Princeton Plasma Physics Laboratory

PPPL- 4790

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Annual Site Environmental Report for Calendar Years 2009 to 2010

Virginia L. Finley

August, 2012

PRINCETON
PLASMA PHYSICS
LABORATORY

Prepared for the U.S. Department of Energy under Contract DE-AC02-09CH11466.

Annual Site Environmental Report

For Calendar years 2009-2010



An Annual Site Environmental Report for

Princeton Plasma Physics Laboratory

PPPL
PRINCETON PLASMA PHYSICS LABORATORY

U.S. DEPARTMENT OF ENERGY

Operated by Princeton University For the U.S. Department of Energy Under Contract DE-AC02-09CH11466

ANNUAL SITE ENVIRONMENTAL REPORT FOR CALENDAR YEARS 2009-2010

Princeton Plasma Physics Laboratory
P.O. Box 451
Princeton, New Jersey 08543

Operated by Princeton University
For the U.S. Department of Energy
Under Contract DE-AC02-09CH11466

See http://www.pppl.gov

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NOTE: Data tables are located in Appendix A - 2009 Tables beginning on page 65 and Appendix B - 2010 Tables on page 86.

List of Acronyms

AEA	Atomic Energy Act of 1954
AFV	alternative fuel vehicles
ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
B1, B2	Bee Brook 1 (upstream of DSN001) and 2 (downstream of DSN001) (surface water stations)
B-20/100	biolfuel (20%/100%)
BAS	building automation system
BPX	Burning Plasma Experiment
Bq	Becquerel
BTU/gsf	British Thermal Unit per gross square feet
C	C-site of James Forrestal Campus, part of PPPL site
CAA	Clean Air Act
CAD	Computer aided design
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
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
CX	categorical exclusion
CY	calendar year
DCE	dichloroethylene
D&D	deconstruction and decontamination
D-D	deuterium-deuterium
D-T	deuterium-tritium
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
DPCC	Discharge Prevention Control and Containment
dpm	disintegrations per minute
D&R	Delaware & Raritan (Canal)
DSN	discharge serial number
E1	Elizabethtown Water (formerly- NJ American Water Co.potable water supplier – surface water station)
E-85	ethanol (85%) fuel
EDE	effective dose equivalent

List of Acronyms

EHS	Environment, Health & Safety
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)
ESA	Endangered Species Act
ES&H	Environment, Safety, and Health
ESHD	Environment, Safety, &Health Directives
ESPC	Energy Savings Performance Contract
FABA	Former Annex Building Area
FFCA	Federal Facility Compliance Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FY	fiscal year (October 1 to September 30)
GHGs	greenhouse gases
GSA	General Services Administration
HQ	Headquarters
HT	tritium (elemental)
HTO	tritiated water
ISO14001	International Standards Organization 14001 (Environmental Management System – EMS)
ITER	International Thermonuclear Experimental Reactor
JET	Joint European Torus facility (United Kingdom)
km	kilometer
kWh	kilowatt hour
LEC	liquid effluent collection (tanks)
LEED	Leadership in Energy and Environmental Design
LEED-EB	Leadership in Energy and Environmental Design - Existing Buildings
LSB	Lyman Spitzer Building (Formerly Laboratory Office Building)
LOI	Letter of Interpretation (Wetlands)
LSI	lined surface impoundment
LTX	Lithium Tokamak Experiment
M1	Millstone River (surface water station)
MC&A	Material Control & Accountability (nuclear materials)
MeV	million electron volts
mVe	milli Volt electric
MG	Motor Generator (Building)
mg/L	milligram per liter
MNA	Monitoring Natural Attenuation
M&O	Maintenance &Operations
mrem	milli radiation equivalent man (per year)
MSDS	Material Safety Data Sheet
msl	mean sea level
mSv	milliSievert
MT	metric ton (equivalent to 2,204.6 pounds or 1.10 tons)
MW	monitoring well

List of Acronyms

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
NJAWC	New Jersey American Water Company
NJDEP	New Jersey Department of Environmental Protection (prior to 1991 and after July 1994)
NJPDES	New Jersey Pollutant Discharge Elimination System
NOEC	no observable effect concentration
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NSTX	National Spherical Torus Experiment
NTS	Nevada Test Site (DOE site)
ODS	ozone-depleting substances (Class I and II)
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
PEARL	Princeton Environmental, Analytical, and Radiological Laboratory
PFC	Princeton Forrestal Center
PFC	plasma facing component
PJM	Pennsylvania, Jersey, Maryland (Electric-power grid controllers/operators)
POTW	publicly-owned treatment works
PPA	Power Purchase Agreement
ppb	parts per billion
ppm	part per million
PPPL	Princeton Plasma Physics Laboratory
PT	proficiency test (Laboratory certification)
PTE	potential to emit (air emissions)
QA	Quality assurance
QC	Quality control
RAA	Remedial Alternative Assessment
RASR	Remedial Action Selection Report
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act
REAM	remote environmental atmospheric monitoring (station)
REC	renewable energy credits
rem	roentgen equivalent man
RESA	Research Equipment Storage and Assembly Building
RF	radio frequency (waves used to heat the plasma)
RI	Remedial Investigation
RWHF	Radiological Waste Handling Facility
S or S-	sulfur
SF_6	sulfur hexafluoride (GHG)

List of Acronyms

SARA	Superfund Amendments and Reauthorization Act of 1986
SBRSA	Stony Brook Regional Sewerage Authority
SDWA	Safe Drinking Water Act
SIT	(DOE's) Sustainability Integration Team
SO_2	sulfur dioxide
SPCC	Spill Prevention Control and Countermeasure
SSPP	Site Sustainability Performance Plan
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
USGBC	US Green Building Council
USGS	US Geological Survey
VOCs	volatile organic compounds
WCR	Waste Characterization Report (NJPDES permit requirement)
χ/Q	atmospheric dilution factor (NOAA)
μg/L	micrograms per liter
μSv	microSievert

Princeton Plasma Physics Laboratory (PPPL)
Certification of Monitoring Data for
Annual Site Environmental Report for 2009 and 2010

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 2009 and 2010," are documented and certified to be correct.

Signed:

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

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Robert S. Sheneman,
Head, Environmental Services Division

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

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Executive Summary

Princeton Plasma Physics Laboratory
Annual Site Environmental Report for
Calendar Years 2009-2010

This report presents the results of environmental activities and monitoring programs at the Princeton Plasma Physics Laboratory (PPPL) for Calendar Years 2009-2010. 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 2009-2010. 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.

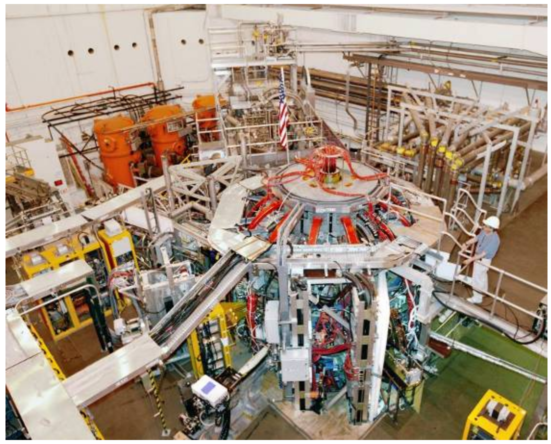
The Princeton Plasma Physics Laboratory has engaged in fusion energy research since 1951. Fusion is the reaction that occurs in our sun as well as in other stars. During fusion reactions, the nuclei of hydrogen atoms in a plasma state, *i.e.* as an ionized gas, fuse or join forming helium atoms and releasing 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

2009-2010 marked the eleventh and twelfth years of the National Spherical Torus Experiment (NSTX) operations, accomplishing 16.84 and 15.43-run weeks respectively. In NSTX the plasma is heated by radio-frequency waves and deuterium (hydrogen isotope with one neutron) neutral beam injection. 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 was a major effort to produce a smaller, more economical fusion reactor. The future plan for NSTX includes an upgrade and redesign of the center stack magnets and the addition of a second neutral beam box from the former Tokamak Fusion Test Reactor (TFTR).

The National Spherical Torus Experiment Heated by Neutral Beam Injection

Shown in the photo below, a new center column or stack will replace the original stack in the center "red core" of the spherically-shaped vacuum vessel that produces a round plasma; the person standing on the right illustrates the scale of this device. The neutral beam box is located behind vacuum vessel; a second neutral beam box will be installed as part of the NSTX upgrade project currently in progress.



In December 2009, a toy train took a spin around the NSTX vacuum vessel carrying a neutron source for its cargo. The purpose of the three-day continuous journey was to calibrate the neutron rate for fusion experiments. The source, Californium-252, emits neutrons with energy similar to those generated during deuterium-deuterium fusion experiments, and because of this, these neutrons served as a good approximation of a plasma.

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 of 2018. When operational ITER will generate 10 times the external power delivered to heat the plasma. PPPL, partnering with Oak Ridge National Laboratory, hosts the U.S. ITER Project office that coordinates U.S. ITER activities - lending to the project design, construction, and technical expertise. Visit www.usiter.org for further information on ITER.

PPPL Activities in 2009-2010

In 2010, the US Department of Energy presented PPPL with the EStar Honorable Mention, the Department's Environmental Sustainability Award, for the Laboratory's commitment to maintain its status as an EPA Energy Star® partner. PPPL significantly reduced its' energy use through improvements to the Lyman Spitzer Building, the Laboratory's main office. PPPL provided its experience and expertise to a local high school helping them achieve Energy Star® partner status.

Since 1961, the C-site Motor Generator (MG) Building housed MG sets that provided electrical power to some of PPPL's earliest experimental devices: Princeton Beta Experiment and Princeton Large Torus Experiment. As these devices were dismantled in the early 1990's, the MG sat idle for more than a decade. The removal project was proposed in 2009 and deconstruction activities began in 2010. An estimated 4500 tons of steel and copper would be removed and recycled, would generate substantial income for PPPL, and would benefit the environment through the reuse of these natural resources.

When the total maximum off-site doses for 2009-2010 were calculated, PPPL's radiological contribution was a small 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 2009 (2010) were:

1. Total maximum off-site dose from all sources—airborne and liquid releases—was 0.0184 mrem per year (0.014 mrem per year).
2. Dose at the nearest business (at the site boundary) due to airborne releases was 0.0161 mrem per year (0.0136mrem per year).
3. The collective effective dose equivalent for the population living within 80 kilometers was 0.131 person-rem (0.113 person-rem).

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 2009-2010, PPPL collaborated with Oak Ridge National Laboratory on the National Stellarator Tokamak Experiment (NSTX) located at PPPL, the Joint European Torus (JET) facility located in the United Kingdom, and International Consortium's International Thermonuclear Experimental Reactor or ITER, which in Latin means "The Way," located in Cadarache, France.

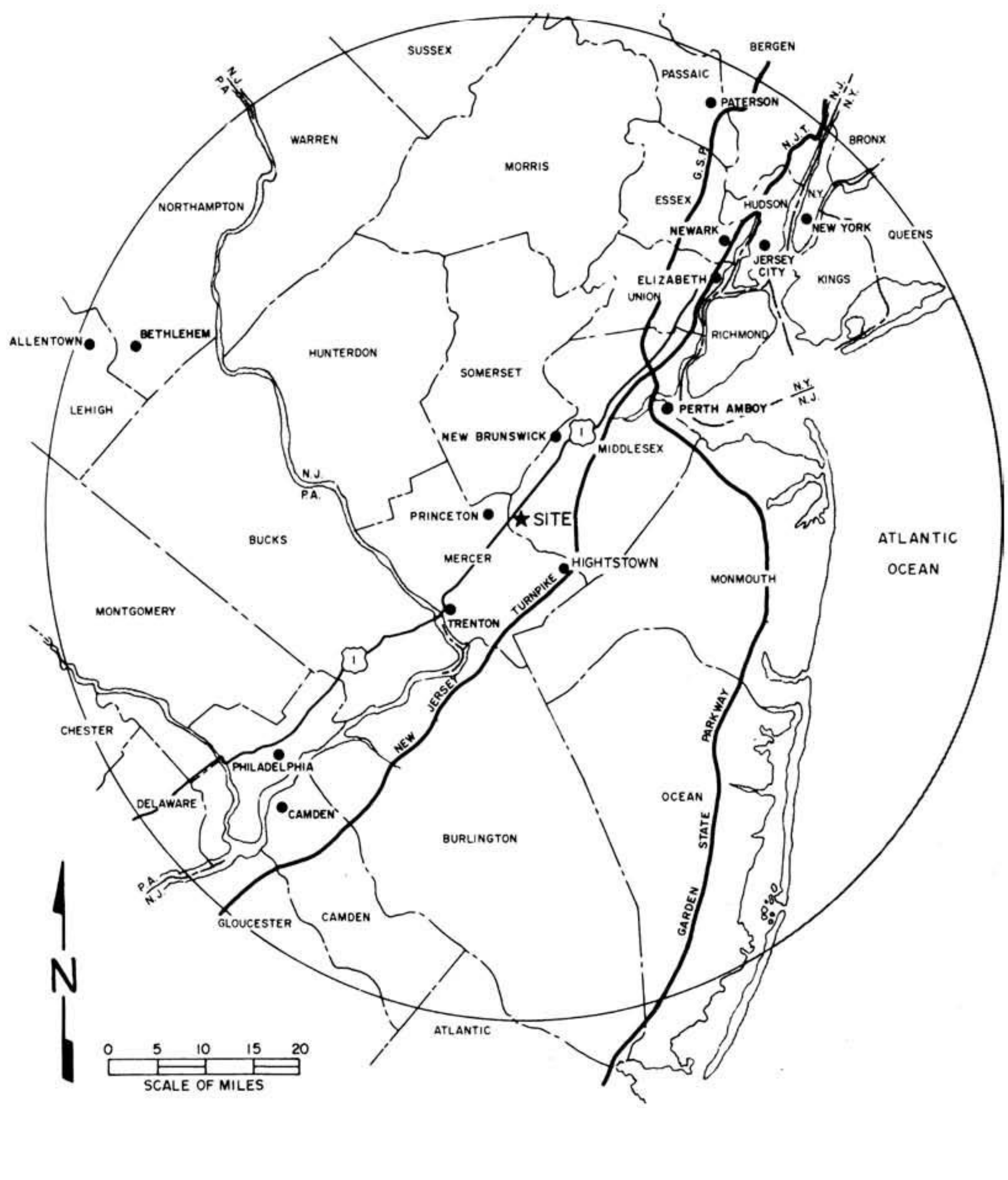
1.2 Site Location

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

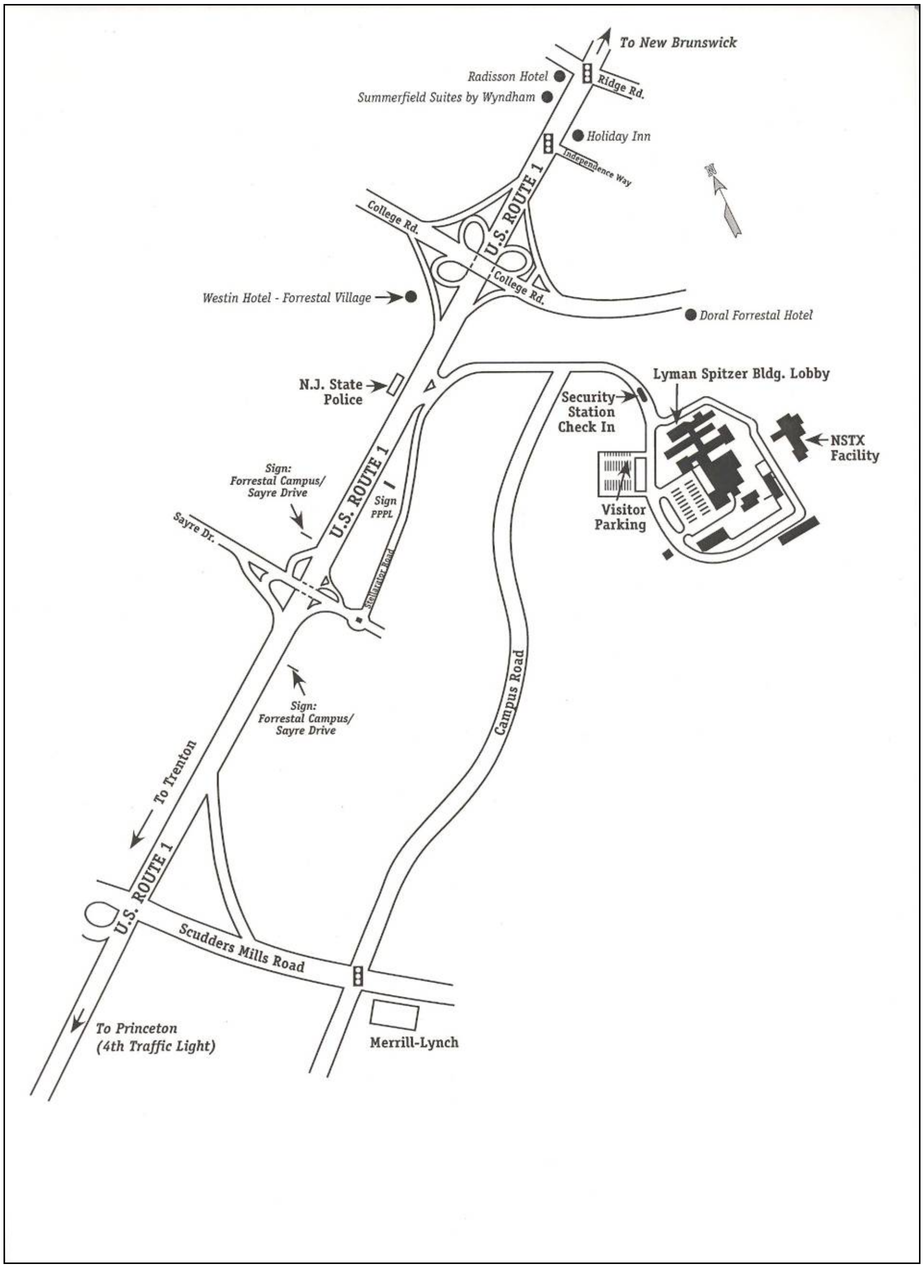
Cranbury, NJ. The Princeton area continues to experience a sustained growth of new businesses locating along the Route 1 corridor near the site. In 2009, the construction of a new hospital, Princeton Center at Plainsboro that will replace the existing Princeton Hospital, began and is located within 2 miles of the site. Princeton University's main campus is approximately three miles west of the site, primarily located within the Borough of Princeton.

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



In 1951, known as "Project Matterhorn", PPPL 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 barbed-wire, chain-linked fence for security purposes. Access to D-site is limited to authorized personnel through the use of card readers. The Site Protection Division of PPPL controls C-site access allowing the public and visitors' access following an identification check and/or the Security Access Form that is completed by the PPPL host. Vehicle inspections may occur prior to entrance.

Exhibit 1-3. Aerial View of PPPL

The aerial photo above (Exhibit 1-3) shows the general layout of the facilities at the C- and D-sites of JFC as viewed from the north; the former TFTR and current NSTX Test Cells are located at D-site (on the left side of photo)

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.

Normally, the 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 2009, the annual rainfall total, 48.1 inches (122 cm), was above the average rainfall (+1.6 in., 4.1 cm) for central New Jersey. The rainfall was consistent throughout the year, maintaining on average 4.1 inches (10.4 cm) every month (Table 2A). In 2010 rainfall was slightly less than the average (40.8 inches, 103.5 cm); this figure would have been significantly less were it not for all the rainfall in March 2010 (10.9 inches, 27.7 cm) (Table 2B).

The most recent archaeological survey was conducted in 1978 as part of the TFTR site environmental assessment study. From historical records, personal interviews, and field investigations one projectile point and a stone cistern were found. Apparently, the site had limited occupation during prehistoric time and has only in recent times been actively used for farming. No significant archeological resources were identified on-site. There are 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 fusion experiments, including NSTX, MRX, or LTX, currently operate at PPPL. NSTX is the largest operating experiment and it is located on D-site. In fiscal year 2009 (FY09), NSTX completed 16.84 weeks of operations, having produced 2,748 plasmas in 2,901 plasma attempts; in FY10, NSTX completed 15.43 weeks of operations, having produced 2,941 plasmas in 3,145 attempts [vH11].

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.

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 the NCSX's construction, PPPL's staff began decommissioning the experiment. All the fabricated parts of the NCSX were moved 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). In October 2010 technicians coated LTX with Lithium for the first time. 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 2010 US Census Bureau Statistics, Middlesex County has a population of 809,858; adjacent counties of Mercer, Monmouth, Somerset, and Union have populations of 366,513, 630,380, 323,444, and, 536,499 respectively [US00]. 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

2009-2010 COMPLIANCE SUMMARY and COMMUNITY INVOLVEMENT

Princeton Plasma Physics Laboratory's (PPPL) environmental goal is to fully comply with applicable state, federal, and local environmental regulations and to operate the facility in a manner that minimizes environmental impacts. PPPL initiates actions which enhance and document compliance with these requirements. Compliance with applicable federal, state, and local 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 summarizing the 2009 and 2010 compliance status and providing the ASER sections where further details are located. The list of "Applicable Environmental Laws and Regulations…" conforms to PPPL's Environmental Management System (EMS) Appendix B, "Summary of Legal and Other Requirements" [PPPL12].

2.2 Site Compliance and Environmental Management System (EMS) Assessments

In 2009, PPPL's Quality Assurance (QA) Division performed nine (9) audits of which three (3) involved environmental topics: Audit of Bethlehem Apparatus (recycler of mercury and alkaline batteries), PPPL's Radioactive Waste Handling Program, and PPPL's Radiological Protection Program. Each audit includes records examination and requirements compliance and is tracked through PPPL's internal QA Audit Database [Ya12]. In 2010, QA performed seven (7) audits, including one (1) environmental – PPPL's Radioactive Waste Handling Program [Ya12].

In 2009, PPPL selected UL-DQS, Inc. to conduct a Stage 1 preliminary evaluation of PPPL's International Standard Organization (ISO) 14001:2004 – "Environmental Management System." In May 2009, UL-DQS visited PPPL to conduct the evaluation and provided the Stage 1 Preliminary Evaluation Report, which indicated that PPPL was ready for its Stage 2 Registration Assessment [UL-DQS09]. In the report, 15 discrepancies detailed the issues to be address/correct as follows: 1) Identifying Legal/Other Requirements , 2) Goal Setting, 3) Communication, 4) EHS Equipment Calibration, 5) Emergency Preparedness and Response, 6) Evaluation of Compliance, 7) Non-conformance, Corrective Action and Preventive Action, and 8) Management Review . PPPL QA tracked these discrepancies and provides the status of each action item until it was closed.

