5.3 Duck Creek and Upper Delaware River Valley

This area consists of the mouth of Crosswicks Creek where it enters the Delaware River in Bordentown and is listed as "impaired". The condition with respect to use for fish and shellfish consumption is listed as "impaired", whereas uses for drinking water, aquatic life and swimming and boating are all listed as "condition unknown". Specific issues listed consist of:

- Mercury; and
- PCBs.

3.9.5.4 Sources of Pollution

Sources of pollution of surface waterways include "point" source and "nonpoint" source pollution.

Point Sources of Pollution

Point source, or piped, pollution, refers to industrial and municipal wastewater discharges of pollutants into surface water. Point source pollution is regulated by NJDEP, which issues permits for known point sources and sets standards for pollution levels. Four point sources are permitted within the City as shown on GIS Map 5:

- Chevron USA Inc - Gulf S/S;
- Exxon S/S 3-0816;
- Ocean Spray Cranberries Inc; and
- Bordentown Gas Works Former.

Immediately adjacent to the City, municipal point source pollution originates from the Bordentown Sewerage Authority (Blacks Creek, just upstream from Route 130).

Nonpoint Sources of Pollution

Nonpoint source pollution refers to the diverse, widespread and unregulated sources, including erosion and chemical runoff from lawns and farms; automotive fluids and road salts from parking lots and roads; leaking chemicals from septic tanks, underground tanks, and airborne pollutants; and fecal pathogens from pet waste, farm animals, and wildlife. Due to its amorphous origins, standards or regulations for nonpoint source pollution are difficult to implement. However, these sources generally lead to and are discharged from storm sewer outfalls to surface water bodies. Within the city, 26 storm sewer outfalls are owned by the municipality, the County, and the State as depicted on GIS Map 5.

Nonpoint sources of pollution include agricultural runoff, suburban/urban surface runoff, and roadways and housing construction. The lower reaches of Crosswicks Creek receive herbicides, pesticides, fertilizer and silt from agricultural runoff. Stream bank erosion from pasture land also contributes to silt loads. Runoff from suburban developments, storm sewers and road maintenance, as well as local septic systems, have also resulted in nonpoint source pollution of waterways in WMA 20.

Some common nonpoint source pollutants include:

- Nutrients (nitrates and phosphates)
- Sediments
- Pesticides and herbicides
- Pathogens (viruses and bacterias)
- Heavy Metals
- Automotive Fluids
- Road Salts

Best Management Practices for Improving Water Quality

A variety of best management practices (BMP) should be employed to control pollution of local waterways. According to the U.S. Environmental Protection Agency, recommended BMPs include:

- Keep litter, pet wastes, leaves, and debris out of street gutters and storm drains--these outlets drain directly to lakes, streams, rivers, and wetlands.
- Apply lawn and garden chemicals sparingly and according to directions.
- Dispose of used oil, antifreeze, paints, and other household chemicals properly, not in storm sewers or drains.

- Clean up spilled brake fluid, oil, grease, and antifreeze. Do not hose them into the street where they can eventually reach local streams and lakes.
- Control soil erosion by planting ground cover and stabilizing erosion-prone areas.
- Encourage local government officials to develop construction erosion/sediment control ordinances.
- Have septic systems inspected and pumped, at a minimum, every 3-5 years so that they operate properly.
- Purchase household detergents and cleaners that are low in phosphorous to reduce the amount of nutrients discharged into lakes, streams and coastal waters.
- Manage animal waste to minimize contamination of surface water and ground water.
- Protect drinking water by using less pesticides and fertilizers.
- Reduce soil erosion by using conservation practices and other applicable best management practices.
- Dispose of pesticides, containers, and tank rinsate in an approved manner.

Pet waste bag station, Hilltop Park

Storm Drain Inlet, East Burlington St. Note

3.10 Vegetation

3.10.1.1 Native Communities

The Inner Coastal Plain is often characterized by botanists as a transition area between the Mixed Oak forest to the north and the Pine-Oak forest of the Outer Coastal Plain. Many species of northern affinity reach their southern limit here, and southern species their northern limit.

The natural vegetation of Bordentown City is depicted with Anderson Land Use-Land Cover Classification System map units in GIS Map 8. The remaining tracts of *deciduous forests* in Bordentown City generally fit the Beech-Oak Forest type of Robichaud and Buell (1973). Once covered by chestnut and beech trees, these areas have been cut repeatedly

since European settlement. American beech, white and red oak are common, along with tulip tree and American holly. Understory trees include dogwood, ironwood, and sassafras; shrubs include maple-leaved viburnum, witch hazel, spicebush, and arrowwood. Rhododendron, more generally associated with cool, moist sites in North Jersey, reach considerable size on north-facing slopes along Thorntown and Blacks Creeks. According to Markley (1971), the Keyport soils on these slopes support the only native stands of rhododendron in the coastal plain. Vines include Virginia creeper and poison ivy; may apple, jack in the pulpit, and fake solomon's seal are the common herbaceous plants.

The *deciduous brush/shrubland* is an area along Route I-295, formerly cleared, which has re-vegetated with sweet gum, tulip tree, black locust, and poison ivy. Invasives are common, including multiflora rose, Japanese honeysuckle, and winged euonymous (Quigley, 2005).

The *deciduous wooded wetlands* are found along stream channels, primarily on alluvial deposits in the floodplain. Dominant trees include box elder, silver maple, white ash, and sycamore; shrubs include spicebush, elderberry, and the invasive privet, multiflora rose, and Japanese barberry. Jewelweed and the invasive garlic mustard and Japanese stiltgrass are found in the herbaceous layer (Quigley, 2005). The *deciduous scrub-shrub wetlands* include those areas with vegetation less than 20 feet in height, and is characterized by a similar suite of trees and shrubs, and the *herbaceous wetlands* contain many of the same herbaceous plants as above. Both of these areas are also found in the floodplains of the City's streams.

Freshwater tidal marsh wetlands are found along Blacks and Crosswicks Creeks. Submerged vegetation such as spatterdock, waterweed, and water milfoil grow in the streams and permanent ponds. High marsh is the most widespread habitat, dominated by a mixture of annuals and perennials, including arrow arum, tearthumb, cattail, reed canary grass, pickerelweed, arrowhead, giant ragweed, and wild rice. Primary production peaks late in the growing season. As of 2003, botanist Mary Leck of Rider University had identified 850 species of plants, including 28 endangered, threatened, or rare for New Jersey, in the Hamilton-Trenton-Bordentown tidal marsh.

3.10.1.2 State Endangered and Rare Plant Species

Endangered

Pale Indian Plantain (Cacalia atriplicifolia)
Low Flatsedge (Cyperus tenuifolia)
Wafer Ash (Ptelea trifoliata)
Star Chickweed (Stellaria pubera)

Wild Rice, Crosswicks Creek

Pickerelweed, Crosswicks Creek

Rare
Purple Giant Hyssop (Agastache scrophularifolia)
Frank's Sedge (Carex frankii)
Smartweed Dodder (Cuscata polygonorum)
Toothed Tick-trefoil (Desmodium cuspidatum)
American Starwort (Elantine americanum)
Tall Thoroughwort (Eupatorium altissimum)
Mud Plantain (Heterantera multiflora)
River-bank Quillwort (Isoetes riparia)
Narrow-panicled Rush (Juncus brevicaudatus)
Torrey's Rush (Juncus torreyi)
Winged Monkey Flower (Mimulus alatus)
Eastern White Water Crowfoot (Ranunculus longirostris)
Subulate Arrow Head (Sagittaria subulata)

Skunk Cabbage, Thorntown Creek

Rhododendrons, Thorntown Creek (abandoned stormwater manhole in foreground)

Beech-Oak upland forest near Thorntown Creek

Tidal marsh and wooded wetlands, Blacks Creek

Smith's Bulrush (Schoenoplectus smithii)
Black Woolgrass (Scirpis atrocinctus)
Wild Pink (Silene caroliniana)
Smooth Hedge-nettle (Stachys tenuifolia)
Humped Bladderwort (Utricularia gibba)
Flat-leaved Bladderwort (*Utricularia intermedia*)

All Endangered and Rare plant species were identified in the Hamilton-Trenton-Bordentown Marsh, with the exception of Star Chickweed, which was found in the woodlands along the lower reach of Thorntown Creek.

3.10.1.3 Shade Trees

Bordentown City Shade Tree Committee

The Bordentown City Shade Tree Committee (hereafter "Committee") was established by ordinance in 1995, and consists of six members. In addition to development of a Shade Tree Master Plan, the Committee has a wide range of responsibilities that include:

- Establishing regulations;
- Planting and care of shade trees, ornamental trees, and shrubbery along public streets, and within public grounds;
- Care of curbing and sidewalk as may be required;
- Removal of trees that may be unsafe, diseased, or that may impact public utilities;
- Encourage arboriculture within the community

The Committee receives an annual operating budget, which as of FY 2020 was $17,000. A majority of tree removals and maintenance expenses are assumed by the Committee, and the entire tree planting budget is the Committee's responsibility.

In 1996 the New Jersey Shade Tree and Community Forest Assistance Act was enacted to provides liability protection and to ensure that Shade Tree Committees statewide are able to fulfill their role in providing a more livable community through the care and management of trees. The Committee has maintained "approved" status in the Community Forest Program by meeting four criteria: the Committee has overseen the development of a Community Forestry Management Plan (CFMP); Committee members have completed mandatory Core Training; Committee members have met continuing education requirements; and the Committee has submitted Annual Accomplishment reports.

A CFMP sets forth each municipality's goals and objectives for a five-year period, and therefore must be updated every five years. The 4th revision of the City's CFMP expires at the end of 2021, and plans are underway to complete a 5th revision which will be effective from 2022 through 2026. The most recent street tree inventory included in the CFMP was completed in 1999. The street tree inventory includes approximately 1,000 trees, consisting of 20-30 different species.

In celebration of Arbor Day, the Committee engages community volunteers to assist with planting new trees throughout the City. In addition to planting street trees, the Committee has been responsible for the reforestation of City parks and historic sites, including Bordentown Beach, Hilltop Park, Second Street Park, Gilder Field, and the Clara Barton House. Since its inception the Committee has planted over 300 new trees. Bordentown City is a Tree City USA community, and has maintained this award for twenty-two consecutive years.

Shade Tree Values and Challenges

The services of the Committee are invaluable, given the many benefits of shade trees to the community:

- Shade trees are particularly effective at capturing airborne pollutants that have serious impacts on human and environmental health. These pollutants include. fine particulates, ozone, nitrogen oxides, sulphur oxides and dioxides, carbon monoxide and carbon dioxide. Given Bordentown City's proximity to heavily traveled highway corridors and other sources of pollution, shade trees may be the City's best defense to poor air quality.
- Shade trees capture precipitation during light rain, and reduce storm stormwater runoff from heavier rain events. Trees roots increase the water holding capacity of the soil.
- Shade trees reduce urban heat island effects; according to the US Department of Agriculture, the net cooling effect of a young, healthy tree is equivalent to ten room-size air conditioners operating 20 hours a day.
- Shade trees reduce energy use by lowering ambient temperatures in the summer, and by providing wind-chill protection in the winter. This in turn, reduces energy use with a concurrent reduction in CO2, Nitrogen oxides, volatile organic compounds, and fine particulate pollution.
- Shade trees sequester carbon and help alleviate the greenhouse effect
- Shade trees provide economic value, through increased property values.
- Shade trees have been shown to effectively calm traffic
- Trees reduce medical costs, reduce stress, and connect people to nature

Despite the advantages mentioned above, ensuring the survival of street trees is often challenging. In particular, street trees are stressed by insects and disease, impervious paving, confined root and trunk growth, soil compaction, and road salts. In addition, severe pruning by utility companies has compromised the integrity and form of many of the City's street trees.

Currently, the biggest disease threat to the City's street trees is the Emerald Ash Borer. While this disease is difficult and expensive to treat, the best course of action is to plant alternative, disease resistant species, and remove affected trees.

In 2022, public input was solicited and used to compile a list of "Special Trees" existing in the City as shown in the table below.

The Trees of Bordentown

Photo	Tree Name	Location
	Ginkgo	318 Prince St.
	Sycamore (pipe)	212 Prince St.
	Japanese Maple	200 Prince St.

Photo	Tree Name	Location
	Holly	20 Prince St.
	American Beech	2 Hilltop
	Magnolia	8 McKnight Ave.

Photo	Tree Name	Location
	Holly	12 McKnight Ave.
	Sycamore	Prince & Farnsworth

3.10.1.4Invasive Plant Species

An "invasive species" is defined as: 1) non-native (or alien) to the ecosystem under consideration and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health. If invasive species are not managed, they can threaten ecosystem services including biodiversity, recreation, and public safety, to name a few examples. Invasive species can be terrestrial and aquatic plants, vertebrate and invertebrate animals, and terrestrial and aquatic pathogens and diseases. Some well-known invasive invertebrate animal species that can be found in Bordentown City include the emerald ash borer (*Agrilus planipennis*), an insect that predominantly infests and impairs ash trees through inhibiting the flow of water and nutrients between the roots and crown of the tree and the spotted lantern fly (*Lycorma delicatula*), an insect that has been observed to infest and impair both native and invasive tree species through sucking sap from the leaves and stems of trees they have infested.

In order to obtain more comprehensive and updated information on the vegetative communities of Bordentown City, in November 2021, the Bordentown City Environmental Commission funded an inventory of invasive plants. This study, which is attached in full to the ERI as an addendum and titled "Bordentown City Stewardship Outline Plans", was conducted by Mike Van Clef of the Friends of Hopewell Valley Open Space New Jersey Invasive Species Strike Team. The study provides a list of not only invasive species, but also native species found at eight different sites throughout Bordentown City:

- Site 1 – Lime Kiln Alley Park
- Site 2 – Blacks Creek Overlook
- Site 3 – Oliver Street Park
- Site 4 – Bordentown Beach
- Site 5 – Hilltop Park
- Site 6 – Gilder Memorial Park
- Site 7 – Undeveloped Parkland
- Site 8 – Ann/Spring Street Park

The highlights of this report are below:

- The invasive species Chinese Yam was detected at three of the study sites (Sites 1, 5 & 6). This is the first known siting of this invasive species in New Jersey. Eradicating this species was recommended to be a high priority.
- The invasive species Paper Mulberry was detected at one of the study sites (Site 1). This is the first known siting of this invasive species in New Jersey, outside of Cape May. Eradicating this species was recommended to be a high priority.
- The following invasive species were identified as species where all observed individuals should be eradicated: Autumn Olive, Common Reed, Chinese Bushclover, Chinese Yam, Japanese Holly, Japanese Maple, Japanese Zelkova, Mimosa, Paper Mulberry, Chinese Wisteria, Yellow Archangel.
- The recommended stewardship plan for all eight of the studied sites includes implementing an effective Deer Management Plan to allow native species to better compete with invasive species.

This report can be a resource to various Bordentown City Commissions, residents, and the governing body. Examples of how this report can be used are as follows:

- This report can be used to inform strategies for how invasive species should be managed in Bordentown City by local commissions and/or the governing body.
- This report can be used to educate the governing body and residents on which plants to avoid planting on public and private property and which plants to eradicate if detected. It can also provide examples of which plants are native and should consider being planted to support propagation of native plants
- This report can be used as a reference point for future vegetation inventories to track changes in vegetative communities in Bordentown City over time.

3.11 Wildlife

From estuarine wetlands to grassy back yards, Bordentown City provides a small but diverse cross- section of wildlife habitats typical of much larger municipalities. Because it is an urbanized area, the built-up area provides a different wildlife habitat than surrounding suburban and rural townships.

Shade trees along streets and in backyards provide roosting spots for birds and small mammals. Back yard feeders provide winter food for birds and squirrels.

Geography contributes to an abundant number of wildlife species that can be found in and around Bordentown. On a global scale, the City is part of the Atlantic Flyway, with birds and monarch butterflies passing through Bordentown from points as far north as the Arctic Circle to tropical regions of the southern United States, Central America, or South America. Relative to the State of New Jersey, Bordentown is not far from the Atlantic Ocean, with its abundance of seabirds and other marine life. Regionally, the City is near the upper estuary of the Delaware River, which also fosters an abundance of habitat types. Finally, the City is bordered by forests and freshwater tidal wetlands, further contributing habitat and food.

Surprising to many, there are natural habitats within the city boundaries. The Landscape Project, a critical area mapping initiative of the New Jersey Division of Fish and Wildlife's Endangered and Nongame Species Program, seeks to protect biological diversity by maintaining imperiled wildlife populations and their habitats. In addition to preserving the critical habitats of threatened and endangered species, this initiative helps protect valuable open space and preserve wetlands, which reduce the threat of flooding, promote degradation of pollutants, enhance groundwater recharge. The mapping of critical habitat also helps prioritize conservation acquisitions, serve as a guide for municipal planning efforts, and provides citizens with a conservation tool.

