2 LABORATORY SETTING

2.1 INTRODUCTION

To help evaluate past and present impacts from Brookhaven National Laboratory (BNL) operations on the environment and to better identify potential pathways for possible exposures to the public and employees, local site characteristics are taken into consideration. These characteristics include human population, geology, hydrology, meteorology data, and natural and cultural resources.

2.2 SITE LOCATION AND LOCAL POPULATION

BNL is located near the geographical center of Suffolk County, Long Island, New York. The Laboratory's 5,320-acre site located in Brookhaven Township, the largest township in both area and population, and is approximately 60 miles east of New York City. BNL is one of the five largest high-technology employers on Long Island, with about 2,500 employees who include scientists, engineers, technicians, and administrative personnel. In addition, the Laboratory annually hosts almost 5,000 visiting scientists and students from universities, industries, and government agencies, who often reside in apartments and dormitories on site or in nearby communities.

2.3 FACILITIES AND OPERATIONS

Most of BNL's principal facilities are located near the center of the site. The developed area is approximately 1,820 acres and consists of the following:

- 500 acres originally developed by the Army (as part of Camp Upton) and still used for offices and other operational buildings;
- 200 acres occupied by large, specialized research facilities;
- 550 acres used for outlying facilities, such as the Sewage Treatment Plant, research agricultural fields, housing facilities, and fire breaks;
- 400 acres of roads, parking lots, and connecting areas;
- 200 acres occupied by the Long Island Solar Farm.

The balance of the site, approximately 3,400 acres, is mostly wooded and represents the native Long Island Pine Barrens ecosystem.

2.4 GEOLOGY AND HYDROGEOLOGY

BNL is situated on the western rim of the shallow Peconic River watershed. The marshy areas in the northern and eastern sections of the site are part of the headwaters of the Peconic River. Depending on the height of the water table relative to the base of the riverbed, the Peconic River both recharges to and receives water from the underlying Upper Glacial aquifer. In times of sustained drought, the river water recharges to the groundwater; with normal to above-normal precipitation, the river receives water from the aquifer.

The terrain of the BNL site is gently rolling, with elevations varying between 44 and 120 feet above mean sea level. Depth to groundwater from the land surface ranges from five feet near the Peconic River to approximately 80 feet in the higher elevations of the central and western portions of the site. Studies of Long Island hydrology and geology near the Laboratory indicate that the up-

permost Pleistocene deposits, composed of highly permeable glacial sands and gravel, are between 120 and 250 feet thick (Warren et al., 1968; Scorca et al., 1999). Water penetrates these deposits readily and there is little direct runoff into surface streams unless precipitation is intense. The sandy deposits store large quantities of water in the Upper Glacial aquifer. On average, approximately half of the annual precipitation is lost to the atmosphere through evapotranspiration, and the other half percolates through the soil to recharge the groundwater (Franke and McClymonds, 1972; Aronson and Seaburn, 1974).

The Long Island Regional Planning Board and Suffolk County have identified the Laboratory site as overlying a deep-flow recharge zone for Long Island groundwater (Koppelman, 1978). Precipitation and surface water that recharge within this zone have the potential to replenish the Magothy and Lloyd aquifer systems lying below the Upper Glacial aquifer. It has been estimated that up to two-fifths of the recharge from rainfall moves into the deeper aquifers. The extent to which groundwater on-site contributes to deep-flow recharge has been confirmed using an extensive network of shallow and deep wells installed at BNL and surrounding areas (Geraghty & Miller, 1996). This groundwater system is the primary source of drinking water for both on- and off-site private and public supply wells and has been designated a sole source aquifer system by the U.S. Environmental Protection Agency.

The Laboratory's five in-service drinking water wells draw up to 1,000 gallons per minute, or approximately 1.34 million gallons of water per day from the aquifer to supply drinking water, process cooling water, or fire protection. Drinking water is treated prior to entering the distribution system. In 2020, approximately 368 million gallons of water were pumped for use on site.

