Annual Site Environmental Report

PPPL - 5068

Princeton Plasma Physics Laboratory

Operated by Princeton University For the U.S. Department of Energy Under Contract DE-AC02-09CH1

2013

PPPL PRINCETON PLASMA PHYSICS LABORATORY

U.S. DEPARTMENT OF ENERGY

Princeton Plasma Physics Laboratory
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NOTE: ***Data tables are located in Appendix A - 2013 Tables beginning on page 68. All tables as noted in the report are located in Appendix A***.

2013 Annual Site Environmental Report
List of Acronyms

A- & B-	A & B-sites of James Forrestal Campus, formerly part of PPPL
AEA	Atomic Energy Act of 1954
AFV	alternative fuel vehicles
ALARA	as low as reasonably achievable
ARD	America Recycles Day (November 15th)
B1, B2	Bee Brook 1 (upstream of DSN001) and 2 (downstream of DSN001) (surface water stations)
B-20/100	biofuel (20%/100%)
BCG	biota concentration guide
BPX	Burning Plasma Experiment
Bq	Becquerel
BTU/gsf	British Thermal Unit per gross square feet
°C	Degrees Celsius
C- & D-	C & D-sites of James Forrestal Campus, currently site of PPPL
C1	Canal - surface water monitoring location (Delaware & Raritan Canal)
c-1,2-DCE	cis-1,2-dichloroethylene
C&D	Construction and demolition (waste)
CAA	Clean Air Act
CAS	Coil Assembly and Storage building
CDX-U	Current Drive Experiment – Upgrade (at PPPL)
CEA	classified exception area
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEDR	Comprehensive Energy Data Report
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
Ci	Curie (3.7^{E10} Becquerel)
CIT	Compact Ignition Tokamak
cm	centimeter
CNG	compressed natural gas
CO_2	carbon dioxide (GHG)
CO_{2e}	carbon dioxide equivalent
COD	chemical oxygen demand
CPO	chlorine-produced oxidants known as total residual chlorine
CWA	Clean Water Act
CXs	categorical exclusions
CY	calendar year
DCE	dichloroethylene
D-D	deuterium-deuterium
DART	days away, restricted transferred (case rate - Safety statistic)
DATS	differential atmospheric tritium sampler
DESC	Defense Energy Supply Center
DMR	discharge monitoring report
DOE	Department of Energy
DOE-HQ	Department of Energy - Headquarters
DOE-PSO	Department of Energy - Princeton Site Office
DOT	Department of Transportation
DPCC	Discharge Prevention Control and Containment
dpm	disintegrations per minute

D&R	Delaware & Raritan (Canal)
DSN	discharge serial number
E1	surface water monitoring station (NJ American Water Co. potable water source)
E-85	ethanol (85%) fuel
EDE	effective dose equivalent
EDP	effective date of permit
EHS	extremely hazardous substance
EISA	Energy Independence and Security Act, Section 432
EML	Environmental Monitoring Laboratory (DOE)
EMS	Environmental Management System
EO	Executive Order
EPA	Environmental Protection Agency (US)
EPCRA	Emergency Planning and Community Right to Know Act
EPEAT	Electronic Product Environmental Assessment Tool
EPP	Environmentally Preferred Products
ESD	Environmental Services Division (PPPL)
ES&H	Environment, Safety, and Health
ESHD	Environment, Safety, & Health Directives
ESPC	Energy Savings Performance Contract
^{o}F	Degrees Fahrenheit
FFCA	Federal Facility Compliance Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FY	fiscal year (October 1 to September 30)
GGE	Gasoline gallon equivalent
GHGs	greenhouse gases
GP	Guiding principles
GPP	General plant projects
GSA	General Services Administration
GSF	gross square feet
HAZMAT	hazardous materials
HP	Health Physics Division of ES&H
HPSB	high performance and sustainable buildings
HQ	Headquarters
HT	tritium (elemental)
HTO	tritiated water or tritium oxide
IC25	Inhibition concentration
ILA	Industrial landscaping and agriculture
ISO14001	International Standards Organization 14001 (Environmental Management System – EMS)
ITER	International Thermonuclear Experimental Reactor (France)
JFC	James Forrestal Campus
JET	Joint European Torus facility (United Kingdom)
km	kilometer
kWh	kilowatt hour
LEC	liquid effluent collection (tanks)
LED	Light emitting diode
LEED	Leadership in Energy and Environmental Design
LEED-EB	Leadership in Energy and Environmental Design - Existing Buildings
LLD	Lower limit of detection

LLW	Low level waste
LSB	Lyman Spitzer Building (Formerly Laboratory Office Building)
LSRP	Licensed Site Remediation Professional
LOI	Letter of Interpretation (Wetlands)
LOTO	lock-out, tag-out (electrical safety)
LSI	lined surface impoundment
LTX	Lithium Tokamak Experiment
M1	Millstone River (surface water station)
MC&A	Material Control & Accountability (nuclear materials)
MG	Motor Generator (Building)
MGD	Million gallons per day
mg/L	milligram per liter
M&O	Maintenance &Operations
mrem	milli roentgen equivalent man (per year)
MRX	Magnetic Reconnection Experiment
MSDS	Material Safety Data Sheet
msl	mean sea level (in feet)
mSv	milliSievert
MT	metric ton (equivalent to 2,204.6 pounds or 1.10 tons)
MW	monitoring well
Mwh	Megawatt hour
MSW	Municipal solid waste
n	neutron
N or N-	nitrogen
NCSX	National Compact Stellarator Experiment
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic and Preservation Act
NIST	National Institute of Standards and Technology
NJAC	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection (prior to 1991 and after July 1994)
NJPDES	New Jersey Pollutant Discharge Elimination System
NNSS	Nevada National Security Site (DOE site)
NOEC	no observable effect concentration
NOVs	Notice of violations
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NSTX-U	National Spherical Torus Experiment Upgrade
NSTXCC	National Spherical Torus Experiment Computer Center
NVLAP	National Voluntary Laboratory Accreditation Program (NIST)
ODS	ozone-depleting substances (Class I and II)
OQA	Office of Quality Assurance (NJDEP)
OPEX	Operating expenses (PPPL budget)
ORPS	occurrence reporting and processing system ((DOE accident/incident reporting system)
OSHA	Occupational Safety and Health Agency
P1, P2	Plainsboro 1 (Cranbury Brook) and 2 (Devil's Brook) (surface water stations)
PCBs	polychlorinated biphenyls

PCE	perchloroethylene, tetrachloroethene, or tetrachloroethylene
pCi/L	picoCuries per liter
PE	Professional engineer
PEARL	Princeton Environmental, Analytical, and Radiological Laboratory
PFC	Plasma facing component
PJM	Pennsylvania, Jersey, Maryland (Electric-power grid controllers/operators)
POTW	publicly-owned treatment works
PPA	Power Purchase Agreement
PPPL	Princeton Plasma Physics Laboratory
PPTRS	Pollution Prevention Tracking System Report
PSTP	Preliminary Site Treatment Plan
PT	proficiency test (Laboratory certification)
PTE	potential to emit (air emissions)
PUE	Power utilization effectiveness
QA/ QC	Quality assurance/ Quality control
RAA	Remedial Alternative Assessment
RASR	Remedial Action Selection Report
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act
REC	renewable energy credits
redox	oxidation-reduction (potential)
rem	roentgen equivalent man
RESA	Research Equipment Storage and Assembly Building
RI	Remedial Investigation
RWHF	Radiological Waste Handling Facility
SF_6	sulfur hexafluoride (GHG)
SARA	Superfund Amendments and Reauthorization Act of 1986
SBRSA	Stony Brook Regional Sewerage Authority
SDWA	Safe Drinking Water Act
SESC	Soil erosion and sediment control
SO_2	sulfur dioxide
SPCC	Spill Prevention Control and Countermeasure
SWPPP	Stormwater Pollution Prevention Plan
SVOCs	semi-volatile organic compounds
T	tritium
TCE	trichloroethene or trichloroethylene
TFTR	Tokamak Fusion Test Reactor
TPHC	total petroleum hydrocarbons
TRI	Toxic Reduction Inventory (CERCLA)
TSCA	Toxic Substance Control Act
TSS	total suspended solids
TW	test wells
UL-DQS	Underwriters Laboratories-DQS (Germany's first certification body)
USGBC	US Green Building Council
USGS	US Geological Survey
VOCs	volatile organic compounds
μg/L	micrograms per liter

Princeton Plasma Physics Laboratory (PPPL)
Certification of Monitoring Data for
Annual Site Environmental Report for 2013

Contained in the following report are data for radioactivity in the environment collected and analyzed by Princeton Plasma Physics Laboratory's Princeton Environmental, Analytical, and Radiological Laboratory (PEARL). The PEARL is located on-site and is certified for analyzing radiological and non-radiological parameters through the New Jersey Department of Environmental Protection's Laboratory Certification Program, Certification Number 12471. Non-radiological surface and ground water samples are analyzed by NJDEP certified subcontractor laboratories – QC, Inc. and Accutest Laboratory. To the best of our knowledge, these data, as contained in the "Annual Site Environmental Report for 2013," are documented and certified to be correct.

Signed:

Virginia L. Finley

Digitally signed by Virginia L. Finley
DN: cn=Virginia L. Finley, o=Princeton Plasma Physics Laboratory, ou=ESH&S Dept., email=vfinley@pppl.gov, c=US
Date: 2014.09.08 17:16:19 -04'00'

Virginia L. Finley,
Head, Environmental Compliance
Environmental Services Division

Robert Sheneman

Digitally signed by Robert Sheneman
DN: cn=Robert Sheneman, o=Princeton Plasma Physics Laboratory, ou=ESH&S Dept., email=rsheneman@pppl.gov, c=US
Date: 2014.09.09 16:19:59 -04'00'

Robert S. Sheneman,
Deputy Head
Environment, Safety, & Health and Security Department

Approved:

Jerry D. Levine

Digitally signed by Jerry D. Levine
DN: cn=Jerry D. Levine, o, ou, email=jlevine@pppl.gov, c=US
Date: 2014.09.09 16:58:45 -04'00'

Jerry D. Levine,
Head
Environment, Safety, & Health and Security Department

Executive Summary

Princeton Plasma Physics Laboratory
Annual Site Environmental Report for
Calendar Year 2013

This report presents the results of environmental activities and monitoring programs at the Princeton Plasma Physics Laboratory (PPPL) for Calendar Year 2013. The report provides the U.S. Department of Energy (DOE) and the public with information on the level of radioactive and non-radioactive pollutants, if any, that are released into the environment as a result of PPPL operations. The report also summarizes environmental initiatives, assessments, and programs that were undertaken in 2013. The objective of the Site Environmental Report is to document PPPL's efforts to protect the public's health and the environment through its environmental protection, safety, and health programs.

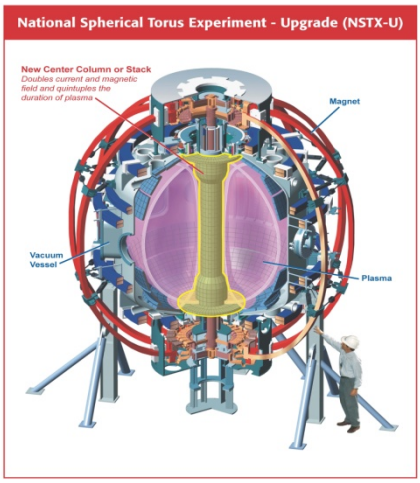
Since 1951, the Princeton Plasma Physics Laboratory has engaged in fusion energy research. Fusion is the reaction that occurs in our sun as well as in other stars. During fusion reactions, the nuclei of hydrogen atoms in a plasma state, *i.e.* as an ionized gas, fuse or join forming helium atoms and releasing of neutrons and energy. Unlike the sun, PPPL's fusion reactions are magnetically confined within a vessel or reactor under vacuum conditions. The long-range goal of the U.S. Magnetic Fusion Energy Science program is to develop and demonstrate the practical application of fusion power as a safe, alternative energy source replacing power plants that burn fossil fuels. Energy from fusion power plants would boil water for steam that drives electric-generating turbines without the production of greenhouse gases and other air pollutants.

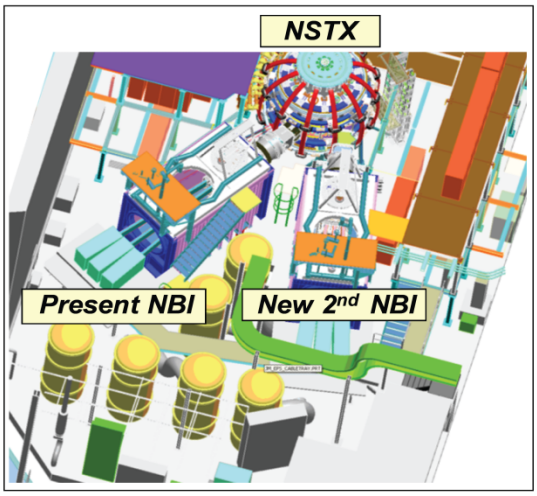
National Spherical Torus Experiment - Upgrade

Though 2013 marked the fifthteenth year of the National Spherical Torus Experiment (NSTX), NSTX did not operate nor conduct experiments. After a thorough review in 2010, PPPL and DOE jointly decided to commence the planned NSTX upgrade project, in lieu of making repairs to the magnetic coils that confine the plasma and continuing operations in 2012. The upgrade plan for NSTX includes the redesign of the center stack magnets and the addition of a second neutral beam box from the former Tokamak Fusion Test Reactor (TFTR). In NSTX, the plasma is heated by radio-frequency waves and deuterium (hydrogen isotope with one neutron) neutral beam injection, which adding a second neutral beam will allow for greater heat capacity and hotter experimental 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 with in 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 new center column or stack is shown in a yellow outline, the vacuum vessel is spherical in shape and produces a "round" plasma, and the person standing next to the right-hand base illustrates the scale of this device. In the drawing on the right, the two neutral beam injectors (NBI) are shown.

ITER Cadarache, France

ITER in Latin means "the way" and is the name of the large international fusion experiment located in the Provence-Alpes-Côte-d'Azur region in southeastern France. Construction began in 2007 with a completion date in the early 2020's. When operational ITER will generate 10 times the external power delivered to heat the plasma. PPPL, partnering with Oak Ridge National Laboratory, leads the U.S. ITER Project that coordinates U.S. ITER activities - lending to the project design, construction, and technical expertise.

PPPL Maximum Off-site Dose in 2013

When the total maximum off-site dose for 2013 was calculated, PPPL's radiological contribution was a fraction of the 10 mrem/year PPPL objective and the 100-mrem/year DOE limit. Based on the radiological monitoring program data, the dose results for 2013 were:

1. Total maximum off-site dose from all sources—airborne and liquid releases—was 6.36 x10^{-3}mrem per year (6.36x10^{-5} mSv per year).
2. Dose at the nearest business (at the site boundary) due to airborne releases was 6.0 x 10^{-4} mrem per year (6.0x10^{-6} mSv per year).
3. The collective effective dose equivalent for the population living within 80 kilometers was 0.0236 person-rem (2.36x 10^{-4} person-Sv).

In 2013, Princeton Plasma Physics Laboratory accepted the following awards:

- U.S. Department of Energy (DOE) GreenBuy Gold Award for the 2nd year in a row, for its green purchasing program. Continued Environmentally Preferred Purchasing over a number of fields to include recycled content, Bio-based, low VOC, Energystar®, EPEAT and less toxic products.
- The New Jersey Department of Environmental Protection (NJDEP) recognized PPPL's outstanding Environmental Stewardship Program. Of the 21 categories, PPPL participates in 20 programs that range from recycling paper, glass, metals, and cardboard to purchasing green sustainable products, including renewable energy. PPPL lead the state in this achievement.

PPPL Achievements and Activities in 2013

PPPL encourages its employees to practice environmental stewardship principles in their daily lives through their personal purchases and recycling activities as well as at PPPL. Each year, the Laboratory hosts events such as Earth Week and America Recycles Day when information on green products and recycling opportunities are provided. PPPL's "Green Team" designs programs and activities to help green PPPL and the whole community. In June 2013, PPPL opened its door and invited the public to a Day at PPPL. Over 3,000 visitors toured the experimental areas, experienced hands-on activities in science education laboratory, and viewed presentations given by PPPL's scientists, engineers, and technical staff.

PPPL Director Steward Prager hold certificate awarded by NJDEP Asst. Commissioner Wolfgang Skacel

The Laboratory expects to continue excelling in all aspects of ES&H as it has in its fusion research program. Efforts are geared not only to full compliance with applicable local, state, and federal regulations, but also to achieve a level of excellence in ES&H performance. PPPL is an institution that serves other research facilities and the nation by providing valuable information gathered from its fusion research program.

Chapter

1

Introduction

1.1 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 understandings and key innovations leading to an attractive fusion energy source [PPPL08a]. Related missions include conducting world-class research along the broad frontier of plasma science, providing the highest quality of scientific education and experimentation, and participating in technology transfer and science education projects/programs within the local community and nation-wide.

The National Spherical Torus Experiment (NSTX) is a collaborative project among 30 U.S. laboratories, including Department of Energy National Laboratories, universities, and institutions, and 28 international institutes from 11 countries. Also located at PPPL are smaller experimental devices, the Magnetic Reconnection Experiment (MRX), the Lithium Tokamak Experiment (LTX) and Hall Thruster, which investigate plasma physics phenomena.

As a part of both off and on-site collaborative projects, PPPL scientists assist fusion programs within the United States and in Europe and Asia. To further fusion science in 2013, PPPL collaborated with other fusion research laboratories across the globe on the Joint European Torus (JET) facility located in the United Kingdom, and the International Thermonuclear Experimental Reactor or ITER, which in Latin means "The Way," located in Cadarache, France. PPPL's main fusion experiment, the National Stellarator Tokamak Experiment Upgrade project (NSTX-U), began in 2011 and is scheduled for completion in late 2014.

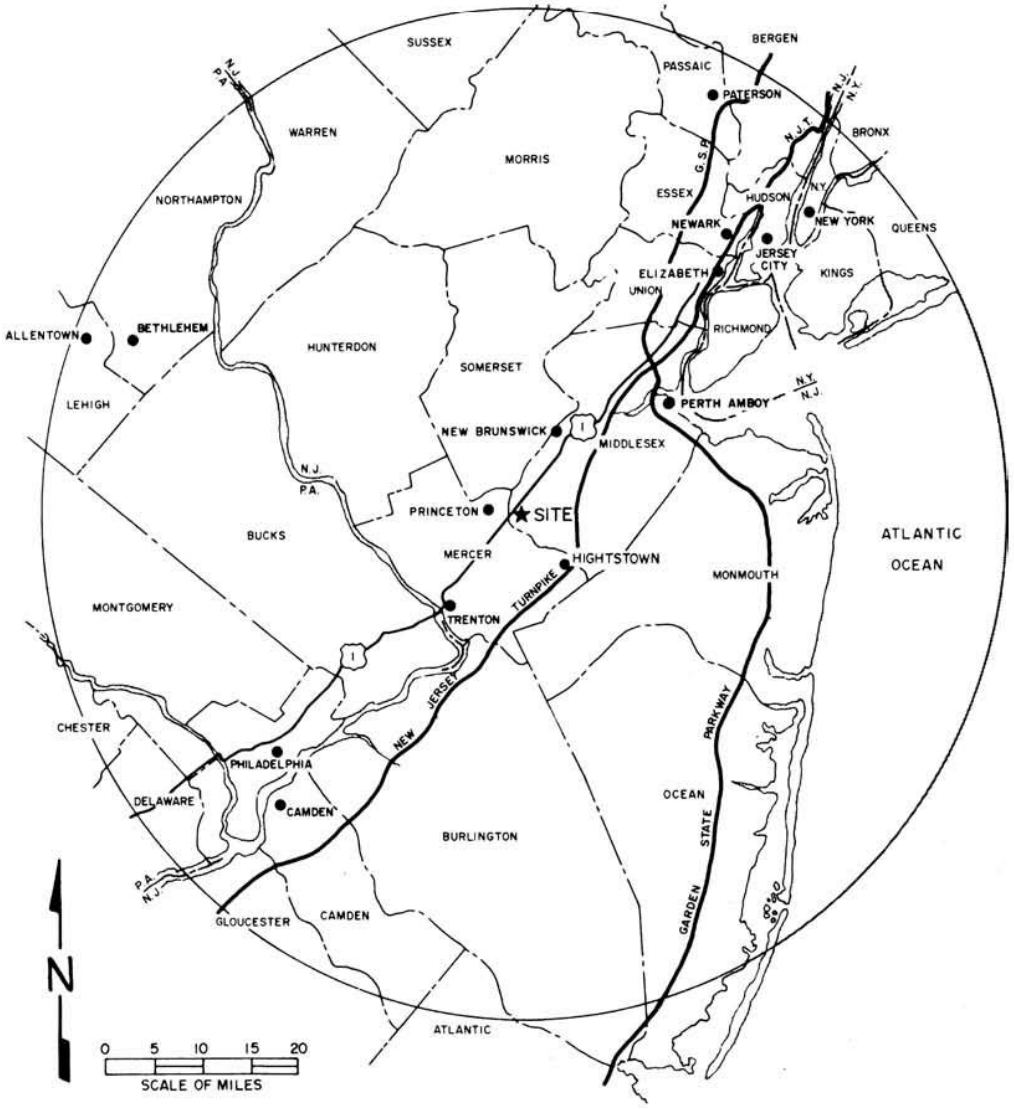
1.2 Site Location

The Princeton Plasma Physics Laboratory site is in the center of a highly urbanized Northeast region. The closest urban centers are New Brunswick, 14 miles (22.5 km) to the northeast, and Trenton, 12 miles (19 km) to the southwest. Within a 50-mile (80 km) radius are the major urban centers of New York City, Philadelphia, and Newark (Exhibit 1-1).

The site is located in Plainsboro Township in Middlesex County (central New Jersey), adjacent to the municipalities of Princeton, Kingston, East and West Windsor, and Cranbury, NJ. The Princeton area continues to experience a sustained growth of new businesses locating along the

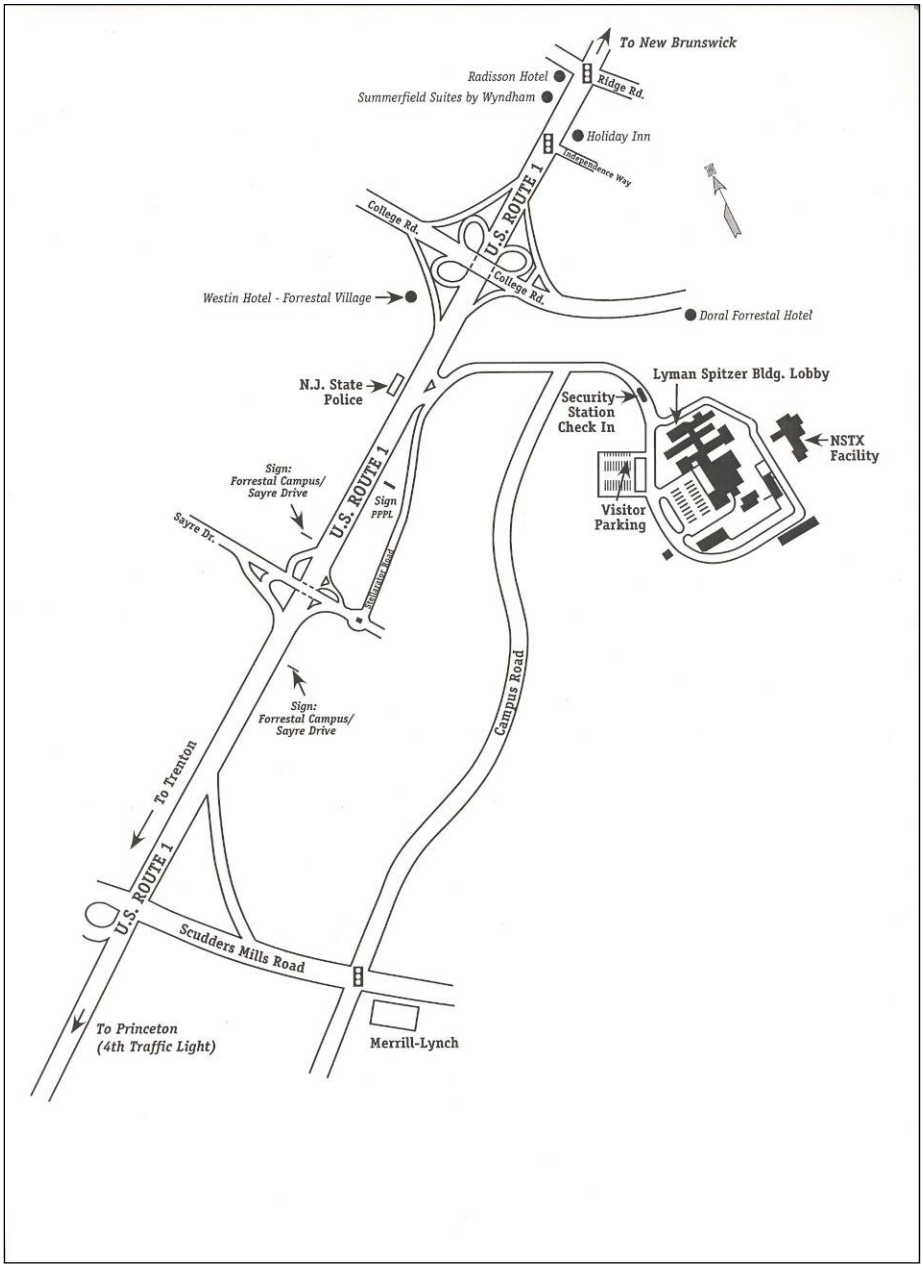
Route 1 corridor near the site. In 2012 construction was completed on the new University Medical Center of Princeton Center at Plainsboro, which is located less than 2 miles south of PPPL. Princeton University's main campus is approximately three miles west of the site.