Exhibit 2.1 Applicable Environmental Laws and Regulations – 2009 and 2010 Status

Regulatory program description	2009 and 2010 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 releases of hazardous waste.	The CERCLA inventory completed in 1993 [DY93] warranted no further CERCLA actions. During 2009-2010, PPPL had no involvement with CERCLA-mandated clean-up actions. A New Jersey-regulated environmental investigation and remediation project is discussed in ASER Chapters 4 and 6.	*4.3.1 B* *6.5*
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 2009, PPPL shipped 18.7 tons (17 metric tons, MT) of hazardous waste of which 8.4 tons (7.6 MT) were recycled (45% recycling rate). In 2010, 8 tons (7.2 MT) of hazardous was waste were shipped, of which only 1 ton (0.9 MT) or 12 % was recycled. The types of waste are highly variable each year, *e.g.*, in 2009, 1.5 tons (1.4 MT) petroleum distillate wastes were recycled vs. in 2010, ~5 tons/4MT of oily debris, used oil, flammable liquids were incinerated [Pue10&11].	*4.2.1 C* *4.2.1 D*
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. An agreement among the regulators was reached 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 2009 and 2010, PPPL reviewed 37 and 35 activities, respectively. 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) [Lev10&11].	
Toxic Substance Control Act (TSCA) governs the manufacture, use, and distribution of regulated chemicals listed.	PPPL shipped in 2009-2010 - 417 pounds and 357 pounds, respectively, of PCB TSCA Hazardous Substances. Five PCB capacitors remain on-site. Asbestos removals in 2009 and 2010 were 40 and 280 cubic yards in volume, respectively [Pue10&11].	*4.2.1B*
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 [Kin10b&11b].	*Exhibit 4- 7* *4.2.1 A*

Regulatory program description	2009 and 2010 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 was current in 2009-2010. 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 either year [PPPL10h].	*4.3.1A*
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)	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*
Clean Air Act (CAA) and New Jersey Air Pollution Control Act controls the release of air pollutants through permit and air quality limits and conditions. USEPA regulates the National Emission Standards for Hazardous Air Pollutants (NESHAPs) for tritium (an airborne radionuclide) and boilers (<10 million BTUs). Greenhouse gas (GHG) emissions inventory tracking and reporting are regulated by EPA.	PPPL-DOE maintain air certificates/permits for the regulated equipment: 4 boilers, 2 emergency/standby generators, 2 dust collectors, 2 above-ground storage tanks (< 10,000 gals. fuel oil) and a fluorescent bulb crusher. PPPL is designated as a synthetic minor and does not exceed any air contaminant thresholds requiring a Title V permit. Annual boiler adjustment results were submitted to NJDEP in 2010 as required by the permit. Fuel consumption and sulfur content for the generators and boilers are recorded and annual boiler emissions are calculated. The NESHAPs report for tritium emissions is submitted annually. PPPL maintains an inventory for ozone-depleting substances (ODS) and greenhouse gas (GHG) emissions [Ne09&10, PPPL10k&11e].	*4.4*

Exhibit 2.1 Applicable Environmental Laws and Regulations – 2009 and 2010 Status (continued)

Regulatory program description	2009 and 2010 Status	ASER section(s)
NJ Safe Drinking Water Act (SDWA) protects the public water supply by criteria standards and monitoring requirements.	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 [Pin12].	*4.1.4 A* *Exhibit 4-4*
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 2009 and 2010 [PPPL10a&11a].	*4.3.1 C* *Exhibit 4-9* *Exhibit 4-10*
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, NJDEP97, PPPL05].	
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 [PPPL09f].	*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 [Pue10&11].	
NJ Regulations Governing Laboratory Certification and Environmental Measurements mandates that all required water analyses be performed by certified laboratories.	PPPL's Princeton Environmental, Analytical, and Radiological Laboratory (PEARL) continued analyze immediately parameters but dropped COD and turbidity certification. PPPL subcontractor analytical laboratory is a NJDEP certified laboratory [PPPL07b].	*7*
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.	PPPL-DOE awaiting the draft NJPDES surface water discharge permit; renewal application submitted to NJDEP in 2010. In 2009, the permit limit for chemical oxygen demand (COD) was exceeded twice due to laboratory error; in September 2010, a high pH (9.18, 9.0 limit) was exceeded due to high productivity/photo-synthesis in the basin (low precipitation/high temperatures). LSI was compliant [PPPL09e, 10c, 10e, 10f, 10i, 10j, 10l &10m].	*4.1.1* *Exhibits 4-1, 4-2, 4-3 and 4-5*

Exhibit 2.1 Applicable Environmental Laws and Regulations – 2009 and 2010 Status (continued)

Regulatory program description	2009 and 2010 Status	ASER section(s)
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.	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 [PPPL10o & 11f].	*6.5*
DOE Order 231.1B, ***Environment, Safety, and Health Reporting,*** requires the timely collection, analysis, reporting, and distribution of information in ES&H issues.	PPPL ES&H 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 [DOE11a].	*2.6.*
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 provides rad-waste requirements in the Environment, Safety, & Health directive (ESHD) 5008, Section 7, "Waste Management," and Environmental Services Division (ESD) procedure, EM-CP-21, "Certification of Low-level Radioactive Waste for Disposal at Nevada Test Site " [DOE01, PPPL11d].	*5.1.3* *Exhibit 5-5 and 5-6*
DOE Order 450.1A, ***Environmental Protection Program,*** requires all DOE facilities to implement an "Environmental Management System" for the protection of air, water, land, and other natural/cultural resources and establish sustainable-stewardship practices.	PPPL's Environmental Management System (EMS) was prepared in 2005 and is reviewed and updated annually. EM-OP-46, "Environmental Aspects and Impacts Evaluation," requires the site's activities are evaluated biennially to ensure the protection of environmental resources and to implement sustainable practices [PPPL09b].	*3*
DOE Order 5400.5, ***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 [DOE01, 11c, PPPL07a, 09c, 09d & 10g].	*5.1* *Exhibit 5-1, 5-2,*

Exhibit 2.1 Applicable Environmental Laws and Regulations – 2009 and 2010 Status (continued)

Regulatory program description	2009 and 2010 Status	ASER section(s)
Atomic Energy Act (AEA) 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*
Executive Order (EO) 13423, *Strengthening Federal Environment, Energy, and Transportation Management,* requires all federal agencies to improve energy efficiency, reduce vehicle petroleum use, increase use of non-petroleum fuel in vehicles, purchase energy from renewable sources, conserve water, improve waste minimization, purchase sustainable products, implement a environmental management system .	PPPL completed the *Executable Plan* in 2009, which outlined the goals and status of compliance with EO 13423 [EO08, PPPL10d].	*3*
Executive Order 13514 , *Federal Leadership in Environmental, Energy, and Economic Performance,* requires the establishment of goals and targets for the reduction of greenhouse gases (GHGs), improve water use efficiency, promote pollution prevention, advance regional and local planning, implement high performance sustainable building design, construction, M&O, and deconstruction, advance sustainable acquisition, promote electronic stewardship, and sustain environmental management systems.	PPPL prepared *the 2011 Site Sustainable Plan* that addressed the goals, targets and status of EO 13514 requirements [EO09 & PPPL11c].	*3*

2.3 External Oversight and Assessments

In 2009, the New Jersey Department of Environmental Protection (NJDEP), Enforcement Bureau, Central Region Office, two inspectors conducted an audit of PPPL-DOE's air and water permit programs. The air audit included four boilers, two above-ground storage tanks, two dust collectors, two emergency (standby) generators and fluorescent bulb crusher operations and records. As the NJDEP inspector found PPPL's program to be compliant, no findings or recommendations were issued as a result of the inspection audit.

The NJDEP inspection of PPPL-DOE's Surface, Ground, and Safe Drinking Water programs included the surface water discharges from the on-site retention basin and the off-site pump house filter-backwash, the lined surface impoundment (retention basin liner), quarterly cross-connection inspections for the potable water supply, and the water use reporting for the Delaware & Raritan Canal (D&R) withdrawals. PPPL's Environmental Water Programs were found to be in compliance during the 2009 NJDEP inspection.

In February 2010, Freehold Soil Conservation District Inspector reviewed the requirements of the Soil Erosion and Sediment Control Plan for the D-site parking lot landscaping project. This project included the replacement of gravel and compacted soil with top soil that was seeded with native grasses and the installation of rain gardens around two storm drains.

2.4 Emergency Reporting of Spills and Releases

There were no releases of hazardous substances or petroleum hydrocarbons on pervious surfaces that exceeded the reportable quantities or required notification to New Jersey's Action Hotline during 2009.

In October 2010, PPPL reported to the NJDEP Hotline a possible finding of petroleum in a test well on D-site (Case No. 10-10-13-1101-29) [PPPL10c]. Ground water from well TW-10 had not been sampled in several years. PPPL received a request from US Geological Survey geologists to collect water from this well as part of a NJDEP study investigating concentrations of certain metals and radionuclides in ground water (see Chapter 6.6). The USGS team lowered a water level probe to measure depth to ground water in the well; when it was retrieved, the probe was covered with an oily film. Samples were collected and analyzed for petroleum hydrocarbons (TPHCs). The results showed no concentrations of TPHCs. TW-10 was checked with PPPL's water level probe that can also detect oil; the results were negative.

Under New Jersey regulations, PPPL is required to call the Action Hotline to report any permit limits that are exceeded. Three such calls were made: one in 2009 and two in 2010.

In 2009, the chemical oxygen demand (COD) results of 79. 8 and 77.3 mg/L collected from the basin discharge (DSN001) were reported. As discussed in the NJDEP Case No. 09-08-13-1407-34 report, PPPL investigated the cause of the exceeded COD maximum limit (>50 mg/L). Results of the split samples with PPPL's subcontractor analytical laboratory indicated that the elevated levels of COD may not have been valid results. PEARL, PPPL's internal analytical laboratory, which reported the elevated COD concentrations, had not passed its proficiency test for COD the previous month (July 28, 2009). It was concluded that due to the age of the COD equipment probably resulted in unreliable COD results. PPPL chose not to replace the COD equipment, instead the samples were sent to subcontractor laboratory for COD analysis as well as other parameters [PPPL09e].

In March 2010, pH level at the Delaware & Raritan (D&R) Canal pump house filter backwash, DSN003, was measured at 5.93 S.U. The permit limits are 6.0 and 9.0. The water level in the Canal was high due to heavy rainfall during the previous days; the pH upper stream in the Canal was found to be lower (5.76). PPPL reported this occurrence to the Action Hotline and prepared the follow-up compliance report, NJDEP Case No. 10-03-18-1648-13. The investigation into the cause of the low pH at the pump house outfall determined that the heavy rainfall and large amount of storm-water runoff was the cause [PPPL10n].

At DSN001 in September 2010, the opposite situation, *i.e.*, little or no rainfall and high temperatures, was determined to be responsible for an elevated pH level above the 9.0 permit limit. On September 2, 2010, the pH was measured at 9.18. The flow from the basin was abnormally low totally less than 16,000 gallons for that day. The combination of low flow and high air temperatures (~97ºF, ~36.1 ºC) resulted in high productivity or photosynthesis activity, which increased the pH in the basin. The NJDEP Case No. 10-09-02-1502-59 was prepared and submitted reporting that the lack of rainfall and the high air temperatures appeared to be the cause of the elevated pH [PPPL10j].

2.5 Notice of Violations and Penalties

There were no notices of violations or penalties for environmental occurrences at PPPL during 2009 or 2010.

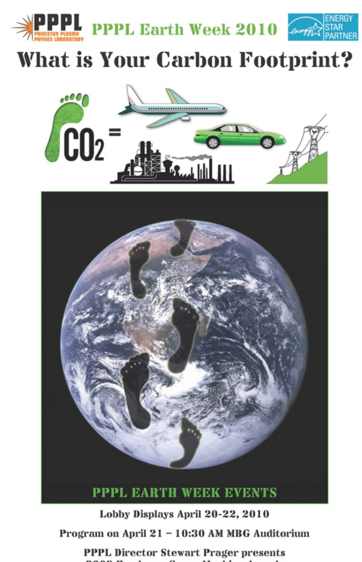
2.6 Community Involvement

2.6.1 Earth Week at PPPL – 2009 and 2010

"Use Natural Resources Wisely for Future Generations" was the theme of PPPL's 2009 Earth Week celebration. On April 22nd, PPPL employees and members of the public were invited to participate in viewing displays on Fusion energy, Sustainable renovations and projects, PPPL's outstanding recycling program, Beneficial landscaping, Alternative fuel vehicle program, Mercer County Improvement Authority, Stony Brook Millstone Watershed Association, and PPPL's subcontractor office supply and waste removal companies. The colloquium speaker, Professor R. Kaufman, Director of CAS Geography and Environment at Boston University, presented "Oil and the American Way of Life: Don't Ask, Don't Tell."

Each year, employees are asked to nominate their fellow workers for their exceptional efforts to minimize waste, improve energy efficiency, and promote sustainable practices at PPPL. In 2009, twenty-five employees received PPPL Green Machine Awards for the following projects or programs:

- Reduction of the motor generator excitation between NSTX plasma operational shots, which saved ~839,500 kWh in electricity at a cost savings of $110K and equal to a reduction of 300 tons of carbon dioxide, a greenhouse gas
- Installation of advanced electric meters allowing real-time power flow to be managed
- Replacing inefficient computing power clusters with energy efficient computing clusters, saving 210,00 kWh and 75 tons of CO_2
- Replacing bottled water coolers with triple-filtered potable water stations, saving ~20,500 gallons of water per year.
- Purchase of Steelcase Cradle to Cradle® office furniture to replace old office furniture
- Awarding of the Lyman Spitzer Building as an EnergyStar® Gold Building in 2008 for its increased energy efficiency



The Earth Week celebration in 2010 promoted the theme, "What is Your Carbon Footprint?" To encourage employees to improve their energy use both at PPPL and at home, PPPL provided methods to calculate the carbon footprint and reusable mugs with a pledge to become an EnergyStar® partner. The "sustainable office renovation" model office, constructed with recyclable furniture, carpet and lighting, was a highlight of the celebration. The 2010 colloquium speaker was Ted Borer from Princeton University's Facilities and Engineering

Department, who presented "Princeton University Climate Change Initiatives Program Update."

Twenty-three PPPL employees were awarded PPPL's 2009 Green Machine Awards. Their accomplishments included:

- Installation of an energy efficient air compressor in the RESA buildings that provided electric and heating saving in winter months
- Computer system replacements with newer more energy efficient systems that not only saving energy, but process code significantly faster
- Recycled ½ mile of cable and reused ¼ mile of multi-pair cable at a cost savings of $7,500
- Collected and recycled over 630 pounds of notebook binders that were donated to the Young Scholars Institute in Trenton, NJ and the Special Olympics in Lawrenceville, NJ

2.6.2 PPPL 's Open House – May 2010

On May 1, 2010, PPPL opened its gates and welcomed over 2,100 guests to the hottest place in New Jersey! PPPL experiments having produced a record plasma temperature of 510 million ºC, earned the title of "hottest place in NJ."

PPPL Director, Stewart Prager, delivered a talk, "Fusion Energy: What, How and When?" discussing the Laboratory's role in finding the path to a safe, clean and abundant energy source for the future. Visitors were provided with cryogenics, nuclear and laser demonstrations; the event included self-guided tours of the experimental laboratories, fusion devices and a display on ITER (multi/international fusion energy research collaboration being construction in southern France), the Visualization Wall, and plasma science toys and other hands-on activities.

2.6.3 PPPL 's Science Education and Mentoring Program 2009-2010

PPPL's hosted several science teachers from across the country who participated in the DOE-sponsored ACTs 3-year program. The Environmental Services Division mentored two teachers from this program, a high school biology teacher from Lawrenceville, NJ and a middle school chemistry/general science teacher from Ewing, NJ. Over an eight-week period during each summer, these teachers took part in a variety of environmental projects from collecting data for PPPL's Leadership in Energy and Environmental Design (LEED) submittal to water sampling and reviewing / commenting on previous Annual Site Environmental Reports (ASERs).

The program benefitted both teachers and mentors as they continue to meet and exchange ideas that they use at their respective school with their students during the school year. PPPL receives feedback from these teachers that is used to improve our communication and participation within the community.

Chapter

3

ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)

PPPL has been successful in meeting the sustainability goals established by Executive Order (EO) 13423 and DOE Orders 450.1A and 430.2B 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 PPPL toward more sustainable operations. The EMS includes energy management, water conservation, renewable energy, greenhouse gas management, environmentally preferred purchasing and facility operation programs to reduce environmental impacts and improve performance. PPPL will continue to proactively implement sustainability practices aimed at meeting, or exceeding, the sustainability goals in its EMS, DOE Orders and Executive Orders.

In 2009, PPPL successfully completed an independent third-party evaluation of its EMS program against the requirements of the ISO-14001:2004 international standard and the requirements of DOE and Executive Orders (EOs). An independent auditing firm, certified as an ISO-14001 registrar, reviewed PPPL's EMS program documents, implementing processes, and performance status and verified that the EMS met the requirements of applicable DOE and Executive Orders and conformed to the ISO-14001 standard. This review verified that PPPL's EMS was "fully implemented" prior to June 20, 2009 as required by DOE Order 450.1A.

3.1 DOE Sustainability Goals

In 2010 PPPL developed plans to address the aggressive new sustainability and green house gas management goals of EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance,* which was signed by President Obama in October 2009. PPPL was a "Road Test" site for the Public Sector Protocol for green house gas reporting and provided expertise to DOE's Sustainability Integration Team (SIT) and the development of DOE's Strategic Sustainability Performance Plan (SSPP) [DOE11b, PPPL10d & 11c].

Energy Efficiency

Between 2003 and 2010, PPPL achieved a reduction in energy intensity (British Thermal Unit per gross square feet, BTU/gsf) for non-experimental energy use of 36% and continues to maintain the level of performance (see Exhibit 3-1). This was achieved through facility management, energy conservation measures and equipment upgrades.

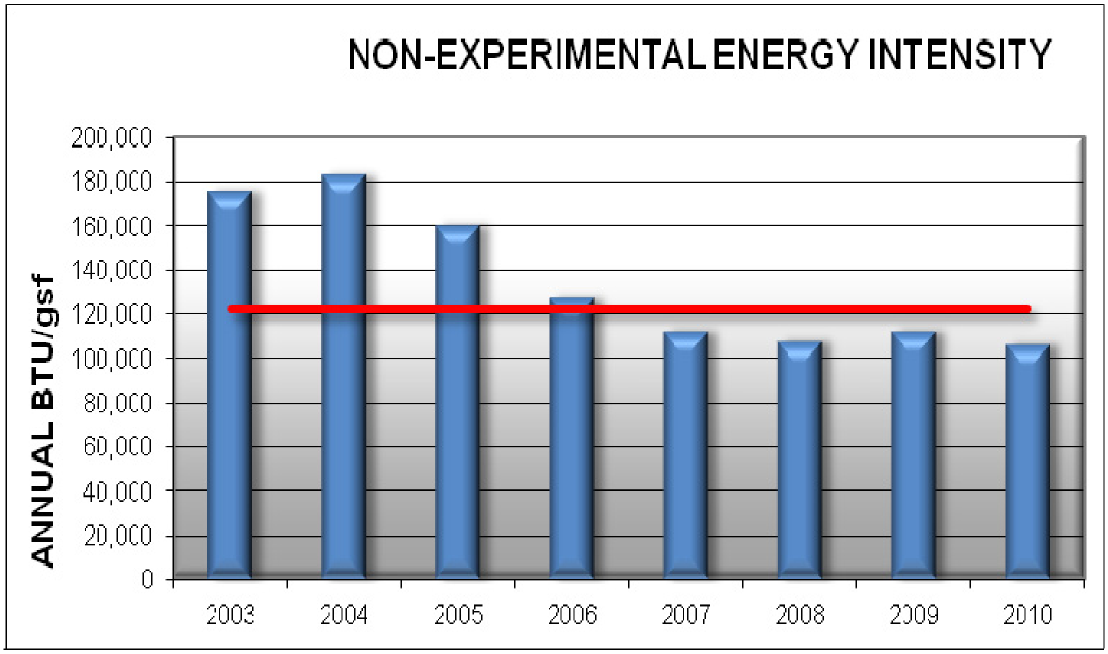


Exhibit 3-1 - Annual Non-Experimental Energy Intensity in BTU/gsf.
(Red line indicates the Federal energy efficiency goal set for 2015)

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. For example, by reducing the excitation of motor generators between plasma shots, PPPL saved approximately 840,000 kWh of electricity and eliminated over 310 metric tons of CO_2 emissions annually.

Renewable Energy

PPPL and DOE-PSO aggressively pursued an on-site solar renewable energy generation project for as much as 40% of non-experimental energy use over the course of three fiscal 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.

Greenhouse Gas Emissions

Between 2008 and 2010, PPPL reduced its Scope 1 and 2 Greenhouse Gas (GHG) emissions by 32%. This significant reduction in GHG emissions, achieved in only two years, 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 and boiler control upgrade projects. A summary of Scope 1 & 2 GHG emissions for 2008 and 2010 is show in Exhibit 3-2.

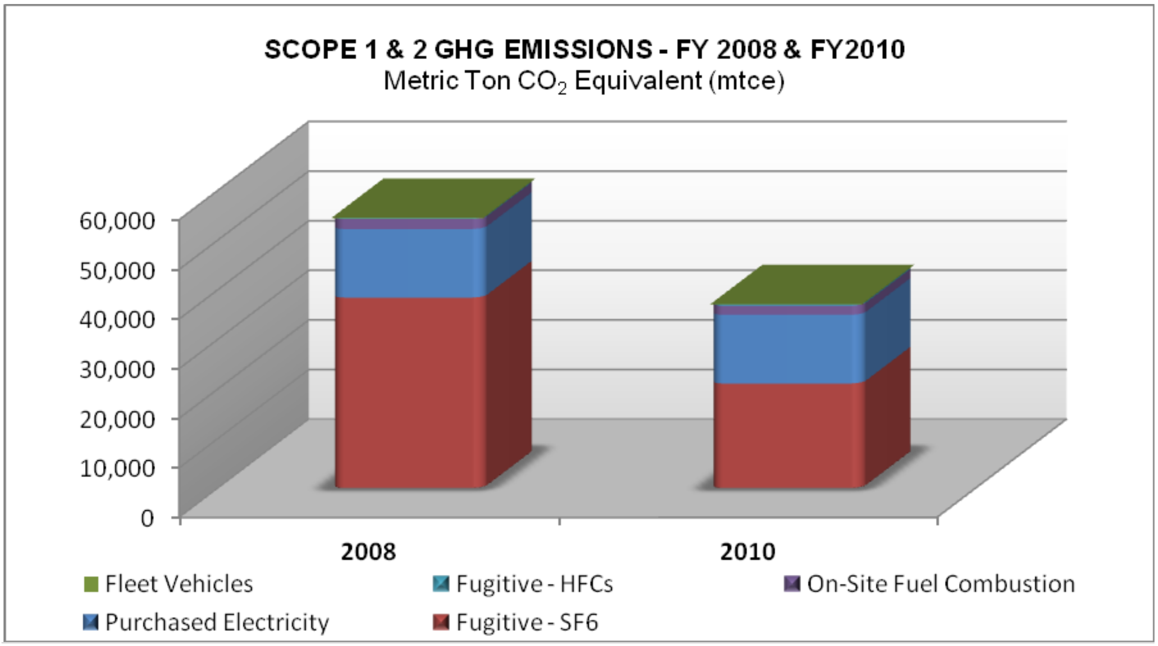


Exhibit 3-2 - Summary of PPPL Scope 1 & 2 GHG Emissions for 2008 and 2010.

Fleet Management

In 2010, PPPL's fleet petroleum fuel use was 62% below 2005 levels (see Exhibit 3-3, below). In addition, alternative fleet fuel consumption in 2010 was 19 times higher than the levels in 2005, representing over 62% of PPPL's total covered fleet fuel use (see Exhibit 3-4).

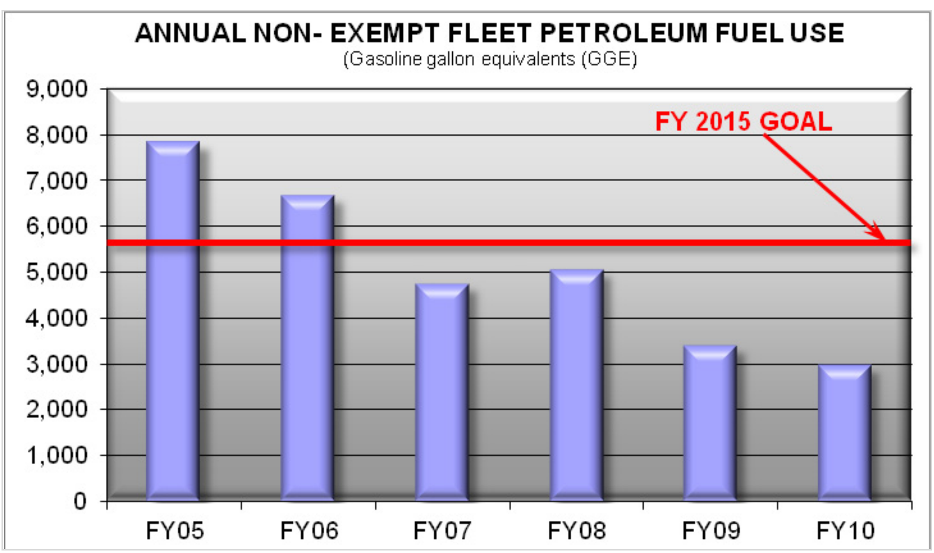


Exhibit 3-3 – Annual Non-Exempt Fleet Petroleum Fuel Use Between FY2005 and FY2010.

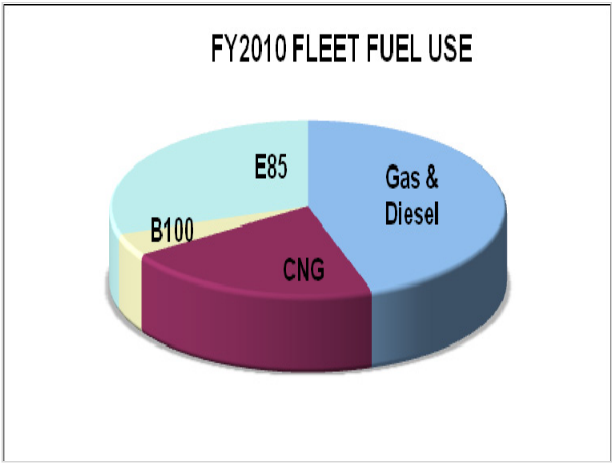


Exhibit 3-4 – FY2010 Non-Exempt Fleet Fuel Use by Type.

Exhibit 3-5. Gator ®Plowing Snow

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. Our present fleet, including exempt emergency vehicles, consists of 30 vehicles: one (1) DOE owned fire truck (Diesel) and 29 GSA leased vehicles. Of the 29 GSA leased vehicles we have one (1) electric hybrid, 21 vehicles using alternative fuels (E85, CNG or B20), and seven vehicles using petroleum products (gasoline or diesel). Thus, 73% of PPPL's fleet is made up of alternative fueled vehicles (AFVs). 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 (Exhibit 3-5). 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 CNG vehicle fueling system.

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 75% between 2000 and 2010 (see Exhibit 3-6). 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 larger opportunities have already been addressed.