Groundwater flow directions across the BNL site are influenced by natural drainage systems: east-ward along the Peconic River, southeast toward the Forge River, and south toward the Carmans River (as shown in Figure 2-1). Pumping from on-site supply wells affects the direction and speed of ground- water flow, especially in the central, developed areas of the site.

The main groundwater divide on Long Island is aligned generally east–west and lies approximately one-half mile north of the Laboratory. Groundwater north of the divide flows northward and ultimately discharges to the Long Island Sound. Groundwater south of the divide flows east and south, discharging to the Peconic River, Peconic Bay, south shore streams, Great South Bay, and Atlantic Ocean. The regional groundwater flow system is discussed in greater detail in *Stratigraphy and Hydrologic Conditions at the Brookhaven National Laboratory and Vicinity* (Scorca et al., 1999).

In most areas at BNL, the horizontal velocity of groundwater is approximately 0.75 to 1.2 feet per day (Geraghty & Miller 1996). In general, this means that groundwater travels for approximately 20 to 22 years as it moves from the central, developed area of the site to the Laboratory’s southern boundary.

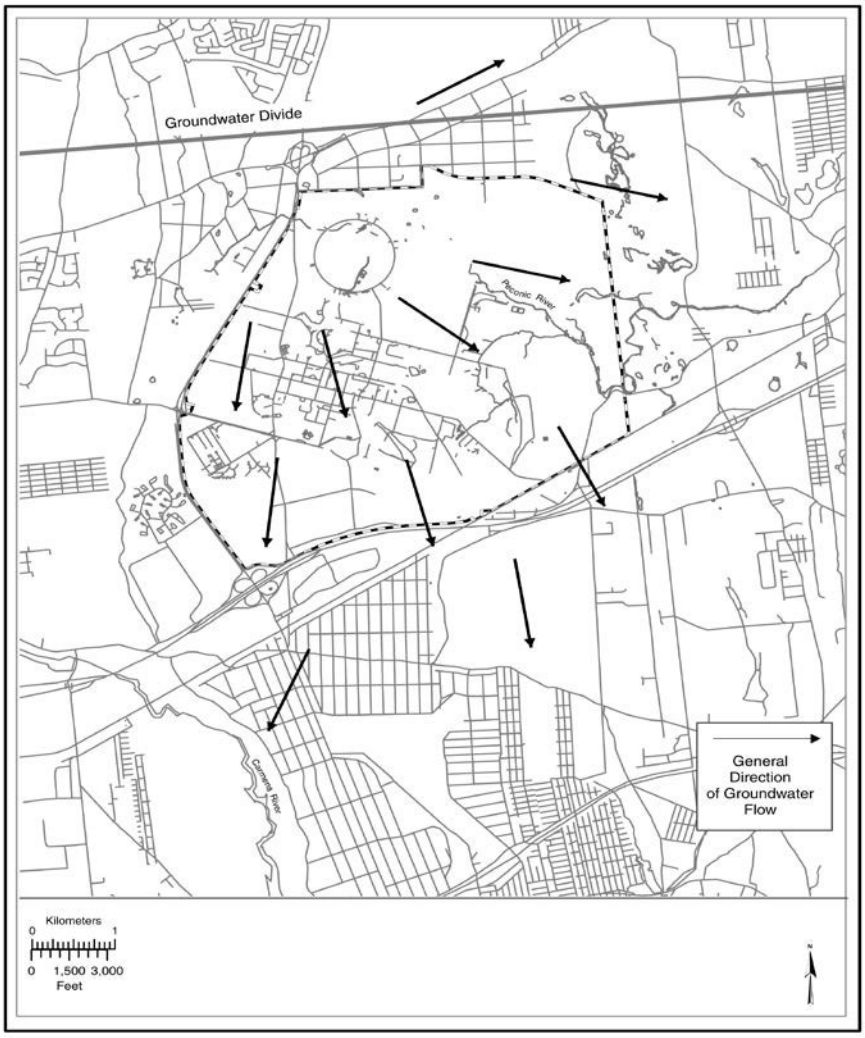


Figure 2.1. BNL Groundwater Flow Map

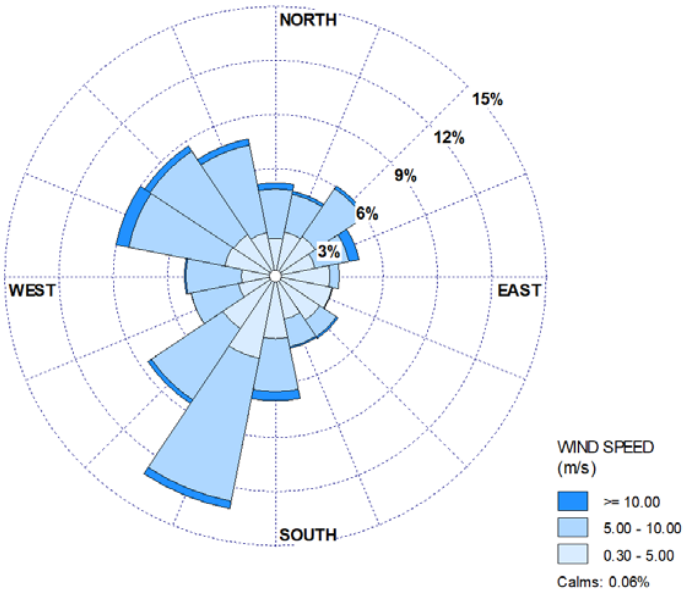
2.5 METEOROLOGICAL DATA