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



PPPL, then known as "Project Matterhorn", was first established on A- and B- sites of the James Forrestal Campus (JFC), Princeton University's research center named for Princeton graduate (Class of 1915) and the first Secretary of Defense, James Vincent Forrestal. Located east of U.S. Route 1 North, PPPL has occupied the C- and D-site location since 1959 (Exhibit 1-2). The alphabet designation was derived from the names given to the Stellarator models, those early plasma fusion devices.

Exhibit 1-2. PPPL James Forrestal Campus (JCF), Plainsboro, NJ



Surrounding the site are lands of preserved and undisturbed areas including upland forest, wetlands, open grassy areas, and a minor stream, Bee Brook, which flows along PPPL's eastern boundary. These areas are designated as open space in the James Forrestal Campus (JFC) site development plan.

D-site is fully surrounded by a chain-linked fence topped with barbed wire for security purposes. Access to D-site is limited to authorized personnel through the use of card readers.

PPPL's Site Protection Division controls access to C-site allowing the public and visitor access following an identification check. Vehicle inspections may occur prior to entrance.

Exhibit 1-3. Aerial View of PPPL

1.3 General Environmental Setting

The climate of central New Jersey is classified as mid-latitude, rainy climate with mild winters, hot summers, and no dry season. Temperatures may range from below zero to above 100 degrees Fahrenheit (°F) (17.8°Celsius (C) to 37.8° C); extreme temperatures typically occur once every five years. Approximately half the year, from late April until mid-October, the days are freeze-free.

The typical regional climate is moderately humid with a total average precipitation about 46 inches (116 cm) evenly distributed throughout the year. Droughts typically occur about once every 15 years [PSAR78]. In 2013, the annual rainfall total was 43.25 inches (109.85 cm), just below the average rainfall for central New Jersey.

The most recent archaeological survey was conducted in 1978 as part of the TFTR site environmental assessment study. Through historical records reviews, 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. No significant archeological resources were identified on-site. There are more significant examples of prehistoric occupation in areas closer to the Millstone River, which are within two miles of the site [Gr77].

1.4 Primary Operations and Activities

Several magnetic fusion experiments, including NSTX, Magnetic Reconnection Experiment (MRX), or Lithium Tokamak Experiment (LTX), currently operate at PPPL. NSTX is the Laboratory's largest experiment and it is located on D-site. NSTX has produced one million amperes of plasma current, setting a new world record for a spherical torus device. This device is designed to test the physics principles of spherical-shaped plasmas forming a sphere with a hole through its center. Plasma shaping is an important parameter for plasma stability and performance enabling viable fusion power. NSITX ceased operations in 2011 and was partially dismantled for major upgrades which are scheduled to be finished in 2014. The upgraded experiment, known as NSTX-U, will have twice the plasma heating power and magnetic confinement and be able to extent the pulse duration by five times.

The former TFTR Test Cell was named the National Compact Stellarator Experiment (NCSX) Coil Winding Facility, where the magnetic coils were wound with copper coils, taped, and baked with an epoxy. In May 2008, when the DOE Office of Science halted NCSX construction, PPPL's staff began decommissioning the experiment. All the fabricated parts of the NCSX are stored into the Test Cell on C-site that would have housed the experiment.

LTX continues to explore new paths for plasma energy efficiency and sustainability. The primary goal of LTX is to investigate the properties of a lithium liquid coating for plasma surfaces or plasma-facing component (PFC). The previous experiment, Current Drive Experiment-Upgrade (CDX-U) held the lithium in a circular tray at the base of the vacuum vessel. The LTX liquid lithium was evaporated and deposited a thin layer inside the vacuum vessel and kept liquid by heater in the shell.

1.5 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]. From the 2013 US Census Bureau Statistics, Middlesex County has a population of 828,919; adjacent counties of Mercer, Monmouth, Somerset, and Union have populations of 370,414, 629,672, 330,585, and, 548,256 respectively [US13]. Other information gathered and updated from previous ITER studies include socioeconomic information [Be87b] and an ecological survey, which were studies describing pre-TFTR conditions [En87].

✵

Chapter

2

2013 COMPLIANCE SUMMARY and COMMUNITY INVOLVEMENT

Princeton Plasma Physics Laboratory's (PPPL) environmental goals are to fully comply with applicable state, federal, and local environmental regulations and to conduct our scientific research and operate the Laboratory facilities in a manner that protects and preserves human health and the environment. PPPL initiates actions, which enhance and document compliance with these requirements. Compliance with applicable environmental statutes or regulations, and Executive or DOE Orders is an important piece of PPPL's primary mission.

2.1 Laws and Regulations

Exhibit 2.1 summarizes the environmental statutes and regulations applicable to PPPL's activities as well as summarizes the 2013 compliance status and provides the ASER sections where further details are located. The list of "Applicable Environmental Laws and Regulations – 2013 Status" conforms to PPPL's Environmental Management System (EMS) Appendix B, "Summary of Legal and Other Requirements" [PPPL14a].

2.2 Site Compliance and Environmental Management System (EMS) Assessments

In 2013, PPPL's Quality Assurance (QA) Division performed one environmental audit of PPPL's Environmental Compliance - Air Program (permits). This audit included records examination and requirements compliance and is tracked through PPPL's internal QA Audit Database. PPPL participated in the New Jersey Department of Environmental Protection (NJDEP) audits of the PPPL Environmental, Analytical and Radiological Laboratory (PEARL) and Surface and Ground Water discharge permits [Cu14].

In 2013, UL-DQS, Inc. was scheduled to conduct an annual surveillance audit of PPPL's EMS against the International Organization for Standards (ISO) standard 14001:2004 – "Environmental Management Systems – Requirements with guidance for use." Due to schedule conflicts, the surveillance audit was postponed until early 2014.

2.3 Environmental Permits

PPPL's environmental permits are incorporated into Exhibit 2-1 as appropriate. All PPPL's permits are current and in compliance.

Exhibit 2-1. Applicable Environmental Laws and Regulations – 2013 Status

Environmental Restoration and Waste Management	2013 Status	ASER section(s)
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) provides the regulatory framework for identification, assessment, and if needed remediation of contaminated sites – either recent or inactive.	The CERCLA inventory completed in 1993 [Dy93] warranted no further CERCLA actions. In 2013, PPPL had no involvement with CERCLA-mandated clean-up actions. A New Jersey-regulated ground water remediation project is discussed in Chapters 4 and 6.	*4.3.1 B* *6.5*
Superfund Amendment and Reauthorization Act (SARA) Title III requires planning, release reporting, chemical inventory.	PPPL has 6 hazardous chemicals under the threshold quantities, maintains material safety data sheets, has no extremely hazardous substance, and is exempt from Toxic Release Inventory submittal.	*4.3.1 C*
Resource Conservation and Recovery Act (RCRA) regulates the generation, storage, treatment, and disposal of hazardous wastes. RCRA also includes underground storage tanks containing petroleum and hazardous substances, universal waste, and recyclable used oil. (NJ-delegated program)	In 2013, PPPL shipped 7.49 tons (6.80 metric tons, MT) of hazardous waste of which 1.71 tons (1.55 MT) were recycled (22.8% recycling rate). The types of waste are highly variable each year; in 2013, majority of incinerated quantities came from, flammable liquids, scintillation vials, and non-PCB capacitors [Pue14a].	*4.2.1 B* *4.2.1 C*
Federal Facility Compliance Act (FFCA) requires the Department of Energy (DOE) to prepare "Site Treatment Plans" for the treatment of mixed waste, which is waste containing both hazardous and radioactive components.	In 1995, PPPL prepared a Preliminary Site Treatment Plan (PSTP). PPPL does not generate mixed waste nor has any future plans to generate mixed waste. Regulators agreed to treat in the accumulation container any potential mixed waste [PPPL95].	
National Environmental Policy Act (NEPA) covers how federal actions may impact the environment and an examination of alternatives to those actions	In 2013, PPPL performed NEPA reviews of 16 proposed activities, and the NEPA reviews for 5 previous activities were revised. All of these activities were determined to be categorical exclusions (CXs) in accordance with the NEPA regulations/guidelines of the Council on Environmental Quality (CEQ) [Stra14].	
Toxic Substance Control Act (TSCA) governs the manufacture, use, and distribution of regulated chemicals listed.	PPPL shipped in 2013 –170 pounds of PCB TSCA Hazardous Substances. Five PCB capacitors remain on-site. Asbestos removals in 2013 were 40 cubic yards [Pue14a].	*4.2.1A*
Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) regulates the user and application of insecticides, fungicides, and rodenticides. (NJ-delegated program)	PPPL used limited quantities of insecticides, herbicides, and fertilizers. A certified subcontractor performs the application under the direction of PPPL's Facilities personnel [Kin14b].	*Exhibit 4- 11* *4.5.3*

Exhibit 2-1. Applicable Environmental Laws and Regulations – 2013 Status (continued)

Radiation Protection	2013 Status	ASER section(s)
DOE Order 435.1, Change 1, *Radioactive Waste Management*, provides guidance to ensure that DOE radioactive waste is properly managed to protect workers, the public and the environment.	PPPL developed a new Low-Level Radioactive Waste Program Basis document to meet the requirements of DOE Order 435.1 and enable shipments to the Energy Solutions disposal facility in Clive, UT. Approval was granted by DOE in July 2012. [DOE01, PPPL13e].	*5.1.3*
DOE Order 458.1, *Radiation Protection*, provides protection of the public and the environment from exposure to radiation from any DOE facility. Operations and its contractors comply with standards and requirements in this Order.	PPPL's policy is to maintain all radiation exposures "As Low as Reasonably Achievable" (ALARA). PPPL implements its radiation protection program as discussed in the Environmental Monitoring Plan Section 6, "Radiological Monitoring Plan." PPPL's contribution to radiation exposure is well below the DOE and PPPL limits [10CFR835, DOE01, DOE11b, PPPL07, 09b, 09c ,09f,10b & 11a].	*5.1* *Exhibit 5-1*
Atomic Energy Act (AEA) of 1954 (42USC 2011 *et seq*.) governs plans for the control of radioactive materials	PPPL's "Nuclear Materials Control and Accountability (MC&A) Plan" describes the control and accountability system of nuclear material at PPPL. This plan provides a system of checks and balances to prevent/detect unauthorized use or removal of nuclear material from PPPL [PPPL08b].	*5.2*

Exhibit 2-1. Applicable Environmental Laws and Regulations – 2013 Status (continued)

Air Quality and Protection	2013 Status	ASER sections
Clean Air Act (CAA) and New Jersey Air Pollution Control Act controls the release of air pollutants through permit and air quality limits/conditions. All permits are in compliance. *PCP960012 and GP-003 – dust collectors* *PCP960002 and GP-005 - generators* *PCP110001 – 4 boilers* *PCP020001 – 25,000 gal. No.2 oil (boilers)* *PCP960012 – 10,000 gal. Ultra-low sulfur oil (generators)* *PCP060001 – fluorescent bulb crusher*	PPPL-DOE maintain air certificates/permits for the regulated equipment: 4 boilers, 3 emergency/standby generators, 2 dust collectors, 2 above-ground storage tanks (< 10,000 gals. fuel oil) and a fluorescent bulb crusher. Designated a synthetic minor, PPPL does not exceed any air contaminant thresholds requiring a Title V permit. As permit requirement, annual boiler adjustment results submitted to NJDEP in 2013. Fuel consumption and sulfur content for the generators and boilers are recorded and annual boiler emissions are calculated.	*4.4*
National Emission Standards for Hazardous Air Pollutants (NESHAPs) 40 CFR Part 61 Subpart H for tritium (an airborne radionuclide) and boilers (<10 million BTUs). Greenhouse gas (GHG) emissions inventory tracking and reporting are regulated by EPA.	The NESHAPs report for tritium emissions are submitted annually [PPPL13g]. Submitted Subpart JJJJJJ Notification to EPA - biennial boiler adjustment. PPPL maintains an inventory for ozone-depleting substances (ODS) and greenhouse gas (GHG) emissions [Ne14].	
Water Quality and Protection	**2013 Status**	**ASER section(s)**
NJ Safe Drinking Water Act (SDWA) protects the public water supply by criteria standards and monitoring requirements. NJDEP NJ0826 – Physical cross-connection inspections.	PPPL conducts quarterly inspections of the potable water cross connection system as required by the NJDEP permit. Potable water is supplied by NJ American Water Company [Pin14].	*4.1.4 A* *Exhibit 4-4*
Stormwater Management and the Energy Independence and Security Act of 2007 (EISA) and Delaware & Raritan Canal Commission Regulations	PPPL's Stormwater Pollution Prevention Plan (SWPPP) was revised in 2012 to provide guidance to reduce the impact of PPPL's operations on storm water quality [PPPL12]	*4.5.4*
Clean Water Act (CWA) and NJ Pollution Discharge Elimination System (NJPDES) regulates surface and groundwater (lined surface impoundment, LSI) quality by permit requirements and monitoring point source discharges *NJPDES NJ—23922 - basin and Canal water discharges monthly, semi-and annual monitoring* *NJPDES 0142051 – Lined surface impoundment - inspections*	In 2013, PPPL-DOE received from NJDEP the final NJPDES surface water discharge permit [PPPL13d]. PPPL reported two (2) non-compliances at DSN001, basin outfall [PPPL13e]. An elevated total suspended solids (TSS) was detected in a duplicate sample; it was undetermined whether the sample was a sampling or analytical error. The second non-compliance was a measure of 0.11 mg/L for chlorine-produced oxidant (CPO), which is above the detection/permit limit (0.1 mg/L). The source of the CPO was undetermined. The LSI was compliant.	*4.1.1* *Exhibits 4-1, 4-2, 4-3 and 4-5*

Exhibit 2-1. Applicable Environmental Laws and Regulations – 2013 Status (continued)

DOE and Executive Orders Program Description	2013 Status	ASER section(s)
DOE Order 231.1B, ***Environment, Safety, and Health Reporting,*** requires the timely collection, analysis, reporting, and distribution of information in ES&H issues.	PPPL ESH&S Department monitors/reports on environmental, safety and health data and distributes the information *via* lab-wide e-mails, PPPL news articles, at weekly Laboratory Management, DOE-Site Office, and staff meetings and at periodic ES&H Executive Board/sub-committees/Lab-wide meetings [DOE13]. PPPL's Annual Site Environmental Report (ASER) is required by this order.	*4.6*
DOE Order 436.1, ***Departmental Sustainability,*** requires all applicable DOE elements to implement an ISO14001-compliant Environmental Management System and support departmental sustainability goals.	PPPL's Environmental Management System (EMS) was prepared in 2005 and is reviewed and updated annually [DOE11a, PPPL11d,13h]. PPPL's EMS is registered to the ISO14001 standard by an independent registrar (UL-DQS) based on annual audits.	*3*
Executive Order (EO) 13423, ***Strengthening Federal Environment, Energy, and Transportation Management,*** requires all federal agencies to improve energy efficiency, reduce vehicle petroleum use by increasing non-petroleum fuel in vehicles, purchase energy from renewable sources, conserve water, improve waste minimization, purchase sustainable products, implement an environmental management system .	PPPL completed the *Executable Plan* in 2009, which outlined the goals and status of compliance with EO 13423 [EO08, PPPL10a].	*3*
Executive Order 13514 , ***Federal Leadership in Environmental, Energy, and Economic Performance,*** requires establishment of goals and targets for reducing greenhouse gases (GHGs), improving water use efficiency, promoting pollution prevention, sustainable acquisition and electronic stewardship, implementing high performance sustainable building design, construction, M&O, and deconstruction, sustaining environmental management systems.	PPPL prepared *the 2014 Site Sustainable Plan* that addressed the goals, targets and status of EO 13514 requirements [EO09 & PPPL13h].	*3*
Executive Order 13653 , ***Preparing the United States for the Impacts of climate change,*** stresses a need to address adaptions for reducing climate impacts.	PPPL will include potential adaptions to reduce climate change impacts beyond the current goals and targets in *the 2014 Site Sustainable Plan (SSP)* in the future SSPs.	

Exhibit 2-1. Applicable Environmental Laws and Regulations – 2013 Status (continued)

Other Environmental Statutes	2013 Status	ASER section(s)
Oil Pollution Prevention provides the regulatory requirements for a Spill Prevention Control and Countermeasure (SPCC) Plan for petroleum containing storage tanks and equipment.	The SPCC plan was reviewed and updated in 2011. PPPL does not meet the threshold quantity of 200,000 gallons of petroleum (excluding transformer oil) for the requirements of a Discharge Prevention Control and Containment (DPCC) plan. PPPL experienced no reportable spills in 2013 [PPPL14b].	*4.3.1 A*
National Historic Preservation Act (NHPA) and New Jersey Register of Historic Places protect the nation and New Jersey's historical resources through a comprehensive historic preservation policy.	Due to the location of the pump house next to the Delaware & Raritan Canal, the Canal and the area within 100 yards are listed on both the federal and state register of historic sites [PPPL05].	
Floodplain Management Programs covers the delineation of the 100- and 500-year floodplain and prevention of development within the floodplain zones. (NJ-delegated program)	The 100- and 500-year floodplains are located at 80 and 85 feet above mean sea level (msl), respectively. The majority of the PPPL site is located at 100 ft. above msl; only HAZMAT building is in the flood hazard zone, but is protected by dikes [NJDEP84].	
Wetlands Protection Act governs the activities that are allowable through the permitting system and mitigation requirements. (NJ-delegated program) *NJDEP Land Use /Wetlands Letter of Interpretation 1218-91-0001.2*	In 2008, PPPL and Princeton Forrestal Center received the wetlands delineation from NJDEP. Any regulated activities either in the wetlands or transition areas must receive approve prior to commencement [PPPL08c].	*4.5.1*
NJ Endangered Species Act prohibits activities that may harm the existence of listed threatened or endangered species	No endangered species reported on PPPL or D&R Canal pump house sites. Cooper's hawks and Bald eagles have been sited within 1 mile [Am98, NJB97, NJDEP97, PPPL05].	
NJ Technical Standards for Site Remediation governs the soil/ground water assessments, remedial investigations, and clean-up actions for sites suspected of hazardous substance contamination. *NJPDES Ground Water (GW) Remediation – SRP PI#014853, RAP130001, quarterly monitoring and biennial report submitted last in August 2013.*	In 1990, ground water monitoring of volatile organic compounds (VOCs) began at PPPL. Over time, more than 20 monitoring wells were installed on-site to determine contamination source and extent of the plume. Quarterly sampling of 9 wells and 1 sump is collected, and annual sampling of 12 wells, 2 sumps and 1 surface water site is collected in September with the results reported annually to NJDEP [PPPL12a].	*6.5*

Exhibit 2-1. Applicable Environmental Laws and Regulations – 2013 Status (continued)

Other Environmental Statutes	2013 Status	ASER section(s)
NJ Soil Erosion and Sediment Control (SESC) Plan requires an approval by the Freehold Soil Conservation District for any soil disturbance greater than 5,000 sq. feet.	PPPL submitted and received SESC plan approval for the D-site parking lot native vegetation planting and installation of rain gardens expired on February 28th 2013 [PPPL09d]. In CY 2013 PPPL no new additional soil erosion permits were obtained.	*4. 5.2*
NJ Comprehensive Regulated Medical Waste Management governs the proper disposal of medical wastes.	Last report submitted to NJDEP in 2004; no longer required to submit report, but continues to comply with proper disposal of all medical wastes [Pue14].	
NJ Endangered Species Act prohibits activities that may harm the existence of listed threatened or endangered species.	No endangered species reported on PPPL or D&R Canal pump house sites. Cooper's hawks and Bald eagles have been sited within 1 mile [Am98, NJB97, NJDEP97, PPPL05].	
NJ Emergency Planning and Community Right-to-Know Act, also referred to as the Superfund Amendment Reauthorization Act (SARA Title III) requires for certain toxic chemicals emergency planning information, hazardous chemical inventories, and the reporting of environmental releases to federal, state, and local authorities	PPPL-DOE submitted annual chemical inventory reports to local health and emergency services departments for 2013 [PPPL14b].	*4.3.1 C* *Exhibit 4-7* *Exhibit 4-8*
NJ Regulations Governing Laboratory Certification and Environmental Measurements mandate that all required water analyses be performed by certified laboratories. *NJDEP Laboratory Certification – NJ12471*	The PPPL Environmental, Analytical, and Radiological Laboratory (PEARL) continued analyze immediately parameters; PPPL received acceptable for all performance tests for tritium, gross beta, pH, total residual chlorine (Chlorine-produced oxidants- CPO) and temperature. PPPL subcontractor analytical laboratory is a NJDEP certified laboratory.	*7*
NJDEP Water Use Registration – *10944W (non-potable) water for cooling and fire-protection systems.*	Monthly Canal water use-annual report.	

"The Princeton Plasma Physics Laboratory, long a leader in the area of fusion energy research, is also a leader in the area of being a good steward of the environment," DEP Commissioner Bob Martin said (on May 21, 2013)…"I commend their efforts at making sound environmental practices that benefit their staff, their community and their state an integral part of the facility's daily operations." (NJDEP 2013)

"We are committed to protecting the environment; our mission, for example, to enable fusion energy – a clean, green, safe, and nearly inexhaustible source of power – illustrates that commitment," said Dr. Adam Cohen, Deputy Director of Operations at PPPL. "This commitment extends to the operations of our facilities and the dedication of our employees." (NJDEP, 2013)

The New Jersey Department of Environmental Protection's (NJDEP) Environmental Stewardship Program is a voluntary program that consists of 21 categories ranging from environmental policies to renewable energy use. PPPL met 20 of the 21 categories, which was the most in the state.

"We have worked hard over many years to reduce our energy use and carbon emissions, convert our vehicles to more environmentally friendly fuels, compost our waste, and in general, implement a

2.4 External Oversight and Assessments

In January 2013, NJDEP Central Region Office, Water Compliance & Enforcement, audited PPPL's New Jersey Pollution Discharge Elimination System (NJPDES) permit requirements for retention basin outfall (DSN001) and the Delaware & Raritan (D&R) Canal pump house filter backwash outfall (DSN003). PPPL monitors these outfalls each month for conventional pollutants, *e.g.*, total petroleum hydrocarbons, total residual chlorine, ph, temperature, *etc.* (Appendix A, Tables 17 & 18). Additional parameters are monitored and reported quarterly, semi-annually, and annually. No findings resulted from this audit.

Exhibit 2.2 Earth Day 2013

In May 2013, PPPL was recognized for being the environmental stewardship leader in New Jersey. See side bar.

For details on PPPL's ongoing Environmental Management System audits and assessments, see Section 2.2 of this Chapter and Chapter 3 of this report [PPPL12b & 14a].

2.5 Emergency Reporting of Spills and Releases

Under New Jersey regulations, PPPL is required to call the Action Hotline to report any permit limits that are exceeded. No releases of hazardous substances or petroleum hydrocarbons on pervious surfaces required notification to New Jersey's Action Hotline during 2013.

2.6 Notice of Violations and Penalties

There were no notices of violations or penalties for environmental occurrences at PPPL during 2013.

2.7 Community Involvement

2.7.1 Earth Week and American Recycles Day at PPPL

"Be a Face of Climate Change" was the theme of PPPL's 2013 Earth Week celebration (See box and Exhibit 2-4). On April 18h, PPPL employees and members of the public were invited to view displays on sustainable renovations and projects: Mercer County Improvement Authority, and PPPL's subcontractors for landscaping, office and janitorial supply, cafeteria, sustainable furniture supply, and electronic waste removal companies. PPPL's electronic recycling vendor provided recycling for employees' personal e-waste that weighed 2,480 pounds.

Thirty-two PPPL employees took two-hours from their normal tasks to improve the environment. Four teams patrolled the grounds by removing recyclables and trash that had escaped the dumpsters.

Included in the Earth Week celebration activities, Emelie Jeffries, a DOE consultant, who with her fellow Native-Americans, known as Raven Wings, performed traditional dances. These dances are an expression of their culture honoring both their people and Mother Earth.

The colloquium speaker, Dr. John Dunne, research oceanographer with the National oceanic and atmospheric Administration's Geophysical Fluid Dynamic Laboratory, presented "How Climate Changes Affects Your Work."

Each year, employees nominate their co-workers for their exceptional efforts to minimize waste, improve energy efficiency, and promote sustainable practices at PPPL. There were seventeen employees who received the 2012 PPPL Green Machine Awards for the following projects:

Exhibit 2.3 PPPL's 2013 Earth Week

Exhibit 2-4. PPPL's Earth Week Poster

Exhibit 2-5. PPPL's Earth Week Green Machine Recipients

- Being good composting and recycling stewards and encouraging colleagues to follow their example.
- Developed Thin-client program that reduced the number of desktop computers.
- Installed new controls to PPPL's boilers that improved efficiency that dramatically reduced nitrogen oxide and sulfur dioxide emissions.
- Converted from paper to electronic tablet format that reduced significantly the amount of paper records/filing.
- Set PPPL printers to default double-siding.
- Developed PPPL Weekly newsletter and other information that is posted electronically to e-mail and flat screens around the site.
- Reduced paper handouts and training materials to electronic formats.

Each year PPPL celebrated America Recycles Day (ARD, officially November 15th). In 2013, PPPL's Green Team, volunteers who promote recycling within their Departments, presented a "Fashionable ARD". On November 14th, a display of dresses made from recyclable or compostable materials found at PPPL were placed in the LSB lobby. Employees asked to vote for their favorite dress chose #3 - the winner was the creation of M. King, Grounds and Facilities Manager. Other activities include employee electronics recycling 1,450 pounds, sign-up pledges to recycle more and posters tracking the progress of each department's recycling efforts.

