Princeton Plasma Physics Laboratory

PPPL- 4732

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Annual Site Environmental Report for Calendar Years 2007-2008

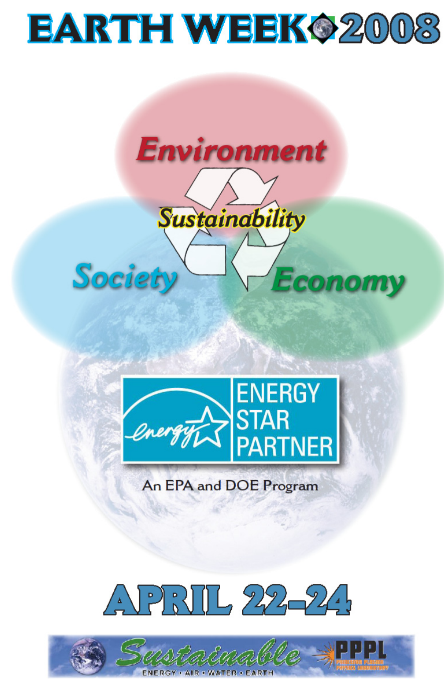
Virginia Finley

February, 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 2007-2008



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Under Contract DE-AC02-76-CHO-3073
See http://www.pppl.gov

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List of Acronyms

AEA	Atomic Energy Act of 1954
AFV	alternative fuel vehicles
ALARA	as low as reasonably achievable
APEC	area of potential environmental concern
AST	above-ground storage tank
B1, B2	Bee Brook 1 (upstream of DSN001) and 2 (downstream of DSN001) (surface water stations)
B-20	biolfuel (20%)
BAS	building automation system
BPX	Burning Plasma Experiment
Bq	Becquerel
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
CASL	Calibration and Service Laboratory
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
CFCs	chlorofluorocarbons
CFR	Code of Federal Regulations
CH_4	methane (GHG)
Ci	Curie (3.7 ^{E10} Becquerel)
CIT	Compact Ignition Tokamak
cm	centimeter
CNG	compressed natural gas
COB	C-site office building
CO_2	carbon dioxide (GHG)
CO_{2e}	carbon dioxide equivalent
COD	chemical oxygen demand
CPO	chlorine-produced oxidants known as total residual chlorine
CRD	contractor requirement document
CS	C-site Stellarator (PPPL)
CWA	Clean Water Act
CX	categorical exclusion
CY	calendar year
DCE	dichloroethylene
DCR	Discharge Cleanup and Reporting plan
D&D	deconstruction and decontamination
D-D	deuterium-deuterium
D-T	deuterium-tritium
D-11, D-12	retention basin monitoring wells 11and 12
DATS	differential atmospheric tritium sampler
DMR	discharge monitoring report
DOE	Department of Energy
DOE-HQ	Department of Energy - Headquarters
DOE-PSO	Department of Energy - Princeton Site Office
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
EA	Environmental Assessment
EDE	effective dose equivalent
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
ERC	Environmental Review Committee
ESA	Endangered Species Act

List of Acronyms

ES&H	Environment, Safety, and Health
ESHD	Environment, Safety, &Health Directives
EUI	energy intensity utilization
FABA	Former Annex Building Area
FFCA	Federal Facility Compliance Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FSAR	Final Safety Analysis Report
FY	fiscal year (October 1 to September 30)
g	gram
GHGs	greenhouse gases
GSA	General Services Administration
HAPs	Hazardous Air Pollutants
HFC	hydrofuorocarbons
HQ	Headquarters
HT	tritium (elemental)
HTO	tritiated water
HVAC	heating, ventilation, and air-conditioning
ICRF	Ion Cyclotron Radio Frequency
ISM	Integrated Safety Management
ISO14001	International Standards Organization 14001 (Environmental Management System – EMS)
IT	information technology
ITER	International Thermonuclear Experimental Reactor
JET	Joint European Torus facility (United Kingdom)
km	kilometer
kV	kilovolt (thousand volts)
LEC	liquid effluent collection (tanks)
LED	light emitting diode
LEED	Leadership in Energy and Environmental Design
LEED-EB	Leadership in Energy and Environmental Design - Existing Buildings
LEPC	Local Emergency Planning Committee
LSB	Lyman Spitzer Building (Formerly Laboratory Office Building)
LOI	Letter of Interpretation (Wetlands)
LSI	lined surface impoundment
LTX	Lithium Tokamak Experiment
LURP	Land Use and Regulation Program (NJDEP)
M1	Millstone River (surface water station)
MC&A	Material Control & Accountability (nuclear materials)
MESD	Materiel & Environmental Services Division (PPPL)
MeV	million electron volts
mVe	milli Volt electric
MG	Motor Generator (Building)
mg/L	milligram per liter
M&O	Maintenance &Operations
MOU	Memorandum of Understanding
mrem	milli radiation equivalent man (per year)
MRI	Magnetorotational Instability Experiment
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
n	neutron
N or N-	nitrogen
N_2O	nitrous oxide (GHG)
NB	Neutral beam
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
NOAA	National Oceanic and Atmospheric Administration
NOEC	no observable effect concentration

List of Acronyms

NOV	notice of violation
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NPK	nitrogen, phosphorus, potassium (fertilizer)
NRC	Nuclear Regulatory Commission
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
P^2	Pollution Prevention
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
POTW	publicly-owned treatment works
ppb	parts per billion
ppm	part per million
PPPL	Princeton Plasma Physics Laboratory
PT	proficiency test (Laboratory certification)
PTE	potential to emit (air emissions)
PV	photovoltaics
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
RMS	Remote Monitoring Station
RWHF	Radiological Waste Handling Facility
S or S-	sulfur
SF_6	sulfur hexafluoride (GHG)
SARA	Superfund Amendments and Reauthorization Act of 1986
SBRSA	Stony Brook Regional Sewerage Authority
SDWA	Safe Drinking Water Act
SERC	State Emergency Response Commission
SO_2	sulfur dioxide
SPCC	Spill Prevention Control and Countermeasure
T	tritium
TCA	trichloroethane
TCE	trichloroethene or trichloroethylene
TFTR	Tokamak Fusion Test Reactor
TMDL	total maximum daily loading (Clean Water Act)
TN	total nitrogen
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
UST	underground storage tanks
VOCs	volatile organic compounds
WCR	Waste Characterization Report (NJPDES permit requirement)
χ/Q	atmospheric dilution factor (NOAA)
$\mu g/L$	micrograms per liter
μSv	microSievert

Princeton Plasma Physics Laboratory (PPPL)
Certification of Monitoring Data for
Annual Site Environmental Report for 2007 and 2008

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 2007 and 2008," are documented and certified to be correct.

Signed:

Virginia Finley
Digitally signed by Virginia Finley
DN: cn=Virginia Finley, o=PPPL, ou=Environmental Services, email=vfinley@pppl.gov, c=US
Date: 2012.02.15 12:11:49 -05'00'

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

Robert Sheneman
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DN: cn=Robert Sheneman, o=PPPL, ou=ES&H/Security Dept., email=rsheneman@pppl.gov, c=US
Date: 2012.02.15 12:34:07 -05'00'

Robert S. Sheneman,
Head, Environmental Services Division

Approved:

Jerry D. Levine
Digitally signed by Jerry D. Levine
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Date: 2012.02.15 13:41:19 -05'00'

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

Chapter

1

Princeton Plasma Physics Laboratory

Annual Site Environmental Report for

Calendar Years 2007-2008

Executive Summary

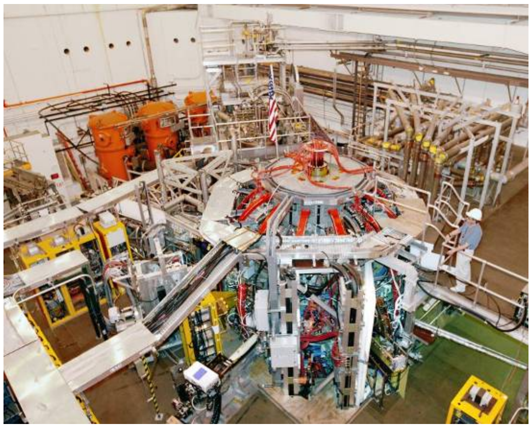
This report presents results of environmental activities and monitoring programs at the Princeton Plasma Physics Laboratory (PPPL) for Calendar Years 2007-2008. The report is prepared to provide the U.S. Department of Energy (DOE) and the public with information on the level of radioactive and non-radioactive pollutants, if any, that are released to the environment as a result of PPPL operations. The report also summarizes environmental initiatives, assessments, and programs that were undertaken in 2007-2008. 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 this fusion reaction, the nuclei of hydrogen atoms, in a plasma state, fuse or join resulting in the formation of helium atoms and the release 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.

Fiscal Years 2007-2008 (FY07-08) marked the ninth and tenth years of the National Spherical Torus Experiment (NSTX) operations, accomplishing 12.63 and 16.63-run weeks respectively. From groundbreaking in May 1998 to the creation of the first plasma on February 12, 1999, NSTX was completed within budget and ahead of the target schedule. PPPL re-used the former TFTR Hot Cell on D-site to house NSTX, which contributed to the cost savings. For the NSTX collaborators, the project was a major effort to produce a smaller, more economical fusion reactor, *i.e.* a volumetric neutron source.

In May 2008, DOE chose to phase out construction of the National Compact Stellarator Experiment (NCSX). The Laboratory had begun construction of the stellarator in April 2003. Its primary purpose was to develop the physics of a compact stellarator as the basis of a fusion power reactor with its unique design; the twisted doughnut-shaped coils, the electromagnets, were to create forces holding the plasma together, and the vacuum chamber was to be the "bottle" containing the plasma. Instead, NSTX was selected to undergo an upgrade, which will include the redesign of the center stack magnets and the addition of a second neutral beam box.

The National Spherical Torus Experiment Heated by Neutral Beam Injection



NSTX is a national collaboration; following institutions are NSTX research participants:

NSTX Collaborators
Columbia University
Fusion Physics & Technology, Inc.
General Atomics
Johns Hopkins University
Lawrence Livermore National Laboratory
Los Alamos National Laboratory
Massachusetts Institute of Technology
Oak Ridge National Laboratory
Sandia National Laboratory
University of California at Davis
University of California at Los Angeles
University of California at San Diego
University of Washington at Seattle

Cadarache, France - the site for ITER

On June 28, 2005, the location of the International Thermonuclear Experimental Reactor or ITER, which in Latin means "the way," was decided at a ministerial-level meeting in Moscow. A bilateral agreement was reached between France and Japan that ITER will be built at Cadarache, France and that the "Broader Approach," the complementary development projects, would be located in Japan.

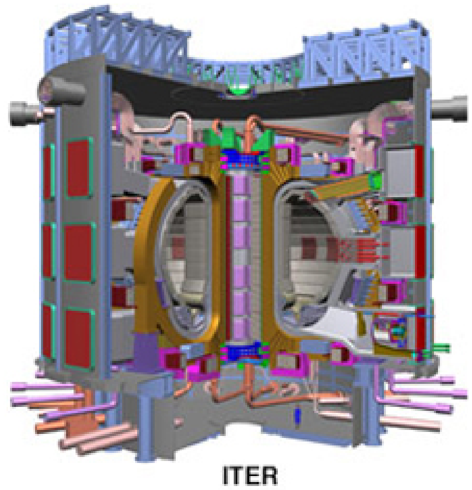
The former Japanese Deputy Minister of Science and Technology, Ambassador Kaname Ikeda, was nominated for Director of ITER Organization. He inaugurated the "Joint Work Site" at Cadarache in December 2005. Another important milestone was the addition of its newest party member, India that brought the total to thirty-three nation participants.

The Cadarache facility is located in southeastern France, in the Provence-Alpes-Côte-d'Azur region (see map). Since 1959, this location has been the site of nuclear research when President Charles de Gaulle launched France's atomic energy program. In 2007, ITER construction began with a projected completion date of 2018.

PPPL partnered with Oak Ridge National Laboratory, hosts the U.S. ITER Project office. This office coordinates U.S. ITER activities.

http://www.iter.org/default.aspx

Location of ITER



Artist's Rendition of the International Thermonuclear Experimental Reactor (ITER)

USEPA Deputy Administrator Marcus Peacock visits PPPL

On April 22, 2008, PPPL became the Department of Energy's (DOE) first facility designated as an ENERGY STAR® partner by US Environmental Protection Agency (USEPA). The Laboratory's commitment to reduce its energy use and carbon footprint through the purchase of energy efficient products and its energy reduction projects while conducting "cutting edge research" was praised by DOE Under Secretary for Science Dr. Raymond Orbach.

The ENERGY STAR® partner designation was presented by USEPA's Deputy Administrator, Mr. Marcus Peacock, to PPPL Director, Rob Goldston, at PPPL's Earth Day celebration.

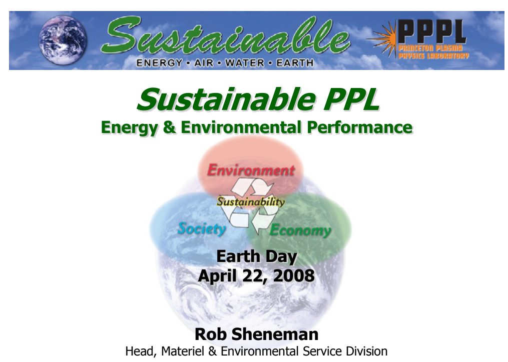
http://www.pppl.gov/polNews.cfm

U.S. Environmental Protection Agency Deputy Administrator Marcus Peacock (right) congratulates PPPL Director Rob Goldston on PPPL being designated as an ENERGY STAR® partner during PPPL's Earth Day celebration. (PPPL Hotline, Vol. 29, No. 7, April 2008)

ENERGY STAR PARTNER

In addition to the , ENERGY STAR® partnership, PPPL presented its annual "Green Machine" awards to those employees who were recognized for their efforts to save energy, reduce waste and improve PPPL's environmental performance.

PPPL received the DOE Office of Science's Pollution Prevention (P^2) Star Award for "Outstanding Recycling in FY07" and Honorable Mention Award for the Laboratory's Compressed Natural Gas and B20 fleet vehicle program.



As evidence by these awards and recognition, PPPL has long prided itself to be "a good environmental neighbor." The spirit of "Sustainability" goes a step beyond excellence in environmental performance to embrace all three components of a sustainable site – Environment, Society, and Economy.

PPPL Achievements 2007-2008

On January 26, 2007, President Bush signed Executive Order (EO) 13423, "Strengthening Federal Environmental, Energy, and Transportation Management." This EO set forth goals in the following categories:

- Petroleum conservation – reduce fleet consumption by 2% annually through 2015

- Alternative fuel use – increase non-petroleum fuel consumption by 10% annually
- Alternative fuel vehicles (AFV)–use plug-in hybrids when available >75% of new vehicles
- Energy efficiency and green-house gases (GHGs) – reduce energy intensity and GHGs by 3% annually through 2015 or 30% by 2015
- Renewable power – at least 50% of current use from renewable energy purchases in service after 1/1/99
- Building performance – construct or renovate buildings using "Guiding Principles" and 15% of existing buildings meet Green building sustainable standards by end of FY2015
- Water conservation – reduce water consumption intensity by 2% annually through 2015 or 16% by end of FY2015
- Procurement – expand purchases of environmentally sound goods and services including bio-based products and 30% post-consumer paper
- Pollution prevention – reduce use of chemicals/toxic materials
- Electronics management – annually purchases meet electronic product environmental assessment tool (EPEAT) requirements for 95% of electronic products, enable Energy Star® features on 100% of computers/monitors, establish and implement policies to extend useful electronics life, and reuse, donate, sell or recycle 100% of electronic products in an environmentally sound way
- Environmental Management System (EMS) – implement EMS at all appropriate levels to ensure use of EMS as primary management approach.

In Chapter 3, Exhibit 3-17 provides PPPL progress in meeting these goals. In general, PPPL has made progress in meeting the eleven goals as outlined above. The following photos show the different ways PPPL is meeting these goals.

Carpet removal and recycling

New E-85 fuel tank

Green cleaning products (Procurement)

Drip hoses to conserve water

New chiller (Energy conservation)

Recycle bins for paper, plastic and aluminum

In 2007-2008, PPPL's radiological environmental monitoring program measured tritium in the air at on-site and off-site sampling stations. PPPL is capable of detecting small changes in the ambient levels of tritium by using highly sensitive monitors. The operation of an in-stack monitor located on D-site is a requirement of the National Emission Standard for Hazardous Air Pollutants (NESHAPs) regulations with limits set by the Environmental Protection Agency (EPA). Also included in PPPL's radiological environmental monitoring program, are precipitation, surface, ground, and wastewater monitoring.

The total maximum off-site doses for 2007-2008 are a small fraction of the 10-mrem/year PPPL objective and the 100-mrem/year DOE limit. The dose results of the radiological monitoring program for 2007 were as follows:

1. Total maximum off-site dose from all sources—airborne and liquid releases—was 0.0162 mrem per year.
2. Dose at the nearest business due to airborne releases was 0.00447 mrem per year.
3. The collective effective dose equivalent for the population living within 80 kilometers was 0.134 person-rem.

The dose results of the radiological monitoring program for 2008 were:

1. Total maximum off-site dose from all sources—airborne and liquid releases—was 0.00784 mrem per year.
2. Dose at the nearest business due to airborne releases was 0.00192 mrem per year.
3. The collective effective dose equivalent for the population living within 80 kilometers was 0.0583 person-rem.

PPPL's Pollution Prevention Program results in 2007 and 2008, respectively, were based on:

1. Usage of recycled material *versus* non-recycled material;
2. Reduction of waste to landfills and/or disposers - hazardous waste (80.4%, 56.6%), solid waste (50%, 51.4 %) and construction waste (93.2%, 74.2%) - accomplished by actively seeking waste recyclers, and
3. Buying recycled rate (90.4% , 90.1%) with the goal of 100%.

PPPL's non-radiological environmental monitoring program demonstrates compliance with applicable environmental requirements. The program includes monthly surface water monitoring and annual chronic toxicity testing. In 2007-2008, annual ground-water monitoring continued as a requirement of the Remedial Action Work Plan including sampling results reporting from selected wells, sumps, and surface water locations. Since 1989, PPPL's investigations have revealed volatile organic compound (VOC) contamination (most likely from solvents) at low levels in three ground-water locations. Based on these results over time, the VOC contaminants are biodegrading through natural attenuation in the ground water. PPPL's remediation of ground water relies on existing building drains for containment and extraction.

PPPL's Community Outreach Program included facilities tours given to school, governmental, service, and private groups, representation at numerous community events, Science on Saturday seminars for the general public, hosting the Regional competition of the New Jersey High School Science Bowl, and participation through the Science Education Program, in local schools and at professional meetings.

The Laboratory is expected 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. ✲

To view current activities and news about PPPL, visit http://www.pppl.gov

Chapter

2

Introduction

2.1 Site Mission

The U.S. Department of Energy's Princeton Plasma Physics Laboratory (PPPL) is a Collaborative National Center for plasma and fusion science. Its primary mission is to develop scientific understanding and key innovations leading to an attractive fusion energy source [PPPL98a]. Related missions include conducting world-class research along the broad frontier of plasma science and providing the highest quality of scientific education and experimentation.

The National Spherical Torus Experiment (NSTX) is a collaborative project among 14 Department of Energy National Laboratories, universities, and institutions. Also located at PPPL are smaller experimental devices, such as 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 in the United States and in other countries. To further fusion science In 2007-2008, 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.

