CULTURAL RESOURCE MANAGEMENT PLAN

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EXECUTIVE SUMMARY

The Princeton Plasma Physics Laboratory (PPPL) originally prepared this Cultural Resource Management Plan (CRMP) in accordance with the US Department of Energy's (DOE) "Environmental Guidelines for Development of Cultural Resource Management Plans – Update," dated September 22, 2004 (DOE G 450.1-3). This directive was cancelled by DOE N 251.82, "Cancellation of Directives," dated June 4, 2010. Under DOE's Order 436.1, "Departmental Sustainability," dated May 2, 2011, PPPL is required to comply with … "applicable laws, regulations, and Executive Orders (EO), related performance scorecards, and sustainability initiatives." Executive Order (EO) 13287, "Preserve America," issued on March 3, 2003, and the National Historic Preservation Act (NHPA) of 1966 amended 2014, requires the identification of historic properties that meet the criteria pursuant to the EO and NHPA.

PPPL determined that the 88.5-acre site located in Plainsboro, New Jersey, is not listed as an historic site on either the New Jersey (state) or National Register of Historic Places. PPPL did, however, identified that its pump house located adjacent to the Delaware and Raritan Canal (D&R Canal) is on land designated as an historic site on both the state and National Registers. The entire Canal bed and all land 100 yards to either side of the center line are part of the Delaware and Raritan Canal Historic District.

The property is owned by Princeton University and is not leased to DOE; the building (pump house) and equipment are owned by DOE, a federal agency responsible for historic preservation and subject to the requirements of the National Historic Preservation Act (Sections 106 and Section 110) and 36 CFR Part 800, "Protection of Historic Properties."

Those laws, regulations, Executive Orders, and guidance pertaining to Native American and/or Indian Tribal Governments are not applicable to this site and are therefore not included in this plan.

1. INTRODUCTION

The Princeton Plasma Physics Laboratory (PPPL) prepared this Cultural Resource Management Plan (CRMP) as a requirement of DOE Order 436.1, "Departmental Sustainability," which requires an Environmental Management System (EMS). PPPL's approach to this requirement is to briefly describe Cultural Resource Management (CRM) goals, the existing conditions at PPPL, and reference CRM methods and procedures and supporting documents.

PPPL's primary goal of this CRMP is to provide a framework that will help PPPL document and manage its cultural resources in an effective and efficient manner. The pre-historic and historic information about PPPL provides the basis for creating this concise format.

2. CRM GOALS

In the short term, PPPL will establish a repository for all materials relevant to PPPL's Cultural Resources and History, preferably in a fire-proof location (fire-proof location about be a file cabinet to room – archival methods for preserving materials). The materials may include artifacts, reports, maps, photographs, drawings, etc.

A long term goal is to educate PPPL employees about cultural resources and a Guide to PPPL's history will be prepared.

3. EXISTING CONDITIONS

3.1 Site Mission

The U.S. Department of Energy's Princeton Plasma Physics Laboratory (PPPL) is a Collaborative National Center for plasma and fusion science. Its primary mission is to develop scientific understanding and key innovations leading to an attractive fusion energy source [PPPL16a]. Related missions include conducting world-class research along the broad frontier of plasma science and providing the highest quality of scientific education and experimentation.

At PPPL, the National Spherical Torus Experiment - Upgrade (NSTX-U) is a collaborative project among many Department of Energy National Laboratories, universities, and institutions. Also located at PPPL are smaller experimental devices, such as the Magnetic Reconnection Experiment (MRX) and the Lithium Tokamak Experiment (LTX) formerly Current Drive Experiment-Upgrade (CDX-U), which investigate plasma physics phenomena.

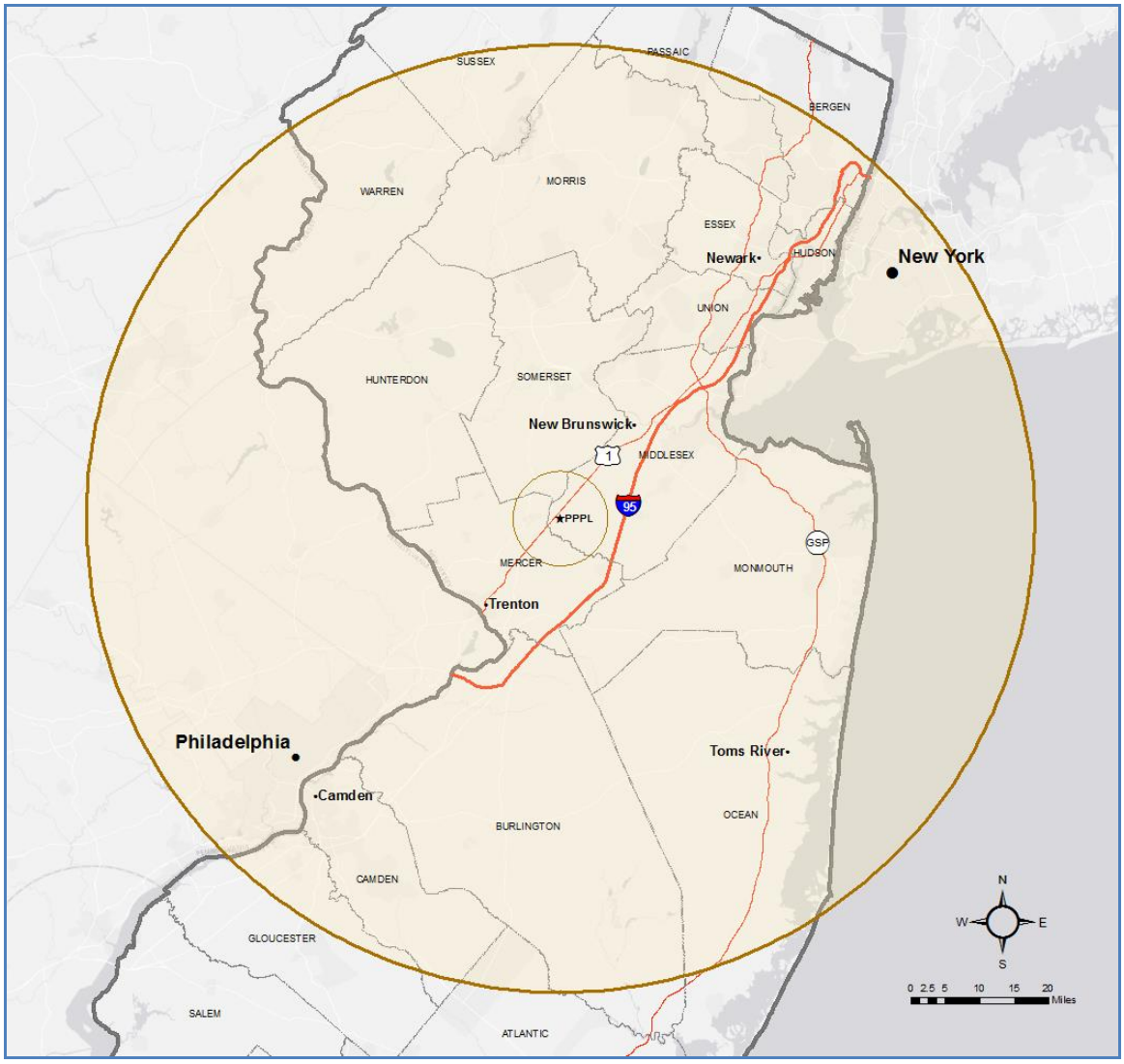
As a part of off-site collaborative projects, PPPL scientists assist fusion programs both in the United States and other countries. Particularly, PPPL collaborated with the Koreans in their K-Star program and with the European community at the Joint European Torus (JET) facility located in the United Kingdom, and the International Thermonuclear Experimental Reactor (ITER also Latin for "the way") in France to further fusion science.

3.2 Site Location

The Princeton Plasma Physics Laboratory site is in the center of a highly urbanized region of the Northeast region. The closest urban centers are New Brunswick, 14 miles to the northeast, and Trenton, 12 miles to the southwest. Major surrounding cities, including New York City, Philadelphia, and Newark, are within 50 miles of the site.