#1 #2 #3 #6 #4 #5

Exhibit 2-6. "Fashion Dress Competition", ARD Logo, Employee Donations and Signing up for the Recycle Pledge (from left to right)

2.7.2 PPPL Open House - June 2013

On June 1, 2013, PPPL opened its doors and in came more than 3,000 people to view the experiments and learn about the Laboratory. From the National Spherical Torus Experiment (NSTX) upgrade to the Science Education Laboratory's 3-D printer and Van De Graff generator, visitors young and not-so young experienced hands-on activities, viewed up close PPPL's fusion device, watched a cryogenics show among other popular venues.

Exhibit 2.7 PPPL's A. Dominguez and J. Desandro tell visitors about NSTX – upgrade

Chapter

3

ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)

PPPL has been successful in meeting the sustainability goals established by Presidential Executive Orders (EO) 13423 and 13514 and DOE Order 436.1 by integrating these goals into its site-wide Environmental Management System (EMS). Since 2005, PPPL has focused on improving the sustainability of Laboratory operations and improving environmental performance. "Sustainable PPPL" is a program that capitalizes on PPPL's existing EMS to move the Laboratory toward more sustainable operations. The EMS includes energy management, water conservation, renewable energy, greenhouse gas management, waste minimization, environmentally preferable purchasing, and facility operation programs to reduce environmental impacts and improve performance [PPPL12b]. PPPL will continue to proactively implement sustainability practices aimed at meeting, or exceeding, the sustainability goals in its EMS, DOE Orders and Executive Orders [EO08, 09].
In 2013, PPPL maintained the registration of its Environmental Management System against the International Standard Organization ISO-14001:2004. The second annual surveillance audit, required to maintain ISO 14001:2004 certification, is scheduled for February 2014.

3.1 DOE Sustainability Goals

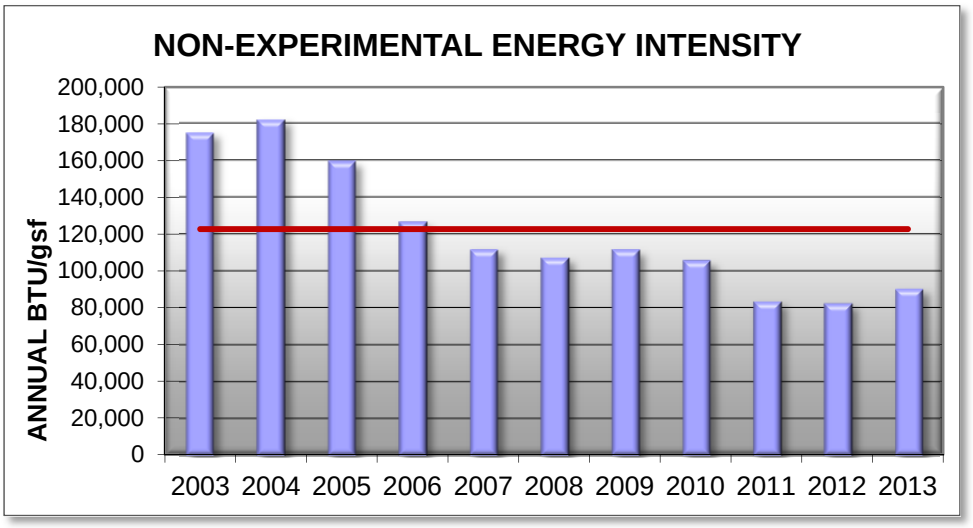
In 2013, PPPL continued to address the aggressive new sustainability and greenhouse gas management goals of EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*. PPPL completed its third annual *Site Sustainability Plan,* which summarized progress and outlined future plans for meeting the departmental sustainability goals under EOs 13423 and 13514, and submitted the Comprehensive Energy Data Report (CEDR) and Pollution Prevention Tracking System Report [PPPL13f & g].

3.1.1 Energy Efficiency

In 2013, PPPL maintained a reduction of 48.3% in energy intensity (British Thermal Unit per gross square feet, BTU/gsf) for non-experimental energy use compared to the 2003 baseline year (see Exhibit 3-1). This value represents a modest increase over 2012, but PPPL's non-experimental buildings still use approximately one-half of the energy consumed in 2003. This was achieved through building automation, energy conservation measures, and equipment upgrades.

PPPL continues to emphasize energy management as part of its facility operations and continues to leverage the success in non-experimental energy management to improve experimental efficiency.

Exhibit 3-1. Annual Non-Experimental Energy Intensity in BTU/gsf
(Red line indicates the Federal energy efficiency goal set for 2015)



For example, PPPL continues to carefully manage its central steam and chilled water plant to maximize efficiency and minimize greenhouse gas emissions. PPPL has standardized on high-efficiency light-emitting diode (LED) lighting for all office renovations and continues to evaluate and implement other energy efficiency projects.

3.1.2 Renewable Energy

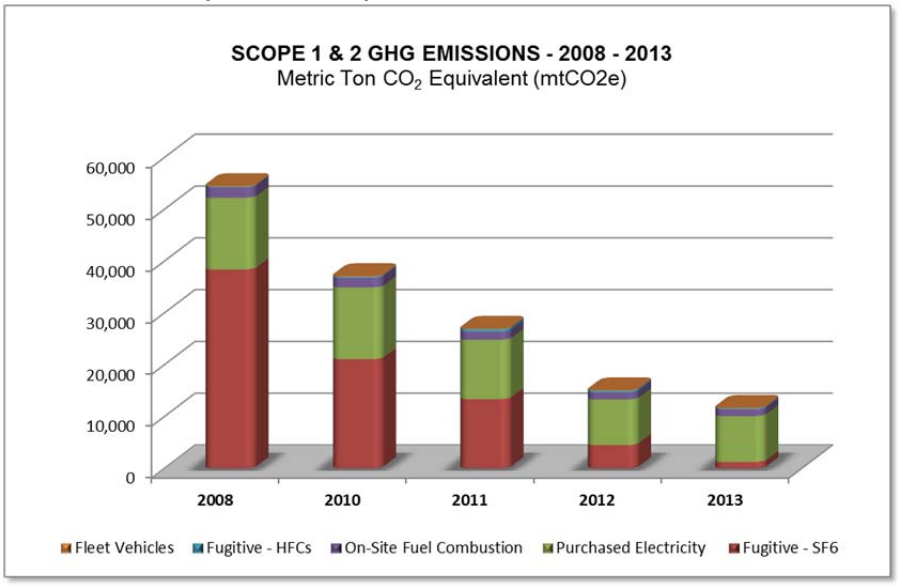
PPPL and DOE-PSO pursued an on-site solar renewable energy generation project for as much as 40% of non-experimental energy use over the course of three years. The Energy Savings Performance Contract (ESPC) proposal received in FY08 was not successful due to the need for significant up-front investment by DOE. PSO and PPPL then pursued a long-term Power Purchase Agreement (PPA) through the Defense Energy Supply Center (DESC). After more than a year of bidding and negotiations, DESC, PSO, PPPL and the vendor were unable to develop a financially viable project. The ESPC and PPA processes at PPPL identified several significant statutory and management barriers to the cost-effective development of renewable power projects at DOE sites. PPPL will continue to purchase renewable energy credits (RECs) to meet its renewable energy commitments and will pursue cost-effective renewable energy project opportunities within the context of the DOE Office of Science's portfolio approach to the EO13514 sustainability goals. PPPL purchased 1,600,000 KWH Renewable Energy Credits from Orion Renewable Energy Trading Group, LLC accounting for 7.8% of total electrical energy used in FY13.

3.1.3 Greenhouse Gas Emissions

Between 2008 and 2013, PPPL reduced its Scope 1 and 2 greenhouse gas (GHG) emissions by 78.6%. This significant reduction in GHG emissions, is largely due to the focused efforts to control fugitive losses of sulfur hexafluoride (SF_6) and reduced emissions from on-site

combustion of fuel through improved boiler operations, boiler control upgrade projects and the use of natural gas as the primary fuel over fuel oil. Sulfur hexafluoride is a potent GHG that is a highly effective high voltage insulator (see Exhibit 3-2).

Exhibit 3-2. Summary of PPPL Scope 1 & 2 GHG Emissions between 2008 and 2013



3.1.4 Fleet Management

In 2013, PPPL's fleet petroleum fuel use was 72.6% below 2005 levels (see Exhibit 3-3). In addition, alternative fleet fuel consumption in 2013 was nearly 21 times higher than the levels in 2005, representing approximately 48% of PPPL's total covered fleet fuel use (see Exhibit 3-4).

Exhibit 3-3. Annual Non-Exempt Fleet Petroleum Fuel Use between 2005 and 2013

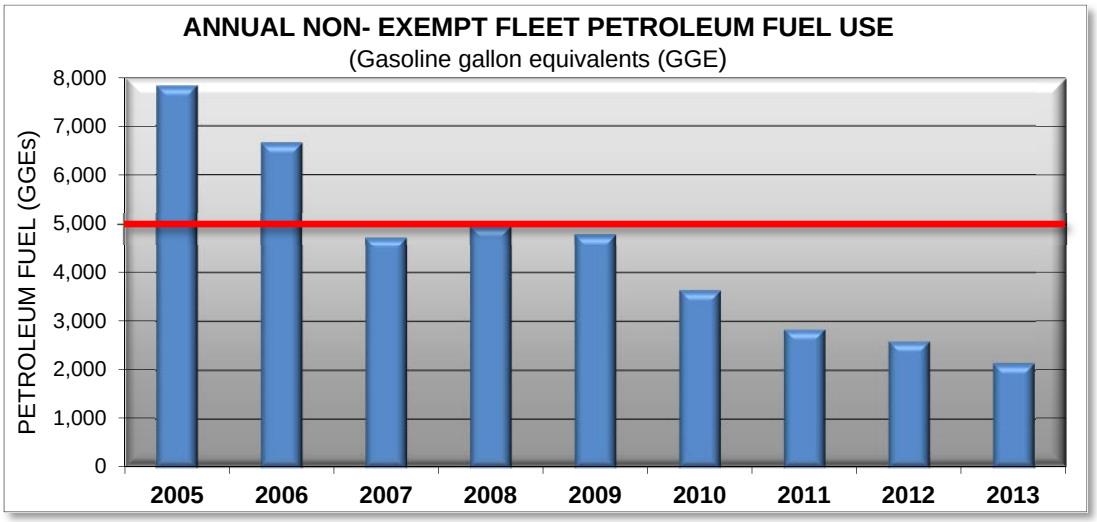
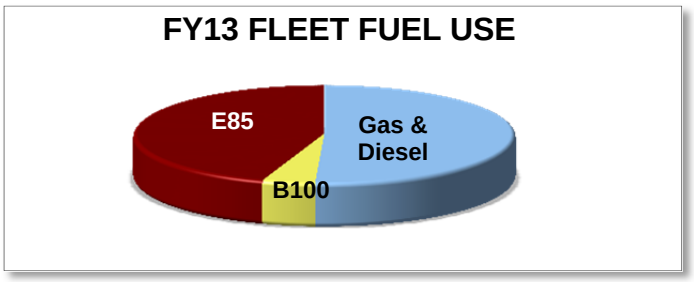


Exhibit 3-4. FY2013 Non-Exempt Fleet Fuel Use by Type

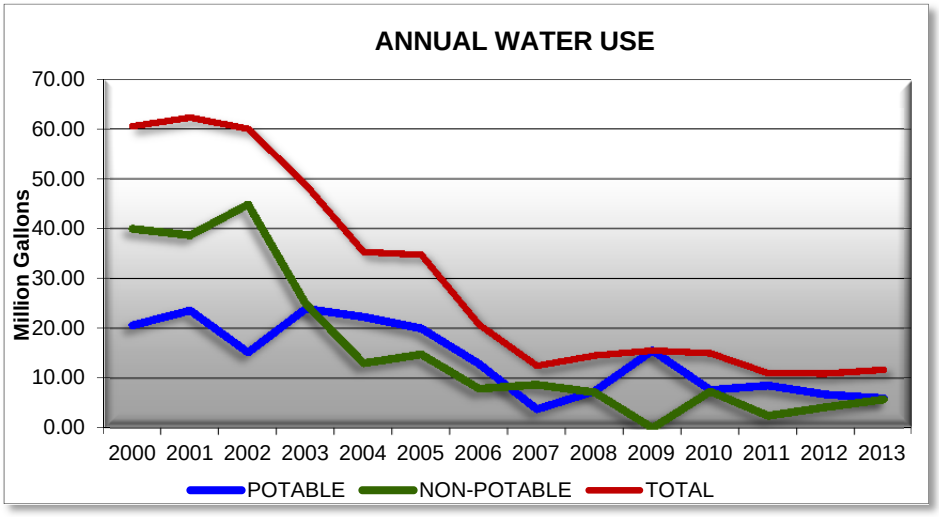


PPPL continues to exceed the goal for 75% acquisition of alternative fuel vehicle (AFV) for light duty vehicles by FY2015. PPPL specifies only AFVs as replacement lease vehicles through the GSA whenever a suitable AFV is available. PPPL's fleet includes gasoline-electric hybrid vehicles, alternative fuel vehicles - Ethanol 85% (E85) or biodiesel 20% (B20) - and petroleum-fueled (gasoline & diesel) vehicles. In addition to the use of alternative fuels in its covered fleet vehicles, PPPL uses B20 in several pieces of heavy-mobile equipment, including a 15-ton forklift, backhoe, and skid steer loader. PPPL's fleet of John Deere Gator® vehicles run exclusively on B20. Following B20 pilot testing in FY2007 and 2008, PPPL expanded its on-site fleet refueling station to support the storage and dispensing of E85 and B20 fuels in addition to the existing compressed natural gas (CNG) vehicle fueling system.

3.1.5 Water Efficiency

PPPL has made significant progress in reducing its use of both potable and non-potable water in recent years achieving an overall water use reduction of approximately 80% between 2000 and 2013 (see Exhibit 3-5). PPPL continues to pursue water conservation pilot projects and to identify new opportunities for water conservation. Given the reductions already achieved additional savings may be incremental over a number of years, as the largest water efficiency opportunities have likely already been addressed.

Exhibit 3-5. PPPL Annual Water Use from 2000 to 2013



3.2 Energy Efficient "Green" Buildings

The Lyman Spitzer Building (LSB), PPPL's main office building was awarded LEED®-Gold certification by the U.S. Green Building Council in April 2011 for meeting the rigorous Leadership in Energy and Environmental Design – Existing Buildings Operations & Maintenance (LEED®-EBOM) standard. The LSB represents approximately 16% of the current building space and certification of this building to the LEED®-EBOM standard is a major step toward the goal of having at least 15% of buildings meeting the Guiding Principles for High Performance and Sustainable Buildings.

PPPL will prioritize infrastructure projects on those buildings identified with the greatest potential for meeting the Guiding Principles to meet the 15% goal, with a long-term objective of 100% HPSB buildings. ENERGYSTAR® Portfolio Manager is used to document progress in meeting these goals. Renovations or other building improvements required to meet the Guiding Principles will be incorporated into PPPL's OPEX and GPP planning process for inclusion in out-year plans. Five buildings have been identified for evaluation and three are targeted for upgrades to meet the Guiding Principles by FY2015.

A tabular summary of PPPL's performance against the comprehensive sustainability goals of EO 13514 and the applicable DOE Orders is presented in Exhibit 3-6.

3.3 Sustainability Awards

PPPL has demonstrated its commitment to sustainability through its mature environmental stewardship programs. PPPL is frequently consulted by DOE Laboratories and other organizations for advice and experience in sustainable environmental performance. In 2013 PPPL received a Silver Award from the Federal Electronics Challenge and was one of two national laboratories to earn the DOE GreenBuy Gold Award for two consecutive years. PPPL's mature and comprehensive waste minimization program was recognized by EPA and NJDEP and PPPL waste named the Federal WasteWise Partner of the Year in 2013. Finally, PPPL was recognized by NJDEP leadership as New Jersey's "top environmental steward" for having the highest level of participation in the New Jersey Environmental Stewardship Program with activities in 21 of 22 program areas.

Exhibit 3-6. 2013 DOE Sustainability Goal Summary Table for PPPL

Goal	DOE Goal	Performance Status	Planned Actions & Contribution
GOAL 1: Greenhouse Gas Reduction and Comprehensive Greenhouse Gas Inventory			
1.1	28% Scope 1 & 2 GHG reduction by FY 2020 from a FY 2008 baseline (2013 target: 17%)	**EXCEEDED** Scope 1&2 GHG emissions down by 78.6%	Continued focus on energy efficiency
1.2	13% Scope 3 GHG reduction by FY 2020 from a FY 2008 baseline (2013 target: 4%)	**ON TARGET**	Continue to emphasize business travel and employee commuting
GOAL 2: Buildings, ESPC Initiative Schedule, and Regional & Local Planning			
2.1	30% energy intensity (Btu per gross square foot) reduction by FY 2015 from a FY 2003 baseline (2013 target: 24%)	**EXCEEDED** 48.7% reduction from 2003 baseline	Continued focus on energy efficiency and building energy performance
2.2	EISA Section 432 energy and water evaluations	**MET**	25% of buildings were evaluated in 2013
2.3	Individual buildings metering for 90% of electricity (by October 1, 2012); for 90% of steam, natural gas, and chilled water (by October 1, 2015), 2013 target: 90% and 50%, respectively	**MET** 6 buildings are separately metered	Additional sub-metering as cost-effective and programmatically appropriate
2.4	Cool roofs, unless uneconomical, for roof replacements unless project already has CD-2 approval. New roofs must have thermal resistance of at least R-30.	**MET** 17% of building footprint has cool roofs	R-30 is standard for roof installation and replacement
2.5	15% of existing buildings greater than 5,000 gross square feet (GSF) are compliant with the Guiding Principles (GPs) of HPSB by FY 2015 (2013 target:11%)	**ON TARGET** LSB is LEED-Gold and met Guiding Principles. Other buildings in progress	Four additional buildings are currently being assessed against the Guiding Principles.
2.6	All new construction, major renovations, and alterations of buildings greater than 5,000 GSF must comply with the GPs	**ON TARGET**	Future Science & Technology Center will comply with Guiding Principles
GOAL 3: Fleet Management			
3.1	10% annual increase in fleet alternative fuel consumption by FY 2015 relative to a FY 2005 baseline (2013 target:114% cumulative since 2005)	**EXCEEDED** 48.6% of fleet fuel used in 2013 was alternative fuel	Fleet management initiative (goal 3.4) have impacted alternative fuel use

Goal	DOE Goal	Performance Status	Planned Actions & Contribution
3.2	2% annual reduction in fleet petroleum consumption by FY 2020 relative to a FY 2005 baseline (2013 target:16% cumulative since 2015)	**EXCEEDED**	Continue to manage fleet to optimize alternative fuel use and support program needs
3.3	100% of light duty vehicle purchases must consist of alternative fuel vehicles (AFV) by FY 2015 and thereafter (75% FY 2000 – 2015)	**MET**	Continue acquiring AFVs as appropriate
3.4	Reduce fleet inventory of non-mission critical vehicles by 35% by FY 2013 relative to a FY 2005 baseline	**MET**	Mission-critical vehicle needs are being evaluated
GOAL 4: Water Use Efficiency and Management			
4.1	26% potable water intensity (Gal per gross square foot) reduction by FY 2020 from a FY 2007 baseline (2013 target: 12%)	**ON TRAGET** Water use down 16.7%. Significant water savings prior to 2007.	Continue to identify water conservation opportunities. Operational needs require flexible water use goals
4.2	20% water consumption (Gal) reduction of industrial, landscaping, and agricultural (ILA) water by FY 2020 from a FY 2010 baseline (2013 target:6%)	**ON TRAGET** Water use down 11.8%. Significant water savings prior to 2007.	Continue to identify water conservation opportunities. Operational needs require flexible water use goals
GOAL 5: Pollution Prevention and Waste Reduction			
5.1	Divert at least 50% of non-hazardous solid waste, excluding construction and demolition debris, by FY 2015	**EXCEEDED** MSW recycling rate was 76%	Continue to maximize waste diversion
5.2	Divert at least 50% of construction and demolition materials and debris by FY 2015	**EXCEEDED** C&D recycling rate was 61%	Continue to maximize waste diversion
GOAL 6: Sustainable Acquisition			
6.1	Procurements meet requirements by including necessary provisions and clauses (Sustainable Procurements / Biobased Procurements)	**MET** >95% for 2013	Procedure ENG-006 includes sustainable acquisition guidance
GOAL 7: Electronic Stewardship and Data Centers			
7.1	All data centers are metered to measure a monthly Power Utilization Effectiveness (PUE) of 100% by FY 2015 (2013 target: 80%)	**ON TARGET**	Enhanced PPLCC metering completed in 2013.
7.2	Maximum annual weighted average PUE of 1.4 by FY 2015 (2013 target:1.60)	**AT RISK** Currently collecting PUE data	Additional energy efficiency opportunities for PPLCC being evaluated

Goal	DOE Goal	Performance Status	Planned Actions & Contribution
7.3	Electronic Stewardship - 100% of eligible PCs, laptops, and monitors with power management actively implemented and in use by FY2012	**ON TATGET**	Traditional power management has limited impact. Alternative power savings options are being evaluated.
GOAL 8: Renewable Energy			
8.1	20% of annual electricity consumption from renewable sources by FY 2020 (2013 target: 7.5%)	**ON TARGET** FY2013 REC purchases: 1,600 MWh	ESPC and PPA were not financially viable. Continue to explore other renewable energy options.
Goal 9: Climate Change Adaptation			
9.1	Climate Change Adaptation - Address DOE Climate Adaptation Plan goals (See Appendix C)	**ON TARGET** PPPL is participating in national and state adaptation planning organizations as programmatic funding can support.	

Chapter

4

ENVIRONMENTAL NON-RADIOLOGICAL PROGRAM INFORMATION

The following sections briefly describe PPPL's environmental programs required by federal, state, or local agencies. These programs were developed to comply with regulations governing air, water, waste water, soil, land use, and hazardous materials, as well as with DOE orders or programs.

4.1 Non-Radiological Water Programs

4.1.1 New Jersey Pollutant Discharge Elimination System (NJPDES) Program

A. Monthly Discharge Monitoring Reports (DMR)

In compliance with permit requirements of the New Jersey Pollutant Discharge Elimination System (NJPDES) permit, NJ0023922, PPPL and DOE-PSO submitted to NJDEP monthly discharge monitoring reports (DMRs) for Discharge Serial Number (DSN)—DSN001, retention basin outfall, and DSN003, Delaware & Raritan (D&R) Canal pump house filter backwash discharge (Appendix Tables 17 , 18, & 21).

In 2013, PPPL received the final NJPDES permit with the effective date of October 1, 2013. In February 2008, NJDEP issued a *Final Surface Water Minor Modification Permit Action* report. Key changes to the permit included eliminating loading requirements and quarterly monitoring for Total nitrogen at DSN001, additional annual and semi-annual Waste Characterization Reports (WCR) from DSN001 and DSN003 and an annual chronic toxicity test for *Ceriodaphnia dubia* (Water flea) [NJDEP13a].

Changes to PPPL's reporting requirements are noted in Exhibit 4-2. Under the current NJPDES permit effective date October 1, 2013, PPPL is required to provide an annual WCR for both DSN001 and DSN003. DSN001 also requires additional semi-annual WCR monitoring for particular metals and semi-volatile organic compounds (SVOC). DSN003 is still required to complete a full WCR once per permit cycle.

During 2013, PPPL's discharges were within allowable limits for all tested parameters (Exhibit 4-1), with the exception of the following. All permit exceedances were reported to NJDEP within the allowable time frame.

- February 5, 2013, Total Suspended Solid (TSS) 50 mg/L limit was exceeded at DSN001 NJDEP Case Number 13-03-18-0940-57 Op 44. Two samples were analyzed for TSS by PPPL's subcontractor laboratory with one sample result below the limit at 2.0 mg/L while the exceedance was 240 mg/L. While the analytical laboratory advised PPPL that there was no demonstrable error in the laboratory analyses, the collection at the same

location and time were vastly different. PPPL did not find the cause of this large difference having completed its review of past on-site activities.

- On August 5, 2013, Chlorine Produced Oxidants (CPO) limit, 0.1 mg/L, was exceeded at DSN001 - NJDEP Case Number 13-80-05-1612-33. Free Available Chlorine levels were elevated in the cooling tower operations, causing the source of exceedance at the DSN001 basin outfall-[PPPL13d].