Using the landscape classification established by the New Jersey DEP's Endangered Species Program, Bordentown falls within the Piedmont Plains Landscape. Stretching from Bergen County next to the Hudson River, it proceeds southwest along the Delaware River, with another branch hugging Raritan Bay and coastal Monmouth County. Landscape Project habitat priority areas are depicted on GIS Map 9. The region's open space is characterized by farm and grasslands, fragmented woodlands and tidal freshwater marshes. Within this landscape category are habitat types ranging from upland forests to estuarine wetlands. Specifically in Bordentown City, natural communities mapped include emergent wetlands, forested wetlands, and forest. Most of these habitats lie within, or adjacent, to stream corridors of Blacks Creek, Crosswicks Creek, Mile Hollow Run, and Thorntown Creek. Because of the proximity of Bordentown to the Hamilton-Trenton-Bordentown Marsh, many wildlife species associated with that wetland system may also find refuge in Bordentown's other natural areas. At the same time, many species may spend part of their lives within these marshes, and occasionally venture into the City's built up landscape in search of food or shelter. Many residents have seen fox, wild turkeys, raccoons, rabbits, skunks, opossums and groundhogs in their yards. It is not unusual to find hawks seeking prey of small mammals and birds.

3.11.1 Wildlife Habitats

3.11.1.1 Open Water

Although miles from the Delaware Bay, the tidal nature on the Delaware River influences the City's portions of Crosswicks Creek, Blacks Creek, Thorntown Creek and other smaller channels. The tidal waters support fish, including Killifish, Catfish, Shad and Yellow Perch. The fish populations, in turn, support fish-eating birds such as Mergansers, Cormorants, Osprey, Egrets, and Herons. Great-blue Herons, Green Herons, Ring-necked Ducks, and Wood Ducks are frequently observed in ponds and slow-moving stream areas. River Otter have recently reestablished the Hamilton/Trenton Marsh as home, and evidence of otter has been found along the banks of Crosswicks and Blacks creeks. Rivers and ponds also provide habitat for amphibians, such as Bullfrogs and Green Frogs, and turtles, including Eastern Painted, Northern Red-bellied, and Common Snapping. There is evidence of Beaver and beaver dams along Crosswicks, Thorntown and Blacks Creeks.

Great Blue Heron, tidal marsh area

Mute Swan, tidal marsh area

Tidewater Mucket

Snapping Turtle, Thorntown Creek

Beaver activity, Blacks Creek

3.11.1.2 Marshes

These areas provide habitat for Muskrats, Marsh Wrens, Least Bitterns, Yellowthroats, and Red-winged Blackbirds. Waterfowl that could be found in the wetlands, as well as creeks, might include Canada Geese, Great Blue Heron, Herring Gull, and Mallard Ducks. Snapping Turtles and Muskrat lodges, especially in winter, have been sighted in the general area of the Trenton-Hamilton-Bordentown Marsh, as well as around the marshy areas of Blacks Creek.

3.11.1.3 Shrub Forest

Shrub forest wetlands are characterized by woody species and occur at the edges of marshes adjacent to upland areas. They also occur at the edges of marshes where they grade into swamps, with trees forming a distinct canopy, which in turn grade into wet forests and then to upland. Among the animals observed have been Baltimore Butterflies, Woodchuck, Red Fox, Willow Flycatchers (nesting), Eastern Kingbirds, Cardinals and Brown Snake.

3.11.1.4 Vernal Pools

As shown on GIS Map 9, areas of potential vernal pool habitat are present in the southernmost portion of the city, near Blacks Creek, and in the northernmost portion of the city near the intersection of Park Street and Route 206. Vernal pools are temporary pool of water present only during the wet seasons. Vernal pools are important habitats for amphibian reproduction.

3.11.1.5 Upland Forests and the Built Environment

During the course of the year, a great variety of birds may be found in upland forests especially during spring and fall migrations. Brown Thrashers, Song Sparrows, and Carolina Chickadees are common. Tufted Titmice and White-breasted Nuthatch frequent winter bird feeders. Blue Jays, Cardinals, Grackles, House Sparrows, Morning Doves and Starlings are wide-ranging throughout the year. It is not unusual to hear the sound of woodpeckers pecking backyard trees searching for insects. Other birds commonly found in upland forests, transitional areas and the built environment include American Goldfinch (New Jersey's State Bird), White-throated Sparrows, and Indigo Bunting. Wintering birds frequenting bird feeders include Tufted Titmouse, Carolina Chickadees, Red-Wing Blackbird, and White Breasted Nuthatch. Some song birds that might be summer residents or spring-fall migrants could include Goldfinch, Common Flicker, American Robin, and various species of warblers. Mammals commonly found in Bordentown's natural and built environment include the ubiquitous Gray Squirrel, Raccoon, Opossum, Eastern Cottontail, Stripped Skunk, Groundhog, White-footed Mouse, and Microtus. Chipmunks, House Mice, Norwegian Rat, and Bats are frequently found in and around buildings. Relying on the upland and wetland forests for cover and food, White-tailed Deer can be found within the City, although due to limited habitat the deer herd is considered quite small..

3.11.2 Incidental Species

Occasionally, species wander into the Bordentown area that are not typically found in this region. In recent years, Wild Turkeys have been observed within Bordentown City, far from the wooded areas of either northern New Jersey forests or the Pine Barrens. In April 2005, area residents were mesmerized by the appearance of a Beluga Whale in the

Delaware River as it swam for over a week between Trenton and Burlington, subsisting on shad runs. Also recently found in Thorntown Creek is American Eel – not an exotic species, but unusual to find in streams in this area.

3.11.3 Feral Cats

Feral cats are those that have become wild after living outside for a long period of time, or those that have been born to ferals. Feral cats survive in the same way as other wild animals do, although often well-intentioned community members serve as caregivers by feeding feral cat colonies. According to the ASPCA, groups of cats that have such caregivers have a life expectancy of up to ten years; cats living outdoors on their own have an expected life span of less than two years; and nearly half of the kittens born outdoors do not survive their first year.

Although the feral cat population does thin out from illness, extensive cold stretches, and starvation, they continue to propagate, and if left unchecked, the population often increases significantly over time. Prior to 2003, the feral cat population found in Bordentown City's woods and among the residents had expanded to the point of being a nuisance and a health problem. The police department was tasked with periodically trapping and transporting cats to the local animal shelter, where most were euthanized.

Recognizing that the cat population could be managed in a more humane manner, Mary Ann Kieffer, along with a group of tireless volunteers, created Bordentown City Cats (BCC) in 2003. The mission of BCC has been to rescue stray and abandoned cats in the hope of finding them new homes; trap and socialize kittens so they can be adopted; and trap, neuter and return (TNR) those cats that cannot be domesticated to a safe outdoor surrounding. As an all-volunteer, Federal 501(c)3 nonprofit, the organization has cared for roughly six feral cat colonies throughout the city, ensuring that all are spayed/neutered and fed on a daily basis. Since its inception, BCC estimates that it has rescued and homed nearly 900 cats. Other measures of the organization's success are that over time the number of ferals requiring neutering/spaying has decreased, and resident cats are living longer, healthy lives, due to vetting, daily feeding, and general attention.

With the continuing and often larger problem of abandoned cats, BCC provides education on the proper and humane treatment of felines in a variety of forums in the Bordentown area, including updates on their Website, http://www.bordentowncitycats.blogspot.com, and through social media tools such as Facebook and Twitter. BCC also uses social media to help reunite lost cats with their owners.

3.11.4 Federal and State Endangered and Threatened Species

Endangered species are those whose prospects for survival are in immediate danger. Threatened species are those that might become endangered if surrounding conditions begin to deteriorate. Both Federal and State-listed species and their habitats are offered levels of protection by various levels of government. The most notable protection measure is afforded listed species in terms of development controls. Any development infringing on wetlands that are part of a listed species habitat are subject to increased controls, which can range from wider vegetative buffers or construction prohibitions during nesting periods for a species, to outright prohibition of any development. Based on information from the New Jersey Natural Heritage Database and also the Landscape Classification System, the Bordentown area (generally corresponding to the Trenton West USGS Survey quadrangle) contains either habitat for, or observed listing for, nine listed species. Nearly all of the listed species are riverine or tidal marsh species associated with the Delaware River and its tributaries. GIS Map 9 indicates areas within the City that are considered critical habitat for threatened and endangered species by the Landscape Project. Areas of "Suitable Habitat" meet the suitability requirements for critical habitat. Areas of "Priority Concern" are those which have had sightings of priority species.

Bald Eagle *(Haliaeetus leucocephalus)*

NJ status: endangered; federal status: threatened

The Hamilton-Trenton-Bordentown Marsh is a nesting and wintering habitat of the Bald Eagle. A nesting pair of eagles has been observed on Newbold's Island in Bordentown Township.

Bald Eagles require a nesting location safe from human disturbance, typically a "supercanopy" tree with a high crown above the surrounding trees, enabling them to arrive and depart from the nest with ease. Bald Eagles are mostly fish eaters, although given the opportunity, will eat almost anything of a similar nature, including carrion. The Landscape Project has identified specific areas along Crosswicks Creek, Thorntown Creek, Blacks Creek, Mile Hollow Run and Love Bridge Run, consisting primarily of emergent wetlands, that serve as critical foraging habitat for Bald Eagles. GIS Map 9 outlines these areas of special concern.

Cooper's Hawk *(Accipiter cooperii)*

NJ status: threatened; federal status: not listed

This hawk is generally found in woodlands and mixed riparian or wetland forests. About the size of a crow, they prey on smaller birds such as morning doves, sparrows, and starlings.

They are commonly found to breed in remote wooded wetlands.

Pied-Billed Grebe *(Podilymbus podiceps)*

NJ status: endangered; federal status: not listed

A small, brown diving bird, it nests in wetlands throughout New Jersey. It both breeds and winters in New Jersey. The diet consists of a variety of aquatic organisms, including fish, crustaceans, insects, and vegetation.

Bog Turtle *(Clemmys muhlenbergii)*

NJ status: endangered; federal status: threatened

The Bog Turtle is the smallest native species of its type in the United States, measuring only 3- 4 inches long as adults. Their habitats are well drained and shallow wetlands with soft, muddy bottoms.

Wood Turtle *(Clemmys insculpta)*

NJ status: threatened; Federal status: not listed

Noted for its sculpted shell, the Wood Turtle is found throughout eastern North America, south to Virginia, and mostly in northern New Jersey. Adults range from 5.5 to 8 inches in length.

They reside in both aquatic and terrestrial environments.

Short-Nose Sturgeon *(Acipenser brevirostrum)*

NJ status: endangered; Federal status: endangered

Once found almost clogging the Delaware River and estuarine streams, sturgeon are now almost unheard of in our region. However, as an anadromous fish, they were prominent in the Delaware River and creeks in the Bordentown area.

Eastern Pondmussel *(Ligumia nastuta)*

NJ status: threatened; Federal status: not listed

In New Jersey, the Eastern Pondmussel can be found in the tidal Delaware River and several of its tributaries.

Tidewater Mucket *(Leptodea ochracea)*

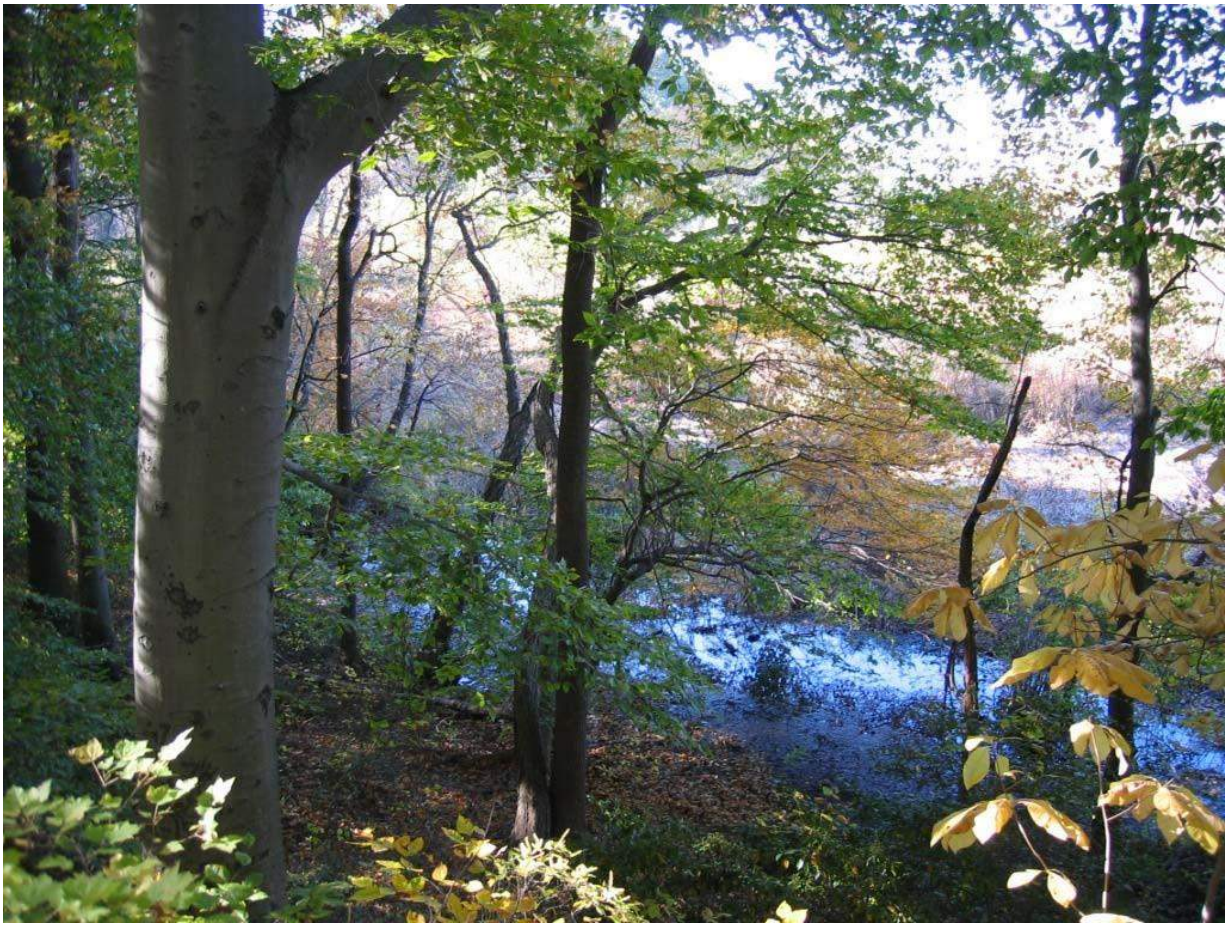
NJ status: threatened; Federal status: not listed

Like the pondmussel, the Tidewater Mucket is found in the Delaware River, although it has been located in both tidal and freshwater portions of the river.

Yellow Lampmussel *(Lampsilis cariosa)*

NJ status: threatened; Federal status: not listed

The Yellow Lampmussel prefers large rivers, like the Delaware River where it has been found, and makes its home in sand/silt substrates.



Bald Eagle foraging habitat, confluence of Thorntown Creek and Crosswicks Creek

Note transition area, upland forest to tidal marsh, with old growth Beech tree and steep slopes

4. THE BUILT ENVIRONMENT

4.1 Demographics

4.1.1 Population

The rise and fall of Bordentown City's population has been greatly influenced by its geography and history. According to the U.S. Census Bureau, the population of the City in 2010 was 3,924, and with a total square mileage of land area only 0.92 miles (one square mile total including water). Bordentown's density is 4,303.6 inhabitants per square mile, which is four times the state average of 1,134.

A small geographic area and housing stock largely built up in the mid-20th century have influenced small changes in either population growth or decline in the city. In 1990 the population of the City was 4,341. The 2000 population represented an 8.6% decrease since 1990. The 2010 census report showed 1.1% decrease with a population of 3,924 and in 2019 an estimated population of 3,792 indicates a still further decrease of 3.4%.

4.1.2 Housing

With its founding in 1682, the City was the center for northern Burlington County's services and industry. It also was a transportation hub, being located at the most southerly point of the Delaware and Raritan Canal. This created a population center that led to its early residential and commercial development, and the older housing stock reflects growth in the 19th and early 20th century. Although not built-out, there is little suitable land remaining for residential development. These combined forces have influenced little population change in the City. The median year housing structures were built in Bordentown City is older than 1939, compared to 1968 for New Jersey. Within the City, of the total 1,977 housing units, only 46% are owner-occupied units, compared to the state average of 63, which is close to the national average.