As shown in Figure 3-1, the site is located in Plainsboro Township within Middlesex County (central New Jersey), adjacent to the municipalities of Princeton, Kingston, West Windsor, and Cranbury, NJ. The Princeton area continues to experience a substantial increase in new businesses locating along the Route 1 corridor near the site. Also, the main campus of Princeton University, primarily located within the Borough of Princeton, is approximately three miles to the west of the site.

Figure 3-1. Region Surrounding PPPL (50-mile radius shown)



In the early 1950's, Dr. Lyman Spitzer's vision for plasma physics culminated in Project Matterhorn, which gained approval of the U.S. Atomic Energy Commission. Its mission was to contain and harness the nuclear burning of hydrogen at temperatures exceeding those found in the sun. Dr. Spitzer became known as the father of the "Stellarator" and was PPPL Director until 1961. Named for Dr. Spitzer's A, B, and C stellarators, PPPL

was first located on A- and B-sites of the James Forrestal Campus; and in 1959, PPPL moved to its present location at C-site. In the late 1970's, D-site hosted the Tokamak Fusion Test Reactor (TFTR), which is was dismantled in 2003, and is now the home of the National Spherical Torus Experiment-Upgrade (NSTX-U) (Figure 3-2).

Undisturbed areas surrounding the site include upland forest, wetlands, open grassy areas, cultivated fields, and a minor stream (Bee Brook), which flows along its eastern boundary. These areas are designated as open space in the JFC site development plan. The following aerial photo (Exhibit 3-3) shows the general layout of the facilities at the C- and D-sites of Forrestal Campus as viewed from the north; former TFTR and NSTX Test Cells are located at D-site (on the left side of photo).

Figure 3-2. PPPL James Forrestal Campus, Plainsboro, NJ

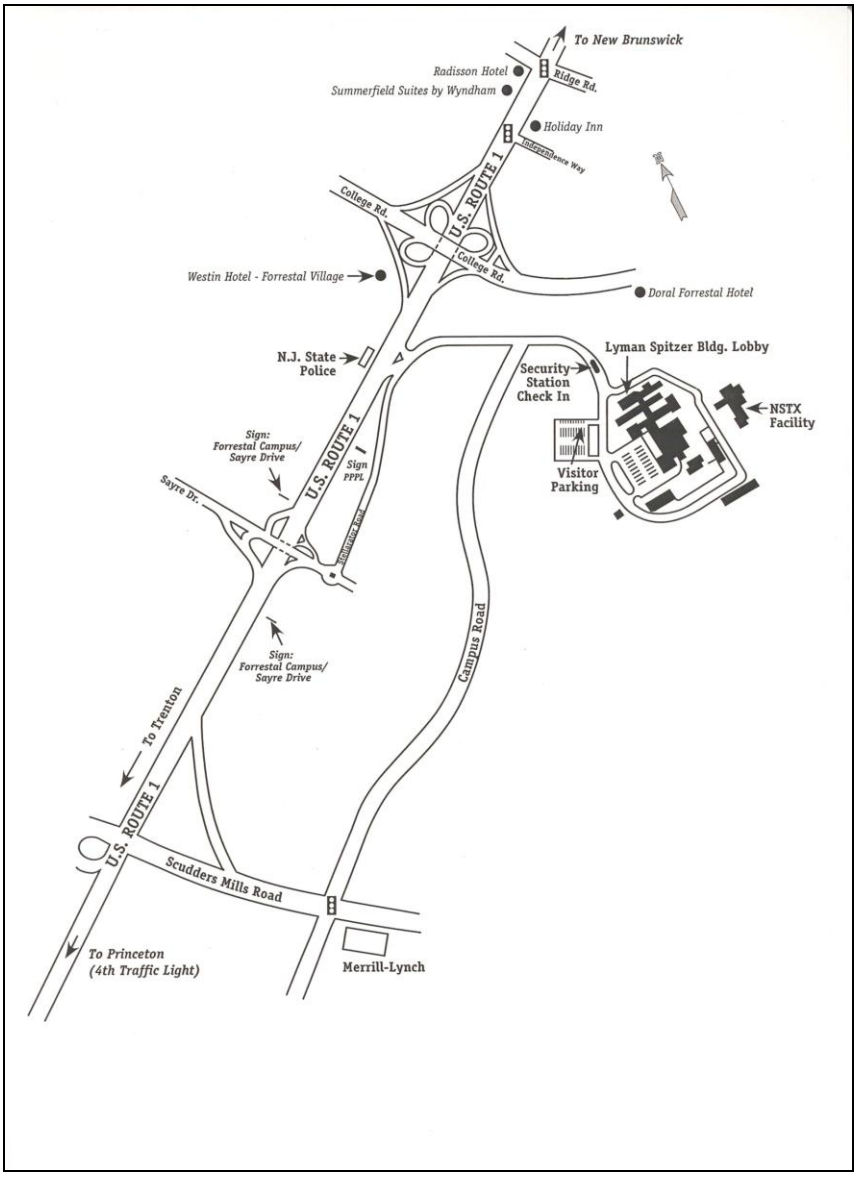
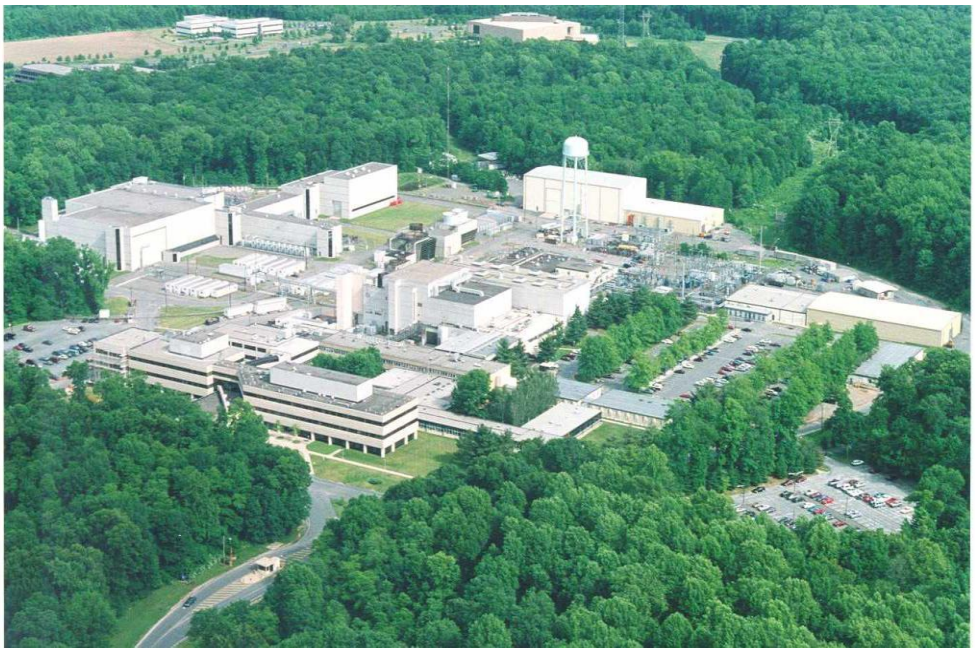


Figure 3-3. Aerial View of PPPL



D-site is fully surrounded with a barbed-wire, chain-linked fence for security purposes. Though PPPL operates C-site as an open access area, allowing the public access for tours and educational purposes, access controls are in place through Site Protection Office's visitor notification system.