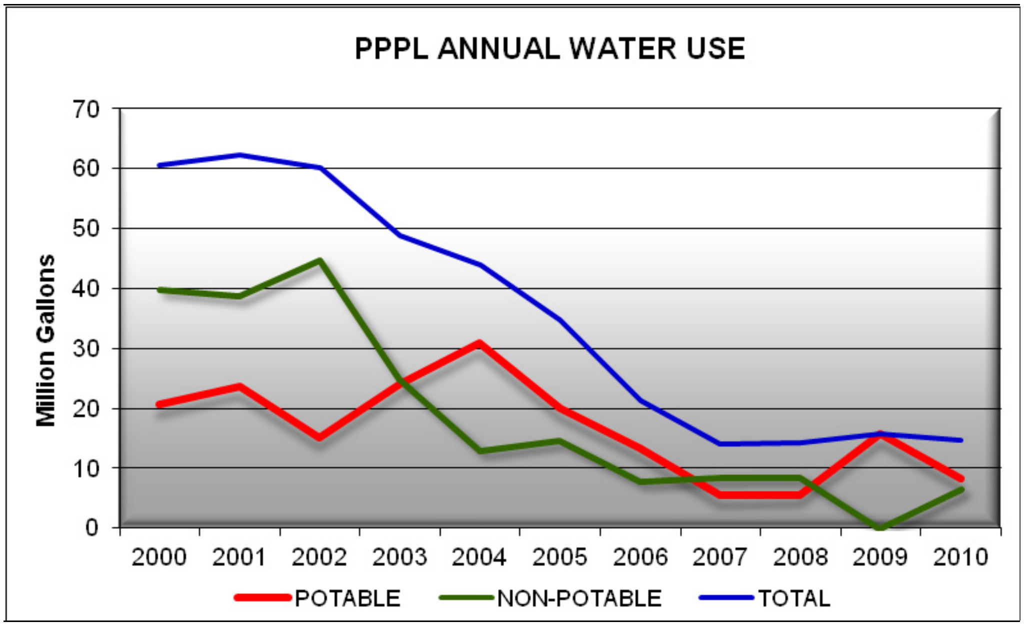


Exhibit 3-6 - PPPL Annual Water Use from 2000 to 2010
(Shows a 75.6% reduction in annual water use)

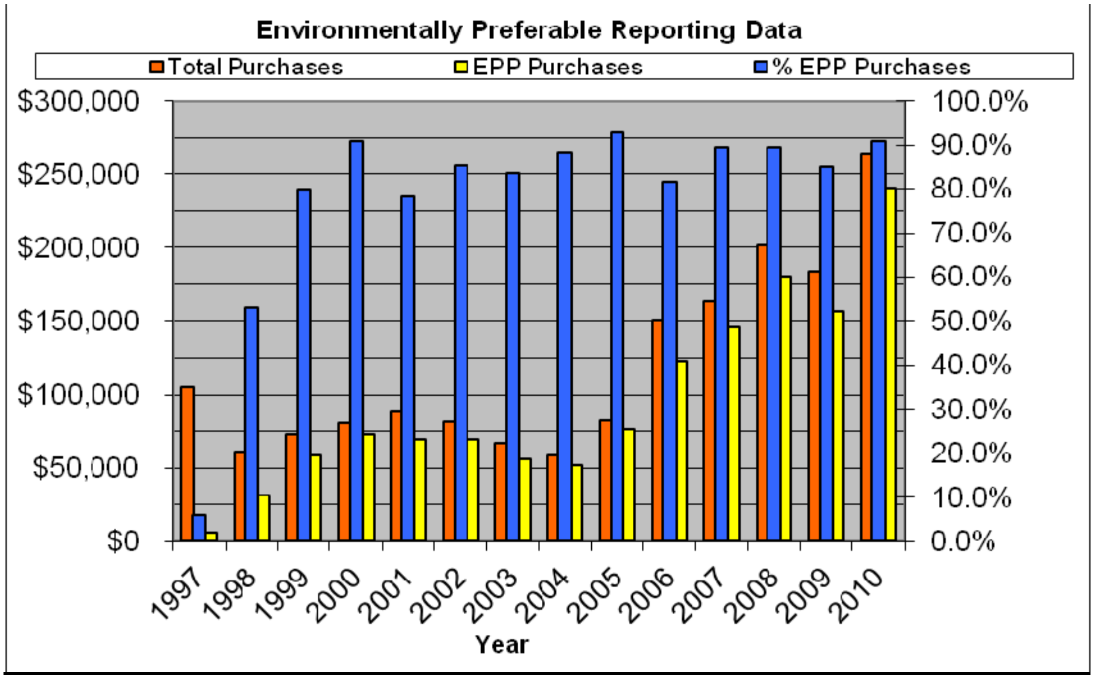
PPPL is pursuing certification of its main office building, the Lyman Spitzer Building (LSB), to the U.S. Green Building Council's Leadership in Energy and Environmental Design – Existing Buildings Operations & Maintenance (LEED-EBOM) standard. The LSB represents approximately 16% of the current building space and certification of this building to the LEED-EB standard will achieve the goal of having at least 15% of building space meet the Guiding Principles for High Performance and Sustainable Buildings. The application and supporting documentation for LEED-Gold certification of the LSB was submitted to USGBC in later 2010.

A tabular summary of PPPL's performance against the comprehensive sustainability goals of EO 13514 and the applicable DOE Orders is presented in Exhibit 3-8.

Environmentally Preferable Products (EPP)

In Exhibit 3-7, the blue bars indicate that during 2009-2010 approximately 85 to 91%, respectively, of PPPL's total purchases were environmentally preferred products (EPP). From office supplies, carpet and flooring tiles, paints, cleaners, lighting, and office furniture, PPPL practices green buying, moving the Lab closer to the goal of 100%. The total dollar averaged $200 K, which was an increase from previous years. PPPL used the Electronic Product Environmental Assessment Tool or EPEAT to evaluate electronics purchases based on the criteria that the product meets American National Standards Institute (ANSI) approved public standards.

Exhibit 3-7.



3.2 Sustainability Awards

In 2009, PPPL received a DOE Office of Science Environmental Sustainability Award for its bio-based products purchasing program which included bio-based machining lubricants, cleaning products, fuels and other products. In 2010, PPPL received a DOE Environmental Sustainability "E-Star" Honorable Mention Award for its Energy Star® partnership and outreach program.

Exhibit 3-8 – 2010 DOE Sustainability Goal Summary Table for PPPL

DOE Goal	FY10 Site Status	Site Planned Actions
28% Scope 1 & 2 GHG reduction by FY2020 from a FY 2008 baseline (related goals indented below)	**MET** 32% reduction in FY2010 v. 2008	Continue to focus on SF6 emissions, purchased electricity and on-site fuel use.
30% energy intensity reduction by FY2015 from a FY 2003 baseline	**EXCEEDED** 39.5% reduction through FY2010	Continue to emphasize energy efficiency; improve building energy performance.
7.5% of a site's annual electricity consumption from renewable sources by FY2010 (2x credit if the energy is produced on-site)	**REC PURCHASES** 1.37MWh	ESPC and PPA were not financially viable. Continue to explore small-scale renewable energy options and integration of renewable energy into new building construction project.
Every site to have at least one on-site renewable energy generating system by FY2010	**MET** Pilot solar pathway lights.	Will continue to explore small-scale renewable energy options and integration of renewable energy into new building construction project.
10% annual increase in fleet alternative fuel consumption by FY2015 relative to a FY2005 baseline	**EXCEEDED** 19 times higher than FY05	Continue acquiring AFVS and supporting CNG, E85, and B20 vehicles.
2% annual reduction in fleet petroleum consumption by FY2015 relative to a FY2005 baseline	**EXCEEDED** 62% reduction	Continue acquiring AFVS and supporting CNG, E85, and B20 vehicles.
75% of light duty vehicle purchases must consist of alternative fuel vehicles (AFV) by FY 2015	**EXCEEDED** 100%	Continue acquiring AFVs.
To the maximum extent practicable: advanced metering for electricity (by October 2012), steam, and natural gas (by October 2016); standard meters for water	**ON TARGET** 9 meters installed	Continue installing advanced meters for electricity and natural gas as practicable. Standard meters for water.
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	**ON TARGET** 1 building with cool roof. 1 project roof insulation to R-30	R-30 is new standard for roof installation. Evaluating other cool roof installations.
Training and outreach. DOE facility energy managers to be Certified Energy Managers by September 2012.	**MET** Training plans in place. PPPL has a Certified Energy Manager.	Continue to train additional staff and create an organizational culture to improve energy efficiency.
Sulfur hexafluoride (SF6) capture program by September 2012.	**MET** Identified key SF_6 emission sources. 2010 SF_6 reduced by 45%	Additional improvements planned in FY2011 and FY2012.
13% Scope 3 GHG reduction by FY 2020 from a FY 2010 baseline	2008 baseline established	Increase in employee commute, through carpooling and alternative employee commuting programs; continued focus on business travel
All new construction and major renovations greater than $5 million to be LEED® Gold certified. Meet HPSB guiding principles if less than or equal to $5 million	All new buildings to meet or exceed requirement of LEED® Gold	Science and Technology Center targeted for LEED® Gold certification.
15% of existing buildings larger than 5,000 gross square feet (GSF) to be compliant with the five guiding principles of HPSB by FY 2015	LEED-EBOM Gold certification submitted for LSB	Additional assessments planned in FY2011; energy efficiency may enable three additional buildings to meet HPSB goal.
16% water intensity reduction by FY2015 from a FY 2007 baseline, 26% by FY2020	88.7% reduction achieved prior to baseline year	Additional water reductions projects are limited. Water conservation measures targeted for new building construction.
20% water consumption reduction of industrial, landscaping, and agricultural (ILA) water by FY 2020 from a FY 2010 baseline	FY2010 baseline established	Additional water reductions projects are limited. Water conservation measures targeted for new building construction.

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 and DSN003 (Tables 17A , 18A, 22A, 17B, 18B & 22B). During 2009-2010, PPPL's discharges were within allowable limits for all tested parameters (Exhibit 4-1).

In 2006, PPPL received the final NJPDES permit with the effective date of February 1, 2006. In February of 2008 NJDEP issued a *Final Surface Water Minor Modification Permit Action* report [NJDEP08]. Permit requirements for 2009-2010 included in Exhibit 4-1.

In July 2010, DOE and PPPL submitted to the NJDEP the renewal application for the NJPDES Surface Water Discharge permit, which was required 180 days prior to the permit expiration (February 1, 2011). All permit requirements remain in effect until a new approved NJPDES permit is issued.

B. Acute Toxicity Study

Acute Biomonitoring Report for the Water Flea *(Ceriodaphnia dubia)* 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 survival rates that complied with the permit limit [PPPL10f].

C. Chronic Whole Effluent Toxicity Study

Annual Chronic Whole Effluent toxicity testing for DSN001 was completed on March 2, 2009 and May 25, 2010 (Exhibit 4-2). In both chronic toxicity tests, *Pimephales promelas* (fathead minnow) survival rate results, as defined by the NJ Surface Water Quality Standards, were within the required permit limits [NJDEP08, PPPL09a, 10e]

Exhibit 4-1. NJPDES Monthly Discharge Monitoring Report (DMR)

Parameter (1)	Location	Permit Limit	Loading	Frequency/ Type
Temperature º C	DSN001	30		Monthly / Grab
pH, S. U.	DSN001, DSN003	Min.: 6.0, Max.: 9.0		Monthly / Grab
Chemical Oxygen Demand (COD), mg/l	DSN001	50		Monthly / Grab
Total Suspended Solids (TSS), mg/l	DSN001 DSN003, C1	50 NA		Monthly / Grab
Petroleum Hydrocarbons (TPHC), mg/l	DSN001 DSN003	Daily max: 10 Monthly avg: 10 Daily max: 15		Monthly / Grab
Flow, MGD	DSN001 DSN003	NA NA	✓	Monthly/ Flow Meter
Chlorine Produced Oxidants (CPO),mg/l	DSN001, DSN003	<0.1	✓	Monthly / Grab
Phosphorus, total mg/L (2)	DSN001	NA	✓	Monthly / Grab
Tetrachloroethylene (PCE), µg/L (3)	DSN001	NA	✓	Monthly / Grab
Total Organic Carbon, mg/L	DSN001, DSN003	NA		Monthly / Grab
Nitrogen, total, mg/L	DSN001	NA	✓	Quarterly

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 the 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 0.7 µg/L.

Exhibit 4-2. NJPDES Reporting Requirements

Parameter	Location	Completed	Frequency/ Type
Acute Whole Effluent Toxicity	DSN003	March 20, 2010	4 – 4.5 Years
Chronic Toxicity (% Effluent)	DSN001	March 5, 2009 May 25, 2010	Annual
Waste Characterization Report (WCR)	DSN001	March 9, 2009 May 25, 2010	Annual
Waste Characterization Report (WCR)	DSN003	March 17, 2010	4 – 4.5 Years

D. Waste Characterization Report (WCR)

Waste Characterization Reports (WCR) are required by NJPDES Permit for monitoring effluent conditions. For DSN001, WCR reports are required annually; DSN003 WCR reports are once per permit cycle, the same schedule as acute toxicity test [NJDEP08]. PPPL completed DSN001 Annual WCR on March 5, 2009, and May 25, 2010 [PPPL09g & 10l]. DSN003 was completed on March 17, 2010 [PPPL10m]. As shown in Tables 24A and 24B, a few parameters were found above the detection levels; none of those parameters have permit limits and are reported values only.

4.1.2 LSI- Lined Surface Impoundment Permit

In compliance with NJDEP Ground Water General Permit No. NJ0142051, PPPL is permitted to operate Lined Surface Impoundment (LSI) under NJG0086029 P.I ID#:47029 dated February 26, 2009. The LSI Permit also authorizes PPPL to discharge from our lined detention basin outlet to surface water Bee Brook in Plainsboro, NJ [NJDEP09].

Exhibit 4-3. PPPL Detention Basin

An estimated total of 83.2 and 67.6 million gallons of water were discharged from the retention basin in 2009 and 2010, respectively (Fin09& 10).

Water flowing through the retention basin includes site storm water, groundwater sump pumps, rainwater, non-contact cooling water, 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 DMR.

2009 Basin Maintenance:

- 3rd Oil Sensor Installed
- Annual Oil Sensor Calibration
- Basin Cleaning May 2009
- Triennial liner inspection & repairs for LSI Permit

4.1.3 Ground Water

A. NJPDES Ground Water Program

As discussed in Chapter 6, "Site Hydrology, Ground Water and Public Drinking Water Protection," the volatile organic compounds (VOCs) detected in the ground water monitoring wells adjacent to the basin are not believed to originate from the detention basin, but rather are the result of historical contamination in the Former Annex Building Area (FABA).

B. Regional Ground Water Monitoring Program

PPPL's *Remedial Investigation and Remedial Action Selection Report (RI & RASR)* was approved by NJDEP in 2000 [PPPL00a]. The Remedial Action Work Plan (RAWP) was approved NJDEP in June 2000 [PPPL00b]. The process of natural attenuation by the indigenous bacteria and other *in-situ* processes are slowly degrading PCE to its daughter species. 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 [PPPL09 and PPPL10].

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 15.57 and 7.65 million gallons in 2009-2010 (Exhibits 4-4 & 4-5) [Pin12]. The dramatic increase of potable water for 2009 is attributed to potable water being the sole source of water to the site due to the non potable water meter out of service.

PPPL uses potable water as a backup resource for fire protection. Reductions in water consumption can be noted by upgrades and retrofitted equipment.

Exhibit 4-4. PPPL Potable Water Use from NJ American Water Co.
[Pin12]

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

Exhibit 4-5. PPPL Non-Potable Water Use from Delaware & Raritan Canal
[Pin12]

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

B. Process (Non-potable) Water

Delaware & Raritan (D&R) Canal non-potable water is used for fire protection and process cooling via Physical Cross-Connection Permit 0826-WPC100001. 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]

In 2009 PPPL did not pump water from the D&R Canal due to a failed meter. PPPL used all potable water for its fire protection and process cooling needs [Pin12].

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 (Tables 18A & 18B). 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. Tables 12A and 12B summarize results of water quality analysis 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 (potable water supplier-E1), Delaware & Raritan Canal (C1), Millstone River (M1), and Plainsboro (P1 & P2) sampling points (Tables 10A -16A and 10B - 16B)—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 LEC tanks on D-Site. PPPL continued to collect radioactive Tritium samples and non-radioactive data (pH and temperature) during 2009-2010 (Tables 8A & 8B).

For 2009-2010, PPPL estimated a total annual sanitary sewage discharge of 19.08 and 22.99 million gallons, respectively, to the South Brunswick sewerage treatment plant [Pin12**].**

4.2 Non-Radiological Waste Programs

4.2.1 Hazardous Waste Programs

A. Herbicides and Fertilizers

During 2009 and 2010, PPPL's M&O Division managed the use of herbicides by outside contractors (Exhibit 4-6). These materials are applied in accordance with state and federal 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 [Kin10a&10b].

Exhibit 4-6. 2009-2010 Fertilizer and Herbicide

Type of Material	Name of Material	Registered EPA No.	2009 Applied	2010 Applied
Fertilizer	Signature Brand 24-5-11 SIG 40SCU	**900-031**	1,500 lbs	
Fertilizer	19-4-6 w/ .15% Dimension	**10404-85**		1481 lbs
Herbicide	Q4 Turf Herbicide	**2217-886**	5 gallons	
Herbicide	Lesco 3 Way	**10404-43**		370 gallons
Herbicide	Roundup	**524-475**	750 gallon	
Herbicide	Roundup	**524-536**		87 gallons

B. TSCA - Polychlorinated Biphenyls (PCBs)

PPPL shipped in 2009-2010 - 417 pounds and 357 pounds, respectively, of PCB TSCA Hazardous Substances. [Pue10&11].

C. Hazardous Wastes

PPPL did not submitted the Hazardous Waste Generator Annual Report to the NJDEP for 2009-2010. Hazardous waste generation did not exceed the quantity threshold during that time period. A description of Resource Conservation and Recovery Act (RCRA) compliance is found in Exhibit 2-1 of this report.

PPPL investigates 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.

D. Recycled Hazardous Waste

Exhibit 4-7. 2009-2010 Hazardous Recycled Material

Recycled Hazardous Waste	2009 (lbs)	2010 (lbs)
Batteries	1476	2540
Fluorescent Bulbs-Mercury	1250	1865
Ballasts	256	
Oil	12,648	
Misc.	1169	34
Total Pounds Recycled	**16,799**	**4,439**
Tons/Metric tons	**8.40/7.64**	**2.22/2.02**

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 4-7 above. Oil and other oily debris usually indicates that a spill clean-up occurred; fluorescent bulbs are replaced and crushed prior to recycling; and batteries are a more typical waste that are recycled each year.

4.3 Environmental Prevention Programs

4.3.1 Release Programs

A. Spill Prevention Control and Countermeasure

PPPL maintains a Spill Prevention Control and Countermeasure Plan (SPCC), which was updated in June 2009 and April 2010. 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 Services Division (ESD) completes a review every year to make any minor changes required to the SPCC [PPPL10h].

B. CERCLA - Continuous Release Reporting

Under CERCLA's 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.

C. 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) 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 by March 1st in 2009 and 2010 [PPPL10a&11a]. No significant changes from the previous year were noted. The SARA Title III reports included information about twelve compounds used at PPPL as listed in Exhibit 4-8 and 4-9.

Exhibit 4-8. 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)
TRI – Toxic Release Inventory

Exhibit 4-9. 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
Bromotrifluoromethane (Halon 1301)	Sudden release of pressure & Acute health effects	**Nitrogen**	Sudden release of pressure
Carbon dioxide	Sudden release of pressure & Reactive	**Propane**	Sudden release of pressure
Diesel Fuel Oil	Fire	**Petroleum Oil**	Fire
Gasoline	Fire & Chronic Health Hazard	**Sulfur Hexafluoride**	Sudden release of pressure
Helium	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 2009 or 2010.

4.3.2 Environmental Releases

No unplanned release of petroleum substances in 2009 and 2010.

4.3.3 Pollution Prevention Program

In 2009-2010, 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.

PPPL employs a number of "green building practices" that include purchasing "green-sustainable" products when renovating offices and other laboratory spaces. From the building automation system (BAS) to Energy Star® equipment and products/lighting fixtures, flooring tiles to carpet squares, low VOC-paints to other types of recycled wall coverings, PPPL actively pursues the use of these types of green products and practices, wherever possible.

In FY 2009 and 2010, PPPL's office recycling rate was 48.5% and 51%, respectively; these rate reflects 72 tons (65.5 MT) and 79 tons (71.9 MT) of municipal solid waste (MSW) that were landfill-avoided. The DOE goal of 45% recycle *versus* disposal rate was met and accomplished by active participation of Laboratory employees. PPPL's FY 2009 and 2010 rate for recycling of construction materials - wood, concrete, roofing stone ballast metals, asphalt - was 72% and 93%, respectively.

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. The total quantity for September collected and sent to the composting facility instead of going to a landfill was 2,330 pounds, ~1.2 tons (1 MT). PPPL intends to increase this amount by replacing non-compostable products (cups, forks, knives, spoons, food containers) with compostable ones and expand the number of locations across the laboratory. Zero waste events are encouraged for all meetings, colloquiums, and other events where refreshments are offered at PPPL.

4.4 Non-Radiological Emissions Monitoring Programs

Air Permits

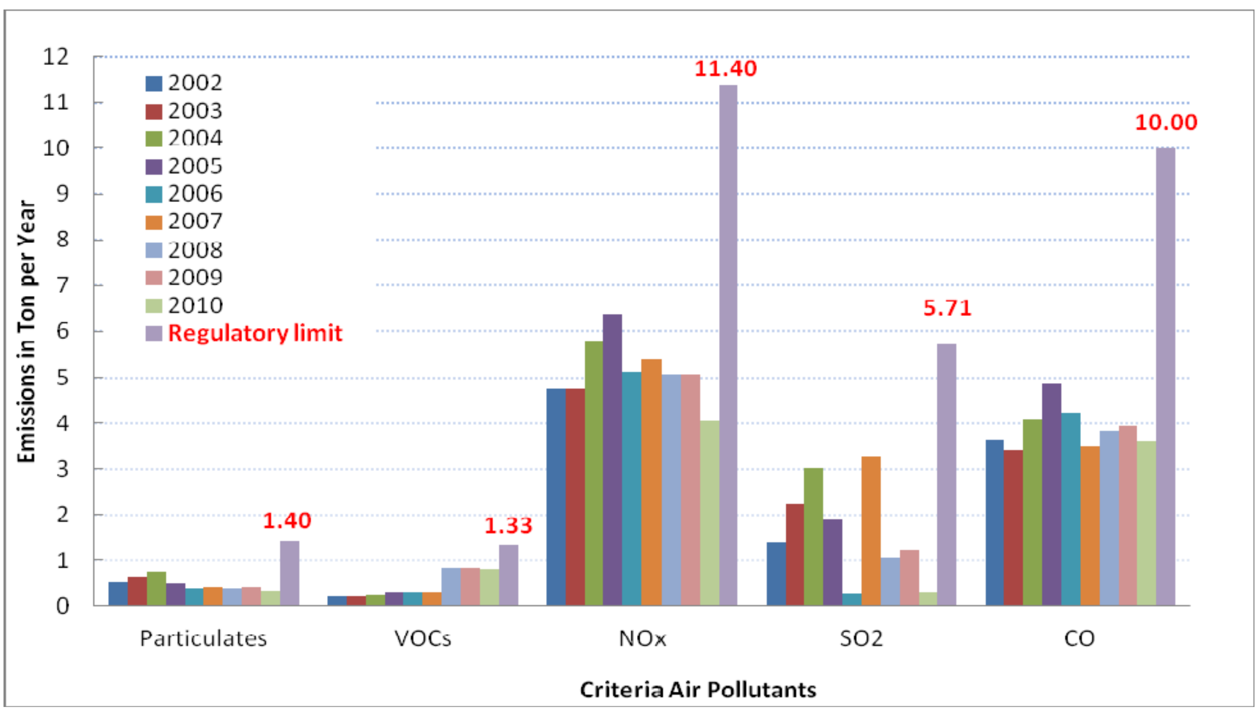
PPPL maintains New Jersey Department of Environmental Protection (NJDEP) air permits/certificates for the equipment as listed in Exhibit 4-10. PPPL is classified as a synthetic-minor facility and does not exceed the Potential to Emit (PTE) limits for any of the Criteria Air Pollutants.

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 (PJM – electric-power grid controllers) and posted on the PJM internet website under the "emergency procedures" menu.

Exhibit 4-10. PPPL's Air-Permitted Equipment

Type of Air Permit	Qty	Location	Requirements
Dust collectors	2	M&O woodworking shop CAS metalworking area	Operate at 99% efficiency Cancelled in 2010
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 M&O	Annual emission testing same quarter each year; annual emission calculations based on hours of operations (Ex.4-11); rolling 12-month calendar total fuel consumed by boiler and fuel type (Tables 9A&9B) [McG10 & 11]. 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 4-11. PPPL's Boiler Emissions from 2002- 2010 vs. Regulatory Limits



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 2009-2010 (Exhibit 4-11 & Table 9A). With the installation of high-efficiency, lower nitrogen oxide (NO_x) burners, the NO_x emissions are being further reduced.

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. No construction or alterations to existing vegetation can commence without state notification. Freshwater line verifications must be present on all suture 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 and is valid for 3.5 years after issued date. PPPL continued to reduce the grassed acreage that required mowing and other maintenance by planting native meadow grasses that are allowed to grow tall [PPPL09f].

4.6 Safety

PPPL's 2009 and 2010 performance with respect to worker safety was as follows [DOE99a, Lev10 & 11]:

Exhibit 4-12. PPPL's Safety Performance 2009-2010

	Total recordable case rate[1]	Days away, restricted transferred (DART) case rate[1]	or DART day rate[1]
2009	1.57	0.45	17.26
2010	1.48	0.85	44.87
	Number of radioactive contaminations (external)	**Number of Safety Occurrence confined exposure and lock incidents**	**reports OSHA space, chemical out/tag out**
2009	0	0	
2010	0	0	

[1] Per 200,000 hours worked

Chapter

5

ENVIRONMENTAL RADIOLOGICAL PROGRAM INFORMATION

5.1 Radiological Emissions and Doses

For 2009, 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. Exhibit 5-2 summarizes the 2010 emissions and doses from D-site operations. The calculated EDEs at the site boundary are less than two-hundredths and 1.4-hundredths of one mrem for 2009 and 2010, far below the annual limit of 10 mrem per year [Lev12a & 12b].

Exhibit 5-1. Summary of 2009 Emissions and Doses from D-Site Operations

Radionuclide & Pathway	Source	Source Term Curies (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 6.1812 Ci (2.29 x 10^{11}Bq) HT 0.1818 Ci (6.73 x 10^{9}Bq)	0.0161 (1.61 x 10^{-4})	87.4	0.1285 (1.28 x 10^{-3})
Tritium (water)	LEC tank	0.082 Ci (HTO) (3.03 x 10^{9} Bq)	0.00164 (1.64 x 10^{-5})	8.9	0.00225 (2.25 x 10^{-5})
Tritium(water)	Surface Ground	294 pCi/L (Devil's Brook) 532 pCi/L (Air shaft sump)	6.6 10-^{4} (6.6 x 10^{-6})	3.6	6.09 10^{-4} (6.09 x 10^{-6})
Direct/Scattered neutron & Gamma Radiation	NSTX	8.88 x 10^{16} DD neutrons	8.88 10^{-5} (8.88 x 10^{-7})	0.48	Negligible
Argon-41 (Air)	NSTX	7.8 10^{-4} (2.89 x 10^{7}Bq)	9.4 10^{-6} (9.4 x 10^{-8})	0.05	1.67 10^{-5} (1.67 x 10^{-7})
Total			**1.84 10-2 (1.84 x 10^{-4}mSv)**		**1.31 10^{-1} (1.31 x 10^{-3})**

[Lev12a & Rul12a]

Bq = Bequerel; mSv = milli Sievert; EDE = effective dose equivalent; TW= test well
HT = elemental tritium; HTO = tritium oxide; LEC = liquid effluent collection tanks; DD=deuterium-deuterium
mrem = milli radiation equivalent man; RWHF = Radioactive Waste Handling Facility- Compactor & vial crusher

Estimated dose equivalent at the nearest business is 4.53 10-3 mrem (4.53 x 10^{-5} mSv) due to tritium air emissions from the D-site stack, Ar-41 air emissions from the NSTX Test Cell (from neutron activation of air from NSTX operations), and direct/scattered neutron and gamma radiation from NSTX operations.