4.1.3 Race and Ethnicity

The demographic makeup of the City of Bordentown shows similarities and differences from the New Jersey norm. Based on the 2010 census with 2019 estimates the racial composition of the City is largely white – 83.51%, compared to the New Jersey average of 72.6%. Blacks, or African Americans, make 10.12% of the population, as compared to the state average of 13.6%. Other racial and ethnic populations within the city include 5.81% Hispanic or Latino, 2.73% Asian, 0.20% Native American, 0.03% Pacific Islander and 1.71% other. Year 2010 median household income of $45,324 was below the state average of $85,751.

High density of population, and in turn high density of residential units, in a small area can lead to certain environmental problems, such as increased amounts of run-off, non-point source pollution and increased demand on storm sewers. An aging housing and building stock means a higher proportion of service utilities that are also aged and subject to eventual leakage into ground and surface waters. Thus, it is crucial for City officials to monitor and maintain infrastructure.

With incomes that are below the New Jersey average, Bordentown City has limited financial resources for costly repairs to its utilities, and in the future will be greatly dependant on state and federal grants for their upkeep and replacement.

4.2 Transportation

4.2.1 Roads & Streets

4.2.1.1 Major Roads

Bordentown City is located close to a number of major roads. Exit 7 of the NJ Turnpike is within two miles of the City, providing North/South travel via a toll road. Interstate 295, a non- toll highway, has north and south exits within a mile of the City boundary. State Routes 130 and 206 also provide north/south travel options. Route 130 connects the Delaware River communities between Trenton and Camden. Route 206 connects Trenton and the Pinelands.

4.2.1.2 Municipal Streets

The streets in Bordentown City are aligned in a grid pattern that developed organically throughout the last 300 years. The main local streets connecting to major roads include Farnsworth Avenue, which serves as the main business district and bisects the City in a north/south axis between Rt. 130 and Crosswicks Creek; Park Street, which runs along a east/west axis between the RiverLINE light rail station and Rt. 206; and Burlington Street, which bisects the City along a east/west axis, and traverses the City between Route 206 in Bordentown Township and the City/Township border at Blacks Creek.

There are two traffic lights in Bordentown City, located at the intersection of Crosswicks Street and Routes 206/130, and at the intersection of Farnsworth Avenue and Route 130.

Principal arterial streets include Farnsworth Avenue, Prince Street, Park Street, Burlington Street and Union Street.

Farnsworth Avenue, looking south from Walnut Street

Farnsworth Avenue, looking south from Railroad Avenue

4.2.1.3 Local Traffic Counts

The Annual Average Daily Traffic (AADT) represents an estimate of all traffic in both directions counted for generally a three-to-five-day period at the locations in and around Bordentown City as indicated.

Street Name	From	To	Month & Year Counted	AADT Count
Farnsworth Ave	Union St	Burlington St	September 2018	**5,179**
Crosswicks St	Hopkinson St	Spring St	December 2018	**2,795**
Burlington Ave	Prince St	Farnsworth Ave	January 2019	**2,407**
Park St	3rd St Alley	3rd St	April 2017	**3,150**
Elizabeth St	Second St	Spring St	June 2018	**853**
Willow St	W. Burlington St	Federal St	April 2017	**1,442**
U.S. Rt 130	Elizabeth St	Woodland Ave	January 2013	**50,637**
U.S. Rt 130	I 295	Farnsworth Ave	June 2018	**30,572**
U.S. Rt 206	Farnsworth Ave	Cemetery La	August 2018	**18,621**

Source: NJ Department of Transportation Traffic Volume Counts – Traffic Count Stations

4.2.2 Mass Transit

Source: Delaware Valley Regional Planning Commission

Bordentown City is well-served by mass transit. Residents have a variety of options to travel to Trenton, New York and Philadelphia, and points in between and beyond, via means other than the automobile. The existence of these convenient transportation options within the downtown area qualify Bordentown City as a transit-friendly town center, providing a variety of options for young and old, disabled and car-free residents. Mass transit nodes are located within a 5-15 minute walk of the majority of residents.

4.2.2.1 Rail

Bordentown City is served by the RiverLINE light rail, which is owned and operated by NJ Transit. The system is comprised of diesel-powered light rail cars traveling on a rail line that is shared with Conrail. Opened in May 2004, the RiverLINE averages 6,100 weekday trips and has served over 3 million passengers as of September 2005. The 33-mile long line connects Trenton and Camden, with 20 stops in communities along the Delaware River, including: Trenton, Bordentown City, Roebling, Florence, Burlington City, Beverly, Edgewater Park, Delanco, Riverside, Cinnaminson, Riverton, Palmyra, Pennsauken and Camden. The track includes the right-of-way of the Camden and Amboy Line, which was opened between South Amboy and Bordentown in 1832.

The Trenton terminus is the Trenton Train Station, where riders may connect with multiple bus routes and Northeast Corridor Rail service, including destinations such as Newark Liberty International Airport and New York Penn Station. The Trenton station is also within walking distance of most government buildings in Trenton and is served by the downtown Capital Connection bus service.

The Camden terminus is the Walter Rand Transportation Center, which provides bus and rail connections, including many NJ Transit bus routes and PATCO rail. Connecting destinations include Atlantic City, downtown Philadelphia, and SEPTA regional rail, which provides service to Philadelphia International Airport.

Regular fares are currently $1. 60 one -way for adults to any station and are valid for two hours after purchase. Ticket must be validated at the station prior to travel. Monthly passes and 10-ride tickets are available. Discounted tickets for seniors ($0.75), children and persons with disabilities are also available. Ticket vending machines are located on the platforms at all stations. The hours of operation are 6am-10pm weekdays, 6am-12 midnight Saturdays, and 6am-10pm Sundays and Holidays. The frequency of stops is every 30 minutes, with service every 15 minutes during morning and evening weekday rush hours. The travel time between Bordentown City and Trenton is 12 minutes. Travel to Camden is approximately 1 hour.

The Bordentown Station, accessible via Park Street, has a parking lot adjacent to the platform that contains approximately 200 spaces. Parking is free. Several handicapped spaces and a bicycle parking rack are located next to the station walkway. Bicycles are permitted on RiverLINE trains at all times. An informal weekday count (Source: Bicycle Coalition of Greater Philadelphia, Fall 2004 newsletter) yielded 20 bicycles on 13 select trains, the equivalent of 135 bicycles per day. Cyclists thus currently account for 2 to 3 percent of daily ridership. Connecting services at the Bordentown Station may be made with the Route #409 NJ Transit bus (see below). Schedule information is available at www.riverline.com.

4.2.2.1.1 The John Bull and the Camden & Amboy Line

The Camden & Amboy was the first railroad to operate in New Jersey. In 1815, John Stevens succeeded in getting the New Jersey Legislature to authorize the forming of a company "to erect a rail road from the River Delaware near Trenton to the River Raritan at or near New Brunswick." This legislation was the first railroad act of the United States. In 1830, the New Jersey Legislature granted a charter for the Camden & Amboy Railroad. Also delivered in 1831 was the engine *John Bull*, which Stevens purchased during his trip to England. The *John Bull*, shipped disassembled, was put together by Isaac Dripps, a young mechanic recently hired by Stevens, without benefit of blueprints or instructions.

The Trenton Branch was built, from Bordentown to Trenton, in 1837-1838 and Trenton to New Brunswick, connecting with the New Jersey Railroad, in 1837-1839. This branch was built alongside the Delaware and Raritan Canal from north of Bordentown through downtown Trenton to Kingston, where it left the canal and went northeast to New Brunswick.

For the first ride on the rails laid between White Hill and Bordentown, Isaac Dripps was the engineer, Benjamin Wiggins was the fireman and Col. Stevens was the conductor. Trenton's officials and notables came down for a free ride. Madame Murat, wife of Prince Murat of the Bonaparte household was the first woman to ride on the “iron horse” that day. The *John Bull* was retired from regular service in 1866.

A 1/16th replica of the *John Bull*, built by Ed Sholl, stands in the Smithsonian Institute in Washington, DC. In 1981, the original *John Bull* was operated on the 150th anniversary of its first use, becoming the oldest operable steam locomotive in the world.

The railroad bridge beneath Farnsworth Avenue, underneath which freight train service presently continues on a small portion of the original Camden & Amboy Line, is the oldest railroad bridge in continuous use in North America.

Sources: Downtown Business Association and the Camden & Amboy Railroad Historical Society, Inc.

4.2.2.2 Bus

The NJ Transit Route #409 Long Distance Suburban Bus provides service between Philadelphia and Trenton, with stops along the Route 130 corridor, including: Trenton Rail Station, Bordentown, Roebling, Florence, Burlington, Burlington Center, Mount Holly, Edgewater Park, Willingboro, Willingboro Shopping Center, Bridgeboro, Delran, Cinnaminson, Pennsauken, Moorestown, Camden, and Philadelphia.

Service is approximately every hour in both directions on weekdays, and approximately every two hours on weekends and holidays, from 6am-10pm.

Four bus stops are located in Bordentown City, including the corner of West Burlington Street and Farnsworth Avenue, the Light Rail (Riverline) station, the corner of Park Street and Second Street, and Park Street by the Park Street Apartment complex. Bus shelters are provided at the Park Street Apartment stops.

Fares depend on distance of travel. Driver will make change. Discounted monthly passes and ten trip tickets are available. Discounted tickets for seniors, students, children and disabled persons are available, including transfers. Bicycles are permitted at all times in the underneath storage compartment, space permitting.

See www.njtransit.com for current schedule information.

4.2.3 Bicycle/Pedestrian

Due to its relatively dense land use pattern and interconnected street grid within one square mile, Bordentown City is a bicycle/pedestrian-friendly center. A wide variety of destinations are easily accessible via bicycle or foot, including grocery stores, restaurants, retail, schools, library, post office and municipal offices. Although the street pattern and density allow for these trips, there is much room for improvement, including rehabilitation and expansion of the sidewalk network; increased bicycle infrastructure (including signage, road striping and bicycle parking), and traffic calming measures along the main thoroughfares.

Major bicycle/pedestrian initiatives have taken place, including the Delaware River Heritage Trail, which enters the City via the updated Delaware & Raritan Canal path and across the pedestrian bridge beside the RiverLINE bridge,

Bicycle parking rack, Farnsworth Avenue

continuing down Farnsworth Avenue, and extending south through Fieldsboro and beyond.

Additionally, walking trails are in place at Lime Kiln Alley Park with additional trails including interpretative signage planned along the proposed Thorntown Creek and Blacks Creek Greenways.

A Bicycle and Pedestrian Circulation Study for Bordentown City was completed in November 2005 (https://bcec.cityofbordentown.com/wp-content/uploads/2013/04/Tech_Memo_2_-_revised_030106.pdf accessed July 18, 2022), but has not been updated since that time.

4.2.4 Air Travel

The closest airport to Bordentown City is the Trenton-Mercer County Airport. This facility provides regional service to the New England, Mid-Atlantic and southern States, as well as corporate flights. See www.mercercounty.org/airport/index.htm for more information.

4.2.5 Marine Travel

Bordentown City has two marinas: Yapewi Aquatic Club and Bordentown Yacht Club. They are located near each other at the confluence of Crosswicks Creek and the Delaware River. These facilities allow boaters to travel to locations along the Delaware River, as well as access to the Delaware Bay, the Atlantic Ocean and various points along the Atlantic Seaboard. Both facilities have a clubhouse and dockage for member vessels on the Crosswicks Creek.

4.2.6 Transit Village: Attributes, Opportunities and Recommendations

With the advent of the RiverLINE light rail service in 2004, Bordentown City satisfies many of the criteria of a Transit Village, a “Smart Growth” strategy that refers to a community with sufficient transit facilities to make it an appealing choice for people to live, work and play, thereby reducing reliance on the automobile. According to the NJ Transit-Transit Village Initiative, a good Transit Village candidate must make a commitment to grow in jobs, housing and population. Bordentown City meets, or is working towards, all of the following criteria:

- A designated Transit Village must have a transit facility. This can be a rail or light rail station, ferry terminal, a bus hub or bus transfer station. (*Qualifies*)
- The candidate for Transit Village designation must have vacant land and/or underutilized or deteriorated buildings within walking distance of transit where redevelopment can take place. (*Qualifies*)
- A Transit Village candidate must have an adopted land-use strategy for achieving compact, transit-supportive, mixed-use development within walking distance of transit. This can be in the form of a redevelopment plan, zoning ordinance, master plan or overlay zone. (*Process ongoing*)
- The candidate must have a strong residential component. This can include mid-rise buildings, townhouses or apartments over first-floor businesses. A wide variety of housing choices within walking distance of transit helps to support transit ridership. (*Qualifies*)
- The candidate will have "ready-to-go" projects. This means at least one transit-oriented project that can be completed within three years. *(Process ongoing)*
- In order for a municipality to succeed as a Transit Village, it should demonstrate pedestrian and bicycle friendliness. This means clear, direct pathways from the transit station to shops, offices, surrounding neighborhoods and other destinations. (*Process ongoing*)
- A good candidate views its transit station as the focal point of the community and uses its station plaza as a gathering place for community activities such as festivals, concerts, public ceremonies and farmers markets. (*Process ongoing*)

- A good candidate includes its transit station in a station area management plan, in a special improvement district (SID), or as part of a Main Street New Jersey designation. (*Process ongoing*)
- A good candidate should strive to minimize automobile use by maximizing the appeal of transit. One example of this is the concierge service in the Metuchen train station. Commuters drop off errands (such as dry cleaning, packages for mailing, etc.) in the morning and pick-up items on the opposite side of the tracks on the way home. (*Process ongoing*)
- The candidate should provide commuter parking for residents and non-residents. A Transit Village should also strive to reduce parking requirements near transit stations and implement shared parking solutions wherever possible. (*Process ongoing*)
- The candidate should support local arts and culture. This brings vibrancy and activity to a community. Designating an arts, antique or restaurant district helps make a Transit Village a destination. (*Qualifies*)
- The candidate should support the historic and architectural integrity of the community by ensuring that new buildings blend in with the existing buildings. This can be done with architectural design guidelines that govern new building facades, window replacements, awnings, lighting and signs. (*Process Ongoing)*

Mode of Transportation to Work

	Total Residents	% of population
Total # of Workers 16 and over		
Bordentown City	2,114	-
NJ	3,984,894	-
US	152,114,957	-
Number of residents who use public transportation		
Bordentown City	31	1.5%
NJ	187,217	5%
US	6,941,363	5%
Number of residents who use car, truck, van or motorcycle		
Bordentown City	1,810	86%
NJ	3,294,716	83%
US	128,181,757	84%
Number of residents who walk, bike, take taxi or motorcycle		
Bordentown City	106	5%
NJ	188,736	5%
US	6,071,162	4%
Number of residents who work at home		
Bordentown City	167	8%
NJ	314,225	8%
US	10,920,675	7%

(*Source*: 2020 US Census https://data.census.gov/cedsci accessed July 18, 2022)

4.3 Land Use

4.3.1 Land Cover

Specific land uses are discussed in details in the June 29, 2021 Bordentown City Comprehensive Plan adopted by the City of Bordentown Planning Board. More relevant to this ERI is the breakdown of areas comprised by developed vs. undeveloped land.

GIS Map 11 shows the general land cover types identified by NJDEP in and around the city. The area represented by each of these land cover types is summarized below.

- Barren Land – 4.9 acres (0.5% of the total municipality area);
- Forest – 104 acres (9.8% of the total municipality area);
- Urban – 740 acres (70% of the total municipality area);
- Water – 57 acres (5.4% of the total municipality area); and
- Wetlands – 153 acres (14.5% of the total municipality area);

Additionally, NJDEP provides a map layer providing an estimate of the percentage of impervious surface coverage throughout the state, which is depicted on GIS Map 11. Summarized, within Bordentown City, approximately 307 acres of land (31% of the land area) is classified as impervious coverage.

4.3.2 Open Space, Trails, and Monuments

Various parcels within the City have been preserved as open space through a combination of City and State ownership, deed restrictions, and private funding. Open space parcels recognized by the NJDEP Green Acres Program are depicted on GIS Map 12.

Parks

Background: The City's parks include local playgrounds, picnic areas, basketball courts, baseball fields, open play space, passive recreation areas, a community garden, and Bordentown Beach.

Gilder Memorial Park is the city's largest park at 17 acres, extending from Crosswicks Street to Elizabeth Street. The property, including the Gilder House that dates back to the 1700's, was donated to the city in 1935 by the Gilder family, on the condition that the house would serve as a museum or public library for the community. Additionally, the Gilder family's love of baseball dictated that the property must host a baseball field. The Gilder House was placed on the New Jersey Register of Historic Places in 1976 and the National Register of Historic Places in 1982.