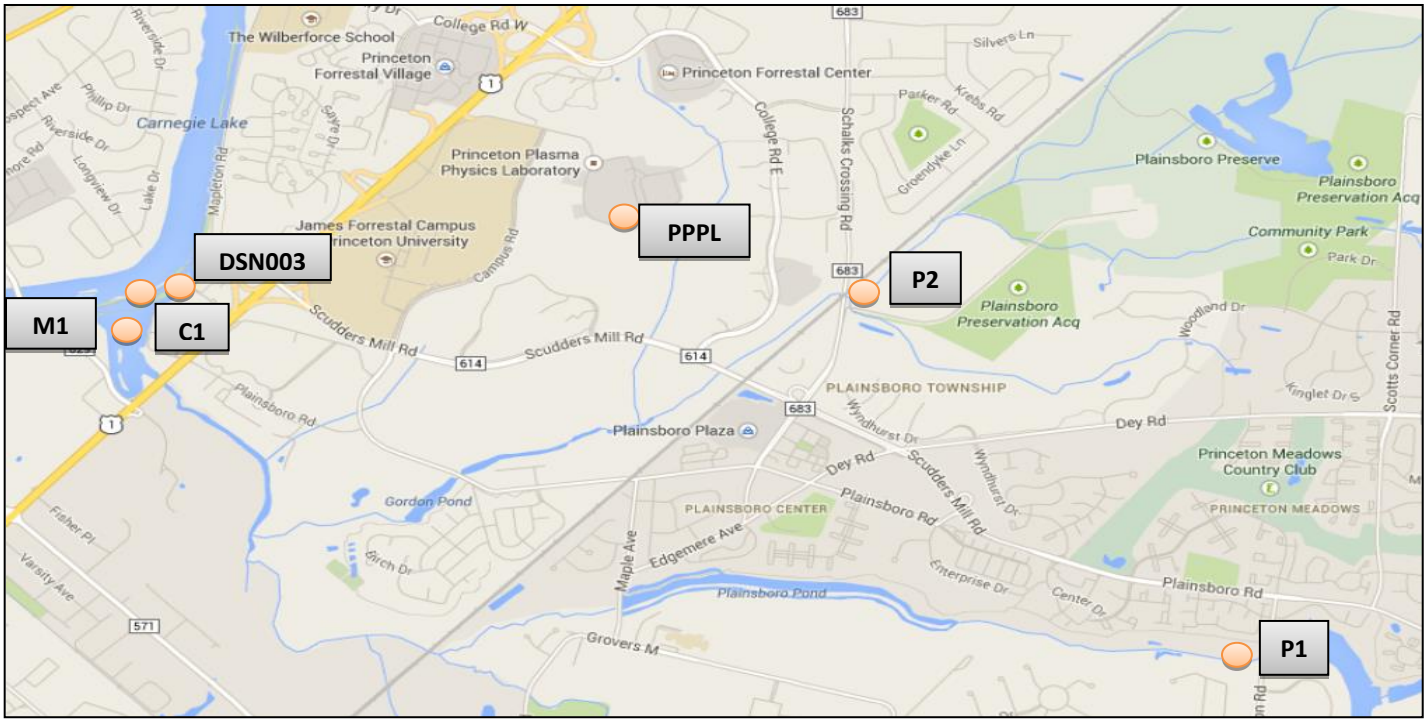
Since 1959, PPPL has diverted water from the Delaware & Raritan Canal (D&R Canal) via its pump house located on Mapleton Road, Plainsboro Township. Water is pumped from the D&R Canal through pipes under US Route 1 to the Lab property, approximately 2 miles east of the Canal. From 1959 to 1978, the Canal water was used mainly for fire protection. In 1987, PPPL changed from potable water to Canal (non-potable) water for the cooling-water systems. PPPL's use of the D&R Canal is authorized by a permit agreement with the New Jersey Water Supply Authority [Mor16]. The present agreement gives PPPL the right to draw up 500,000 gallons of water per day for process and fire-fighting purposes.

The Canal pump house is located adjacent to D&R Canal and is therefore located within the Delaware & Raritan Canal Historic District, which extends the length of the Canal from the center line to 100 yards on either side of the Canal channel. The D&R Canal Historical District is listed on the National Register of Historic Places as well as on the State of New Jersey's Register of Historic Places.

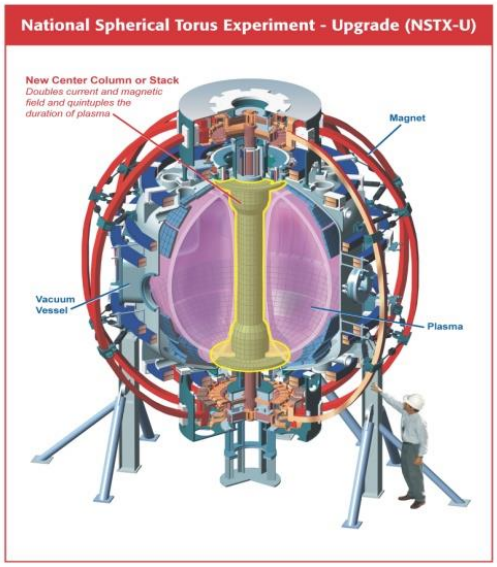
Filtration to remove solids and the addition of chlorine and a corrosion inhibitor are the primary water treatment at the canal pump house. Discharge serial number DSN003, located at the canal pump house filter-backwash, is a separate discharge point in the New Jersey Pollutant Discharge Elimination System (NJPDES) surface-water permit and is monitored monthly. A sampling point (C1) was established to provide baseline data for

surface water that is pumped from the D&R Canal for non-potable uses. Water quality data are summarizes in the Annual Site Environmental Report prepared for each calendar year. In Figure 3-4, the location of the D&R Canal pump house is designated as DSN003; other locations are off- site surface water monitoring stations that PPPL quarterly monitors the water quality.

Figure 3-4 D& R Canal Pump House Location (DSN0003)



An archaeological survey was conducted in 1978 as part of the TFTR site environmental assessment study. From historical records, personal interviews, and field investigations one projectile point and a stone cistern were found. Apparently, the site had limited occupation during prehistoric time and has only in recent times been actively used for farming. There are examples of prehistoric occupation in areas closer to the Millstone River, which are within a mile of the site [Gr77].



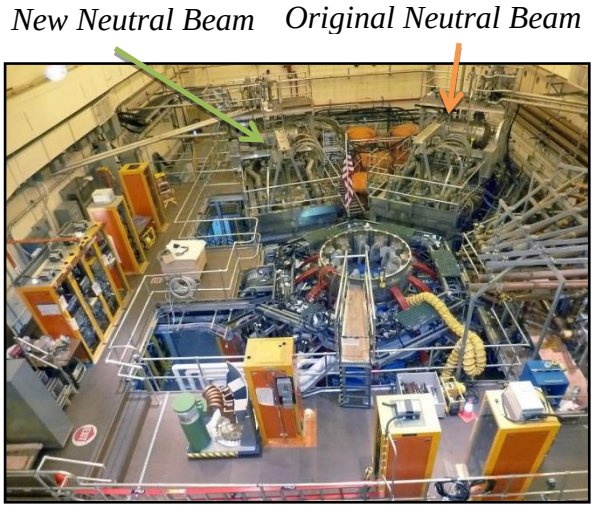
3.4 Primary Operations and Activities

The fusion experiments, such as NSTX-U, MRX, or LTX, currently operate at PPPL.

National Spherical Torus Experiment - Upgrade

2015 marked the seventeenth year of the National Spherical Torus Experiment's (NSTX). Though NSTX did not operate nor conduct experiments in 2015, the NSTX upgrade project, the installation of a new center stack with more powerful magnets and the addition of a second neutral beam line from the Tokamak Fusion Test Reactor (TFTR), was completed in 2015. In drawing on the right, the vacuum vessel is spherical in shape; the person standing to the right of the base illustrates the scale of this device. The new center stack shown in a yellow outline, are two magnets bound together – one contains vertical copper bars creating a magnetic field up and down the stack. The other is a coil wound around the center that drives a magnetic force or current through the plasma, which produces round-shape plasmas. The new center stack design will increase the field strength to one tesla - or 20,000 times the strength of Earth's magnetic field. The magnetic field generated by the polodial field coils is used to control the plasma shape within the vacuum vessel. For the NSTX research collaborators from 30 U.S. institutions and 11 other countries, the project is a major effort to produce a smaller, more economical fusion reactor.

The National Spherical Torus Experiment
Heated by Neutral Beam Injection (NBI)



The second neutral beam line now injects neutral atoms, deuterium, (hydrogen isotope with one neutron), into the ionized gas or plasma causing the plasma to heat to temperatures on the order of 100 million degrees. The plasma is also heated by radio-frequency waves and together with the neutral beam injection, will allow for greater heat capacity and hotter experimental plasmas. In the photo to the left, the two neutral beam injectors (NBI) are shown.