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.

Annual limit is 10 mrem/year; background is about 360 mrem/year.

Half life of tritium (HTO & HT) is 12.3 years.

Exhibit 5-2. Summary of 2010 Emissions and Doses from D-Site Operations

Radionuclide & Pathway	Source	Source Term Curies (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 5.2423 (1.94 x10^{11}) HT 0.3098 (1.15 x 10^{10})	1.36 10^{-2}) (1.36 x 10^{-4})	67.4	0.112 (1.12 x 10^{-3})
Tritium (water)	LEC tank	HTO 0.317 (1.17 x 1010	6.3 10^{-3} (6.3 x 10^{-5})	31.35	8.7 10^{-3} (8.7 x 10^{-5})
Tritium (water)	Surface Ground	216 pCi/L (DSN001) 567 pCi/L (MG sump)	1.56 10^{-4} (1.56 x 10^{-6})	0.7	1.89 10^{-4} (1.89 x 10^{-6})
Direct/Scattered neutron & Gamma Radiation	NSTX	1.6 X10^{17} DD neutrons	1.6 10^{-4}) (1.6 x 10^{-6})	0.79	Negligible
Argon-41 (Air)	NSTX	1.41 10-3 (5.2 x 10^{7})	1.7 10^{-5} (1.7 x 10^{-7})	0.08	3.0 10^{-5} (3.0 x 10^{-7})
Total			**2.0 10^{-2} (3) (2.0 x 10^{-4})**		0.121 (3) (1.21 x 10^{-3})

[Lev12a & Rul12a]

Bq = Bequerel mSv = milli Sievert EDE = effective dose equivalent TW= test well
HT = elemental tritium HTO = tritium oxide LEC = liquid effluent collection tanks DD=deuterium-deuterium
mrem = milli radiation equivalent man RWHF = Radioactive Waste Handling Facility- Compactor & vial crusher
NSTX = National Spherical Torus Experiment

Estimated dose equivalent (EDE)at the nearest business 3.87 10-3 mrem (3.87 x 10^{-5} mSv) due to tritium air emissions from the D-site stack, Ar-41 air emissions from the NSTX Test Cell (from neutron activation of air from NSTX operations), and direct/scattered neutron and gamma radiation from NSTX operations

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.

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 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 all 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.

5.1.1 Penetrating Radiation

The NSTX conducted experiments during 2009 that generated neutron and gamma radiation. Experimental shots were conducted using neutral beam injection, which generated deuterium-deuterium (D-D) million electron volts (MeV) neutrons. Gamma and x-ray radiation generated in the range of 0-10 MeV during NSTX experiments contributed to the 2009 and 2010 total penetrating radiation dose at the site boundary of 8.88×10^{-5} mrem from D-D neutrons and 1.6×10^{-4} mrem from D-D neutrons, respectively. NSTX deuterium-tritium (D-T) neutron generation is very small, and no longer tracked [Lev10, 11].

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 2009 and 2010 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 (2×10^6pCi/liter for tritium).

As shown in Exhibits 5-3 and 5-4, the 2009 and 2010 total amount of tritium released to the sanitary sewer were 0.082 and 0.317 Curies, respectively, less than 32 percent of the allowable 1.0-Curie per year limit. In Table 10A and 10B, the gross beta activity is reported; the gross beta activity ranges from <1680 pCi/L for 2009 and <9170 pCi/L for 2010. A slight increase in readings from previous years can be attributed to Neutral Beam experiment cleaning and NSTX upgrade.

Exhibit 5-3.
Annual Releases to Sanitary System from Liquid Effluent Collection Tanks 1994-2010

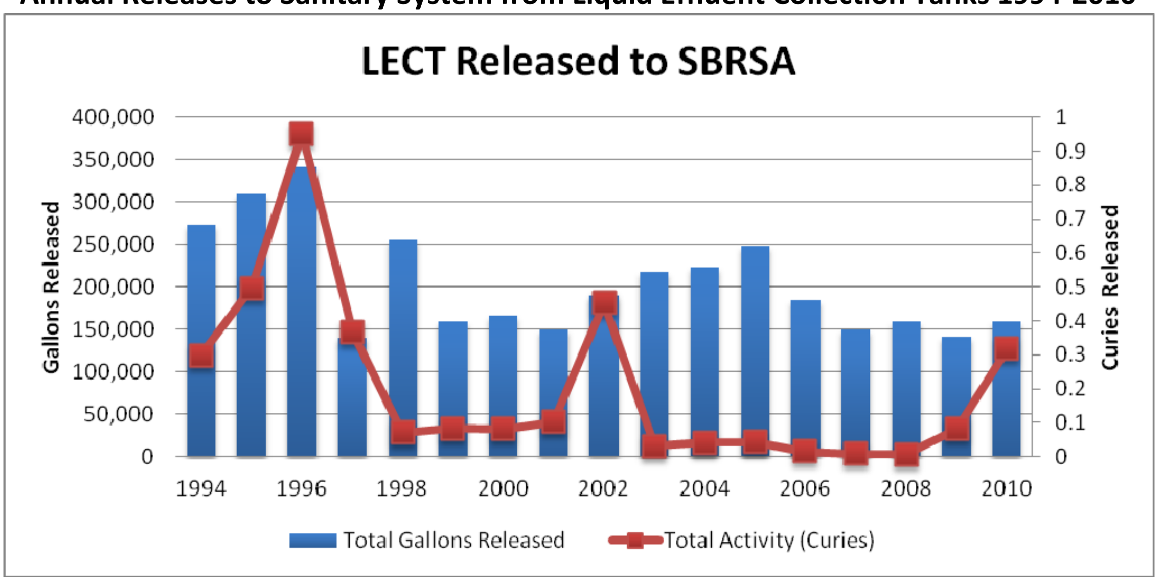


Exhibit 5-4.
Total Annual Releases (LEC tanks) to Sanitary System from 1994 to 2010

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

Exhibit 5-5.
Total Low-Level Radioactive Waste from 1997-2010

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})

5.1.3 Radioactive Waste

Exhibit 5-6. B-box with Liner in RWHF for Shipping Radioactive Waste to NTS

In 2009-2010, low-level radioactive wastes were stored on-site in the Radioactive Waste Handling Facility (RWHF) prior to off-site disposal (Exhibit 5-5).

PPPL made one shipment of low-level radiotactive wast to Neveda Test Site (NTS) for burial 2010. Radioactive waste was not shipped during CY 2009. The wastes are packaged for shipment and disposal in Type-B metal containers, refered to as "B-boxes" (Exhibit 5-6). PPPL maintains a detailed waste profile for each type of low-level waste shipped to NTS. Periodically, NTS audits PPPL's radioactive waste program, which includes employee training, waste characterization, waste packaging, quality control, and records retention. At a minimum, an internal QA review of the waste program is performed to ensure compliance with NTS requirements.

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 (Tables 3A, 3B, and Exhibit 3-8). Projected dose equivalent at the nearest off-site business from airborne emissions of tritium was 0.0045 mrem/year (0.045 μSv/year) in 2009 and 0.0038 mrem/year (0.038 μSv/year) in 2010.

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 2009 and 2010 (Exhibits 5-1 & 5-2).

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 dpm/100 cm^2. No activated or contaminated materials were free-released in 2009 or 2010. All materials were either reused in controlled environments or properly disposed.

5.3 Protection of Biota

The highest measured concentrations of tritium in surface, ground, or rainwater in 2009 was 532 pCi/L (Air shaft sump in Janaury in Table 5A) and for 2010 567 pCi/L (Groundwater D-Site MG Sump in August 2010, on Table 5B). This concentration is a small fraction of the water biota concentration guide (BCG) (for HTO) of 3×10^8 pCi/L for aquatic system evaluations, and the water BCG (for HTO) of 2×10^8 pCi/L for terrestrial system evaluations, per DOE Standard STD-1153-2002, "A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota" [Lev12a & 12b].

5.4 Unplanned Releases

There were no unplanned radiological releases in 2009 or 2010.

5.5 Environmental Radiological Monitoring

5.5.1 Waterborne Radioactivity

A. Surface Water

Surface-water samples at nine locations (two on-site: DSN001, and E1; and seven off-site: B1, B2, C1, DSN003, M1, P1, and P2) have been analyzed for tritium (Tables 4A & 4B).

In November 2009, at on-site location, P2 Devil's Brook, the tritium concentration was detected at 294 pCi/L, which was the highest for surface water samples (Table 4A). In August 2010, at the basin (DSN001)) the tritium concentration was 200 pCi/L, which was the highest surface water HTO concentration (Table 4B).

Rain water samples, which will eventually reach surface waters, were collected and analyzed and ranged from below detection to 375 pCi/L in 2009 (Table 6A) and 469 pCi/L in 2010 (Table 6B). With the end of TFTR D&D project in September 2002, the decrease in rain, surface, and ground water tritium concentrations have mirrored the decreased tritium emissions measured at the D-site stack.

Based on this data and associated literature [Jo74, Mu77, Mu82, Mu90], it is believed that the observed increase in tritium concentrations in rain water is due to washout by precipitation of a portion of the tritium released from the D-site stack. Monitoring of tritium concentrations in rain water continues.

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 2009 and 2010 weekly rainfall amounts are shown on Tables 2A & 2B. Based on the average rainfall, a comparison of dry or wet years shows that 2009 was slightly wetter than average year, 47.1 inches (119.6 cm), and 2010 was a drier year, 40.8 inches (103.6 cm) when compared with 46.5 average inches (118.1 cm) (Tables 7A &7B).

B. Ground Water

In August 1995, PPPL began to monitor tritium levels in on-site ground water more intensely. This increase in ground water monitoring was prompted by the slight increase in tritium levels in well TW-1. An investigation into the potential sources began in the Fall of 1995. Leak tests and checks of lines and equipment in the area near TW-1 (north side of D-site) were performed; none were found to be leaking tritiated water into the ground water.

In January 2009, the highest concentration of tritium was found in Air Shaft Sump at 532 pCi/L, one tenth of the previous years highest concentration (June 2008, 5,473 pCi/L). In November 2010, the D-site MG sump had the highest concentration of tritium at 567 pCi/L (Tables 5A & 5B). 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 not tested for tritium in 2009 or 2010 because extensive prior monitoring indicated downward trends with the decreasing releases of tritium from D-Site operations. Ground water monitoring was resumed in early 2011 based on increased stack releases do to ongoing neutral beam cleaning in preparation for the NSTX upgrade project.

From 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 venting of tritium from the D-site stack and the resulting "wash-out" during precipitation. Ground water monitoring of the wells and the foundation sump (dewatering sump for D-site buildings) will continue.

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 was established (E1 location) to provide baseline data for water coming onto the site. Radiological analysis has included gamma spectroscopy and tritium-concentration determination. In 2009 and 2010, tritium concentrations at this location were less than the lower limit of detection (Tables 4A & 4B).

5.5.2 Foodstuffs, Soil, and Vegetation

There were no foodstuffs, soil, or vegetation samples gathered for analysis in 2009 or 2010. 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

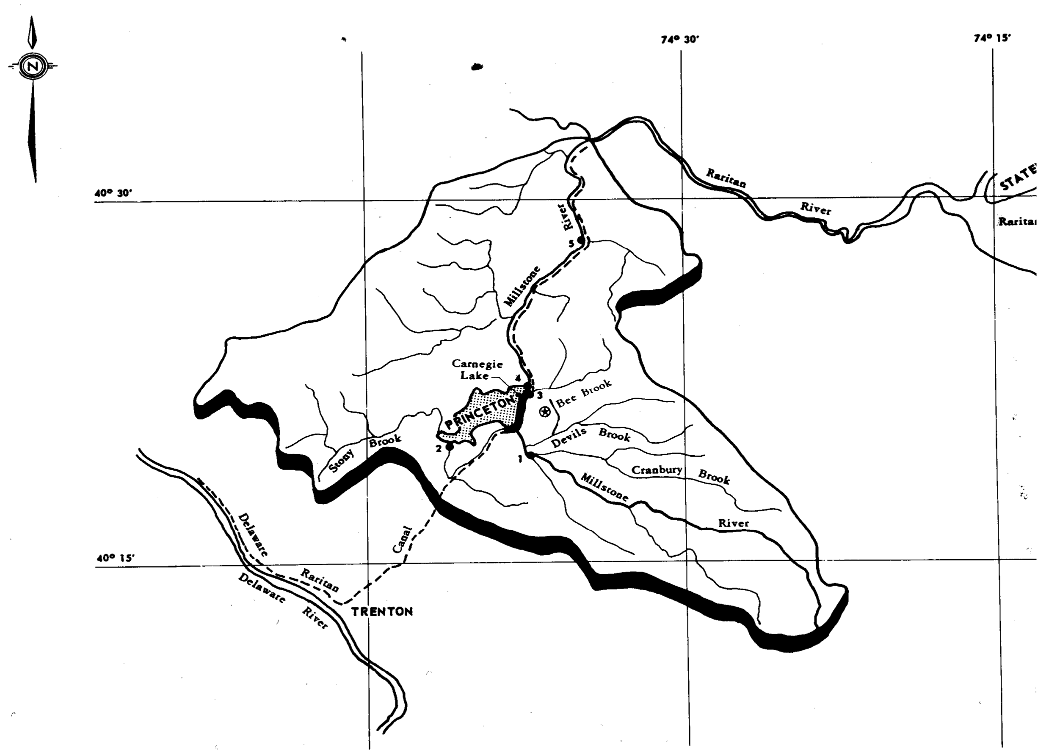
SITE HYDROLOGY, GROUND WATER, AND DRINKING WATER PROTECTION

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 then 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 along the southern boundary. The low-lying topography of the Millstone River drainage reflects the glacial origins of the surface soils; sandy loams with varying percents of clay predominate.

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

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

In the slightly higher elevations (above 70 feet), the sandy loams are better drained and belong to the Sassafras series. 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.

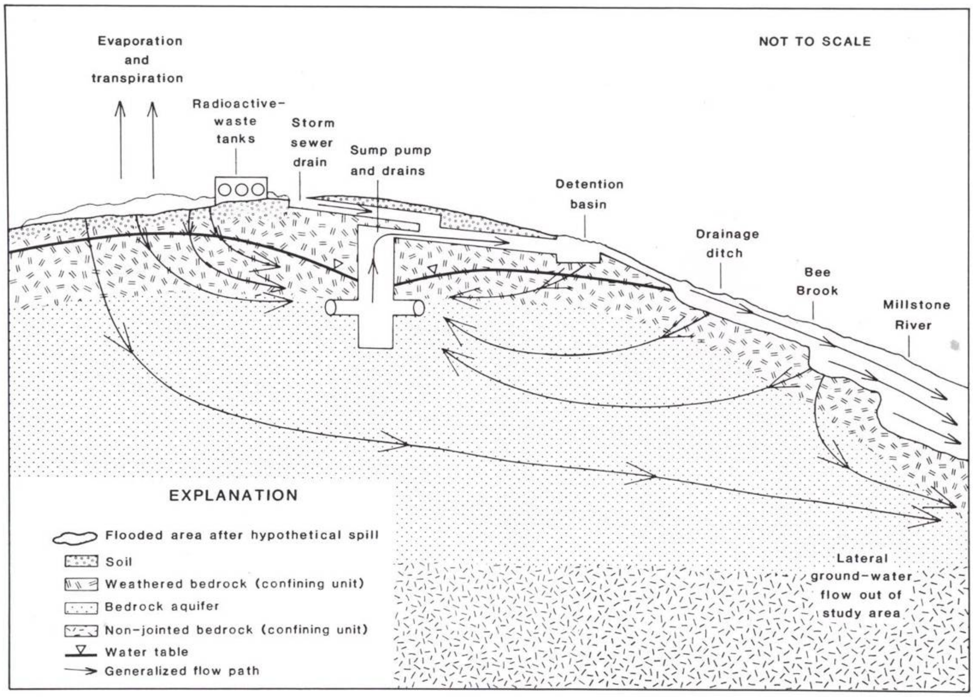
The under-story of the wooded areas is partially open with isolated patches of shrubs, vines, and saplings occurring mostly in the uplands area. The poorly drained areas have a low ground cover of ferns, grasses, and leaf litter.

6.4 Flood Plain

All of PPPL's storm water runoff flows to Bee Brook, either directly *via* the 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, which excludes wetlands – 18 acres of the 88.5 acres [PPPL09h & SE96].

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



Also, the 500-year flood plain elevation (85 ft above 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 retention 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 installed a total of 44 wells to monitor ground-water quality under various regulatory programs (Exhibit 6-3). 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 [PPPL99b & c]. A Remedial Action Work Plan (RAWP) was approved by NJDEP in which ground water monitoring continues as part of the selected remedy [PPPL00].

Exhibit 6-3. 2009-2010 Monitoring Wells

	Remedial Action Monitoring Well (MW)	Environmental Surveillance (TW)
Active Wells Monitored On-Site	18	10
Active Wells Monitored Off-Site	0	0
Number of Wells Sampled	15	-
Sampling Rounds Completed	7	-

Exhibit 6-4. Groundwater Contamination

Ranges of Results for Positive Detections				
	2009 Wells	**2010 Wells**	**2009 Sumps**	**2010 Sumps**
Tritium (pCu/L)	-	-	Bkg – 213.5	Bkg - 567.1
PCE (µg/L)	ND – 171.0	ND – 107.0	3.20 – 28.6	1.67 – 34.9
TCE (µg/L)	ND - 7.85	ND - 4.92	ND – 3.45	ND – 3.88

Note: ND- Not Detected; Bkg: Radiations 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 can be seen 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 (Exhibits 6-8). 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

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

[EPA99 & PPPL09j & 10b]

C. 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 and is currently being implemented [HLA97, HLA98, Sh00, Sh01, Sh03].

In January 2002 an Aquifer Classification Exception Area (CEA) Request 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 2009 with submittal of a Biennial Remedial Action and Ground Water Classification Exception Area Recertification Report (PPPL09i).

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 2009-2010 Events include:

- Quarterly sampling in March 2009, June 2009, September 2009, December 2009, March 2010, June 2010, and December 2010.
- Drought conditions prevented quarterly ground water sampling in September 2010.
- A long-term groundwater level monitoring study was conducted to evaluated seasonal fluctuations in ground water flow patterns.
- Bladder pumps and monitoring well casings were refurbished as necessary.

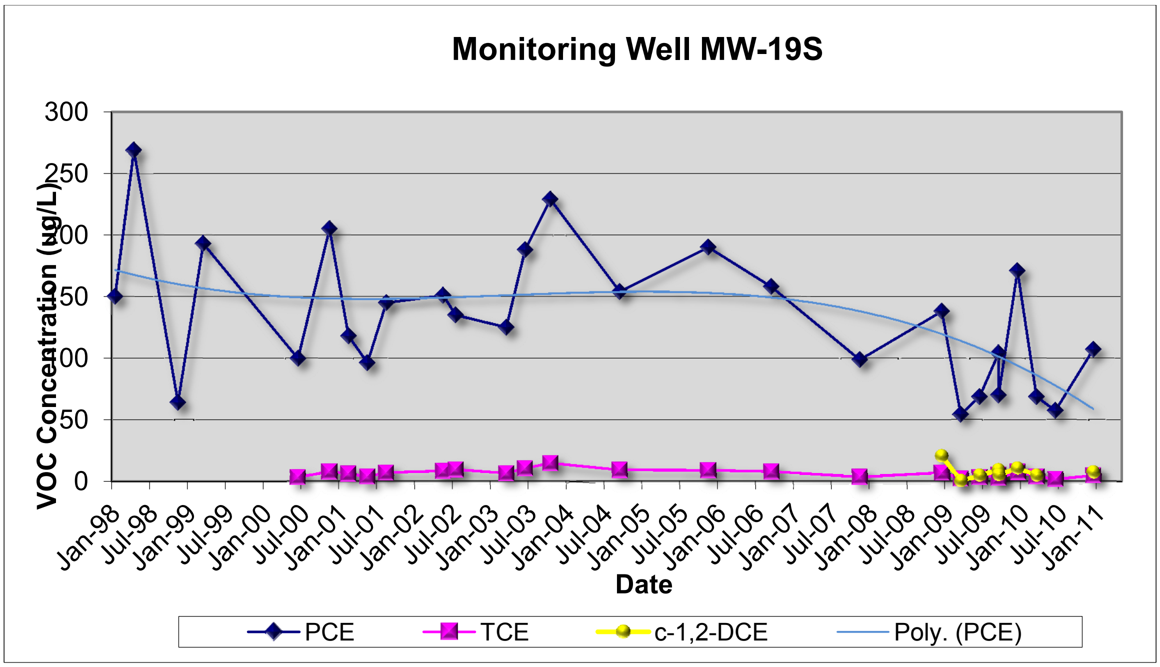
D. Monitored Natural Attenuation

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 (Tables 19-22A & 19-21B).

Natural attenuation processes are active as evidenced by presence of degradation compounds in ground water down gradient of source area (Tables 19-22A & 19-21B). 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 [PPPL11b, Sh06, Sh07, SH08 & Sh09].

Review and examination of the analytical results indicate that contaminant concentrations, particularly PCE, are generally 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 (Exhibit 6-7 & 6-9). 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[PPPL11b].

Exhibit 6-7 PCE Concentration vs. Time at MW-19S (1998-2010)



6.6 Drinking Water Protection

USGS Results from TW-10

In October 2010,the US Geological Survey(USGS) collected a ground water sample from TW-10 as part of a drinking water quality study for NJDEP. TW-10 or Test well 10 is located on D-site and is the deepest of the monitoring wells on-site. The parameters of interest were Gross Alpha, Radium-226 + Radium-224, manganese, and iron. The results for these parameters were all above the Primary and Secondary Drinking Standards, however, groundwater is not PPPL's potable source (Table 22B) [USGS11].