Exhibit 4-1. 2013 NJPDES Permit Compliance

Parameter (1)	Frequency	Permit Limit	# Permit Exceedance	# Samples Taken (4)	# Compliant Samples	Percent Compliance	Dates Exceeded
Outfall DSN001							
Chemical Oxygen Demand (COD), mg/L	Monthly	50.0	0	16	16	100%	-
Chlorine Produced Oxidants (CPO),mg/L	Monthly	0.1	1	32	31	97%	8/5/13
Flow, MGD	Monthly	-	0	12	16	100%	-
Petroleum Hydrocarbons (TPHC), mg/L	Monthly	10.0 Avg 15.0 Max	0	16	16	100%	--
pH, S. U.	Monthly	>6.0; <9.0	0	16	16	100%	-
Phosphorus, total mg/L (2)	Monthly	-	0	16	16	100%	-
Temperature º C	Monthly	30.0	0	16	16	100%	-
Tetrachloroethylene (PCE), µg/L (3)	Monthly	0.703	0	16	16	100%	-
Total Suspended Solids (TSS), mg/L	Monthly	50.0	1	16	15	94%	2/5/13
Outfall DSN003							
Chlorine Produced Oxidants (CPO),mg/L	Monthly	>0.1	0	12	12	100%	-
Flow, GPD	Monthly	-	0	12	12	100%	-
Petroleum Hydrocarbons (TPHC), mg/L	Monthly	10.0 Avg 15.0 Max	0	12	12	100%	-
pH, S. U.	Monthly	>6.0; <9.0	0	12	12	100%	-
Phosphorus, total mg/L (2)	Monthly	-	0	12	12	100%	-
Total Suspended Solids (TSS), mg/L	Quarterly	-	0	12	12	100%	-
Intake C1							
Total Suspended Solids (TSS), mg/L	Quarterly	-	0	12	12	100%	-

NA = Not applicable
Note: All samples reported in quality or concentration on monthly DMR

(1) *Methods for Chemical Analysis of Water and Wastes*, Environmental Monitoring and Support Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, March 1983, EPA-600 4-79-020 [EPA83].
(2) Phosphorus Evaluation Study will be included in NJDEP's Raritan Watershed Study.
(3) Tetrachloroethylene (PCE) found in the retention basin outfall results from ground water from the building foundation drainage system. Additional basin aeration is expected to keep the discharge concentration of PCE at or below 0.703 µg/L.
(4) Number of samples taken indicates the minimum number of samples required for the current NJPDES permit. Additional samples may be taken and reported each CY year.

Exhibit 4-2. NJPDES Reporting Requirements

Parameter	Location	Frequency/Type	Last Completed
Discharge Monitoring Report (DMR)	DSN001, DSN003, C1	Monthly	Monthly 2013
Acute Whole Effluent Toxicity	DSN003	4 – 4.5 Years per Permit	3/20/2010
Chronic Toxicity (% Effluent) IC25 7 Day *Ceriodaphnia dubia* & *Pimephales promelas*	DSN001	Annual	3/12/2013
Waste Characterization Report (WCR) – Complete WCR	DSN001	Annual	3/5/2013
Waste Characterization Report (WCR) – Metals, SVOC, Chloroform	DSN001	Semi Annual	11/8/2013
Waste Characterization Report (WCR) - Metals	DSN003	Annual	To be completed 2014
Waste Characterization Report (WCR) – Complete WCR	DSN003	4 – 4.5 Years per Permit	3/17/2010

B. Acute Toxicity Study

The Acute Biomonitoring Report for the *Ceriodaphnia dubia* (water flea) was completed on March 20, 2010 for DSN003. Samples were collected for the 48-hour acute toxicity survival test, required to be performed between 4 to 4.5 years after the effective date of the permit (Exhibit 4-2). The toxicity test with *Ceriodaphnia dubia* resulted in an inhibition concentration (IC25) of >100 percent [PPPL10a].

C. Chronic Whole Effluent Toxicity Study

Chronic Whole Effluent Toxicity Study for DSN001 was completed on March 12, 2013 (Exhibit 4-2). In all chronic toxicity tests, *Pimephales promelas* (fathead minnow) survival rate inhibition concentration (IC25), defined by the NJ Surface Water Quality Standards, was IC25 >100 percent (statistically possible) no observable effect concentration (NOEC) [NJDEP13a, PPPL13i].

D. Waste Characterization Report (WCR)

The Waste Characterization Report (WCR) is required by NJPDES Permit for monitoring effluent conditions. Under the previous NJPDES permit valid until September 30, 2013, DSN001 WCR reports were required annually, while DSN003 WCR reports were required once per permit cycle between 4 to 4.5 years after the effective date of the permit (EDP) [NJDEP13a]. PPPL completed DSN001 Annual WCR on March 5, 2013 [PPPL13j]. DSN003 was completed once per permit cycle on March 17, 2010 [PPPL10c].

4.1.2 Lined Surface Impoundment Permit (LSI)

PPPL complies with NJDEP Ground Water General Permit No. NJ0142051 and is permitted to operate Lined Surface Impoundment (LSI) Program Interest (P.I.) ID#47029 dated February 26, 2009. LSI Permit operates on a 5-year permit cycle, expiring on February 28, 2014. The LSI Permit also authorizes PPPL to discharge from our lined basin outlet to surface water, Bee Brook, a tributary to Devils Brook and the Millstone River in Plainsboro, NJ [NJDEP09]. An estimated total of 90.5 million gallons of water was discharged from the lined surface impoundment in 2013 [Fin14a].

Exhibit 4-3. PPPL Lined Surface Impoundment/Basin, Flow Sensor, and Discharge Gate

LSI permit requires inspection and maintenance of liner every three years. In April 2012, PPPL completed its annual basin cleaning and inspected and certified the liner by Professional Engineer (P.E.) for repairs and maintenance. Liner inspection was reported to the state during May 2012.

Water flowing through the retention basin includes site storm water, groundwater from building foundation drains, non-contact cooling water, and cooling tower and boiler blow down. PPPL operates and maintains all equipment associated with the retention basin including aerators, sonic algae control, oil sensors, oil boom, sump pump and flow meter (Exhibit 4-3). If oil is detected within the basin, an alarm signals Site Protection Office and automatically closes the discharge valve. The ultrasonic flow meter measures flow from the basin is downloaded monthly for NJPDES Discharge Monitoring Report (DMR). The following maintenance activities were conducted in 2013:

- Sump pump maintained and oil sensors replaced and calibrated.
- Calibrated the detention basin flow meter via certified outside vendor August 2013.

4.1.3 Ground Water

A. NJPDES Ground Water Program

No ground water monitoring is required by the LSI NJPDES Groundwater permit.

B. Regional Ground Water Monitoring Program

PPPL's Remedial Investigation and Remedial Action Selection Report (RI & RASR) was approved by NJDEP in 2000 [PPPL99b]. The Remedial Action Work Plan (RAWP) was approved NJDEP in June 2000 [PPPL00]. The process of natural attenuation by the indigenous bacteria and other *in-situ* processes are slowly degrading tetrachloroethylene or perchloroethylene (PCE) to its natural degradation products. The de-watering sumps located in the D-site MG and air shaft (formerly TFTR) basements draw ground water radially from the shallow aquifer, controlling ground water flow and preventing off-site contaminant migration. For details, see Chapter 6 "Site Hydrology, Ground Water, and Drinking Water Protection."

In August 2013, NJDEP issued Groundwater Remedial Action Permit number RAP13001, effective for 30 years, for the ongoing remediation and monitoring programs at PPPL. [NJDEP13b] PPPL has modified it monitoring program to meet conditions of the new permit. Additional groundwater information can be found in Chapter 6.

4.1.4 Metered Water

A. Drinking (Potable) Water

Potable water is supplied by the public utility, New Jersey American Water Company. PPPL used approximately 4.52 million gallons in 2013 (Exhibits 4-4 & 4-5) [Pin14]. PPPL uses potable water as a backup resource for fire protection.

Exhibit 4-4. PPPL Potable Water Use from NJ American Water Co. [Pin14]

CY	In million gallons
2003	23.97
2004	22.33
2005	20.01
2006	12.85
2007	3.78
2008	7.41
2009	15.57
2010	7.65
2011	8.54
2012	6.75
2013	4.52

Exhibit 4-5. PPPL Non-Potable Water Use from Delaware & Raritan Canal[Pin14]

CY	In million gallons
2003	24.87
2004	13.02
2005	14.77
2006	7.90
2007	8.71
2008	7.15
2009	0.00
2010	7.35
2011	2.47
2012	4.19
2013	5.73

B. Process (Non-potable) Water

Delaware & Raritan (D&R) Canal non-potable water is used for fire protection and process cooling water. Non-potable water is pumped from the D&R Canal as authorized through a contract with the New Jersey Water Supply Authority that allows for the withdrawal of up to 150,000 gpd and an annual limit of 54.75 million gallons [NJWSA07]. PPPL used 5.73 million gallons of non-potable water from the D&R Canal in 2013 [Pin14].

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 NJPDES surface-water permit and is monitored monthly (Appendix Table 18). 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. Appendix Table 12 summarizes the results of water quality analysis at the water intake C1, at the D&R Canal.

C. Surface Water

Surface water is monitored for potential non-radioactive pollutants both on-site and at surface-water discharge pathways upstream and downstream off-site. Other sampling locations—Bee Brook (B1 & B2), New Jersey American Water Company (potable water supplier-E1), Delaware & Raritan Canal (C1), Millstone River (M1), and Cranbury and Devil's Brooks in Plainsboro (P1 & P2) sampling points (Appendix Tables 10 -16)—are not required by regulation, but are a part of PPPL's environmental surveillance program.

D. Sanitary Sewage

Sanitary sewage is discharged to the Publicly-Owned Treatment Works (POTW) operated by South Brunswick Township, which is part of the Stony Brook Regional Sewerage Authority (SBRSA). SBRSA requires quarterly reporting of total volume discharged from the Liquid Effluent Collection (LEC) tanks on D-Site. PPPL continued to collect radioactive Tritium samples and non-radioactive data (pH and temperature) during 2013 (Appendix Table 8). Detailed radiological and discharge quantities for LEC tanks can be found in Chapter 5 "Environmental Radiological Program Information".

For 2013, PPPL estimated a total annual sanitary sewage discharge of 4.77 million gallons to the South Brunswick sewerage treatment plant [Pin14**].**

4.2 Non-Radiological Waste Programs

4.2.1 Hazardous Waste Programs

A. Toxic Substance Control Act (TSCA)

In 2013, PPPL shipped 315 pounds of PCB waste and 40 cubic yards of asbestos waste. The PCB contents were recycled or incinerated as TSCA Hazardous Waste. Asbestos was landfilled at a permitted facility [Pue14].

B. Hazardous Waste

PPPL submitted a Biennial Hazardous Waste Generator Report to NJDEP for waste generated in CY2013. A description of Resource Conservation and Recovery Act (RCRA) compliance is found in Exhibit 2-1 of this report [Pue14]. PPPL continues to evaluate opportunities to remove hazardous materials from the workplace that have the potential to become hazardous wastes by substituting them with non-hazardous materials that has the added benefit of reducing employee exposure.

C. Recycled Hazardous/Universal Waste

The types and quantities of waste that are recycled each year changes due to the activities varying greatly from year to year as shown in Exhibit 4-6. Recycled universal and hazardous waste included fluorescent bulbs are replaced and crushed prior to recycling, ballasts and batteries are a more typical waste which are recycled each year [Pue14a].

Exhibit 4-6. 2013 Hazardous Recycled Material [Pue14a]

Recycled Hazardous Waste	CY 2013 (lbs)
Batteries	6415
Mercury	1308
Ballasts	488
Total Recycled	**8211 lbs**

4.3 Environmental Protection Programs

4.3.1 Release Programs

A. Spill Prevention Control and Countermeasure (SPCC)

PPPL maintains a Spill Prevention Control and Countermeasure Plan (SPCC), which was updated in 2011. An annual review, but no revisions were made to SPCC in 2013. The SPCC Plan is incorporated as a supplement to the PPPL Emergency Preparedness Plan. In addition to the 5-year major revision as required by the USEPA, PPPL's Environmental Service Division (ESD) completes a review every year to make any minor changes required to the SPCC [PPPL11b, Pue14b].

B. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) - Continuous Release Reporting

Under Comprehensive Environmental Recovery, Compensation, and Liability Act, (CERCLA) reporting requirements for the release of listed hazardous substances in quantities equal to or greater than its reportable quantity, the National Response Center is notified and the facility is required to report annually to EPA. Because PPPL has not released any CERCLA-regulated hazardous substances, no "Continuous Release Reports" have been filed with EPA in CY 2013 [Sla14].

C. Superfund Amendments and Reauthorization Act (SARA) Title III Reporting Requirements

NJDEP administers the Superfund Amendments and Reauthorization Act (SARA) Title III, also known as the Emergency Reporting and Community Right-to-Know Act (EPCRA), reporting for EPA Region II. The modified Tier I form includes SARA Title III and NJDEP-specific reporting requirements. PPPL submitted the SARA Title III Report to NJDEP prior to the March 1st deadline on February 24, 2014 [PPPL14b].

Changes for 2013 EPCRA/SARA report include:

1. The cover page has additional information as required by the EPA for the EPCRA Section 302.
2. The printout no longer shows the codes, rather it writes out the inventory information.

SARA Title III reports included information about twelve compounds used at PPPL as listed in Exhibits 4-7and 4-8.

Exhibit 4-7. 2013 Summary of PPPL EPCRA Reporting Requirements

SARA	YES	NO	NOT REQUIRED
EPCRA 302-303: Planning Notification	✓		
EPCRA 304: EHS Release Notification		✓	
EPCRA 311-312: MSDS/Chemical Inventory	✓		
EPCRA 313: TRI Report			[✓]

EHS – Extremely hazardous substances (No EHS are on-site at PPPL)
MSDS – Material Safety Data Sheets
TRI – Toxic Release Inventory

Exhibit 4-8. 2013 Hazard Class of Chemicals at PPPL

Compound	Category	Compound	Category
Bromochlorodifluoro-methane (Halon 1211)	Sudden release of pressure & Acute health effects	**Lead**	Chronic health effects
Carbon dioxide	Sudden release of pressure & Reactive	**Nitrogen**	Sudden release of pressure
Diesel Fuel Oil	Fire	**Propane**	Sudden release of pressure
Gasoline	Fire & Chronic Health Hazard	**Petroleum Oil**	Fire
Helium	Sudden release of pressure	**Sulfur Hexafluoride**	Sudden release of pressure
		Sulfuric acid	Acute Health Hazard & Reactive

Though PPPL does not exceed threshold amounts for chemicals listed on the Toxic Release Inventory (TRI), PPPL completed the TRI cover page and laboratory exemptions report for 1996, and submitted these documents to DOE. Since PPPL did not exceed the threshold amounts, no TRI submittal was completed for 2013.

4.3.2 Environmental Releases

PPPL reported no oil or chemical spills in CY 2013[Pue14b]. Due to New Jersey's no *de minimus* thresholds, all oil released to unpaved surfaces must be reported. If spills occur, PPPL removes dirt and tests the soil to ensure adequate cleanup of petroluem hydrocarbons and any other chemicals.

4.3.3 Pollution Prevention Program

In 2013, PPPL continued to pursue waste minimization and pollution prevention opportunities through active recycling efforts and through the purchasing of recycled-content and other environmentally-preferable products (EPP).

In FY 2013, PPPL's office recycling rate was 76.1%; this rate reflects over 83 tons of municipal solid waste (MSW) that were diverted from landfills. The DOE EO 13514 goal of 50% recycle *versus* disposal rate was met and accomplished by active participation of Laboratory employees. PPPL's FY 2013 rate for recycling of construction materials including wood, concrete, and stone was 73.5% by weight [Kin14a].

In September 2010, PPPL initiated the collection and recycling of food waste from the cafeteria kitchen and the trash bins located in the cafeteria and select locations around the laboratory. In FY2013, PPPL composted 15.3 tons of food waste. Changes in from non-compostable products (cups, plates and corn starch food containers) to compostable ones, new color-coded signs and bins increased composting across the laboratory [Kin14a].

4.4 Non-Radiological Emissions Monitoring Programs

Air Permits

PPPL maintains New Jersey Department of Environmental Protection (NJDEP) air permits/certificates for the equipment as listed in Exhibit 4-9. PPPL is classified as a synthetic- minor facility and does not exceed the Potential to Emit (PTE) limits for any of the Criteria Air Pollutants.

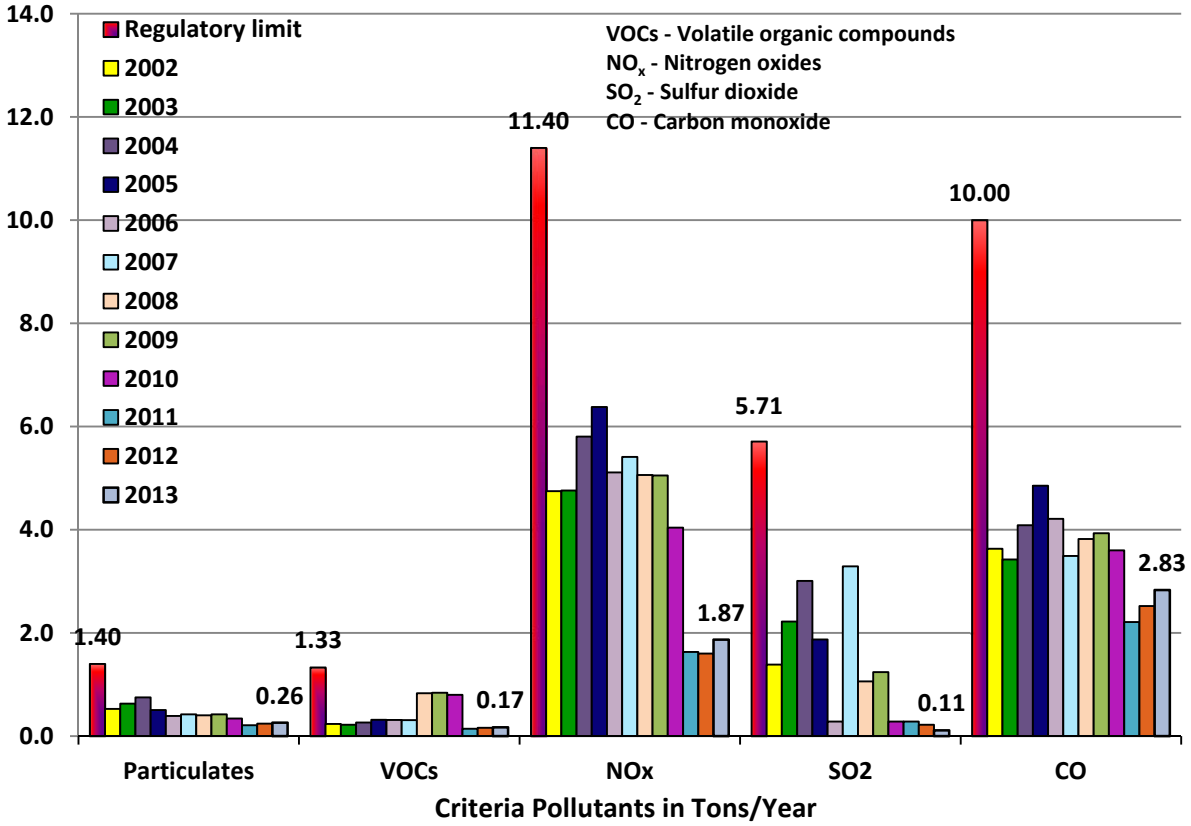
PPPL tracks NJDEP Air Quality Conditions Alerts. Unhealthy conditions are noted and all generator repairs and maintenance are postponed until normal air quality is reinstated. During those times, the standby (emergency) generators may be used only in an emergency (power outage) or when a voltage reduction issued by Pennsylvania, Jersey, Maryland Interconnect (PJM – electric-power grid controllers) and posted on the PJM internet website under the "emergency procedures" menu.

In 2008, NJDEP reduced the regulatory limits for the Criteria air pollutants for operating the boilers; PPPL's operated these four boilers were well below those limits in 2013 (Exhibit 4-10 & Appendix Table 9). With the installation of digital controls and high-efficiency, lower nitrogen oxide (NO_x) burners, the NO_x , volatile organic compounds (VOCs), particulates, sulfur dioxide (SO_2), and carbon monoxide (CO) emissions are being further reduced [Nem14].

Exhibit 4-9. PPPL's Air-Permitted Equipment

Type of Air Permit	Qty	Location	Requirements
Dust collectors	2	Facilities Woodworking shop C-Site MG Annex	Operate at 99% efficiency General Permit July 2011; reused from C-site Assembly and Storage/Research Equipment Storage and Assembly (CAS/RESA) buildings
Storage tanks vents	2	25,000 gal. No. 2 & 4 oil 15,000 gal. No.1 oil	TANKS – EPA annual emissions based on amount of fuel through-put
Diesel generators	2	D-site generator C-site generator	Annual Limit of 200 hours for D-site & 100 hours for C-site of operation excluding emergencies; no testing on NJDEP Air Action Days
Utility boilers	4	Units 2,3,4, & 5 in Facilities	Annual emission testing same quarter each year; annual emission calculations based on hours of operations (Ex.4-12); rolling 12-month calendar total fuel consumed by boiler and fuel type (Tables 9A&9B). Visual stack checked weekly when operating.
Fluorescent bulb crusher	1	Hazardous Materials Storage Facility	Hours of operations and number of bulbs crushed; air monitoring for mercury during filter changes.

Exhibit 4-10. PPPL's Boiler Emissions from 2002- 2013 vs. Regulatory Limits (Fin14b)



4.5 Land Resources and Conservation

4.5.1 Wetlands Letter of Interpretation (LOI)

PPPL operates under NJDEP Land Use Wetlands (LOI). Under permit No. 1218-06-0002.2FWW070001 NJDEP has line verified LOI PPPL's freshwater boundaries in 2008. PPPL's permit expired in 2013. NJDEP's Permit Extension Act of 2001 as Amended though 2012 extends all NJDEP LOI's until December 31, 2014. No construction or alterations to existing vegetation can commence without state notification. Freshwater line verifications must be present on all future site development drawings [PPPL08c].

4.5.2. Soil Erosion and Landscaping

In 2009, PPPL applied for Soil Erosion Permit through Freehold Soil Conservation District. Permit No. 2009-0343 for PPPL's D-Site Parking Lot rain garden conversion was issued on August 28, 2009, expired on February 28, 2013. In CY 2013 PPPL no new additional soil erosion permits were obtained. Draft internal soil erosion and sediment control guidelines were for inclusion in PPPL's Engineering Standards. PPPL continued to reduce the grassed acreage that required mowing and other maintenance by planting native meadow grasses that are allowed to grow tall through PPPL's Storm water Pollution Prevention Plan [PPPL12a].

4.5.3 Herbicides and Fertilizers

During 2013, PPPL's Facilities Division used herbicides, insecticide and fertilizer on campus grounds (Exhibit 4-11). These materials are applied in accordance with state and federal FIFRA regulations. Chemicals are applied by certified applicators. No herbicides or fertilizers are stored on site; therefore, no disposal of these types of regulated chemicals is required by PPPL [Kin14b].

Exhibit 4-11. 2013 Fertilizer and Herbicide Use

Type of Material	Name of Material	Registered EPA No.	2013 Applied
Herbicide	Trimaec Bentgrass Broadleaf	**2217-529**	261 Oz.
Herbicide	Produece	**228-509**	448 Oz.
Insecticide	None	**-**	-
Fertilizer	None	**-**	-

4.5.4 Stormwater Pollution Prevention

PPPL's Stormwater Pollution Prevention Plan (SWPPP) was revised in 2012 to provide guidance to reduce the impact of PPPL's operations on stormwater quality [PPPL12a]. As summarized in Exhibit 8 of SWPPP, PPPL reduces stormwater quantity by utilizing best management practices, such as limiting the mowing areas with rain gardens and native grass meadows plantings.

4.6 Safety

PPPL's 2013 performance with respect to worker safety is noted in Exhibit 4-12 [Lev14a].

Exhibit 4-12. 2013 PPPL's Safety Performance

	Total OSHA recordable case rate[1]	Days away, restricted transferred (DART) case rate[1]
2013	0.88	0.44
	Number of radioactive contaminations (external)	**Number of Safety report OSHA (ORPS) Occurrence confined space, chemical exposure and (LOTO) incidents**
2013	0	0

OSHA – Occupational Safety and Health Administration

[1] Per 200,000 hours worked

Chapter

5

ENVIRONMENTAL RADIOLOGICAL PROGRAM INFORMATION

5.1 Radiological Emissions and Doses

For 2013, the releases of tritium in air and water and the total effective dose equivalent (EDE) contribution at the site boundary and for the population within 80 kilometers of PPPL are summarized in Exhibit 5-1 below. The calculated EDEs at the site boundary are less than 0.009 milli radition equivalent man (mrem) per year, far below the annual limit of 10 mrem per year [Lev14a & 14b].

Exhibit 5-1. Summary of 2013 Emissions and Doses from D-Site Operations

Radionuclide & Pathway	Source	Source Term Curies (Ci) (Bequerel, Bq)	EDE in mrem/yr (mSv/yr) at Site Boundary	Percent of Total	Collective EDE w/in 80 km in person-rem (person-Sv)
Tritium (air)	D-site stack	HTO – 2.21 (8.18×10^{10}) HT - 27.51 (1.02×10^{12})	6.5×10^{-3} (6.5×10^{-5})	69.6	0.60 (6.0×10^{-3})
Tritium (water)	LEC tank	HTO - 0.0099 (3.66×10^{8})	1.99×10^{-4} (1.99×10^{-6})	2.1	2.73×10^{-4} (2.73×10^{-6})
Tritium (water)	Surface Ground	1331 pCi/L (DR Canal) 140 pCi/L(TW-5)	2.61×10^{-3} (2.61×10^{-5})	28.3	2.64×10^{-3} (2.64×10^{-5})
Direct/Scattered neutron & Gamma Radiation	NSTX	0 DD neutrons	N/A	0	N/A
Argon-41 (Air)	NSTX	N/A	N/A	0	N/A
Total			**9.28×10^{-3}** **(9.28×10^{-5})**	100	0.603 (6.03×10^{-3})

[Lev14a & Rul14a]

Bq = Bequerel Ci = Curie DD=deuterium-deuterium EDE = effective dose equivalent
HT = elemental tritium HTO = tritium oxide LEC =liquid effluent collection mrem/yr = milli radiation equivalent man/year
mSv/yr = milli Sievert/year NSTX = National Spherical Torus Experiment pCi/L=picoCuries/liter Sv=Sievert

Estimated dose equivalent (EDE)at the nearest business 1.81×10^{-3} mrem (1.81×10^{-5} mSv) due to tritium air emissions from the D-site stack.