Meteorological Services (MET Services) at BNL has been recording on-site weather data since August 1948. MET Services is responsible for the maintenance, calibration, data collection, and data archiving for the weather instrumentation network at BNL. Measurements include wind speed, wind direction, temperature, rainfall, barometric pressure, and relative humidity. Figures shown in this chapter reflect the latest data available.

The Laboratory is broadly influenced by continental and maritime weather systems. Locally, the Long Island Sound, Atlantic Ocean, and associated bays influence wind directions and humidity and provide a moderating influence on extreme summer and winter temperatures. The prevailing

ground-level winds at BNL are from the southwest during the summer, from the northwest during the winter, and about equally from those two directions during the spring and fall (Nagle 1975, 1978). Figure 2-2 shows the 2020 annual wind rose for BNL, which depicts the annual frequency distribution of wind speed and direction, measured at an on-site meteorological tower at heights of 33 feet (10 meters) and 300 feet (85 meters) above land surface.

The coolest month of the year, January, had a monthly average temperature of 35.8ºF while the warmest month of the year, July, had a monthly average temperature of 75.1ºF. Figures 2-3 and 2-4 show the 70-year annual and monthly precipitation data, respectively. The yearly total snowfall for 2020 was 10.5 inches, well below the 33.0 inches average yearly snowfall for this area of Long Island.



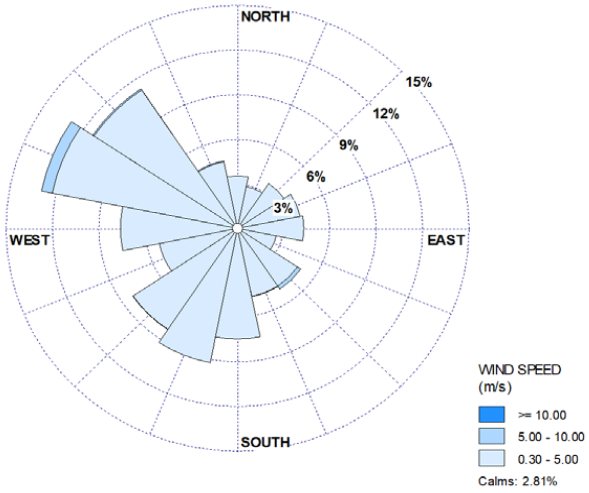


Figure 2.2. BNL Wind Rose (2020).