2.2 Site Location

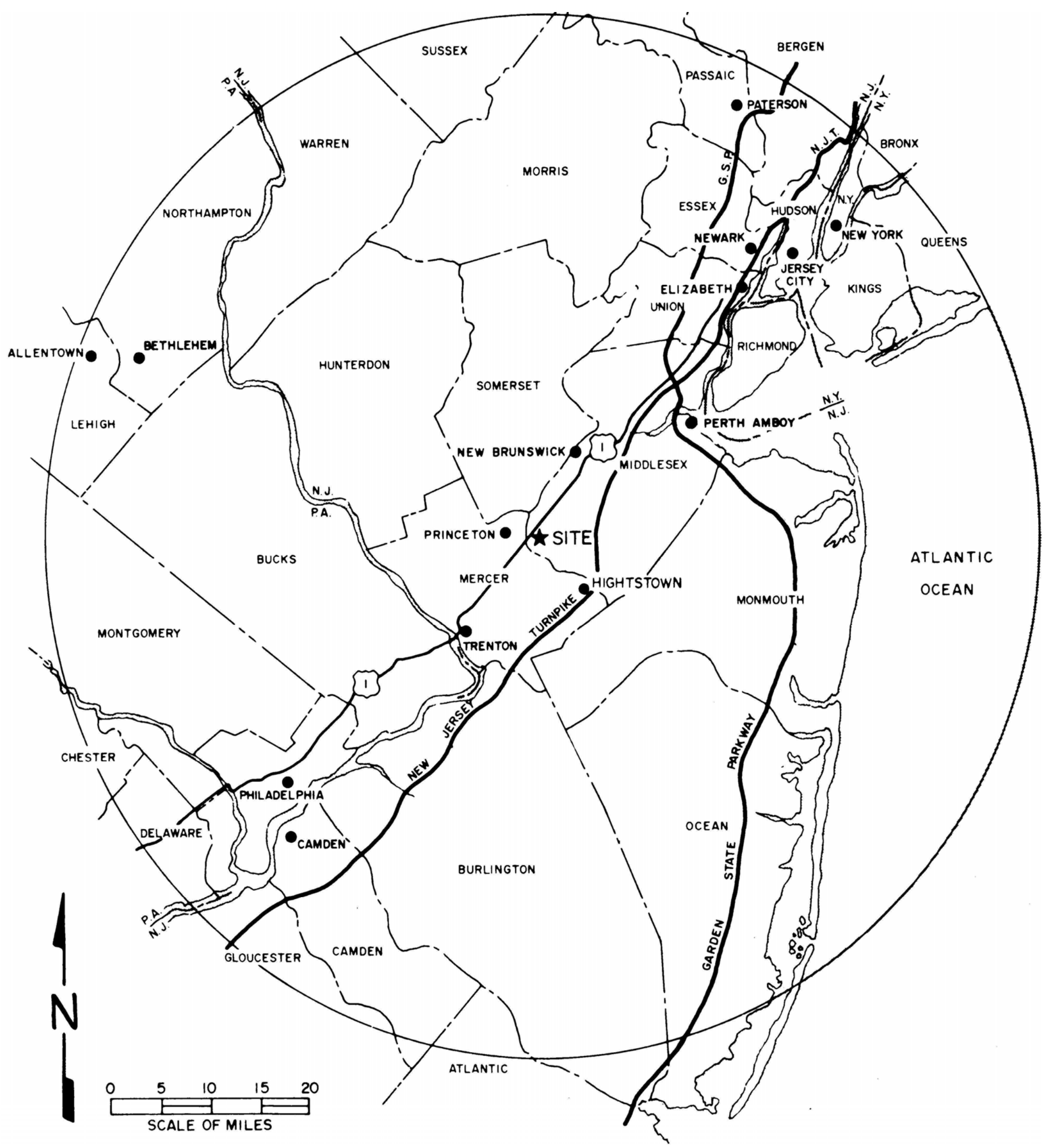
The Princeton Plasma Physics Laboratory site is in the center of a highly urbanized Northeast region. The closest urban centers are New Brunswick, 14 miles (22.5 km) to the northeast, and Trenton, 12 miles (19 km) to the southwest. Within 50 miles (80 km) of the site major surrounding cities, include New York City, Philadelphia, and Newark (Exhibit 2-1).

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 substantial increase in new businesses locating along the Route 1 corridor near the site. Also, the main campus of Princeton University, primarily located within the Borough of Princeton, is approximately three miles west of the site.

In the early 1950's, Dr. Lyman Spitzer's vision for plasma physics culminated in Project Matterhorn, which gained approval of the U.S. Atomic Energy Commission. Its mission was to contain and harness the nuclear burning of hydrogen at temperatures exceeding those found in the sun. Dr. Spitzer became known as the father of the "Stellarator" and was PPPL Director until 1961. Named for Dr. Spitzer's A, B, and C Stellarators, PPPL was first located on A- and B-sites of the James Forrestal Campus (JFC). In 1959, PPPL moved to its present location at C-site. In the late 1970's, D-site became the home of the Tokamak Fusion Test Reactor (TFTR), which operated from 1982 to 1997, and was dismantled and removed between 1999 and 2002. D-site has been home to the National Spherical Torus Experiment (NSTX) since 1998 (Exhibit 2-2).

Surrounding the site are preserved lands that are undisturbed areas including upland forest, wetlands, open grassy areas, and a minor stream, Bee Brook, which flows along PPPL's eastern boundary.

Exhibit 2-1. Region Surrounding PPPL (50-mile radius shown)



These areas are designated as open space in the JFC site development plan. The following aerial photo (Exhibit 2-3) shows the general layout of the facilities at the C- and D-sites of JFC as viewed from the north; former TFTR and NSTX Test Cells are located at D-site (on the left side of photo).

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

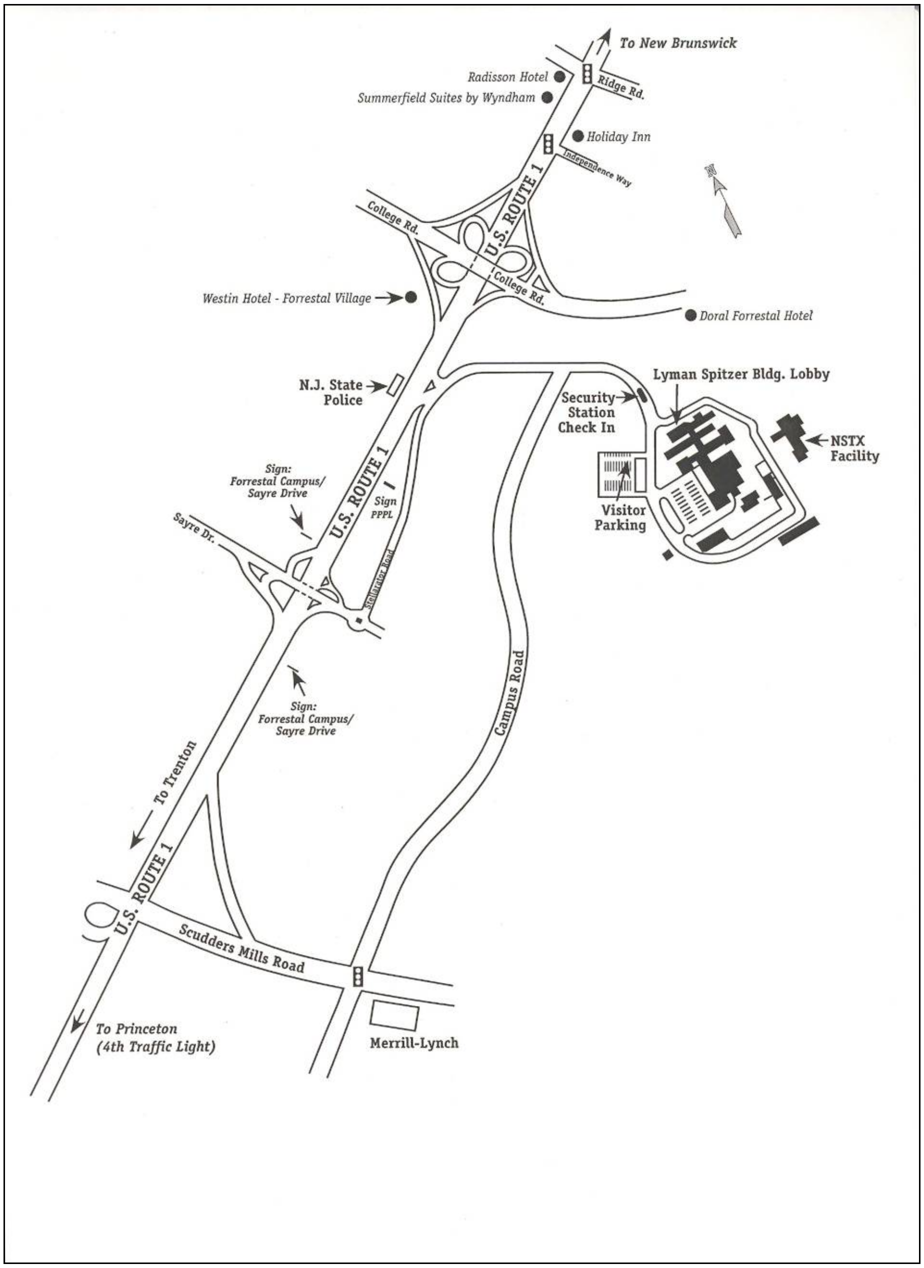


Exhibit 2-3. Aerial View of PPPL

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 Office of PPPL operates 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.

2.3 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 2007, the annual rainfall total, 49.1 inches (124.7 cm), was above the average rainfall for central New Jersey. This above-average level was primarily due to wet weather in April when 14.3 inches (36.3 cm) were recorded (Table 2A). 2008 was another above-average year for annual precipitation (48.15 inches, 122.3 cm) due in part to above-average rainfall in September (7.89 inches, 20.04 cm) (Table 2B).

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

2.4 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 FY07, NSTX completed 12.63 weeks of operations, having produced 1879 plasmas in 2078 plasma attempts; in FY08, NSTX completed 16.62 weeks of operations, having produced 2571 plasmas in 2760 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 to plasma stability and performance ultimately enabling viable fusion power.

In the former TFTR Test Cell, currently named the National Compact Stellarator Experiment (NCSX) Coil Winding Facility, PPPL engineers and technical staff continued the fabrication of the magnetic coils for the NCSX in 2007 and early 2008. The process included copper wire wound on a 360° frame shaped to conform to the twisted vacuum vessel. In order for the copper wire to maintain its shape, the coil was impregnated with an epoxy and placed in a large oven (called an autoclave) where it baked. Then the coil was allowed to cool "curing" the epoxy.

In May 2008, the DOE Office of Science halted the construction of the vacuum vessel and coils and cancelled the funding for the project. DOE cited as the rationale behind its decision were the schedule uncertainties and expanding budget compared to the unknown risks of the project. The remainder of 2008 was spent preparing documentation of the design and component fabrication efforts, preparing components for storage, and moving the coils and vacuum vessel segments into storage on C-site.

One bright area in 2008 at PPPL was the Lithium Tokamak Experiment (LTX) that produced its first plasma in September 2008. The primary goal of LTX is to investigate the properties of a lithium liquid coating for plasma surfaces or plasma-facing component (PFC). The previous experiment, Current Drive Experiment-Upgrade (CDX-U) held the lithium in a circular tray at the base of the vacuum vessel. The LTX liquid lithium was evaporated and deposited a thin layer inside the vacuum vessel and kept liquid by heater in the shell.

Using "Pro/ENGINEER" computer assisted design software (CAD), B. Paul, a PPPL designer, created a CAD model of the entire machine including the diagnostics (Exhibit 2-4) [Hotline Nov. 2008].

Exhibit 2-4. CAD model of Lithium Tokamak Experiment (LTX)

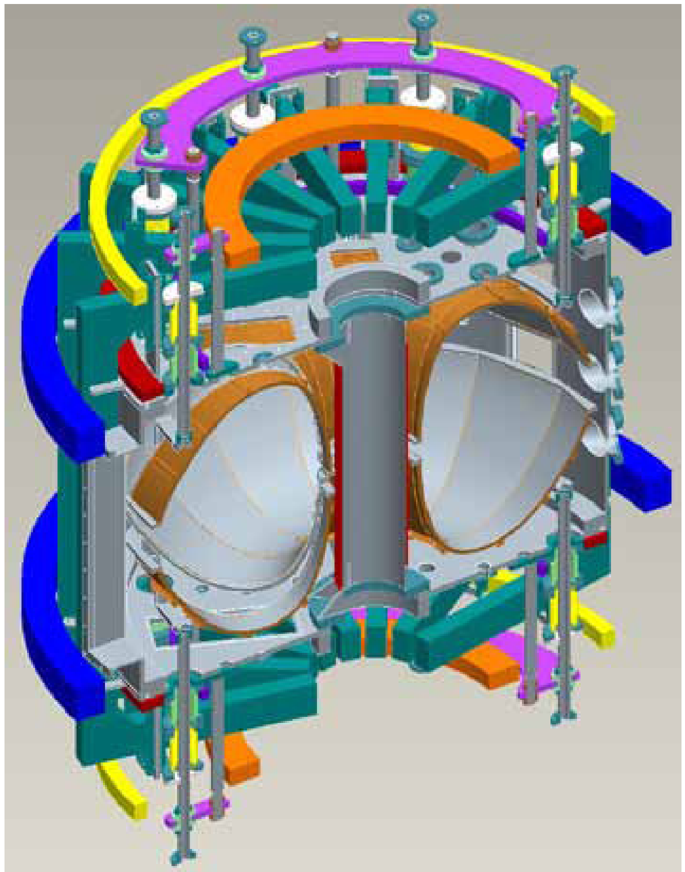


Exhibit 2-4 shows the vacuum vessel in gray in this cut-away view and the magnetic pickup coils on the interior of the shell. The scale of the device is about four feet (1.25 meters) in diameter and about two feet (~0.63 meters) above the floor where the vessel sits atop four supports.

2.5 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 2000 US Census Bureau Statistics, Middlesex County has a population of 750,162; adjacent counties of Mercer, Monmouth, Somerset, and Union have populations of 350,761, 615,301, 297,490, and, 522,541 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

3

2007-2008 COMPLIANCE SUMMARY

3.1 Environmental Restoration and Waste Management

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 way that minimizes environmental impacts. PPPL initiates actions which enhance and document compliance with the requirements. Compliance with each applicable federal, state, and local environmental statute or regulation, and Executive or DOE Orders [DOE93a, 99b, 00, 03a, 03b, and 08] are discussed in this chapter.

3.1.1 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

During 2007-2008, PPPL had no involvement with CERCLA-mandated cleanup actions. Following the 1991 assessment by a Department of Energy – Headquarters (DOE-HQ) environmental team, known as the Tiger Team, PPPL developed a plan to evaluate and document past CERCLA hazardous substances releases. A CERCLA inventory was completed in 1993 [Dy93], no further CERCLA actions were warranted. A state-regulated environmental investigation/remediation project is discussed further in Chapters 6 and 7.

3.1.2 Resource Conservation and Recovery Act (RCRA) and Solid Waste

The Laboratory complies with the requirements of a large-quantity hazardous waste generator. In 2007, PPPL shipped approximately 9.3 tons (8.4 metric tons (MT)) of waste to off-site facilities permitted to treat, store, or dispose of hazardous waste; other waste, equaling 39.8 tons (36.1 MT) or 80.4% of the total, was recycled, [MP08a]. Summaries of PPPL's annual hazardous waste generation amounts and waste reduction/recycling efforts are presented in Exhibits 3-1 & 3-2. In 2007, PPPL recycled 50% of its municipal solid waste stream, which met PPPL's internal goal of 50% recycled waste [Kin 08, McG08].

In 2008, PPPL shipped approximately 9.2 tons (8.3 metric tons, MT) of waste to off-site facilities permitted to treat, store, or dispose of hazardous waste; other waste, equaling 12 tons (10.9 MT) or 56.6% of the total, was recycled, [MP09a]. Summaries of PPPL's annual hazardous waste generation amounts and waste reduction or recycling efforts are presented in Exhibits 3-1 & 3-3. In 2008, PPPL recycled 51.4% of its municipal solid waste stream, which exceeded DOE's goal of 45% and PPPL's 50% internal goal [Kin09, McG09].

Exhibit 3-1 compares the three largest quantities by waste type generated from 1998 to 2008. Normally, waste types vary yearly, however, from 2005 to 2008, the largest waste categories/types were similar: largest waste streams-recycled electronic/computer monitors and batteries. The exception was oil/oily soil in 2007 that resulted from a large spill in December 2006, requiring removal of contaminated soil (recycled with paving materials).

Exhibit 3-1. Hazardous Waste Comparisons 1998-2008 (3 largest categories)

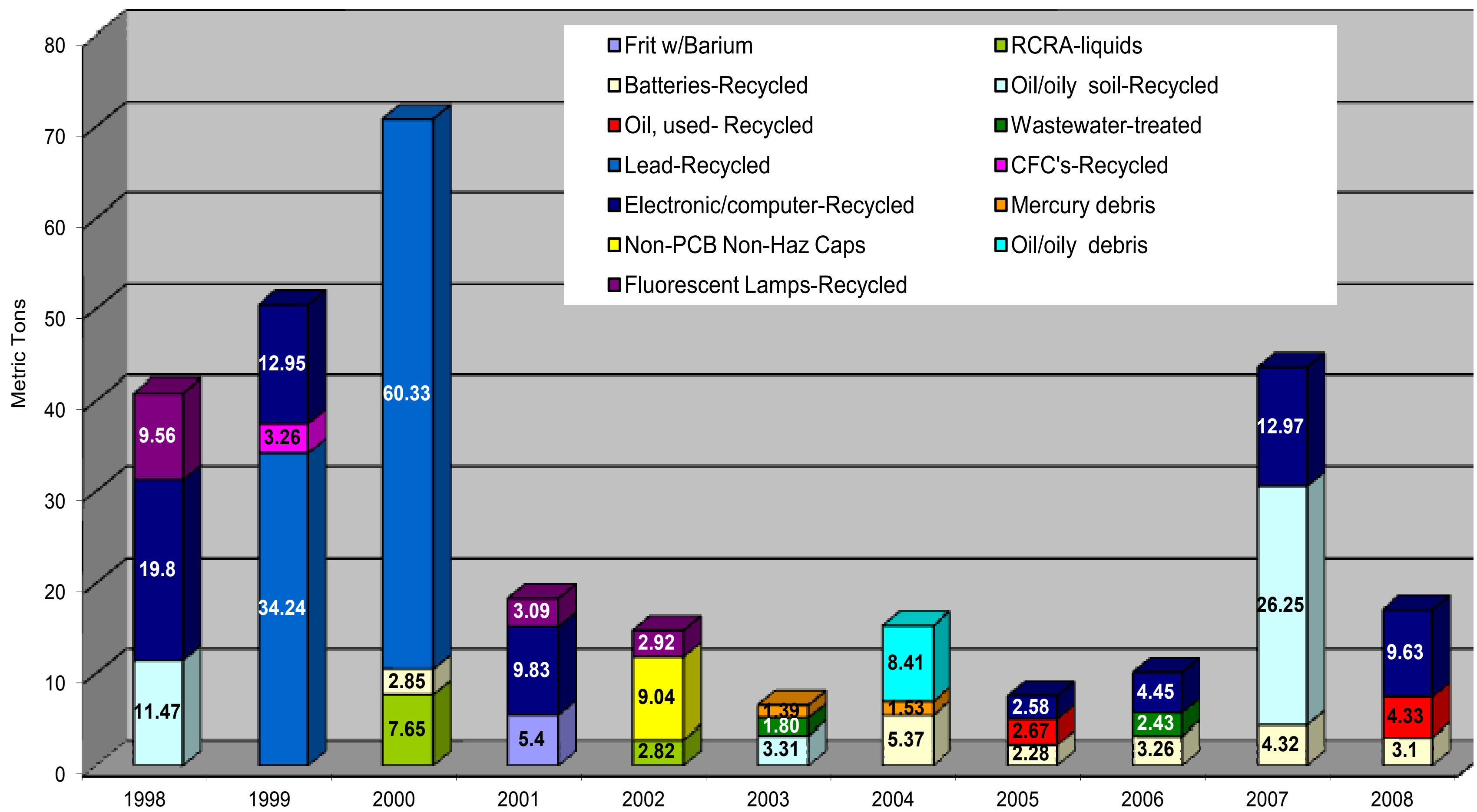


Exhibit 3-2. 2007 Waste Recycling/Reduction/Green Purchases vs. Landfill/Incineration

View PPPL Pollution Prevention accomplishments @http://tis.eh.doe.gov/p2/wastemin/RecycleRpt.Asp

Metric ton equals 2,205 pounds or 1.10 tons

Type	Source	Amount	Fate
Hazardous	**Recycled / Total Hazardous Waste**	**80.4%**	
Waste	Oil used	1.34 MT	**Recycled**
	Oily sand, soil, gravel	**26.25** MT	**Recycled**
	Batteries (includes lead acid)	**4.31** MT	**Recycled**
	Fluorescent lamps (contain Hg)	0.31 MT	**Recycled**
	Mercury /Mercury debris	0.49 MT	**Recycled**
	Oily debris	0.53MT	**Recycled**
	Mixed glycol	2.31MT	**Recycled**
	Optishield	0.58MT	**Recycled**
	RCRA Solvents	2.70 MT	**Incinerated**
	Diethyl hexyl phthalate	1.01 MT	**Incinerated**
	Selenium	0.88 MT	**Incinerated**
	Scintillation vials	0.61 MT	**Incinerated**
	Diesel fuel	0.44 MT	**Incinerated**
	Waste acids –sulfuric, hydrochloric	0.32 MT	**Incinerated**
	Non-PCBs ballasts	1.73 MT	**Incinerated**
	Hydroxide-sodium, potassium	0.40 MT	**Incinerated**
TSCA	Asbestos	40 cu. yds.	**Land-filled**
	Ballasts incl. Ballasts (PCBs)	0.25 MT	**Incinerated**
Municipal	**Office Waste Stream**	**50.01 %**	
Solid	Front end trash	51.85 MT	**Land-filled**
Waste	Aluminum & glass (bottles & cans)	6.92 MT	**Recycled**
(MSW)	Cardboard/ Paper (mixed)	44.96 MT	**Recycled**
	Industrial Waste Stream	**100 %**	
	Scrap metals (Al, SS, Cu, Fe)	165.94 MT	**Recycled**
	Computer monitors/Electronic Media	**12.97** MT	**Recycled**
	Toner /printer cartridges	0.35MT	**Recycled**
	Construction waste		
	(Land-filled v. Recycled)	**93.17 %**	
	Construction & Demolition trash	157.43 MT	**Land-filled**
	Wood	26.25 MT	**Recycled**
	Concrete/Asphalt	272.15 MT	**Recycled**
	Roof ballast stone	1,850.48 MT	**Recycled**
	Buy Recycled Products Rate-unadjusted	**90.4 %**	

[Kin08a, MP08a, McG 08]]

Exhibit 3-3. 2008 Waste Recycling/Reduction/Green Purchases vs. Landfill/Incineration

View PPPL Pollution Prevention accomplishments @http://tis.eh.doe.gov/p2/wastemin/RecycleRpt.Asp

Metric ton equals 2,205 pounds or 1.10 tons

Type	Source	Amount	Fate
Hazardous	**Recycled / Total Hazardous Waste**	**56.57%**	
Waste	Oil used	**4.33** MT	**Recycled**
	Diethyl hexyl phthalate	0.19 MT	**Recycled**
	Batteries (includes lead acid)	**3.10** MT	**Recycled**
	Fluorescent lamps (contain Hg)	0.59 MT	**Recycled**
	Chemical process liquids	2.27 MT	**Recycled**
	Non-PCB capacitors	1.46 MT	**Incinerated**
	Silicone	0.20 MT	**Incinerated**
	Waste gasoline	0.15 MT	**Incinerated**
	Waste acids –sulfuric, hydrochloric, acetic, tannic	0.31 MT	**Incinerated**
	Disodium trioxosilcate.	0.19 MT	**Incinerated**
	Scintillation vials	0.79 MT	**Incinerated**
	Solvents	1.32 MT	**Incinerated**
	Oily debris	3.08 MT	**Land-filled**
	Petroleum/Oil contaminated soil	0.25 MT	**Land-filled**
TSCA	Asbestos	40 cu. yds.	**Land-filled**
Waste	PCB capacitors, ballasts &debris	0.30 MT	**Incinerated**
Municipal	**Office Waste Stream**	**51.35 %**	
Solid	Front end trash	44.48 MT	**Land-filled**
Waste	Aluminum & glass (bottles & cans)	6.76 MT	**Recycled**
(MSW)	Cardboard/ Paper (mixed)	40.19 MT	**Recycled**
	Industrial Waste Stream	**100 %**	
	Scrap metals (Al, SS, Cu, Fe)	103.85 MT	**Recycled**
	Computer monitors /Electronic Media	**9.63** MT	**Recycled**
	Toner/printer cartridges	0.16 MT	**Recycled**
	Construction waste		
	(Land-filled v. Recycled)	**74.18 %**	
	Construction & Demolition trash	64.07 MT	**Land-filled**
	Wood	9.63	**Recycled**
	Concrete/Asphalt	168.80	**Recycled**
	Buy Recycled Products Rate-unadjusted	**90.1 %**	

[Kin08a, MP08a, Mc08]

PPPL is in compliance with the requirements of the RCRA-mandated Underground Storage Tank (UST) Program having completed the closure of all USTs. In 1995, PPPL completed the removal or in-place closure of all on-site USTs. In March 1997, PPPL submitted a Site Assessment Report as part of the Remedial Investigation and Remedial Alternative Assessment (RI/RAA) Report [HLA97]. In March 2000, NJDEP issued a "No Further Action" determination for the UST closure in correspondence with Princeton University.