3.5 Relevant Demographic Information

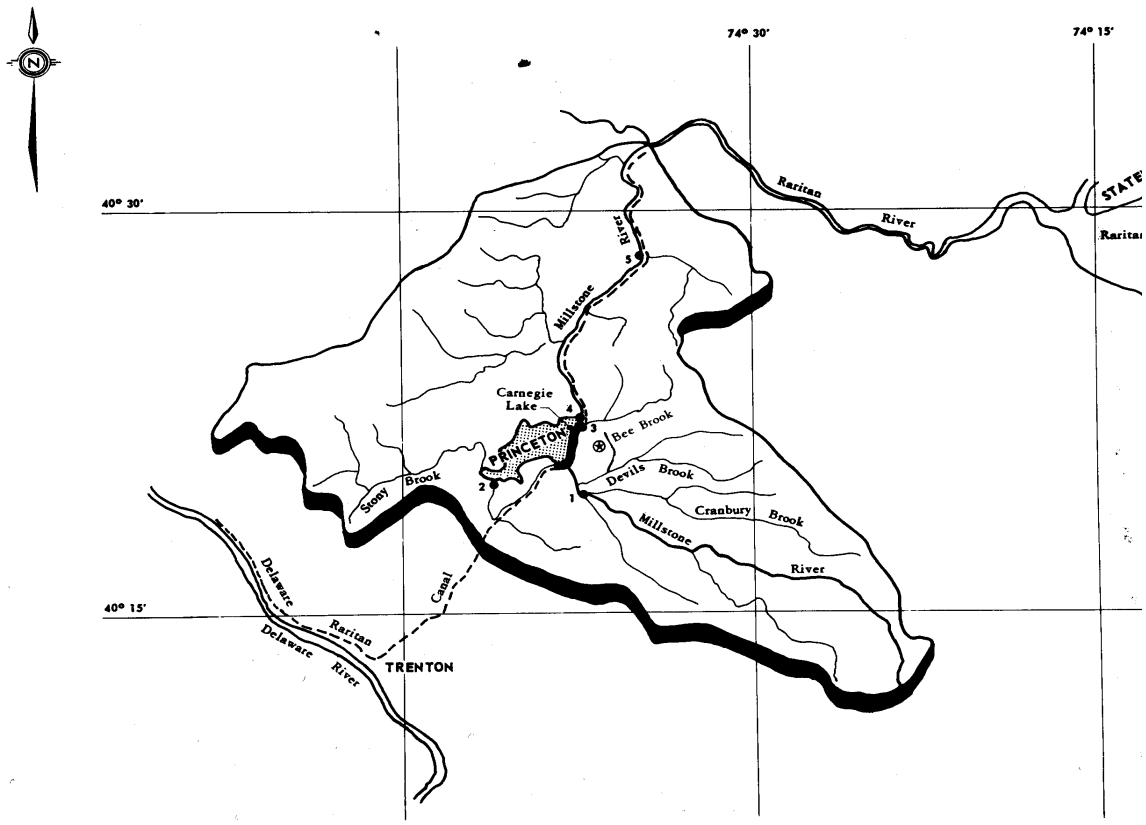
A demographic study of the surrounding 31.1 miles (50 kilometers) was completed in 1987 as part of the Environmental Assessment for the proposed Burning Plasma Experiment (BPX), which was also known as Compact Ignition Tokamak (CIT) [Be87a]. Other information gathered and updated from previous TFTR studies include socioeconomic information [Be87b] and ecological surveys [En87]; which were studies describing pre-TFTR conditions. For each subsequent calendar year, the Annual Site Environmental Report (ASER) for PPPL includes the most recent U.S. population census data for the surrounding area.

3.6 Site Hydrology and Ground Water

PPPL is located within the Bee Brook Watershed, a tributary to the Millstone River, and a part of the Raritan River Watershed (Figure 3-7). NJDEP has developed a watershed-based management program for prospective environmental planning and has divided the State of New Jersey into twenty watershed basins.

Locally, the Bee Brook Watershed encompasses approximately 700 acres within the Princeton Forrestal Center and James Forrestal Campus tracts. It begins at College Road East (approximately 1600 feet east of US Route 1), flows south in a wide flood plain, and then discharges into Devil's Brook at the entrance to Mill Pond [Sa80].

Figure 3-7 Millstone River Watershed Basin



PPPL is situated on the eastern edge of the Piedmont Physiographic Province, approximately one-half mile from the western edge of the Atlantic Coastal Plain Province. The site is underlain largely by gently dipping and faulted sedimentary rock of the Newark Basin. The Newark Basin is one of several rift basins that were filled with sedimentary material during the Triassic Period. At PPPL, bedrock is part of the Stockton Formation, which is reportedly more than 500 feet thick and consists of

fractured red siltstone and sandstone [Lew87]. Regionally, the formation strikes approximately north 65 degrees east, and dips approximately 8 degrees to the northwest. The occurrence of limited amounts of clean sand near the surface indicates the presence of the Pennsauken Formation. This alluvial material was probably deposited during the Aftonian Interglacial period of the Pleistocene Ice Age.

Within 25 miles, there are a number of documented faults; the closest of which is the Hopewell fault located about 8 miles from the site. The Flemington Fault and Ramapo Faults are located within 20 miles. None of these faults are determined to be "active" by the U.S. Geological Survey. This area of the country (eastern central US) is not earthquake-prone, despite the occurrence of minor earthquakes that have caused little or no damage.

The Millstone River and its supporting tributaries geographically dominate the region. The well-watered soils of the area have provided a wealth of natural resources including good agricultural lands from prehistoric times to the present. Land use was characterized by several small early centers of historic settlement and dispersed farmland. It has now been developed into industrial parks, housing developments, apartment complexes and shopping centers [Gr 77].

The topography of the site is relatively flat and open with elevations ranging from 110 feet in the northwestern corner to 80 feet above mean sea level along the southern boundary. The low-lying topography of the Millstone River drainage reflects the glacial origins of the surface soils; sandy loams with varying percents of clay predominate.

Two soil series are recognized for the immediate environs of the site. Each reflects differences in drainage and subsurface water tables. Along the low-lying banks of stream tributaries, Bee Brook, the soils are classified Nixon-Nixon Variant and Fallsington Variant Association and Urban Land [Lew87].

This series is characterized by nearly level to gently sloping upland soils, deep, moderate to well drained, with a loamy subsoil and substratum. The yellowish-white sands contain patches of mottled coloring caused by prolonged wetness. On a regional scale, the water table fluctuates between 1.5 and 2.5 feet below the surface in wet periods and drops below 5 feet during drier months.

In the slightly higher elevations (above 70 feet), the sandy loams are better drained and belong to the Sassafras series. The extensive farmlands and nurseries in the area indicate this soil provides a good environment for agricultural purposes, both today and in the past.

An upland forest type with dominant Oak forest characterizes vegetation of the site. Associated with the various oaks are Red Maple, Hickories, Sweetgums, Beech, Scarlet Oak, and Ash. Red, White, and Black Oaks are isolated in the lower poorly drained areas. Along the damp borders of Bee Brook, a bank of Sweetgum, Hickory, Beech,

and Red Maple define the watercourse. The forest throughout most of the site has been removed either for farmland during the last century or recently for the construction of new facilities. Grass has replaced much of the open areas.

The under-story of the wooded areas is partially open with isolated patches of shrubs, vines, and saplings occurring mostly in the uplands area. The poorly drained areas have a low ground cover of ferns, grasses, and leaf litter.

All of PPPL's storm water runoff flows to Bee Brook, either directly *via* the detention basin discharge (NJPDES permitted location, DSN001) or along the western swale to the wetlands south of the site. Approximately 45 % of the site's total area is covered by impervious surfaces - buildings, roadways and parking lots, and storage trailers.