Located adjacent to Crosswicks Street, Carslake Community Center was built in 1957, and an addition was constructed in about 1997. The park hosts a small playground behind the community center, two parking lots, a batting cage, and a natural turf baseball field. The concrete bleacher system that also serves as a retaining wall was constructed in 1937 through the Work Project Administration. The bleachers were renovated in 1995 by the City's Department of Public Works.

A small portion of the park is used by the Bordentown City Department of Public Works. The area north of the public works yard is generally wooded and traversed by Thornton Creek. Portions of the park closest to Elizabeth Street have been utilized for unmonitored recreational activities such as dirt bike riding, resulting in negative environmental impacts.

Bordentown Beach is the city's second largest park at 6.44 acres. The City took ownership in about 1974 through an arrangement with the Yapewi Yacht Club. Located at the base of Park Street at the Delaware River, the park hosts

the city's only formal access to the Delaware River. The boat ramp is available to the public by permit only. Newer park amenities include two gazebos, picnic tables, and grills.

Completed in 2013, a 2.8-mile segment of the Delaware River Heritage Trail originates at Bordentown Beach and links Bordentown City to portions of Bordentown Township and Fieldsboro Borough. More recently the Delaware & Raritan Greenway Land Trust (DRGLT) has partnered with the city to begin educational programing at the beach. A trailer has been added to the park, allowing the DRGLT to store kayaks that will be used for organized tours and events.

Lime Kiln Alley Preserve is a 5.77-acre park, assembled from a network of smaller parcels adjacent to Blacks Creek, is located at the base of Lime Kiln Alley. The preservation effort began in 2004 through the efforts of DRGLT, the NJDEP, Green Acres Program, and the Bordentown City Environmental Commission. Intended as a passive recreation area, amenities now include a gazebo, picnic table, and hiking trail. The park is also home to the famous "sledding hill", a favorite destination for children of all ages after a snowfall. In 2009 a wide variety of native plants were installed by volunteers in the meadow area of the preserve; however, this area is now in need of replanting and regular maintenance. In 2013 a pollinator garden was established through a partnership between the DRGLT and the Bordentown City Environmental Commission. The pollinator garden is maintained by volunteers. Currently, the preserve extends from Lime Kiln Alley to the Conrail /PATCo Right-of-Way; with all of the property in City ownership except for Block 801, Lot 34.01. This lot is still owned by Delaware Raritan Greenway Land Trust.

Oliver Street Park is a nearly 4-acre site at the southern end of Oliver Street, providing passive open space area in the southern section of the city. The property was originally preserved through the efforts of the DRGLT, with funding assistance from the NJDEP, Green Acres Program, and transferred to Bordentown City ownership in 2007. The park includes several contiguous lots on either side of the Oliver Street Right of Way, and two additional lots with frontage on Mill Street. At one time the park featured a loop pedestrian path and native plantings; however, without regular maintenance the trail and meadow became overgrown. This area was eventually mowed and has been maintained as an open field. Most of the perimeter of the park is wooded. Love Bridge Run, a small stream and tributary to Black's Creek, traverses the southeast side of the park, . The property consists of sloping topography that extends down to the adjacent freshwater marshland Black's Creek.

Oliver Street Extension is a 1.73-acre parcel located to the west of Oliver Street Park. Approximately 1.2 acres of the park is comprised of freshwater tidal marsh. Oliver Street Park Extension was also preserved with assistance from the Delaware Raritan Greenway Land Trust and NJDEP, Green Acres Program.

Second Street Park is located in the northern section of the city, between West Park and Thompson Streets. At 1.16 acres, Second Street Park features the City's largest playground, two basketball courts, and an open play area. Formerly a cannery, the property was purchased from the Bordentown Military Institute by Bill Gray, who initially leased, and then sold, the property to the City in 2005.

Hilltop Park is a 1-acre parcel located between Farnsworth Avenue and Second Street. It is estimated that the park originated in the late 1800's, and was originally known as Goodwin Park. In 1936 it was renamed William R. Flynn Memorial Park. The rehabilitated park was the first project completed by the Burlington County Works Progress Administration. Situated on a bluff, Hilltop Park is noted for its scenic views of the Delaware River, Crosswicks Creek, freshwater tidal marsh, marinas, and the NJ Transit Riverline bridge. Hilltop Park consists of pathways, benches, a small gazebo, the Frank Carr Memorial Iris Garden, and the Point Breeze Garden. The decorative ornamental railing was salvaged from Colonel Hoagland's Inn (1770-1980), after a fire. More recently, a group of volunteers has initiated a vegetation restoration project within the planting strip at the Farnsworth Avenue park entrance.

Ann/Spring Street Park is an irregularly shaped lot in the northeast section of the city. Formerly owned by the Bordentown Military Institute and then Ocean Spray, the property was transferred to city ownership in 1990. The park features a relatively large flat area occupied by a baseball field, as well as steep slopes that descend to Thornton Creek. There are plans to renovate the field area, pending site remediation.

West Street Park consists of a small, 0.12-acre neighborhood playground, located on West Street between Farnsworth Avenue and Borden Street. The park is slated for renovation in 2022.

Chief Francis Lee Memorial Park is an undeveloped parcel located at the corner of Borden and West Streets. At this time, the park is undeveloped; area residents have been surveyed as to what amenities would best serve the community.

Anderson Family Park is a 0.45-acre parcel located on Park Street. The park was bequeathed to the City by Marietta Sabo, with restrictions that the land must be named after her parents, and maintained as a park. The property was transferred to the City in about 1995. While funding was left by the family for maintenance of the property, the parcel remains undeveloped.

Point Breeze Park is the most recent open space acquisition in the City. As background, the former Joseph Bonaparte estate known as "Point Breeze" was purchased by the Divine Word Missionaries as a seminary in 1941. In early 2021, Point Breeze was sold to the State of New Jersey (Green Acres Program), the City of Bordentown, and the D&R Greenway Land Trust. The City purchased 5.4 acres, intending to repurpose existing buildings for municipal services. The D&R Greenway Land Trust purchased 1 acre, which includes the Gardener's House, the only remaining Bonaparte-era structure. The Gardener's House will house an education center, and the surrounding gardens will be restored. The remaining 52 State-owned acres will be managed by the City as public open space. Preservation of this historic property will provide the public with outdoor recreation opportunities, including ball fields, open lawn and trails; a museum and educational center; and historic demonstration gardens. Archeological study and digs continue on the site continually uncovering significant historical locations and artifacts.

Gardens, Other Public Spaces, and Monuments

The **Bordentown City Community Garden** is located on East Burlington Street, at the Board of Education Burlington Street Annex. The garden and a small pollinator garden occupy a small portion of the 1.7-acre property. Other amenities at this location include a basketball court and a baseball field. The property is owned and maintained by the Bordentown Board of Education.

The **Library Pollinator Garden** is located on East Union Street, in the rear corner of the library parking lot. The garden was created in approximately 2013, to demonstrate the ecological value and beauty of native plants in the landscape. The garden is maintained by volunteers.

Railroad Avenue Promenade was established in 2007, utilizing a grant from NJDOT's Safe Route to Transit program, as linear park immediately adjacent to (and above) the freight rail line from Prince Street to Second Street. The Promenade facilitates pedestrian movement within the central business district, and at the time of its inception, was intended to serve as a link between the RiverLine light rail stop, the Delaware River Heritage Trail, and the Thornton Creek Trail.

Thomas Paine Park, celebrates the contributions of revolution-era Bordentown resident Thomas Paine. The monument was installed 1997 and is located within the northwest terminus of the Prince Street right-of-way.

Veterans Memorial: Construction of the Veterans Memorial began in 1997**, and s**erves to memorialize those Veterans from Bordentown City who have fought from the Revolutionary War to present day. The memorial replaces the former Honor Roll that was in deteriorated condition. The memorial is located at the corner of Farnsworth Avenue and Veteran's Way.

John Bull Monument: Located at Farnsworth Avenue near Church Street, the John Bull monument commemorates the first run of the historic John Bull locomotive in 1831. The monument was commissioned by Penn General Railroad and gifted to Edward S. Sholl in 1970. Mr. Sholl displayed the monument at his residence located on Willow Street until

approximately 1975, when the monument was moved to its current location. The City is in possession of a second monument that commemorate the first run of the John Bull, which is in storage at this time.

WW I Monument: A monument commemorating WWI was erected in 1924 in the center of Walnut Street, between Farnsworth Avenue and Prince Street. The monument was subsequently moved to the US Post Office property located at Walnut and Prince Street.

Bordentown Military Institute (BMI) Monument: The "Cadet Statue" is located on 70 Park Street. It represents a cadet in salute in front of where "Old Main" was formerly located. The statue was dedicated October 1996 by the BMI Alumni Association.

Battle of the Kegs: This monument is located at the end of Prince Street, just beyond the Thomas Paine monument. It marks a revolutionary ploy whereby kegs armed with gun powder were floated down the river towards Philadelphia. Upon realizing the danger, British soldiers began firing at any suspicious debris in the river. John Hopkinson wrote a ballad that mocked the British soldiers, and bolstered the spirits of the American rebel army.

Other Natural Areas, Plans, and Water Access Points

Crosswicks Creek Access is located near the Second Street entrance to Hilltop Park, where a stairway descends to the Crosswicks Creek floodplain. The city owns 0.5 acres of land in this vicinity; the balance of approximately 60 acres is owned by the State of NJ.

Thorntown Creek Greenway is a wooded area presently owned by the City. Construction of a walking trail was begun in about 2010 with a grant from NJDOT; however, the trail has not been maintained in many years. An assessment and plan was prepared in 2005 to preserve the natural corridor along the creek floodplain, with a pedestrian trail extending from Gilder Field to the mouth of Thorntown Creek where it meets Crosswicks Creek. See https://bcec.cityofbordentown.com/local-info/ for additional information.

Blacks Creek Greenway is referenced in the City's 2005 Environmental Resource Inventory. Although not yet implemented, this trail would traverse both Bordentown City and Bordentown Township properties. The plan envisioned a loop trail from the Bordentown Beach area, across Blacks Creek to the Township side, traversing the upland side of the creek in a southerly direction, and re-entering the City across Blacks Creek at the location of the remnant bridge abutments across Mill Street (with a connection to Oliver Street Park).

4.3.3 Areas of Scenic Value

Bordentown City's historic downtown is surrounded by densely developed neighborhoods, parks, and areas of undeveloped open space. The BCEC solicited input from the public via Facebook in 2022 and several scenic views of the natural and the built environments were identified as valuable resources as described below.

- Viewshed from Hilltop Park

  The viewshed at Hilltop Park is valuable both in terms of its natural beauty and historic significance. From this location on top of the bluffs, one can take in a panoramic view of the Delaware River, Crosswicks Creek and the Abbott Marshlands. This view encompasses the Lock #1 area of the Delaware & Raritan Canal (that is also the southern entrance to the D&R Canal State Park), including the area that contained the lock tender's house and the location of several sunken Revolutionary War-era ships. At the base of the bluff, is the Bordentown Yacht Club, a former industrial area used by steamships and the former Riverview Iron Works, among others, and the NJ Transit RiverLine rail and pedestrian bridge, which traverses Crosswicks Creek.

Within Hilltop Park, visitors find respite along the pathway hugged by mature trees, and enjoy the Frank Carr Memorial Iris Garden, especially when the iris are in bloom.

- Viewshed from Point Breeze property

  The viewshed from Park Street into the Pointe Breeze property is valuable in terms of its natural beauty and archeological and historical significance. The landscape consists of both open lawn and mature forest, reflecting the landscape as it existed during the time of Joseph Bonaparte's Point Breeze Estate, and provides views overlooking Crosswicks Creek and the Abbott Marshlands.

- Viewshed from Bordentown Beach

  Bordentown Beach provides visitors with a view of the Delaware River, and the mouth of Black's Creek. Many of the historic features seen from Hilltop Park can are also captured from this vantage point.

- Viewshed From Route 295 Bridge

  While crossing the mouth of Crosswicks Creek on Route 295, one can see Bordentown City and its waterfront from a unique perspective. The view includes the homes atop the steep northern and eastern bluffs, a sightline up Crosswicks Creek, boats moored at the Yapewi Aquatic Club and Bordentown Yacht Club, Bordentown Beach, the NJ Transit RiverLine tracks and bridge, and historically industrial areas along the waterfront and railroad.

- Viewsheds of the Lime Kiln Alley Park and Blacks Creek areas

  Various viewsheds of Blacks Creek are accessible within Bordentown City, especially from Lime Kiln Alley Park, Bordentown Beach as described above, and from the Burlington Street bridge that traverses Blacks Creek. These views provide an intimate glimpse into the ecology and wildlife of a tidally influenced stream and marsh. The tidal zone, which is exposed by as much as nine feet twice each day, offers a dramatic view of the stream channel, changing stream flow, and the rich variety of vegetation and wildlife that exist in this dynamic area. The area is frequented by numerous bird species and is a critical Bald Eagle foraging habitat.

- Viewsheds of the Built Environment

  Some of the treasured views within the City are the Old City Hall Clock Tower; the historic business district along Farnsworth Avenue; and Mary Street when the ornamental street trees are in bloom.

Photos of the scenic areas described above are provided on the following pages.

Hilltop Park Viewshed

Above photo by Val Sassaman

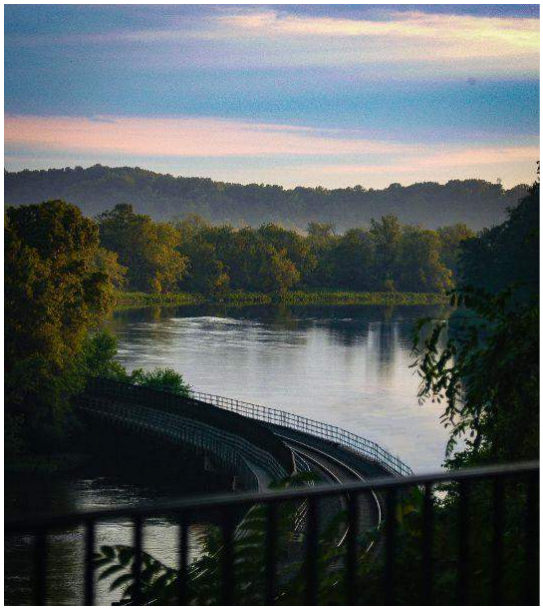


Photo by Anne Lyon

Hilltop Park

Photo by Anne Lyon

Photo by Kelly Grala

Lime Kiln Alley Park / Blacks Creek Viewshed

Lime Kiln Alley Park Gazebo and pollinator garden

Blacks Creek at Lime Kiln Alley Park

Crosswicks Creek Viewshed

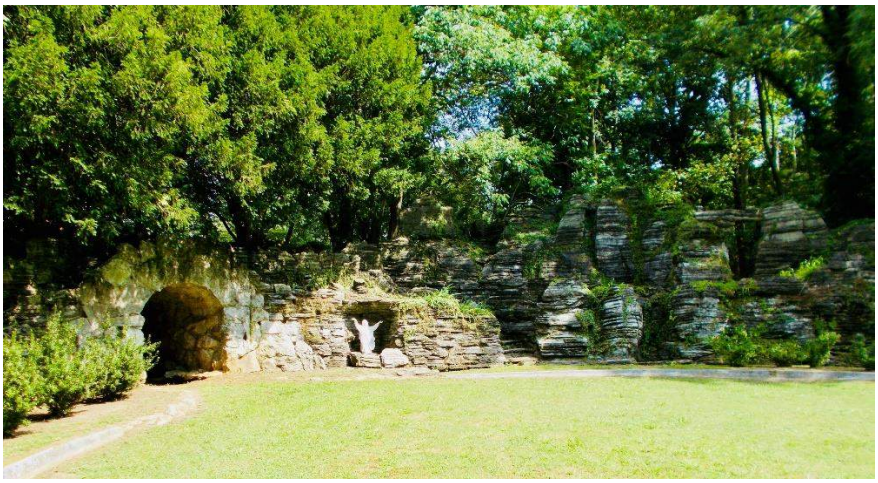
Kayaker on Crosswicks Creek

Blacks Creek, low tide, looking west from bridge at East Burlington Street

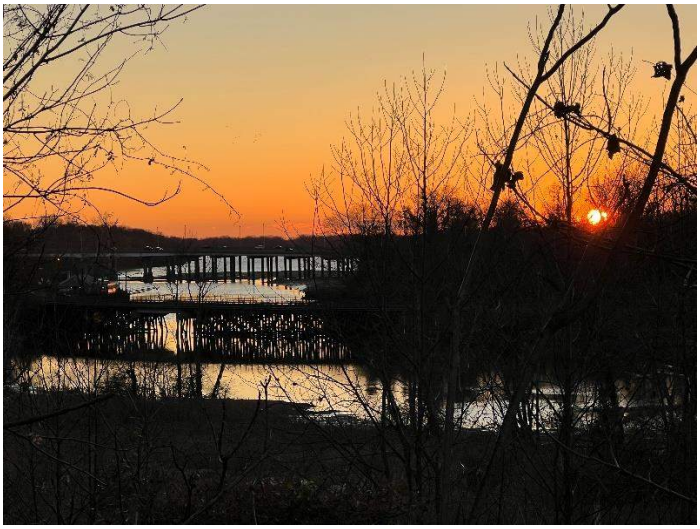
RiverLine from pedestrian bridge. Photo by Val Sassaman

Point Breeze Park Viewshed

Point Breeze Park, from Park Street



Grotto at Point Breeze Park. Photo by Kelly Grala



View from Point Breeze Park. Photo by Joel Dowshen

Built Environment Views

Old City Hall. Photo by Val Sassaman

View of Thomas Paine Park. Photo by Val Sassaman

Christ Episcopal Church Cemetery. Photo by Val Sassaman

View of Farnsworth Avenue. Photo by Val Sassaman

4.3.4 Recreational Waterways

Recreational waterways that are accessible to Bordentown City include the Delaware River, Crosswicks Creek, Blacks Creek, Duck Creek, Watson's Creek, and other of their navigable tributaries. The Delaware River is used for a variety of recreational activities including power boats, sailboats, jet-skis, kayaks, canoes, and standup/paddleboards. It is accessible from the Bordentown Beach and Yacht clubs at the western end of Park Street and northern end of Farnsworth Avenue. The beach has public launching areas for powerboats (by permit) and for non-motorized watercraft (free). All the waterways noted above are subject to the tides, that can swing 9 feet from low to high. Attention to the tides is important, especially while navigating the creeks and tributaries.