Airborne doses assume maximum exposed individual is in continuous residence at the site boundary; waterborne doses assume that maximum exposed individual uses the ultimate destination of liquid discharges (Millstone River) as sole source of drinking water.[Rul14]

Annual limit is 10 mrem/year; background is about 360 mrem/year. Half life of tritium (HTO & HT) is 12.3 years.

Laboratory policy states that when occupational exposures have the potential to exceed 1,000 mrem (1 rem) per year (10 mSv/y), the PPPL Environment, Safety, and Health (ES&H) Executive Board must approve an exemption. This value (1,000 mrem per year limit) is 20 percent of the DOE legal limit for occupational exposure. In addition, the Laboratory applies the "ALARA" (As Low As Reasonably Achievable) policy to its operations. This philosophy for control of occupational exposure means that environmental radiation levels for device operation are also very low. From all operational sources of radiation, the ALARA goal for maximum individual occupational exposure was less than 100 mrem per year (1.0 mSv/year) above natural background at PPPL. The average annual dose to a member of the general population is considered to be about 360 mrem/year:

- Cosmic radiation – 28 mrem/yr
- Terrestrial sources /earth's crust – 28 mrem/yr
- Food – 40 mrem/yr
- Radon – ~200 mrem/yr
- Medical sources: x-rays – 40 mrem/yr
- Other medical sources –14 mrem/yr

5.1.1 Penetrating Radiation

Due to the upgrade project, the NSTX reactor did not conduct experiments during 2013, and therefore, did not generate neutrons. The upgrade project includes installation of a new center stack and additional diagnostic instruments among other upgrades.

5.1.2 Sanitary Sewage

Drainage from D-site sumps in radiological areas is collected in the one of the three liquid effluent collection (LEC) tanks; each tank has a capacity of 15,000 gallons. Prior to release of these tanks to the sanitary sewer system, *i.e.*, Stony Brook Regional Sewerage Authority (SBRSA), a sample is collected and analyzed for tritium concentration and gross beta. All samples for 2013 showed effluent quantity and concentrations of radionuclides (tritium) to be within allowable limits established in New Jersey regulations (1 Ci/y for all radionuclides), the National Safe Drinking Water regulations (40 CFR 141.16 limit of 20,000 pCi/L) and DOE Order 5400.5 (2×10^6 pCi/liter for tritium) (Exhibit 5-2).

As shown in Exhibits 5-2 and 5-3, the 2013 total amount of tritium released to the sanitary sewer was 0.0099 Curies, 0.990 curies less than the allowable 1.0-Curie per year limit. In Appendix Table 8, the gross beta activity is reported; the gross beta activity ranges from <1680 pCi/L. The continued drop off in activity can presumably be attributed to the upgrade of NSTX that is currently in progress.

Exhibit 5-2.
Annual Releases to Sanitary System from Liquid Effluent Collection Tanks 1994-2013

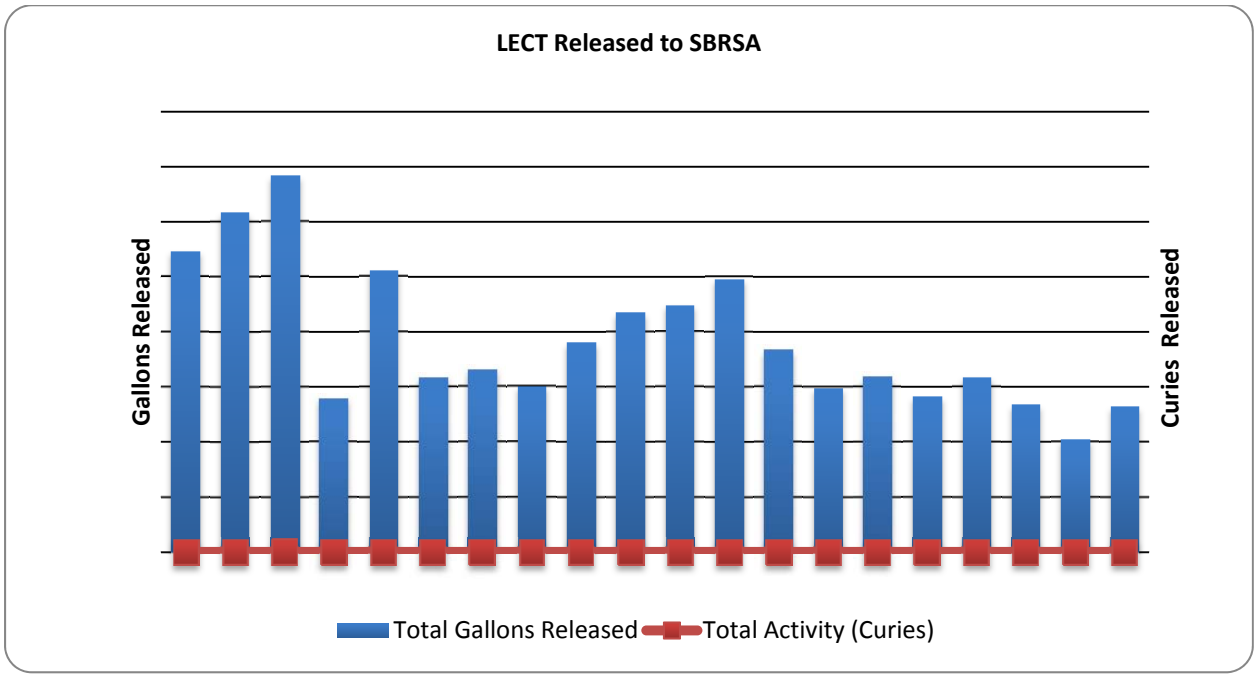


Exhibit 5-3.
Total Annual Releases (LEC tanks) to Sanitary System from 1994 to 2013

Calendar Year	Total Gallons Released	Total Activity (Curies)
1994	273,250	0.299
1995	308,930	0.496
1996	341,625	0.951
1997	139,650	0.366
1998	255,450	0.071
1999	158,760	0.084
2000	165,900	0.081
2001	150,150	0.103
2002	190,200	0.453
2003	217,320	0.032
2004	223,650	0.041
2005	247,950	0.044
2006	183,657	0.015
2007	149,100	0.009
2008	159,450	0.007
2009	140,850	0.082
2010	158,900	0.317
2011	134,450	0.041
2012	102,000	0.018
2013	132,250	0.009

Exhibit 5-4.
Total Low-Level Radioactive Waste from 1997-2013

Year	Cubic meters (m^3) or Kilograms (kg)	Total Activity in Curies (Bq)
1997	56.6 m^3	31,903.0 (1.18 x 10^{15})
1998	15.1 m^3	204.80 (7.58 x 10^{12})
1999	33.6 m^3	213.76 (7.91 x 10^{12})
2000	120 m^3	50.0 (1.85 x 10^{12})
2001	565 m^3	1,288.43 (4.77 x 10^{13})
2002	858,568 kgs	4,950.14 (1.83 x 10^{14})
2003	8,208 kgs	0.03 (1.11 x 10^{9})
2004	4,467 kgs	0.0202 (7.48 x 10^{8})
2005	30.29m^3	0.01997 (7.389 x 10^{8})
2006	11.12m^3	2.3543 (8.711 x 10^{10})
2007	8.6 m^3	0.09285 (3.435 x10^{9})
2008	3.63 m^3	0.08341 (3.086 x10^{9})
2009	No Shipment	No Shipment
2010	13.3	6.30270 (2.332 x10^{11})
2011	15.6 m^3	0.0351 (1.297x10^{9})
2012	No shipment	No shipment
2013	34.9m^3	0.357 (1.32X10^{10})

5.1.3 Radioactive Waste

Exhibit 5-5. B-box with Liner in RWHF for Shipping Radioactive Waste to Clive

In 2013, low-level radioactive wastes (LLW) were stored on-site in the Radioactive Waste Handling Facility (RWHF) prior to off-site disposal(Exhibit 5-5).

PPPL shipped 1233 cubic feet of waste to the Energy Solutions facility in Clive, Utah. The wastes are packaged for shipment and disposal in metal containers, refered to as "B-boxes" (Exhibit 5-5). PPPL maintains detailed waste profiles for LLW that is shipped off-site for burial. PPPL has changed its LLW burial facility from the Nevada National Security Site to the Energy Soluions facility in Clive, Utah. PPPL's radioactive waste program is audited periodically to ensure compliance with burial facility and DOT requirements. The audit includes employee training, waste characterization, waste packaging, quality control, and records retention.

5.1.4 Airborne Emission - Differential Atmospheric Tritium Samplers (DATS)

PPPL uses differential atmospheric tritium sampler (DATS) to measure elemental (HT) and oxide tritium (HTO) at the D site stack. DATS are similarly used at four environmental sampling stations located on D-site facility boundary trailers (T1 to T4), All of the aforementioned monitoring is performed on a continuous basis.

Tritium (HTO and HT) was released and monitored at the D-site stack (Appendix Table 3). Projected dose equivalent at the nearest off-site business from airborne emissions of tritium was 0.0018 mrem/year (0.018 μSv/year) in 2013.

The EDE at the site boundary was calculated based on annual tritium totals as measured at the stack (DATS air) and water samples at the LEC tanks and highest measurements from well and surface water during 2013 (Exhibit 5-1).

5.2 Release of Property Containing Residual Radioactive Material

Release of property containing residual radioactivity material is performed in accordance with PPPL ES&H Directives (ESHD) 5008, Section 10, Subpart L.

Such property cannot be released for unrestricted use unless it is demonstrated that contamination levels on accessible surfaces are less than the values in Appendix D of ES&HD 5008, Section 10, and that prior use does not suggest that contamination levels on inaccessible surfaces exceed Appendix D values. For tritium and tritiated compounds, the removable surface contamination value used for this purpose is 1,000 disintegration per minute (dpm)/100 cm^2.

5.3 Protection of Biota

The highest measured concentrations of tritium in ground water in 2013, was 140 pCi/L (Well TW-5 in April - Appendix Table 4) and for 1331 pCi/L surface water (D&R Canal C1 - Appendix Table 5). This concentration is a small fraction of the water biota concentration guide (BCG) for HTO of 3 x10^8 pCi/L for aquatic system evaluations, and the water BCG for HTO of 2 x 10^8 pCi/L for terrestrial system evaluations, per DOE Standard STD-1153-2002, "A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota" [Lev13a & 13b]. Because of these low doses, PPPL does not conduct direct biota monitoring.

5.4 Unplanned Releases

There were no unplanned radiological releases in 2013.

5.5 Environmental Radiological Monitoring

5.5.1 Waterborne Radioactivity

A. Surface Water

Surface-water samples at eleven locations (two building foundation sumps: D-Site Airshaft, and D-Site MG; two on-site locations: DSN001, and E1; and seven off-site locations: B1, B2, C1, DSN003, M1, P1, and P2) have been analyzed for tritium (Appendix Table 5).

In October 2013 at C1 D&R Canal, the tritium concentration was detected at 1331 pCi/L, which was the highest for surface water sample (Appendix Table 5).

Rain water samples, which will eventually reach surface waters, were collected and analyzed and ranged from below detection to 258 pCi/L in 2013 (Appendix Table 6). With the end of TFTR D&D project in September 2002, tritium concentrations in rain, surface, and ground water samples have decreased, reflecting the decreased atmospheric tritium releases measured at the D-site stack.

In April 1988, PPPL began on-site precipitation measurements as part of its environmental surveillance program. On a weekly basis, precipitation is measured by an on-site rain gauge. The 2013 weekly precipitation amounts are shown on Appendix Table 2. Based on the average rainfall, a comparison of dry or wet years shows that 2013 was just below the average rainfall total at 43.25 inches (109.86 cm) (Appendix Table 7).

B. Ground Water

The highest concentration of tritium in ground water was found in well TW-5 at 140 pCi/L in December 2013 (Appendix Table 4). These tritium concentrations are well below the Drinking Water Standard of 20,000 pCi/L. The three on-site wells used to monitoring for tritium in the ground water (TW-1, TW-5, TW-8) were tested for tritium in 2013. Ground water monitoring

continued in 2013 based on increased stack releases due to ongoing neutral beam cleaning in preparation for the NSTX upgrade project.

Based on PPPL's environmental monitoring data and the available scientific literature [Jo74, Mu77, Mu82, Mu90], the most likely source of the tritium detected in the on-site ground water samples is from the atmospheric releases of tritium from the D-site stack and the resulting "wash-out" during precipitation. Monitoring of ground water from wells and the building foundation sump (dewatering sump for D-site buildings) will continue as on-going atmospheric releases necessitate.

C. Drinking (Potable) Water

Potable water is supplied by the public utility, New Jersey American Water Company, formerly Elizabethtown Water Company. In April 1984, a sampling point at the input to PPPL (E1 location) was established to provide baseline data for water coming onto the site. Radiological analysis has included gamma spectroscopy and tritium-concentration determination. In 2013, tritium concentrations at this location were less than the lower limit of detection (Appendix Tables 5)

5.5.2 Foodstuffs, Soil, and Vegetation

There were no foodstuffs, soil, or vegetation samples gathered for analysis in 2013. In 1996, the Health Physics (HP) Manager reviewed the requirement for soil/biota sampling. At that time, a decision was made to discontinue the sampling program. Tritium was not detected in almost all samples and these data were not adding to the understanding of tritium transport in the environment. Greater emphasis was placed on water sampling and monitoring, which produced more relevant results.

Chapter

6

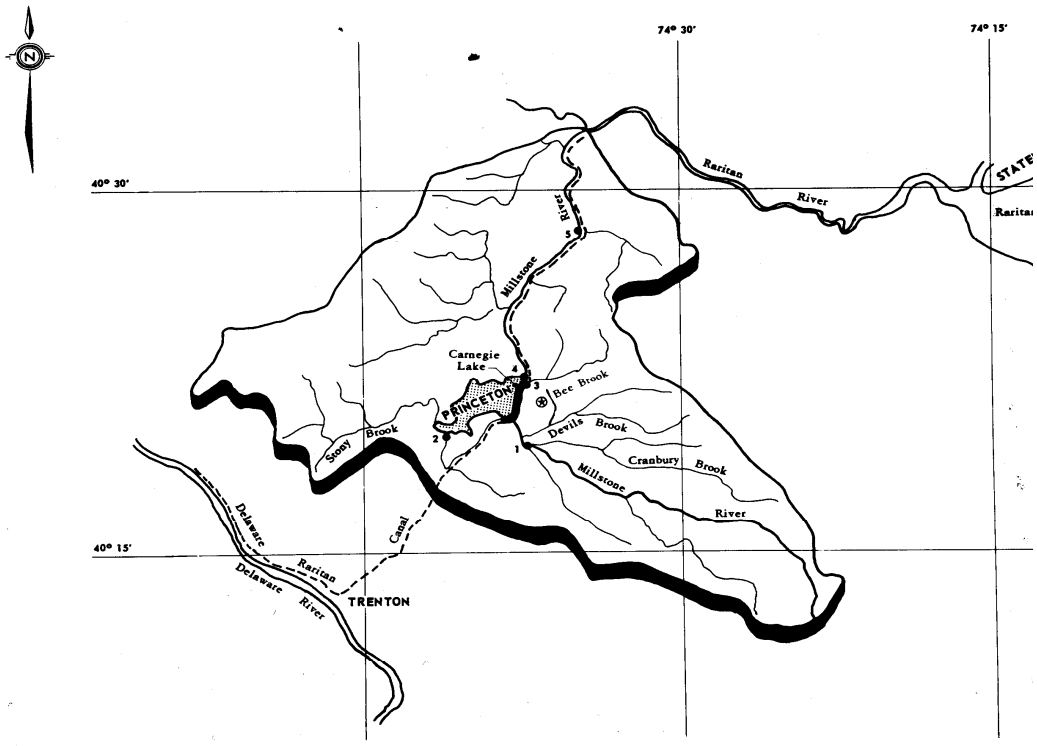
SITE HYDROLOGY, GROUND WATER, AND DRINKING WATER PROTECTION

6.1 Lower Raritan River Watershed

PPPL is located within the Bee Brook Watershed. Bee Brook is a tributary to the Millstone River, which is part of the Raritan River Watershed (Exhibit 6-1). 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 discharges into Devil's Brook at the entrance to Mill Pond [Sa80].

Exhibit 6-1. Millstone River Watershed Basin



6.2 Geology & Topography

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, about 250-200 Ma (million years ago). 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 Epoch (approximately 2.6 million to 12,000 years ago).

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 (msl) 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 percentages of clay predominate.

Two soil series are recognized in the immediate vicinity of the site. Each reflects differences in drainage and subsurface water tables. Along the low-lying banks of stream tributary, 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 msl), the sandy loams are better drained and belong to the Sassafras series. Extensive historic farmlands and nurseries in the area indicate this soil provides a good environment for agricultural purposes, both today and in the past.

6.3 Biota

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.

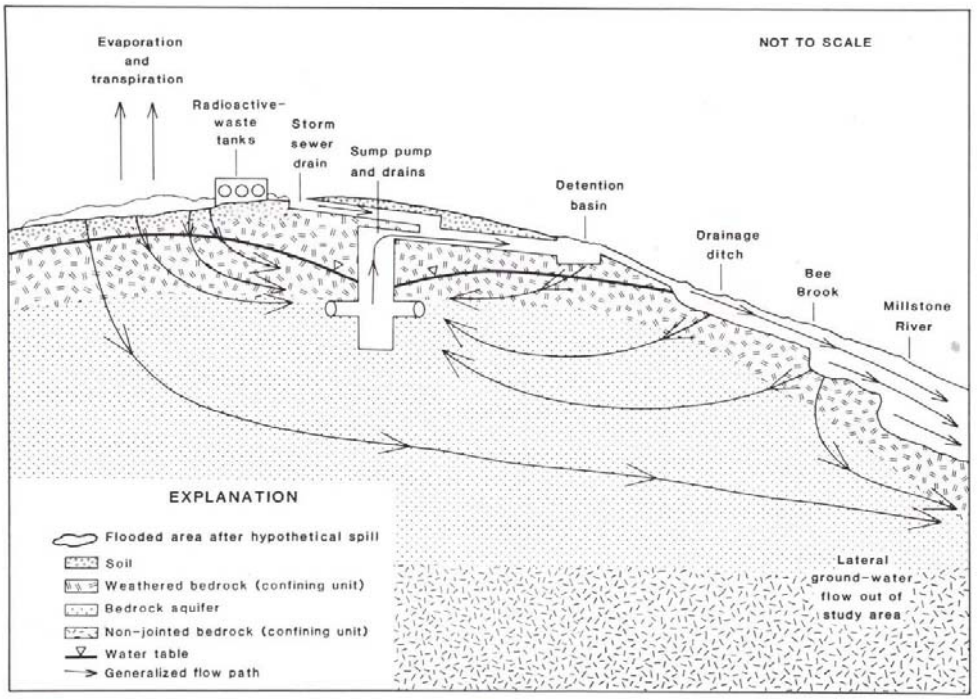
The under-story of the wooded areas is partially open with isolated patches of shrubs, vines, and saplings occurring mostly in the uplands area. The poorly drained areas have a low ground cover of ferns, grasses, and leaf litter.

6.4 Flood Plain

All of PPPL's storm water runoff flows to Bee Brook, either directly *via* the lined surface impoundment/retention basin (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. Eighteen acres of PPPL's 88.5-acre site are wetlands, 14.5 acres grass, and 18.4 acres upland forest. Gravel, which is semi-impervious, covers approximately 11.1 acres, resulting in an impervious cover (buildings, roadways, sidewalks, etc.) of 26.5 acres. PPPL's current site impervious cover is well under SWPPP's Best Management Practice of 60 percent of total developable coverage. [PPPL12a & SE96].

Exhibit 6-2. Generalized Potentiometric Surface of the Bedrock Aquifer at PPPL [Le87]



Also, the 500-year flood plain elevation (85 ft above mean sea level, msl) 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 (Exhibit 6-2).

Ground water is pumped from the sumps into the 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.

6.5 Groundwater Monitoring

6.5.1 Monitoring Wells

PPPL has installed a total of 46 wells to monitor ground-water quality under various regulatory programs (Exhibit 6-3), although many wells have since been decommissioned. PPPL has 32 active monitoring wells for environmental monitoring and surveillance purposes. Remedial Investigation and Remedial Alternatives Analysis (RI/RAA) studies were conducted to delineate shallow ground water contamination and identify a suitable remedy for ground water contamination under the New Jersey Site Remediation Program [PPPL99a & b]. A Remedial Action Work Plan (RAWP) was

approved by NJDEP in 2000. Ground water monitoring continues as part of the selected remedy [PPPL00]. PPPL completed the transition from NJDEP oversight to the new state-mandated Licensed Site Remediation Professional (LSRP) program in May 2012. In August 2013, NJDEP issued Groundwater Remedial Action Permit number RAP13001, effective on August 27th, 2013 for 30 years, for the ongoing remediation and monitoring programs at PPPL. PPPL has modified it monitoring program to meet conditions of the new permit [NJDEP13b].

Exhibit 6-3. 2013 Monitoring Wells

	Remedial Action Monitoring Well (MW)	Environmental Surveillance (TW)
Active Wells Monitored On-Site	22	10
Active Wells Monitored Off-Site	0	0
Number of Wells Sampled	15	3
Sampling Rounds Completed	4	4

Exhibit 6-4. 2013 Groundwater Contamination

Ranges of Results for Positive Detections		
	2013 Wells	**2013 Sumps**
Tritium (pCi/L)	Bkg – 140.0	Below Bkg
PCE (µg/L)	ND – 110.0	ND – 31.9
TCE (µg/L)	ND – 15.0	ND – 4.34

Note: ND- Not Detected;
Bkg- Background radiation naturally present

6.5.2 Sampling Events

In support of the approved ground water remedial action, PPPL monitors the groundwater wells quarterly in March, June, September and December. The type of equipment used by PPPL to sample the ground water is shown in Exhibits 6-5. Gas from either a compressed gas (carbon dioxide) cylinders or from a gasoline–powered air compressor is pumped down into the well via a Teflon-lined polyethylene tube into the dedicated bladder pump. The air pushes the water up through the exit tube and water flows through a chamber containing instruments to measure pH, conductivity, dissolved oxygen, temperature, and turbidity. Discharged water flows into a bucket that measures the volume discharged. A water level gauge is used to determine the rate of water recharging back into the well to ensure the sample will be representative of the groundwater. Groundwater parameters sampled are listed in Exhibit 6-6.

Exhibit 6-5.
Well Monitoring Setup –Compressed Air, Water Depth. Meter, Discharge Collection Bucket, and Probe

Ground water monitoring results show that tetrachloroethylene, trichloroethylene (PCE, TCE), and their natural degradation products are present in a number of shallow and intermediate-depth wells on C-site (Exhibit 6-4). These VOCs are commonly contained in industrial solvents or metal degreasing agents. The source of these chemicals has been identified as a former waste storage area known as the PPPL Annex Building.

Foundation de-watering sumps located on D-site influence ground water flow across the site (Figure 2). The sumps create a significant cone of depression drawing ground water toward them. Under natural conditions, ground water flow is to the south-southeast toward Bee Brook; however, because of building foundation drains on D-Site, ground water beneath the site is drawn radially toward the D site sumps.

Exhibit 6-6. Groundwater Parameters

Frequency	Analytical Parameter	Analytical Method
Quarterly	Volatile Organic Compounds (VOC) + Library Search	EPA-624
Annual	Nitrate & Nitrite	EPA-300.0
Annual	Chloride	EPA-300.0
Annual	Sulfate	EPA-300.0
Annual	Alkalinity	SM 2320B
Annual	Manganese	EPA-200.7
Annual	Ferrous Iron (Fe^{+2})	SM20/3500FEB
Annual	Dissolved Methane, Ethane, Ethene	EPA-8015 (modified)
Annual	Ortho-phosphate	SM4500P E
Annual	Sulfide	SM 4500S D
Annual	Total Organic Carbon (TOC)	SM 5310C
Quarterly (TW Wells)	Tritium	EPA 906.0

[EPA99 & PPPL13h]

6.5.3 Remedial Action Work Plan (RAWP)

Following a site-wide RI/RAA study and remedy selection process, PPPL prepared and submitted a Remedial Action Work Plan (RAWP) outlining continual operation of the ground water extraction system and a long-term monitoring program [Sh00]. The RAWP was submitted to NJDEP in May 2000, which was implemented until the Ground Water Remedial Action permit was issued in August 2013 [HLA97, HLA98, Sh00-01, Sh03, Sh05-13].

In January 2002, an Aquifer Classification Exception Area (CEA) Designation was submitted to NJDEP. The CEA designation identifies specific areas where state-wide Ground Water Quality Standards are not met and will not be met for some time. The CEAs was granted for a specific area of an aquifer to address specific VOCs in the shallow (<60 feet deep) aquifer. The CEA request was approved by NJDEP in August 2002. The CEA was recertified in 2013, with submittal of a Biennial Remedial Action and Ground Water Classification Exception Area Recertification Report (PPPL13b).

General RAWP activities monitored:

- Examination of analytical data and water level measurements indicates an inverse relationship between ground water level and VOC concentration.
- Natural attenuation (anaerobic biodegradation) occurs in the wetlands adjacent to CAS/RESA.
- Contaminated ground water is captured by building sumps and is not migrating off-site.

RAWP 2013 activities include:

- NJDEP issued PPPL's Groundwater Remedial Action Permit No. RAP13001, effective for 30 years starting August 27, 2013.
- Quarterly and Annual sampling JM Sorge subcontractor sampled March, June, September, and December.
- Starting in December 2013, PPPL Quarterly sampling will only include VOC + library search.
- Annual sampling will be conducted with VOC + library search and monitored natural attenuation (MNA) parameters in September 2014, and occurring in March in following subsequent years.
- Submittal of the *Remedial Action Progress Report* in May 2013 and *Remedial Action Biennial Certification for Ground Water* to NJDEP in 2013.
- Bladder pumps and monitoring well casings were refurbished as necessary.
- Groundwater monitoring equipment repairs.