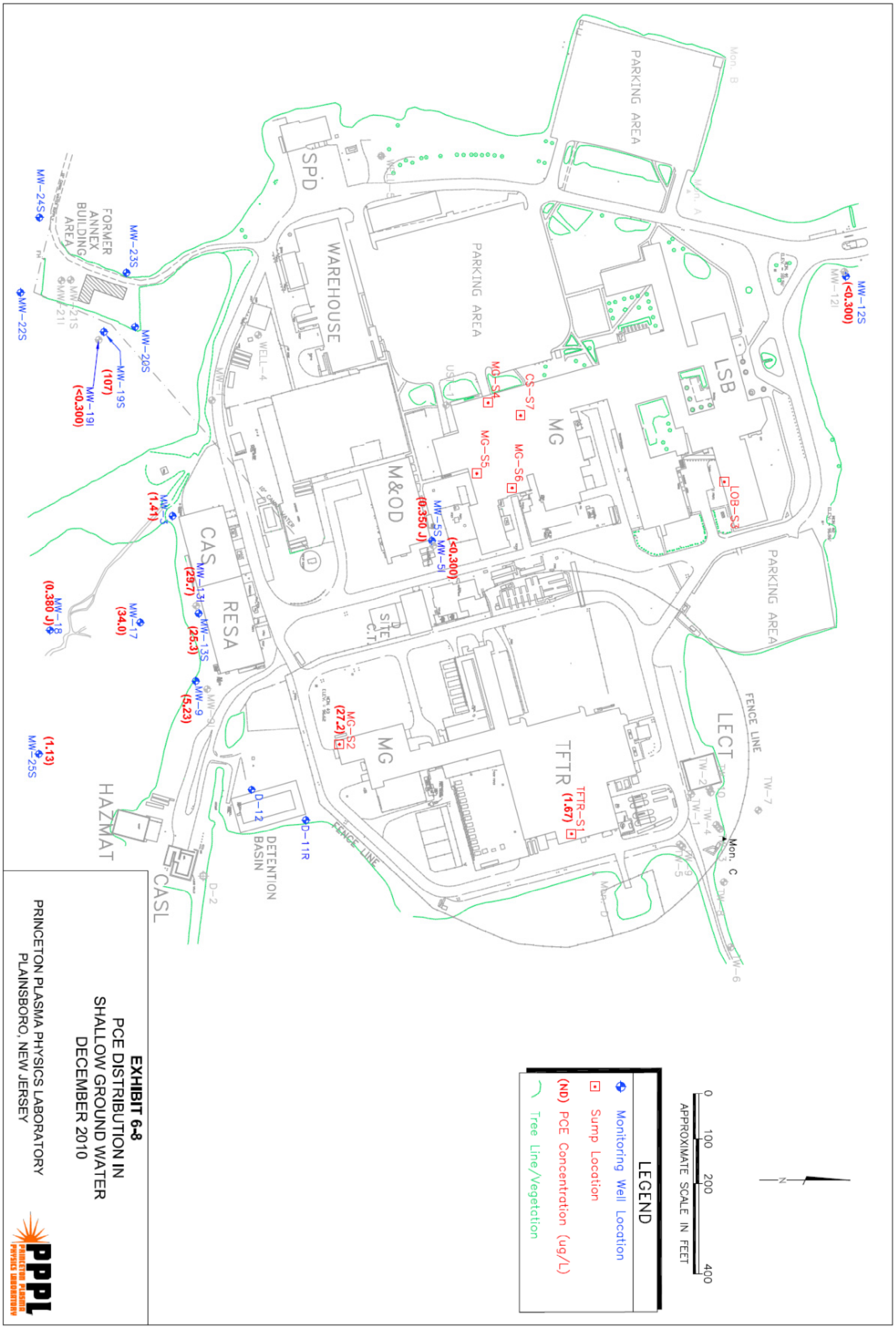


EXHIBIT 6-8
PCE DISTRIBUTION IN
SHALLOW GROUND WATER
DECEMBER 2010
PRINCETON PLASMA PHYSICS LABORATORY
PLAINSBORO, NEW JERSEY
LEGEND
Monitoring Well Location
Sump Location
(ND) PCE Concentration (ug/L)
Tree Line/Vegetation
APPROXIMATE SCALE IN FEET
0
100
200
400
PARKING AREA
SPD
WAREHOUSE
LSB
MG
M&OD
CAS
RESA
TFTR
LECT
HAZMAT
CASL
DETENTION BASIN
FENCE LINE
FORMER ANNEX BUILDING AREA
MW-12S (<0.300)
MW-19S (107)
MW-19I (<0.300)
MW-3 (1.41)
MW-5S MW-5I (0.350 J) (<0.300)
MW-13I (29.7)
MW-13S (25.3)
MW-17 (34.0)
MW-18 (0.380 J)
MW-9 (5.23)
MG-S2 (27.2)
MW-25S (1.13)
TFTR-S1 (1.67)
MW-20S
MW-22S
MW-23S
MW-24S
D-12
D-11R
MG-S4
CS-S7
MG-S5
MG-S6
LOB-S3

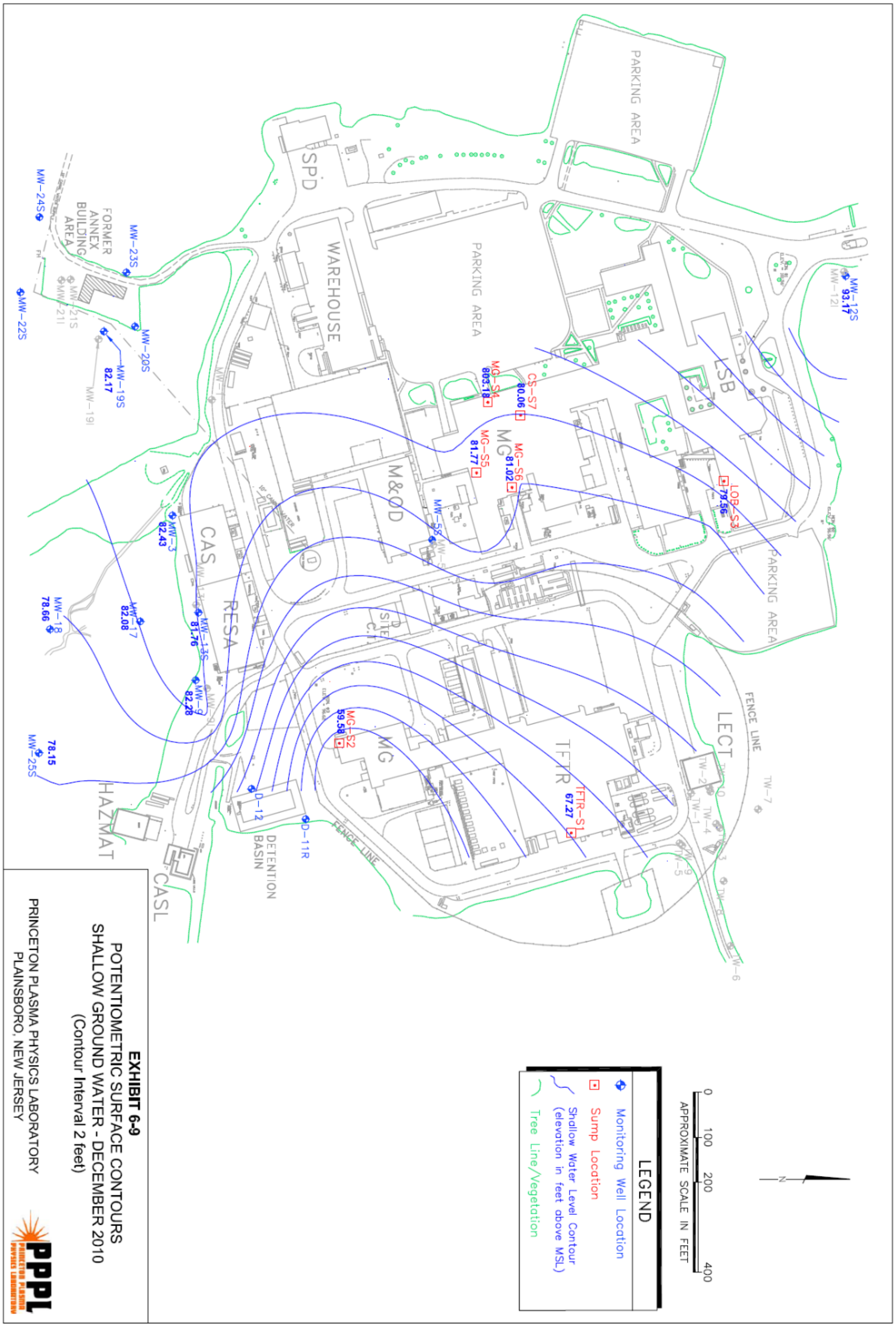


EXHIBIT 6-9
POTENTIOMETRIC SURFACE CONTOURS
SHALLOW GROUND WATER - DECEMBER 2010
(Contour Interval 2 feet)
PRINCETON PLASMA PHYSICS LABORATORY
PLAINSBORO, NEW JERSEY
LEGEND
Monitoring Well Location
Sump Location
Shallow Water Level Contour (elevation in feet above MSL)
Tree Line/Vegetation
APPROXIMATE SCALE IN FEET
0
100
200
400
N
PARKING AREA
SPD
WAREHOUSE
LSB
MG
M&OD
CAS
RESA
TFTR
LECT
HAZMAT
CASL
DETENTION BASIN
FENCE LINE
FORMER ANNEX BUILDING AREA
MW-12S 93.17
MW-12I
MG-S4 80?.18
CS-S7 80.06
MG-S5 81.77
MG-S6 81.02
LOB-S3 79.56
MW-3 82.43
MW-17 82.08
MW-18 78.66
MW-13S 81.76
MW-9 82.28
MW-19S 82.17
MW-19I
MW-20S
MW-21S
MW-21I
MW-22S
MW-23S
MW-24S
MW-25S 78.15
MG-S2 59.58
TFTR-S1 67.27
D-12
D-11R
MW-5S
TW-1
TW-2
TW-4
TW-5
TW-6
TW-7

Chapter

7

QUALITY ASSURANCE

As required by DOE Order 450.1, Environmental Protection Program, PPPL has established a QA/QC Program to ensure that the accuracy, precision, and reliability of environmental monitoring data are consistent

In 2009-2010, analyses of environmental samples for radioactivity and other 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

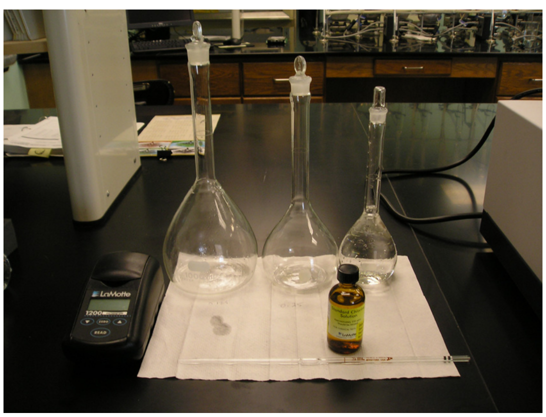


Exhibit 7-2. Distilling Samples for Tritium Analysis Performed at PEARL

The 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* [SM92] that are nationally recognized standards.

7.1 Lab Certification - Proficiency Testing

Beginning in 1984, PPPL participated in a NJDEP certification program initially through the USEPA Quality Assurance (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.

A. Radiological

To maintain its radiological certification, PPPL participates in a NIST NVLAP accredited radiochemistry proficiency testing program twice annually in both 2009-2010. Cesium uses a gamma spectroscopy technique while Tritium uses a distillation and liquid scintillation method (Exhibit 7-3) (Table 24A & 24B).

Exhibit 7-3 Radiological Certified Parameters 2009-2010

Parameter	Approved Method
Cesium 134/137	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 (Table 24A & 24B).

In Tables 22A and 22B, the radiological and non-radiological proficiency testing (PT) results show that all PEARL's results were in the acceptable range except for chemical oxygen demand (COD) in April 2009, and were subsequently dropped from PPPL's lab certification. COD is currently analyzed by a NJDEP certified subcontractor lab. Turbidity was also dropped from PPPL's laboratory certification at the end of 2010 and is no longer measured in surface water samples.

Exhibit 7-4. Non-Radiological Certified Parameters 2009-2010

Parameter	Approved Method
Specific Conductance	SM 2510 B
Chlorine	SM 4500-Cl G
Oxygen (dissolved)	SM 4500-O G
pH	SM 4500-H B
Temperature	SM 2550 B

7.2 Subcontractor Labs

PPPL followed its internal procedures, EM-OP-31—"Surface Water Sampling Procedure," and EM-OP-38—"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 2009-2010 for laboratory analysis.

7.3 Internal QA/QC

A. Internal Audit

PPPL did not participate in any internal or NJDEP state audits for PEARL operations in 2009-2010.

B. Internal QA Check

Temperature calibrations are conducted quarterly with NIST (National Institute of Standards and Technology) 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 with the set of secondary standards: Blank (0mg/L), 0.2 mg/L, 1.0 mg/L, and 2.0 mg/L Total residual chlorine.

Dissolved oxygen (DO) meter is QA checked by performting DO Titration. The Winker Titration Kit is performed against field sample of DO to check sample accuracy.

C. Calibrations

PPPL calibrates all equipment per equipment manual and following HP-LAB-03 Procedure. 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 and expiration date are all checked to ensure chemical quality for calibration.

Chapter

8

REFERENCES

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Chapter

9

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Appendix

A

TABLES for 2009

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

CONDITION		PUBLIC	EXPOSURE[(b)]	OCCUPA-TIONAL	EXPOSURE
		REGULATORY LIMIT	DESIGN OBJECTIVE	REGULATORY LIMIT	DESIGN OBJECTIVE
<u>ROUTINE OPERATION</u> 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		
<u>ACCIDENTS</u> 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 2009

START DATE	WEEK	INCH	CUM.INCHES	MONTH	MONTHLY TOTAL
6-Jan-09	**1**	0.00	0.00		
13-Jan-09	**2**		0.00		
20-Jan-09	**3**	1.49	1.49		
27-Jan-09	**4**	0.00	1.49		
3-Feb-09	**5**	**0.80**	**2.29**	**January**	**2.29**
10-Feb-09	**6**	0.10	2.39		
17-Feb-09	**7**	0.06	2.45		
24-Feb-09	**8**	0.24	2.69		
3-Mar-09	**9**	**0.00**	**2.69**	**February**	**0.40**
10-Mar-09	**10**	0.03	2.72		
17-Mar-09	**11**	0.00	2.72		
24-Mar-09	**12**	0.13	2.85		
31-Mar-09	**13**	**1.28**	**4.13**	**March**	**1.44**
7-Apr-09	**14**	1.18	5.31		
14-Apr-09	**15**	0.70	6.01		
21-Apr-09	**16**	1.42	7.43		
28-Apr-09	**17**	**0.21**	**7.64**	**April**	**3.51**
5-May-09	18	0.29	7.93		
12-May-09	**19**	3.04	10.97		
19-May-09	**20**	0.26	11.23		
26-May-09	**21**	0.63	11.86		
2-Jun-09	**22**	**0.75**	**12.61**	**May**	**4.97**
9-Jun-09	**23**	2.10	14.71		
16-Jun-09	**24**	1.23	15.94		
23-Jun-09	**25**	1.19	17.13		
30-Jun-09	**26**	**0.60**	**17.73**	**June**	**5.12**
7-Jul-09	**27**	0.22	17.95		
14-Jul-09	**28**	0.79	18.74		
21-Jul-09	**29**	0.76	19.50		
28-Jul-09	**30**	2.60	22.10		
4-Aug-09	**31**	**3.77**	**25.87**	**July**	**8.14**
11-Aug-09	**32**	0.15	26.02		
18-Aug-09	**33**	0.00	26.02		
25-Aug-09	**34**	2.79	28.81		
1-Sep-09	**35**	**2.13**	**30.94**	**August**	**5.07**
8-Sep-09	**36**	0.01	30.95		
15-Sep-09	**37**	1.33	32.28		
22-Sep-09	**38**	0.04	32.32		
29-Sep-09	**38**	**2.32**	**34.64**	**September**	**3.70**
6-Oct-09	**39**	**0.19**	**34.83**		
13-Oct-09	**40**	0.09	34.92		
20-Oct-09	**41**	1.19	36.11		
27-Oct-09	**42**	2.41	38.52		
3-Nov-09	**44**	**0.62**	**39.14**	**October**	**4.50**
10-Nov-09	**45**	0.53	39.67		
17-Nov-09	**46**	0.39	40.06		
24-Nov-09	**47**	0.79	40.85		
1-Dec-09	**48**	**0.96**	**41.81**	**November**	**2.67**
8-Dec-09	**49**	0.95	42.76		
15-Dec-09	**50**	3.12	45.88	Snow ~16”	
22-Dec-09	**51**	0.01	45.89	Snow ~2”	
29-Dec-09	**52**	2.00	**47.89**	**December**	**6.08**

Table 3. D-site Stack Tritium Releases in Curies - 2009

Week Ending	HTO (Ci)	HT (Ci)	Weekly Total (Ci)	Annual Total (Ci)
1/7/09	0.0364	0.0034	0.0398	0.0398
1/14/09	0.0528	0.0024	0.0552	0.0950
1/21/09	0.0325	0.0026	0.0351	0.1301
2/4/09	0.0205	0.0026	0.0231	0.1532
2/18/09	0.0758	0.0056	0.0814	0.2346
3/4/09	0.0714	0.0020	0.0734	0.3080
3/11/09	0.0963	0.0040	0.1003	0.4083
3/18/09	0.0840	0.0012	0.0852	0.4935
3/25/09	0.0784	0.0038	0.0822	0.5757
4/1/09	0.0640	0.0023	0.0663	0.6420
4/8/09	0.0721	0.0033	0.0754	0.7174
4/15/09	0.0677	0.0010	0.0687	0.7861
4/22/09	0.0667	0.0034	0.0701	0.8562
4/29/09	0.0926	0.0003	0.0929	0.9491
5/6/09	0.1060	0.0025	0.1085	1.0576
5/12/09	0.1470	0.0063	0.1533	1.2109
5/20/09	0.1280	0.0071	0.1351	1.3460
5/27/09	0.1580	0.0063	0.1643	1.5103
6/10/09	0.1350	0.0047	0.1397	1.6500
6/17/09	0.1730	0.0046	0.1776	1.8276
6/24/09	0.1930	0.0069	0.1999	2.0275
7/1/09	0.1530	0.0031	0.1561	2.1836
7/8/09	0.1420	0.0052	0.1472	2.3308
7/15/09	0.1400	0.0038	0.1438	2.4746
7/22/09	0.1300	0.0059	0.1359	2.6105
7/29/09	0.1660	0.0023	0.1683	2.7788
8/5/09	0.1150	0.0064	0.1214	2.9002
8/12/09	0.1250	0.0027	0.1277	3.0279
8/19/09	0.1300	0.0056	0.1356	3.1635
8/26/09	0.1500	0.0024	0.1524	3.3159
9/2/09	0.1460	0.0040	0.1500	3.4659
9/9/09	0.1260	0.0012	0.1272	3.5931
9/16/09	0.1480	0.0036	0.1516	3.7447
9/23/09	0.2170	0.0028	0.2198	3.9645
9/30/09	0.1630	0.0029	0.1659	4.1304
10/7/09	0.2040	0.0039	0.2079	4.3383
10/14/09	0.2270	0.0050	0.2320	4.5703
10/21/09	0.1350	0.0019	0.1369	4.7072
10/28/09	0.1880	0.0064	0.1944	4.9016
11/4/09	0.1890	0.0030	0.1920	5.0936
11/11/09	0.1740	0.0056	0.1796	5.2732
11/18/09	0.2270	0.0043	0.2313	5.5045
11/24/09	0.1620	0.0056	0.1676	5.6721
12/2/09	0.1380	0.0029	0.1409	5.8130
12/9/09	0.1640	0.0057	0.1697	5.9827
12/16/09	0.1350	0.0023	0.1373	6.1200
12/22/09	0.1300	0.0052	0.1352	6.2552
12/30/09	0.1060	0.0018	0.1078	6.3630
TOTAL	**6.1812**	**0.1818**		**6.3630**

Table 4. Surface Water Tritium Concentrations for 2009 (in picoCuries/Liter

Sample Location	Bee Brook (B1)	Bee Brook (B2)	Basin (DSN001)	D&R Canal (C1)	D&R Canal (DSN003)
January					
February				<132	**145**
March			<137	<134	<132
April			<137	<Bkg	<Bkg
May	<139	<Bkg	**155**	<139	
June			<Bkg		
July			<142		
August	<Bkg	<142	<142	<Bkg	
September			<152		
October			**155**		
November	**133**	**182**	**164**	**254**	
December			<118		

Sample Location	Potable Water (E1)	Millstone River (M1)	Cranbury Brook (P1)	Devil's Brook (P2)
January				
February			<146	<Bkg
March				
April				
May	<Bkg	<Bkg	<Bkg	<139
June				
July				
August	<Bkg	<142	<Bkg	<142
September				
October				
November	<Bkg	**235**	**255**	**294**
December				

BOLD indicates above the level of detection Background = Bkg

Table 5. Ground Water Tritium Concentrations for 2009 (in picoCuries/liter)

Sump Location	Jan.	Feb.	Mar.	Apr.	May	June
Air Shaft Sump	**532**	<146	**146**	<140	<142	<140
D-site MG Sump	<146	<145	**194**	<137	<142	<140
	July	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**
Air Shaft Sump	<141	<142	<152	**214**	<122	**121**
D-site MG Sump	<141	<142	<152	**178**	<122	<118

BOLD indicates highest concentrations above background (bkg) levels.

Table 6. Rain Water Tritium Concentrations (in picoCuries/liter)
Collected On-Site (R1E – R2N) and Off-Site (REAM 2-6) in 2009

250 feet From Stack	R1E (East)	R1W (West)	R1S (South)	R1N (North)	R1ND (Duplicate)
2/16/09	**210**	<146	<146	<146	<146
4/30/09	<140	<Bkg	<Bkg	<Bkg	<Bkg
5/18/09	<142	<142	<142	<142	<142
6/24/09	<142	<142	<142	<142	<142
8/13/09	<152		<152	<Bkg	
9/30/09	**144**	**246**	**177**	<140	<128
11/4/09	**375**	**263**	<122	**250**	**301**
12/8/09	**127**	<118	**212**	**156**	<118

500 feet from Stack	R2E (East)	R2W (West)	R2S (South)	R2N (North)
2/16/09	**145**		<146	<146
4/30/09	<Bkg	<Bkg	<140	<Bkg
5/18/09	<141	<142	<142	<142
6/24/09	<142	<142	<142	<142
8/13/09	<152	<152	<Bkg	<Bkg
9/30/09	<140	<140	<128	<140
11/4/09	**304**	<122	<122	**265**
12/8/09	<118	<118	**200**	<118

Offsite	REAM 1 Off-site	REAM 2 Off-site	REAM 4 Off-site	REAM 5 Off-site	REAM 6 Off-site
5/12/09		<Bkg		<Bkg	
6/19/09	<140	<140		<140	<Bkg
9/4/09	<140	<140		<140	<140
11/7/09		<Bkg	<Bkg	<122	<122
12/4/09		**175**		<122	<122

BOLD indicates highest concentrations above background (Bkg) levels.

Table 7. Annual Range of Tritium Concentration in Precipitation at PPPL from 1985 to 2009

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 (38.7 w/out Floyd)	+0.8 (-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	47.9	+1.4

Table 8. Liquid Effluent Collection Tank Release Data for 2009

Sample Date	Gallons Released	COD (mg/l)	Tritium Sample LLD (pCi/L)	Tritium Sample Activity (pCi/L)	Total Tank Activity (Ci)	Annual Cumulative Activity (Ci)	Gross Beta Sample LLD (pCi/L)	Gross Beta Sample Activity (pCi/L)
4/1/09	12,000	48	305	5,030	0.000229	0.000229	197	Bkg
5/21/09	11,400	<20	310	37,600	0.001620	0.001849	197	299
6/15/09	12,750	32	293	141,000	0.006780	0.008629	198	840
6/30/09	12,750	NS	260	288,000	0.013900	0.022529	198	1,680
7/27/09	12,450	<20	714	208,000	0.009820	0.032349	394	896
8/3/09	12,750	<20	336	16,200	0.007810	0.040159	197	838
8/11/09	13,050	NS	319	151,000	0.007460	0.047619	197	898
8/19/09	12,300	NS	284	152,000	0.007080	0.054699	198	840
8/28/09	11,700	NS	287	172,000	0.007630	0.062329	198	959
10/6/09	12,000	NS	277	170,000	0.007730	0.070000	197	1,070
12/10/09	12,750	NS	377	171,000	0.003210	0.073300	280	901
12/10-/09	4,950	NS	369	184,000	0.008760	0.082000	280	841
Total gals. released	140,850							

Table 9. Criteria Air Pollutants from Boilers 2-5 Emission 2009-2010 (tons/year)

Tons/year	Particulates	VOCs	NO_x	SO_2	CO
2002	0.53	0.24	4.75	1.39	3.63
2003	0.63	0.22	4.76	2.22	3.42
2004	0.75	0.26	5.80	3.01	4.09
2005	0.51	0.31	6.38	1.87	4.85
2006	0.39	0.31	5.11	0.28	4.21
2007	0.42	0.31	5.41	3.29	3.49
Regulatory limit	**1.8**	**0.66**	**15.26**	**9.68**	**10.23**
2008	0.40	0.83	5.06	1.06	3.82
2009	0.42	0.84	5.05	1.24	3.93
2010	0.34	0.80	4.04	0.32	3.60
Regulatory limit	**1.8**	**0.66**	**15.26**	**9.68**	**10.23**

Table 10. Surface Water Analysis for Bee Brook, B1, 2009

Location B1 = Bee Brook upstream of PPPL basin discharge

Sample Date	2/2/09	2/16/09	5/4/09	8/4/09	11/3/09
Ammonia nitrogen as N, mg/L	<0.10		<0.10	<0.10	<0.10
Biological Oxygen Demand, mg/L			<2.40	<2.00	
Chemical Oxygen Demand, mg/L	9.27	9.27	17.37	43.58,33.08	
Nitrogen, total, mg/L					0.75
Nitrate-N, mg/L	1.70		<0.50	1.78	<0.50
Oxidation-Reduction Potential, mV	25.2		- 42.5	32.5	-2.6
pH, standard units	6.37		7.54	6.09	6.65
Phosphorus, total, mg/L	<0.050		0.079	0.075	0.059
Temperature, ^{o}C	1.0		13.18	21.3	9.7
Total Suspended Solids, mg/L	2.40		4.00	34.00	4.00
Total Organic Carbon, mg/L	3.98		15.60	8.96	
Total Dissolved Solids, mg/L	483		157	326	

Table 11. Surface Water Analysis for Bee Brook, B2, in 2009

Location B2 = Bee Brook downstream of PPPL basin discharge

Sample Date	2/2/09	5/4/09	8/4/09	11/3/09
Ammonia nitrogen as N, mg/L	<0.10	<0.10	<0.10	<0.10
Biological Oxygen Demand, mg/L		<2.40	<2.00	
Chemical Oxygen Demand, mg/L	28.08	27.18	23.83, 24.21	
Nitrogen, total, mg/L				1.19
Nitrate-Nitrite, mg/L	1.34	<0.50	1.53	0.69
Oxidation-Reduction Potential, mV	-10.70	-20.40	-2.00	-35.40
pH, standard units	7.06	7.13	6.71	7.26
Phosphorus, total, mg/L	<0.05	0.079	0.081	0.059
Temperature, ^{o}C	4.6	13.53	21.6	10.9
Total Suspended Solids, mg/L	3.60	16.70	6.00	9.50
Total Organic Carbon, mg/L	2.96	13.70	14.60	
Total Dissolved Solids, mg/L	446	160	203	

Table 12. Surface Water Analysis for Delaware & Raritan Canal, C1, in 2009

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

Sample Date	2/2/09 (2/16/09)	3/19/09	4/20/09	5/4/09	8/4/09	11/3/09
Ammonia nitrogen as N, mg/L	0.24			<0.10	<0.10	<0.10
Biological Oxygen Demand, mg/L				<2.40	<2.00	
Chemical Oxygen Demand, mg/L	55.45 (<10.0)	<10.0		<10.0	8.552	
Nitrogen, total, mg/L						1.13
Nitrate -N, mg/L				0.819	0.819	
Oxidation-Reduction Potential, mV	-3.60	-12.0	-16.2	-3.00	38.60	-9.80
pH, standard units	6.92	7.00	7.07	6.82	5.99	6.79
Phosphorus, total, mg/L	0.119	<0.05	<0.05	0.084	0.123	0.059
Temperature, ^{o}C	9.60	8.60	12.53	16.93	24.90	10.90
Total Suspended Solids, mg/L	<2.00	<2.00	6.50	4.40	17.20	4.00
Total Organic Carbon, mg/L	2.29	3.19	3.90	4.82	9.82	
Total Dissolved Solids, mg/L	151			169.0	97.0	