3.1.3 Federal Facility Compliance Act (FFCA)

The 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. Based on the possibility of the site generating mixed waste, which could require treatment on site, PPPL was identified on the list of DOE sites that would be included in the FFCA process [PPPL95]. In 1995, PPPL prepared its proposed "Site Treatment Plan (STP) for Princeton Plasma Physics Laboratory (PPPL)." PPPL does not currently generate mixed waste and has no future plans to generate mixed waste.

PPPL developed an approach where any potential mixed waste would be treated in the original accumulation container within 90 days of generation of the hazardous waste. This treatment option was discussed with the State of New Jersey Environmental Protection Department (NJDEP) and Environmental Protection Agency (EPA) Region II regulators, who were in agreement with this approach. Based on their agreement, this approach keeps PPPL in compliance with the applicable Resource Conservation and Recovery Act (RCRA) Land Disposal Restrictions. DOE provides the state and EPA with annual updates and keeps the regulators apprised of activities. If mixed waste was generated that could not be treated in an original accumulation container, PPPL would notify the regulators and provide them with a revised "Site Treatment Plan" [PPPL95].

3.1.4 National Environmental Policy Act (NEPA)

Twenty-five (25) PPPL activities received NEPA reviews in 2007. Eighteen (18) PPPL activities received NEPA reviews in 2008. All of these activities were determined to be categorical exclusions (CX) in accordance with the NEPA regulations and guidelines of the Council on Environmental Quality (CEQ) and DOE, or covered in a previously approved environmental assessment (EA). [Lev08b, Lev09b].

3.1.5 Toxic Substance Control Act (TSCA)

PPPL complies with the terms and conditions of TSCA for the protection of human health and the environment by requiring that specific chemicals be controlled and regulations restricting use are implemented. The last TSCA-regulated polychlorinated biphenyl (PCB) transformers were removed from the site in 1990.

In September 1998, 640 regulated capacitors were removed from the total inventory of 645 capacitors. At the end of 2007-2008, 5 PCB capacitors that met the regulation criteria remained at PPPL [MP09b].

3.1.6 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

Certified subcontractors, who meet all the requirements of FIFRA, performed the application of herbicides, pesticides, insecticides, and fertilizers. The PPPL Maintenance & Operations Division (M&O) monitors this subcontract. These herbicides/insecticide /fertilizer were used on the PPPL site in 2007-2008 [Kin08b, Kin09b].

	Herbicides	Insecticides	Fertilizer
2007	Roundup (5.8 gallons) Dimension (3 qts.)	Sevin Carbaryl(160 gal. diluted)	NPK (1600 lbs.)
2008	Roundup (5.9 gallons) Dimension (6 qts.)	Sevin Carbaryl (15 gals.)	Lime (1500 lbs.) NPK (1500 lbs.) 24-0-5 (1600 lbs.)

3.1.7 Spill Prevention Control and Countermeasure (SPCC)

As a requirement of 40 CFR 112 "Oil Pollution Prevention" regulation changes, PPPL revised the Spill Prevention Control and Countermeasures (SPCC) plan in 2007 [PPPL07e]. There are numerous transformers containing non-PCB mineral oil as well as fuel oil tanks (25,000 and 15,000 gallon aboveground storage tanks) for supplying fuel to the boilers and emergency generators located on-site. Smaller vehicle refueling tanks and equipment oil storage tanks containing petroleum products are included in PPPL's SPCC plan. The SPCC plan is reviewed annually and updated at least every five years.

The most recent inspection of the facility conducted occurred in June 1998 by US EPA Region 2. Under New Jersey regulations, NJDEP classified PPPL as a non-major facility [NJDEP98a]. The threshold of 200,000 gallons of petroleum (not in transformers) is not exceeded. As a minor facility, the Discharge Prevention Control and Containment (DPCC) plan and Discharge Cleanup and Reporting plan (DCR) requirements do not apply to PPPL.

In November 2004, NJDEP notified PPPL that although PPPL has reporting obligations under the regulations to call the NJDEP Action Hotline, the 30-day written discharge confirmation report was no longer required for minor spills that are cleaned up in a timely manner [NJDEP04a]. PPPL notifies NJDEP when oil/hazardous materials are accidentally released to a pervious surface, and PPPL proceeds to control the release and clean-up the spill. Significant spills and/or spill that migrate off-site still require notification to NJDEP and/or EPA under the SPCC and other regulations.

3.2 <u>Radiation Protection</u>

3.2.1 DOE Order 5400.5, *Radiation Protection of the Public and the Environment*

For radiation protection of the public and the environment, PPPL follows the requirements documented in the Radiological Monitoring Plan contained in PPPL's Environmental Monitoring Plan [PPPL03b]; the Plan meets the applicable requirements of DOE Order 5400.5 [DOE93a].

Through its monitoring program, the Plan provides assurance that the release of radioactive material on-site or off-site will be within regulatory limits and PPPL's policy to maintain all radiation exposures "As Low As Reasonably Achievable" (ALARA). The order pertains to permissible dose equivalents and concentration guides as well as giving guidance on maintaining exposures to ALARA limits.

When 10 CFR 835, "Occupational Radiation Protection," became effective, PPPL made operational changes reflected in personnel monitoring requirements. Specific criteria for implementing the requirements are included in the NSTX Safety Assessment Document [PPPL01a]. These criteria are shown in Table 1A.

The radiation monitoring program emphasizes exposure pathways appropriate to PPPL's fusion energy research. The pathways include external exposure from direct penetrating radiation and internal exposure from tritium releases.

After TFTR deuterium and tritium experiments (isotopes of hydrogen, D-T) concluded in 1997, internal exposure from radionuclides, tritium (HT and HTO) in air and water, continued to be monitored. Tritium releases were measured following TFTR shut down, during TFTR Decontamination and Decommissioning (D&D) Project, and post-D&D. Six major critical pathways are considered appropriate (Exhibit 3-4).

The radiation monitoring program, described in the TFTR Final Safety Analysis Report [FSAR82], was updated to reflect the environment around TFTR and D site (Exhibit 3-5). PPPL's Environment, Safety & Health Directives (ESHD) 5008, Section 10, "Radiation Safety," Subpart L, "Release of Materials and Equipment from Radiological Areas," and Subpart P, "Radiological Environmental Monitoring Program," support the requirements for compliance with DOE 5400.5 [PPPL93a]. Monitoring of equipment and the environment ensures radiation protection for employees and public good.

3.2.2 DOE Order 435.1, *Radioactive Waste Management*

To comply with the requirements of DOE Order 435.1, PPPL manages its radioactive waste by two implementing documents [DOE99b]:

1. PPPL ESHD 5008, Section 7, "Waste Management" [PPPL03c]; and
2. Materiel & Environmental Services Division (M&ES), EM-CP-21, Certification of Low-level Radio-active Waste for Disposal at Nevada Test Site [PPPL05c].

The first document discusses roles and responsibilities for the management of radioactive waste and describes the Radioactive Waste Handling Facility (RWHF) operations. The second document describes PPPL's organization and methodology for characterizing, handling, and certifying low-level radioactive and mixed waste that may be generated by PPPL. This plan includes transportation and subsequent burial at the Nevada Test Site (NTS) outside of Las Vegas, Nevada. Other M&ES procedures provide specific instructions for sampling, packaging and preparing waste for shipment/disposal.

Exhibit 3-4. Critical Pathways

	Source and Pathway
A1	Atmospheric ---> Whole Body Exposure
A2	Atmospheric ---> Inhalation Exposure
A3	Atmospheric ---> Soil and Vegetation Deposition---> Ingestion/Whole Body Exposure
L1	Liquid Water Way ---> Drinking Water Supply --> Human
L2	Liquid Water Way ---> External Exposure
L3	Liquid Water Way ---> Fish ---> Human

Exhibit 3-5. Radiation Monitoring Program Covering Critical Pathways

Type of Sample	Critical Pathway Exhibit 3-4	Sample Location	Sampling Frequency	Type of Analysis
Surface Water	L1, L2, L3 & A3	1 – Basin Outfall (DSN001) 2 – Delaware & Raritan Canal (DSN003) 3 – Off-site (Bee, Cranbury, Devils Brooks, Millstone River)	1 – Monthly 2 – Monthly 3 - Quarterly	All surface water samples –HTO
Rain Water	L1, L2, & L3	Within 250 and 500' radius of D-site stack (N,S,E, & W) Within 1 km radius (co-located with air monitoring stations)	Monthly (as filled)	HTO
Ground Water	L1, L2, & L3	1– Select ground water monitoring wells 2 –D-site sumps-Air shaft and MG basements	Monthly	HTO
Sanitary Waste Water	L1 & L2	Liquid effluent collection tanks (3 tanks each 15,000 gal. on D-site)	As required	HTO Gross beta
Air	A1, A2, & A3	TFTR Test Cell	Continuously	HT and HTO
Air	A1, A2, & A3	Tritium Vault	Continuously	HT and HTO
Air	A1, A2, & A3	D-site Stack (HVAC)	Continuously	HT &HTO, Particulates
Direct & Air (on-site)		4 air monitoring trailers on D-site facility boundary	Continuously	g, n, HT and HTO,
Direct & Air (off-site)		6 locations off-site with 1 km radius	Continuously	HT and HTO

HT = elemental tritium   HTO = tritiated water   Gross b = Gross beta   g = gamma   n = neutron

3.2.3 Atomic Energy Act (AEA) of 1954 (442 USC 2001 *et seq*.)

PPPL complies with the requirements of the Atomic Energy Act (AEA) of 1954 through adherence to its plan developed for controlling radioactive material. PPPL's "Nuclear Materials Control and Accountability (MC&A) Plan" describes the system for control and accountability of nuclear materials in PPPL's custody [PPPL04, Rev. 5]. PPPL's management program assures that nuclear material used at PPPL is properly controlled, inventoried, and accounted for as required in DOE Order 474.1 [DOE00].

The objective of the MC&A program is to provide a basis for planning, implementing, and evaluating an information and control system. The system is a combination of checks and balances sufficient to detect and assist in the prevention of the unauthorized use and removal of nuclear materials from PPPL.

3.3 Air Quality and Protection

3.3.1 Clean Air Act (CAA)

PPPL complied with the requirements of the CAA in 2007-2008. Under Title I, "Non-attainment Provisions," PPPL is located in a severe 17-ozone non-attainment area (ozone attainment to be reached 15 to 17 years following date of regulations, *i.e.* 2005 - 2007). This classification limits the threshold potential-to-emit (PTE) to 25 tons per year of nitrogen oxides (NO_x) and 10 tons per year of volatile organic compounds (VOCs). Formed during the burning of fossil fuels in boilers, generators, vehicle engines, *etc.*, NO_x and VOCs are precursors to ozone formation.

At PPPL, NO_x is the class of regulated air contaminant that could exceed PTE thresholds limit of greater than 25 tons per year. Annually, PPPL calculates total emissions using natural gas and fuel oil consumption and hours of operations for all four boilers in order to document compliance with this limit. Annual fuel use limits for the boilers assure that PPPL's total emissions are below the limit. PPPL's emergency diesel generators are limited by the maximum hours of operation permitted annually.

PPPL requested from NJDEP the fuel limits (Exhibit 3-6) and limited hours of operations for the generators. NJDEP granted the request and imposed a maximum annual fuel (oil and natural gas) use limitation for the C-site boilers as a whole rather than the individual boiler fuel use limit. PPPL continues to operate successfully within the stated limitations (typically less than 30% of the limitations) [NJDEP95b, Ne08]. In 2007, actual NO_x emission from the four boilers was calculated to be 5.41 tons, well below the regulatory limit of 15.26 tons per year (Exhibit 3-7).

In 2008, actual NO_x emission from the four boilers was calculated to be 5.06 tons, well below the regulatory limit of 15.26 tons per year (Exhibit 3-7).

As a requirement of New Jersey Administrative Code (NJAC) Title 7:27-21, "Emissions Statements," PPPL submitted the 1994 Air Emission Survey to NJDEP; this Emission Survey was the last survey submitted. In March 1996, the NJDEP approved PPPL's request for Annual Emission Statement Non-Applicability.

The CAA Title V, "Operating Permit Program," is implemented through the State of New Jersey. In August 1995, PPPL filed a negative declaration for the New Jersey Operating Permit Program. By reducing the annual operating hours from 500 to 200 for the D-site (formerly TFTR) emergency diesel generator, PPPL lowered the NO_x potential to emit to below the 25 ton-per-year threshold. NJDEP granted approval in March 1996, effective November 29, 1995.

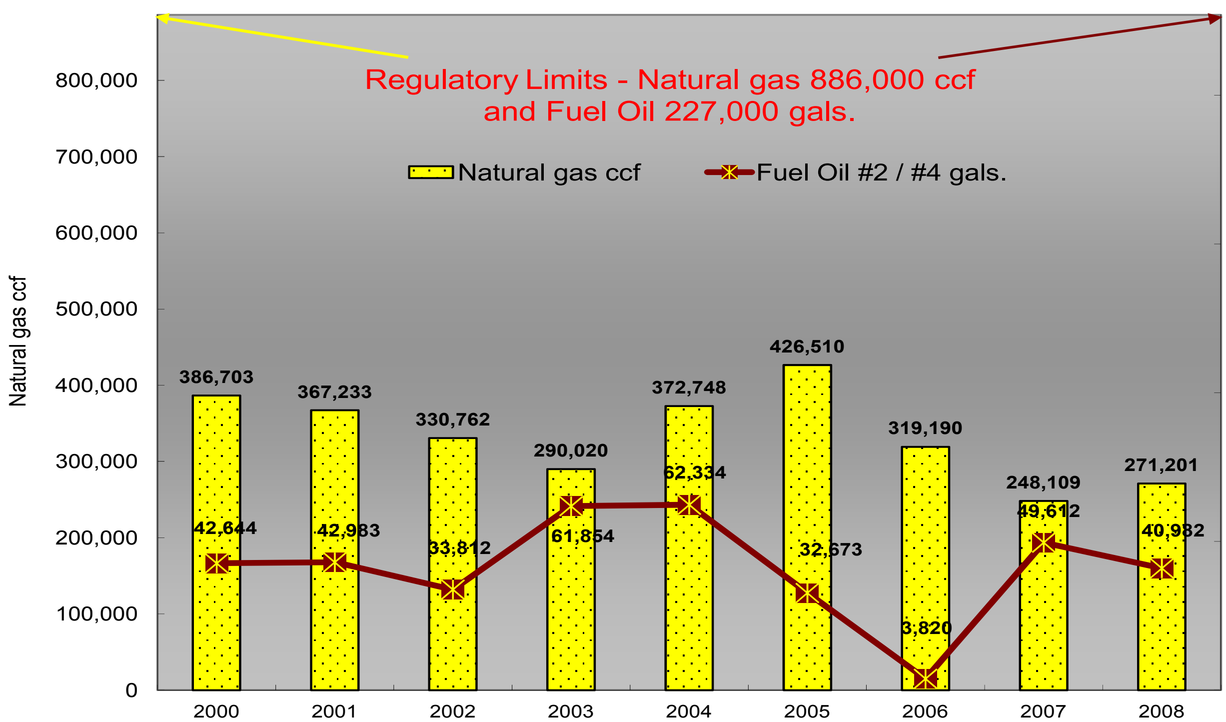
Under CAA Title VI, "Stratospheric Ozone Depletion," PPPL's use of certified refrigerant recovery units and trained technicians comply with Section 608 of the CAA, which prohibits the venting of ozone-depleting substances. PPPL maintains an inventory of Class I and II ozone-depleting substances (chlorofluorocarbons or CFCs and Halon).

PPPL safely disposes of equipment containing ozone-depleting substances by removing refrigerants to specified levels prior to disposal of equipment. PPPL employs trained and certified technicians to service and repair equipment containing ozone-depleting substances (ODS) and to operate the four refrigerant recovery units. In 2007-2008, fire protection systems that contain Halon 1211 or 1301 were the only remaining Class I ODS on-site.

In its efforts to track gases that contribute to global warming, NJDEP requested that PPPL determine the amount of sulfur hexafluoride (SF_6) released annually from TFTR. Prior to 1995, the amount of SF_6 needed to maintain the SF_6 systems ranged from 28,060 pounds to 36,340 pounds per year. During TFTR operations, SF_6 maintained high-voltage electrical equipment - modulator regulators, ion cyclotron radio frequency (ICRF), and neutral beam (NB) high voltage and ion source enclosures.

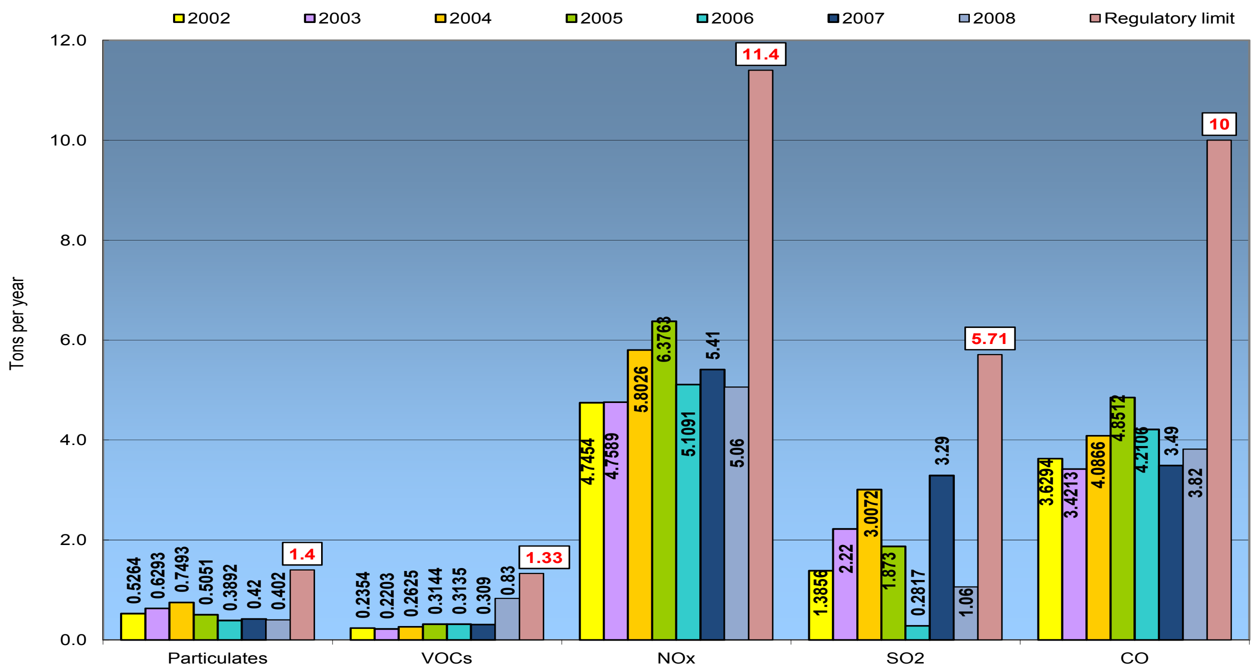
Following TFTR shutdown in 1997, PPPL removed SF_6 from those systems; as SF_6 is currently used in NSTX's high voltage power, ICRF, and NB systems as an electrical insulating gas, PPPL maintains a working inventory of SF_6 and the necessary gas handling and recovery systems.