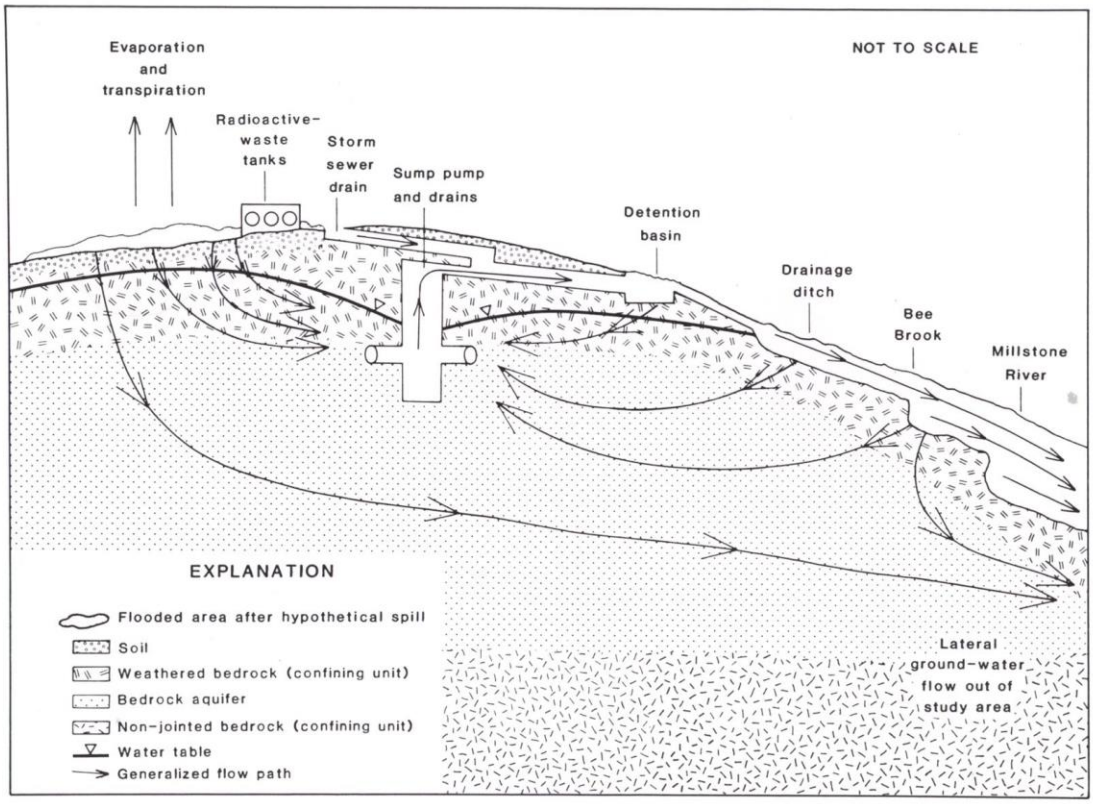
PPPL's Stormwater Management Plan allows for a maximum impervious coverage of 60 % of the developable land, which excludes wetlands – 18 acres of the 88.5 acres [D&R CC80, PPPL 98].

The 500-year flood plain elevation (85 ft. above mean sea level) delineates the storm protection corridor, which is vital to the flood and water quality control program for PPPL as well as the Princeton Forrestal Center site. This "corridor" is preserved and protected from development by Princeton Forrestal Center in the Site Development Plan [PFC80].

The general direction of ground-water flow on the site is from the northwest of PPPL toward the southeast in the direction of Bee and Devil's Brooks. The operation of several building foundation drain sump pumps creates a local and shallow cone of depression radially toward the sumps (Figure 3-8).

Ground water is pumped from the sumps into the detention basin, which flows into Bee Brook. Bee Brook is hydraulically connected with ground water; during flooding stages, the brook recharges ground water and during low-flow periods, ground water discharges to the brook.

Figure 3-8. Generalized Potentiometric Surface of the Bedrock Aquifer at PPPL [Le87]



3.7 Known Cultural Resources

Prehistoric and Historic Properties – See Appendix A for a description of the Cultural History

3.8 Cultural and Historic Setting

Traditional Lands and Resource Uses – See Appendix B for a description of the Land Use

3.9 CRM Accomplishments

Archeological Surveys

As cited in Section 3.4 of this CRMP, an archeological survey was conducted in compliance with federal historic preservation statutes in accordance with the procedures of the Advisory Council of Historic Preservation (ACHP) regulations (36 CFR Part 800). The survey performed in 1977, was required for the proposed construction of Tokamak Fusion Test Reactor (TFTR) on D-site of PPPL. The survey was conducted by Rutgers Archaeological Survey Office (Cook College – New Brunswick, NJ) through a subcontract with Ebasco Services, who was PPPL's architectural/engineering subcontractor for TFTR.

The primary results of the archeological survey were the finding of "an isolated unassociated projectile point and the presence of a cobble-lined 'cistern'" outside the zone of construction. The following section describes the two findings:

Excerpt from the Rutgers - Grossman Survey pp 43-46:

IV. Results, Assessments, and Discussion

Of the three separate areas subjected to subsurface testing, two, Area B and Area C (fig. 4) proved to be free of any identifiable, cultural materials, either historic or prehistoric. Area A (fig. 4), however, did contain cultural materials, and those will be described and evaluated below.

(A) THE TFTR COMPLEX

Two features of note were encountered while conducting surface reconnaissance and subsurface testing within, and adjacent to, the immediate impact area of the proposed TFTR complex. One was a single projectile point recovered while augering in the proposed parking lot area immediately north of the exclusion zone, and second, a subterranean field-stone lined depression tentatively identified as a drainage cistern.

1. <u>The Projectile Point</u>:

The only item of prehistoric human manufacture recovered was a fragmentary argillite projectile point (fig.11). The point was recovered while augering 950 feet north and 200 feet west of the central datum point of the 1000 foot interval grid (fig. 4). The immediate vicinity of this find consisted of fine-grained sandy clay that was damp because of the high water table.

The triangular shape of the point suggests that it may be of the Levanna type characteristic of the Late Woodland forms (1200-1700 A.D.) throughout much of the Mid-Atlantic and northeast United States.

Once the argillite point was encountered, the immediate area was intensively investigated. A cluster of auger borings were drilled around the original auger hole. This was done to determine if the projectile point represented a "site," the location of a group of associated artifacts of integrated prehistoric or historic activity, or an "isolated find," the location of a chance remain of a single prehistoric or historic activity.

If indicative of a prehistoric site, the projectile point would be expected to occur in association with other materials of prehistoric activity. To establish the potential existence of such materials, ten additional auger boring were drilled with in ten feet of the initial find. The soil matrix from each was screened through ¼ inch mesh. From these additional probes, a total volume of 16.35 cubic feet of soil was screened. The results were negative.

The lack of any associated cultural materials in and around the area of the first auger boring indicated that the single projectile point represents a chance occurrence of an isolated find, not an aspect of a pre-historic occupation site.

2. The "Cistern:"

Outside the boundary of the proposed construction activities, a subterranean, stone-lined, conical pit was encountered, 50-100 feet outside the northeastern exclusion zone boundary, while surveying for the test auger grid (fig. 12).

This subterranean construction is oval at its ground level opening, varied between four and five feet in diameter, and has an unknown depth. Leaves obscured the bottom of the feature at a depth of 2 feet below the surface. A deposit of highly organic, dark brown mud occurred beneath the leaf layer. Because it is outside the jurisdiction of our mandate for subsurface testing, investigation of the pit was limited to a single 10-inch wide shovel probe to a depth of 7 feet below the surface. No cultural materials were encountered in this limited probe.

The southern and eastern sides of the pit are level with the surrounding grade. A 30-foot long, shallow depressions dipped towards the northeastern edge of the pit, and a cluster of unworked fieldstones at the lip of the pit formed a four-sided enclosed "conduit," which appeared to form a spillway or run-off in line with the depression.

An interpretation of the function of this feature is made difficult by the lack of published references and any associated archaeological evidence indicative of its date or use. This lack of data allows two interpretations. The pit could have been a small well for providing potable water, or it could represent an attempt to increase available agricultural land by drainage of excess surface water.

The idea that it represents a well seems plausible because of the high water table of the surrounding area and because of the proximity of Bee Brook to the east. Even during dry periods in this area, water can be drawn at no deeper than(t) 10-12 feet below the surface. However, this is unlikely since there is no evidence, either documentary or cartographic, of any nearby historic structure or residence which may have required a well.