6.5.4 Monitored Natural Attenuation

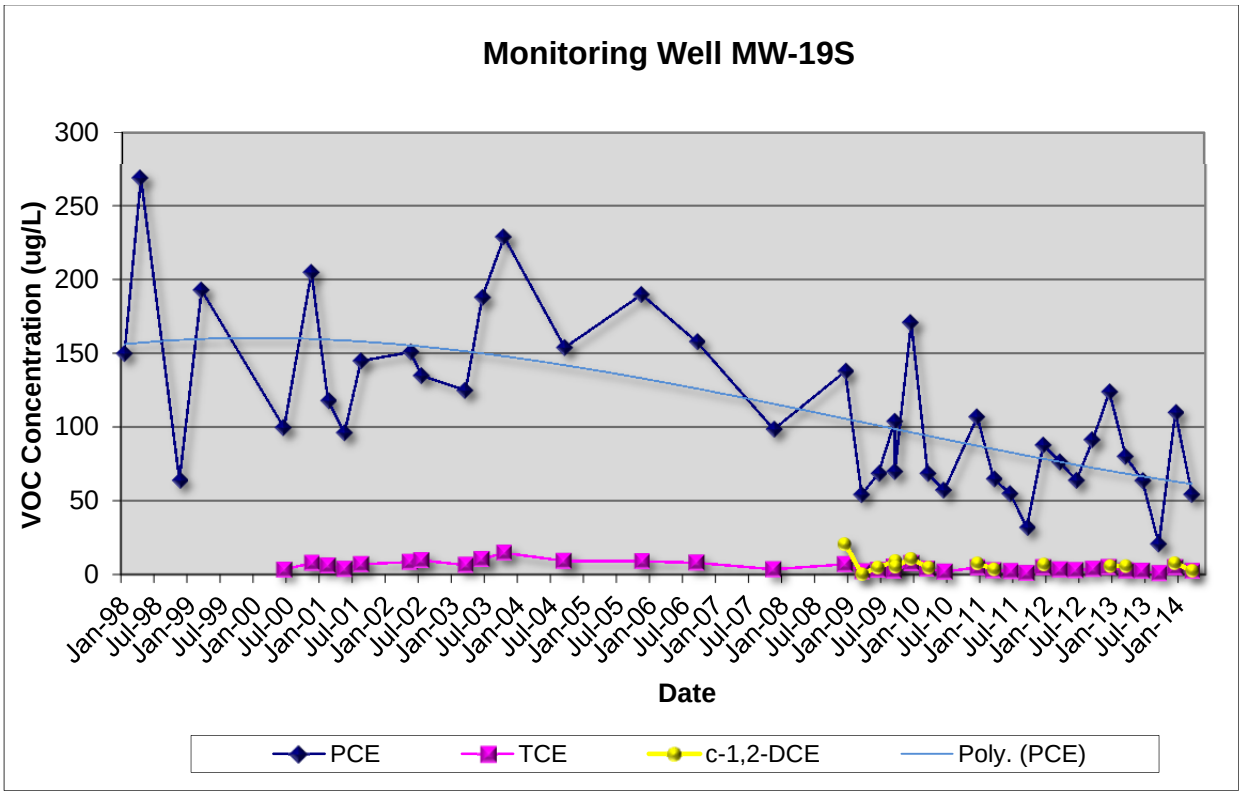
Examination of analytical data and water level measurements during the Remedial Investigation and the beginning of the Remedial Action indicated an inverse relationship between ground water level and VOC concentration (particularly PCE). Periods of higher water level generally corresponded

with lower PCE results. Conversely, higher PCE results are generally coincident with period of lower ground water elevation (Appendix Tables 19-22).

Natural attenuation processes are active as evidenced by presence of degradation compounds in ground water down gradient of source area (Appendix Tables 19-22). PCE is sequentially degraded into trichloroethylene (TCE) and cis-1,2-dichloroethlyene (c-1,2-DCE). The presence of c-1,2-DCE, dissolved methane, reduced dissolved oxygen levels and negative oxidation-reduction potential (redox) values provide definitive evidence of on-going biological degradation of chlorinated ethenes [PPPL13b, Sh06, Sh07, SH08, Sh09].

Review and examination of the analytical results indicate that contaminant concentrations, particularly PCE, are generally decreasing and are below the levels documented at the beginning to the Remedial Investigation. Seasonal fluctuations in VOC concentrations were seen in data collected during the RI and during the first two years of remedial action monitoring. These data generally showed peak VOC concentration during the late fall/winter months (Appendix Figure 1 and 2, Exhibits 6-7). The time-trend graph shown in Exhibit 6-7 also includes a second-order polynomial regression line fitted to PCE concentrations. This trend line shows an overall downward trend in contaminant concentration with a significant decrease since early 2007. Spring and summer results are generally lower [PPPL13b].

Exhibit 6-7: PCE Concentration vs. Time at MW-19S (1998-2013)



6.6 Drinking Water Protection

PPPL and the surrounding area do not rely on on-site or shallow supply wells for potable water. All potable water in the immediate area of the Laboratory is provided by New Jersey American Water Company. New Jersey American Water Company is supplied by a variety of sources, including surface water intakes and deep supply wells located throughout its service area. The nearest wells supplying water to New Jersey American are located approximately 2 miles south-southwest of the Laboratory near the Millstone River. As discussed above, ground water contaminated with PCE and other organic chemicals is captured by the building foundation drains and is not migrating offsite.

Chapter

7

QUALITY ASSURANCE

PPPL has established a Quality Assurance/Quality Control (QA/QC) Program to ensure that the accuracy, precision, and reliability of environmental monitoring data are consistent.

7.1 PEARL Lab Certification - Proficiency Testing

In 2013, analyses of environmental samples for radioactivity and other analyze immediately non radiological parameters were conducted by PPPL's on-site analytical laboratory (Exhibits 7-1 & 7-2).

Exhibit 7-1. PEARL Chlorine Standard Check for Accuracy

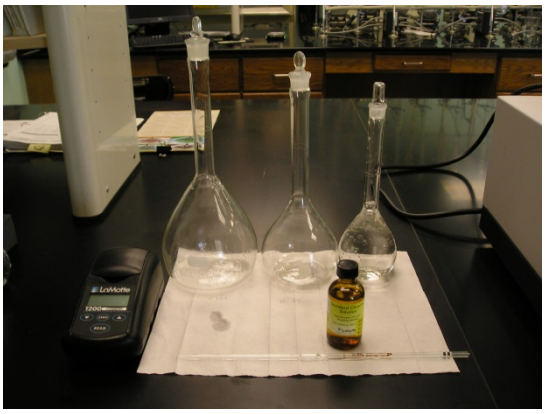


Exhibit 7-2. Distilling Samples for Tritium Analysis Performed at PEARL

The PPPL Environmental Analytical Radiological Laboratory (PEARL) procedures follow the DOE's Environmental Measurements Laboratory's *EML HASL-300 Manual* [Vo82], EPA's *Methods and Guidance for Analysis of Water* [EPA99] *and Standard Methods of Water and Wastewater Analysis* [SM12] that are nationally recognized standards.

Beginning in 1984, PPPL participated in a NJDEP certification program initially through the USEPA QA program. In March 1986, EPA/Las Vegas and NJDEP reviewed PPPL's procedures and inspected its facilities. The laboratory became certified for tritium analysis in urine (bioassays) and water. In 2001, USEPA turned the QA program over to the states; NJDEP chose a contractor laboratory, ERA, to supply the radiological proficiency tests. As

of October 2013, NJDEP is no longer administrating PT Sample Contracts, requiring individual sites to obtain their own approved PT Sample Providers to obtain PT samples.

A. Radiological

To maintain its radiological certification, PPPL participates in a National Institute for Standards and Technology's (NIST) National Voluntary Laboratory Accreditation Program (NVLAP) accredited radiochemistry proficiency testing program twice annually in 2013. Cesium, cobalt and zinc use a gamma spectroscopy technique while tritium uses a distillation and liquid scintillation method (Exhibit 7-3) (Table 23) [PPPL11a].

Exhibit 7-3. 2013 NJDEP Radiological Certified Parameters

Parameter	Approved Method
Cesium 134/137	SM 7120
Cobalt 60	SM 7120
Zinc 65	SM 7120
Tritium	EPA 906.0

B. Non-Radiological Parameters

For non-radiological parameters, PPPL participates in NJDEP Laboratory Certification program (NJ ID #12471) (Exhibit 7-4). A requirement of the certification program is to analyze within the acceptance range the quality control (QC) and proficiency test (PT) samples that are purchased from outside laboratory suppliers. These PT samples are provided as blind samples for analysis; the test results are submitted prior to the end of the study. Results are supplied to PPPL and NJDEP to confirm a laboratories' ability to correctly analyze those parameters being tested. In Table 23, the radiological and non-radiological proficiency testing (PT) results show that all PEARL's results were in the acceptable range.

During PPPL's NJDEP Environmental Laboratory Certification Program audit, PPPL dropped Specific Conductivity and Dissolved Oxygen from its state certification. These parameters were strictly for groundwater sampling, which proved unnecessary as groundwater was being conducted by subcontractor which provides its own NJDEP laboratory certified sampling equipment.

Exhibit 7-4. 2013 NJDEP Non-Radiological Certified Parameters

Parameter	Approved Method
Chlorine	SM 4500-Cl G
pH	SM 4500-H B
Temperature	SM 2550 B

7.2 Subcontractor Labs

PPPL followed its internal procedures, HP-LAB-03- "Methods for Measuring Analyze Immediately Parameters," EM-OP-31—"Surface Water Sampling," and EM-OP-38—"Low-Flow Ground Water Sampling" procedures. These procedures provide detailed descriptions of all NJPDES permit-required sampling and analytical methods for collection of samples, analyses of these samples, and quality assurance/quality control requirements. Chain-of-custody forms are required for all samples; holding times are closely checked to ensure that analyses are performed within established holding times and that the data is valid; trip blanks are required for all volatile organic compound analyses.

Subcontractor laboratories used by PPPL are certified by NJDEP and participate in the state's QA program; the subcontractor laboratories must also follow their own internal quality assurance plans. QC Laboratories and Accutest Laboratories where used in 2013 for environmental laboratory analysis. Hazardous waste sample analyses were conducted by Precision Testing Laboratories.

7.3 Internal QA/QC

A. Internal Audit

PPPL did not participate in any internal audits for PEARL operations in 2013.

B. Internal QA Check

PPPL's PEARL ensures QA/QC through HP-ENV-12 "Quality Assurance/Quality Control Plan for Analyze Immediately Parameters ." Temperature calibrations are conducted quarterly with NIST Thermometer. Temperature on all pH and dissolved oxygen meters are calibrated against NIST. Chlorine field meters are calibrated at least annually by chlorine standard concentrations. Annual Accuracy and Precisions Reports are generated to evaulate concentration standards data. Prior use, the chlorine field meter is checked once monthly verified prior to NJPDES sampling by calibrated LaMotte Secondary Standards.

C. Calibrations

PPPL calibrates all equipment per equipment manual and following HP-LAB-03 and HP-ENV-12 Procedures. Calibrations are recorded in lab calibration log and reported to Head QA Officer for review.

D. Chemicals

Chemical inventories are performed quarterly to insure proper storage, expiration and quantity checks. Chemical name, stock number, lot number, date received, date opened and expiration date are all checked to ensure chemical quality for calibration.

7.4 External QA/QC

In July 2013, NJDEP Office of Quality Assurance (OQA) audited PPPL's Princeton Environmental, Analytical and Radiological Laboratory, PEARL. PPPL completed corrective actions and recommendations on May 24, 2014. PEARL conducts analyses for Analyze-Immediately parameters to support the New Jersey Pollutant Discharge Elimination System (NJPDES) permit requirements and radiological parameters for internal samples.

Chapter

8

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Chapter

9

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Appendix

A

TABLES for 2013

Table 1. PPPL Radiological Design Objectives and Regulatory Limits[a]

CONDITION		PUBLIC EXPOSURE[b]		OCCUPATIONAL EXPOSURE	
		REGULATORY LIMIT	DESIGN OBJECTIVE	REGULATORY LIMIT	DESIGN OBJECTIVE
ROUTINE OPERATION Dose equivalent to an individual from routine operations (rem per year, unless otherwise indicated)	NORMAL OPERATIONS	0.1 Total, 0.01[c] Airborne, 0.004 Drinking Water	0.01 Total	5	1
	ANTICIPATED EVENTS ($1 > P \geq 10^{-2}$)	0.5 Total (including normal operation)	0.05 per event		
ACCIDENTS Dose equivalent to an individual from an accidental release (rem per event)	UNLIKELY EVENTS $10^{-2} > P \geq 10^{-4}$	2.5	0.5	(e)	(e)
	EXTREMELY UNLIKELY EVENTS $10^{-4} > P \geq 10^{-6}$	25	$_5$(d)	(e)	(e)
	INCREDIBLE EVENTS $10^{-6} > P$	NA	NA	NA	NA

P = Probability of occurrence in a year.

[a] All operations must be planned to incorporate radiation safety guidelines, practices and procedures included in PPPL ESHD 5008, Section 10.

[b] Evaluated at PPPL site boundary.

[c] Compliance with this limit is to be determined by calculating the highest effective dose equivalent to any member of the public at any offsite point where there is a residence, school, business or office

[d] For design basis accidents (DBAs), i.e., postulated accidents or natural forces and resulting conditions for which the confinement structure, systems, components and equipment must meet their functional goals, the design objective is 0.5 rem.

(e) See PPPL ESHD-5008, Section 10, Chapter 10.1302 for emergency personnel exposure limits.

Table 2. Annual Precipitation Data for 2013

START DATE	WEEK	INCH	CUM. INCHES	TOTAL	MONTHLY TOTAL
1-Jan-13	1	0.00	0.00		
8-Jan-13	2	0.02	0.02		
15-Jan-13	3	0.89	0.91		
22-Jan-13	4	0.78	1.69		
29-Jan-13	5	1.13	2.82	2.8200	**JANUARY**
5-Feb-13	6	0.03	2.85		
12-Feb-13	7	0.00	2.85		
19-Feb-13	8	1.11	3.96		
26-Feb-13	9	0.66	4.62	1.8000	**FEBRUARY**
5-Mar-13	10	0.27	4.89		
12-Mar-13	11	0.80	5.69		
19-Mar-13	12	1.00	6.69		
26-Mar-13	13	0.30	6.69	2.3700	**MARCH**
2-Apr-13	14	0.22	7.21		
9-Apr-13	15	1.05	8.26		
16-Apr-13	16	0.35	8.61		
23-Apr-13	17	0.39	9.00	2.0100	**APRIL**
30-May-13	18	0.26	9.26		
7-May-13	19	0.89	10.15		
14-May-13	20	1.06	11.21		
21-May-13	21	0.18	11.39		
28-May-13	22	1.43	12.82	3.8200	**MAY**
4-Jun-13	23	0.61	13.43		
11-Jun-13	24	5.36	18.79		
18-Jun-13	25	0.74	19.53		
25-Jun-13	26	0.55	20.08	7.2600	**JUNE**
2-Jul-13	27	3.10	23.18		
11-Jul-13	28	0.41	23.59		
16-Jul-13	29	2.32	25.91		
23-Jul-13	30	1.08	26.99		
30-Jul-13	31	1.43	28.42	8.3400	**JULY**
6-Aug-13	32	1.04	29.46		
13-Aug-13	33	2.04	31.50		
20-Aug-13	34	0.02	31.52		
27-Aug-13	35	0.52	32.04	3.6200	**AUGUST**
3-Sep-13	36	0.18	32.22		
10-Sep-13	37	0.24	32.46		
17-Sep-13	38	1.50	33.96		
24-Sep-13	38	0.00	33.96	1.9200	**SEPTEMBER**
1-Oct-13	39	0.00	33.96		
8-Oct-13	40	0.00	33.96		
15-Oct-13	41	0.00	33.96		
22-Oct-13	42	0.00	33.96		
29-Oct-13	44	1.65	35.61	1.6500	**OCTOBER**
5-Nov-13	45	0.00	35.61		
12-Nov-13	46	0.42	36.03		
19-Nov-13	47	0.18	36.21		
26-Nov-13	48	2.60	38.81	3.2000	**NOVEMBER**
3-Dec-13	49	0.00	38.81		
10-Dec-13	50	1.50	40.31		
17-Dec-13	51	1.20	41.51		
24-Dec-13	52	0.04	41.55		
31-Dec-13	53	1.70	43.25	4.4400	**DECEMBER**

Table 3. D–Site Tritium Stack Releases in Curies in 2013

Week Ending	HTO (Ci)	HT (Ci)	Weekly Total (Ci)	Annual Total (Ci)
1/9/2013	0.0355	0.00163	0.03713	0.0371
1/16/2013	0.0457	0.00051	0.04621	0.0833
1/23/2013	0.0385	0.00487	0.04337	0.1267
1/30/2013	0.0355	0.00026	0.03576	0.1624
2/6/2013	0.0344	0.00145	0.03585	0.1983
2/13/2013	0.0229	0.00054	0.02344	0.2217
2/20/2013	0.0344	0.00139	0.03579	0.2575
2/27/2013	0.0356	0.00142	0.03702	0.2945
3/6/2013	0.0301	0.00070	0.03080	0.3253
3/13/2013	0.0328	0.00183	0.03463	0.3600
3/19/2013	0.0340	0.42100	0.45500	0.8150
3/27/2013	0.0346	0.00133	0.03593	0.8509
4/3/2013	0.0315	0.03110	0.06260	0.9135
4/10/2013	0.0343	0.00192	0.03622	0.9497
4/17/2013	0.0420	0.00114	0.04314	0.9928
4/24/2013	0.0464	0.00178	0.04818	1.0410
5/1/2013	0.0431	0.00124	0.04434	1.0854
5/8/2013	0.0457	22.90000	22.94570	24.0311
5/15/2013	0.0520	0.00144	0.05344	24.0845
5/22/2013	0.0437	0.00099	0.04469	24.1292
5/29/2013	0.0513	0.00199	0.05329	24.1825
6/5/2013	0.0819	1.79000	1.87190	26.0544
6/12/2013	0.0607	0.00169	0.06239	26.1168
6/19/2013	0.0524	0.00220	0.05460	26.1714
6/26/2013	0.0457	0.37400	0.41970	26.5911
7/3/2013	0.0404	0.00235	0.04275	26.6338
7/10/2013	0.0528	0.38500	0.43780	27.0716
7/17/2013	0.0668	0.00300	0.06980	27.1414
7/24/2013	0.0669	0.00087	0.06777	27.2092
7/31/2013	0.0618	0.17100	0.23280	27.4420
8/7/2013	0.0466	0.00036	0.04696	27.4889
8/14/2013	0.0412	0.19200	0.23320	27.7221
8/21/2014	0.0406	0.01210	0.05270	27.7748
8/28/2013	0.0410	0.10100	0.14200	27.9168
9/4/2013	0.0441	0.00078	0.04488	27.9617
9/11/2013	0.0367	0.11700	0.15370	28.1154
9/18/2013	0.0434	0.00216	0.04556	28.1610
9/25/2013	0.0763	0.15500	0.23130	28.3923
10/2/2013	0.0469	0.00182	0.04872	28.4410
10/9/2013	0.0400	0.13900	0.17900	28.6200
10/16/2013	0.0446	0.00217	0.04677	28.6668
10/23/2013	0.0401	0.00200	0.04210	28.7089
10/30/2013	0.0034	0.00027	0.00365	28.7125
11/6/2013	0.0317	0.26900	0.30070	29.0132
11/13/2013	0.0588	0.00437	0.06317	29.0764
11/20/2013	0.0407	0.10700	0.14770	29.2241
11/27/2013	0.0253	0.00083	0.02613	29.2502
12/4/2013	0.0269	0.08910	0.11600	29.3662
12/11/2013	0.0315	0.00160	0.03310	29.3993
12/18/2013	0.0272	0.20200	0.22920	29.6285
1/8/2014	0.0871	0.00363	0.09073	29.7193
Total	**2.2075**	**27.51181**	**29.71929**	

Table 4. Ground Water Tritium Concentrations for 2013 (in picoCuries/Liter)

TW wells are sampled quarterly and sumps are taken monthly

**All sample dates not listed or shown without a number, are below LLD*

Quarter	Well TW-1	Well TW-5	Well TW-8
1	137.8	*	*
2	*	*	*
3	*	*	*
4	*	139.6	*

Table 5. Surface Water Tritium Concentrations for 2013 (in picoCuries/liter)

Month	Bee Brook (B1)	Bee Brook (B2)	Basin (DSN001)	D&R Canal (C1)	D&R Canal (DSN003)	E1	M1	P1	P2
January			*	*	*				
February	*	*	*	*	*	*	*	*	*
March			*	*	*				
April			*	*	*				
May	*	*	*	*	*	*	*	*	*
June			*	*	*				
July			*	*	*				
August	*	*	*	*	*	*	*	*	*
September			*	*	*				
October			*	1331	*				
November	*	*	*	*	*	*	*	*	*
December			*	*	*				

Sample locations B1, B2, E1, M1, P1, and P2 are taken quarterly

Sample locations DSN001, DSN003, and C1 are taken monthly

** All sample dates not listed or shown without a number, were below the LLD*

Table 6. Rain Water Tritium Concentrations (in picoCuries/liter) Collected On-Site in 2013

250 feet from Stack	R1E (East)	R1W (West)	R1S (South)	R1N (North)	R1ND (Duplicate)
January	*	*	*	*	*
February	*	*	*	*	*
March	*	*	122.5	*	*
April	*	*	258.1	*	*
May	*	*	*	*	*
June	*	*	*	*	*
July	*	174.3	174.3	*	*
August	*	*	*	*	*
October	*	*	*	*	*
November	*	*	*	*	*
December	*	*	*	*	*

500 feet from Stack	R2E (East)	R2W (West)	R2S (South)	R2N (North)
January	*	*	*	*
February	*	*	*	*
March	*	*	*	*
April	*	130.2	*	*
May	*	*	*	*
June	*	*	*	*
July	*	*	*	*
August	*	*	*	*
October	*	*	*	*
November	*	*	*	*
December	*	*	*	234.2

All rain water samples are taken monthly

** All sample dates not listed or shown without a number, were below the LLD*

- No sample taken for date

Table 7. Annual Range of Tritium Concentration at PPPL in Precipitation from 1985 to 2013

Year	Tritium Range picoCuries/Liter	Precipitation In Inches	Difference from Middlesex County Avg. Precipitation of 46.5 inches/yr
1985	40 to 160		
1986	40 to 140		
1987	26 to 144		
1988	34 to 105		
1989	7 to 90	55.4	+8.8
1990	14 to 94	50.3	+3.8
1991	10 to 154	45.1	-1.5
1992	10 to 838	41.9	-4.6
1993	25 to 145	42.7	-3.8
1994	32 to 1,130	51.3	+4.8
1995	<19 to 2,561	35.6	-10.9
1996	<100 to 21,140	61.0	+14.5
1997	131 to 61,660	42.0	-4.5
1998	<108 to 26,450	42.9	-3.6
1999	<58 to 7,817	47.3	+0.8
		(38.7 w/out Floyd)	(-7.8)
2000	<31 to 3,617	38.7	-7.8
2001	153 to 14,830	32.8	-13.7
2002	24 to 3,921	47.9	+1.4
2003	9 to 1,126	54.7	+8.2
2004	27 to 427	40.5	-6.0
2005	<37 to 623	48.4	+1.9
2006	9 to 3,600	48.1	+1.6
2007	<93 to 1,440	49.1	+2.6
2008	<103 to 1,212	48.2	+1.7
2009	< Bkg to 375	47.1	+1.6
2010	<105 to 469	40.8	-5.7
2011	<109 to 269	65.1	+18.6
2012	3 to 182	38.9	-7.6
2013	<Bkg to 1331	43.25	-3.25

Table 8. Liquid Effluent Collection Tank Release Data for 2013

Release Date	Gallons Released	Tritium Sample LLD (pCi/L)	Tritium Sample Activity (pCi/L)	Total Tank Activity (Ci)	Annual Cumulative Activity (Ci)
1/28/2013	11,500	345	23,400	0.0010	0.001020
6/16/2013	12,750	302	24,800	0.0012	0.002210
7/1/2013	12,750	388	24,000	0.0012	0.003370
7/11/2013	12,750	374	26,500	0.0013	0.004650
7/22/2013	12,750	352	24,800	0.0012	0.005850
7/30/2013	12,750	358	10,500	0.0005	0.006355
8/9/2013	12,750	386	19,000	0.0009	0.007273
8/30/2013	12,750	364	18,600	0.0009	0.008172
9/11/2013	12,750	382	12,200	0.00058	0.008760
10/25/2013	12,750	359	20,100	0.00097	0.009731
11/12/2013	9,000	405	65,600	0.00024	0.009955
Total Gallons	**135,250**				

Table 9. Total Fuel Consumption by Fuel Type from 2000 to 2013

Year	*Natural Gas (mmcf)*	*Fuel Oil # 2 or Fuel Oil # 4 (kgals.)*
2000	0.387	42.6
2001	0.367	43
2002	0.331	33.8
2003	0.290	61.9
2004*	0.373	62.3
2005	0.427	32.7
2006	0.319	3.8
2007	0.248	49.6
2008	0.271	41
Permit limit	**0.886**	**227**
2009	0.275	33.6
2010	0.267	17.5
2011	0.230	8.0
2012	0.201	4.8
2013	0.262	5.0
Permit limit	**2.176**	**251**