Exhibit 3-6. Natural Gas and No. 2 and 4 Fuel Oil Consumption from 2000 to 2008



Note: **No. 2 Fuel oil consumption first began December 2004.**
No. 4 Fuel oil no longer burned after December 2004.

Exhibit 3-7. 2002 to 2008 Total Air Emissions from Boilers 2-5



3.3.2 National Emission Standards for Hazardous Air Pollutants (NESHAPs) (40 CFR Part 61, Subpart H- Emissions of Radionuclides)

PPPL has a sampling system within the D-site stack to monitor tritium releases. The monitor has been independently verified as meeting NESHAPs radionuclide emission monitoring requirements. In August 1993, EPA concurred with this determination. Exhibit 3-8 presents the total air releases from the D-site stack that occurred from 1994 to 2008 and the associated activities.

In 2007, the levels of tritium released during operations were: 6.1316 curies of HTO and 0.5225 curies of HT (Exhibit 3-8 & Table 3 A). In 2008, the levels of tritium released during operations were: 2.58 curies of HTO and 0.237 curies of HT. These levels are well below the maximum annual release limit of 500 Curies of HTO and HT. Exhibits 3.8 and 3.9 provide a summary of annual D-site stack releases from 1994 to 2008.

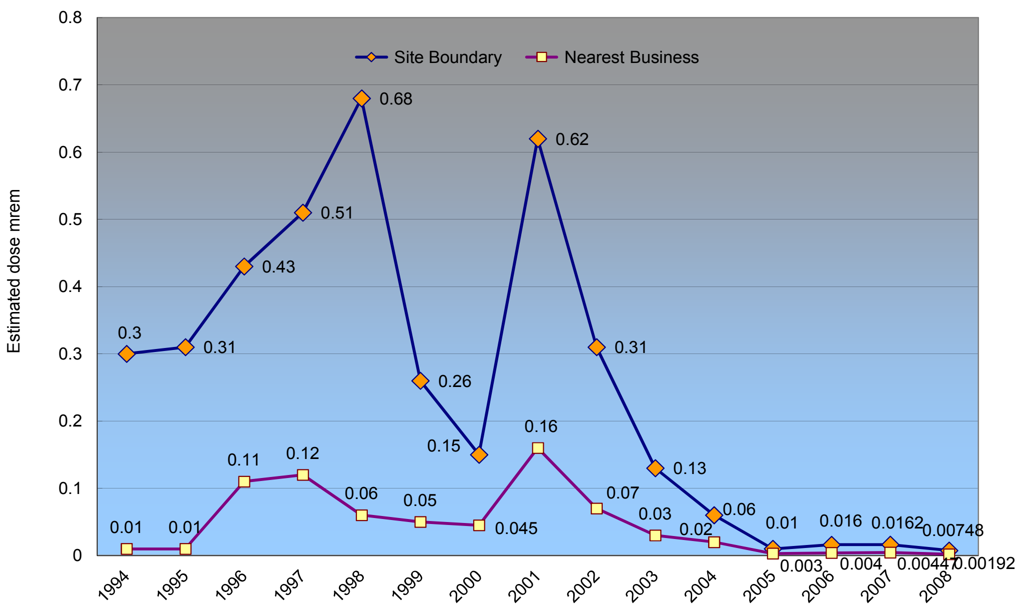
In 2007 and 2008**,** the effective dose equivalents (EDE) to a person at the business nearest PPPL due to radionuclide air emissions were 0.004 mrem (0.04 μSv) and 0.0019 mrem (0.019 μSv**)** (0.00188 mrem from tritium plus 0.0000084 mrem from Argon-41), respectively, which are significantly lower than the NESHAPs standard of 10 mrem/yr (Exhibit 3-9) [Lev11]. During their March 1998 inspection of PPPL's facilities, representatives from EPA Region II indicated that PPPL complied with NESHAPs requirements.

Exhibit 3-8. Total Air Releases from D-Site (formerly TFTR) Stack from 1994 to 2008

Calendar Year	HTO (Curies)	HT (Curies)	Total Curies (HTO + HT)	Activities
1994	45.55	93.13	138.68	TFTR D-T Operations
1995	37.031	24.87	61.901	TFTR D-T Operations
1996	118.624	64.88	183.504	TFTR D-T Operations
1997	124.093	63.019	187.112	TFTR shutdown
1998	45.867	28.982	74.849	TFTR shutdown
1999	59.712	21.779	81.491	TFTR D&D preparation
2000	58.320	18.073	76.393	TFTR D&D activities
2001	221.242	38.742	259.984	TFTR D&D activities
2002	96.495	13.761	110.256	TFTR D&D activities
2003	34.329	1.789	36.118	NSTX Operations
2004	21.117	1.259	22.970	NSTX Operations
2005	4.392	0.800	5.192	NSTX Operations
2006	5.553547	0.579591	6.132138	NSTX Operations
2007	6.1316	0.5225	6.6541	NSTX Operations
2008	2.5799	0.2371	2.817	NSTX Operations

Annual Limit is 500 Curies.

Exhibit 3-9. Estimated Dose (mrem) from PPPL Operations from 1994 to 2008



The Annual Limit is 10 mrem per year and applies to the estimated dose equivalent at the site boundary only.

3.4 Water Quality and Protection

3.4.1 Clean Water Act (CWA)

PPPL complies with the requirements of the CWA. Based on an assessment of leaking underground storage tanks (USTs) that contained fuel oil, PPPL conducted quarterly ground water monitoring for petroleum hydrocarbons and VOCs until September 1997 The data collected for 24 quarters (6 years) were consistent: trace or no petroleum hydrocarbons were detected and the former USTs were not contributing to ground water contamination.

Under the CWA and "New Jersey Discharge of Petroleum and Hazardous Substances" regulation (New Jersey Administrative Code Title 7, Chapter 1E), PPPL reported no releases during CY07, and 2 releases during CY08: 1) transformer oil from the D-site transformer yard that flowed to the retention basin and 2) transformer oil overflow from its sump/basin in the ICRF courtyard [PPPL08a, 08b]. Both the transformer sumps were cleaned up and the releases terminated. The transformer in the ICRF transformer yard was repaired and an oil detection alarm was installed in D-site transformer yard sump.

3.4.2 National Pollutant Discharge Elimination System (NPDES)

In 2007, PPPL operated under the requirements of New Jersey Pollutant Discharge Elimination System (NJPDES) surface water discharge permit (NJ0023922) [NJDEP06].

Monitoring locations designated in the permit are the on-site retention basin outfall (DSN001) and the filter backwash discharge (DSN003) located at the Delaware & Raritan (D&R) Canal pump house. These two locations are designated as monitoring points. All monthly/quarterly samples analyzed in 2007-2008 for Discharge Monitoring Program of the NJPDES permit were within the permit limits, *i.e.*, no non-compliances (Exhibit 3-10).

In February 2006, the revised NJPDES permit was issued by NJDEP. The effective date of the permit (EDP) was February 1, 2006. New permit conditions included a change from quarterly to monthly monitoring of total phosphorus (Total P) and tetrachloroethylene also known as perchloroethylene (PCE) and reporting quantity or loading in kg/day for phosphorus, PCE, chlorine-produced oxidants (CPO) at DSN001 and CPO at DSN003. The primary use of PCE at PPPL was to remove oils/dirt/films from metal components prior to their installation in experimental devices or supporting equipment. PCE at DSN001 is the result of ground water contaminated with PCE being captured by building foundation drains then being discharged to the storm sewer system that flows to the retention basin.

Phosphorus is a component of water treatment chemicals used to prevent corrosion in PPPL's boilers, cooling tower, and on-site non-potable water lines. It also occurs naturally in ground water and surface waters. PPPL monitored for Total P at the retention basin outfall, DSN001, and elsewhere on-site to gain a perspective of Total P in the environment (Tables 18A and 18B).

Additional monitoring for the "Waste Characterization Report" (WCR) annually at DSN001 and once in five years at DSN003 was also added to the permit requirements in 2006. The WCR parameters as listed in NJAC 7:14A-4, Appendix A Toxic Pollutants include acid, base/neutral, and volatile organic compounds, metals and cyanide, total phenols, pesticides, polychlorinated biphenyls (PCBs), conventional and non-conventional pollutants. At 4 to 4.5 years after the EDP, acute toxicity testing at DSN003 is required. A Total P study to help determine nutrient loading capacity (total maximum daily loading – TMDL) for the receiving water body (Bee Brook and Millstone-Raritan watershed) and a remedial action PCE study were new additions to the permit requirements.

On March 4, 2004, the Stony Brook Regional Sewerage Authority (SBRSA), the publicly owned treatment works that receives PPPL's sanitary wastewater stream, notified PPPL that the discharge license had been terminated [SBRSA04**].** PPPL continues to maintain its inventory of wastewater streams (industrial discharges) and monitors the quantity and quality discharged. In 2007-2008, SBRSA's only requirement of PPPL is to report the total volume discharged quarterly from the D-site liquid effluent collection (LEC) tanks (Tables 10A and 10B).

Exhibit 3-10. NJPDES Non-Compliances 2000-2008

Outfall No.	Para-meter	# Non-compliance	# Samples	#Compliant Samples	% Compliant	Date(s) Exceeded	Description/Solution
DSN001	CPO	2	7	5	71	8/7/02	Automated chlorination equipment installed.
DSN001	COD	4	19	15	79	6/6/03 7/1/03 11/7/03	Basin cleaned and inspected; discharge closely monitored.
DSN001 2000-01 2005		0	93	93	100	None	pH, Temp., COD, CPO,TSS, TPHC monthly; Tot. P and PCE quarterly
DSN003 2000- 2006		0	59	59	100	None	pH, CPO,TPHC monthly; TSS (2) quarterly; monthly after Feb. 2006.
DSN001 2006	COD	2	25	23	92	5/9/06	COD max (>50 mg/L) over limit twice
DSN001 DSN003	2007 to 2008	0 0	144 144	144 144	100 100	None None	pH, Temp., COD, TSS, CPO, TPHC, Tot.P, PCE, flow- daily avg., monthly max.

3.4.3 Safe Drinking Water Act (SDWA)

PPPL receives its drinking water from the New Jersey American Water Company (NJAWC), formerly Elizabeth-town Water Company. While NJAWC tests the drinking water supply, PPPL periodically tests incoming water quality (Tables 14A and 14B).

PPPL is able to switch from D & R Canal water (non-potable) to potable water for its non-contact water supply in the event of a fire of other emergency situation or when D&R Canal water is unavailable.

On a quarterly basis, PPPL inspects and pressure tests the back flow prevention equipment at both locations: the main potable water connection where NJAWC water enters C site and the cross-connect system beneath the elevated water tower. Back flow prevention equipment prevents contamination of the potable water supply *via* a large cross-connection. On an annual basis, these systems are completely disassembled, inspected, and tested by certified technicians. Inspection reports are submitted to the NJDEP annually.

3.5 <u>Other Environmental Statutes</u>

3.5.1 Endangered Species Act (ESA)

PPPL occupies 88.5 acres of the Forrestal Campus of Princeton University. As documented in historical environmental assessments, no endangered species have been indicated on-site [ERDA75] [DOE92] [DOE93b] [Dy93].

In 1997, as part of the Remedial Investigation, Amy S. Greene Environ-mental Consultants, Inc. conducted a baseline ecological evaluation [Am98]. The New Jersey Audubon Society has visually verified and reported a pair of Cooper's Hawks (*Accipiter cooperii*) nesting within one mile of the PPPL property [NJB97]. Cooper's hawks are presently listed as threatened in the state of New Jersey [NJDEP97].

3.5.2. Migratory Bird Treaty Act

In 2007-2008, PPPL took no migratory bird species nor conducted any programs or actions that call for such activities as banding, marking or scientific collection, taxidermy and/or depredation control.

3.5.3 National Historic Preservation Act (NHPA)

On the 88-acre PPPL site, no archaeological resources, no buildings or structure were identified as historical [Gr77]. Located on Mapleton Road in Plainsboro along-side the Delaware & Raritan Canal, PPPL's pump house withdraws water for cooling/process water and for fire protection. The pump house is situated on property within the D&R Canal District as listed on the National and State Register of Historic Places, because the district includes 100 yards on either side of the Canal center line.

3.6 <u>DOE Order 450.1 *Environmental Protection Program*</u>

3.6.1 Pollution Prevention Activities

In 2007-2008, 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 using green products when renovating older offices and other laboratory spaces. From the building automation system (BAS) to Energy Star® equipment and products/lighting fixtures, from flooring tiles to carpet squares, from low VOC-paints to other types of recycled wall coverings, PPPL actively pursued the use of these types of green products and practices (Exhibits 3-12 & 3-13).

PPPL has replaced traditional petroleum-based hydraulic oil with vegetable-based hydraulic oils in several elevators. By using the bio-based products, PPPL reduced its potential to release hazardous materials to the environment.

In 2007 and 2008, PPPL's recycling rate was 50% and 51.4%, respectively, that was landfill-avoided. The DOE goal of 45% recycle versus disposal rate was met and accomplished by active participation of Laboratory employees.

Typically, operators of metal-cutting machines hand-spray lubricants or use flood cooling systems when cutting. This operation can leave lubricants on their clothes, their bodies, and everywhere elsewhere in the machine shop. PPPL purchased an Accu-Lube® micro-lubrication system for the largest machine shop. Accu-Lube® uses soybean-based biodegradable oil that is non-toxic, environmentally safe and can be applied to a variety of materials without contamination or discoloration (Exhibit 3-18). The amount of waste generated is reduced and the safety to the employees is improved. This change is a win-win situation from a pollution-prevention and a safety viewpoint.

In 2007, PPPL received the US DOE's Pollution Prevention and Environmental Stewardship Accomplishment Award. This award was in recognition of the laboratory's commitment to use of bio-based products from the metal-cutting lubricants to cleaning products and elevator hydraulic fluids (Exhibit 3-11).

In 2007, the use of alternative fuels, especially B-20, increased to 747 gallons that powered five John Deere Gators, two stake body and three utility trucks, and a John Deere backhoe (Exhibit 4-4). By 2008, a dual 500-gallon above-ground storage tank was ordered to accommodate the increased use of B-20 and the newly available E-85 fuel for PPPL's fleet vehicles.

Exhibit 3-11. PPPL employees receive DOE Award (Bio-based Cutting Fluid Use)

Exhibit 3-12. Hall Thruster New Floor (recycled content)

Exhibit 3-13. Bio-based cleaners in use

Exhibit 3-14 . Road way corner at PPPL - 100% recycled plastic parking stops

3.6.2 Site Environmental Compliance and EMS Audits

In 2007, PPPL's Quality Assurance (QA) Division performed fifteen (15) audits of which three involved environmental topics: Procurement/use/disposal of chemicals, PPPL's Environmental Management System (EMS) program, and radioactive waste handling. Each audit includes records examination and requirements compliance and is tracked through PPPL's internal QA Audit Database [Ya11].

In 2008, QA performed fourteen (14) audits, including six (6) environmental: hazardous waste sub-contractor, sub-contractor analytical laboratory, PPPL's Radioactive Waste Program Review by Nevada Test Site (NTS), internal radioactive waste program audit, NJDEP Princeton Environmental and Radiological Laboratory (PEARL) Audit and the NJDEP Hazardous Waste Management Inspection [Ya11]. Findings and action items resulting from audits are assigned to Responsible Line Managers for resolution and are tracked by PPPL's Quality Assurance (QA) Division until closed.

3.6.3 Beneficial Landscaping

In 2005, PPPL prepared its first "Beneficial Landscaping Plan," which identified areas that required improved landscaping for operational, aesthetic, or environmental reasons. Well-planned and maintained landscaping improves stormwater quality by reducing soil erosion and rainfall amount allowed to runoff the property. This plan is reviewed and revised annually. In the Beneficial Landscaping Plan, areas for landscaping projects were identified and prioritized for their potential to eliminate soil erosion by reducing storm-water runoff. Roadway corners appear particularly vulnerable to exposure and potential erosion problems (Exhibit 3-14). The photographs in Exhibits 3-14 to 3-16 document some progress of PPPL's landscaping efforts in 2007-2008.

Exhibit 3-15. Swale as it looked in 2006

Exhibit 3-16. Swale as it looked in 2008 after planting

In 2007, swale maintenance began with the removal of the overgrown trees and shrubs along the south bank and the placement of rip-rap stone at the exit of the pipe at the north end (Exhibit 3-15). In 2008, the swale banks were planted with seed matting and native plants along the southern slope embankment (Exhibit 3-16).

Through the beneficial landscaping efforts in 2007-2008, PPPL accomplished a 3-acre mowing reduction and the planting of native and/or drought and deer tolerant species, which improved wild habitat and enhanced the overall site aesthetics. Reduced mowing also results in lower herbicide/fertilizer use and less fuel consumption causes a reduction in greenhouse gas emissions.

3.6.4 Progress on DOE Secretarial Goals

During calendar year 2007, the recycling rate of 50% met PPPL's 50% goal and the EO 13148's 45% goal (superseded in 2007 by EO 13423). Again in 2008 (51.4%), PPPL met its internal 50% goal of recycling versus disposal rates [Kin08a, McG08, Kin09a, McG09].

Hazardous waste and municipal solid waste reduction activities are discussed in Section 3.1.2 (Exhibits 3-2 and 3-3). Activities that greatly improved the 2007-2008 recycling rate were roof replacement of Theory, Administration, and New Engineering Buildings, recycling of concrete shield blocks, concrete side-walk replacements on C-site, and metal window replacements for Theory and C-site Office Building (COB) first floor.

Exhibit 3-17, PPPL's Progress in Meeting Executive Order 13423, "Strengthening Federal Environmental, Energy, and Transportation Management," provides the status of PPPL's activities and accomplishments in pursing these goals.

PPPL's progress toward achieving these goals is discussed in the next section of this report.

3.7 Executive Orders (EO)

3.7.1 Executive Order (EO) 13423, "Strengthening Federal Environmental, Energy, and Transportation Management"

On January 24, 2007, President George W. Bush signed this EO, which set goals for all government agencies to achieve:

- improve petroleum conservation and use of alternative fuels and vehicles,
- reduction of greenhouse gases,
- increase energy efficiency,
- purchase of renewable energy sources,
- follow building performance , *i.e.* green buildings standards,
- promote water conservation and
- increase purchasing of green products including 30% post-consumer paper
- reductions in toxic/ hazardous chemicals,
- purchase electronics/computers that meet EPEAT requirements and extend useful life of electronic equipment
- implement environmental management systems

Each Federal agency develops a written implementation plan, which is submitted to EPA and annual progress reports on the progress achieved to meet the goals by the set deadlines. PPPL prepared a report, "DOE Order 430.2B Executable Plan," in December 2008 that documents the progress made to meet the goals of EO13423 [DOE08, PPPL08c].

Exhibit 3-17. PPPL's Progress to Meet - Executive Order 13423 "Strengthening Federal Environmental, Energy, and Transportation Management" (January 24, 2007)

Category	Description	Criteria	Baseline	2007	2008
Petroleum conservation(g)(i)	Reduce fleet consumption by	2% annually through 2015	2005	40% reduction from 2005	36 % reduction from 2005
Alternative Fuel Use (g)(ii)	Increase non-petroleum fuel consumption by	10% annually	2005	85% increase	>100% increase from 2005
Alternative Fuel Vehicles (AFV) (g)(iii)	Use plug-in hybrids (PIH) when available LCC justified	>75% of new vehicles must be AFV		Bio-diesel Gators 100% AFVs	100% AFVs
Energy Efficiency and **Green house Gases** (**GHGs)** (a)(i) (ii)	Reduce energy intensity utilization (EUI) and GHGs by Reduce energy intensity and GHGs by	3% annually through 2015 **OR** 30% by 2015	2003 – Energy 2008 - GHGs	Met EUI = 36.1% reduction GHGs-Not required	Met EUI = 38.7% reduction Total GHGs 54,471 MT(CO_2 E)
Renewable Power (b)(i)	At least 50% of current renewable energy purchases must come from new renewable sources	In service after Jan. 1, 1999		Not met	Not met
Building Performance (f)(i)	Construct or renovate buildings in accordance with Guiding Principles	Including resource conservation, reduction and use; siting; and indoor air quality		Recycled carpet,/floor tiles, Cradle-to-cradle furniture, Low-no VOCs paints	Recycled construction debris – concrete, wood, metals Applying for LSB USGB LEED- EB certification
(f)(ii)	Meet Green building sustainable standards	For 15% of existing buildings by end FY15		In progress	In progress
Water Conservation (c)	Reduce water consumption intensity by	2% annually through 2015 **OR** 16% by end FY15	2007	Total - 12.5 million gallons	Not met 14.6 million gallons
Procurement (d)(i)	Expand purchases of environmentally-sound goods and services	Include bio-based products		See 3.6.1	See 3.6.1
(d)(ii)	Purchase 30% post-consumer paper			50% of total met this goal	50% of total met this goal
Pollution Prevention(e)(i)(ii)	Reduce use of chemicals/toxic materials	Purchase lower risk chemicals/toxic materials		See 3.6.1	See 3.6.1
Electronics Management(h)(i)	Annually, purchases that meet EPEAT[1] requirements	For 95% of electronic products		Met through purchase requirements	Met through purchase requirements
(h)(ii)	Enable Energy Star® features on	100% of computers and monitors		Met	Met
(h)(iii)	Establish/implement policies to extend	Useful life of electronic equipment		Internal re-use is SOP-no written policy	Internal re-use is SOP-no written policy
(h)(iv)	Reuse, donate, sell, or recycle	100% of electronic products using environmentally sound practices		Met	Met
Environmental Management Systems (EMS)	Implement EMS at all appropriate levels to ensure use of EMS as primary mgt approach			Met	Met

[1]EPEAT Electronic Product Environmental Assessment Tool

Since the baseline year, 2005, PPPL has moved aggressively in the area of petroleum conservation, alternative fuel vehicles (AFV), and fuel use. PPPL uses 3-compressed natural gas (CNG) vehicles, converted 85% of its covered fleet diesel vehicles to B20 bio-diesel, used B20 bio-diesel in the John Deere "Gator" neighborhood vehicles and in the non-covered heavy and mobile equipment. To supply the alternative fuel use, new on-site fuel storage and dispensing system was installed.