The second possibility, that the feature represents a drainage function, seems more probable for two reasons. First, while interviewing Mr. Flemer III of the Princeton Nurseries, he repeatedly mentioned his family's efforts to reclaim the local forest and swamp lands for increased agricultural production. Years ago, aside from the forest itself, the greatest obstacle to increased agricultural production throughout much of the Millstone drainage was the extensive freshwater swamps bordering Devils and Cranbury Brooks. Because of this endemic environmental dilemma, swamp drainage was a key concern for the nineteenth century farmer entrepreneurs of the region.

One of the region's most noteworthy features and greatest financial endeavors for the historians of the middle 1800's to record was the construction of the "Great Ditch" to clear and reclaim "Pigeon Swamp." It was located approximately 10 miles northeast of

the Forrestal Campus. This drainage system was seven miles long and was only one of numerous endeavors to augment the Township's agricultural potential. The Forrestal "cistern" may represent a similar effort on a smaller scale.

Assessments:
Given the presence of cultural materials, and the involvement of Federal funding in the proposed project, it is required by law that each item or feature encountered be evaluated and assessed according to the criteria of eligibility for nomination to the National Register of Historic Places. The criteria for evaluating properties for inclusion in the National Register state that such properties must possess integrity of location, design, setting, materials, workmanship, feeling, and association and:

1) "that are associated with events that make a significant contribution to the broad patterns of our history; or
2) "that are associated with the lives of persons significant in our past;
3) "that embody the distinctive characteristics of a type, period, or method of construction; or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual information important in the prehistory of history (36 CFR, National Park Service, U.S. Department of Interior, 1972)."

Under the above criteria, it is the determination of this study that neither the single "sporadic find" of the isolated projectile point within the proposed TFTR construction zone, nor the "cistern" outside the proposed construction zone represents levels of significance which would qualify these items as eligible for nomination to the National Register of Historic Places. (End Excerpt)

Structure and Facility Management – Campus Modernization Plan – July 2014

In July 2014, PPPL completed a strategic improvement plan for the modernization of campus buildings and infrastructure to support the Lab's strategic scientific research mission. The Campus Modernization Plan aligns with DOE's strategic vision for the Lab and builds on PPPL's core scientific and engineering capabilities in the areas of plasma science and fusion energy. The Plan identifies key buildings and campus infrastructure in need to life-extending renovation and realignment projects. It provides a roadmap for campus-wide infrastructure investments to improve and modernize office/meeting spaces, high-bay and medium bay experimental spaces, collaborative spaces and supporting functions, such as technical shops and storage. Completion of the planned modernization projects will also remove many temporary modular buildings and storage trailers and improve the overall campus aesthetic. The modernization effort has begun with funding for General Plant Project (GPP) improvements and a line-item funded building renovation and reconfiguration project known as the Infrastructure and Operational Improvement project.

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Regarding the Delaware & Raritan Canal pump house, no future changes to the building exterior or grounds are presently proposed. PPPL is committed to maintaining the building and equipment located inside the pump house in good operating condition. Several years ago (circa 2001) vandals entered the property, which is fenced and has a locked gate, and sprayed graffiti on the Canal facing wall. As soon as PPPL discovered this action, PPPL personnel cleaned the paint off the building. No trace remains today.

Legal Compliance Accomplishments

As demonstrated prior to the construction of TFTR, PPPL initiated the Archeological Survey pursuant to the requirements of the following statute and regulation:

NHPA and 36 CFR Part 800
NHPA Sections 106 and 110(f)
NHPA Sections 110(a)-(e) and (g)-(j)

For future projects, PPPL will initiate similar actions, based on the requirements to perform an archeological survey.

4. SUPPORTING DOCUMENTS

PPPL Annual Site Environmental Report for Calendar Year 2014, 2015.

Princeton Plasma Physics Laboratory, Campus Modernization Plan, July 2014

Landscape of the Raritan River Basin, A Technical Report for the Raritan Basin Watershed Management Project, New Jersey Water Supply Authority, final Report, August 2002.

New Jersey and National Registers of Historic Places, Middlesex County, Plainsboro Township, New Jersey Department of Environmental Protection – Historic Preservation Office, 2/9/05.

Environmental Guidelines for Development of Cultural Resource Management Plans – Update, U.S. Department of Energy, Washington, D.C. DOE-G 450.1, 9-22-04.

5.0 REFERENCES

Be87a Bentz, L. K., and Bender, D. S., 1987, *Population Projections, 0-50 Mile Radius from the CIT Facility: Supplementary Documentation for an*

Environmental Assessment for the CIT at PPPL, EGG-EP-7751, INEL, Idaho Falls, Idaho.

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PSAR78 *Preliminary Safety Analysis Report, Princeton Plasma Physics Laboratory Tokamak Fusion Test Reactor*, 1978.

Sa80 Sasaki Associates, February 1980, *Princeton Forrestal Center, Storm Water Management Plan for Bee Brook Watershed*, prepared for Delaware & Raritan Canal Commission.

St82 Strenge, D. L., Kennedy, W. E., Jr., and Corley, J. P., 1982, *Environmental Dose Assessment Methods for Normal Operations of DOE Nuclear Sites*, PNL-4410/UC-11.

Appendix A – Prehistoric and Historic Properties

Excerpts from "Landscape of the Raritan River Basin: a Technical report for the Raritan Basin Watershed Management Project" Final Report - August 2002, prepared by New Jersey Water Supply Authority, pages 6-8.

Lenni-Lenape – The Original People

The land that encompasses present day New Jersey was inhabited for thousands of years before the first European settlers arrived. During the last ice age, nomadic tribes from Asia crossed over the Bering Straits onto the North American continent. These voyagers continued traveling in an eastwardly direction until they finally came upon the Atlantic Ocean. The tribes, which settled in the woodlands of the Mid-Atlantic Region, were of the Algonquin group and spoke a similar language. In the area of present-day New York State and Ontario, Canada, the Five Nations of Iroquois made their home. The Five Nations of Iroquois was comprised of the Mohawks, Senecas, Cayugas, Onondagas and Oneidas. To the south of Iroquois, in the area of New Jersey, Pennsylvania, Delaware, and Maryland, lived the Lenni-Lenape Indians. The Lenni-Lenape Indians settled in valleys along the Delaware, Susquehanna, and Raritan Rivers. Like the Iroquois, the Lenni-Lenape Nation was comprised of several distinct tribes. In the Raritan Basin, two tribes, the Minsi and the Unami, shared the land. The Minsi tribe lived north of the Raritan River and Unami tribe resided south and west of the Raritan River. Tribal villages were located near the mouth and lower reaches of the Raritan River. Historical records indicate settlements existed near the present-day towns of Bound Brook, New Brunswick, South River, and Perth Amboy. Other villages were discovered in the Millstone Valley, Round Valley, and Neshanic Valley. Up until the European settlers began purchasing (or confiscating) land from the Indians, the area adjacent to the Raritan River played an important role in the Indian way of life. The Raritan River, which the Lenni-Lenape called the Wawitan or Naraitcong, provided food and transportation for the earliest inhabitants of the Basin.

The earliest native tribes living within the Raritan Basin relied on hunting and gathering for food. The males would hunt a variety of animals that were prevalent in New Jersey including deer, elk, black bear, turkey, beaver and other small game. Females would gather berries, nuts and other sources of food from the surrounding vegetation. Through time, agriculture became a common practice among the tribal population. (Gardening is a more accurate term since plots were relatively small and tilled by hand.) The three primary crops cultivated by the tribes were corn, beans, and squash, commonly known as the "three sisters." Other crops such as tobacco, sugar maple and pumpkins complemented their diet. To make way for gardens, areas of forests needed to be cleared. Trees would be stripped of their bark and eventually died, allowing the trees to go down easier. Another method of clearing forests included setting fires to the underbrush and burning the trees down. Once a forest area was cleared of remaining debris, the area was suitable for farming. Gardens were commonly located in flood plains, in close proximity to the village. Once a field was unable to produce successful harvests, the tribe abandoned the field and began the process again in another area. Since the farming plots

were relatively small in size, the Native American inhabitants disturbance to the forests were low. They had a great respect for the land and were excellent caretakers. Utilizing only the natural resources needed to survive, the impact on the environment was minimal. For example, tribes built their shelters, called wigwams, from saplings and bark collected along the forest floor rather than cutting down large trees for logs. To navigate through the dense forests, they blazed a series of trails oriented between the Delaware River and the Atlantic Ocean. Many of these trails recognized the topography of the land and followed along the river valleys. Today, modern roadways such as the Lincoln Highway, Easton Highway and Old York Road generally follow the path of these former trails. Canoes were used to navigate along the Raritan River and its tributaries.[2]