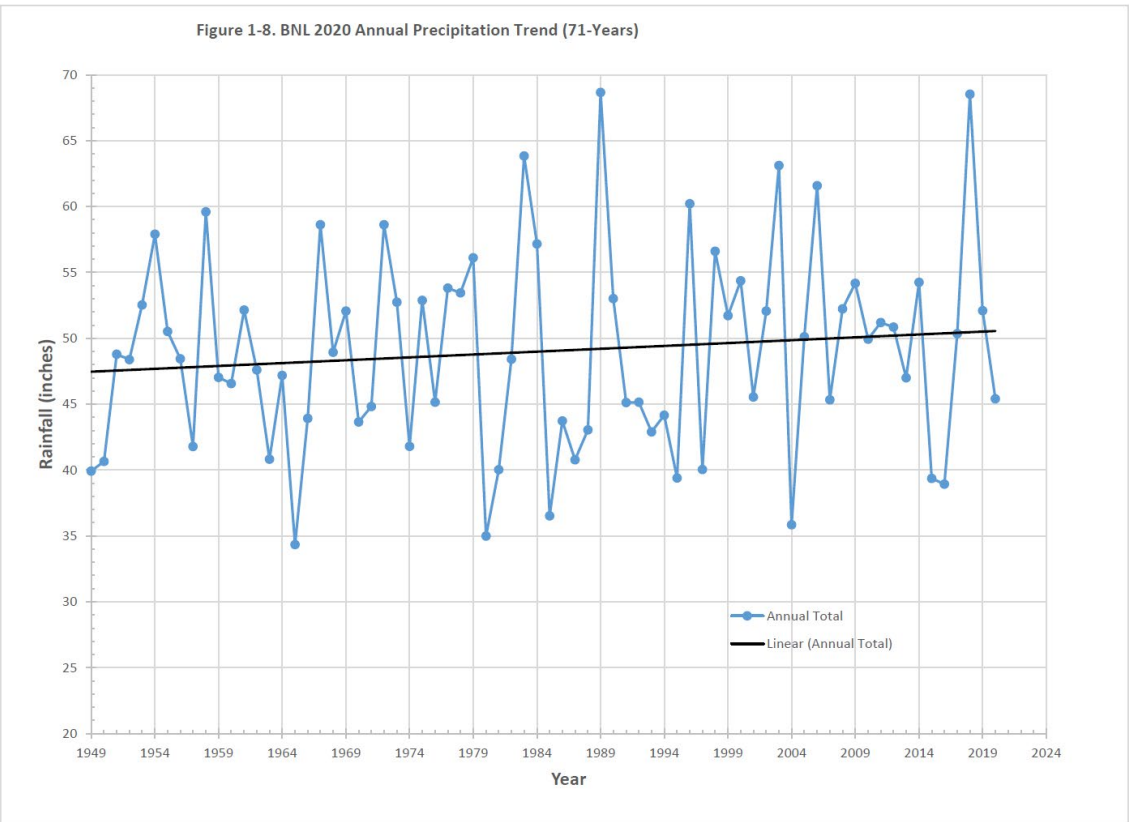


Figure 2.3. BNL 2020 Annual Precipitation Trend (70 Years)