Kayaker on Crosswicks Creek

Crosswicks Creek, Bordentown Twp.

Crosswicks Creek enters the Delaware River immediately north of Bordentown Beach and extends upstream to the north providing access to the Abbott Marshlands. The creek extends past the Bordentown Bluffs (a part of the D&R Canal State Park) and branches off through Bordentown Township and to Watson's Creek through Hamilton Township to Spring Lake at the John A. Roebling Memorial Park. The creek is navigable by kayaks and canoes, and by small motor craft at non-wake speed to avoid disruption of the abundance of wildlife and non-motorized watercraft.

Blacks Creek enters the Delaware River just south of the Bordentown Beach extending upstream through wetlands on the southwestern side of Bordentown City. It flows beside Lime Kiln Alley Park and into Bordentown Township. It too provides chances to observe birds, wildlife (including resident beaver and their lodges), and a large variety of foliage.

Duck Creek has an inlet to the Delaware River approximately 0.8 miles north of the Bordentown Beach and extends north through Duck Island, a large wetland extending upriver to Trenton. This waterway's full length is accessible only for a few hours before and after high tide.

Depending on the tides there are numerous navigable tributaries and side streams running from these Bordentown waterways opening access to an amazing display of flora and fauna.

4.3.5 Known Contaminated Sites

NJDEP maintains a list of all known contaminated sites in the state where remedial activities are either underway or required. The table below constitutes the Known Contaminated Sites in the City of Bordentown and the locations of

these sites is presented on GIS Map 13. Note that at sites with no Remedial Level, contamination has been addressed, but may remain at the site. The up-to-date list of known contaminated sites can be viewed in NJDEP's interactive map, NJ-GeoWeb by visiting the following link and looking under Sites and Facilities, https://www.nj.gov/dep/gis/geowebsplash.htm.

Definitions

Status Date: For cases with an active status designation, the date provided represents the date the site was assigned to the designated contact bureau. For cases with a pending status designation, the date provided represents the date the pending status was determined.

Active: This status is designated when a contaminated site is assigned to a remedial program and measures such as a preliminary assessment, remedial investigation or cleanup work is underway.

Remedial Levels:

B: Single phase remedial action in emergency response; simple removal activities of contaminants; usually no impact to soil or groundwater.

C1: A remedial action with simple sites; one or two contaminants localized to soil and the immediate spill or discharge area.

C2: A remedial action with more complicated contaminant discharges; multiple site spills and discharges; more than one contaminant, with both soil and groundwater impacted or threatened.

C3: A multi-phase remedial action with high complexity and threatening sites. Multiple contaminants some at high concentrations with unknown sources continuing to impact soils, groundwater, and possibly surface waters and potable water sources. Dangerous for direct contact with contaminated soils.

D: Same conditions as C3, except that D levels are also usually designated as federal "Superfund Sites".

ND: Not designated.

PI Number: Program Interest Number – an identifier unique to the site or facility, used by NJDEP.

Site Name	PI Number	Address	Case Status	Status Date	Remedial Level
Bordentown Coal Gas (PSE&G)	G000008793	Walnut & Willow St.	Active – RAP	1/28/2014	
Ocean Spray Cranberry	023203	104 East Park St.	Active	8/3/2017	C2
Bosoya Fuel NJ 0042	007350	258 260 Rt. 130 N	Active - RAP	3/26/2020	
US Gas	007351	196 Rt. 130 & Crosswicks Rd	Active	11/9/2011	C2
PJ Goldman LLC	025001	15 Park St. E.	Active	5/15/2014	C2
Mr & Mrs Dengler	025278	226 Rt 206 & 130	Active	12/28/2012	C1
Craftsmen of Old Crosswicks Incorporated	G000012489	1 The Waterfront	Active	7/23/2018	C2
228 Walnut Street	456813	228 Walnut St.	Active – Post Rem	7/22/2009	B
Anne Street Ballfield	753163	21 Ann St	Active	1/2/2019	B

4.3.6 Noise Factors

Noise negatively affects human health and well-being. Problems related to noise include hearing loss, stress, high blood pressure, sleep loss, distraction and lost productivity, and a general reduction in the quality of life and opportunities for tranquility.

Most areas of Bordentown City's one square mile are exposed to above-average noise levels, due primarily to the local topography and proximity of residential housing to major roads.

Particularly affected are the residential streets on the edges of the City. The most significant noise comes from automobile and, especially, truck traffic on the I-295 bridges over Burlington Street and Crosswicks Creek, as well as noise from Rt. 130 on the southern and eastern edges of the City.

In addition, there are noise issues related to local passenger train service. The introduction of the RiverLINE light rail service in 2004 created new noise issues in the north/northwestern quadrants of the City. The train car rings a bell as it stops at the station located at the end of Park Street and blows its horn once at the grade crossing at the end of Farnsworth Avenue. Noise from the RiverLINE train is not currently a factor from 10:00 pm to 6:00 am as the train does not operate during these hours.

The CSX freight train that runs through the City along a roughly northeasterly axis (paralleling Railroad Avenue) during the early morning hours also presents a noise issue. It blows its horn at the grade crossing at the Second Street Alley. This train has no set schedule, but its early morning hours effect nearby residents.

No record of decibel level measurements in any locations within Bordentown City has been found.

4.4 Infrastructure

4.4.1 Water Supply

The Bordentown City Water Department (BCWD) is a Public Community Water System identified with PWSID 0303001, owned and operated by the City of Bordentown, which serves approximately 16,000 residents through 5,180 connections in the City of Bordentown and Bordentown Township and also provides water at a bulk rate to the Borough of Fieldsboro. Water is drawn from the Potomac-Raritan-Magothy (PRM) aquifer via four wells (Well #1, Well #2A, Well #3, and Well #5R) located in Hamilton Township near the intersection of Route Rt. 206 and South Broad Street. Wells #2A and #5R were new replacement wells installed in 2016 and 2015 respectively.

NJDEP provides well head protection areas (WHPAs) for public community water supply wells in New Jersey. A WHPA delineates the horizontal extent of groundwater captured by a well pumping at a specific rate over two-year (Tier 1), five-year (Tier 2), and twelve-year (Tier 3) periods. WHPAs for Bordentown City's public water supply, shown on GIS Map 14, indicate that water is drawn from a primarily residential area with some commercial development.

Samples from the water system are analyzed regularly (varies from multiple times per month to annually) for compounds including total coliform, disinfection byproducts, metals and inorganics, radiologicals (radium, uranium, etc.), secondary contaminants (color, odor, hardness, etc.), Per- and Polyfluoroalkyl Substances (PFAS), and volatile organic compounds (VOCs) as required by the New Jersey Department of Environmental Protection's (NJDEP) Division of Water Supply & Geoscience. The BCWD has worked to address elevated levels of gross alpha identified in 2014 and 2015 and radium removal (via ion exchange) is now a part of the drinking water treatment facility. In addition, elevated lead levels were identified in samples collected inside certain homes and buildings beginning in 2017. The lead was not present in the water supplied by the BCWD, but was leached from plumbing pipe and fixtures within the homes. In response to the lead issue, the BCWD undertook extensive efforts to identify the cause and remediate the issue, including but not limited to the following:

- Providing free voluntary testing of drinking water to homeowners (totaling over 420 free samples to date);
- Establishing a resident advisory committee (Bordentown City Water Advisory Board) to work with the City Commissioners on issues relating to public awareness, quality of water and quality of service. Via this collaboration, our local government and residents have worked together to systemically rebuild outdated and aging underground infrastructure servicing Burlington Street, Willow Street, Second Street, and Oliver Street. As of this writing in 2022, a project to upgrade the water systems servicing Brooks Avenue and Union Street are underway. Further upgrades including replacement of one of the BCWD water tanks and replacement of all water meters throughout the distribution system are slated for 2022 and into 2023.
- Conducting a survey of water mains, which found no known lead service lines;
- Assessing the service lines to determine materials of construction;
- Working with affected homeowners to reduce lead exposure and assist homeowners in identifying potential sources of lead inside the home;
- Developing an Asset Management Plan that inventoried all of its water systems (plant, pumps, hydrants, tanks, mains, meters, and such) and prioritized capital improvements based on an independent evaluation of their performance and life cycle. In compliance with the state regulations, this ten year capital investment plan was submitted to the state and readily available to the public (including on the city's website); and
- Upgrading the treatment plant to control pH and introduce a blended orthophosphate corrosion inhibitor to control the corrosion causing the lead issue.

Lead results for the water system met the requirements in 2020 and 2021, the latest annual data available.

Detailed information regarding the water system assets and planned maintenance thereof is available in the City of Bordentown Water Department Asset Management Plan. Presently, the latest version is dated November 2020. Reports on water quality testing results are summarized in an Annual Drinking Water Quality Report provided by the water department to residents and available on the City's website (https://cityofbordentown.com/wp-content/uploads/2021-Consumer-Confidence-Report-2020-Data.pdf). Sampling data provided to NJDEP are available at their Drinking Water Watch Site: https://www9.state.nj.us/DEP_WaterWatch_public/JSP/WSDetail.jsp?tinwsys=74.

4.4.2 Sewerage

Bordentown Sewerage Authority

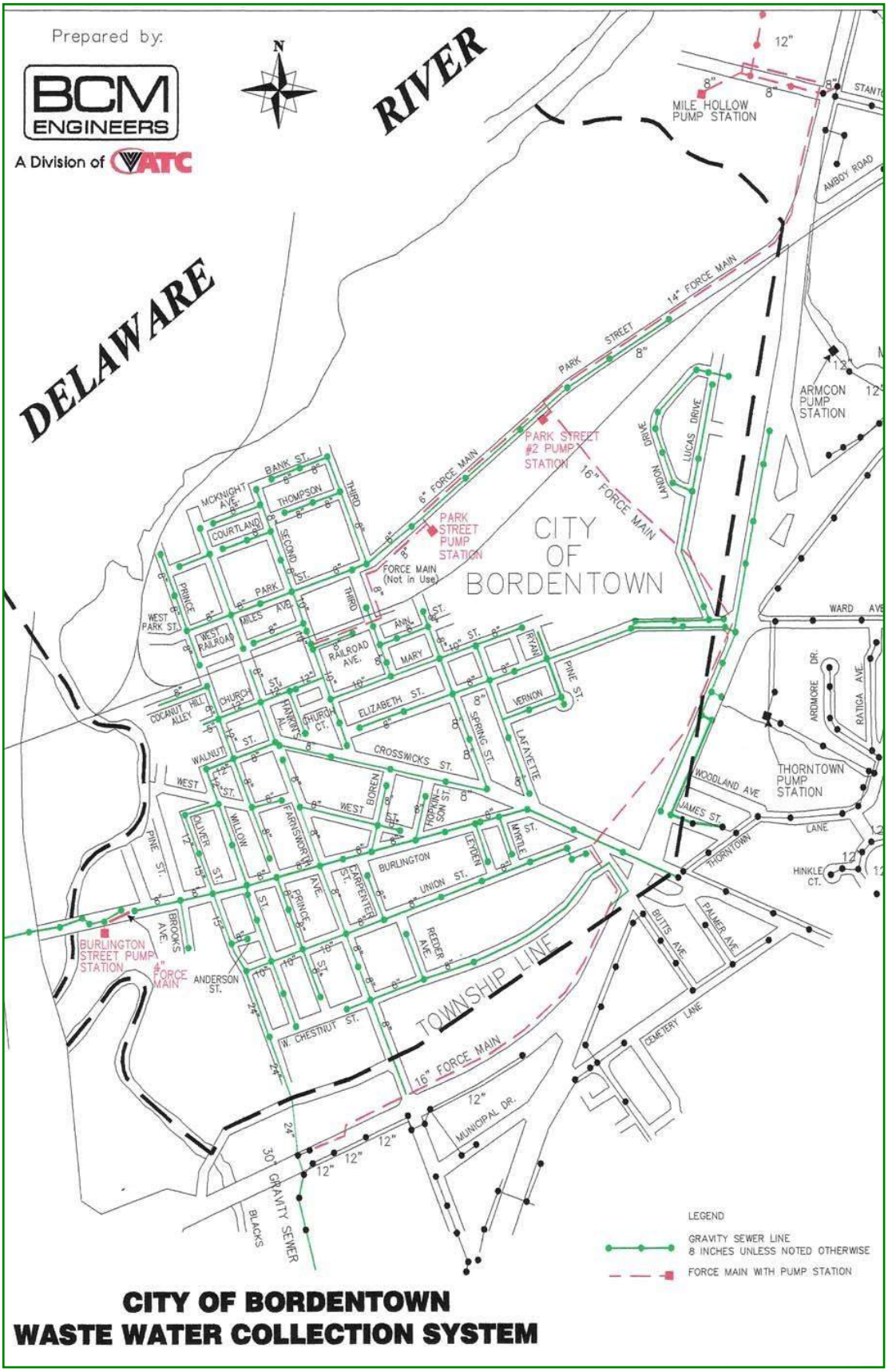
In 1986 the Bordentown Sewerage Authority (BSA) was formed to provide a centralized wastewater treatment system for both Bordentown City and Bordentown Township. A

3.0 million gallon per day treatment plant was constructed located along Blacks Creek at the intersection of Route 206 and Farnsworth Avenue in Bordentown Township. The collection system is approximately 60 miles long and at present contains 15 pumping stations.

Directly benefiting from this effort are the residents of Bordentown Sewerage Authority's service area, which includes the territorial boundaries of both the City and Township of Bordentown. Fully operational early in 1991, the plant has successfully been meeting its discharge permit limits ever since. Flows are averaging 1.6 million gallons per day and the plant's rated capacity is 3.0 million gallons per day.

Sewage enters the wet well of the screw pump station, which raises the water high enough to flow via gravity through the rest of the plant. From there it travels to the Bar Screen/Grit Building. Here, an automatically cleaned bar screen protects the downstream process equipment by removing large debris. A bypass channel is provided for alternate operations. Sewage then flows into an aerated grit chamber that is cleaned with a screw conveyor/bucket, elevator/grit washing mechanism and delivered to the dumpster on the outside of the building. The flow continues to a splitter box to evenly distribute the flow to two (2) primary clarifiers. Sludge from the one that is in operation at this time is pumped by progressive cavity pumps housed in the primary sludge pump station. Scum collection and pumping is handled here also. Primary sludge and scum are directed to holding tanks in the Sludge Thickening Building. The plant's flow travels to the oxidation ditch area where two (2) 1.1 million gallon volume ditches are aerated with disc aerators. Secondary clarifiers settle the activated sludge for return to the ditches via return pumps in the basement of the Sludge/Chemical Building. Sludge wasting pumps located there also deliver to holding tanks in the Sludge Thickening Building. Sieve drum concentrators there thicken sludge before being sent to the liquid sludge loading station located at the far end of the Sludge/Chemical Building or to belt presses where a sludge cake is produced, which in turn is sent to the Burlington County Composting Facility. Wastewater then proceeds to the chlorine contact tanks for disinfection, with the chlorine being supplied by sodium hypochlorite. Dechlorination takes place in the next tank, using sulfur dioxide being supplied in ton containers. After dechlorination, post aeration tanks are available to provide sufficient dissolved oxygen in the effluent. Lastly, flow is measured in the Parshall flume and discharged to Blacks Creek.