Historic Properties – Colonial Settlement

The native tribes and culture all but vanished from the New Jersey landscape soon after the induction of the first European settlers. Sailing under the French flag, the Italian explorer Giovanni da Verrazano, entered into the Raritan Bay near Sandy Hook in 1524, but did not land. Later Henry Hudson, an Englishman sailing under the Dutch flag, traveled to "the New World" in search of the Great Northwest Passage to India. After exploring the Delaware River, Hudson sailed up the New Jersey coast and landed at Sandy Hook in 1609 before continuing onto the River that today carries his name. Not long after Hudson's voyage, the Dutch began settling the area along the Hudson and Delaware Rivers, establishing the colony of New Netherlands. The focal point of the Dutch settlement was the fortress at New Amsterdam located on the island of Manhattan. Essentially, the Dutch were more concerned with searching for gold and fur trading than forming permanent settlement in the "New World." A few of the more adventurous settlers spread out beyond the security of New Amsterdam into New Jersey along the Raritan and Hackensack River valleys. However, not until 1660 did the village of Bergen (present-day Jersey City) become the first permanent settlement in New Jersey. Soon after, in 1664, the English seized control of all the land between the Connecticut and Delaware Rivers, thus ending Dutch claim to the area. The English were eager to attract new colonists to [the] settle the area, farm the land and establish permanent settlements. During the period between1670-1720, colonists from Long Island, New England and the Hudson Valley migrated into New Jersey. The rich soils and inexpensive land of New Jersey were preferred over the rocky terrain further north. Puritans, Quakers, and Baptists from adjacent colonies settled in New Jersey to enjoy religious freedom. In addition to the English, many Scottish, German and Dutch settlements were [estimated] established within the Raritan Basin.[3]

Under the British regime, the area located between the Hudson and Delaware Rivers became known as the Province of New Cesarea or New Jersey. After King Charles II established English claim to the area in 1664, land rights were exchanged several times until 1676 when the Province was split in half to form East Jersey and West Jersey. The Keith Line, surveyed in 1687, ran straight through the Raritan Basin dividing East Jersey from West Jersey. The line began at a point along the Barnegat Bay and traversed northwesterly to Three Bridges on the South Branch of the Raritan River. The Coxe and

Barclay Line extended the boundary north along the Lamington and Passaic Rivers. What are now the counties of Hunterdon, Morris and part of Mercer were located in West Jersey. Monmouth, Middlesex, Somerset, Union, and the remainder of Mercer were situated in East Jersey. Formation of counties began in 1683 when Essex, Bergen, Middlesex and Monmouth became the four original counties of East Jersey. Somerset County was set off from Middlesex County in 1688 due to flooding issues in Somerset County. In the West Jersey portion of the Raritan Basin, the land was entirely within what was then Burlington County. After East and West Jersey were reunited in 1702, county boundaries became more defined. As the population increased and the more remote sections of the colony were settled, new counties were formed. Due to extremely long distance required to travel to court in Burlington County, Hunterdon County was formed in 1714. Likewise in 1739, Morris County formed as a result of the long journey to the Hunterdon County courthouse. Not until 1838 was Mercer County created from parts of Burlington, Hunterdon, Middlesex, and Somerset counties. The final county comprising the Raritan Basin, Union County, split from Essex County in 1857 due to political struggles between Newark and Elizabeth.[4]

Elizabethtown, located in present day Union County, was the first English settlement within New Jersey. Shortly after, the Navesink Patent was founded in Monmouth County along the shores of Raritan Bay. The boundaries of both settlements extended deep into the Raritan Basin. Piscataway, the first settlement located entirely within the Raritan Basin, and Woodbridge, were established in 1666.[5] At the mouth of the Raritan River, Perth Amboy was founded in 1683. The village attracted many settlers and in 1686, became the capital of East Jersey. By 1685, much of land along the main stem of the Raritan River had been settled. These first settlements were located adjacent to the rivers, which were the primary routes of transportation. John Inian, the creator of the Assanpink Trail, founded a settlement known as Inian's Landing at present-day New Brunswick in 1686. As exploration continued, settlements spread further inland during the remainder of 1600's and into the early 1700's. Communities developed along the North and South Branch Raritan River, Millstone River and South River and by 1735, most of the Raritan Basin was at least sparsely inhabited. [6] As the population gradually increased, the Raritan Basin remained rural with the exception of a few small market towns such as Perth Amboy, Freehold, New Brunswick, and Princeton. New Brunswick and Perth Amboy developed into successful ports, which resulted in the entire lower Raritan River becoming an important transportation link with the potential to be one of the busiest waterways in the colonies.

The Raritan Basin was fortunate to contain both the College of New Jersey (Princeton University) which relocated to Princeton in 1756 and Queens College (Rutgers University) in New Brunswick, formed in 1766. In fact, New Jersey was the only colony at that time to boast two colleges within its borders. During the time of the American Revolution, the towns within the Raritan Basin were brimming with activity. New Brunswick and Princeton, both played a central role in the formation of the new Nation. Princeton, for example, was the capital of the United States for a brief time after the War. Two of the six colonial barracks were located in the Raritan Basin at Perth Amboy and

New Brunswick. Figure 2 displays the population density of the State and political boundaries in 1784 and 1810.

Appendix B – Traditional and Resource Use

Excerpts from "Landscape of the Raritan River Basin,: a Technical report for the Raritan Basin Watershed Management Project " Final Report - August 2002, prepared by New Jersey Water Supply Authority, pages 8-10.

Early Agriculture and Industry

At the onset of European settlement, the rich soils and favorable climate made the land in New Jersey ideal for agricultural development. Although mostly forested, the Raritan Basin, especially in the Piedmont Province, was well suited for farming and attracted farmers from surrounding colonies and abroad. Initially, land was inexpensive and plentiful for those who settled in the area. By the end of the colonial period, the forested land suitable for farming was transformed to agricultural production. As population in the colonies grew, Raritan Basin farmers enjoyed the close proximity to the large urban markets of Philadelphia and New York. Highly perishable fruits and vegetables, grown in New Jersey, were transported only a short distance to the marketplaces. Wheat was the primary crop grown in New Jersey, thereby giving the State the reputation as one of the "bread colonies." Particularly in the Raritan Valley (Middlesex and Somerset counties) wheat was an important crop. The lush soils found in Hunterdon County also produced high yields of wheat for flour. Rye and white potatoes also were grown within the Basin particularly in Monmouth, Mercer and Middlesex counties. Southern Middlesex County was especially known for its garden vegetables and fruits. Apple orchards were abundant in Cranbury Township, Middlesex County, as well as in Monmouth and Mercer counties. Peach orchards were found in the northern part of the Basin and also in the areas adjoining the Sourland Mountains. In addition to the variety of crops grown within the Raritan Basin, early residents relied on fishing, trapping, hunting and later herding. When the Europeans settlers arrived in the "New World," they brought with them farm animals that were not native to North America such as chickens, sheep, hogs and cattle. Flax, wool and cattle flourished in the Black River Valley of Morris County. Dairy production was a staple in Hunterdon County. Finally, the forests within the Raritan Basin were vital during the colonial times since all the structures were made of wood cut from local forests. However, a growing population and the looming industrial boom would begin an unending competition for land in New Jersey. This competition for land has resulted in a statewide decline of agricultural land use form three million acres in 1860 to 850,000 acres in 1992.[8]

The initial industries evolved along the rivers of the Raritan Basin. The stream network provided the waterpower necessary to run the gristmills, sawmills, paper mills and textile mills that spread throughout the area. Iron mines operated in the extreme northwest

portion of the Basin, around Chester and Schooley's Mountain. An iron forge and foundry operated at Union, near High Bridge in Hunterdon County. By the late 1700's, the bog-iron industry, common in the southern part of New Jersey, extended northward into Spotswood. Nearby forests supplies the fuel to operate the iron production. Copper mining thrived in the Rocky Hill area, in the hills of Morris County, and in the vicinity of Pluckemin, along the First Watchung Ridge. [9] Marl was mined in Western Monmouth County, while brick and clay production was focused in Middlesex County. Whiskey distilleries became common throughout the Basin. With the beginning of the industrial revolution in the 1820's, the Raritan Basin again prospered due to its strategic location between New York and Philadelphia. Towns including Flemington and Somerville flourished financially. New Brunswick was an active producer of rubber and wallpaper. Helmetta specialized in snuff and tobacco production. Copper smelting and refining centers, chemical plants, petroleum refineries, pharmaceutical companies and ship building facilities developed along the lower Raritan River. With the increase in employment opportunities, the population continued to rise steadily through the Industrial Revolution. From 18730 to 1880, New Jersey's population rose by 200%. The State reached one million residents by 1880 and could be considered an urbanized state, having 54% of its population living in towns. New Brunswick was the largest city in the Raritan Basin with over 15,000 residents, followed by the City of Plainfield with over 5,000 residents.[10] Immigration during the 1800's also contributed to the rise in population. New arrivals from Europe and around the world made their way to the Raritan Basin via the ports of Hoboken and Jersey City.