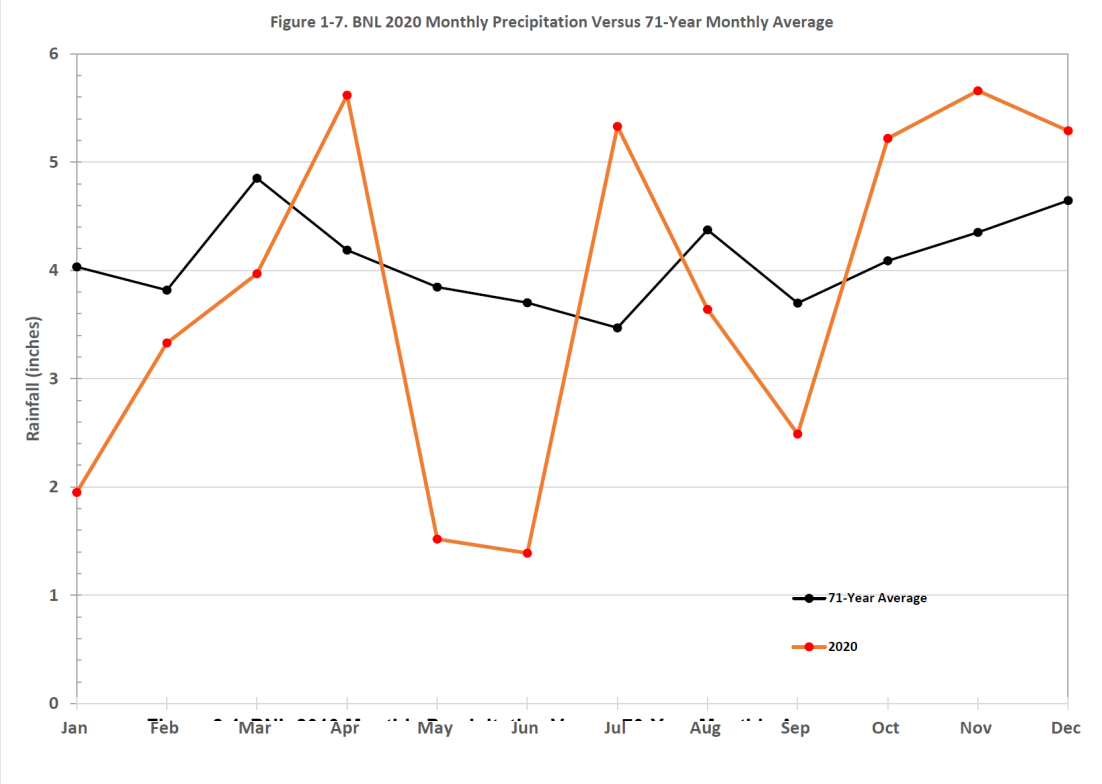


Figure 2.4. BNL 2020 Monthly Precipitation Versus 70-Year Monthly Average

2.6 NATURAL RESOURCES

The Laboratory is located in the oak/chestnut forest region of the Coastal Plain and constitutes about five percent of the 100,000-acre New York State–designated region on Long Island known as the Central Pine Barrens. The section of the Peconic River running through BNL is designated as "scenic" under the New York State Wild, Scenic, and Recreational River System Act of 1972. Due to the general topography and porous soil, the land is very well drained and there is little surface runoff or open standing water. However, depressions form numerous small, pocket wetlands with standing water on a seasonal basis (vernal pools), and there are six regulated wetlands on site. Thus, a mosaic of wet and dry areas correlates with variations in topography and depth to the water table.

Vegetation on site is in various stages of succession, which reflects a history of disturbances to the area. For example, when Camp Upton was constructed in 1917, the site was entirely cleared of its native pines and oaks. Although portions of the site were replanted in the 1930s, portions were cleared again in 1940 when Camp Upton was reactivated by the U.S. Army. Other past disturbances include fire, local flooding, and draining. Current operations minimize disturbances to the undeveloped areas of the site.

More than 400 plant, 30 mammal, 100 bird, 13 amphibian, 12 reptile, and 10 fish species have been identified on site, some of which are New York State threatened, endangered, exploitably vulnerable, or species of special concern. To eliminate or minimize any negative effects that BNL operations might cause to these species, precautions are in place to protect habitats and natural resources at the Laboratory.

In November 2000, the U.S. Department of Energy (DOE) established the Upton Ecological and Research Reserve at BNL. The 530-acre Upton Reserve (ten percent of the Laboratory's property) is on the eastern portion of the site, in the Core Preservation Area of the Central Pine Barrens. The Upton Reserve creates a unique ecosystem of forests and wetlands that provides habitats for plants, mammals, birds, reptiles, and amphibians. From 2000 to 2004, funding provided by DOE under an Inter-Agency Agreement between DOE and the U.S. Fish & Wildlife Services was used to conduct resource management programs for the conservation, enhancement, and restoration of wildlife and habitat in the reserve. In 2005, management was transitioned to the Foundation for Ecological Research in the Northeast (FERN). Management of the Upton Reserve falls within the scope of BNL's Natural Resource Management Plan, and the area will continue to be managed for its key ecological values and as an area for ecological research (BNL 2016).

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