Electricity supplied by PSE&G is transformed down from 13,200 volts to usable 480 volts in the central power substation, and distributed to the various buildings' motor control centers. A 1.25 million watt standby generator has been provided for emergency use.


Prepared by:
BCM ENGINEERS
A Division of ATC
N
DELAWARE RIVER
CITY OF BORDENTOWN
MILE HOLLOW PUMP STATION
ARMCON PUMP STATION
PARK STREET #2 PUMP STATION
PARK STREET PUMP STATION
FORCE MAIN (Not in Use)
14" FORCE MAIN
16" FORCE MAIN
8" FORCE MAIN
THORNTOWN PUMP STATION
BURLINGTON STREET PUMP STATION
4" FORCE MAIN
TOWNSHIP LINE
30" GRAVITY SEWER
LEGEND
GRAVITY SEWER LINE
8 INCHES UNLESS NOTED OTHERWISE
FORCE MAIN WITH PUMP STATION
CITY OF BORDENTOWN
WASTE WATER COLLECTION SYSTEM

All tanks have drains built into them for dewatering purposes and all drains collect at the central drain pump station for delivery to the head of the plant, thereby eliminating the need for portable pumps for dewatering.

Bordentown Sewerage Authority treatment facility

Soda ash, used for alkalinity control, is purchased in bulk and stored in the sixty (60) foot tall silo along side the Sludge/Chemical Building.

Local government wastewater management planning is controlled by the NJDEP through review and approval of regional Water Quality Management Plans. Burlington County is the regional agency responsible to NJDEP for City of Bordentown's Water Quality Management Plan (a.k.a. the "201 Plan" from its legislative authorization). Water quality planning includes protective measures for both surface waters and groundwater. The conveyance, treatment, and re-entry of treated wastewater to the environment are addressed regionally by the Water Quality Planning process, and locally in the City's approved 201 Plan.

The initial 201 Water Quality Management Plan for the region was revised in 1983 and focused on Bordentown City and Bordentown Township. The Plan proposed the construction of a new wastewater treatment plant (WWTP) at the site of the existing City facility to handle flows from both municipalities. Since the proposed construction was confined to the City and Township, it was agreed that a new authority appointed by the two impacted municipalities would best serve the interest of the communities. On April 22, 1986, the Local Finance Board of the New Jersey Department of Community Affairs approved the creation of the Bordentown Sewerage Authority (BSA). BSA is the implementing agency responsible for the recommendations of the 201 Plan. The newly constructed WWTP startup and training were completed by the end of July 1991.

The BSA currently provides wastewater treatment for residents of the City of Bordentown and a large portion of the Township at its Blacks Creek WWTP. A six- member board conducts Authority business. Three members are appointed by the City and three members are appointed by the Township. One key provision in the BSA Charter is that any site that either wholly or partially contains wetlands will not be serviced by public sewer unless approved with a special grant waiver by the United States Environmental Protection Agency.

Wastewater Conveyance

The sewerage system within the City was essentially constructed in 1908, with several short extensions added as needed. It is composed of approximately 15 miles of pipe ranging in size from 8-inch to 15-inch, 275 manholes and two pump stations. Almost all of the system is gravity-fed, except for one section, which is force main. Almost the entire City is serviced by the BSA, with only the following few locations still utilizing septic systems:

- 356 Park Street
- 200 Lime Kiln Alley
- 215 Lime Kiln Alley
- 216 Lime Kiln Alley
- Water Street (no address)
- 100 Walnut Street (Shipps Coal Yard)
- Bordentown Yacht Club
- Yapewi Yacht Club
- Riverview Studios (end of Farnsworth Avenue)

There are two wastewater pumping stations that convey sewage from the City to the WWTP. They are the Park Street #1 Pumping Station, and the Burlington Street Pumping Station.

Currently wastewater conveyance systems in the City are in good condition. Sewerage rates are based upon water consumption.

Wastewater Treatment

The BSA WWTP was fully operational in early 1991. The facility has a hydraulic design of 3 mgd. The plant can be expanded to 4.5 mgd (ultimate design capacity) if the need arises. The WWTP has an administration building, which houses the billing office, conference room, laboratory, various administrative and plant offices, and a maintenance shop/garage area. The raw sewage enters the facility from the collection system where it is pumped (lifted) up to the treatment units via the screw pump lift station. The forward flow then moves by gravity through the rest of the treatment units, which include (in order): bar screen and grit removal process, primary clarifiers (2), oxidation ditch treatment process, secondary clarifiers (2), and the final disinfection and metering process prior to final discharge of effluent to Blacks Creek. The sludge processing train includes sludge thickening and dewatering units prior to offsite sludge disposal. The WWTP is operated efficiently and economically. The facility has received the highest USEPA award for operations excellence.

The City of Bordentown's wastewater is conveyed from the City's conveyance piping to a BSA trunk line and then to the WWTP. The BSA wastewater flow is approximately 1.6 million gallons per day and continues to slowly increase as commercial and residential development continues in the approved public sewer service area of the Township. There is very little flow increase attributable to the City since almost all developable land has already been developed. There is no reservation of capacity for future development specifically in the City.

Current BSA treatment plant capacity values are:

- Plant permitted capacity 3,000,000 gpd
- Actual flow 1,600,000 gpd

4.4.3 Stormwater

Stormwater is a nonpoint source of a variety of pollutants that travel from lawns, roads, parking lots and other impervious surface areas into local waterways. Stormwater drains to all waterways in Bordentown City through a number of outfall pipes, which are connected by dozens of storm drains throughout the City.

Stormwater initially flows into the stormwater system through a storm drain. These are frequently located along the curbs of parking lots and roadways. The grate that prevents larger objects from flowing into the storm sewer system is called a catch basin. Once below ground, the stormwater flows through pipes that lead to an outfall where the stormwater enters a stream, river or lake. In most areas of New Jersey, the stormwater sewer goes directly to a local waterway without any treatment.

Storm Drain Catch Basin with stencil, Farnsworth Avenue

In some areas of the state, the outfall may lead to a stormwater management basin. These basins control the flow of stormwater and can also improve water quality, depending on how they are designed. These basins are frequently seen in newer commercial and residential areas.

In some older urban areas of the state, the stormwater and sanitary sewer systems may be combined. Here both stormwater and sewage from households and businesses travel together in the same pipes. Both stormwater and sewage are treated at sewage treatment plants, except during heavy rains. During these occasions, both the

stormwater and untreated sewage may exceed the capacity of the treatment plant. In this case, overflow is directed into local waterways.

Stormwater outfall pipe, slope of Thorntown Creek floodplain, behind Third Street

The City of Bordentown is located adjacent to the Delaware River. Topography for the City slopes gently from east to west (towards the Delaware River). Precipitation falling in the western and southern portions of the City runs off to water-courses that flow to the Delaware River (Blacks and Thorntown Creeks). The precipitation events generate stormwater which, until 2003, was not required to be permitted. As a result of the United States Environmental Protection Agency's (USEPA) Phase II Rules, the NJDEP has developed the Municipal Stormwater Regulation Program. This program addresses pollutants entering our waters from certain storm drainage systems owned or operated by local, county, state, interstate or federal government agencies. These systems are called "municipal separate storm sewer systems" or MS4s. Bordentown City received its general permit No. NJ0088315 in October 2004. The City is considered a Tier A Municipality.

Twelve municipal outfall pipes have been identified in Bordentown City, at the following locations (with evidence of scouring noted): Pine Street (scouring present), Thorntown Creek (no scouring), East Park Street (no scouring), Bank Street (no scouring), Stoney Hill (no scouring), RiverLINE Light Rail bridge (some scouring), Walnut Street (no scouring), Federal Street (no scouring), Blacks Creek (no scouring), West Union Street (no scouring), West Chestnut Street (scouring present), and Love Bridge Run (scouring present). Additionally, an NJDOT outfall pipe is located on East Chestnut Street. See map on page 104 for location of stormwater inlets and outfall pipes in Bordentown City.

Detention basin outfall (from Ocean Spray property), Thorntown Creek

Under the NJPDES Municipal Stormwater Regulation Program, the City has met the following requirements:

- The City has prepared and implemented a written Stormwater Pollution Prevention Plan (SWPP) that describes the City's stormwater program and serves as a mechanism for the implementation of the statewide basic requirements (SBRs).
- The City has adopted a stormwater management (SWM) plan in accordance with N.J.A.C. 7:8-4.
- The City has adopted a stormwater control ordinance in accordance with N.J.A.C. 7:8-4.
- The City, in conjunction with the Bordentown City Environmental Commission (BCEC), has copied and distributed an educational brochure (provided by NJDEP) annually to residents and businesses, and conducted an educational event in 2005.
- In accordance with the NJDEP Municipal Stormwater regulation program, Yard Waste Ordinance; Wildlife Feeding Ordinance; and Prohibition of Illegal connections to the MS4.


Prepared by:
BCM ENGINEERS
A Division of VATC
DELAWARE
RIVER
CITY OF BORDENTOWN
PARK STREET
PARK STREET #2 PUMP STATION
PARK STREET PUMP STATION
BURLINGTON STREET PUMP STATION
FORCE MAIN
TOWNSHIP LINE
STANTON AVE.
AMBOY ROAD
MILE
WARD AVENUE
WOODLAND AVE
THORNTOWN
MUNICIPAL DR.
CEMETERY LANE
BLACKS
LEGEND
INLETS
OUTFLOW
SCALE: 1"=400'
CITY OF BORDENTOWN
STORM WATER COLLECTION SYSTEM

4.4.4 Energy

Natural gas and electricity are provided publicly in Bordentown City by Public Service Electric & Cas Co. (PSE&G). Residents are also able to choose third party suppliers, which may offer different rates, renewable alternatives, etc.

Presently, residents are free to pursue their own roof-top solar or other renewable energy installations in accordance with PSE&G requirements, building codes, and local ordinances, etc. There are no city ordinances or zoning requirements specific to solar or wind energy generation though additional structures, e.g., ground-based solar or a wind tower may be subject to building limitations such as setback or height restrictions in the zoning ordinances.

NJDEP provides a map layer, which depicts the suitability of land for development of solar energy projects, which is shown on GIS Map 15. 358 acres (61%) of land is shown to be preferrable for solar, 149 acres (25%) is not preferred, and 78 acres (13%) is indeterminate.

The City of Bordentown was awarded a $10,000 grant from Sustainable Jersey, funded by the Gardinier Environmental Fund, to support a feasibility study to determine the suitability of municipal buildings and spaces for solar energy production. This project is currently underway.

Additionally, the City was awarded an $8,000 grant by NJDEP through the "It Pay$ to Plug In" program designed to offset the cost to purchase and maintain electric vehicle charging stations in New Jersey. Installation of an electric vehicle charging station is included in the renovation currently underway as part of the relocation of multiple City services to Point Breeze Park.

Multiple programs are available through New Jersey's Clean Energy Program to reimburse residents, businesses, and local governments for some of the costs associated with conversions to clean energy and building efficiency upgrades (https://njcleanenergy.com/).

4.4.5 Solid Waste Management & Recycling

Bordentown City Waste Collection

The Bordentown City Department of Public Works provides residents with municipal trash collection twice a week. In addition, trash, recyclables, hazardous materials (used motor oil, anti-freeze, tires, gas propane tanks, batteries, wood scraps, household paint (oil- based and latex)), organic materials (grass clippings, leaves, branches, stumps, etc.), electronics (computers, televisions), scrap metal, and concrete are accepted at the Bordentown City Recycling Center at the Gilder Field Complex (207 Crosswicks Road) on Wednesdays from 7 am to noon, and Saturday, 8am to noon. No commercial contractors are permitted. Proof of City residency is required. The estimated number of City resident visits to the Recycling Center in the past year exceeds 3,000. As an alternative, the County Resource and Recovery Complex is open to City residents year-round.

County Facility and Solid Waste Collection

Bordentown City's solid waste and recycling needs are managed under the direction of the Burlington County Department of Solid Waste. The County's administrative offices are located at 1200 Florence Columbus Road, Mansfield, NJ. This office oversees Recycling, Household Hazardous Waste, and the Clean Communities programs.

The County owns and operates the Burlington County Resource Recovery Complex in Florence and Mansfield Townships, New Jersey. The Complex is the site of all solid waste processing and disposal activities undertaken by the County pursuant to directives of the New Jersey Solid Waste Management Act. Solid waste from all of the County's forty municipalities is accepted at this facility. Household and small quantity generator hazardous waste is collected, packaged, temporarily stored and transported off site for final disposition.

The Complex commenced operation in 1989, and current projections anticipate that the Complex will meet the disposal needs of Burlington County until 2027. The Complex includes: a state-of-the-art landfill, on-site transfer station, convenience center, leachate treatment plant, potable water storage and treatment facility, landfill gas collection/conveyance and treatment facilities, Class B recycling facility for bulky waste materials, household and conditionally exempt small quantity generator hazardous waste facility, a research and demonstration greenhouse operated by Rutgers University, a biosolids composting facility and a 7.125 MW landfill gas to energy facility.

Recycling

Burlington County Regional Recycling Program offers curbside pickup of household recyclables every second Monday. Accepted materials include paper, cardboard, aluminum and steel/tin food and beverage cans, glass bottles and jars, and #1, #2 and #5 plastic containers.

Clean Communities

Bordentown City participates in NJDEP's Clean Communities Program, which was established in 1986 with funding from taxes levied on sale of litter generating products. Municipalities receive funding in the form of state aid that may be used for: litter cleanup; education programs to promote Clean Communities; graffiti abatement; and enforcement of local anti-litter laws.

Paper Shredding Events

The Bordentown City Environmental Commission has partnered with Bordentown Township to host bi-annual paper shredding events. This enables residents to shred personal documents safely and economically, and the shredded paper is upcycled into new paper products. Shredded paper is not accepted in the Burlington County Recycling Program, and outside of these events, must be disposed of as regular municipal trash. The October 2020 event was the most successful to date, with a total of 1,300 pounds of paper shredded.

Pizza Box Recycling

In 2019, the Bordentown City Environmental Commission, in coordination with the City's Recycling Coordinator, launched a Pizza Box Composting Program, in partnership with Fernbrook Farm. The goals of this program were to: 1) reduce the city's waste stream since currently pizza boxes with any oil or food remnants are not recyclable, 2) provide Fernbrook Farm material that could be used to suppress weeds and add organic carbon to the soil, and 3) inspire residents to think about alternatives to landfills for their household waste, such as composting. The program has been popular with residents and from June to December 2020 over 3,500 pizza boxes were recycled, keeping approximately 1,800 pounds of waste out of the landfill.

The program has been expanded to include three farms, which pick up the boxes in rotation approximately weekly. In addition to the original drop-box installed in 2019, with expansion of the program in 2020, three drop boxes are now located at the Public Works facility for residents to deposit pizza boxes 24-hours per day, 7-days per week.

4.4.6 Schools

The Bordentown Regional School District serves public school students in grades pre-kindergarten through twelfth grades from Bordentown City, Bordentown Township and the Borough of Fieldsboro.

The district is comprised of five schools with an enrollment of approximately 2,528 students and 182.8 classroom teachers. The schools consist of Peter Muschal Elementary School with approximately 512 students in grades PreK – 3 (serving students from Bordentown Township and the Borough of Fieldsboro), Clara Barton Elementary School with approximately 235 students in grades K-3 (serving Bordentown City and the Holloway Meadows section of Bordentown Township), William MacFarland Intermediate School with approximately 391 students in grades 4-5,

Bordentown Regional Middle School with approximately 623 students in grades 6-8 and Bordentown Regional High School with approximately 733 students in grades 9-12.

The district has a nine member elected board of education of which three seats (based on the population of the municipalities) are assigned to Bordentown City.

The New Hanover Township School District (New Hanover Township, Cookstown and Wrightstown Borough) sends approximately 50 students to Bordentown Regional High School on a tuition basis.

4.4.7 City Services

Fire and Emergency

Two fire companies service Bordentown City. Consolidated Fire Association (Station 601) is located on Crosswicks Street and Hope Hose Humane Co. 1 (Station 602/609) is located on West Burlington Street. Station 601 has a ladder truck and an engine as well as a fire police unit. Station 602 has two rescue engines as well as two marine rescue boats.