The six major greenhouse gases gas types are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), perfluorocarbons (PFCs) and hydrofluorocarbons (HFCs). The 2008 GHGs baseline data were generated using the "Greenhouse Gas Protocol" developed by the World Resources Institute and the World Business Council for Sustainable Development. The data are divided into 3 categories or scopes.

- Scope 1 is direct emission sources – fuel combustion, fleet vehicles, and fugitive emissions such as refrigerant and sulfur hexafluoride (SF_6) losses.
- Scope 2 is indirect emission sources – electricity purchases.
- Scope 3 is other indirect emission sources – employee business travel, waste disposal, employee commuting, contractor vehicles, product use, and production of purchased materials.

The 2008 baseline GHGs total is 54,447 metric tons (MT) carbon dioxide equivalent (CO_2 e) of which sulfur hexafluoride (SF_6) accounts for 70% of Scope 1 and 2 GHGs. Subtracting SF_6, the total is 16,087 MT CO_2 e. SF_6 is used in the modulator-regulators in NSTX and to insulate other high voltage electrical equipment. Though PPPL uses a recovery unit when working on the electrical systems containing SF_6, the modulator-regulators are not 100% leak-tight.

PPPL tracks facility energy efficiency as a measurement of Energy Utilization Indices (EUI), which is the total energy (BTUs) per square foot of buildings. In 2007 and 2008, the EUI were reduced 36.12% and 38.67%, respectively, from the 2003 baseline year. By better control of the temperature and lighting in office spaces through the building automation system (BAS), PPPL reduced the energy demands to below the EO target level of 30% by 2015. Operational changes in the central steam plant and system configuration changes to the chilled water system helped to save energy by lowering pumping rates.

For 2007-2008, PPPL and DOE-PSO did not purchase any renewable energy credits (RECs) that would meet the 50% renewable energy from new renewable sources goal. PPPL chose to pursue on-site renewable energy generation, specifically, photovoltaic (PV) project funded through a long-term power purchase agreement.

During 2007-2008, PPPL's began a project for certification of the Lyman Spitzer Building (LSB) under the U.S. Green Building Council (USBGC) Leadership in Energy and Environmental Design – Existing Buildings (LEED-EB) standard. By achieving LEED-EB certification for LSB, the 15% of the site's building portfolio to be high performance sustainable buildings requirement would be met as specified in the "High Performance and Sustainable Buildings Guidance [Dec. 1, 2008]." The Maintenance and Operations (M&O) Division renovated interior office and experimental spaces and replaced roofs and windows on the exterior. Building performance standards *i.e.,* the Guiding Principles, were followed. Recycled content carpet and floor tiles, low VOC or no-VOC paints and recycled content wall coverings, solid-state light emitting diode (LED) lighting were used. New office furniture was purchased from Steel Case's Cradle-to-Cradle® furniture line. Roofs were replaced with Energy Star® materials and the roof ballast was recycled or reused on-site.

In April 2008, PPPL became the first DOE Laboratory to be an EPA Energy Star® partner and the LSB was certified as an Energy Star® building. Mr. Marcus Peacock, USEPA Deputy Administrator presented Director Rob Goldston with the Energy Star® certificate (see photo on pg.3 in the Executive Summary,). The Energy Star® plaque now hangs in the LSB lobby (Exhibit 3-24).

Water conservation is a high priority at PPPL. By 2007, numerous projects were completed that reduced total water demand. A once-through water cooled chiller was replaced with a new air-cooled unit. A water-cooled air conditioner was eliminated. Improved filtration and new chemical controllers at the cooling tower and improvement to boiler operations reduced the volume of non-potable water used by the facility. Old water mains were replaced with new lines that prevented water leakage. On-demand faucets and low-flow urinals replaced old fixtures in all lavatories. As a result of these water conservation projects, PPPL reduced its water usage dramatically to 12.5 million gallons (total of potable and non-potable water). In part because 2007 was the lowest water usage since water use data was collected, the reduction of 2% annually was not met in 2008 (14.6 million gallons). In 2008, PPPL experienced steam line leaks (increased make-up water demand) and repairs to the Delaware & Raritan Canal pump house may have contributed to increased water use.

As discussed in Section 3.6.1, Pollution Prevention," PPPL received an award for its purchasing and use of bio-based cleaning products, and included the green purchasing of the Accu-Lube® Hydraulic Lubricant for metal cutting (Exhibit 3-18). Also, part of PPPL's green purchasing program, the laboratory standard for paper is the 30% post-consumer paper used for both printing and copying.

Exhibit 3-18. Accu-Lube® used in PPPL's machine shop

PPPL's has two Laboratory-wide policies addressing the Pollution prevention goal to lower the risk to employees from hazardous/toxic chemicals/materials. In turn, the risk to the environment would be lowered by avoiding hazardous wastes. The Policies are: P-014, "Waste Minimization" and P-082, "Environmentally Preferred Purchasing." Prior to the purchase or use of a new chemical, PPPL requires the employee to submit for approval a chemical review performed by ES&H Industrial Hygiene. This requirement protects the employee and the laboratory from unnecessary exposure to toxic and hazardous chemicals.

All desktop information technology (IT) purchases are required to use the electronic purchasing environmental assessment tool (EPEAT) to meet EO 13423 goals. The Computer Division manages the requirement that Energy Star® and/or EPEAT specifications are included in all computers or network printers purchased by PPPL. The reuse, donation, sale or recycling of excess electronic equipment is managed by the Laboratory's Materiel Control group.

The EO13423 required that the EMS be implemented at 2,500 Federal operations by 2010. By 2005, PPPL has integrated its Environmental Management System (EMS) with the Integrated Safety Management System (ISMS) program that was begun in 1999 [PPPL99a]. In 2007-2008, PPPL conducted scheduled EMS aspects and impact assessments and activities as listed in Procedure EM-OP-46.

3.7.2 Executive Order (EO) 11988, "Floodplain Management"

In 2007-2008, PPPL complied with EO 11988, "Floodplain Management." Delineation of the 500 and the 100-year floodplains was completed in February 1994. The 500-year and the 100-year floodplains are located at the 85-foot elevation and at the 80-foot elevation mean sea level (msl), respectively [NJDEP84] (Exhibit 3-20).

The 88.5-acre parcel that PPPL occupies is included in Princeton Forrestal Center's (PFC) Storm Water Management Plan-Phase I [PFC80]. The 88.5-acre parcel is part of the Bee Brook watershed included in the PFC storm water plan.

One condition of the PFC Storm Water Management Plan is that the average density of development cannot exceed a maximum of 60% impervious coverage of developable areas. PPPL meets the ≤60% impervious coverage limit. The Site-Wide Storm Water Management Plan was completed in February 1996, and PPPL is in compliance with this Plan [SE96].

In 2008, PPPL revised a Site-Wide Storm Water Pollution Prevention Plan [PPPL08h]. Incorporating the Storm Water Management Plan, Spill Prevention Control and Countermeasure (SPCC) Plan, and other best management practices, this plan was a summary of activities already in practice at PPPL. The plan will be reviewed and updated triennially or as site changes warrant.

3.7.3 Executive Order (EO) 11990, "Protection of Wetlands"

PPPL complied with EO 11990, "Protection of Wetlands." The Land Use Regulation Program within NJDEP continues to be the lead agency for establishing the extent of state and federally regulated wetlands and waters. The U.S. Army Corps of Engineers have the right to re-evaluate and modify wetland boundary determinations.

In 1994, PPPL received a "Letter of Interpretation" (LOI) from NJDEP for defining the wetland boundaries and wetlands classification. This LOI is needed before NJDEP issues wetlands permits for a site. The LOI is valid for a five-year period with the option to renew for an additional five years. In 1999, PPPL submitted a renewal application to

NJDEP and was granted the five-year extension, beginning in January 1999 and valid through January 2004 (Exhibit 3-20).

During 2007-2008, Princeton University submitted an original and modified NJDEP Land Use Regulation Program (LURP) LOI application for combined the James Forrestal Campus and Forrestal Center properties. PPPL's site required a new LOI in order to include 16 additional acres (total of 88.5 acres). In April 2008, the new LOI was issued, which confirmed the delineation of wetland and upland areas on and adjacent to the PPPL site.

3.7.4 Executive Order (EO) 12856, "Federal Compliance with Right-to-Know and Pollution Prevention Requirements," and Superfund Amendments and Reauthorization Act (SARA) Title III, Emergency Planning and Community Right-to-Know Act (EPCRA)

Emergency Planning and Community Right-to-Know Act, Title III of the 1986 SARA amendments to CERCLA created a system for planning responses to emergency situations involving hazardous materials and for providing information to the public regarding the use and storage of hazardous materials. Under the reporting requirements of EO 12856 and SARA Title III, PPPL complied with the following information in Exhibit 3-19, "Summary of PPPL EPCRA Reporting Requirements. In 2007-2008, PPPL submitted an annual chemical inventory in compliance with SARA Title III (EPCRA Section 312). This inventory reports the quantities of chemicals listed in the CERCLA regulations (Exhibit 3-21).

Under SARA Title III, PPPL provides the following to the applicable emergency response agencies:

1. An inventory of hazardous substances stored on-site;
2. Material Safety Data Sheets (MSDS); and
3. SARA Tier I form

PPPL completed the listing of each hazardous substance stored by users above a certain threshold planning quantity (typically 10,000 pounds, but lower for certain compounds). Exhibit 3-21 lists hazardous compounds at PPPL reported under SARA Title III for 2007-2008 [PPPL 08a, 09a]. These chemicals are found in 40 CFR Part 372, Subpart D, which lists names and chemical abstract system numbers for toxic chemicals.

Exhibit 3-19. Summary of PPPL EPCRA Reporting Requirements

	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

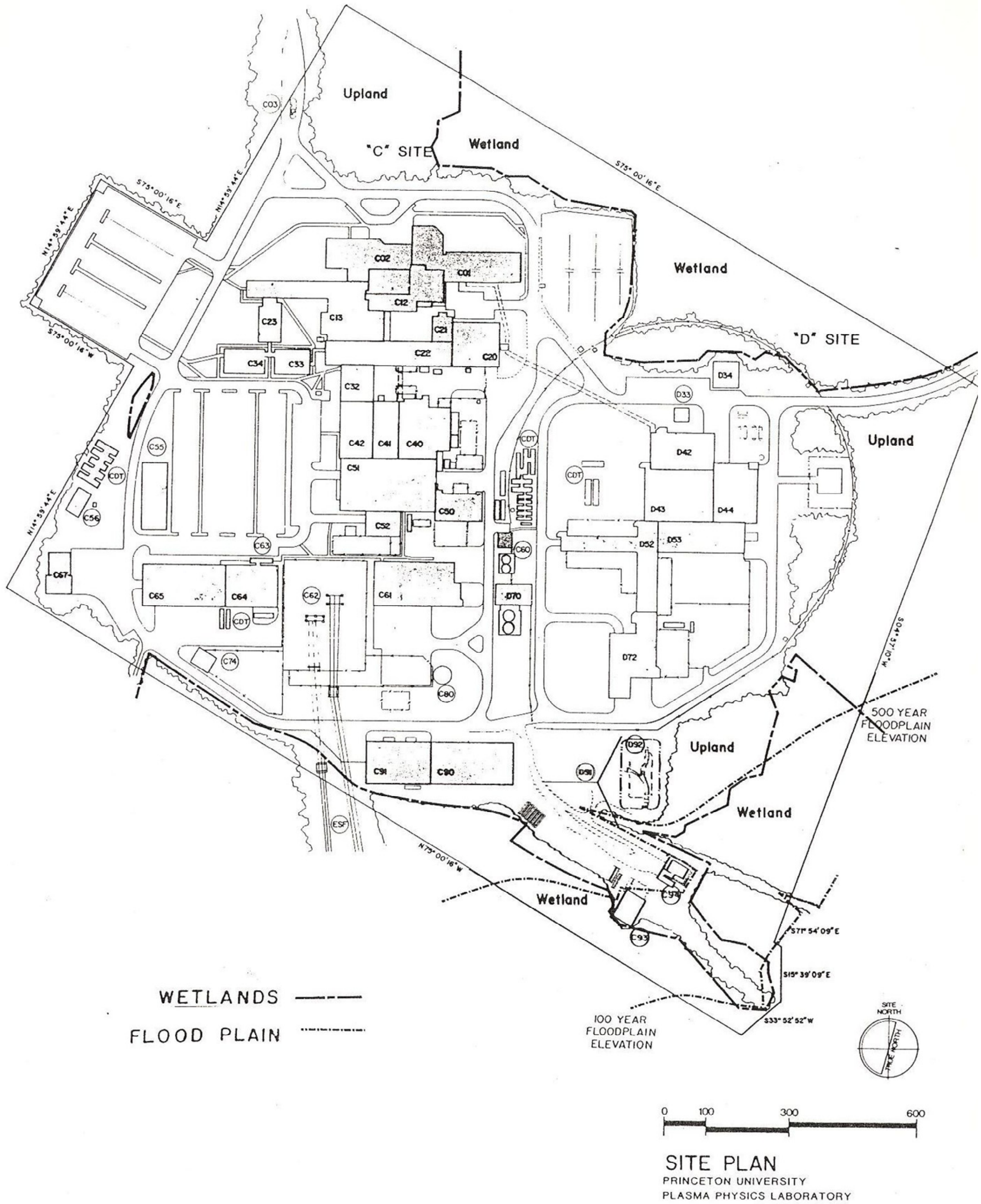


Exhibit 3-20 PPPL Site Map – Floodplain and Wetlands Boundaries

Of the twelve, seven chemicals are in their gaseous form and are therefore classified as sudden release of pressure hazards; two gaseous compounds are also classified as acute health hazards. There are five liquid chemicals; nitrogen is used in both gaseous and liquid forms, and one solid chemical, lead.

Exhibit 3-21. 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

Fuel oil, gasoline, petroleum oil, and propane are flammables; sulfuric acid is the liquid compound that is classified as acute health hazard and a reactive to the environment.

Section 304 of SARA Title III requires that the Local Emergency Planning Committee (LEPC) and State Emergency Response Commission (SERC) be notified of accidental or unplanned releases of certain hazardous substances. To ensure compliance with such notification provisions, a Laboratory-wide procedure, ESH-013, "Non-Emergency Environmental Release—Notification and Reporting," includes SARA Title III requirements [PPPL05b]. The NJDEP administers SARA Title III reporting for the USEPA and has modified the Tier I form to include SARA Title III reporting requirements and NJDEP reporting requirements [PPPL08a, 09a].

Because PPPL's use of chemicals listed on the Toxic Release Inventory (TRI) is below threshold amounts, PPPL is not required to submit the annual TRI report. Following DOE's guidance, PPPL completed an annual submittal to DOE for 1997 that included the TRI cover page and laboratory exemption report. PPPL did not submit a TRI in 2007-2008 as none was required.

3.8 Other Major Issues and Actions

3.8.1 Air Quality

In 2007, no new or modified air permits for PPPL's equipment, boilers, emergency generators, dust collectors/woodworking equipment, were needed. PPPL received a revised General Permit for the C-site, 300kW emergency generator from NJDEP.

In 2008, an air permit modification was submitted for modifications to Boilers #3 and #4. The modifications included the installation of low NO_x burners and digital controls for both boilers. In October 2008, the modification approval was granted, however, the actual modifications to the boilers did not begin until late 2008 for Boiler #3 and in 2010 for Boiler #4.

Limited by the total quantity of fuel consumed by fuel type, all four boilers are allowed to burn natural gas, No. 2 or No. 4 fuel oil. Since December 2004, only No. 2 fuel oil, a lighter and cleaner burning petroleum distillate, has been burned, which lowered sulfur dioxides (SO_2) emissions (Exhibit 3-7). As required by the air permit, a Compliance Plan was implemented. Records are kept to meet the Potential to Emit (PTE) limit requirements for the Criteria Air Pollutants (CO, NO_x, SO_2, VOCs, and Total Particulates) and total fuel consumed by boiler and fuel type for each 12-month period (rolling 12-month calendar).

3.8.2 Surface Water Quality

Under NJPDES requirements, PPPL was required to analyze for total phosphorus (Tot P) and tetrachloroethylene (perchloroethylene, PCE) at DSN001, the on-site retention basin outfall. Tot P was required, because it is present in corrosion inhibitors chemicals used in the boilers and cooling towers for water treatment. PCE was required because of its presence in the ground water from historical use and disposal practices.

2007 was the first full year of analyses for both Tot P and PCE. Tot P ranged from below detection (<0.050 mg/L) to a maximum concentration of 1.25 mg/L (March 2007). PCE ranged from below detection (<0.660 μg/L) to a maximum concentration of 0.71 μg/L in January 2007 (Table 18A).

In 2008, Tot P ranged from below detection (<0.050 mg/L) to a maximum concentration of 0.194 mg/L (July 2008). PCE ranged from 0.54 μg/L to a maximum concentration of 0.74 μg/L that occurred in March and April 2008 (Table 18B).

During the early autumn in 2007 and 2008, the pH levels were elevated, 8.39 to 8.99 S.U., which are below the 9.00 limit. The elevated pH may be due to the warmest water temperatures (~24-25ºC), which are optimal for photosynthesis.

Permit limits at neither DSN001 nor DSN003, Delaware & Raritan Canal pump-house, filter back-wash outfall, were exceeded during 2007-2008. Therefore, no non-compliance reporting was necessary (Exhibit 3-10).

3.8.3 Ground Water Quality

Under New Jersey's State program for NJPDES ground water discharges, PPPL has a general permit (NJ0142051) for the retention basin as a lined surface impoundment (LSI). In May 2006, NJDEP issued the LSI, which replaced the individual ground water discharge permit. Monitoring of the ground water (seven wells and two basin inflows) was no longer a requirement of the new permit.

PPPL has been monitoring ground water under a Memorandum of Understanding (MOU) signed by NJDEP and Princeton University since 1993. Princeton University agreed to investigate A- and B-sites while PPPL and DOE-PSO were to investigate C-and D-sites of the James Forrestal Research Campus. A summary of the remedial investigation and remedial action project milestones is presented below:

1993 Prepared specifications for Remedial Investigation and Remedial Alternative Assessment project (RI/RAA).

1994 Harding Lawson Associates (HLA) began RI/RAA. Sampled existing wells, sumps, and soil borings. Soil beneath the Facilities Building and adjacent to C Site Cooling Tower removed.

1995 HLA conducted ground water sampling; prepared RI/RAA report.; completed UST closure activities.

1996 RI/RAA report submitted. Installed four new monitoring wells south of the CAS/RESA Building to delineate extent of contamination.

1997 New area of potential environmental concern (APEC) near the former PPPL Annex Building identified by sampling ground water from eight new wells and soil borings. Report submitted.

1998 Phase 3 RI report submitted to NJDEP in September 1998 [HLA98].

1999 Phase 4 RI and Remedial Action Selection reports submitted in October. Ground water monitoring continued.

2000 Remedial Action Work Plan submitted to NJDEP in May, quarterly ground water monitoring continued [Sh00, Sh01].

2001 Remedial Action Monitoring Report submitted; quarterly monitoring continued [Sh01 & Sh03].

2002 Remedial Action Monitoring Report submitted; quarterly monitoring continued [Sh01 & Sh03].

2003 Remedial Action Monitoring continued; quarterly March and June 2003; first annual monitoring performed in October 2003. Fourteen monitoring wells permanently removed [Sh04].

2004 Continued to annually monitor (in September 2004) the wells and sumps and report results to NJDEP[Sh05]. Aquifer Classification Exception Area (CEA) designated for ground water contamination.

2005 Continued to annually monitor (in November 2005) the wells and sumps and report results to NJDEP[Sh06].

2006 Continued to annually monitor (in September 2006) the wells and sumps and report results to NJDEP[Sh07].

2007 Removed old production wells 4 and 5. Continued annual RA wells and sumps monitoring [Sh08]

2008 Continued annual RA wells and sumps monitoring in September.
First quarterly monitoring in December – selected wells and 1 sump [SH09].

3.8.4 EARTH Day/Week at PPPL

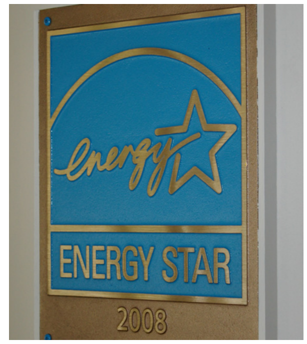
Each April, PPPL displays posters in the laboratory lobby. These posters provide information regarding PPPL's efforts to be good environmental stewards; resource materials provide suggestions how employees can be environmentally responsive in their homes by recycling and lowering their energy usage. These posters are brought to a local Earth Day community event for school-aged children and their parents (Exhibit 3-22).