* Note: No. 2 Fuel oil consumption first began December 2004.
No. 4 Fuel oil no longer burned after December 2004.
Mmcf = millions of cubic feet
kgals. = thousands of gallons

Table 10. Surface Water Analysis for Bee Brook, B1, in 2013

Location B1 = Bee Brook upstream of PPPL basin discharge

B1									
Parameters	**Units**		**February**		**May**		**August**		**Nov.**
Ammonia nitrogen as N, NH3	mg/L		0.10	<	0.10	<	0.10	<	0.04
Biological Oxygen Demand, BOD	mg/L			<	2.68		6.04		
Chemical Oxygen Demand, COD	mg/L		16.00		17.00	<	10.00		61.00
Kjeldhal N, TKN	mg/L	<	0.60		0.62		0.90		
Nitrite as N, NO2	mg/L	<	0.025	<	0.025	<	0.100		
Nitrate as N, NO3	mg/L		2.08		1.49		2.42		
Phosphorus, total	mg/L		0.05	<	0.030		0.128		0.153
Total Dissolved Solids, TDS	mg/L				320.00		343.00		
Total Organic Carbon, TOC	mg/L		3.92		3.42		3.27		
Total Suspended Solids, TSS	mg/L		2.00		5.00		4.00		3.00
Field Parameters									
pH	SU		7.07		6.87		6.68		6.57
Oxidation-Reduction Potential, ORP	mV		-8.50		-5.80		8.00		23
Temperature	o C		2.10		13.65		19.50		12.4
Dissolved Oxygen, DO	mg/L		13.63		9.51		7.83		2.08

Table 11. Surface Water Analysis for Bee Brook, B2, in 2013

Location B2 = Bee Brook downstream of PPPL basin discharge

B2									
Parameters	**Units**		**February**		**May**		**August**		**Nov.**
Ammonia nitrogen as N, NH3	mg/L	<	0.10	<	0.10	<	0.10	<	0.04
Biological Oxygen Demand, BOD	mg/L			<	2.68	<	2.60		
Chemical Oxygen Demand, COD	mg/L	<	10.00		17.00	<	10.00		13.00
Kjeldhal N, TKN	mg/L		0.73		0.72		1.33		
Nitrite as N, NO2	mg/L	<	0.025	<	0.040	<	0.100		
Nitrate as N, NO3	mg/L		1.60	<	3.31		1.91		
Phosphorus, total	mg/L		0.092		0.356		0.052	J	0.022
Total Dissolved Solids, TDS	mg/L				414.00		394.00		
Total Organic Carbon, TOC	mg/L		2.520		3.070		2.710		
Total Suspended Solids, TSS	mg/L		3.00		8.00		2.00		2.00
Field Parameters									
pH	SU		6.80		7.40		6.60		7.45
Oxidation-Reduction Potential, ORP	mV		6.40		-35.30		12.40		-25.5
Temperature	o C		3.60		14.40		19.25		13.35
Dissolved Oxygen, DO	mg/L		13.88		10.28		8.55		10.11

Table 12. Surface Water Analysis for Delaware & Raritan Canal, C1, in 2013

Location C1 = Delaware & Raritan Canal State Park at Mapleton Avenue, Plainsboro midway on pedestrian bridge

C1												
Parameters	**Units**	**January**		**Feb.**		**March**		**April**		**May**		**June**
Ammonia Nitrogen	mg/L		<	0.10					<	0.10		
BOD	mg/L								<	2.68		
COD	mg/L	14.00		12.00	<	10.00	<	10.00		13.00	<	10.00
Kjeldhal N, TKN	mg/L		<	0.60					<	0.60		
Nitrite as N, NO2	mg/L		<	0.025					<	0.025		
Nitrate as N, NO3	mg/L			0.88						0.52		
Phosphorus, total	mg/L	< 0.030		0.112		0.253	<	0.030	<	0.030		0.099
Total Dissolved Solids	mg/L									131.00		
Total Organic Carbon	mg/L	3.36		3.25		2.94		2.93		2.87		3.90
Total Suspended Solids	mg/L	2.00		2.00	<	2.00		4.00		4.00		5.00
Field Parameters												
pH	SU	6.88		7.00		6.75		7.25		7.13		6.80
Oxidation-Reduction Potential	mV	-4.40		-6.50		5.8				-20.60		-4.60
Temperature	o C	2.85		2.75		5.75		10.10		19.90		24.90
Dissolved Oxygen, DO	mg/L	12.39		13.67		13.5		13.42		9.35		

C1									
Parameters	**Units**	**July**		**Aug.**		**Sept.**	**Oct.**	**Nov.**	**Dec.**
Ammonia Nitrogen	mg/L		<	0.10					
BOD	mg/L		<	2.68					
COD	mg/L	16.00		11.00	<	10.00	< 10.00	12.00	12.00
Kjeldhal N, TKN	mg/L		<	0.60					
Nitrite as N, NO2	mg/L		<	0.100					
Nitrate as N, NO3	mg/L			0.95					
Phosphorus, total	mg/L	0.080	<	0.030		0.057	0.062	0.093	0.037
Total Dissolved Solids	mg/L			166.00					
Total Organic Carbon	mg/L	4.30		3.24		3.13			
Total Suspended Solids	mg/L	45.00		6.00		5.00	4.00	2.00	2.00
Field Parameters									
pH	SU	6.72		6.79		7.24	7.43	7.48	6.62
Oxidation-Reduction Potential	mV			3.20		13.60	-24.90		16.80
Temperature	o C	25.40		23.40		24.80	20.85	12.50	7.00
Dissolved Oxygen, DO	mg/L	5.49		6.21		5.94	7.10	8.98	

Table 13. Surface Water Analysis for Elizabethtown Water, E1, in 2013

Location E1 = Elizabethtown Water (potable) collected at Main Gate Security Booth

E1										
Parameters	**Units**		**February**		**May**		**August**		**Nov.**
Ammonia nitrogen as N, NH3	mg/L	<	0.10		0.34		0.27	<	0.04
Biological Oxygen Demand, BOD	mg/L			<	2.68	<	2.60		
Chemical Oxygen Demand, COD	mg/L	<	10.00		14.00		11.00		7.00
Kjeldhal N, TKN	mg/L	<	0.60		0.66		1.23		
Nitrite as N, NO2	mg/L	<	0.025	<	0.025	<	0.100		
Nitrate as N, NO3	mg/L		1.40		0.66		1.28		
Phosphorus, total	mg/L		0.955		1.010		1.290		0.425
Total Dissolved Solids, TDS	mg/L				269.00		223.00		
Total Organic Carbon, TOC	mg/L		1.93		1.98		2.26		
Total Suspended Solids, TSS	mg/L	<	2.00	<	2.00		3.00	<	2.00
Field Parameters									
pH	SU		6.68		6.74		6.75		6.99
Oxidation-Reduction Potential, ORP	mV		13.60		1.60		4.30		-0.4
Temperature	o C		11.70		17.65		24.05		17.15
Dissolved Oxygen, DO	mg/L		12.10		9.21		7.67		8.4

Table 14. Surface Water Analysis for Millstone River, M1, in 2013

Location M1 = Millstone River at Delaware & Raritan Canal State Park at Mapleton Road

M1									
Parameters	**Units**		**February**		**May**		**August**		**Nov.**
Ammonia nitrogen as N, NH3	mg/L		0.41		0.28		0.16	<	0.04
Biological Oxygen Demand, BOD	mg/L				2.78		3.29		
Chemical Oxygen Demand, COD	mg/L		10.00		18.00		20.00		18.00
Kjeldhal N, TKN	mg/L		1.44		1.13		0.91		
Nitrite as N, NO2	mg/L		0.0288		0.0500	<	0.1000		
Nitrate as N, NO3	mg/L		2.160		2.600		1.880		
Phosphorus, total	mg/L		0.117	<	0.030	<	0.030		0.052
Total Dissolved Solids, TDS	mg/L				220.00		197.00		
Total Organic Carbon, TOC	mg/L		3.85		4.59		4.88		
Total Suspended Solids, TSS	mg/L		10.00		5.00		6.00		4.00
Field Parameters									
pH	SU		6.90		7.08		6.76		6.99
Oxidation-Reduction Potential, ORP	mV		-1.00		-17.50				
Temperature	o C		2.80		21.05		23.40		12.7.
Dissolved Oxygen, DO	mg/L		12.22		9.92		6.31		8.4

Table 15. Surface Water Analysis for Cranbury Brook (Plainsboro), P1, in 2013

Location P1 = Cranbury Brook at George Davison Road, Plainsboro mid-span on bridge southbound

P1										
Parameters	**Units**		**February**		**May**		**August**		**Nov.**	
Ammonia nitrogen as N, NH3	mg/L		0.19	<	0.10	<	0.10	<	0.04	
Biological Oxygen Demand, BOD	mg/L			<	2.68	<	2.60			
Chemical Oxygen Demand, COD	mg/L		19.00		30.00		13.00		11.00	
Kjeldhal N, TKN	mg/L		1.24	<	0.06		0.94			
Nitrite as N, NO2	mg/L	<	0.025	<	0.025	<	0.100			
Nitrate as N, NO3	mg/L		1.650		2.050		1.240			
Phosphorus, total	mg/L		0.152	<	0.030		0.186	J	0.027	
Total Dissolved Solids, TDS	mg/L				131.00		154.00			
Total Organic Carbon, TOC	mg/L		4.02		9.30		5.43			
Total Suspended Solids, TSS	mg/L		17.00		7.00		4.00		3.00	
Field Parameters										
pH	SU		6.94		6.74		6.55		6.42	
Oxidation-Reduction Potential, ORP	mV		-1.10		1.70		15.40		31.10	
Temperature	o C		4.10		17.00		23.20		12.75	
Dissolved Oxygen, DO	mg/L		11.16		7.25		5.57		5.55	

Table 16. Surface Water Analysis for Devil's Brook (Plainsboro), P2, in 2013

Location P2 = Devil's Brook at Schalks Road overpass, adjacent to Amtrak railroad tracks

P2										
Parameters	**Units**		**February**		**May**		**August**		**Nov.**	
Ammonia nitrogen as N, NH3	mg/L		0.14	<	0.10	<	0.10		7.46	
Biological Oxygen Demand, BOD	mg/L			<	2.68	<	2.60			
Chemical Oxygen Demand, COD	mg/L		27.00		22.00		23.00		10.00	
Kjeldhal N, TKN	mg/L	<	0.60		1.04		1.32			
Nitrite as N, NO2	mg/L	<	0.025	<	0.025	<	0.100			
Nitrate as N, NO3	mg/L		1.22		2.18		2.150			
Phosphorus, total	mg/L		0.171	<	0.030	<	0.030	<	0.018	
Total Dissolved Solids, TDS	mg/L				166.00		149.00			
Total Organic Carbon, TOC	mg/L		7.13		4.42		8.38			
Total Suspended Solids, TSS	mg/L		5.00		14.00		4.00	<	2.00	
Field Parameters										
pH	SU		6.91		6.91		6.67		6.44	
Oxidation-Reduction Potential, ORP	mV									
Temperature	o C		3.50		15.45		21.50		13.15	
Dissolved Oxygen, DO	mg/L		11.79		9.15		6.68		4.81	

Table 17. DSN001 – Retention Basin Outfall Surface Water Analysis (NJPDES NJ0023922) in 2013

DSN001													
Parameters	**Units**		**January**		**Feb.**		**March**		**April**		**May**		**June**
Ammonia nitrogen as N, NH3	mg/L			<	0.10					<	0.10		
Biological Oxygen Demand, BOD	mg/L									<	2.68		
Chemical Oxygen Demand, COD	mg/L		12.00		10.00	<	10.00	<	10.00		17.00	<	10.00
Kjeldhal N, TKN	mg/L			<	0.60						1.02		
Nitrogen, total	mg/L				1.83						5.96		
Nitrite as N, NO2	mg/L				0.028						0.088		
Nitrate as N, NO3	mg/L				1.25						4.85		
Phosphorus, total	mg/L		0.052		0.132		0.322	<	0.030		0.742		0.050
Tetrachloroethylene, PCE	ug/L	<	0.31	J	0.37	<	0.31	<	0.31	J	0.48	J	0.43
Total Petroleum Hydrocarbon	mg/L	<	5.00	<	5.00	<	5.00	<	5.00	<	5.00	<	5.00
Total Dissolved Solids, TDS	mg/L										474.00		
Total Organic Carbon, TOC	mg/L		2.330		1.160		1.020		1.270		2.560		3.110
Total Suspended Solids, TSS	mg/L	<	2.00		2.00		2.00		5.00		5.00		8.00
Field Parameters													
Chlorine Produced Oxidants, CPO	mg/L	<	0.10	<	0.10	<	0.10	<	0.10	<	0.10	<	0.10
pH	SU		7.42		7.16		6.67		7.75		6.97		6.90
Oxidation-Reduction Potential,	mV		-33.60		-137		10.80				-11.60		-10.60
Temperature	o C		8.55		7.15		10.6		10.50		16.20		18.45
Dissolved Oxygen, DO	mg/L		11.14		11.00		12.52		13.32		10.40		8.90

DSN001													
Parameters	**Units**		**July**		**August**		**Sept.**		**Oct.**		**Nov.**		**Dec.**
Ammonia nitrogen as N, NH3	mg/L			<	0.1								
Biological Oxygen Demand, BOD	mg/L				3.86								
Chemical Oxygen Demand, COD	mg/L	<	10.00		17.00	<	10.00	<	10.00	<	10.00		8.00
Kjeldhal N, TKN	mg/L				0.65								
Nitrogen, total	mg/L				1.96								
Nitrite as N, NO2	mg/L			<	0.100								
Nitrate as N, NO3	mg/L				1.26								
Phosphorus, total	mg/L		0.041		0.049		0.057	<	0.030		0.032		0.037
Tetrachloroethylene, PCE	ug/L	<	0.31	<	0.17	<	0.13	<	0.11	<	0.13	J	0.26
Total Petroleum Hydrocarbon, TPHC	mg/L	<	5.00	<	5.00	<	5.00	<	5.00	<	1.89	<	1.89
Total Dissolved Solids, TDS	mg/L				389.00								
Total Organic Carbon, TOC	mg/L		2.720		2.500		1.650						
Total Suspended Solids, TSS	mg/L		4.00		4.00		5.00		6.00		8.00		4.00
Field Parameters													
Chlorine Produced Oxidants, CPO	mg/L	<	0.10		0.11	<	0.10	<	0.10	<	0.10	<	0.10
pH	SU		6.90		6.76		8.08		8.36		8.19		8.03
Oxidation-Reduction Potential, ORP	mV		16.00		3.90		-61.20		-77.10		-66.70		-52.90
Temperature	o C		20.25		18.65		18.60		17.70		13.40		9.55
Dissolved Oxygen, DO	mg/L		8.52		8.97		8.91		9.81		9.32		10.71

Table 18. D&R Canal Pump House – DSN003
Monthly Surface Water Analysis (NJPDES NJ0023922) in 2013

DSN003													
Parameters	**Units**		**January**		**Feb.**		**March**		**April**		**May**		**June**
Ammonia nitrogen as N, NH3	mg/L			<	0.10					<	0.10		
Biological Oxygen Demand	mg/L									<	2.68		
Chemical Oxygen Demand	mg/L	<	10.00		16.00		13.00		10.00		12.00		13.00
Kjeldhal N, TKN	mg/L			<	0.60					<	0.60		
Nitrite as N, NO2	mg/L			<	0.025					<	0.025		
Nitrate as N, NO3	mg/L				0.820						0.515		
Phosphorus, total	mg/L		0.03		0.087		0.311		0.030	<	0.030		0.139
Total Petroleum Hydrocarbon	mg/L	<	5.00	<	5.00	<	5.00	<	5.00	<	5.00	<	5.00
Total Dissolved Solids, TDS	mg/L										140.00		
Total Organic Carbon, TOC	mg/L		2.88		3.59		3.94		2.72		2.86		3.54
Total Suspended Solids, TSS	mg/L		2.00		6.00		4.00		3.00		6.00		6.00
Field Parameters													
Chlorine Produced Oxidants	mg/L	<	0.10	<	0.10	<	0.10	<	0.10	<	0.10	<	0.10
pH	SU		6.91		6.97		6.92		7.04		6.99		6.69
Oxidation-Reduction Potential	mV		-5.90				-3.5		-9.60		-12.60		4.90
Temperature	o C		4.60		5.55		6.65		12.05		19.80		25.20
Dissolved Oxygen, DO	mg/L		9.79		9.49		9.41		8.63		6.07		4.64

DSN003													
Parameters	**Units**		**July**		**Aug.**		**Sept.**		**Oct.**		**Nov.**		**Dec.**
Ammonia nitrogen as N, NH3	mg/L			<	0.10								
Biological Oxygen Demand	mg/L			<	2.68								
Chemical Oxygen Demand	mg/L		22.00		21.00		10.00	<	10.00	<	10.00		12.00
Kjeldhal N, TKN	mg/L			<	0.60								
Nitrite as N, NO2	mg/L			<	0.100								
Nitrate as N, NO3	mg/L				0.801								
Phosphorus, total	mg/L		0.095		0.032		0.092		0.241		0.123		0.138
Total Petroleum Hydrocarbon	mg/L	<	5.00	<	5.00	<	5.00	<	5.00	<	1.89	<	1.89
Total Dissolved Solids, TDS	mg/L				169.00								
Total Organic Carbon, TOC	mg/L		5.47		5.330		3.24						
Total Suspended Solids, TSS	mg/L		6.00		8.00		8.00		3.00		4.00		3.00
Field Parameters													
Chlorine Produced Oxidants	mg/L	<	0.10	<	0.10	<	0.10	<	0.10	<	0.10	<	0.10
pH	SU		6.61		6.69		6.99		7.45		7.09		6.86
Oxidation-Reduction Potential	mV				9.20		0.60		-25.60		-5.50		4.10
Temperature	o C		25.40		25.00		24.70		22.00		12.90		8.40
Dissolved Oxygen, DO	mg/L		4.00		3.67		4.18		5.09		7.28		7.84

Blank indicates no measurement *NA = not applicable* *NL = no limit*

Table 19. Summary of Ground Water Sampling Results – March 2013

Target Chlorinated Volatile Organic Compounds (VOC), Monitored Natural Attenuation (MNA)

Well No.		MW-3S	MW-5I	MW-5S	MW-9S	MW-13S	MW-17	MW-18	MW-19S	MW-25	D-MG SUMP	MW-26 *	TB-1	TB-2	TB-3	NJ Ground
PPPL Sample No.		13-120	13-122	13-121	13-123	13-124	13-125	13-126	13-127	13-128	13-130	13-129	13-131	13-131	13-131	Water
Lab Sample No.		L3480488-1	L3480488-2	L3480488-3	L4491829-3	L4491829-1	L4491828-3	L4491828-2	L4491828-4	L4491828-1	L4491828-5	L4491829-2	L4491828-6	L4491829-4	L3480488-4	Standard
Target Volatile Organic Compounds (ug/L)																
Tetrachloroethylene		<0.110	<0.110	0.510 J	0.480 J	**19.5**	**15.7**	0.190 J	**80.1**	0.140 J	**20**	**20.1**	<0.110	<0.110	<0.110	1
Trichloroethylene		<0.0800	**2.06**	<0.0800	0.130 J	**14.4**	0.960 J	<0.0800	**2.84**	<0.0800	**1.73**	**14.7**	<0.0800	<0.0800	<0.0800	1
c-1,2-Dichloroethylene		ND	7.86 JN	ND	ND	22.1 JN	ND	ND	5.84 JN	ND	ND	22.5 JN	ND	ND	ND	70
t-1,2-Dichloroethylene		<0.160	<0.160	<0.160	<0.160	0.170 J	<0.160	<0.160	<0.160	<0.160	<0.160	0.190 J	<0.160	<0.160	<0.160	100
1,1,1-Trichloroethane		<0.130	<0.130	<0.130	<0.130	<0.130	<0.130	<0.130	<0.130	<0.130	<0.130	<0.130	<0.130	<0.130	<0.130	30
1,1-Dichloroethylene		<0.150	<0.150	<0.150	<0.150	0.240 J	<0.150	<0.150	<0.150	<0.150	0.360 J	0.280 J	<0.150	<0.150	<0.150	2
Chloroform		<0.120	<0.120	<0.120	<0.120	0.390 J	0.150 J	0.120 J	<0.120	<0.120	0.140 J	0.400 J	<0.120	<0.120	<0.120	6
Vinyl Chloride		<0.140	<0.140	<0.140	<0.140	<0.140	<0.140	<0.140	<0.140	<0.140	<0.140	<0.140	<0.140	<0.140	<0.140	2
Tentatively Identified Compounds (ug/L)																
Unknown		9.90 JB	11.6 JB	ND	3.71 J	10.8 JB	7.85 J	10.6 JB	13.09 JB	6.22 JB	ND	9.35 JB	ND	ND	ND	--
1,1,2-Trichloro-1,2,2-Trifluoroetha		ND	ND	ND	ND	56.3 JN	ND	ND	ND	ND	ND	58.5 JN	ND	ND	ND	--
1,2-Dichloro-1,1,2-Trifluoroethane		ND	ND	ND	ND	5.80 JN	ND	ND	ND	ND	ND	4.76 JN	ND	ND	ND	--
Natural Attenuation Indicators																
Chloride	mg/L	8.55	**260**	125	<5.00	52.3	11.3	14.3	5.61	120	148	52.1	-	-	-	250
Manganese	mg/L	**1.8**	**0.274**	0.00550 J	0.0074	**0.4**	**0.0843**	**0.217**	0.0163	**5.08**	**3.18**	**0.335**	-	-	-	0.05
Alkalinity	mg/L	227	57.6	22.8	63.3	56.3	33.2	9.68	23	94.4	105	55.5	-	-	-	--
Nitrate as N	mg/L	0.15	<0.100	1.29	0.1	<0.100	0.12	<0.100	0.45	<0.100	1.11	0.74	-	-	-	10
Nitrite	mg/L	<0.0250	<0.0250	<0.0250	<0.0250	<0.0250	<0.0250	0.0262	<0.0250	<0.0250	<0.0250	<0.0250	-	-	-	1
Sulfide	mg/L	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	-	-	-	--
Sulfate	mg/L	22.3	<5.00	9.79	6.22	16.5	25.9	24.8	29.5	20.9	17.5	16.3	-	-	-	250
Total Organic Carbon	mg/L	19.7	0.732	0.807	6.89	1.6	1.72	1.55	1.49	2.09	1.86	1.69	-	-	-	--
Ferrous Iron	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	--
Dissolved Methane	ug/L	2.8	0.99	<0.11	0	0.24	<0.11	<0.11	1.6	2.9	6.2	0.23	0.54	0.63	<0.11	--
Dissolved Ethane	ug/L	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	--
Dissolved Ethene	ug/L	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	--
Dissolved Oxygen	mg/L	0.81	0.24	-	7.07	3.93	0.29	1.46	6.33	0.24	-	3.93	-	-	-	--
pH	Std. Units	5.42	6.9	-	6.33	6.13	5.97	5.92	5.48	6.83	-	6.13	-	-	-	--
Redox Potential	mVe	187.1	-57.1	-	145.7	142.2	180.6	153	246.8	90.2	-	142.2	-	-	-	--

NOTES

B - Compound found in blank as well as sample

J - Estimated, concentration listed greater than the MDL but lower than the lowest standard. N - Indicates presumptive evidence of the compound's presence.

* MW-26 is duplicate sample from well MW-13S.

Ground water quality standards as published in N.J.A.C. 7:9-6.9.

-- Compound-specific Ground Water Quality Standard not published.