Emergency Medical Services (EMS) in Bordentown City are a shared service with Bordentown Township and the ambulances are based at Hope Hose Humane Co. 1 (Station 602/609) located on West Burlington Street.

Police

As of 2021, the Bordentown City Police Department employs 14 officers, including 1 Chief/EMT, 1 Captain/EMT, 4 Sergeants, two of whom are EMTs, 6 Patrolmen, one of who is an EMT; and 2 Class 1 Police Officers, one of whom is an EMT.

The Police Department utilizes 5 patrol vehicles, one K-9 patrol vehicle, one parking enforcement/animal control vehicle, and one road construction traffic vehicle. Bicycle patrol is utilized when staffing and weather permits.

There are two officers on patrol at all times. When staffing allows, an officer overlaps shifts to provide 3 officers on patrol. Two administrative officers are available Monday through Friday from 9 am to 5 pm.

The Police Station is currently located in the lower level of City Hall. As of March 2022, new facilities for the Police Department are under construction/renovation at the Point Breeze Estate.

Library

The Bordentown Public Library is located at 18 East Union Street. The building was constructed in 1941 with funds from the Carnegie Foundation and has been a branch of the Burlington County Library System since 1971.

Between 2003 and 2006 the library entered into a construction program to expand and remodel the facility. With the additional space, the library was able to provide increased computer space, more shelf space and library materials and expanded programs for adults and children. Handicapped accessible features, children's study areas and meeting rooms for library staff and local organizations were also included in the plan.

Currently the facility features:

- Free WiFi
- Museum Pass Program offers free passes to the region's best attractions
- Community meeting and small group study spaces

- Ebooks and audio ebooks to download or stream videos directly to your device
- Subscription to the library newsletter to stay up-to-date on library news
- Books or DVD's mailed to you.

The library is open six days a week with the exception of July and August when it is closed on Saturday.

5. THE ENVIRONMENT AND PLANNING FOR THE FUTURE

Planning efforts at the local, county, state, and regional levels reflect how environmental resources and impacts are rarely confined within administrative boundaries. Each plan described below is cumulative and continues to involve coordination among various entities at each level to achieve the City's vision for a sustainable future.

5.1 Local Planning

5.1.1 Bordentown City Comprehensive Plan

The City Commissioners adopted an updated Comprehensive Plan (conventionally known as a Master Plan) in July 2021 to reaffirm the City's broad goals and strategies for land use and related policies. Generally, the plan sets the foundation for more specific plans for parks and open space, infrastructure, smart growth, and other impacts on the urban ecology of the City. The Comprehensive Plan is to be reexamined at least once every six years and in coordination with the content of the Environmental Resource Inventory.

5.1.2 Blacks Creek Greenway

Bordentown City and Bordentown Township have been working together to protect and preserve land along the Blacks Creek stream corridor. These efforts entail studies of the ecology of the area, removal of invasive species and consideration of future trails with interpretive signage. Conservation of land along Blacks Creek Greenway and other streams is addressed in the Land Use Element of the Comprehensive Plan.

5.1.3 Crosswicks Creek/Doctors Creek Regional Greenway Plan

The Crosswicks Creek and Doctors Creek Regional Greenway Plan was initiated in 2004 by a planning group and F.X. Browne, Inc to protect water quality, preserve historic and agricultural resources, and develop a system of trails and contiguous natural habitat. This effort has involved preservation of farmland and open space, riparian buffers, and trail development among municipalities in Burlington, Mercer, and Monmouth County. Bordentown City is located at the terminus of the study area on Crosswicks Creek and the Abbott Marshlands and will thus continue to play a role in this planning process as the greenway expands throughout the watershed.

5.2 Regional Planning

5.2.1 New Jersey State Development and Redevelopment Plan

The New Jersey State Planning Commission adopted the State Development and Redevelopment Plan in 2001 to promote cohesive planning efforts at the local, county, regional, and statewide levels. While the State Plan is due for an update, it continues to provide statewide planning objectives for municipalities regarding strategies for land use, housing, transportation, and other areas of focus.

Bordentown City and portions of Bordentown Township lie within the Metropolitan Planning Area (PA1), similar to other built-out, historic towns in the area such as Burlington, Trenton, and Princeton. Per the State Plan, Metropolitan Planning Area (PA1) is intended to provide for redevelopment and revitalization, promote compact urban growth, stabilize older suburbs, protect the character of existing stable communities, and encourage transit-oriented development. To achieve this vision, the State Plan establishes specific policies, objectives, and recommendations that guide state funding and local planning efforts within the region. Bordentown City's 2021 Comprehensive Plan reflects many of the smart growth principles included in the State Plan.

5.2.2 DVRPC Connections 2050 (2021)

The Delaware Valley Regional Planning Commission (DVRPC) is the federally designated Metropolitan Planning Organization for the nine-county region of Greater Philadelphia. DVRPC's Long-Range Plan, *Connections 2050* (https://www.dvrpc.org/plan), establishes a vision and sets forth recommendations to coordinate regional transportation with land use and other objectives. *Connections 2050* identifies five core principles to achieve its regional vision:

- Sustain the Environment;
- Develop Livable Communities;
- Expand the Economy;
- Advance Equity and Foster Diversity; and
- Create an Integrated, Multi-modal Transportation Network.

Through *Connections 2050*, DVRPC has identified Bordentown City as a Town Center targeted for investment in transit, redevelopment, and greenway connections to surrounding farmland and the regional greenspace network.

The *Connections 2050* Greenspace Network envisions Bordentown's local greenways connected to a much wider network in greater Philadelphia, central New Jersey and beyond. Locally DVRPC-identified greenways include the Delaware River, Delaware and Raritan Canal, Blacks Creek, Crosswicks Creek, Assunpink Creek, Doctors Creek, and minor tributaries like Pond-Run-Back Creek, Crafts Creek, and Bacons Run.

5.2.3 Northern Burlington County Growth and Preservation Plan (2008)

The Burlington County Board of Chosen Freeholders adopted the Northern Burlington County Growth and Preservation Plan (GAPP) in 2008 to promote regional growth management among the 13 participating municipalities. At a more local level of policymaking, the GAPP effectively emphasizes the State Plan and encourages local growth and development to occur in county-designated centers – categorized as nodes, hamlets, villages, and towns – while preserving farmland, open space, and natural features.

The GAPP designated Bordentown City as a "Town Center" envisioned to incorporate smart growth principles such as transit-oriented development, a revitalized mixed-use downtown, and infill redevelopment. The implications of "Town Center" status for Bordentown - in comparison to surrounding rural townships - are considered through nearly all aspects of the City's Comprehensive Plan such as transportation, open space, land use, and housing.

5.2.4 Delaware River Heritage Trail

Initiated by the Delaware River Greenway Partnership, the Delaware River Heritage Trail is a 60-mile on- and off- road loop trail project from Trenton to Palmyra in New Jersey, and from Philadelphia to Morrisville in Pennsylvania. The route highlights the cultural, historical and ecological resources of the Lower Delaware River with interpretive signage, wayfinding, and bike/ped infrastructure.

The trail intersects Bordentown City by way of the Route 130 Bypass Section, which utilizes the Delaware & Raritan Canal towpath Farnsworth Avenue and West Burlington Street. The trail then continues through Fieldsboro and Crystal Lake Park in Mansfield Township. Trail markers were installed along the route and at Bordentown Beach in 2013, while the segments to the south of Bordentown continue to be constructed.

The Delaware River Heritage Trail utilizes portions of the Delaware and Raritan Canal Trail to form a component of the East Coast Greenway envisioned to connect Maine to Florida. The trail also overlaps with part of the NJ Womens Heritage Trail and Delaware and Lehigh National Heritage Corridor.

5.2.5 East Coast Greenway

The East Coast Greenway is a multi-state regional greenway effort to form a contiguous multi-use trail from Maine to Florida. The Greenway utilizes many historic rights of way like the Delaware and Raritan Canal, linking Bordentown to a national trail network through several metropolitan areas.

5.3 Development Pressures and Limitations

As the City of Bordentown is mostly built-out, growth and development is primarily limited to redevelopment and scattered-site infill on the few remaining buildable lots. As a result, large-scale impacts on impervious coverage and flood capacity from new construction are not expected. Preservation of Point Breeze in 2020 has reduced the City's buildable land by more than 60 acres, and aside from the Ocean Spray Redevelopment Area, the City has relatively few remaining buildable lots that remain unencumbered by environmental constraints like wetlands, steep slopes, and streams. The City's historic building stock, existing infrastructure, and compact property sizes also limit additional growth capacity. Nonetheless, infill and redevelopment are to be consistent with the City's Comprehensive Plan and New Jersey's smart growth policies, which seek to promote a more vibrant and sustainable utilization of urban, transit-connected areas.

A basic Build-Out Analysis was conducted for the City's 2021 Comprehensive Plan. Taking into account existing floodplains, wetlands, projected sea level rise, and limited infill capacity, approximately 18 acres of vacant or buildable land are suitable for development, primarily comprising the 14.3-acre Ocean Spray Redevelopment Area along Park Street.

6. REFERENCES

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Volkert, R. and Stanford, S. 2018. Bedrock Geologic Map of the New Jersey Part of the Trenton West and Trenton East Quadrangles, Mercer and Burlington Counties, New Jersey. New Jersey Geological and Water Survey Open File Map OFM 122.

Owens, J.P. and J.P. Minard. 1979. Upper Cenozoic sediments of the Lower Delaware Valley and the Northern Delmarva Peninsula, New Jersey, Pennsylvania, Delaware, and Maryland. U.S. Geological Survey Professional Paper 1067-D. 47 pp.

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Leck, M.A. 2004. Significance of the Hamilton-Trenton Marsh – A brief view. Personal Communication.

Quigley, P.A. 2005. Blacks Creek Greenway Study: Natural Resources Inventory and Management Recommendations. 39 pp.

Robichaud, B., and M.F. Buell. 1973. *Vegetation of New Jersey: A Study of Landscape Diversity*. Rutgers University Press, New Brunswick, N.J. 340 pp.

FIGURES

This (map/publication/report) was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized or endorsed.

Potomac Formation

Magothy Formation

Merchantville Formation

Woodbury Formation

Legend

- Parcels
- Bordentown City Boundary

Coastal Plain Geology

- Magothy Formation
- Merchantville Formation
- Potomac Formation
- Woodbury Formation

0 200 400 800 Feet

Sources
Aerial - Bing Maps Hybrid
BurlingtonCountyParcels - Accessed 1/29/2022 - https://geoapps.nj.gov/njgin/parcel/parcels_shp_dbf_Burlington.zip
Municipal_Boundaries_of_NJ - https://gisdata-njdep.opendata.arcgis.com/datasets/newjersey::municipal-boundaries-of-nj/explore?location=40.141200%2C-74.743150%2C8.63
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Bordentown City, New Jersey
Environmental Resource Inventory

Coastal Plain Geology
GIS Map #1

DATE: FEBRUARY 2022	1 inch = 400 feet
DRAWN BY: RTS	DOC: GIS Map 01 Bedrock Geology

Figure Exported: 2/13/2022 By: rsimon Using: C:\Projects\My Documents\Home\GIS\ArcDocs\2022 BCEC\ER\GIS Map 01 Bedrock Geology.mxd

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Qtu
Qmm
Qwcp
Qst
Qwcp
Qtu
Qst
Qwcp
Qmm
Qtu
Qwcp
Qwcp
Qmm
Qtu
Qwcp
Qal
Qwcp
Qtu
Tp

Legend

- Parcels
- Bordentown City Boundary

Surficial Geology

- Qal, ALLUVIUM
- Qmm, SALT-MARSH AND ESTUARINE DEPOSITS
- Qst, POSTGLACIAL STREAM TERRACE DEPOSITS
- Qtu, UPPER STREAM TERRACE DEPOSITS
- Qwcp, WEATHERED COASTAL PLAIN FORMATIONS
- Tp, PENSAUKEN FORMATION

0 200 400 800 Feet

Sources
Aerial - Bing Maps Hybrid
BurlingtonCountyParcels - Accessed 1/29/2022 - https://geoapps.nj.gov/njgin/parcel/parcels_shp_dbf_Burlington.zip
Municipal_Boundaries_of_NJ - https://gisdata-njdep.opendata.arcgis.com/datasets/newjersey::municipal-boundaries-of-nj/explore?location=40.141200%2C-74.743150%2C8.63
Surficial Geology of New Jersey - Accessed 2/13/2022 - https://njdep.maps.arcgis.com/home/item.html?id=e32d33d844684eecb22a0d50db3895e5

Bordentown City, New Jersey
Environmental Resource Inventory

Surficial Geology
GIS Map #2

DATE: FEBRUARY 2022	1 inch = 400 feet
DRAWN BY: RTS	DOC: GIS Map 02 Surficial Geology

Figure Exported: 2/13/2022 By: rsimon Using: C:\Projects\My Documents\Home\GIS\ArcDocs\2022 BCEC\ERI\GIS Map 02 Surficial Geology.mxd

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Legend

- Parcels
- Bordentown City Boundary

Soils

- FmhAt
- FrmA
- FrmB
- FrmC
- FrmkB
- HodA
- HodB
- KeoA
- KeoC
- KeoD
- KeoE
- MamnAv
- MbaAt
- PHG
- SaeB
- SaekA
- ThfC
- URCLAB
- URSAAB
- UddcB
- UddfB
- UdrB
- WATER

0 200 400 800 Feet

Sources
Aerial - Bing Maps Hybrid
BurlingtonCountyParcels - Accessed 1/29/2022 - https://geoapps.nj.gov/njgin/parcel/parcels_shp_dbf_Burlington.zip
Municipal_Boundaries_of_NJ - https://gisdata-njdep.opendata.arcgis.com/datasets/newjersey::municipal-boundaries-of-nj/explore?location=40.141200%2C-74.743150%2C8.63
October 2021 gSSURGO Database - Accessed 2/13/2022 - https://nrcs.app.box.com/v/soils

Bordentown City, New Jersey
Environmental Resource Inventory

Soils
GIS Map #3

DATE: FEBRUARY 2022	1 inch = 400 feet
DRAWN BY: RTS	DOC: GIS Map 03 Soils

Figure Exported: 2/13/2022 By: rsimon Using: C:\Projects\My Documents\Home\GIS\ArcDocs\2022 BCEC\ERI\GIS Map 03 Soils.mxd

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Legend

- Parcels
- Bordentown City Boundary

Ground Water Recharge (Rank, Values)

- No Recharge or Hydric Soils
- Water or Wetland
- B, 11 to 15 in/yr
- C, 8 to 10 in/yr
- D, 1 to 7 in/yr
- E, 0 in/yr

0 200 400 800 Feet

Sources
Aerial - Bing Maps Hybrid
BurlingtonCountyParcels - Accessed 1/29/2022 - https://geoapps.nj.gov/njgin/parcel/parcels_shp_dbf_Burlington.zip
Municipal_Boundaries_of_NJ - https://gisdata-njdep.opendata.arcgis.com/datasets/newjersey::municipal-boundaries-of-nj/explore?location=40.141200%2C-74.743150%2C8.63
Ground Water Recharge Areas in New Jersey - Accessed 2/13/2022 - https://njdep.maps.arcgis.com/home/item.html?id=f24d4dfbb21542b9b08196e273aaf96b

Bordentown City, New Jersey
Environmental Resource Inventory

Ground Water Recharge Areas
GIS Map #4

DATE: FEBRUARY 2022	1 inch = 400 feet
DRAWN BY: RTS	DOC: GIS Map 04 GW Recharge

Figure Exported: 2/13/2022 By: rsimon Using: C:\Projects\My Documents\Home\GIS\ArcDocs\2022 BCEC\ERI\GIS Map 04 GW Recharge.mxd

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Legend

Storm Sewer Outfalls

- County
- Municipality
- State
- NJPDES Surface Water Discharges
- Parcels
- Bordentown City Boundary

Streams - Surface Water Quality Classification

- FW2-NT (non-trout)
- Riparian Buffer - 75 Feet

Sub-Watersheds

- 20BC02, Crosswicks Ck(below Doctors Creek)
- 20CA03, Blacks Creek (below Bacons Run)
- 20DA01, Duck Creek and UDRV to Assunpink Ck
- 20EA03, LDRV tribs (Crystal Creek area)

Ocean Spray Cranberries Inc

Bordentown Gas Works Former

Chevron USA Inc - Gulf S/S

Exxon S/S 3-0816

Crosswicks Creek

Blacks Creek

Thorton Creek

Love Bridge Run

Ridgeway Brook (Unmapped)