Table 13. Surface Water Analysis for Elizabethtown Water, E1, in 2009

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

Sample Date	2/2/09	5/4/09	8/4/09	11/3/09
Ammonia nitrogen as N, mg/L	<0.10	<0.10	0.13	0.13
Biological Oxygen Demand, mg/L		<2.40	<2.00	
Chemical Oxygen Demand, mg/L	28.78	<10.0		
Nitrogen, total , mg/L				1.48
Nitrate-N, mg/L	1.74	0.913	0.66	0.98
Oxidation-Reduction Potential, mV	-10.8	-11.7	20.8	-13.5
pH, standard units	7.06	6.97	6.30	6.86
Phosphorus, total, mg/L	0.055	0.697	<0.05	0.397
Temperature, ^{o}C	14.2	15.8	22.1	16.1
Total Suspended Solids, mg/L	<2.00	<2.00	<2.00	2.00
Total Organic Carbon, mg/L	1.70	2.85	3.40	
Total Dissolved Solids, mg/L	420	309	20	

Table 14. Surface Water Analysis for Millstone River, M1, in 2009

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

Sample Date	2/2/09	5/4/09	8/4/09	11/3/09
Ammonia nitrogen as N, mg/L	0.34	0.17	0.10	0.19
Biological Oxygen Demand, mg/L		<2.40	<2.00	
Chemical Oxygen Demand, mg/L	34.05	<10.0	10.45	
Nitrogen, total, mg/L				1.94
Nitrate-N, mg/L	2.78	1.83	<0.50	1.44
Oxidation-Reduction Potential, mV	34.1	17.50	40.30	2.30
pH, standard units	6.22	6.45	5.96	6.57
Phosphorus, total, mg/L	0.119	0.105	0.193	0.121
Temperature, ^{o}C	6.9	15.8	25.1	13.1
Total Suspended Solids, mg/L	9.60	7.00	11.60	23.50
Total Organic Carbon, mg/L	3.81	6.65	9.96	
Total Dissolved Solids, mg/L	280	206	111	

Table 15. Surface Water Analysis for Cranbury Brook (Plainsboro), P1, in 2009

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

Sample Date	2/2/09	5/4/09	8/4/09	11/3/09
Ammonia nitrogen as N, mg/L	0.17	0.17	<0.10	0.10
Biological Oxygen Demand, mg/L		<2.40	<2.00	
Chemical Oxygen Demand, mg/L	23.96	<5.0	15.03	
Nitrogen, total, mg/L				1.49
Nitrate-N, mg/l	1.95	0.896	<0.50	0.99
Oxidation-Reduction Potential, mV	57.3	26.3	41.5	15.3
pH, standard units	5.79	6.28	5.94	6.32
Phosphorus, total, mg/L	0.113	0.147	0.118	0.74
Temperature, ^{o}C	7.0	15.3	25.7	12.20
Total Suspended Solids, mg/L	24.0	25.5	10.8	10.0
Total Organic Carbon, mg/L	4.07	6.87	9.85	
Total Dissolved Solids, mg/L	263	157	100	

Table 16. Surface Water Analysis for Devil's Brook (Plainsboro), P2, in 2009

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

Sample Date	2/2/09	2/16/09	5/4/09	8/4/09	11/3/09
Ammonia nitrogen as N, mg/L	0.16		<0.10	<0.10	<0.10
Biological Oxygen Demand, mg/L			<2.40	<2.00	
Chemical Oxygen Demand, mg/L	7.42	7.42	14.95	<10.0	
Nitrogen, total, mg/L					1.22
Nitrate-N, mg/l	1.45		0.56	<0.50	0.72
Oxidation-Reduction Potential, mV	86.2		36.7	53.3	22.7
pH, standard units	5.25		6.09	5.73	6.18
Phosphorus, total, mg/L	0.06		0.079	0.081	0.069
Temperature, ^{o}C	5.6		13.7	22.9	10.8
Total Suspended Solids, mg/L	4.0		5.0	5.2	5.5
Total Organic Carbon, mg/L	4.87		15.1	16.3	
Total Dissolved Solids, mg/L	151		123	89	

Table 17. DSN001 - Detention Basin Outfall Surface Water Analysis (NJPDES NJ0023922) in 2009

Permit Limit	Units	Parameters	1/5/09	2/2/09*	2/16/09	3/4/09	4/1/09	5/4/09*	6/2/09
NA	mg/L	Ammonia-N		<0.10 <0.10				<0.100	
NA	mg/L	Biological Oxygen Demand						<2.40	
50 mg/L max.	mg/L	Chemical Oxygen Demand	11.0	5.05 23.60	15.64 22.80	<5.0 <5.0	46.02	<5.0 <5.0	<5.0 <5.0
0.016	mg/L	Chlorine Produced Oxidants	<0.1	<0.1 <0.1		<0.1	<0.1 <0.1	<0.1 <0.1	<0.1 <0.1
NA	MGD	Flow, Avg. Monthly	0.347	0.274		0.257	0.197	0.222	0.424
NA	mg/L	Nitrate-Nitrite		1.15 1.18				0.782	
NA	mg/L	Nitrite as N						<0.200	
NA	mg/L	Ortho Phosphate as P						0.088	
NA	mV	Oxidation-Reduction Potential	-34.4	-22.6		-52.6	-23.2	-16.8	-104.6
10 mg/L	mg/L	Petroleum Hydrocarbons	<5.00	<5.00		<5.00	<5.00	<5.00	<5.00
6.0-9.0	S.U.	pH	7.48	7.27		8.00	7.23	7.07	8.63
NA	mg/L	Phosphorus, Reactive						0.081	
NA	mg/L	Phosphorus, Total	0.076	0.060 0.071		<0.050	0.064	0.131	0.230
NA	µg/L	Tetrachloroethylene	<0.64	<0.64		<0.64	0.91	<0.64	<0.64
30^{o}C max.	^{o}C	Temperature	11.35	10.35		5.35	13.28	15.28	20.90
NA	mg/L	Total Dissolved Solids		423 406				240.0	
NA	mg/L	Total Organic Carbon	1.32	1.23 1.10		1.41	2.03	3.94	2.42
50 mg/L	mg/L	Total Suspended Solids	<2.0	<2.0 <2.0		3.0	4.4	4.8	4.0

Table 17 continued. DSN001 - Detention Basin Outfall Surface Water Analysis (NJPDES NJ0023922) in 2009

Permit Limit	Units	Parameters	7/07/09	8/4/09*	9/1/09	10/6/09	11/3/09* 11/13/09	12/1/09
NA	mg/L	Ammonia-N		<0.1 <0.1			<0.1 0.1	
NA	mg/L	Biological Oxygen Demand		<2.00 <2.00				
50 mg/L max.	mg/L	Chemical Oxygen Demand	32.09 38.20	79.78** 77.31*	15.0	18.0	<10.0	<10.0
0.016	mg/L	Chlorine Produced Oxidants	<0.1 <0.1	<0.1 <0.1	<0.1 <0.1	<0.1 <0.1	<0.1 <0.1	<0.1 <0.1
NA	MGD	Flow, Avg. Monthly	0.1564	0.2019	0.1944	0.1824	0.1821	0.3674
NA	mg/L	Nitrate- Nitrite		1.84 2.18				
NA	mg/L	Nitrate as N					1.08	
NA	mg/L	Nitrite as N		<0.025 <0.025			<0.025	
NA	mg/L	Nitrogen, Total					1.593	
NA	mg/L	Ortho Phosphate as P		0.081 0.081				
NA	mV	Oxidation-Reduction Potential	-84.1	-39.3	-55.7	-93.7	-57.3	-54.0
10 mg/L	mg/L	Petroleum Hydrocarbons	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
6.0-9.0	S.U.	pH	8.25	7.38	7.73	8.25	7.66	7.65
NA	mg/L	Phosphorus, Reactive Dissolved		0.061 0.065				
NA	mg/L	Phosphorus, Total	0.075	0.091 0.102	0.102	0.074	<0.050	0.090
NA	µg/L	Tetrachloroethylene	<0.640	0.690 J	<0.640	<0.640	<0.640	0.670 J
30^{o} C max.	^{o}C	Temperature	20.4	23.2	19.75	16.8	14.5	12.5
NA	mg/L	Total Dissolved Solids		446 454				
NA	mg/L	Total Organic Carbon	3.46	3.79 2.36	3.98	3.76	1.10	1.76
50 mg/L	mg/L	Total Suspended Solids	2.8	4.0 2.8	2.0	<2.0	<2.0	2.4

Blank indicates no measurement

NA = not applicable NL = no limit

* DSN-001 was duplicated as DSN004

** Indicates parameter exceeded permit limit as provided in column 1.

Table 18. D&R Canal Pump House - DSN003
Monthly Surface Water Analysis (NJPDES NJ0023922) in 2009

Permit Monthly Avg.	Units	Parameters	2/27/09	3/19/09	4/20/09**
NA	mg/L	Ammonia-N			
NA	mg/L	Biological Oxygen Demand			
NA	mg/L	Chemical Oxygen Demand	<5.0	<5.0	12.0
0.019	mg/L	Chlorine Produced Oxidants	<0.1 <0.1	<0.1 <0.1	<0.1 <0.1
NA	mg/L	Kjeldahl Nitrogen			
NA	mg/L	Total Nitrate/Nitrite			
NA	mg/L	Nitrite as N			
NA	mg/L	Nitrate as N			
NA	mg/L	Nitrogen, Total			
NA	mg/L	Ortho Phosphate as P			
NA	mV	Oxidation-Reduction Potential	-2.4	-6.7	-6.3
10 mg/L	mg/L	Petroleum Hydrocarbons	<5.00	<5.00	<5.00
6.0 – 9.0	S.U.	pH	6.88 7.11	6.90	6.89
NA	mg/L	Phosphorus, Reactive Dissolved			
NA	mg/L	Phosphorus, Total	0.0810	<0.050	1.21
NA	^{o}C	Temperature	7.70	8.00	12.73
NA	mg/L	Total Dissolved Solids			
NA	mg/L	Total Organic Carbon	2.52	3.93	4.92
NA	mg/L	Total Suspended Solids*	<2.00	2.50	34.8

Flow = 250 gallons per minute X 2 minutes per cycle X 10 cycles per day = 5,000 gallons per day

* Permit changed from monthly to quarterly monitoring and no limit for Total suspended solids
** Canal pumphouse did not operate from April 20, 2009 until 2010.
Blank indicates no measurement
NA = not applicable
DSN003 was duplicated as DSN002

Table 19. Summary of Ground Water Sampling Results March 2009
Target Chlorinated Volatile Organic Compounds (VOC), Monitored Natural Attenuation (MNA)

Well No.		MW-3S	MW-9S	MW-13S	MW-17	MW-18	MW-19S	MW-25	D-MG Sump	MW-26 *	TB-3/18	TB-3/23	NJ GW Std
PPPL Sample No.		09-156	09-157	09-158	09-159	09-160	09-161	09-162	09-164	09-163	09-168/65	09-169/66	
Target Volatile Organic Compounds (ug/L)													
Tetrachloroethylene		<0.640	**27.6**	**22.7**	**26.5**	<0.640	**54.3**	**1.12**	**28.4**	**37.6**	<0.640	<0.640	1
Trichloroethylene		<0.780	**7.57**	**50.3**	**1.48**	<0.780	**2.23**	<0.780	**3.46**	**69.0**	<0.780	<0.780	1
c-1,2-Dichloroethylene		<0.500	<0.500	15.4 JN	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	70
1,1,1-Trichloroethane		<0.520	0.810 J	<0.520	<0.520	<0.520	<0.520	<0.520	<0.520	<0.520	<0.520	<0.520	30
1,1-Dichloroethylene		<0.750	<0.750	<0.750	<0.750	<0.750	<0.750	<0.750	<0.750	0.780 J	<0.750	<0.750	2
Chloroform		<0.560	1.27	<0.560	0.980 J	0.460 J	<0.560	<0.390	<0.390	0.720 J	<0.560	<0.560	6
Vinyl Chloride		<0.600	<0.600	<0.600	<0.600	<0.600	<0.720	<0.600	<0.600	<0.600	<0.600	<0.600	2
Natural Attenuation Indicators													
Chloride	mg/L	21.1	12.0	29.2	14.2	7.26	5.5	134	164	28.5			--
Manganese	mg/L	1.25	0.0033	0.776	0.0912	0.272	0.0146	5.38	1.27	0.835			--
Alkalinity	mg/L	98.3	32.4	52.1	20.1	12.0	16.8	75.6	102	51.0			--
Nitrate	mg/L	<0.500	<0.500	<0.500	0.84	<0.500	<0.500	<0.500	0.73	<0.500			--
Nitrite	mg/L	<0.500	<0.0200	<0.0200	0.0700	<0.0200	<0.0200	<0.0200	0.73	<0.0200			--
Sulfide	mg/L	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100			--
Total Organic Carbon	mg/L	12.1	1.55	1.75	3.85	1.64	1.98	1.82	1.38	1.49			--
Ferrous Iron	mg/L	<0.20	<0.20	0.22	<0.20	<0.20	<0.20	<0.20	2.7	0.53			--
Dissolved Methane	mg/L	0.68	<0.10	3.9	0.32	<0.10	<0.10	0.92	9.7	10.4	0.45	0.4	--
Dissolved Ethane	mg/L	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	--
Dissolved Ethene	mg/L	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	--
Dissolved Oxygen	mg/L		0.5	0.99	0.65	0.48	3.36	0.45					--
pH	Std. Units		5.92	5.78	5.8	5.61	5.31	6.23					--
Redox Potential	mVe		23.6	39.8	30.0	40.0	61.5	8.5					--

Notes: "J" indicates a value that is greater than the MDL but lower than the lowest standard.
"N" indicates presumptive evidence of a compound. * MW-26 is duplicate sample from well MW-13S.
Ground water quality standards as published in N.J.A.C. 7:9-6.9.

Table 20. Summary of Ground Water Sampling Results June 2009
Target Chlorinated Volatile Organic Compounds (VOC), Monitored Natural Attenuation (MNA)

Well No.		MW-3S	MW-5S	MW-5I	MW-9S	MW-13S	MW-17	MW-18	MW-19S	MW-25	D-MG Sump	MW-26 *	TB-6/18	TB-6/19	NJ GW
PPPL Sample No.		09-276	09-277	09-278	09-279	09.280	09-281	09-282	09-283	09-284	09.386	09-285	09-288	09-277	Std
Target Volatile Organic Compounds (ug/L)															
Tetrachloroethylene		<0.640	0.790 J	<0.640	**23.6**	**33.7**	**8.78**	<0.640	**68.6**	<0.640	**28.5**	**44.1**	<0.640	<0.640	1
Trichloroethylene		<0.780	<0.780	**4.15**	**15.6**	**43.9**	<0.780	<0.780	**3.28**	<0.780	**3.18**	**55.6**	<0.780	<0.780	1
c-1,2-Dichloroethylene		<0.500	<0.500	5.21 JN	<0.500	20.4 JN	<0.500	<0.500	4.92 JN	<0.500	<0.500	27.1 JN	<0.500	<0.500	70
1,1,1-Trichloroethane		<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	30
1,1-Dichloroethylene		<0.680	<0.680	<0.680	<0.680	<0.680	<0.680	<0.680	<0.680	<0.680	<0.680	1.190	<0.680	<0.680	2
Chloroform		<0.390	<0.390	<0.390	1.05	<0.390	<0.390	1.25	<0.390	<0.390	<0.390	<0.390	<0.390	<0.390	6
Vinyl Chloride		<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	1.52	<0.600	<0.600	2
Natural Attenuation Indicators															
Chloride	mg/L	16.8	135	315	15.2	44.1	143.0	12.5	9.1	163	196	44.5			--
Manganese	mg/L	0.935	0.0047	0.580	0.0257	3.51	1.09	0.188	0.0154	6.57	0.92	3.45			--
Alkalinity	mg/L	71.9	17.1	165	55.3	62.2	75.9	14.0	20.2	83.3	103	58.2			--
Nitrate as N	mg/L	<0.500	1.88	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	1.14	<0.500			--
Nitrite	mg/L	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200			--
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	48.8	11.4	17.9	19.2	18.5	15.4	26.9	33.15	22.3	19.2	18.7			--
Total Organic Carbon	mg/L	9.96	<1.00	<1.00	2.81	1.46	32.90	1.33	1.55	1.62	1.01	1.34			--
Ferrous Iron	mg/L	0.45	<0.20	<0.20	<0.20	2.8	<0.20	<0.20	<0.20	0.45	2.0	2.8			--
Dissolved Methane	ug/L	3.6	<0.10	0.59	0.12	38.1	0.13	<0.10	<0.10	6.0	8.4	36.1	0.47		--
Dissolved Ethane	ug/L	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12		--
Dissolved Ethene	ug/L	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16		--
Dissolved Oxygen	mg/L		6.67	4.83	3.86	3.4	4.86	6.06	9.08	7.99					--
pH	Std. Units		7.08		5.44	5.64	6.14	5.03	4.93	3.77					--
Redox Potential	mVe		-75	-114.7	39.0	30.4	-10.2	-29.5	54	-25.4					--

Notes: "J" indicates a value that is greater than the MDL but lower than the lowest standard.
"N" indicates presumptive evidence of a compound. * MW-26 is duplicate sample from well MW-13S.
Ground water quality standards as published in N.J.A.C. 7:9-6.9.

Table 21. Summary of Ground Water Sampling Results September 2009
Target Chlorinated Volatile Organic Compounds (VOC), Monitored Natural Attenuation (MNA)

Well No.		MW-3S	MW-5S	MW-5I	MW-9S	MW-12S	MW-13S	MW-13I	MW-17	MW-18	MW-19S	NJ Ground
PPPL Sample No.		09-352	09-353	09-354	09-355	09-356	09-357	09-358	09-359	09-380	09-361	Water
Target Volatile Organic Compounds (ug/L)												
Tetrachloroethylene		<0.640	0.680 J	<0.640	**30.3**	<0.640	**36.7**	**24.1**	**29.8**	<0.640	**104**	1
Trichloroethylene		<0.780	<0.780	**3.00**	**4.21**	<0.780	**38.2**	<0.780	**1.35**	<0.780	**5.60**	1
c-1,2-Dichloroethylene		<0.500	<0.500	7.24 JN	<0.500	<0.500	22.4 JN	<0.500	<0.500	<0.500	9.31 JN	70
t-1,2-Dichloroethylene		<0.600	<0.600	<0.600	<0.600	<0.600	0.690 J	<0.600	<0.600	<0.600	<0.600	100
1,1,1-Trichloroethane		<0.700	<0.700	<0.700	0.770 J	<0.700	<0.500	1.26	<0.500	<0.700	<0.700	30
1,1-Dichloroethylene		<0.680	<0.680	<0.680	<0.680	<0.680	0.740 J	<0.680	<0.680	<0.680	<0.680	2
Chloroform		<0.390	<0.390	<0.390	1.32	<0.390	0.580 J	1.450	0.890 J	<0.390	<0.390	6
Vinyl Chloride		<0.600	<0.600	<0.600	<0.600	<0.600	1.76	<0.600	<0.600	<0.600	<0.600	2
Natural Attenuation Indicators												
Chloride	mg/L	30.3	67.5	296	14.6	23.7	45	15.6	14.2	10.2	5.84	--
Manganese	mg/L	1.10	0.0033	0.494	0.0263	0.00110 B	2.04	0.101	0.0419	0.216	0.0168	--
Alkalinity	mg/L	94.7	20.3	149	27.3	133	59	82.1	14.6	14.8	22.8	--
Nitrate as N	mg/L	<0.500	1.60	<0.500	<0.500	2.40	<0.500	<0.500	<0.500	<0.500	<0.500	--
Nitrite	mg/L	<0.0250	<0.200	<0.200	<0.0250	<0.200	<0.0250	<0.0250	<0.0250	<0.0250	<0.0250	--
Sulfate	mg/L	38.1	9.06	17.0	19.5	12.2	18.2	21.0	20.6	26.7	29.5	
Sulfide	mg/L	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	--
Total Organic Carbon	mg/L	11.8	1.00	1.89	1.80	<1.00	1.89	1.02	6.74	1.49	1.64	--
Ferrous Iron	mg/L	2.2	<0.20	<0.20	<0.20	<0.20	7.1	<0.20	<0.20	0.65	<0.20	--
Dissolved Methane	ug/L	35.6	<0.10	0.16	<0.10	<0.10	70.7	<0.10	1.0	<0.10	3.4	--
Dissolved Ethane	ug/L	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	--
Dissolved Ethene	ug/L	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	--
Dissolved Oxygen	mg/L	N/A	11.36	6.47	6.78	3.55	5.91	10.43	10.26	11.23	9.75	--
pH	Std. Units	N/A	6.19	7.19	10.40**	7.53	11.42**	13.16**	10.41**	10.30**	5.02	--
Redox Potential	mVe	N/A	32.4	-69.6	-26.2	-93.6	-35.9	-52.6	-26.0	-25.1	80.2	--

Notes: "J" indicates a value that is greater than the MDL but lower than the lowest standard.
"N" indicates presumptive evidence of a compound. * MW-26 is duplicate sample from well MW-13S.
Ground water quality standards as published in N.J.A.C. 7:9-6.9.

Table 21 Continued. Summary of Ground Water Sampling Results September 2009
Target Chlorinated Volatile Organic Compounds (VOC), Monitored Natural Attenuation (MNA)

Well No.		MW-19I	MW-22S	MW-23S	MW-24	MW-25	D-MG Sump	TFTR Sump	MW-26 *	DSN-001	TB-9/15	TB-9/16	NJ Ground
PPPL Sample No.		09-362	09-363	09-364	09-365	09-366	09-367	09-368	09-372	09-367	09-370	09-371	Water
Target Volatile Organic Compounds (ug/L)													
Tetrachloroethylene		<0.640	<0.640	<0.640	<0.640	0.840 J	**26.2**	**3.2**	**36.2**	<0.640	<0.640	<0.640	1
Trichloroethylene		<0.780	<0.780	<0.780	<0.780	<0.780	**2.93**	<0.780	**38.6**	<0.780	<0.780	<0.780	1
c-1,2-Dichloroethylene		<0.500	<0.500	<0.500	<0.500	3.15 JN	<0.500	<0.500	22.6 JN	<0.500	<0.500	<0.500	70
t-1,2-Dichloroethylene		<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	0.760 J	<0.600	<0.600	<0.600	100
1,1,1-Trichloroethane		<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	30
1,1-Dichloroethylene		<0.680	<0.680	<0.680	<0.680	<0.680	<0.680	<0.680	0.810 J	<0.680	<0.680	<0.680	2
Chloroform		<0.390	<0.390	<0.390	<0.390	<0.390	<0.390	1.5	0.560 J	0.970 J	<0.390	<0.390	6
Vinyl Chloride		<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	1.96	<0.600	<0.600	<0.600	2
Natural Attenuation Indicators													
Chloride	mg/L	69.9	71.4	7.58	6.31	142	166	109	45.6	98.7			--
Manganese	mg/L	0.008	0.0245	0.0161	0.0074	5.69	1.76	0.104	2.16	0.0485			--
Alkalinity	mg/L	29.1	5.99	10.4	12.2	78.9	110	113	59.8	83.6			--
Nitrate as N	mg/L	1.23	1.18	<0.500	<0.500	<0.500	0.890	1.53	<0.500	1.13			--
Nitrite	mg/L	<0.0250	<0.0250	<0.0250	<0.0250	<0.0250	<0.0250	<0.0250	<0.0250	<0.200			--
Sulfate	mg/L	14.5	17.8	49.9	12	23.3	17.8	19.1	18.2	27.9			
Sulfide	mg/L	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100			--
Total Organic Carbon	mg/L	<1.00	1.28	1.61	<1.00	1.63	1.31	1.07	1.97	1.96			--
Ferrous Iron	mg/L	<0.20	<0.20	<0.20	<0.20	0.26	<0.20	<0.20	6.9	<0.20			--
Dissolved Methane	ug/L	<0.10	<0.10	<0.10	<0.10	6.3	5.5	<0.10	83.2	0.48	1.2	0.92	--
Dissolved Ethane	ug/L	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	--
Dissolved Ethene	ug/L	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	--
Dissolved Oxygen	mg/L	10.38	11.00	8.22	7.56	22.48							--
pH	Std. Units	5.43	4.82	4.87	4.68	13.55**							--
Redox Potential	mVe	58.0	84.2	84.1	87.5	-56.0							--

Notes: "J" indicates a value that is greater than the MDL but lower than the lowest standard.
"N" indicates presumptive evidence of a compound. * MW-26 is duplicate sample from well MW-13S.
Ground water quality standards as published in N.J.A.C. 7:9-6.9.

Table 22. Summary of Ground Water Sampling Results December 2009
Target Chlorinated Volatile Organic Compounds (VOC), Monitored Natural Attenuation (MNA)

Well No.		MW-3S	MW-9S	MW-13S	MW-13I	MW-17	MW-18	MW-19S	NJ Ground
PPPL Sample No.		10-062	10-063	10-066	10-077	10-068	10-069	10-070	Water
Target Volatile Organic Compounds (ug/L)									
Tetrachloroethylene		<0.640	**26.2**	**49.9**	**35.3**	**29.9**	<0.640	**171**	1
Trichloroethylene		<0.780	**2.19**	**57.7**	<0.780	1.33	<0.780	**7.85**	1
c-1,2-Dichloroethylene		<0.500	<0.500	19.7 JN	<0.500	<0.500	<0.500	10.8 JN	70
t-1,2-Dichloroethylene		<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	100
1,1,1-Trichloroethane		<0.700	<0.700	<0.700	1.59	<0.700	<0.700	<0.700	30
1,1-Dichloroethylene		<0.680	<0.680	0.980 J	0.810 J	<0.680	<0.680	<0.680	2
Chloroform		<0.390	1.01	0.610 J	1.65	<0.390	0.81 J	<0.390	6
Vinyl Chloride		<0.600	<0.600	1.82	<0.600	<0.600	<0.600	<0.600	2
Natural Attenuation Indicators									
Chloride	mg/L	32.1	12.6	30.1	15.3	15.2	8.87	<5.00	--
Manganese	mg/L	1.35	0.0146	1.85	0.0841	0.039	0.226	0.0223	--
Alkalinity	mg/L	113	28.5	57.7	84.6	20.2	21.3	22.3	--
Nitrate as N	mg/L	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	--
Nitrite	mg/L	<0.0250	<0.0250	<0.200	<0.200	<0.200	<0.200	<0.200	--
Sulfate	mg/L	30	18.9	18.2	20.4	18.2	30.2	28.5	
Sulfide	mg/L	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	--
Total Organic Carbon	mg/L	11.2	1.59	1.75	<1.00	1.55	2.12	1.37	--
Ferrous Iron	mg/L	4.2	<0.20	8.2	<0.20	<0.20	<0.20	<0.20	--
Dissolved Methane	ug/L	59.4	<0.10	60.0	<0.10	1.8	<0.10	9	--
Dissolved Ethane	ug/L	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	--
Dissolved Ethene	ug/L	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	--
Dissolved Oxygen	mg/L	8.30	10.65	11.32	12.25	4.50	11.12	-11.15	--
pH	Std. Units	5.58	5.37	5.68	8.53	5.04	5.07	5.09	--
Redox Potential	mVe	31.0	64.5	35.7	-1.5	54.0	35.7	43.1	--

Notes: "J" indicates a value that is greater than the MDL but lower than the lowest standard.
"N" indicates presumptive evidence of a compound. * MW-26 is duplicate sample from well MW-13S.
Ground water quality standards as published in N.J.A.C. 7:9-6.9.