Table 20. Summary of Ground Water Sampling Results –June 2013

Target Chlorinated Volatile Organic Compounds (VOC), Monitored Natural Attenuation (MNA)

Well No.		MW-3S	MW-5I	MW-5S	MW-9S	MW-13S	MW-17	MW-18	MW-19S	MW-25	D-MG Sump	MW-26 *	TB-1 (6/17)	TB-2 (6/18)	TB-3 (6/19)	NJ Ground
PPPL Sample No.		13-169	13-171	13-170	13-172	13-173	13-174	13-175	13-176	13-177	13-179	13-178	13-180	13-180	13-180	Water
Lab Sample No.		L4653022-4	L4599351-3	L4599351-4	L4653022-1	L4653022-2	L4599353-2	L4599353-1	L4653022-5	L4599351-1	L4599351-2	L4653022-3	L4599353-9	L4599351-7	L4653022-6	Standard
Target Volatile Organic Compounds (ug/L)																
Tetrachloroethylene		<0.310	<0.310	<0.310	**11.2**	**27.2**	**9.46**	<0.310	**63.7**	<0.310	**17.6**	**28.5**	<0.310	<0.310	<0.310	1
Trichloroethylene		<0.340	**2.58**	<0.340	**14.6**	**13**	0.740 J	<0.340	**2.62**	<0.340	**1.78**	**13.4**	<0.340	<0.340	<0.340	1
c-1,2-Dichloroethylene		ND	4.54 JN	ND	3.73 JN	13.7 JN	ND	ND	ND	ND	ND	14.1 JN	ND	ND	ND	70
t-1,2-Dichloroethylene		<0.290	<0.290	<0.290	<0.290	<0.290	<0.290	<0.290	<0.290	<0.290	<0.290	<0.290	<0.290	<0.290	<0.290	100
1,1,1-Trichloroethane		<0.260	<0.260	<0.260	<0.260	<0.260	<0.260	<0.260	<0.260	<0.260	<0.260	<0.260	<0.260	<0.260	<0.260	30
1,1-Dichloroethylene		<0.320	<0.320	<0.320	<0.320	<0.320	<0.320	<0.320	<0.320	<0.320	<0.320	<0.320	<0.320	<0.320	<0.320	2
Chloroform		<0.290	<0.290	<0.290	<0.290	0.450 J	<0.290	1.07	<0.290	<0.290	<0.290	0.530 J	<0.290	<0.290	<0.290	6
Vinyl Chloride		<0.380	<0.380	<0.380	<0.380	0.480 J	<0.380	<0.380	<0.380	<0.380	<0.380	0.520 J	<0.380	<0.380	<0.380	2
Tentatively Identified Compounds (ug/L)																
Unknown		ND	ND	ND	5.79 J	6.14 J	ND	ND	ND	ND	ND	6.25 J	ND	ND	ND	--
1,1,2-Trichloro-1,2,2-Trifluoroethan		ND	ND	ND	ND	44.3 J	ND	ND	ND	ND	ND	44.3 J	ND	ND	ND	--
1,2-Dichloro-1,1,2-Trifluoroethane		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--
Natural Attenuation Indicators																
Chloride	mg/L	<5.00	**411**	77.9	8.45	65.3	9.05	17.6	5.66	114	123	65.9	-	-	-	250
Manganese	mg/L	**0.565**	**0.654**	0.00140 B	**0.0984**	**1.91**	**0.125**	**0.135**	0.0333	**5.52**	**52.9**	**2.07**	-	-	-	0.05
Alkalinity	mg/L	188	139	32.2	97.1	47	72.6	16.5	13.7	95.1	112	47.9	-	-	-	--
Nitrate as N	mg/L	-	<0.500	2.65	-	-	<0.500	<0.500	-	<0.100	1.46	-	-	-	-	10
Nitrite	mg/L	<0.0250	<0.0250	<0.0250	<0.0250	<0.0250	<0.200	<0.200	<0.0250	<0.0250	<0.0250	<0.0250	-	-	-	1
Sulfide	mg/L	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.250	<0.100	-	-	-	--
Sulfate	mg/L	18.2	17.4	9.41	14.2	15.3	16.7	28.9	33.3	20.2	20.1	15.2	-	-	-	250
Total Organic Carbon	mg/L	11.3	0.984	1.17	4.62	1.69	1.42	2.05	1.98	2.18	5.72	1.63	-	-	-	--
Ferrous Iron	mg/L	<0.20	1.1	<0.20	<0.20	2.1	0.2	0.37	<0.20	<0.20	<0.20	2.8	-	-	-	--
Dissolved Methane	ug/L	0.55	2.2	<0.030	2.5	25.4	<0.030	<0.030	<0.030	8.6	3.8	24.5	0.18	0.34	0.46	--
Dissolved Ethane	ug/L	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	--
Dissolved Ethene	ug/L	<0.095	<0.095	<0.095	<0.095	<0.095	<0.095	<0.095	<0.095	<0.095	<0.095	<0.095	<0.095	<0.095	<0.095	--
Dissolved Oxygen	mg/L	0.51	0.37	820	0.19	1.09	0.04	0.68	7.19	0.04	-	1.09	-	-	-	--
pH	Std. Units	5.09	6.67	7.08	6.07	5.58	6.17	5.51	5.01	6.48	-	5.58	-	-	-	--
Redox Potential	mVe	163.1	-88.3	667	136.2	97.2	143.7	195.4	256.1	45.9	-	97.2	-	-	-	--

NOTES: J - Estimated, concentration listed greater than the MDL but lower than the lowest standard.

N - Indicates presumptive evidence of the compound's presence.

* MW-26 is duplicate sample from well MW-13S.

Ground water quality standards as published in N.J.A.C. 7:9-6.9.

-- Compound-specific Ground Water Quality Standard not published.

Table 21 Summary of Ground Water Sampling Results –September 2013
Target Chlorinated Volatile Organic Compounds (VOC), Monitored Natural Attenuation (MNA)

Well No.		MW-3S	MW-5I	MW-5S	MW-9S	MW-12S	MW-13S	MW-13I	MW-17	MW-18	MW-19S	MW-19I	NJ Ground
PPPL Sample No.		13-223	13-225	13-224	13-226	13-227	13-228	13-229	13-230	13-231	13-232	13-233	Water
Lab Sample No.		L4772030-3	L4241326-4	L4771752-5	L4771752-6	L4121797-1	L4771752-7	L4772030-2	L4771752-2	L4771752-3	L4121797-4	L4241326-2	Standard
Target Volatile Organic Compounds (ug/L)													
Tetrachloroethylene		<0.130	<0.130	0.910 J	**35.2**	<0.130	**32.1**	**2.62**	**41.6**	<0.130	**20.8**	<0.130	1
Trichloroethylene		<0.330	**1.85**	<0.330	**6.78**	<0.330	**13.8**	<0.330	**2.03**	<0.330	0.960 J	<0.330	1
c-1,2-Dichloroethylene		ND	4.89 JN	ND	ND	ND	10.9 JN	ND	ND	ND	ND	ND	70
t-1,2-Dichloroethylene		<0.240	<0.240	<0.240	<0.240	<0.240	<0.240	<0.240	<0.240	<0.240	<0.240	<0.240	100
1,1,1-Trichloroethane		<0.250	<0.250	<0.250	0.480 J	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	30
1,1-Dichloroethylene		<0.310	<0.310	<0.310	<0.310	<0.310	<0.310	<0.310	<0.310	<0.310	<0.310	<0.310	2
Chloroform		<0.180	<0.180	<0.180	1.23	<0.180	0.510 J	<0.180	1.09	<0.180	<0.180	<0.180	6
Vinyl Chloride		<0.230	<0.230	<0.230	<0.230	<0.230	1.64	<0.230	<0.230	<0.230	<0.230	<0.230	2
Tentatively Identified Compounds (ug/L)													
Unknown		ND	3.26 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	--
1,1,2-Trichloro-1,2,2-Trifluoroethane		ND	ND	ND	9.89 J	ND	82.6 J	ND	ND	ND	ND	ND	--
1,1,2-Trifluoroethane		ND	ND	ND	ND	ND	6.14 J	ND	ND	ND	ND	ND	--
1,2-Dichloro-1,1,2-Trifluoroethane		ND	ND	ND	ND	ND	10.9 J	ND	ND	ND	ND	ND	--
Natural Attenuation Indicators													
Chloride	mg/L	17.4	**359**	95.7	18.7	55.5	89.1	<5.00	16.6	15.8	7.76	148	250
Manganese	mg/L	**1.55**	**0.86**	0.00180 B	**0.0585**	0.00290 B	**3.31**	0.0067	0.0226	**0.371**	0.0302	0.0068	0.05
Alkalinity	mg/L	200	71.5	36.1	36.8	117	59.7	21.6	16.2	12.6	13.4	17.3	--
Nitrate as N	mg/L	-	-	-	-	-	-	-	-	-	-	-	10
Nitrite	mg/L	<0.0250	<0.100	<0.100	<0.100	<0.0250	<0.100	<0.0250	<0.0250	<0.250	<0.0250	<0.100	1
Sulfide	mg/L	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	--
Sulfate	mg/L	23.5	6.07	11.3	23	12.8	16.6	<5.00	20.3	23.4	35.6	7.36	250
Total Organic Carbon	mg/L	17.2	0.684	1.15	1.33	0.667	1.87	1.66	1.12	1.6	2.74	0.586	--
Ferrous Iron	mg/L	1.3	2.1	<0.20	<0.20	<0.20	11.8	0.33	<0.20	0.52	<0.20	<0.20	
Dissolved Methane	ug/L	0.7	263	<0.030	0.15	<0.030	36	0.25	0.29	0.12	0.44	<0.030	
Dissolved Ethane	ug/L	<0.090	1	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	
Dissolved Ethene	ug/L	<0.095	<0.095	<0.095	<0.095	<0.095	<0.095	<0.095	<0.095	<0.095	<0.095	<0.095	
Dissolved Oxygen	mg/L	3.99	8.05	NA	9.87	11.01	7.18	NA	4.08	3.46	5.86	6.36	--
pH	Std. Units	5.73	6.93	NA	5.58	7.14	5.64	NA	4.96	5.17	4.04	6.49	--
Redox Potential	mVe	28	-113	NA	214	239	45	NA	206	154	405	319	--

NOTES: J - Estimated, concentration listed greater than the MDL but lower than the lowest standard. Ground water quality standards as published in N.J.A.C. 7:9-6.9.

N - Indicates presumptive evidence of the compound's presence. -- Compound-specific Ground Water Quality Standard not published.

* MW-26 is duplicate sample from well MW-13S. NA - Field parameters not collected due to low water level in well or equipment malfunction

Table 21 cont. Summary of Ground Water Sampling Results –September 2013
Target Chlorinated Volatile Organic Compounds (VOC), Monitored Natural Attenuation (MNA)

Well No.		MW-22S	MW-23	MW-24	MW-25S	MW-26 *	DSN001	D-MG Sump	D-SITE AIR SHAFT	TB-9/16	TB-9/17	TB-9/18	TB-9/19	TB-9/20	NJ Ground
PPPL Sample No.		13-234	13-235	13-236	13-237	13-238	13-239	13-240	13-241	13-242	13-242	13-242	13-242	13-242	Water
Lab Sample No.		L4241326-3	L4121797-3	L4772030-4	L4771752-1	L4771752-8	L4772030-5	L4772030-6	L4772030-7	L4121797-2	L4241326-1	L4771752-4	L4772030-1	JB48101-1	Standard
Target Volatile Organic Compounds (ug/L)															
Tetrachloroethylene		<0.130	<0.130	<0.130	0.780 J	**34.9**	<0.130	<0.130	<0.130	<0.130	<0.130	<0.130	<0.130	-	1
Trichloroethylene		<0.330	<0.330	<0.330	0.460 J	**14.8**	<0.330	**4.34**	<0.330	<0.330	<0.330	<0.330	<0.330	-	1
c-1,2-Dichloroethylene		ND	ND	ND	ND	11.5 JN	ND	ND	ND	ND	ND	ND	ND	-	70
t-1,2-Dichloroethylene		<0.240	<0.240	<0.240	<0.240	0.320 J	<0.240	<0.240	<0.240	<0.240	<0.240	<0.240	<0.240	-	100
1,1,1-Trichloroethane		<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	-	30
1,1-Dichloroethylene		<0.310	<0.310	<0.310	<0.310	<0.310	<0.310	0.590 J	<0.310	<0.310	<0.310	<0.310	<0.310	-	2
Chloroform		<0.180	<0.180	0.720 J	<0.180	0.530 J	<0.180	<0.180	0.250 J	<0.180	<0.180	<0.180	<0.180	-	6
Vinyl Chloride		<0.230	<0.230	<0.230	<0.230	1.84	<0.230	<0.230	<0.230	<0.230	<0.230	<0.230	<0.230	-	2
Tentatively Identified Compounds (ug/L)															
Unknown		ND	ND	ND	ND	6.30 J	ND	ND	ND	ND	ND	ND	ND	-	--
1,1,2-Trichloro-1,2,2-Trifluoroethane		ND	ND	ND	ND	93.8 J	ND	ND	ND	ND	ND	ND	ND	-	--
1,1,2-Trifluoroethane		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	--
1,2-Dichloro-1,1,2-Trifluoroethane		ND	ND	ND	ND	11.5 J	ND	ND	ND	ND	ND	ND	ND	-	--
Natural Attenuation Indicators															
Chloride	mg/L	112	7.31	5.5	65.2	89.2	106	180	94.1	-	-	-	-	-	250
Manganese	mg/L	0.0477	0.0174	0.009	**4.22**	**3.44**	**0.0571**	**2.54**	**5.56**	-	-	-	-	-	0.05
Alkalinity	mg/L	4.59	9.61	9.71	66	59.8	107	102	120	-	-	-	-	-	--
Nitrate as N	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	10
Nitrite	mg/L	<0.100	<0.0250	<0.0250	<0.0250	<0.100	<0.0250	<0.0250	<0.0250	-	-	-	-	-	1
Sulfide	mg/L	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	-	-	-	-	-	--
Sulfate	mg/L	19.3	50.9	13	21.8	16.5	17.4	16.9	17.8	-	-	-	-	-	250
Total Organic Carbon	mg/L	1.03	1.32	0.993	6.96	1.88	1.17	1.47	0.958	-	-	-	-	-	--
Ferrous Iron	mg/L	<0.20	<0.20	<0.20	0.94	10.8	<0.20	1.6	<0.20	-	-	-	-	-	--
Dissolved Methane	ug/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.45	0.39	0.45	0.4	0.32	--
Dissolved Ethane	ug/L	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	--
Dissolved Ethene	ug/L	<0.095	<0.095	<0.095	3.6	44.9	1.5	8.6	0.4	<0.095	<0.095	<0.095	<0.095	<0.095	--
Dissolved Oxygen	mg/L	7.59	NA	9.66	3.57	7.18	-	-	-	-	-	-	-	-	--
pH	Std. Units	6.21	NA	5.12	5.96	5.64	-	-	-	-	-	-	-	-	--
Redox Potential	mVe	341	NA	242	12	45	-	-	-	-	-	-	-	-	--

NOTES:

J - Estimated, concentration listed greater than the MDL but lower than the lowest standard.

N - Indicates presumptive evidence of the compound's presence.

* MW-26 is duplicate sample from well MW-13S.

Ground water quality standards as published in N.J.A.C. 7:9-6.9.

-- Compound-specific Ground Water Quality Standard not published.

NA - Field parameters not collected due to low water level in well or equipment malfunction

Table 22. Summary of Ground Water Sampling Results –December 2013

Target Chlorinated Volatile Organic Compounds (VOC)

Well No.	MW-3S	MW-5I	MW-5S	MW-9S	MW-13S	MW-17	MW-18	MW-19S	MW-25S	D-MG Sump	MW-26S*	TB-1 12/17	TB-2 12/18	NJ Ground
PPPL Sample No.	14-033	14-035	14-034	14-036	14-037	14-038	14-039	14-040	14-041	14-043	14-042	14-044	14-044	Water
Lab Sample No.	L4653149-6	L4653149-4	L4653149-5	L4354202-6	L4653149-2	L4354202-4	L4354202-3	L4653149-7	L4354202-2	L4354202-5	L4653149-3	L4354202-1	L4653149-1	Standard
Target Volatile Organic Compounds (ug/L)														
Tetrachloroethylene	<0.130	<0.130	0.930 J	**14.1**	**27**	**28.1**	0.740 J	**110**	<0.130	**31.9**	**25.7**	<0.130	<0.130	1
Trichloroethylene	<0.190	**3.02**	<0.190	**1.67**	**15**	**1.38**	0.750 J	**5.04**	<0.190	**3.61**	**14.4**	<0.190	<0.190	1
c-1,2-Dichloroethylene	<0.210	5.54	<0.210	0.360 J	19.7	0.400 J	0.210 J	7.85	<0.210	2.14	19.2	<0.210	<0.210	70
1,1,1-Trichloroethane	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.160	<0.200	30
1,1-Dichloroethylene	<0.210	0.270 J	<0.210	<0.210	<0.190	<0.190	<0.190	<0.210	<0.210	0.620 J	<0.190	<0.190	<0.190	2
Chloroform	<0.150	<0.150	<0.150	0.470 J	0.400 J	0.670 J	<0.150	<0.150	0.330 J	<0.150	0.380 J	<0.150	<0.150	6
Vinyl Chloride	<0.230	<0.230	<0.230	<0.230	1.35	<0.230	<0.230	<0.230	<0.230	<0.230	1.27	<0.230	<0.230	2
Tentatively Identified Compounds (ug/L)														
Unknown	51.1 J	13.5 J	15.3 J	8.29 J	32.2 J	8.07 J	17.4 J	54.6 J	10.6 J	13.2 J	25.6 J	ND	ND	--
1,1,2-Trichloro-1,2,2-Trifluoroethane	ND	ND	ND	3.87	85.2	1.58	ND	ND	ND	0.680 J	79.1	ND	ND	--
1,2-Dichloro-1,1,2-Trifluoroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--
Natural Attenuation Indicators	NA	NA	NA	NA	NA	NA	NA	NA	NA					

NOTES:
J - Estimated, concentration listed greater than the MDL but lower than the lowest standard.
N - Indicates presumptive evidence of the compound's presence.
NA - Not Analyzed
Ground water quality standards as published in N.J.A.C. 7:9-6.9.
-- Compound-specific Ground Water Quality Standard not published.

Table 23. Quality Assurance Data for Radiological and Non-Radiological Samples for 2013

Laboratory, Program, and Parameter	Reported Value	Actual Value	Acceptance Range	Acceptable Not acceptable
ERA *(picoCuries/Liter)*				
May 2013 RAD 93				
Barium-133	76.64	82.1	69.0-90.3	Acceptable
Cesium-134	42.71	42.8	34.2-47.1	Acceptable
Cesium-137	44.16	41.7	37.0-48.8	Acceptable
Cobalt-60	68.29	65.9	59.3-75.0	Acceptable
Zinc-65	214.36	189	170-222	Acceptable
Tritium	4159.46	4050	3450-4460	Acceptable
November 2013 RAD 95				
Barium-133	53.905	54.2	44.7-59.9	Acceptable
Cesium-134	83.79	867	71.1-95.4	Acceptable
Cesium-137	207.8	206	185-228	Acceptable
Cobalt-60	104.1	102	91.8-114	Acceptable
Zinc-65	357.8	333	300-389	Acceptable
Tritium	18382	17700	15500-19500	Acceptable
May 2013 WP-218				
Conductivity (umhos/cm)	322.5	306	271-341	Acceptable
pH (S.U.)	7.80	7.71	7.51-7.91	Acceptable
Total residual chlorine (mg/L)	2.08	1.91	1.37-2.35	Acceptable

Table 24. Waste Characterization Report (WCR) for DSN001

Surface Water Sampling March 5, 2013

Laboratory Parameter	Reported Value (mg/L)
Chloride	130
Silver	0.00066 B
Arsenic	0.0067 B
Barium	0.225
Beryllium	0.000075 B
Copper	0.0025 B
Manganese	0.0549
Nickel	0.0025 B
Zinc	0.0219

Figure 1. PCE Distribution for Shallow Groundwater Wells
Annual Sampling Event- September 2013

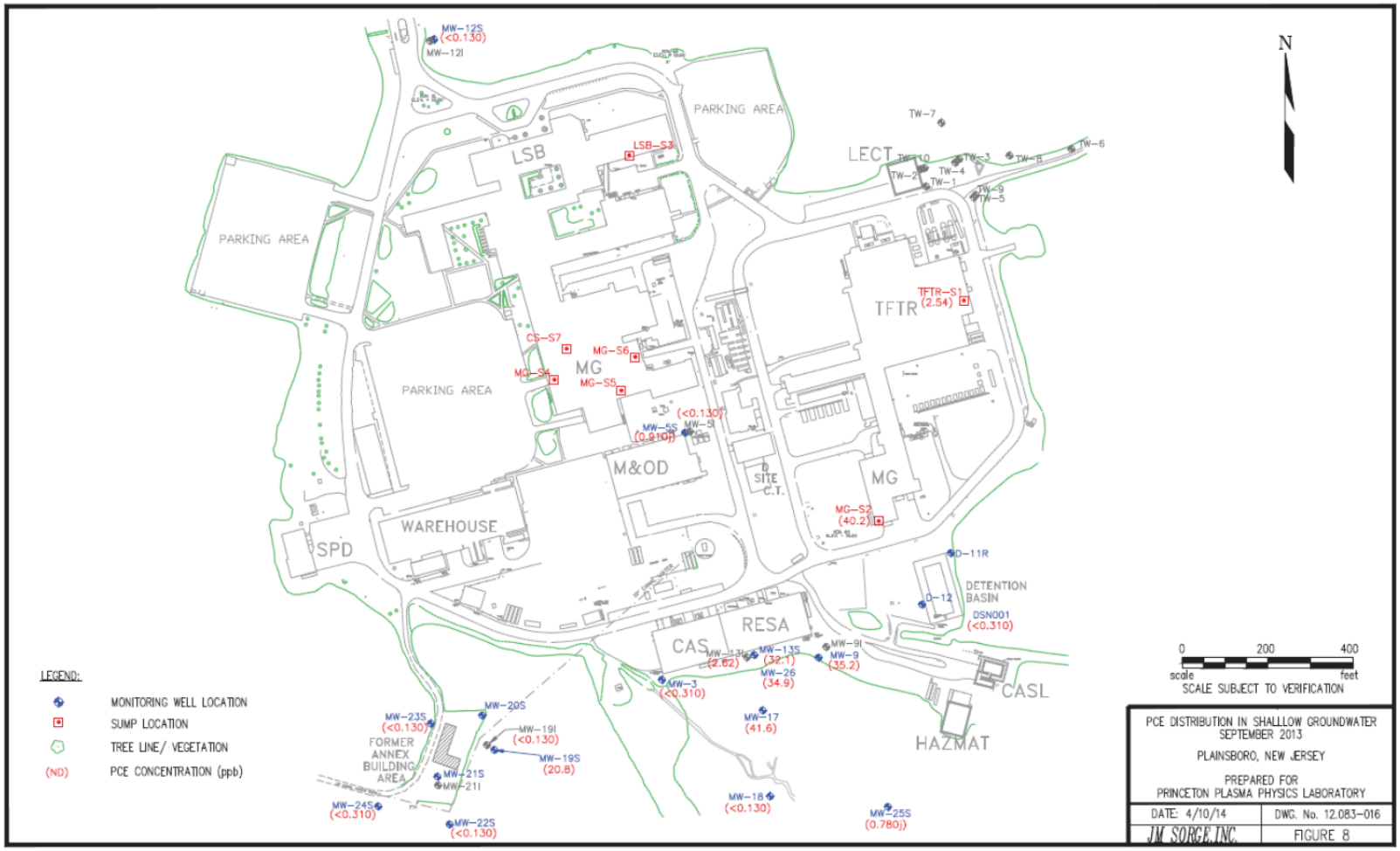
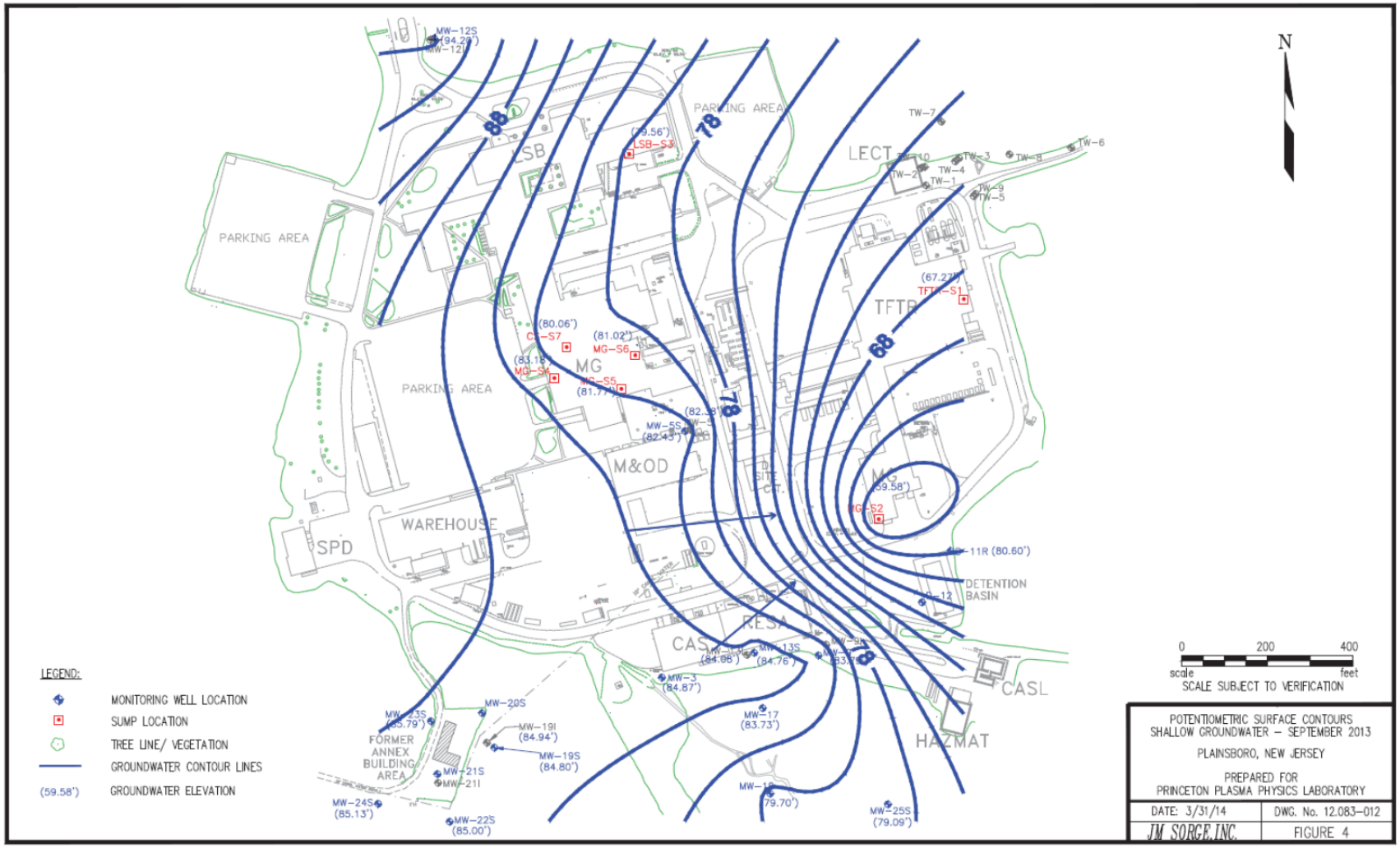


Figure 2. Potentiometric Surface Contours Shallow Groundwater Wells
Annual Sampling Event- September 2013



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B

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