Transportation

With an expanding population, productive farms and a developing manufacturing base, a strong transportation system has always been an essential component of the State. In addition to the river, the colonial transportation network consisted of improved Native American trails. Eventually, the need for better roadways between the bustling cities of Philadelphia and New York was realized and new roads were blazed. Old York Road, a popular stagecoach route between the two cities, also served Centerville, Two Bridges, White Oaks, and Somerville in the Basin. Present-day State Route 27 is almost identical to the colonial route between New Brunswick and Trenton. King's Highway (Georges Road) connected Allentown, New Jersey to New Brunswick via Cranbury, Dayton, and Deans. Towns such as Pottersville, Raritan, Englishtown, Bound Brook, and Chester flourished along stagecoach routes with taverns and inns serving weary travelers. Initially, road conditions were miserable and stagecoaches traveling these poorly maintained roads dealt with extremely unpleasant conditions (bumps, ditches, water). Beginning in 1801, a system of turnpikes was planned and built mostly in the northern half of New Jersey. These routes were "pay as you go" and tolls were set at one cent per mile per horse, to be paid at barriers and pikes. Traffic continued to increase with more passenger trips as well as wagons transporting farm produce to ships bound for places such as New England. Roads were eventually improved and topped with crushed gravel. Many of the turnpikes authorized during this time connected with the towns of the Raritan Basin. The Easton Turnpike, later called the New Jersey Turnpike (modern U.S. 22) traversed the Basin from Phillipsburg to New Brunswick via Clinton and Somerville.

Washington Turnpike connected Phillipsburg with Morristown and meandered through the villages of Long Valley, Chester, and Mendham. Other former turnpikes including Old Germantown, Bordentown & South Amboy, Franklin & Georgetown, Perth Amboy and Woodbridge have remnants still visible today. Eventually, the turnpikes were abandoned as toll roads in 1832.

In addition to the road network, the need for a fast, safe water passageway between Philadelphia and New York was desired. In 1676, William Penn envisioned the construction of a canal through the "waist" of New Jersey and a possible canal route was surveyed as early as 1794. However, it was not until 1804 when the New Jersey Legislature chartered the New Jersey Navigation Company that the plans for a canal proceeded. In 1816, the route was decided upon and construction of the Delaware & Raritan Canal (D&R Canal) began in 1830. The first segment between Trenton and Kingston opened in 1833 for local traffic. Finally, on June 25, 1834, the entire length between Bordentown and New Brunswick opened with celebrations led by Governor Peter Vroom. The Canal operated during the peak of the Industrial Revolution and had a significant impact on the growth of manufacturing, especially in South Bound Brook and New Brunswick. Standard Paint Company and Shurt's Yard were located on the D&R Canal in South Bound Brook. Many of the steamboats that traveled on the Canal were built at Shurt's Yard. The largest steamboat built here was called the *Franklin*, which measured 130 feet long and could haul 300 tons.[12] Many of the boat yards and repair facilities were located in New Brunswick in the vicinity of Albany Street. At New Brunswick, the Canal's northern terminus, boats were able to navigate the Raritan River and head out to sea via ports in New York or New Jersey. Many small towns grew along the banks of the D&R Canal. In the Raritan Basin, Kingstown, Griggstown, Blackwell Mills, and East Millstone supported the operation of the Canal with taverns, inns, mills and farms.

Prior to the opening of the D&R Canal, goods destined for New York from Philadelphia were shipped by sea around Cape May and continued by way of the Atlantic Ocean. However, with the new canal route, the travel distance between the two cities was reduced by 110 miles. One of the primary articles transported on the D&R Canal was anthracite coal from the Lehigh Valley destined to factories in New York. Large, flat boats called barges, carried up to 192 tons of coal in a single trip. By the start of the Civil War, the D&R Canal was experiencing very high levels of traffic, and reached its peak in 1871. Ironically, that same year, the D&R Canal was leased to the Pennsylvania Railroad for a period of 999 years. The thriving days of the Canal would not last much longer. In 1893, the Canal operated at a deficit for the first time ever. By the beginning of the 20th century, use of the Canal continued to decline and was constantly operating at a loss. Under the control of the Pennsylvania Railroad, repairs became more and more infrequent and the Canal began to exhibit signs of deterioration. During the winter months, the Canal closed for dredging and repairs to the stone linings and banks. By the spring of 1933, the Pennsylvania Railroad alerted the State that the Canal would not reopen. The Canal was taken over by the State in 1934 and formally deeded over in 1937. Inevitably, the boom of the railroad industry brought about the demise of canals. Railroads transported manufactured goods, raw materials and agricultural produce to the

cities at a faster pace and lesser cost. Trains were able to haul coal from the Lehigh Valley to the ports of Jersey City, Hoboken and Newark more efficiently. Passenger rail lines moved large numbers of commuters into the cities and vacationers to the mountain and shore resorts.

Receiving a charter in 1830, the Camden and Amboy Railroad (C&A Railroad) became the first rail line in the State of New Jersey. In 1834, the route from South Amboy to Bordentown and onto Camden was completed, allowing goods to move between Philadelphia and New York utilizing a system of rail lines and ferries. Within the Raritan Basin, the Camden and Amboy Railroad served the towns of Hightstown, Jamesburg, Helmetta, Spotswood, and Old Bridge. By 1840, track was laid between Trenton and New Brunswick, completing the first continuous rail line from Philadelphia to New York via Metuchen, Elizabeth and Newark. Several branch lines were built to connect to East Millstone, Kingston and Princeton to the mainline. The branch lines from Monmouth Junction in South Brunswick Township to Sea Girt served the communities of Jamesburg and Freehold. As service between Philadelphia and New York intensified, the line through New Brunswick was extended to four tracks in 1893. By that time, as with the D&R Canal, the Pennsylvania Railroad took over operation of the C&A rail lines. In 1876, a competing line was built between Philadelphia and the Raritan Bay. The Philadelphia & Reading Railroad, entering New Jersey at West Trenton, served the towns of Pennington, Hopewell, Belle Meade, Manville and Bound Brook. Railroad construction continued throughout the Raritan Basin during the 1800's, creating an extensive network of heavily traveled rail lines that crisscrossed the terrain.

From the brochure – "Delaware & Raritan Canal State Park," State of New Jersey, Department of Environmental Protection, Division of Parks and Forestry, State Park Service.

Today, "the 70 mile Delaware and Raritan Canal State Park is one of central New Jersey's most popular recreational corridors for canoeing, jogging, hiking, bicycling, fishing and horseback riding. The canal and the park are part of the National Recreation Trail System. This linear park is also a valuable wildlife corridor connecting fields and forest. A bird survey conducted in the park revealed 160 species, almost 90 of which nest in the park.

In 1973, the canal and its remaining structures were entered on the National Register of Historic Places. In 1974, over 60 miles of the canal and a narrow strip of land on both banks were made a state park. A portion of the Belvidere-Delaware Railroad corridor from Bull's Island to Frenchtown was added to the park in the 1980's. The park's trail system was designated a National Recreation Trail in 1992."