Table 22 Continued. Summary of Ground Water Sampling Results December 2009
Target Chlorinated Volatile Organic Compounds (VOC), Monitored Natural Attenuation (MNA)

Well No.		MW-25	D-MG Sump	MW-26 *	MW-5I	TB-12/2	TB-12/1	NJ Ground
PPPL Sample No.		10-071	10-073	10-072	10-064	10-075	10-074/078	Water
Target Volatile Organic Compounds (ug/L)								
Tetrachloroethylene		**1.12**	**28.6**	**49.1**	<0.640		<0.640	1
Trichloroethylene		<0.780	**3.45**	**53.1**	3.98		<0.780	1
c-1,2-Dichloroethylene		<0.500	<0.500	20.4 JN	3.54 JN		<0.500	70
t-1,2-Dichloroethylene		<0.600	<0.600	<0.600	<0.600		<0.600	100
1,1,1-Trichloroethane		<0.700	<0.700	<0.700	<0.700		<0.700	30
1,1-Dichloroethylene		<0.680	<0.680	0.790 J	<0.680		<0.680	2
Chloroform		<0.390	<0.390	0.620 J	<0.390		<0.390	6
Vinyl Chloride		<0.600	<0.600	1.81	<0.600		<0.600	2
Natural Attenuation Indicators								
Chloride	mg/L	112	160	30.5	262			--
Manganese	mg/L	4.90	1.35	1.95	0.484			--
Alkalinity	mg/L	85.6	112	60.4	155			--
Nitrate as N	mg/L	<0.500	0.713	<0.500	<0.500			--
Nitrite	mg/L	<0.200	<0.200	<0.200	<0.200			--
Sulfate	mg/L	24	17.5	18.4	17.9			
Sulfide	mg/L	<0.100	<0.100	<0.100	<0.100			--
Total Organic Carbon	mg/L	1.60	1.74	1.77	<1.00			--
Ferrous Iron	mg/L	<0.20	2.5	7.7	<0.20			--
Dissolved Methane	ug/L	3.0	11.0	67.2	0.12	0.28	0.98	--
Dissolved Ethane	ug/L	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	--
Dissolved Ethene	ug/L	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	--
Dissolved Oxygen	mg/L	8.13			-0.13			--
pH	Std. Units	5.80			7.35			--
Redox Potential	mVe	18.5			-38.6			--

Notes: "J" indicates a value that is greater than the MDL but lower than the lowest standard.
"N" indicates presumptive evidence of a compound. * MW-26 is duplicate sample from well MW-13S.
Ground water quality standards as published in N.J.A.C. 7:9-6.9.

Table 23. Quality Assurance Data for Radiological and Non-Radiological Samples for 2009

Laboratory, Program, and Parameter	Reported Value	Actual Value	Acceptance Range	Accepted
ERA (picoCuries/Liter)				
RAD-77				
Tritium (pCi/L)	20870	20300	17800-22300	Y
Cesium 134 (pCi/L)	65.5	72.9	59.5 - 80.2	Y
Cesium 137 (pCi/L)	136.36	168	151 - 187	N
RAD-79				
Tritium (pCi/L)	16596	16400	14300 - 18000	Y
Cesium 134 (pCi/L)	70.78	79.4	65.0 - 87.3	Y
Cesium 137 (pCi/L)	46.41	54.6	49.1 - 62.9	N
ERA WP-167				
Turbidity (NTU)	10.34	9.08	7.66-10.3	N
ERA WP-171				
Chemical oxygen demand (mg/L)	149.705	146	111-167	Y
pH (S.U.)	6.97	6.89	6.67-7.09	Y
Total residual chlorine (mg/L)	2.60	2.43	1.74-2.99	Y
ERA WP-173				
Chemical oxygen demand (mg/L)	161.018	134	102-154	N
Specific conductance (µmhos/cm)	417	419	375-463	Y
pH (S.U.)	6.23	6.21	6.01-6.41	Y
Total residual chlorine (mg/L)	0.77	0.92	0.664-1.15	Y
Turbidity (NTU)	6.72	6.20	5.16-7.14	Y

Table 24. Waste Characterization Report (WCR) for DSN001 March 5, 2009

WCR Parameters	Reported Values (µg/L)
Chloroform	0.550 J
Barium	241.0
Copper	3.3
Manganese	68.2
Nickel	5.00
Zinc	43.0
Di-n-butylphthalate	3.19 J

J indicates an estimated value

Appendix

B

TABLES for 2010

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

CONDITION		PUBLIC	EXPOSURE[b]	OCCUPA-TIONAL	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 2010

START DATE	WEEK	INCH	CUM. INCHES	TOTAL	MONTHLY TOTAL
5-Jan-10	1	0.09	0.09		
12Jan-10	2	0.01	0.10		
19-Jan-10	3	0.79	0.89		
26-Jan-10	4	**2.48**	**3.37**	**3.37**	**JANUARY**
2-Feb-10	5	0.00	3.37		8.2"snow 2/5-2/6
9-Feb-10	6	0.05	3.42		13.5" snow 2/9-2/10
16-Feb-10	7	0.29	3.71		2" snow 2-16,
23-Feb-10	8	1.31	5.02		10" 2/25
2-Mar-10	9	**0.52**	**5.54**	**2.17**	**FEBRUARY**
9-Mar-10	10	0.08	5.62		
16-Mar-10	11	6.29	11.91		
23-Mar-10	12	1.2	13.11		
30-Mar-10	13	**3.35**	**16.46**	**10.92**	**MARCH**
6-Apr-10	14	0.00	16.46		
13-Apr-10	15	0.41	16.87		
20-Apr-10	16	0.42	17.29		
27-Apr-10	17	**1.56**	**18.85**	**2.39**	**APRIL**
4-May-10	18	0.51	19.36		
11-May-10	19	0.61	19.97		
18-May-10	20	1.37	21.34		
25-May-10	21	0.14	21.48		
1-Jun-10	22	**1.82**	**23.30**	**4.45**	**MAY**
8-Jun-10	23	0.02	23.32		
15-Jun-10	24	0.98	24.30		
22-Jun-10	25	0.03	24.33		
29-Jun-10	26	**0.00**	**24.33**	**1.03**	**JUNE**
6-Jul-10	27	0.00	24.33		
13-Jul-10	28	2.54	26.87		
20-Jul-10	29	0.47	27.31		
27-Jul-10	30	0.53	27.87		
3-Aug-10	31	**0.01**	**27.88**	**3.55**	**JULY**
10-Aug-10	32	0.00	27.88		
17-Aug-10	33	1.34	29.22		
24-Aug-10	34	0.32	29.54		
31-Aug-10	35	**0.10**	**29.64**	**1.76**	**AUGUST**
7-Sep-10	36	0.00	29.64		
14-Sep-10	37	0.24	29.88		
21-Sep-10	38	0.80	30.68		
28-Sep-10	39	**0.97**	**31.65**	**2.01**	**SEPTEMBER**
5-Oct-10	40	2.91	34.56		
12-Oct-10	41	0.61	35.17		
19-Oct-10	42	0.73	35.90		
26-Oct-10	43	0.4	36.30		
2-Nov-10	44	**0.00**	**36.30**	**4.65**	**OCTOBER**
9-Nov-10	45	1.24	37.54		
16-Nov-10	46	0.47	38.01		
23-Nov-10	47	0.22	38.23		
30-Nov-10	48	**0.27**	**38.50**	**2.20**	**NOVEMBER**
7-Dec-10	49	1.97	40.47		
14-Dec-10	50	0.25	40.72		
21-Dec-08	51	0.00	40.72		
28-Dec-08	52	0.02	40.74		18-20" snow 12/22
4-Jan-11	53	**0.03**	**40.77**	**2.27**	**DECEMBER**

Table 3. D–Site Tritium Stack Releases in Curies in 2010

Week Ending	HTO (Ci)	HT (Ci)	Weekly Total (Ci)	Annual Total (Ci)
1/6/10	0.07260	0.00410	0.07670	0.07670
1/13/10	0.08830	0.00170	0.09000	0.16670
1/21/10	0.06620	0.01360	0.07980	0.24650
1/27/10	0.15600	0.01360	0.16960	0.41610
2/9/10	0.15700	0.01290	0.16990	0.58600
2/17/10	0.17500	0.00620	0.18120	0.76720
2/24/10	0.16000	0.00350	0.16350	0.93070
3/3/10	0.09420	0.00860	0.10280	1.03350
3/10/10	0.12400	0.00690	0.13090	1.16440
3/17/10	0.22200	0.00670	0.22870	1.39310
3/24/10	0.15700	0.00340	0.16040	1.55350
3/31/10	0.11700	0.01200	0.12900	1.68250
4/7/10	0.08490	0.00650	0.09140	1.77390
4/14/10	0.16500	0.00480	0.16980	1.94370
4/21/10	0.16100	0.00270	0.16370	2.10740
4/28/10	0.14000	0.00370	0.14370	2.25110
5/5/10	0.16600	0.00220	0.16820	2.41930
5/12/10	0.13900	0.00390	0.14290	2.56220
5/22/10	0.15000	0.00200	0.15200	2.71420
5/27/10	0.14200	0.00450	0.14650	2.86070
6/2/10	0.12300	0.00250	0.12550	2.98620
6/12/10	0.22800	0.01430	0.24230	3.22850
6/17/10	0.27900	0.01200	0.29100	3.51950
6/25/10	0.07040	0.00920	0.07960	3.59910
7/6/10	0.05970	0.01230	0.07200	3.67110
7/16/10	0.50000	0.01390	0.51390	4.18500
7/22/10	0.07630	0.01550	0.09180	4.27680
7/28/10	0.24400	0.05150	0.29550	4.57230
7/30/10	0.33700	0.01950	0.35650	4.92880
8/6/10	0.12000	0.00790	0.12790	5.05670
8/13/10	0.19200	0.00950	0.20150	5.25820
8/20/10	0.11100	0.00700	0.11800	5.37620
8/25/10	0.04160	0.00490	0.04650	5.42270
9/1/10	0.11500	0.00590	0.12090	5.54360
9/8/10	0.00260	0.00004	0.00264	5.54624
9/15/10	0.00040	0.00001	0.00041	5.54665
9/22/10	0.00040	0.00001	0.00041	5.54706
9/29/10	0.00030	0.00002	0.00032	5.54738
10/6/10	0.00020	0.00003	0.00023	5.54761
10/13/10	0.00030	0.00002	0.00032	5.54793
10/27/10	0.0003	0.00001	0.00031	5.54824
11/3/10	0.0005	0.00001	0.00051	5.54875
11/10/10	0.0002	0.00001	0.00021	5.54896
11/17/10	0.0006	0.00003	0.00063	5.54959
11/24/10	0.0002	0.00001	0.00021	5.54980
12/1/10	0.0003	0.00002	0.00032	5.55012
12/8/10	0.0003	0.00001	0.00031	5.55043
12/15/10	0.0002	0.00007	0.00027	5.55070
12/31/10	0.0013	0.00008	0.00138	5.55208
TOTAL	**5.2423**	**0.30978**		**5.55208**

Table 4. Surface Water Tritium Concentrations for 2010 (in picoCuries/Liter)

BOLD indicates above the level of detection. Below Bkg. = Below the Background tritium concentration.

Well No. or Sump Location	Well TW-1	Well TW-5	Well TW-8	Air Shaft Sump	D-site MG Sump
January				**125**	<118
February				Below Bkg.	Below Bkg.
March				Below Bkg.	**136**
April				**134**	<116
May				<117	<117
June				<121	Below Bkg.
July				<130	<130
August				<130	Below Bkg.
September				**144**	**179**
October				**222**	<125
November				<129	**567**
December					

Table 5. Ground Water Tritium Concentrations for 2010 (in picoCuries/liter)

Sample Location	Bee Brook (B1)	Bee Brook (B2)	Basin (DSN001)	D&R Canal (C1)	D&R Canal (DSN003)
January			<118		
February	<96	<96	<96	Below Bkg.	Below Bkg.
March			Below Bkg.	Below Bkg.	
April			<116	<116	<116
May	Below Bkg.	Below Bkg.	Below Bkg.	Below Bkg.	Below Bkg.
June			<117	Below Bkg.	Below Bkg.
July			Below Bkg.	Below Bkg.	Below Bkg.
August			**216**		
September			**200**	<121	<121
October			<125	<125	<125
November	Below Bkg.	<129	**142**	<123	<231
December					

Sample Location	Potable Water (E1)	Millstone River (M1)	Cranbury Brook (P1)	Devil's Brook (P2)
January				
February	<105	Below Bkg.	Below Bkg.	Below Bkg.
March				
April				
May	Below Bkg.	Below Bkg.	Below Bkg.	<117
June				
July				
August				
September				
October				
November	<129	<123	<123	<123
December				

Bold indicates the highest concentrations above background levels. Blank indicates no samples collected.

Table 6. Rain Water Tritium Concentrations (in picoCuries/liter) Collected On-Site in 2010

250 feet from Stack	R1E (East)	R1W (West)	R1S (South)	R1N (North)	R1ND (Duplicate)
1/22/10	<105	<105	<105	<105	<105
2/23/10	**469**	<133	**197**	<133	Below Bkg.
3/31/10	**160**	<106	Below Bkg.	<106	<106
4/27/10	<116	**193**	<117	<117	**150**
6/1/10	**144**	<121	Below Bkg.	Below Bkg.	<117
7/16/10	<132		<132	<130	<130
8/27/10	<127	<127	<127	Below Bkg.	<127
10/6/10	<226	Below Bkg.	<126	<126	Below Bkg.
11/12/10	<129	<127	**200**	<127	<127

500 feet from Stack	R2E (East)	R2W (West)	R2S (South)	R2N (North)
1/22/10	<105	<105	Below Bkg.	<105
2/23/10	**273**	<133	<133	<133
3/31/10	**151**	**249**	<106	
4/27/10		**151**	<117	
6/1/10		<121	<121	
6/2/10	Below Bkg.		Below Bkg.	<117
7/16/10	Below Bkg.	Below Bkg.	Below Bkg.	<132
8/27/10	<127	<127	Below Bkg.	**151**
10/6/10	Below Bkg.	<126	<126	<126
11/12/10	**164**	<127	<127	<127

BOLD indicates highest concentrations above background levels.
Blank indicates no sample collected.

Table 7. Annual Range of Tritium Concentration at PPPL in Precipitation from 1985 to 2010

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 tp 375	47.1	+1.6
2010	<105 to 469	40.8	-5.7

Table 8. Liquid Effluent Collection Tank Release Data for 2010

Sample Date	Gallons Released	Tritium Sample LLD (pCi/L)	Tritium Sample Activity (pCi/L)	Total Tank Activity (Ci)	Annual Cumulative Activity (Ci)	Gross Beta Sample LLD (pCi/L)	Gross Beta Sample Activity (pCi/L)
4/1/2010	12,600	236	179,000	0.008550	0.008550	279	839
5/18/2010	11,250	267	285,000	0.012100	0.020650	279	1,620
6/4/2010	12,750	310	880,000	0.042500	0.063150	279	6,300
6/22/2010	12,500	325	1,320.000	0.063500	0.126650	279	9,170
6/30/2010	12,750	325	709,000	0.034200	0.160850	279	9,170
7/12/2010	11,000	374	619,000	0.029900	0.190750	279	3,590
7/21/2010	12,700	291	450,000	0.021700	0.212450	279	2,750
7/28/2010	11,250	371	455,000	0.019400	0.231850	280	2,760
8/12/2010	12,750	345	430,000	0.020700	0.252550	280	2,770
8/24/2010	12,750	341	449,000	0.021700	0.274250	281	2,470
9/21/2010	11,250	376	436,000	0.018600	0.292850	281	2,590
11/5/2010	12,600	338	388,000	0.018500	0.311350	279	2,340
12/17/2010	12,750	259	122,000	0.005910	0.317260	282	<282
Total gallons	158,900						

Table 9. Total Fuel Consumption by Fuel Type from 2000 to 2010

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
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 2010

Location B1 = Bee Brook upstream of PPPL basin discharge

Sample Date	2/4/10	5/11/10	8/3/10	09/16/10	11/5/10
Ammonia nitrogen as N, mg/L	<0.10	<0.10	<0.10		<0.10
Biological Oxygen Demand, mg/L		<2.43	4.60		
Chemical Oxygen Demand, mg/L	<10.0	<10.0	10.0		40.0
Nitrogen, total mg/L	3.715	3.395	1.7		1.552
Oxidation-Reduction Potential, mV	25.20	70.90	68.90	68.00	-47.60
pH, standard units	6.66	5.86	5.83	5.88	7.87
Phosphorus, total, mg/L	<0.050	<0.050	<0.050		0.063
Temperature, ^{o}C	1.05	13.35	21.70	18.90	9.40
Total Suspended Solids, mg/L	3.20	7.50	2.80		2.00
Total Organic Carbon, mg/L	2.33	2.25	4.13		16.10
Total Dissolved Solids, mg/L		223.0	300.0		

Table11. Surface Water Analysis for Bee Brook, B2, in 2010

Location B2 = Bee Brook downstream of PPPL basin discharge

Sample Date	2/4/10	5/11/10	8/3/10	9/16/10	11/5/10
Ammonia nitrogen as N, mg/L	<0.10	<0.10	<0.10		<0.10
Biological Oxygen Demand, mg/L		2.91	6.32		
Chemical Oxygen Demand, mg/L	<10.0	<10.0	<10.0		35.0
Nitrogen, total mg/L	2.925	3.485	1.701		1.549
Oxidation-Reduction Potential, mV	7.3	20.0	-1.20	-40.60	-13.70
pH, standard units	7.00	6.79	7.08	7.81	7.24
Phosphorus, total, mg/L	<0.050	0.077	<0.050		0.053
Temperature, ^{o}C	3.60	11.15	22.15	19.45	9.55
Total Suspended Solids, mg/L	2.80	6.00	12.40		3.20
Total Organic Carbon, mg/L	1.62	1.89	1.78		14.00
Total Dissolved Solids, mg/L		331.0	351.0		

Table 12. Surface Water Analysis for Delaware & Raritan Canal, C1, in 2010

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

Sample Date	2/4/10	3/4/10	4/2/10	5/11/10
Ammonia nitrogen as N, mg/L	<0.10			<0.10
Biological Oxygen Demand, mg/L				<2.43
Chemical Oxygen Demand, mg/L	10.0	14.0	26.0	<10.0
Nitrogen, total mg/L	2.065			1.905
Oxidation-Reduction Potential, mV	15.70	17.60		17.80
pH, standard units	6.84	6.81		6.84
Phosphorus, total, mg/L	<0.05	<0.05	0.11	0.05
Temperature, ^{o}C	2.80	6.30		16.15
Total Suspended Solids, mg/L	4.80	2.40	12.80	5.50
Total Organic Carbon, mg/L	2.60	3.97	6.17	2.98
Total Dissolved Solids, mg/L				111.0

Sample Date	6/2/10	7/13/10	8/3/10	9/2/10
Ammonia nitrogen as N, mg/L			<0.10	
Biological Oxygen Demand, mg/L			4.32	
Chemical Oxygen Demand, mg/L	18.0	<10.0	<10.0	<10.0
Nitrogen, total mg/L			2.144	
Oxidation-Reduction Potential, mV	17.0	20.3	-7.7	14.2
pH, standard units	6.82	6.75	7.19	6.83
Phosphorus, total, mg/L	0.077	0.067	0.067	0.053
Temperature, ^{o}C	23.55	28.40	27.35	27.70
Total Suspended Solids, mg/L	8.00	2.80	8.80	5.60
Total Organic Carbon, mg/L	3.89	3.00	2.74	3.83
Total Dissolved Solids, mg/L			160.0	

Sample Date	10/1/10	11/3/10	12/9/10
Ammonia nitrogen as N, mg/L		<0.10	
Biological Oxygen Demand, mg/L			
Chemical Oxygen Demand, mg/L	10.0	<10.0	14.0
Nitrogen, total mg/L		1.50	
Oxidation-Reduction Potential, mV	-36.4	18.1	52.6
pH, standard units	7.29	6.67	6.05
Phosphorus, total, mg/L	<0.05	<0.05	<0.05
Temperature, ^{o}C	7.29	6.67	6.05
Total Suspended Solids, mg/L	4.0	<2.0	3.6
Total Organic Carbon, mg/L	3.19	3.47	4.32
Total Dissolved Solids, mg/L			

Table 13. Surface Water Analysis for Elizabethtown Water, E1, in 2010

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

Sample Date	2/4/10	5/11/10	8/3/10	11/3/10
Ammonia nitrogen as N, mg/L	<0.10	0.23	<0.10	0.34
Biological Oxygen Demand, mg/L		<2.43	<2.00	
Chemical Oxygen Demand, mg/L	<10.0	<10.0	<10.0	<10.0
Nitrogen, total mg/L	2.775	2.215	1.772	2.050
Oxidation-Reduction Potential, mV	31.9	59.8	-30.0	24.9
pH, standard units	6.55	6.09	6.53	6.55
Phosphorus, total, mg/L	0.296	1.33	1.35	0.412
Temperature, ^{o}C	14.2	16.2	23.4	15.6
Total Suspended Solids, mg/L	<2.0	<2.0	<2.0	<2.0
Total Organic Carbon, mg/L	1.68	1.66	1.89	2.10
Total Dissolved Solids, mg/L		203.0	206.0	

Table 14. Surface Water Analysis for Millstone River, M1, in 2010

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

Sample Date	2/4/10	5/11/10	8/3/10	11/3/10
Ammonia nitrogen as N, mg/L	0.50	0.49	<0.10	0.69
Biological Oxygen Demand, mg/L		9.90	47.90	
Chemical Oxygen Demand, mg/L	11.0	21.0	115.0	<10.0
Nitrogen, total, mg/L	4.635	4.803	10.370	4.810
Oxidation-Reduction Potential, mV	22.7	17.9	-6.1	22.8
pH, standard units	6.71	6.83	7.16	6.59
Phosphorus, total, mg/L	<0.05	0.131	0.839	<0.05
Temperature, ^{o}C	3.15	16.15	27.50	11.65
Total Suspended Solids, mg/L	9.6	12.7	136.0	4.0
Total Organic Carbon, mg/L	3.05	5.64	10.20	3.88
Total Dissolved Solids, mg/L		151.0	209.0	

NS = Not sampled

Table 15. Surface Water Analysis for Cranbury Brook (Plainsboro), P1, in 2010

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

Sample Date	2/4/10	5/11/10	8/3/10	11/3/10
Ammonia nitrogen as N, mg/L	0.17	0.10	<0.10	0.12
Biological Oxygen Demand, mg/L		3.07	4.85	
Chemical Oxygen Demand, mg/L	<10.0	12.0	<10.0	<10.0
Nitrogen, total, mg/L	3.705	5.195	7.980	6.66
Oxidation-Reduction Potential, mV	34.7	82.2	51.2	48.3
pH, standard units	6.48	5.69	6.16	6.12
Phosphorus, total, mg/L	<0.05	0.06	<0.05	<0.05
Temperature, ^{o}C	4.20	14.70	26.15	10.65
Total Suspended Solids, mg/L	15.6	12.0	5.6	2.4
Total Organic Carbon, mg/L	3.06	4.56	2.54	3.14
Total Dissolved Solids, mg/L		174.0	189.0	

Table 16. Surface Water Analysis for Devil's Brook (Plainsboro), P2, in 2010

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

Sample Date	2/4/10	5/11/10	8/4/10	11/3/10
Ammonia nitrogen as N, mg/L	0.17	0.10	<0.10	<0.10
Biological Oxygen Demand, mg/L		2.63	3.76	
Chemical Oxygen Demand, mg/L	16.0	19.0	<10.0	<10.0
Nitrogen, total, mg/L	2.925	3.645	6.420	5.580
Oxidation-Reduction Potential, mV	24.3	69.2	28.4	50.5
pH, standard units	6.68	5.91	6.56	6.07
Phosphorus, total, mg/L	<0.05	0.066	<0.05	<0.05
Temperature, ^{o}C	4.35	12.70	23.70	17.00
Total Suspended Solids, mg/L	11.60	4.70	2.80	2.80
Total Organic Carbon, mg/L	4.38	7.24	1.35	2.54
Total Dissolved Solids, mg/L		129.0	191.0	

Table 17. DSN001 - Retention Basin Outfall Surface Water Analysis (NJPDES NJ0023922) in 2010