Exhibit 3-22. PPPL Participates at Earth Day at Mercer County Park (2007)

Earth Day 2007's program emphasized "Celebrate Earth Day Every Day." The Program included the annual presentation of "Green Machine Awards" to 17 employees for their outstanding contributions to PPPL's pollution prevention activities (see photo on pg. 4 of the Executive Summary). These awards are based on their actions that help PPPL improve its recycled and energy saving efforts (see Section 3.6.1) The highlight of the 2007 Earth Day program was *"Energy and Climate Change: Planning New Jersey's Future"* presented by NJDEP's Commissioner, Lisa Jackson (Exhibit 3-23).

Exhibit 3-23. 2007 Earth Day Speaker NJDEP Commissioner Lisa Jackson

Exhibit 3-24. PPPL's Lyman Spitzer Building is an ENERGY STAR® building



As shown in this report's Executive Summary (Chapter 1), the PPPL's 2008 Earth Day theme was "Sustainability – Environment, Economy, and Society" and the USEPA Energy Star® Partner award presented by USEPA Deputy Administrator Marcus Peacock (see photo on pg 3 in the Executive Summary and Exhibit 3-24). PPPL earned this award through its energy savings projects that not only imporved the laboratory's energy efficiency, but helped protect the environment, and reduce the lab's release of greenhouse gases.

3.8.5 Facility Improvements

In 2007, the Facilities renovated office and experimental spaces using recycled content materials (flooring tiles, carpet squares, wall coverings), low VOC paints, and LED lighting and Cradle to Cradle® furniture where possible. The D-site cooling tower was renovated with new interior framework.

Exhibit 3-25. Installing energy-efficient windows in Theory Wing

In 2008 was a busy year for Facilities; in Theory wing and first floor of C-site Office Building (COB), new doubled windows placed the old single-paned windows, dramatically improving the comfort and energy efficiency of these buildings (Exhibit 3-25).

Exhibit 3-26 Exterior insulation installed for new SciEd lab.

The new Science Education laboratories and Calibration and Source Laboratory (CASL) were constructed on the first floor of the Radio Frequency (RF) building requiring new interior and exterior insulation, flooring, walls, and ventilation systems. (Exhibit 3-26).

3.8.6 Safety

PPPL's 2007 and 2008 performance with respect to worker safety was as follows [Lev08b, 09b]:

	Total recordable case rate[1]	Days away, restricted or transferred (DART) case rate[1]	DART day rate[1]
2007	1.43	0.24	46.27
2008	0.95	0.47	1.18

[1] Per 200,000 hours worked

	Number of radioactive contaminations (external)	Number of Safety Occurrence reports OSHA confined space, chemical exposure and lock out/tag out incidents)
2007	0	0
2008	0	0

3.9 Continous Release Reporting

In 2007-2008, PPPL had no continuous releases to report.

3.10 Unplanned Releases

During CYs 2007-2008, two unplanned releases of hazardous or petroleum substances occurred; none in 2007 and two in 2008. In March 2008, oil was detected in the retention basin when the oil sensors alarmed. The oil source was traced back to one of the D-site transformer yard sumps where small amounts of oil collected along with storm water. Inadvertently, the sump pump was manually activated, releasing the oil/water mixture to the basin where the *in-situ* oil boom contained it. PPPL personnel cleaned up the oil in the basin as well as oil residue in the sump. An oil sensor was installed in the transformer yard sump to avoid this situation from recurring.

In September 2008, oil was detected in the basin after the sensor alarmed. Its source was oil from a transformer located in C-site. The oil was released from a transformer in the ICRF transformer yard; the transformer was repaired following the spill clean-up. Additional oil detection equipment will be installed in this area to prevent a recurrence.

3.11 Current Issues and Actions

3.11.1 Environmental Management System (EMS)

The comprehensive Environmental Management System (EMS) is established at PPPL. Under EO 13423, "Strengthening Federal Environmental, Energy, and Transportation Management," PPPL continued to implement its action plan as set forth in the EMS program. A more fully integrated approach to include PPPL's ISM within the EMS framework was performed to fully comply with EO13423.

As part of PPPL's EMS outreach goal, the Laboratory hosted the November 2007 "Government Laboratory Environmental Compliance – Federal Regulatory Requirements" workshop, sponsored by USEPA, Region 2.

3.11.2 Regulatory Inspections/Audits

In August 2007, NJDEP conducted a NJPDES inspection of PPPL's records and facilities. No violations or enforcement actions were issued for this Surface Water and Ground water Quality regulatory inspection.

In August 2008, NJDEP conducted a Hazardous Waste Inspection of PPPL's records and facilities. On October 6, 2008, PPPL received a Notice of Violation (NOV) for "a drum of sodium dichromate." In reality, the drum contained a dilute mixture of sodium hydroxide, potassium permanagate and sample water. Though NJDEP did not formally reply to PPPL's response to the NOV, PPPL was given no fines nor enforcement actions.

3.12 Summary of Environmental Permits

The following table (Exhibit 3-27) presents the different regulatory requirements/permits with which PPPL must comply. It is not solely a list of environmental permits, but rather a list that specifies the citation for environmental regulations, PPPL's requirement or permit, and where data reports may be found. A discussion of environmental permits required by the applicable statutes is found in Sections 5.0 and 6.0, "Environmental Radiological and Non-Radiological Program Information."

Exhibit 3-27. PPPL Environmental Requirements

Media	Regulatory Citation	Requirement/Permit	Data Reported
Air	40 CFR 61 – National Emission Standards for Hazardous Air Pollutants (NESHAPs)	Monitor D site stack for tritium	Reported in the annual Site Environmental Report (ASER)
	40 CFR 82 – Protection of Stratospheric Ozone	Training & certification; Chillers, HVAC, fire suppression systems, cylinders	Ozone Depleting Substances (ODS) Inventory
	NJAC 7:27- – Air Pollution Control –Subchapter 8 Permits and Certificates	4 Boiler stacks; 2 Storage tank vents; 2 Dust collectors; 2 emergency diesel generators.	Fuel use reported in ASER; Generator hours recorded in logbook
Asbestos	29 CFR 1910.1001, 1910.1200 – OSHA General Industry Standard	Identify locations prior to removal (roofing, tiles, walls, pipes, insulation, etc.)	Reporting to EPA prior to removal; Track generated quantities
EPCRA	40 CFR 370 – Hazardous Chemical Reporting: Community Right-to-Know	SARA Title III listed substances above threshold amounts	Section 312 annual report to EPA in March; Also reported in ASER
Laboratory Certification	NJAC 7:18 - Regulations Governing Laboratory Certification and Environmental Measurements	Princeton Environmental, Analytical, and Radiological Laboratory (PEARL) – tritium, COD, and analyze immed. parameters	Annual application; semi-annual performance testing; results reported in ASER
Land Use - Wetlands	NJAC 7:7A – Freshwater Wetlands Protection Act Rules	Delineated wetlands; 26-kV tower maintenance, well installations	Status reported in quarterly updates; Also, reported in ASER
Meteorology	DOE Order 430.1A - Life Cycle Asset Management	Meteorological tower – Removed in 2005. Rain gauge	Precipitation reported in ASER
Safe Drinking Water	40 CFR 141.16 –National Primary Drinking Water Regulations	Best Management Practices - Tritium analyzed in ground, surface, & rain water	20,000 pCi/L or 4 mrem/year annual dose. Reported in ASER
Soil	NJAC 7:1E – Discharge of Petroleum and Other Hazardous Substances	Reporting discharge of petroleum or hazardous substances on soil/ unpaved areas/ water	30-Day confirmation report to NJDEP; Also reported in ASER
	Standards for Soil Erosion and Sediment Control Act Chapter 251	Projects which create soil disturbance greater than 5,000 sq. feet	Quarterly status reported in updates
SPCC	NJAC 7:1E – Discharge of Petroleum and Other Hazardous Substances 40 CFR 110 – Discharge of Oil 40 CFR 112 – Oil Pollution Prevention	PPPL designated minor facility – no DPCC or DCR required; Spill Prevention, Control, and Countermeasure Plan (SPCC) required	SPCC Plan required; Inspections, records, procedures
TSCA	40 CFR 761- Polychlorinated Biphenyls (PCBs)	Label, inspect, records of polychlorinated biphenyls (PCBs) in capacitors	Inventory; Disposal records; Also reported in ASER

Exhibit 3-27. Environmental Requirements (cont.)

Media	Regulatory Citation	Requirement/Permit	Data Reported
Waste - Hazardous	40 CFR 260 –279 – Resource Conservation and Recovery Act (RCRA) NJAC 7:26-8 – Hazardous Waste Regulations	On-site 90 –day temporary storage; EPA ID # NJ1960011152 Manifest records	Biennial report to NJDEP (last report required in 2003)
Waste - Medical	NJAC 7:26-3A Regulated Medical Waste	Disposal of medical wastes generated from dispensary	Annual report to NJDEP(last report required in 2004)
Waste - Sanitary	NJAC 7:28 – Bureau of Radiation Protection	Liquid effluent collection (LEC) tanks sampled for: Tritium Gross beta	Tritium concentrations not to exceed 1 Curie per year
	DOE Order 5400.5 – Radiation Protection of the Public and the Environment	LEC tank - Tritium Gross beta	2 million picoCuries/Liter per discharge limit
	Stony Brook Regional Sewerage Authority – rules and regulations	Quantity released Not required samples LEC tank for: Tritium & Gross beta pH, temperature, Chemical oxygen demand (COD)	Quarterly volume discharged reported to SBRSA Data reported in ASER
Waste - Solid	NJAC 7:26 – Solid Waste	Registered Solid waste hauler; recycling separation of materials	Recycle report for paper, cardboard, glass/aluminum, plastics, scrap metals, batteries, office waste, *etc*.; Also reported in ASER
Water - Ground	NJAC 7:14A – The New Jersey Pollutant Discharge Elimination System (NJPDES)	Integrity testing of the liner once every 3 years.	Last inspection/test in 2006. Next inspection due 2009.
	NJAC 7:19 – Water Supply Allocation Rules	Monthly volume withdrawn From D&R Canal	Annual report to NJDEP
	NJAC 7:26E – Technical Requirements for Site Remediation	Investigation –annually ground water monitoring, 12 wells, 2 sumps, and one surface water location	Remedial Investigation reports to NJDEP; Also , reported in ASER
Water - Potable	NJAC 7:10 – Safe Drinking Water Act	Quarterly inspection of back-flow preventors; annual internal inspection	Annual report to NJDEP & water purveyor
Water – Storm	NJAC 7:13 – Flood Hazard Area Control	Basin inspection & maintenance	Records
Water - Surface	NJAC 7:14A – The New Jersey Pollutant Discharge Elimination System (NJPDES)	Monthly surface water samples at two locations – DSN 001 and 003; annual chronic toxicity test @ DSN 001	Monthly discharge monitoring reports to NJDEP; annual chronic toxicity test report to NJDEP; Also, reported in ASER

Chapter

4

ENVIRONMENTAL PROGRAM INFORMATION

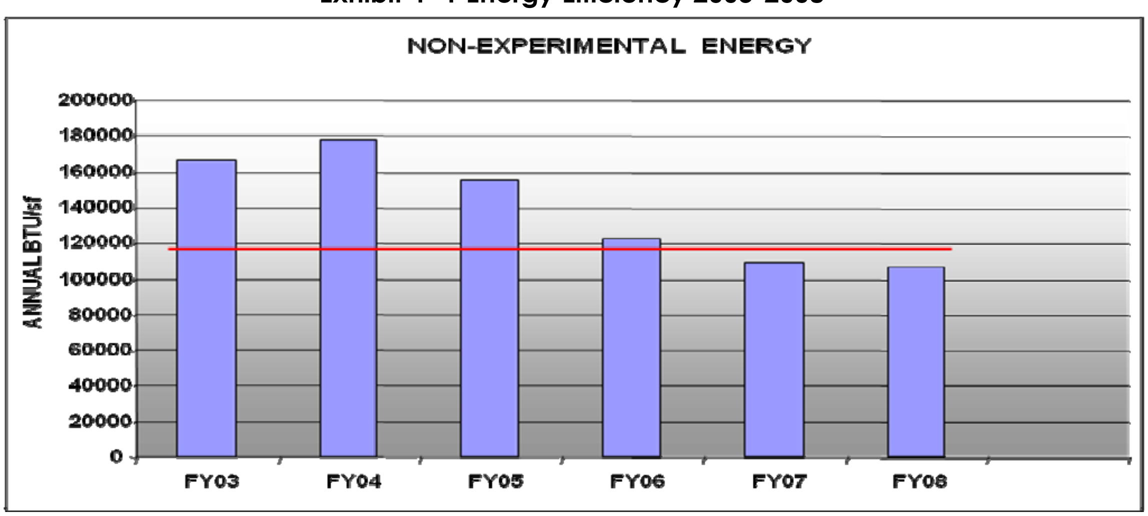
4.1 Environmental Management System and Environmental Protection Programs

4.1.1 Environmental Management System (EMS) and Sustainability Goals

The Executive Order (EO) 13423, "Strengthening Federal Environmental, Energy and Transportation Management," required that an EMS program be prepared and implemented at all Federal facilities, including U.S. Department of Energy (DOE) Laboratories. The EMS follows or uses the International Standards Organization (ISO) 14001 standard. DOE Order 450.1A required compliance with the EMS requirement and implementation be completed by June 2009. The significant environmental aspects at PPPL are as follows with several aspects, as noted, discussed elsewhere in this report:

- Energy Use –non- experimental electricity, natural gas and oil consumption (Exhibit 4-1)
- Water Use – potable and non-potable (Exhibit 6-5)
- Material Use – office supplies, construction materials, metals, etc. (Exhibit 4-2)
- Fleet Fuel Use – petroleum, alternative fuel vehicles, fuel efficiency (Exhibit 4-3)
- Waste Generation – hazardous, radiological, municipal, medical (Exhibits 3-1 to 3-3)
- Effluents and Emissions – air, water, storm water, waste water (Exhibits 3-7, 3-8 & 3-10)
- Potential Spills – fuels, oils, chemicals, other (See Section 3.1.7).
- Chemical Use – types, safety, storage, disposal (Exhibits 3-13, 3-18 & 3-21)
- Landscape, Land Use, and Habitat Enhancements – erosion, open spaces, wetlands (Exhibits 3-14 to 3-16 & 3-19)
- Radiation Exposure – dose to employees, public (Exhibit 3-9)

Exhibit 4- 1 Energy Efficiency 2003-2008

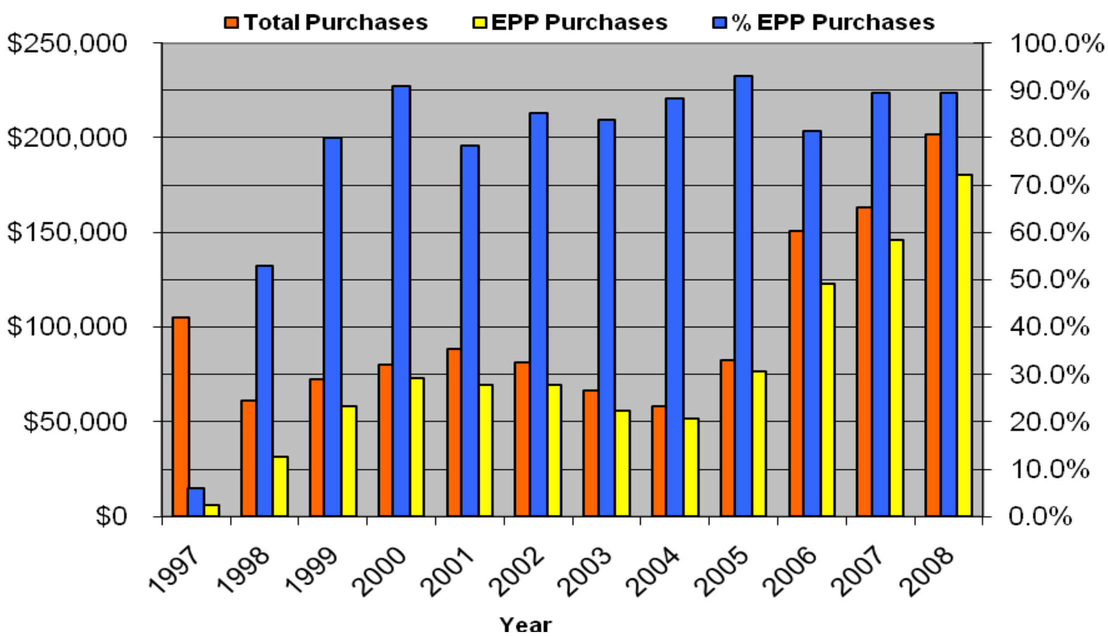


The Energy Efficiency goal is to reduce the energy intensity, as a measurement of BTUs per square foot, by 30% on average by FY2015 compared to the FY2003 baseline. Similarly, the reduction of Greenhouse gases (GHGs) or carbon dioxide (CO_2) and carbon dioxide equivalents (CO_2 E) must be achieved at the same level (30% by FY2015). PPPL achieved this Energy Efficiency goal in FY2007 and FY2008, with the energy intensity reduction of the non-experimental area by 37% and 36%, respectively. In Exhibit 4-1, the red horizontal line represents the 2015 (30% reduction) goal of EO13423. As shown in Exhibit 4-1, PPPL met that goal in FY2007 and improved its performance in FY2008. These reductions also lowered annual CO_2 emissions by over 4000 tons compared to the 2003 baseline.

The two areas contributing to these reductions were improvements to facility process equipment and operations. Annual savings of water, energy and chemicals was achieved at the cooling tower by installing multiple bag filters that replaced the cyclone strainer, which removes suspended solids from non-potable water. Also at the cooling tower, significant savings were made by installing a new chemical controller; the chemical controller increased the cycles of concentration, which in turn reduced the need for water treatment chemicals, water, and energy to operate the cooling tower.

Two old, water-cooled air compressors were replaced with new air-cooled compressors. The new air-cooled units used significantly less water and energy to operate than the water-cooled units; only one unit operates at a time, while the second unit is on stand-by.

Exhibit 4-2. Environmentally Preferable Purchases (EPP) Reporting Data

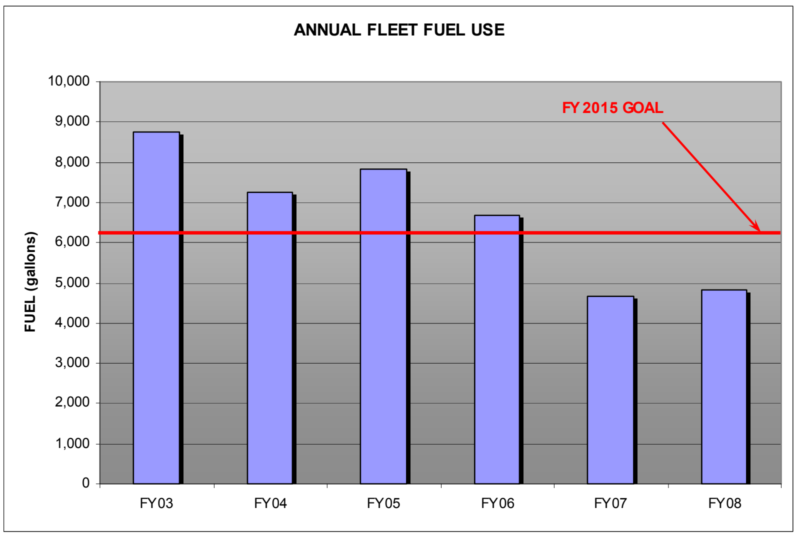


In Exhibit 4-2, the blue bars indicate that during 2007-2008 approximately 90% of PPPL's total purchases were environmentally preferred products (EPP). From office supplies, carpet and flooring tiles, paints, cleaners, lighting, and office furniture, PPPL practiced green buying moving closer to the goal of 100%. The total dollar also increased for both years.

PPPL's Transportation management accomplished:

- Alternative Fuel Vehicles and Usage rate 100% of goal
- Petroleum consumption of 4600 and 4850 gallons in 2007 and 2008 were below the goal of 5320 gallons (30% reduction of 7600 gallons)

Exhibit 4-3. Annual Fleet Fuel Use FY2003-2008



By 2007, PPPL had exceeded the 30% reduction goal by lowering its petroleum consumption by an average of 38% from 2003 levels (Exhibit 4-3). These decreases were made possible by the alternative fuel vehicles, which used compressed natural gas (CNG), B-20, or E-85 or flex fuels. PPPL's alternative fuel vehicles included John Deere® Gators that are used to transport employees and equipment and for plowing snow (Exhibit 4-4).

Exhibit 4-4. Gator snow plow

4.1.2 Environmental Protection Program

DOE Order 450.1, "Environmental Protection Program," was approved on January 15, 2003. As this Order requires the protection of air, water, land, and other natural and cultural resources that may be impacted by DOE and PPPL operations, the Environmental Review Committee (ERC) subcommittee was similarly tasked with the action to spearhead the Laboratory's adoption of the Order's requirements. These requirements were to be implemented within 12 months of the inclusion of the Contractor Requirement Document (CRD) into the facility goals and contract, which occurred in May 2003.

Formalized programs were developed in order to fulfill CRD goals: environmentally and economically beneficial landscaping, supply specifications and acquisitions and operational assessments for pollution prevention projects, and ozone-depleting substance management. The integration of EMS into ISMS as well as revisions to implementing documents was completed in 2005.