Mile Hollow Run

Abandoned Canal

Delaware River

Sources
Aerial - Bing Maps Hybrid
BurlingtonCountyParcels - Accessed 1/29/2022 - https://geoapps.nj.gov/njgin/parcel/parcels_shp_dbf_Burlington.zip
Municipal_Boundaries_of_NJ - https://gisdata-njdep.opendata.arcgis.com/datasets/newjersey::municipal-boundaries-of-nj/explore?location=40.141200%2C-74.743150%2C8.63
14 Digit Hydrologic Unit Code Delineations for New Jersey - Accessed 2/6/2022 - https://njdep.maps.arcgis.com/home/item.html?id=8de4c55bcf6540bcbe173df2b0552eb2
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NJPDES Surface Water Discharges in New Jersey, (1:12,000) - Accessed 6/19/2022 - https://mapsdep.nj.gov/arcgis/rest/services/Features/Structures/MapServer/0

0 200 400 800 Feet

Bordentown City, New Jersey
Environmental Resource Inventory

Surface Water Features
GIS Map #5

DATE: JUNE 2022	1 inch = 400 feet
DRAWN BY: RTS	DOC: GIS Map 05 Surface Water

Figure Exported: 6/19/2022 By: rsimon Using: C:\Projects\My Documents\Home\GIS\ArcDocs\2022 BCEC\ERI\GIS Map 05 Surface Water.mxd

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Legend

- Parcels
- Bordentown City Boundary

Wetlands (Code, Type)

- 1461, WETLAND RIGHTS-OF-WAY
- 6120, FRESHWATER TIDAL MARSHES
- 6210, DECIDUOUS WOODED WETLANDS
- 6231, DECIDUOUS SCRUB/SHRUB WETLANDS
- 6240, HERBACEOUS WETLANDS

Sources
Aerial - Bing Maps Hybrid
BurlingtonCountyParcels - Accessed 1/29/2022 - https://geoapps.nj.gov/njgin/parcel/parcels_shp_dbf_Burlington.zip
Municipal_Boundaries_of_NJ - https://gisdata-njdep.opendata.arcgis.com/datasets/newjersey::municipal-boundaries-of-nj/explore?location=40.141200%2C-74.743150%2C8.63
Land_lu_2015 - Accessed 1/30/2021 - https://www.arcgis.com/home/item.html?id=6f76b90deda34cc98aec255e2defdb45

0 200 400 800 Feet

Bordentown City, New Jersey
Environmental Resource Inventory

Wetlands
GIS Map #6

DATE: FEBRUARY 2022	1 inch = 400 feet
DRAWN BY: RTS	DOC: GIS Map 06 Wetlands

Figure Exported: 2/13/2022 By: rsimon Using: C:\Projects\My Documents\Home\GIS\ArcDocs\2022 BCEC\ER\IGIS Map 06 Wetlands.mxd

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Legend

- Parcels
- Bordentown City Boundary

Flood Hazard

- Regulatory Floodway
- 1% Annual Chance Flood Hazard
- 0.2% Annual Chance Flood Hazard
- Area of Minimal Flood Hazard

Sources
Aerial - Bing Maps Hybrid
BurlingtonCountyParcels - Accessed 1/29/2022 - https://geoapps.nj.gov/njgin/parcel/parcels_shp_dbf_Burlington.zip
National Flood Hazard Layer (NFHL) of New Jersey - Accessed 2/5/2022 - https://www.arcgis.com/home/item.html?id=300f228c6d7e4d8fb204e5a35bfd3ef2#overview

0 200 400 800 Feet

Bordentown City, New Jersey
Environmental Resource Inventory

Flood Hazard Areas
GIS Map #7

DATE: FEBRUARY 2022	1 inch = 400 feet
DRAWN BY: RTS	DOC: GIS Map 07 Flood Hazard

Figure Exported: 2/13/2022 By: rsimon Using: C:\Projects\My Documents\Home\GIS\ArcDocs\2022 BCEC\ER\IGIS Map 07 Flood Hazard.mxd

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Legend

- Parcels
- Bordentown City Boundary

Vegetation Type (Code, Label)

- 1461, WETLAND RIGHTS-OF-WAY
- 4110, DECIDUOUS FOREST (10-50% CROWN CLOSURE)
- 4120, DECIDUOUS FOREST (>50% CROWN CLOSURE)
- 4410, OLD FIELD (< 25% BRUSH COVERED)
- 4420, DECIDUOUS BRUSH/SHRUBLAND
- 4440, MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND
- 6120, FRESHWATER TIDAL MARSHES
- 6141, PHRAGMITES DOMINATE COASTAL WETLANDS
- 6210, DECIDUOUS WOODED WETLANDS
- 6231, DECIDUOUS SCRUB/SHRUB WETLANDS
- 6240, HERBACEOUS WETLANDS

Sources
Aerial - Bing Maps Hybrid
BurlingtonCountyParcels - Accessed 1/29/2022 - https://geoapps.nj.gov/njgin/parcel/parcels_shp_dbf_Burlington.zip
Municipal_Boundaries_of_NJ - https://gisdata-njdep.opendata.arcgis.com/datasets/newjersey::municipal-boundaries-of-nj/explore?location=40.141200%2C-74.743150%2C8.63
Land_lu_2015 - Accessed 1/30/2021 - https://www.arcgis.com/home/item.html?id=6f76b90deda34cc98aec255e2defdb45

0 200 400 800 Feet

Bordentown City, New Jersey
Environmental Resource Inventory

Natural Vegetation
GIS Map #8

DATE: FEBRUARY 2022	1 inch = 400 feet
DRAWN BY: RTS	DOC: GIS Map 08 Natural Vegetation

Figure Exported: 2/13/2022 By: rsimon Using: C:\Projects\My Documents\Home\GIS\ArcDocs\2022 BCEC\ERI\GIS Map 08 Natural Vegetation.mxd

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Legend

- ☐ Parcels
- ▭ Bordentown City Boundary

Vernal Habitats

- ▨ Potential vernal habitat area
- ▨ Bald Eagle Habitat

Priority Habitats

- ■ Rank 1 - Habitat specific requirements
- ■ Rank 2 - Special Concern
- ■ Rank 3 - State Threatened
- ■ Rank 4 - State Endangered
- ■ Rank 5 - Federal Listed

0 200 400 800
Feet

Sources
Aerial - Bing Maps Hybrid
BurlingtonCountyParcels - Accessed 1/29/2022 - https://geoapps.nj.gov/njgin/parcel/parcels_shp_dbf_Burlington.zip
Municipal_Boundaries_of_NJ - https://gisdata-njdep.opendata.arcgis.com/datasets/newjersey::municipal-boundaries-of-nj/explore?location=40.141200%2C-74.743150%2C8.63
Landscape_3.3_Data_for_Piedmont_Plains_Region_of_New_Jersey - Accessed 1/30/2021 - https://gisdata-njdep.opendata.arcgis.com/datasets/landscape-3-3-data-for-piedmont-plains-region-of-new-jersey/explore?location=40.281350%2C-74.754550%2C9.23
Landscape 3.3 Data for Vernal Habitats of New Jersey - Accessed 2/13/2022 - https://njdep.maps.arcgis.com/home/item.html?id=e31e69d4088b4f23b8da5ea21d2f85c5

Bordentown City, New Jersey
Environmental Resource Inventory

NJ Landscape Project
Priority Habitats
GIS Map #9

DATE: MAY 2022	1 inch = 400 feet
DRAWN BY: RTS	DOC: GIS Map 09 Habitat Priorities

Figure Exported: 5/15/2022 By: rsimon Using: C:\Projects\My Documents\Home\GIS\ArcDocs\2022 BCEC\ERI\GIS Map 09 Habitat Priorities.mxd

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Legend

- Parcels
- Bordentown City Boundary

Land Use Type

- AGRICULTURE
- BARREN LAND
- FOREST
- URBAN
- WATER
- WETLANDS

0 200 400 800 Feet

Sources
Aerial - Bing Maps Hybrid
BurlingtonCountyParcels - Accessed 1/29/2022 - https://geoapps.nj.gov/njgin/parcel/parcels_shp_dbf_Burlington.zip
Municipal_Boundaries_of_NJ - https://gisdata-njdep.opendata.arcgis.com/datasets/newjersey::municipal-boundaries-of-nj/explore?location=40.141200%2C-74.743150%2C8.63
Land_lu_2015 - Accessed 1/30/2021 - https://www.arcgis.com/home/item.html?id=6f76b90deda34cc98aec255e2defdb45

Bordentown City, New Jersey
Environmental Resource Inventory

Land Use Types
GIS Map #10

DATE: FEBRUARY 2022	1 inch = 400 feet
DRAWN BY: RTS	DOC: GIS Map 11 Land Use

Figure Exported: 2/13/2022 By: rsimon Using: C:\Projects\My Documents\Home\GIS\ArcDocs\2022 BCEC\ERI\GIS Map 11 Land Use.mxd

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Legend

- Parcels
- Bordentown City Boundary

Impervious Surface Coverage (%)

- 81 - 100
- 61 - 80
- 41 - 60
- 21 - 40
- Less than 20

Sources
Aerial - Bing Maps Hybrid
BurlingtonCountyParcels - Accessed 1/29/2022 - https://geoapps.nj.gov/njgin/parcel/parcels_shp_dbf_Burlington.zip
Municipal_Boundaries_of_NJ - https://gisdata-njdep.opendata.arcgis.com/datasets/newjersey::municipal-boundaries-of-nj/explore?location=40.141200%2C-74.743150%2C8.63
Impervious Surface of New Jersey from Land Use/Land Cover 2012 Update - Accessed 3/27/2022 - https://njdep.maps.arcgis.com/home/item.html?id=7e2cfb9fce5949b8bedf0961f5daaf5b

0 200 400 800 Feet

Bordentown City, New Jersey
Environmental Resource Inventory

NJDEP
Impervious Surface
GIS Map #11

DATE: MARCH 2022	1 inch = 400 feet
DRAWN BY: RTS	DOC: GIS Map 12 Impervious Surface

Figure Exported: 3/27/2022 By: rsimon Using: C:\Projects\My Documents\Home\GIS\ArcDocs\2022 BCEC\ERI\GIS Map 12 Impervious Surface.mxd

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Legend

- Parcels
- Bordentown City Boundary

Green Acres Program Open Space (Owned By, Managed By)

- Bordentown City, Bordentown City
- Bordentown Township, Bordentown Township
- Delaware and Raritan Greenway Land Trust, Delaware and Raritan Greenway Land Trust
- Fieldsboro Borough, Fieldsboro Borough
- Hamilton Township, Hamilton Township
- New Jersey Department of Environmental Protection, Bordentown City
- New Jersey Department of Environmental Protection, Division of Parks and Forestry

0 200 400 800 Feet

Sources
Aerial - Bing Maps Hybrid
BurlingtonCountyParcels - Accessed 1/29/2022 - https://geoapps.nj.gov/njgin/parcel/parcels_shp_dbf_Burlington.zip
Municipal_Boundaries_of_NJ - https://gisdata-njdep.opendata.arcgis.com/datasets/newjersey::municipal-boundaries-of-nj/explore?location=40.141200%2C-74.743150%2C8.63
State%2C_Local_and_Nonprofit_Open_Space_of_New_Jersey - Accessed 1/30/2021 - https://njogis-newjersey.opendata.arcgis.com/datasets/njdep::state-local-and-nonprofit-open-space-of-new-jersey/explore?location=40.147905%2C-74.698432%2C15.24

Bordentown City, New Jersey
Environmental Resource Inventory

Preserved Open Space
GIS Map #12

DATE: FEBRUARY 2022	1 inch = 400 feet
DRAWN BY: RTS	DOC: GIS Map 12 Open Space

Figure Exported: 2/13/2022 By: rsimon Using: C:\Projects\My Documents\Home\GIS\ArcDocs\2022 BCEC\ERI\GIS Map 12 Open Space.mxd

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CRAFTSMEN OF OLD CROSSWICKS INCORPORATED
G000012489

P J GOLDMAN LLC
025001

OCEAN SPRAY CRANBERRIES INC
023203

ANN STREET BALLFIELD
753163

ALSTARZ SPORTS PUB LLC
300073

191 ROUTE 130
019665

228 WALNUT STREET
456813

AUTO BODY SHOP (ABANDONED)
G000023201

US GAS
007351

BASOYA FUEL
NJ0042
007350

BORDENTOWN COAL GAS (PSE&G)
G000008793

MR & MRS DENGLER
025278

HOUGH PETROLEUM CORP
168703

JOHNS CAR CARE CENTER
019253

SATURN OF BORDENTOWN
031546

BORDENTOWN AMERA
007601

D&S MANAGEMENT OF NJ INC
018771

APCO PETROLEUM CORP FARNSWORTH
003322

Legend

- Parcels
- Bordentown City Boundary

NJDEP Site Remediation Program Sites (Status)

- Active
- Active - UHOT
- RAP\Post Remedial
- Pending
- Ground Water Classification Exception Areas
- Deed Notice Areas

0 200 400 800 Feet

Sources
Aerial - Bing Maps Hybrid
BurlingtonCountyParcels - Accessed 1/29/2022 - https://geoapps.nj.gov/njgin/parcel/parcels_shp_dbf_Burlington.zip
Municipal_Boundaries_of_NJ - https://gisdata-njdep.opendata.arcgis.com/datasets/newjersey::municipal-boundaries-of-nj/explore?location=40.141200%2C-74.743150%2C8.63
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Deed Notice Extent in New Jersey - Accessed 3/13/2022 - https://njdep.maps.arcgis.com/home/item.html?id=39a2bb409e644b27a751d084f275267c
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Bordentown City, New Jersey
Environmental Resource Inventory

NJDEP
Contaminated Sites
GIS Map #13

DATE: MARCH 2022	1 inch = 400 feet
DRAWN BY: RTS	DOC: GIS Map 13 Known Contaminated Sites

Figure Exported: 3/13/2022 By: rsimon Using: C:\Projects\My Documents\Home\GIS\ArcDocs\2022 BCEC\ERI\GIS Map 13 Known Contaminated Sites.mxd

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Legend

Well Head Protection Areas For Public Community Water Supply Wells In New Jersey

- Tier 1: 2-Year
- Tier 2: 5-Year
- Tier 3: 12-Year
- Bordentown City Boundary

Sources
Aerial - Bing Maps Hybrid
BurlingtonCountyParcels - Accessed 1/29/2022 - https://geoapps.nj.gov/njgin/parcel/parcels_shp_dbf_Burlington.zip
Municipal_Boundaries_of_NJ - https://gisdata-njdep.opendata.arcgis.com/datasets/newjersey::municipal-boundaries-of-nj/explore?location=40.141200%2C-74.743150%2C8.63
Well Head Protection Areas - Accessed 3/12/2022 - https://njdep.maps.arcgis.com/home/item.html?id=d9fead9109f84c71997e07dba8502bea

0 500 1,000 2,000 Feet

Bordentown City, New Jersey
Environmental Resource Inventory

Well Head Protection Areas
GIS Map #14

DATE: MARCH 2022	1 inch = 1,000 feet
DRAWN BY: RTS	DOC: GIS Map 14 WHPAs

Figure Exported: 3/12/2022 By: rsimon Using: C:\Projects\My Documents\Home\GIS\ArcDocs\2022 BCEC\ER\IGIS Map 14 WHPAs.mxd

This (map/publication/report) was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized or endorsed.

Figure Exported: 3/27/2022 By: rsimon Using: C:\Projects\My Documents\Home\GIS\ArcDocs\2022 BCEC\ERI\GIS Map 15 Solar\GIS Map 15 Solar.aprx

Legend

Bordentown City Boundary

Solar Siting Analysis of New Jersey selection

- Indeterminate
- Not-Preferred
- Preferred

Sources
Aerial - Bing Maps Hybrid
BurlingtonCountyParcels - Accessed 1/29/2022 - https://geoapps.nj.gov/njgin/parcel/parcels_shp_dbf_Burlington.zip
Municipal_Boundaries_of_NJ - https://gisdata-Solar Siting Analysis of New Jersey - Accessed 3/20/2022 - njdep.opendata.arcgis.com/datasets/newjersey::municipal-boundaries-of-nj/explore?location=40.141200%2C-74.743150%2C8.63
https://njdep.maps.arcgis.com/home/item.html?id=f3aef415f61943f0be097aa53c6744d4

0 200 400 800 Feet

Bordentown City, New Jersey
Environmental Resource Inventory

NJDEP
Solar Siting Analysis
GIS Map #15

DATE: MARCH 2022	1:4,800
DRAWN BY: RTS	DOC: GIS Map 15 Solar