Permit Limit	Units	Parameters	1/6/10	2/4/10	3/4/10	4/2/10	5/11/10	6/1/10
NA	mg/L	Ammonia-N		<0.10 <0.10			0.11 <0.10	
NA	mg/L	Biological Oxygen Demand					<2.43 <2.43	
50 mg/L max.	mg/L	Chemical Oxygen Demand	<10.0	<10.0 <10.0	14.0	<10.0	<10.0 <10.0	13.0
0.016	mg/L	Chlorine Produced Oxidants	<0.10	<0.10 <0.10	<0.10		<0.10 <0.10	<0.10 <0.10
NA	MGD	Flow, Avg. Monthly	0.321	0.336	0.488	0.243	0.156	0.066
NA	mg/L	Kjeldahl Nitrogen		<1.00 <1.00			1.33 1.13	
NA	mg/L	Nitrite as N		<0.025 <0.025			0.0341 0.0325	
NA	mg/L	Nitrate as N		1.12 1.14			2.37 1.76	
NA	mg/L	Nitrogen, Total		2.145 2.165			3.734 2.923	
NA	mg/L	Ortho Phosphate as P					0.102 0.073	
NA	mV	Oxidation-Reduction Potential	-46.9	-12.9	-2.6	39.6	-15.7	22.4
10 mg/L	mg/L	Petroleum Hydrocarbons	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
6.0-9.0	S.U.	pH	7.50	7.30 7.37	7.18	6.43	7.43	6.73
NA	mg/L	Phosphorus, Total	<0.05	<0.05 <0.05	0.291	<0.05	0.109 0.104	0.088
NA	µg/L	Tetrachloroethylene	0.410 J	0.440 J 0.390 J	0.360 J	0.670 J	0.340 J 0.370 J	0.390 J
30^{o} C max.	^{o} C	Temperature	9.25	7.20	11.80	14.10	13.5	22.35
NA	mg/L	Total Dissolved Solids					417.0 411.0	
NA	mg/L	Total Organic Carbon	1.57	<1.00 <1.00	1.65	1.25	1.70 1.59	3.66
50 mg/L	mg/L	Total Suspended Solids	<2.0	5.6 8.0	11.2	2.00	2.80 2.00	24.0

Table 17 continued. DSN001 - Retention Basin Outfall Surface Water Analysis (NJPDES NJ0023922) in 2010

Permit Limit	Units	Parameters	7/14/10	8/3/10	9/2/10	10/1/10	11/5/10	12/1/10	12/9/10
NA	mg/L	Ammonia-N		<0.10 <0.10			<0.10 <0.10		
NA	mg/L	Biological Oxygen Demand		12.6 5.70					
50 mg/L max.	mg/L	Chemical Oxygen Demand	14.0	<10.0 <10.0	21.0	19.0	16.0 13.0	15.0	
0.016	mg/L	Chlorine Produced Oxidants	<0.10	<0.10 <0.10	<0.10	<0.10	<0.10 <0.10	<0.10 <0.10	
NA	MGD	Flow, Avg. Monthly	0.076	0.0403	0.060	0.085	0.103	0.257	
NA	mg/L	Kjeldahl Nitrogen		<1.00 <1.00			<1.00 <1.00		
NA	mg/L	Nitrite as N		<0.20 <0.20			0.072 0.072		<0.20
NA	mg/L	Nitrate as N		<0.50 <0.50			0.680 0.730		10.8
NA	mg/L	Nitrogen, Total		1.700 1.700			1.752 1.802		
NA	mg/L	Ortho Phosphate as P		<0.05 <0.05					
NA	mV	Oxidation-Reduction Potential	8.2	-72.4	10.1	-16.2	5.8		
10 mg/L	mg/L	Petroleum Hydrocarbons	<5.00	<5.00 <5.00	<5.00	<5.00	<5.00	<5.00	
6.0-9.0	S.U.	pH	6.91	8.34	9.18	6.91	6.89	6.32	
NA	mg/L	Phosphorus, Reactive Dissolved		0.017 0.015					
NA	mg/L	Phosphorus, Total	0.051	<0.05 <0.05	<0.05	0.104	0.104 0.053	0.149	
NA	µg/L	Tetrachloroethylene	<0.300	<0.300 <0.300	<0.300	<0.300	<0.300 <0.300	<0.300	<0.300
30^{o} C max.	^{o}C	Temperature	23.50	22.50	26.50	18.80	11.90	13.65	
NA	mg/L	Total Dissolved Solids		369.0 331.0					
NA	mg/L	Total Organic Carbon	4.34	1.67 1.46	3.20	4.44	5.03 5.14	4.43	5.35
50 mg/L	mg/L	Total Suspended Solids	3.60	4.00 10.0	18.4	6.40	5.60 5.60	21.5	

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

Table 18. D&R Canal Pump House - DSN003
Monthly Surface Water Analysis (NJPDES NJ0023922) in 2010

Permit Monthly Avg.	Units	Parameters	1/6/10*	2/4/10	3/4/10	4/2/10	5/11/10	6/2/10
NA	mg/L	Ammonia-N		<0.10			<0.10	
NA	mg/L	Biological Oxygen Demand					<2.43	
NA	mg/L	Chemical Oxygen Demand		<10.0		<10.0	11.0	
0.019	mg/L	Chlorine Produced Oxidants		<0.10	<0.10	<0.10	<0.10	<0.10
NA	mg/L	Kjeldahl Nitrogen		<1.00			<1.00	
NA	mg/L	Total Nitrate/Nitrite						
NA	mg/L	Nitrite as N		<0.025			<0.025	
NA	mg/L	Nitrate as N		0.980			0.890	
NA	mg/L	Nitrogen, Total		2.005			1.915	
NA	mg/L	Ortho Phosphate as P					<0.05	
NA	mV	Oxidation-Reduction Potential		25.4	16.1		25.7	33.8
10 mg/L	mg/L	Petroleum Hydrocarbons		<5.00			<5.00	<5.00
6.0 – 9.0	S.U.	pH		6.66	6.83		6.69	6.52
		pH 3/17/10			5.93			
NA	mg/L	Phosphorus, Reactive Dissolved					<0.05	
NA	mg/L	Phosphorus, Total		0.070	<0.050	0.109	<0.05	0.066
NA	$^{\circ}$C	Temperature		1.80	6.05		16.85	23.45
NA	mg/L	Total Dissolved Solids					103.0	
NA	mg/L	Total Organic Carbon		2.61	4.10	6.34	2.98	3.72
NA	mg/L	Total Suspended Solids		5.60	4.40	14.00	9.60	2.80

**Note – NO discharge from DSN003 during January 2010*

Table 18 continued. D&R Canal Pump House - DSN003
Monthly Surface Water Analysis (NJPDES NJ0023922) in 2010

Permit Monthly Avg.	Units	Parameters	7/13/10	8/3/10	9/2/10	10/1/10	11/3/10	12/9/10
NA	mg/L	Ammonia-N		<0.10			<0.10 <0.10	
NA	mg/L	Biological Oxygen Demand		5.04				
NA	mg/L	Chemical Oxygen Demand	<10.0	<10.0	<10.0	10.0	<10.0 <10.0	13.0
0.019	mg/L	Chlorine Produced Oxidants	<0.10	<0.10	<0.10	<0.10 <0.10	<0.10 <0.10	<0.10
NA	mg/L	Kjeldahl Nitrogen		<1.00			<1.00 <1.00	
NA	mg/L	Total Nitrate/Nitrite					<0.50 <0.50	
NA	mg/L	Nitrite as N		<0.200				
NA	mg/L	Nitrate as N		0.961				
NA	mg/L	Nitrogen, Total		2.161			1.500 1.500	
NA	mg/L	Ortho Phosphate as P		0.089				
NA	mV	Oxidation-Reduction Potential	9.0	-72.4	6.4	25.9	4.20	63.1
10 mg/L	mg/L	Petroleum Hydrocarbons	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
6.0 – 9.0	S.U.	pH	6.94	8.34	7.08	6.13	6.23	6.53
NA	mg/L	Phosphorus, Reactive Dissolved		0.052				
NA	mg/L	Phosphorus, Total	0.125	0.056	<0.05	<0.05	<0.05 <0.05	<0.05
NA	°C	Temperature	28.75	22.5	26.60	20.95	11.15	3.75
	mg/L	Total Dissolved Solids		149.0				
NA	mg/L	Total Organic Carbon	2.92	2.79	3.79	2.96	3.47 3.49	4.43
NA	mg/L	Total Suspended Solids	7.60	10.0	4.00	4.00	3.60 2.80	4.40

Note: *Delaware & Raritan Canal pump house did not operate during October through December 2010.
Flow = 250 gallons per minute X 2 minutes per cycle X 10 cycles per day = 5,000 gallons per day
Permit changed from monthly to quarterly monitoring and no limit for Total suspended solids
Blank indicates no measurement
NA = not applicable
NL = no limit

Table 19. Summary of Ground Water Sampling Results –March 2010
Target Chlorinated Volatile Organic Compounds (VOC), Monitored Natural Attenuation (MNA)

Well No.		MW-3S	MW-5S	MW-5I	MW-9S	MW-13S	MW-17	MW-18	NJ Ground
PPPL Sample No.		10-134	10-135	10-136	10-137	10-138	10-139	10-140	Water
Target Volatile Organic Compounds (ug/L)									
Tetrachloroethylene		0.330 J	0.370 J	<0.640	**27.9**	**32.3**	**6.48**	0.500 J	1
Trichloroethylene		<0.310	<0.780	**2.99**	**30.4**	**22.9**	0.620 J	<0.310	1
c-1,2-Dichloroethylene		<0.500	<0.700	<0.700	3.41 JN	10.9 JN	<0.500	<0.500	70
t-1,2-Dichloroethylene		<0.230	<0.600	<0.600	<0.230	<0.230	<0.230	<0.230	100
1,1,1-Trichloroethane		<0.260	<0.500	<0.500	0.400 J	0.280 J	<0.260	<0.260	30
1,1-Dichloroethylene		<0.290	<0.680	<0.680	0.300 J	0.400 J	<0.290	<0.290	2
Chloroform		<0.220	<0.390	<0.390	0.370 J	0.540 J	<0.220	<0.220	6
Vinyl Chloride		<0.350	<0.600	<0.600	<0.350	<0.350	<0.350	<0.350	2
Natural Attenuation Indicators									
Chloride	mg/L	24.6	163	243	10.6	44.9	10.4	11.9	--
Manganese	mg/L	1.44	<0.500	0.455	0.00120 B	1.30	0.311	<0.200	--
Alkalinity	mg/L	135	20.4	126	97.8	47.0	82.7	14.4	--
Nitrate as N	mg/L	<0.500	1.66	<0.500	<0.500	<0.500	<0.500	<0.500	--
Nitrite	mg/L	<0.200	<0.0250	<0.0250	<0.200	<0.0250	<0.200	<0.200	--
Sulfate	mg/L	29.6	9.32	12.1	17.4	17.7	13.0	25.7	
Sulfide	mg/L	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	--
Total Organic Carbon	mg/L	11.7	<1.00	<1.00	2.48	1.47	5.34	1.83	--
Ferrous Iron	mg/L	1.7	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	--
Dissolved Methane	ug/L	69.0	<0.10	0.95	1.1	6.7	<0.10	<0.10	--
Dissolved Ethane	ug/L	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	--
Dissolved Ethene	ug/L	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	--
Dissolved Oxygen	mg/L	0.07	12.08	0.88	9.8	0.02	0.20	8.08	--
pH	Std. Units	2.40	5.99	2.2	6.20	5.20	4.43	5.30	--
Redox Potential	mVe	45.6	14.2	49	1.9	45.7	73.5	48.9	--

Notes: "J" indicates a value that is greater than the MDL but lower than the lowest standard.
"N" indicates presumptive evidence of a compound. * MW-26 is duplicate sample from well MW-13S.
Ground water quality standards as published in N.J.A.C. 7:9-6.9.

Table 19 Continued. Summary of Ground Water Sampling Results –March 2010
Target Chlorinated Volatile Organic Compounds (VOC), Monitored Natural Attenuation (MNA)

Well No.		MW-19S	MW-25	D-MG Sump	MW-26 *	TB-3/8	TB-12/1	NJ Ground
PPPL Sample No.		10-141	10-142	10-133	10.143	10-132	10-131	Water
Target Volatile Organic Compounds (ug/L)								
Tetrachloroethylene		**68.6**	0.590 J	**15.4**	**31.5**	<0.640	<0.640	1
Trichloroethylene		**4.03**	<0.780	**1.74**	**22.1**	<0.780	<0.780	1
c-1,2-Dichloroethylene		4.95 JN	<0.700	<0.700	11.1 JN	<0.700	<0.700	70
t-1,2-Dichloroethylene		<0.230	<0.600	<0.600	<0.600	<0.600	<0.600	100
1,1,1-Trichloroethane		<0.260	<0.500	<0.500	0.270 J	<0.500	<0.500	30
1,1-Dichloroethylene		<0.290	<0.680	0.290 J	0.420 J	<0.680	<0.680	2
Chloroform		<0.220	<0.390	0.420 J	0.450 J	<0.390	<0.390	6
Vinyl Chloride		<0.350	<0.600	<0.600	<0.600	<0.600	<0.600	2
Natural Attenuation Indicators								
Chloride	mg/L	7.82	146	180	44.7			--
Manganese	mg/L	0.0365	5.32	0.785	1.38			--
Alkalinity	mg/L	16.1	82.9	99.0	47.0			--
Nitrate as N	mg/L	<0.500	<0.500	0.828	<0.500			--
Nitrite	mg/L	<0.200	<0.0250	<0.0250	<0.0250			--
Sulfate	mg/L	31.9	21.1	19.4	17.5			
Sulfide	mg/L	<0.100	<0.100	<0.100	<0.100			--
Total Organic Carbon	mg/L	1.74	1.30	1.12	1.32			--
Ferrous Iron	mg/L	<0.20	<0.20	1.5	0.33			--
Dissolved Methane	mg/L	3.7	1.9	6.0	9.2	0.62	<0.10	--
Dissolved Ethane	mg/L	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	--
Dissolved Ethene	mg/L	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	--
Dissolved Oxygen	mg/L	10.51	9.68					--
pH	Std. Units	5.31	6.30					--
Redox Potential	mVe	49.3	-2.8					--

Notes: "J" indicates a value that is greater than the MDL but lower than the lowest standard.
"N" indicates presumptive evidence of a compound. * MW-26 is duplicate sample from well MW-13S.
Ground water quality standards as published in N.J.A.C. 7:9-6.9.

Table 20. Summary of Ground Water Sampling Results –June 2010
Target Chlorinated Volatile Organic Compounds (VOC), Monitored Natural Attenuation (MNA)

Well No.		MW-3S	MW-5S	MW-5I	MW-9S	MW-13S	MW-17	MW-18	MW-19S	MW-25	D-MG Sump	MW-26 *	TB	NJ Ground
PPPL Sample No.		10-220	10-221	10-222	10-223	10-224	10-225	10-226	10-227	10-228	10-230	10-229	10-231	Water
Target Volatile Organic Compounds (ug/L)														
Tetrachloroethylene		<0.300	0.350 J	<0.300	**39.6**	**42.0**	**36.2**	<0.300	**57.3**	**1.17**	**34.9**	**44.2**	<0.300	1
Trichloroethylene		<0.310	<0.310	0.390 J	**5.03**	**23.8**	**1.84**	<0.310	**2.01**	0.540 J	**3.88**	**24.7**	<0.310	1
c-1,2-Dichloroethylene		<0.250	<0.250	<0.250	<0.250	9.43 JN	<0.250	<0.250	<0.250	<0.250	<0.250	9.47 JN	<0.250	70
t-1,2-Dichloroethylene		<0.230	<0.230	<0.230	<0.230	0.260 J	<0.230	<0.230	<0.230	<0.230	<0.230	<0.230	<0.230	
1,1,1-Trichloroethane		<0.260	<0.260	<0.260	0.850 J	0.350 J	0.300 J	<0.260	<0.260	<0.260	<0.260	0.360 J	<0.260	30
1,1-Dichloroethylene		<0.290	<0.290	<0.290	<0.290	0.500 J	<0.290	<0.290	<0.290	<0.290	0.630 J	0.460 J	<0.290	2
Chloroform		<0.220	<0.220	<0.220	1.59	0.590 J	1.17	<0.220	<0.220	<0.220	0.600 J	0.660 J	0.340 J	6
Vinyl Chloride		<0.350	<0.350	<0.350	<0.350	0.880 J	<0.350	<0.350	<0.350	<0.350	<0.350	0.750 J	<0.350	2
Natural Attenuation Indicators														
Chloride	mg/L	19.7		105	14.3	57.3	10.3	10.3	5.05	141	179	57.4		--
Manganese	mg/L	1.69		0.172	.00470 B	4.25	0.0539	0.249	0.0161	6.21	2.07	4.23		--
Alkalinity	mg/L	149		42.0	28.8	54.6	31.1	11.8	15.7	81.6	101	52.9		--
Nitrate as N	mg/L	<0.025		<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	1.20	<0.025		--
Nitrite	mg/L	<0.500		<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500		--
Sulfide	mg/L	<0.100		<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100		--
Sulfate	mg/L	31.3		<5.00	23.3	18.4	21.4	24.7	35.0	24.7	18	18.3		
Total Organic Carbon	mg/L	16.4		1.16	1.73	2.20	1.95	2.27	2.50	2.05	1.58	2.13		--
Ferrous Iron	mg/L	11.5	<0.20	<0.20	<0.20	2.1	<0.20	1.9	<0.20	0.67	1.0	3.0		--
Dissolved Methane	mg/L	107	<0.10	0.30		<0.10	0.33	0.13	<0.10	5.9	8.9	41.4	0.37	--
Dissolved Ethane	mg/L	<0.12	<0.12	<0.12		<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	--
Dissolved Ethene	mg/L	<0.16	<0.16	<0.16		<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	--
Dissolved Oxygen	mg/L	14.2	+	4.73	-3.1	+	2.77	6.54	+	0.54	<0.500			--
pH	Std. Units	6.30	7.04	7.09	6.30	6.97	6.20	5.73	6.55	6.33	<0.500			--
Redox Potential	mVe	-27.8	24	-59.0	-28.1	2.0	-22.2	-5.2	40	-28.7	<0.500			--

Notes: "J" indicates a value that is greater than the MDL but lower than the lowest standard.
"N" indicates presumptive evidence of a compound. * MW-26 is duplicate sample from well MW-13S.
Ground water quality standards as published in N.J.A.C. 7:9-6.9.

Table 21. Summary of Ground Water Sampling Results –December 2010
Target Chlorinated Volatile Organic Compounds (VOC), Monitored Natural Attenuation (MNA)

Well No.		MW-3S	MW-9S	MW-12S	MW-13S	MW-13I	MW-17	MW-18	MW-19S	NJ Ground
PPPL Sample No.		11-061	11-063	11-064	11-065	11-066	11-067	11-068	11-069	Water
Target Volatile Organic Compounds (ug/L)										
Tetrachloroethylene		**1.41**	**5.23**	<0.300	**25.3**	**29.7**	**34.0**	0.380 J	**107**	1
Trichloroethylene		0.380 J	**8.69**	<0.310	**26.4**	0.450 J	**1.15**	<0.310	**4.92**	1
c-1,2-Dichloroethylene		<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	7.68 JN	70
t-1,2-Dichloroethylene		<0.230	<0.230	<0.230	0.290 J	<0.230	<0.230	<0.230	<0.230	
1,1,1-Trichloroethane		<0.260	<0.260	<0.260	<0.260	1.29	0.310 J	<0.260	<0.260	30
1,1-Dichloroethylene		<0.290	<0.290	<0.290	<0.290	0.530 J	<0.290	<0.290	<0.290	2
Chloroform		<0.220	<0.220	<0.220	<0.220	1.04	0.700 J	<0.220	<0.220	6
Vinyl Chloride		<0.350	<0.350	<0.350	<0.350	<0.350	<0.350	<0.350	<0.350	2
Natural Attenuation Indicators										
Chloride	mg/L	34.4	9.37	101	51.6	16.8	13.0	8.19	6.22	--
Manganese	mg/L	0.684	0.0387	0.0131	2.36	0.0394	0.0242	0.0630	0.0254	--
Alkalinity	mg/L	54.6	81.0	49.9	69.8	101	20.5	23.2	24.9	--
Nitrate as N	mg/L	0.879	<0.025	2.77	<0.025	<0.025	<0.025	<0.025	<0.025	--
Nitrite	mg/L	<0.0250	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	--
Sulfide	mg/L	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	--
Sulfate	mg/L	31.0	19.0	10.6	19.2	20.7	31.0	22.8	32.1	
Total Organic Carbon	mg/L	5.07	1.43	1.17	2.32	<0.500	4.05	1.41	1.86	--
Ferrous Iron	mg/L	<0.20	<0.20	<0.20	9.4	<0.20	<0.20	<0.20	<0.20	--
Dissolved Methane	mg/L	0.20	<0.10	<0.10	64.8	<0.10	0.13	<0.10	5.7	--
Dissolved Ethane	mg/L	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	--
Dissolved Ethene	mg/L	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	--
Dissolved Oxygen	mg/L	7.50	15.64	9.5	3.86	15.24	5.8	9.5	8.8	--
pH	Std. Units	5.61	5.83	13.4 **	5.38	6.37	6.20	6.2	12 **	--
Redox Potential	mVe	115.7	121.5	-78.2	50.0	72.6	15.2	15.0	-60.0	--

Notes: "J" indicates a value that is greater than the MDL but lower than the lowest standard.
"N" indicates presumptive evidence of a compound. * MW-26 is duplicate sample from well MW-13S.
Ground water quality standards as published in N.J.A.C. 7:9-6.9.

Table 21 Continued. Summary of Ground Water Sampling Results –December 2010
Target Chlorinated Volatile Organic Compounds (VOC), Monitored Natural Attenuation (MNA)

Well No.		MW-19I	MW-25	D-MG Sump	TFTR Sump	MW-26 *	DSN-001	TB-12/8/11	TB-12/8/11	NJ Ground
PPPL Sample No.		11-070	11-071	11-073	11-074	11-072	11-075	11-077	11-076	Water
Target Volatile Organic Compounds (ug/L)										
Tetrachloroethylene		<0.300	**1.13**	**27.2**	**1.67**	**24.8**	<0.300	<0.300	<0.300	1
Trichloroethylene		<0.310	0.500 J	**3.25**	<0.310	**25.6**	<0.310	<0.310	<0.310	1
c-1,2-Dichloroethylene		<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	70
t-1,2-Dichloroethylene		<0.230	<0.230	<0.230	<0.230	0.270 J	<0.230	<0.230	<0.230	
1,1,1-Trichloroethane		<0.260	<0.260	<0.260	<0.260	<0.260	<0.260	<0.260	<0.260	30
1,1-Dichloroethylene		<0.290	<0.290	<0.290	<0.290	0.350 J	<0.290	<0.290	<0.290	2
Chloroform		<0.220	<0.220	<0.220	<0.220	<0.220	<0.220	<0.220	<0.220	6
Vinyl Chloride		<0.350	<0.350	<0.350	<0.350	0.950 J	<0.350	<0.350	<0.350	2
Natural Attenuation Indicators										
Chloride	mg/L	85.9	85.7	177	95.0	50.6	152			--
Manganese	mg/L	0.00970	2.87	1.39	0.0394	2.37	0.0661			--
Alkalinity	mg/L	23.4	85.7	112	131	66.5	145			--
Nitrate as N	mg/L	1.19	<0.025	1.18	1.39	<0.025	10.8			--
Nitrite	mg/L	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500			--
Sulfide	mg/L	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100			--
Sulfate	mg/L	8.33	30.8	19.5	19.5	19.1	64.4			
Total Organic Carbon	mg/L	<0.500	3.52	1.23	1.06	2.20	5.35			--
Ferrous Iron	mg/L	<0.20	0.44	2.7	<0.20	10.5	<0.20			--
Dissolved Methane	mg/L	<0.10	2.5	10.8	<0.10	67.4	0.32	0.72	0.68	--
Dissolved Ethane	mg/L	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	--
Dissolved Ethene	mg/L	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	--
Dissolved Oxygen	mg/L	13.02	4.6							--
pH	Std. Units	5.43	12 **							--
Redox Potential	mVe	137.9	-60.9							--

Notes: "J" indicates a value that is greater than the MDL but lower than the lowest standard.
"N" indicates presumptive evidence of a compound. * MW-26 is duplicate sample from well MW-13S.
Ground water quality standards as published in N.J.A.C. 7:9-6.9.

Table 22. Drinking Water Standard Results for Test Well 10

Parameters	*Maximum Contaminant Levels*	*TW-10 Results*
Primary Drinking Water Standards-		
Gross Alpha	15 pCi/L	27 pCi/L
Radium-226 + Radium 224	5 pCi/L	8.64 pCi/L
Secondary Drinking Water Standards-		
Manganese	50 μg/L	410 μg/L
Iron	300 μg/L	916μg/L

pCi/l = pico Curies/Liter

Table 23. Quality Assurance Data for Radiological and Non-Radiological Samples for 2010

Laboratory, Program, and Parameter	Reported Value	Actual Value	Acceptance Range	Acceptable Not acceptable
ERA (picoCuries/Liter)				
RAD 81	12,534	12,000	10,400-13,200	Acceptable
RAD 83	2296	2220	1830-2460	Acceptable
April 2010				
Chemical oxygen demand (mg/L)	91.213	141	107-162	Not acceptable
Specific conductance (µmhos/cm)	866	819	725-901	Acceptable
pH (S.U.)	7.65	7.68	7.48-7.88	Acceptable
Total residual chlorine (mg/L)	0.64	0.732	0.530-0.919	Acceptable
Turbidity (NTUs)	6.26	6.52	5.43-7.49	Acceptable
July 2010 WP-161				
Chemical oxygen demand (mg/L)	126.717	110	82.3-128	Acceptable
Specific conductance (µmhos/cm)	347.75	328	291-364	Acceptable
pH (S.U.)	9.42	9.52	9.32-9.72	Acceptable
Total residual chlorine (mg/L)	1.075	1.16	0.834-1.44	Acceptable
Turbidity (NTUs)	13.95	12.2	10.4-13.7	Not acceptable
December 2010 WP-167				
Turbidity (NTUs)	10.34	9.08	7.66-10.3	Not acceptable
Dropped Turbidity certification				

Table 24. Waste Characterization Report for DSN001 Surface Water Sampling in November 2010

Laboratory Parameter	Reported Value (µg/L)
Barium	0.222
Manganese	0.0712
Zinc	0.0220

Appendix

C

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