PPPL's progress toward meeting the CRD goals are discussed in Sections 3.3.1, "Clean Air Act (CAA)," 3.6.3, "Beneficial Landscaping," and 3.6.4, "Progress on DOE Secretarial Goals" of this report.

Through PPPL's Environmental Monitoring Plan activities, PPPL actively pursues ways to track the level of water quality at its two discharges. Under the New Jersey Pollutant Discharge Elimination System (NJPDES) regulations, monthly, quarterly, and annual monitoring has occurred at both outfalls since 1992 (Exhibit 4-6). Improvements include the actions taken by PPPL for the retention basin: annual maintenance and triennial liner inspection (last one in 2006), new aeration/bubbler equipment, three oil-detection units and instrumentation, and an ultrasonic unit to reduce algal growth.

To maintain good storm water quality, PPPL conducts site-wide grounds clean-ups, landscaping of disturbed areas to reduce pollutants and eliminate runoff, and swale maintenance to improve drainage. For water conservation, PPPL has replaced many original non-potable water lines and installed water-saving fixtures in many buildings.

At annual briefings, PPPL representatives meet with local officials to provide updates on the current status of experimental projects at the Laboratory and also to provide the opportunity to discuss environmental topics or other concerns.

Exhibit 4-5. Radiological Air Monitoring Stations

Station Name	Number/Description	Exhibit #
Remote Environmental Air Monitoring (REAM)-off site	REAM or *R 1- 6*: Tritium	4-8
Radiological monitoring system (RMS) on D site	*T 1-4*: Passive tritium monitors	4-7

Exhibit 4-6. Radiological and Non-Radiological Water Monitoring Stations

Station #	Location/Exhibit #	Description
B1	Off-site / 4-7	Bee Brook Upstream of discharge from retention basin
B2	On-site / 4-7	Bee Brook Downstream of discharge from retention basin
C1	Off-site / 4-8	Delaware & Raritan Canal (Plainsboro)
DSN001	On-site / 4-7	Surface Water Discharge from the retention basin
DSN003	Off-site / 4-8	Delaware & Raritan Canal pump house outfall
E1	On-site / 4-7	Elizabethtown Water Company - potable water supply
M1	Off-site / 4-8	Millstone River - Plainsboro & West Windsor boundary- Route 1
P1	Off-site / 4-8	Plainsboro Surface Water - Millstone River
P2	Off-site / 4-8	Plainsboro Surface Water - Devils Brook
D-MG & TFTR	On-site /4-7	Basement sumps that drain ground water to retention basin
D-11R & D-12	On-site /4-7	Ground water monitoring wells next to retention basin
TW-1,2,3,& 10	On-site /4-7	Ground water monitoring wells north of NSTX
LECT 1,2,or 3	On-site /4-7	Liquid effluent collection tanks north of NSTX
R1S to R2N	On-site /4-7	Rain water stations N,S ,E, & W @ 250 & 500 ft. from stack
Rainwater R1-R6	Off-site /4-7	Rain water stations (5 co-located with air DATS)

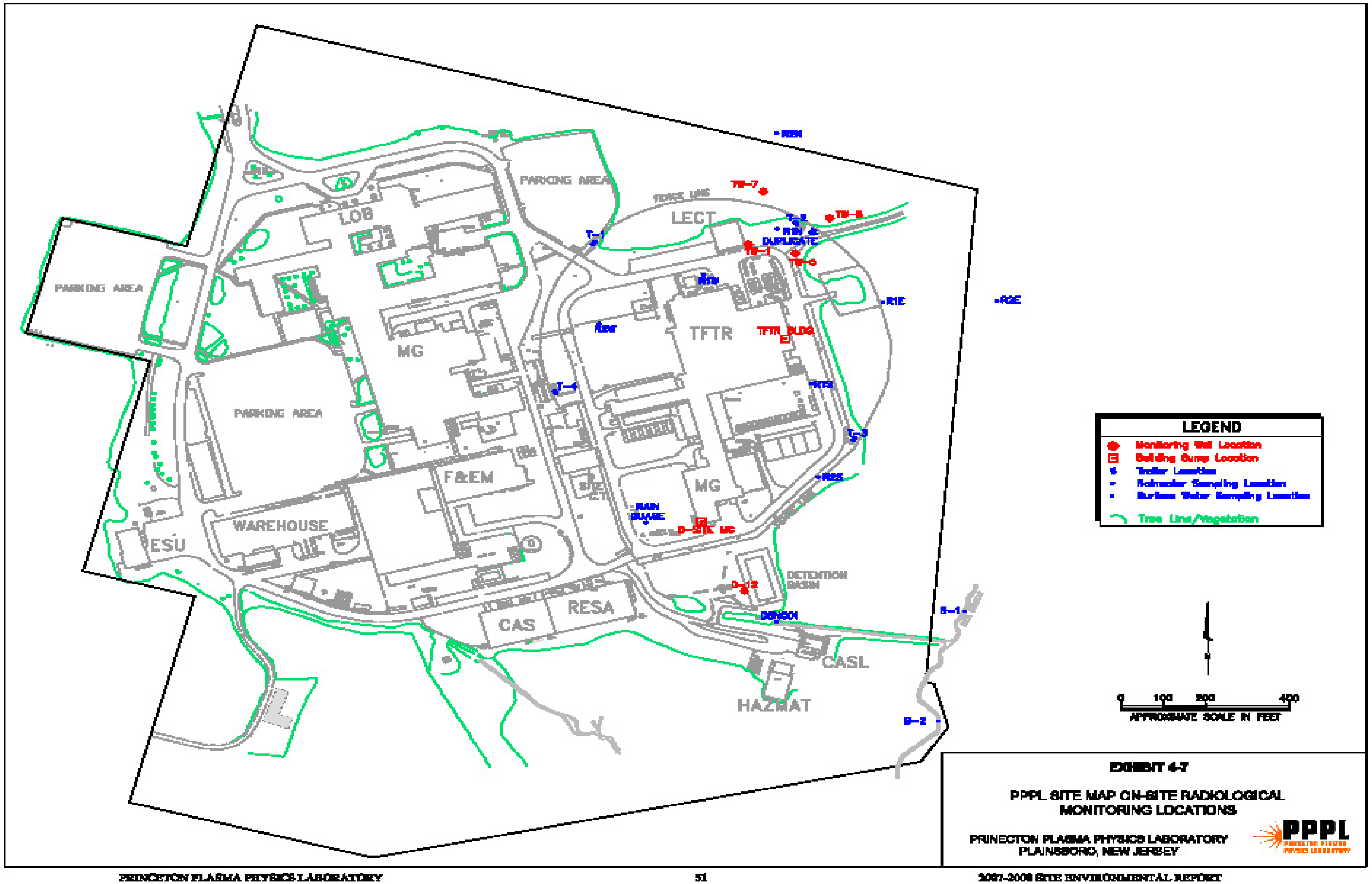


Exhibit 4-7. PPPL Site Map On-site Radiological and Non-Radiological Monitoring Locations

Exhibit 4-8. Off-site Monitoring Locations

4.2 Summary of Radiological Monitoring Program

The monitoring for sources of potential radiological exposures is extensive. In 1981, real-time prompt gamma and/or neutron environmental monitoring on D-site began to establish baselines prior to TFTR operations. Exhibit 4-5 lists the air stations that were monitored for radiological parameters in 2007 and 2008. Surface, ground, rain, and process water samples are collected at the same locations for both non-radiological and radiological (HTO) analysis (Exhibits 4-6, 4-7, & 4-8).

PPPL is situated in the metropolitan corridor between New York City to the northeast and Philadelphia to the southwest. Census data indicate that approximately 18 million people live within a 50-mile radius (80 km) of the site and approximately 253,000 within 10 miles (16 km) of PPPL based on the 2000 population census [US00].

The overall, integrated, effective-dose equivalent (EDE) from all sources (excluding natural background) to a hypothetical individual residing at the nearest business was calculated in milli radiation equivalent man (mrem) and microSievert (μSv): 0.0045 mrem

(0.0447 μSv) for 2007 and 0.00192 mrem (0.0192 μSv) for 2008 (Exhibits 5-1 & 5-2) [Lev08a, 09a]. Detailed person-radioactive equivalent man (rem) calculations for the surrounding population was not performed, because the value would be insignificant in comparison to the approximately 100 mrem (1.0 mSv) that each individual receives from natural background, excluding radon, in New Jersey.

4.3 Summary of Non-Radiological Monitoring Program

During 2007-2008, PPPL operated under New Jersey Pollutant Discharge Elimination System (NJPDES) surface water permit, number NJ0023922, which was renewed effective February 2006. PPPL continued monthly monitoring of the retention basin discharge (DSN001) as stated in the permit conditions. Monthly DSN001 data exists dating back to 1984.

Monthly water quality monitoring at DSN001:

- Temperature, pH
- Petroleum hydrocarbon (TPHC)
- Total suspended solids (TSS)
- Chemical oxygen demand (COD)
- Chlorine-produced oxidants (CPO)
- Total phosphorus(Tot. P)
- Tetrachloroethylene (PCE)
- Flow - monthly daily average and maximum daily flow

Quarterly water quality monitoring at DSN001:

- Total nitrogen (TN) = Nitrite-N, Nitrate-N, Ammonia-N, Total Kjeldahl N

Annual:

- Chronic Toxicity Testing
- Waste Characterization Report parameters

Monthly sampling for total petroleum hydrocarbons (TPHC), chlorine-produced oxidants (CPO), and pH continued at DSN003— the filter backwash discharge located at the Delaware and Raritan Canal pump house. Monthly monitoring of total suspended solids (TSS) was included for the discharge and intake (upstream in D&R Canal designated as C1) without a permit limit for TSS (Exhibit 4-5).

As required by the surface water permit, a chronic toxicity characterization study was conducted to test the DSN001 effluent with the fathead minnow (*Pimephales promelas*) as the test organism [NJDEP95a]. Annual study results were submitted for the September 2007 and November 2008 tests [PPPL07c, 08c]. PPPL's discharge water and the control tests were the same – no mortality ofthe test specimens. The Waste Characterization Report parameters are sampled at the same time as the chronic toxicity testing.

Ground water monitoring conducted for the Environmental Restoration program is discussed in Chapters 6 and 7.

4.4 Environmental Requirements

Environmental requirements of which DOE and PPPL subscribe are listed in Exhibit 3-27 and are discussed in Chapters 3.0, "Environmental Compliance Summary" and 6.0, "Environmental Non-Radiological Program Information," of this report.

4.5 Environmental Impact Statements and Environmental Assessments

No Environmental Impact Statements or Environmental Assessments were prepared in 2007 or 2008.

4.6 <u>Summary of Significant Environmental Activities at PPPL</u>

4.6.1 Sustainable PPPL

Exhibit 4-9. Earth Week 2007 Sustainable PPPL Banner

PPPL's Earth Week Committee designed the above banner for the 2007 Earth Week events (Exhibit 4-9). The concept of "sustainability" was not new to PPPL, however, the idea was to bring this message to the forefront. By making the message more tangible and visual, sustainability formed a platform on which to launch the goals of the new Executive Order 13423. These goals of Environmental, Energy, and Transportation management are discussed in Sections 3.7.1 and 4.1 of this report.

4.6.2 PPPL Environmental Awards

Vehicle Fleet Management Award to an Organization

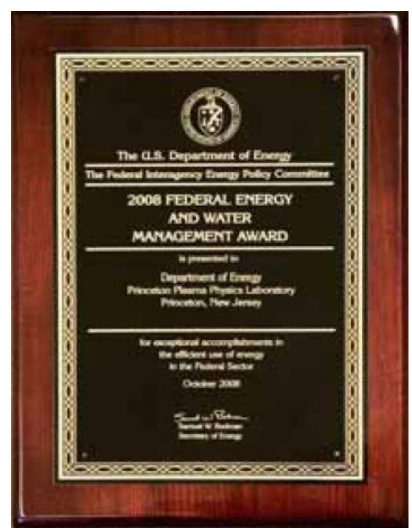
Department of Energy

Princeton University Plasma Physics Laboratory

Princeton, New Jersey

In FY 2007, the Department of Energy's Princeton University Plasma Physics Laboratory (PPPL) first began using B-20 biodiesel as an alternative fuel for new utility vehicles and existing diesel-powered fleet vehicles. The use of this fuel in a new utility vehicle—the John Deere Gator—was groundbreaking as this was the first time B20 fuel was used in this vehicle. PPPL also reinstituted the use of natural gas powered vehicles, obtaining three new full size pickup trucks from the GSA. These efforts, along with managing vehicle use, allowed PPPL to reduce petroleum fuel from more than 7,200 gallons in the FY 2005 base year to just over 4,600 gallons in FY 2007. This reduction of 36% is nearly double the 2015 goal of 20%. The use of B-20 results in a reduced carbon footprint of more than 2,400 pounds of carbon dioxide. PPPL's alternative fuel program is growing, with plans to obtain additional flex fuel, diesel, and natural gas vehicles to augment the current fleet.

Exhibit 4-10.
DOE Award for Vehicle Fleet Management



In 2008, PPPL received the first ever DOE Federal Energy and Water Management Award in the category of Fleet Management. In 2007, PPPL received the DOE Office of Science's "Best Practices" Pollution Prevention (P^2) Award for sustained outstanding recycling performance. PPPL recycling rate was greater than 50 % for municipal solid waste and ~ 90% for construction wastes for both years 2006 and 2007.

From 2006-2008, PPPL was awarded three DOE P^2 Environmental Stewardship Accomplishment Awards for 1) bio-based products in hydraulic systems and cleaning products (Exhibit 3-13), 2) vehicle alternative fuels and fuel conservation (Exhibits 4-3, 4-4 & 4-10), and 3) 100% bio-based cleaning product use and metal cutting lubricants (Exhibits 3-11 & 3-18).

In addition to the DOE awards, PPPL received Environmental Protection Magazine's Facility of the Year Competition – Honorable Mention twice for 2006 and 2007, based on PPPL's outstanding recycling rates. Also in 2007, the New Jersey Department of Environmental Protection (NJDEP) awarded PPPL for Outstanding Achievement in Recycling in the "Institution" category.

4.6.3 Tritium in the Environment

Since TFTR deuterium-tritium (D-T) experiments began in 1994, PPPL monitored tritium in continuous air samples from the test cell stack (vent). To monitor for tritium in water, rain, ground and surface, five monitoring wells and two ground-water sumps, ten on-site and six off-site rainwater-monitoring stations and surface water at one on-site and one off-site station were sampled monthly from 1995 through 2008 (Exhibits 4-11 & 4-12, Tables 3A-8A and Tables 3B-8B) [Lev08c, 09c].

Exhibit 4-11. 2007 Highest Tritium Concentrations in Environmental Samples

Media	Location	Highest HTO	Date
Air	T2(NE D-site)	6.95 pCi/m^3	
	R6 (S of PPPL)	2.84 pCi/m^3	
	D-site Stack	0.20 Ci	Oct.31
Well	TW-1	257 pCi/L	May
Rain water	R1W	1441 pCi/L	Mar. 13 -Stack 0.0796 Ci HTO
Surface water	DSN001/003	126 pCi/L	September

Ci = Curie pCi/L = picoCuries per Liter HTO = tritiated water

Exhibit 4-12. 2008 Highest Tritium Concentrations in Environmental Samples

Media	Location	Highest HTO	Date
Air	T1(NW D-site)	3.03pCi/m^3	
	R4 (W of PPPL)	1.35 pCi/m^3	
	D-site Stack	0.1320 Ci	Dec. 3
Well	TW-1	5473 pCi/L	June
Rain water	R2S	1212pCi/L	Jan. - Stack 0.071 Ci HTO
Surface water	DSN003	523 pCi/L	July

Ci = Curie pCi/L = picoCuries per Liter HTO = tritiated water

4.6.4 National Compact Stellarator Experiment (NCSX) Cancelled

Begun in 2005, the Coil Winding Facility for the National Compact Stellarator Experiment (NCSX) was located in the former TFTR Test Cell (Exhibit 4-13). The fabrication of NCSX's modular coils was among the most complex tasks. Eighteen winding non-magnetic stainless steel castings with surfaces machined to a tolerance of ±0.020 inch were used to cast the magnets; the largest being 110 inches tall and each weighing approximately 6,000 pounds. Coil fabrication continued in 2007 and early 2008.

In May 2008, the DOE Office of Science's NCSX project review concluded that due "to schedule delays and continuing uncertainties of the NCSX construction project necessitate(d) its closure…" [DOE08]. Instead, PPPL refocused its priorities on the proposed upgrades to the National Spherical Torus Experiment (NSTX), its "proven, productive, world-leading scientific facility." ✵

Exhibit 4-13. PPPL's NCSX Magnetic Coils Group (March 2007)

March 2007 PPPL Hotline: http://www.pppl.gov/polNewsletters_Archive.cfm?Year=2007&Month=3

May 2008 PPPL Hotline: http://www.pppl.gov/polNewsletters_Archive.cfm?Year=2008&Month=5

Chapter

5

ENVIRONMENTAL RADIOLOGICAL PROGRAM INFORMATION

5.1 Radiological Emissions and Doses

For 2007, 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 2008 emissions and doses from D-site operations. The calculated EDE at the site boundary are two-hundredths and one-hundredths of one mrem for 2007 and 2008, far below the annual limit of 10 mrem per year [Lev08a, 09a].

Exhibit 5-1. Summary of 2007 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 6.1146 Ci (2.26×10^{11}Bq) HT 0.5233 Ci (1.94×10^{10}Bq)	0.0159 (1.59×10^{-4})	98.05	0.134085 (1.34×10^{-3})
Tritium (water)	LEC tank	0.00899 Ci (HTO) (3.33×10^{8} Bq)	0.00018 (1.80×10^{-6})	1.11	0.0002477 (2.47×10^{-6})
Tritium(water)	Surface Ground	234 pCi/L (DSN001) 257 pCi/L (TW) 1)	0.000072 (7.20×10^{-6})	0.44	0.000099 (9.90×10^{-7})
Direct/Scattered neutron & Gamma Radiation	NSTX	5.81×10^{16} DD neutrons	0.000058 (5.80×10^{-7})	0.36	Negligible
Argon-41 (Air)	NSTX	0.000513 Ci (1.90×10^{7}Bq)	0.000006 (6.00×10^{-8})	0.04	0.000012 (1.20×10^{-7})
Total			**0.016216** **(1.62×10^{-4}mSv)**		**0.134443** **(1.34×10^{-3})**

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

Estimated dose equivalent at the nearest business is 0.00447 mrem (4.47×10^{-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.

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

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

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.

Exhibit 5-2. Summary of 2008 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 2.5799 (9.54×10^{10}) HT 0.2371 (8.77×10^{9})	0.00671 (1)(2) (6.71×10^{-5})	85.63	0.056903 (5.69×10^{-4})
Tritium (water)	LEC tank	HTO 0.00737 (2.73×10^{8})	0.000147 (1.47×10^{-6})	1.88	0.000201 (2.01×10^{-6})
Tritium (water)	Surface Ground	171 pCi/L (DSN001) 5473 pCi/L (TW 1)	0.000860 (8.60×10^{-6})	10.97	0.001178 (1.18×10^{-5})
Direct/Scattered neutron & Gamma Radiation	NSTX	1.08×10^{17} D-D neutrons	0.000108 (1) (1.08×10^{-7})	1.38	Negligible
Argon-41 (Air)	NSTX	0.000953 (3.53×10^{7})	0.000011 (1) (1.10×10^{-7})	0.14	0.000022 (2.20×10^{-7})
Total			**0.007836 (3)** **(7.84×10^{-5})**		0.058304 (3) (5.83×10^{-4})

Bq = Bequerel
HT = elemental tritium
mrem = milli radiation equivalent man
NSTX = National Spherical Torus Experiment
mSv = milli Sievert
HTO = tritium oxide
EDE = effective dose equivalent
LEC = liquid effluent collection (tanks)
TW = test well

(1) Estimated dose equivalent (EDE)at the nearest business is 0.00192 mrem (1.92×10^{-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
(2) 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.
(3) Annual limit is 10 mrem/year; background is about 360 mrem/year.
Half life of tritium (HTO and 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 2007 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 2007 and 2008 total penetrating radiation dose at the site boundary of 5.81×10^{-5} mrem from D-D neutrons and 1.08×10^{-4} mrem from D-D neutrons, respectively. NSTX deuterium-tritium (D-T) neutron generation is very small, and no longer tracked [Lev08a, 09a]

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 2007 and 2008 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 2007 and 2008 total amount of tritium released to the sanitary sewer were 0.009 and 0.007 Curies, respectively, less than 1 percent of the allowable 1.0-Curie per year limit. In Tables 10A and 10B, the gross beta activity is reported; the gross beta activity ranges from <196 pCi/L for 2007 and <213 pCi/L for 2008.

Exhibit 5-3
Annual Releases to Sanitary System from Liquid Effluent Collection Tanks 1994-2008

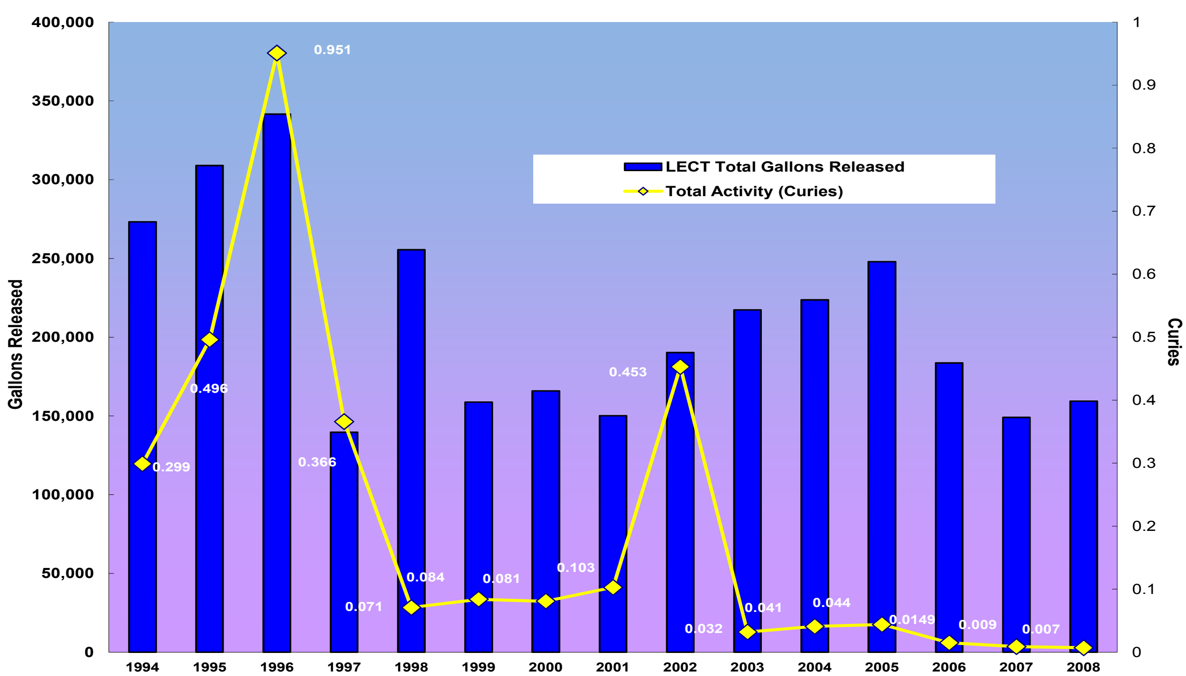


Exhibit 5-4
Total Annual Releases (LEC tanks) to from
Sanitary System from 1994 to 2008

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

Exhibit 5-5
Total Low-Level Radioactive Waste

1997-2008

Year	Cubic feet (ft^3) or Cubic meters (m^3) Kilograms (kg)	Total Activity in Curies (Bq)
1997	1,997.7 ft^3	31,903.0 (1.18×10^{15})
1998	533.74 ft^3	204.80 (7.58×10^{12})
1999	1188 ft^3	213.76 (7.91×10^{12})
2000	4,235.7 ft^3	50.0 (1.85×10^{12})
2001	19,949.8 ft^3	1,288.43 (4.77×10^{13})
2002	858,568 kgs	4,950.14 (1.83×10^{14})
2003	8,208 kgs	0.03 (1.11×10^{9})
2004	4,467 kgs	0.0202 (7.48×10^{8})
2005	30.29m^3 (3,997 kgs)	0.01997 (7.389×10^{8})
2006	11.12m^3 (4,705 kgs)	2.3543 (8.711×10^{10})
2007	8.6 m^3	0.09285 (3.435×10^{9})
2008	3.63 m^3	0.08341 (3.086×10^{9})

5.1.3 Radioactive and Mixed Waste

In 2007-2008, low-level radioactive wastes were stored on-site in the Radioactive Waste Handling Facility (RWHF) prior to off-site disposal (Exhibit 5-5). Each year one shipment of low-level radioactive waste was made in 2007 and 2008. [MP11]. No low-level radioactive mixed waste was generated in 2007 or 2008.

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

PPPL made one shipment of low-level radiotactive wast to Neveda Test Site (NTS) for burial each yar in 2007 and 2008. The wastes are packaged for shipment and disposal in specially-designed and fabricated Type-B containers, referred to as "B-boxes" (Exhibit 5-6). In order to be approved to dispose of low-level wast at NTS, PPPL applied to NTS and after a rigorous review process received approval. PPPL maintains a detailed waste profile for each type of low-level waste shipped to NTS. Annually, NTS audits PPPL's radioactive waste program, which includes employee training, waste characterization, waste packaging, quality control, and records retention.

5.1.4 Airborne Emissions - 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 eleven (11) environmental sampling stations: 4 located on D-site facility boundary trailers (T1 to T4), 7 located at remote environmental air monitoring stations (R1 to R6 and BM1) (Tables 4A and 4B). 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 (0.0447 μSv/year) in 2007 and 0.00192 mrem/year (0.0192 μSv/year) in 2008. Measurements at the D-site facility boundary (T1 to T4) have measured concentrations in the range from 0 to 9.22 pCi/m^3 elemental tritium (HT) and from 0 to 6.95 pCi/m^3 oxide tritium (HTO) in 2007 and 0 to 6.35 pCi/m^3 elemental tritium (HT) and from 0 to 3.03 pCi/m^3 oxide tritium (HTO) in 2008 (Tables 4A and 4B). Measurements from off-site monitoring stations (R1 to R6) are shown in Tables 4A and 4B, "Ranges of Air Tritium Concentrations Collected On-site and Off-site in 2007/2008," [Lev06a, 07a].

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 2007 and 2008 (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 disintegrations per minute (dpm)/100 cm^2. No active or contaminated materials were free-released in 2007 or 2008. 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 2007 was 1,441 pCi/L (Rain water R1W on March 13, 2007, on Table 7A) and 1,212 pCi/L (Rain water R2S on January 18, 2008, on Table 7B). This concentration is a small fraction of the water biota concentration guide (BCG) (for HTO) of 3 x10^8 pCi/L for aquatic system evaluations, and the water BCG (for HTO) of 2 x 10^8 pCi/L for terrestrial system evaluations, per DOE Standard STD-1153-2002, "A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota" [Lev06c, 07c].

5.4 Unplanned Releases

There were no unplanned radiological releases in 2007 or 2008.

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; seven off-site: B1, B2, C1, DSN003, M1, P1, and P2) have been analyzed for tritium (Tables 5A and 5B). Locations are shown in Exhibits 4-7 (on-site) and 4-8 (off-site locations).

In September 2007, at on-site location, DSN001 basin outfall, the tritium concentration was detected at 234 pCi/L, which was the highest for surface water samples (Table 5A). In July 2008, at D7R Canal pump house (DSN003)) the tritium concentration was 523 pCi/L, which was the highest surface water HTO concentration (Table 5B).

Rain water samples, which will eventually reach surface waters, were collected and analyzed and ranged from below detection to 1,441 pCi/liter in 2007 (Table 7A) and 1,212 pCi/L in 2008 (Table 7B), which is lower than the seven-year high of 61,660 pCi/liter. 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 [Lev08c, 09c].

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.

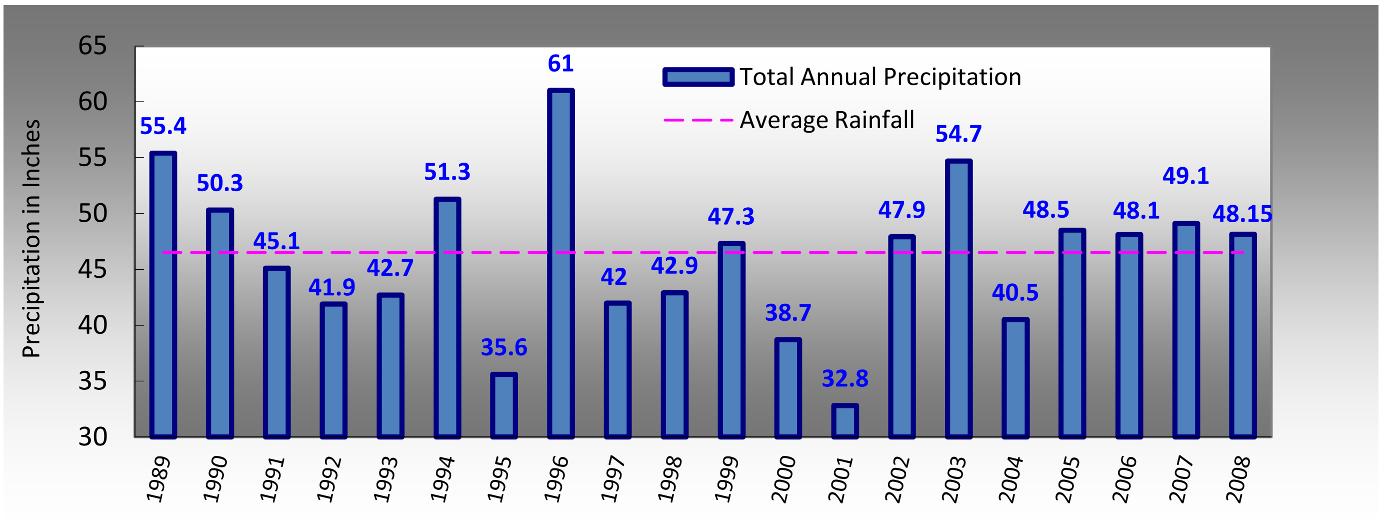
In April 1988, PPPL began precipitation measurements. On a weekly basis, on-site precipitation is measured by a rain gauge. Exhibit 5-7 shows the comparison of dry and wet years based on the 45-inch average (Tables 2A and 2B). Total precipitation in 2007 and 2008 were above the precipitation mean - 45.6 inches – at 49.1, and 48.2 inches, respectively (124.7 cm and 122.2 cm vs. 115.8 cm).

B. Ground Water

In August 1995, PPPL began to monitor tritium levels in on-site ground water more intensely. This increase in the scope of 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 May 2007, the highest concentration of tritium was found in well TW-1 (257 pCi/L); in June 2008 well TW-1 had the highest concentration of tritium at 5,473 pCi/L. These tritium concentrations are well below the Drinking Water Standard of 20,000 pCi/L. 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.

Exhibit 5-7. Total Annual Precipitation from 1989 to 2008



Rainfall collected in 1988 for 10 months; est. >40 inches.

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 2007 and 2008, tritium concentrations at this location were less than the lower limit of detection (Tables 5A and 5B).

5.5.2 Foodstuffs, Soil, and Vegetation

There were no foodstuffs, soil, or vegetation samples gathered for analysis in 2007 or 2008. 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

ENVIRONMENTAL NON-RADIOLOGICAL PROGRAM INFORMATION

6.1 New Jersey Pollutant Discharge Elimination System (NJPDES) Program

6.1.1 Surface and Storm Water

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 18A , 19A, 23A, 18B, 19B and 23B). During 2007-2008, PPPL's discharges were within allowable limits for all tested parameters with the exception of chemical oxygen demand, which was believed to be due to laboratory error.

In December 2003, PPPL submitted the renewal application for the NJPDES permit; in 2006, PPPL received the final NJPDES permit with the effective date of February 1, 2006. New permit requirements for DSN001 included:

- Monthly reporting of the loading calculations for total phosphorus, tetrachloro-ethylene, and chlorine-produced oxidants
- An annual waste characterization report (WCR)
- A phosphorus evaluation study to determine impacts of PPPL's impact on the total maximum daily loading (TMDL) for the Raritan watershed
- A remediation plan for tetrachloroethylene found in ground water and monitored at DSN001

Exhibit 6-1. 2007 Aerator and Boom in Retention Basin

The new requirements for DSN003 were a WCR and acute toxicity test using *Ceriodaphnia dubia* (Water flea) conducted between 4 and 4.5 years after the effective date of the permit between February 1, 2010 and July 31, 2010.

Changes to the basin include the annual basin cleanup that occurred in 2007 and 2008, and installation of a new bubbler/aerator (Exhibit 6-1).

6.1.2 Chronic Toxicity Characterization Study

In 2007 and 2008, annual chronic toxicity testing for DSN001 effluent continued. In all chronic toxicity tests, *Pimephales promelas* (fathead minnow) was the only test species required [NJDEP06]. NJDEP chose the fathead minnow as the more sensitive species for the Chronic Toxicity Biomonitoring requirements.

As the result of the annual chronic toxicity test, the survival rate, as defined by the NJ Surface Water Quality Standards, was >100 percent (statistically possible) no observable effect concentration (NOEC) [PPPL07b, 08f]. The last unsuccessful test occurred in March 1995 when the fathead minnows' mortality was observed in the 100 percent effluent test (Exhibit 6-2).

Exhibit 6-2. Summary of Chronic Toxicity Testing 1994- 2008

[PPPL07b, 08f]

Test Freq.	Bi-month	Quarter	Semi-annual	Test year	Annual (Month of Test)
1994		4*		1999	October
1995		4*		2000	December
1996	3	2		2001	November
1997		4		2002	September
1998		3		2003	October
1999			March	2004	June
				2005	September
				2006	July
				2007	September
				2008	November

(*One test result <100 NOEC failed))

6.1.3 Ground Water

In 1985, the US Geological Survey (USGS) in co-operation with PPPL and DOE, installed ten monitoring wells north of the former TFTR on D-site. The purpose was to collect ground water elevation and quality data. In particular, USGS modeled the ground water flow from PPPL as a hypothetical spill of radioactive water from the liquid effluent collection tanks. The study concluded that the ground water flow would be a less likely pathway [Le87]. In 2007 and 2008, three of these wells were used to collect ground water samples that were analyzed for tritium (Tables 6A and 6B). The tritium concentrations are compared over time.

In 1989, PPPL installed and monitored ground-water quality in five wells in compliance with the NJPDES ground water discharge permit, NJ0086029. In 2007, one well (D-12) was monitored quarterly for tritium analysis and annually under the Site Remediation program [NJDEP01].

A. *NJPDES Ground Water Program in 2007 and 2008*

PPPL is no longer required to collect quarterly ground water samples as a condition of a site-specific discharge to ground water permit for the detention basin. The retention basin is now regulated as a lined surface impoundment under a state-wide general permit. PPPL maintains compliance through its Operation and Maintenance Manual for the retention basin.

As discussed in Chapter 7, "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 retention basin, but rather are the result of historical contamination in the Former Annex Building Area (FABA).

Exhibit 6-3. Ultrasonic flow transducer on right-hand wall of basin exit chamber

An estimated total of 72.6 and 80.1 million gallons of water were discharged from the retention basin in 2007 and 2008, respectively. Installed in December 2000 and with a meter upgrade in 2005, an ultrasonic flow transducer measured flow from the basin; data are downloaded to a data spreadsheet from which total flow, maximum and daily average flows were calculated (Exhibit 6-3). The lined retention basin operates with a permanent oil boom and new oil detection system capable of sending an alarm signal to Site Protection Office and automatically closing the discharge valve if oil is detected. Normally the retention basin operates in a flow-through mode. A gated and locked, chain-link fence surrounds the perimeter of the basin.

B. Regional Ground Water Monitoring Program

In 1993, a Memorandum of Under-standing (MOU) was signed between Princeton University, the landowner of the James Forrestal Campus, and the NJ Department of Environmental Protection (NJDEP). For C- and D-sites, the Remedial Investigation is discussed in Section 3.2.3 and is fully documented in the *Remedial Investigation and Remedial Action Selection Report (RI and RASR)* approved by NJDEP in 2000 [PPPL00a]. The Remedial Action Work Plan (RAWP) was submitted by PPPL in May 2000 and conditionally approved by NJDEP in June 2000 [PPPL00b].

In 2007, annual ground water monitoring activities were continued in the area of potential environmental concern (APEC) near the location of the former PPPL Annex Building in the wooded area southwest of CAS/RESA. (Tables 20A and 20B) [Sh08]. Samples were collected from twelve wells, two sumps, and one surface water location.

In December 2008, the first quarterly ground water samples were collected from a reduced number of locations: seven wells and one sump. Annual sampling was conducted in September 2008.

Volatile organic compounds (VOCs), probably from degreasing solvents, were detected above the NJ Ground Water Standard (1.0 μg/L) in 9 of the 15 wells/sumps sampled. The highest concentrations of tetrachloroethylene (PCE) in 2007 and 2008 were measured in well MW-19S (98.6 and 138 μg/L), both slightly lower than in 2004 (154 μg/L). PCE concentrations in D-site MG sump (2007 – 38.7 μg/L and 2008 – 27.9 μg/L) were lower than in 2002 (88.6 μg/L), the highest concentration since sampling began in 2002. The process of natural attenuation by the indigenous bacteria and other *in-situ* processes appear to be 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. The probable source of the PCE is from the former Annex building that housed hazardous waste activities in the 1980's.

6.2 Non-Radiological Programs

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.

6.2.1 Non-Radiological Emissions Monitoring Programs

A. Airborne Effluents

PPPL maintains New Jersey Department of Environmental Protection (NJDEP) air permits for its four boilers located on C-site, two above-ground storage tank vents for petroleum products, two emergency diesel generators, one fluorescent bulb-crusher, and two carpentry shop dust collectors (Exhibit 6-4).

Measurements of actual boiler emissions are not required. To optimize boiler efficiency and to reduce fuel cost.] PPPL utilizes an outside contractor to test and adjust the boilers on an annual basis and provide a report for each boiler. The report includes the boiler efficiency, oxygen content, flue-gas temperature, nitrogen oxides, carbon monoxide, and carbon dioxide content of the stack gas for both oil and natural gas fuels. The PPPL boiler operations Chief Engineer maintains records of this information [Ne 08, Ne 09]. PPPL operates the following equipment having air permits with conditions to operate:

Exhibit 6-4. PPPL's Air-Permitted Equipment
(Exhibit 3-27

Type of Air Permit	Location	Requirements
Dust collectors	M&O woodworking shop CAS metalworking area	Operate at 99% efficiency
Storage tanks vents	25,000 gal. No. 2 & 4 oil 15,000 gal. No.1 oil	TANKS – annual emissions based on amount of fuel through-put
Diesel generators	D-site generator C-site generator	Annual Limit of 200 hours of operation excluding emergencies; no testing on NJDEP Air Action Days
Utility boilers	Units 2,3,4, & 5 in M&O	Annual emission testing same quarter each year; annual emission calculations based on hours of operations (Ex. 3-7); rolling 12-month calendar total fuel consumed by boiler and fuel type (Ex. 3-6). No opacity
Fluorescent bulb crusher	Hazardous Materials Storage Facility	Hours of operations and number of bulbs crushed

B. Drinking (Potable) Water

Potable water is supplied by the public utility, New Jersey American Water Company, formerly Elizabethtown Water Co. PPPL used approximately 3.89 and 7.41 million gallons in 2007-2008 (Exhibits 6-5 & 6-7) [Kir08, Kir09]. A cross-connection installed beneath the water tower provides back-up potable water to the tower for the fire-protection and other systems. Reductions in water consumption from previous years resulted from projects such as replacing water cooled equipment with new more efficient equipment or those requiring no water use, installing low-flow fixtures in many lavatories, and replacing old steam lines with new lines so the steam system requires less makeup water.

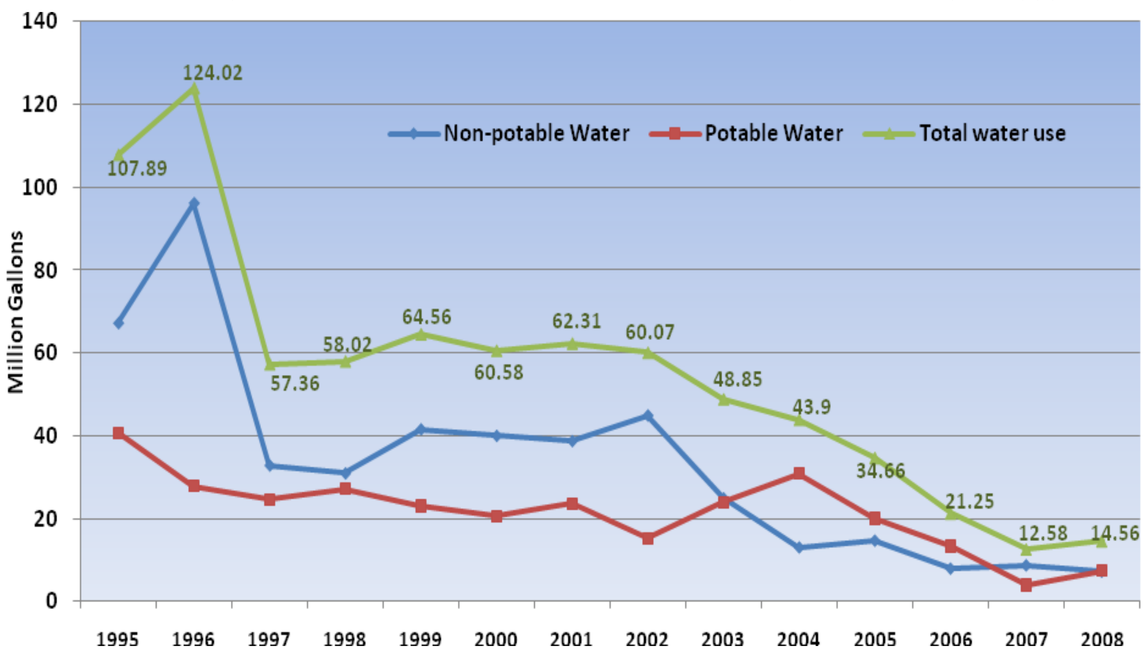
Exhibit 6-5. PPPL Potable Water Use from NJ American Water Co.
[Kir08, 09]

CY	In million gallons
1995	40.69
1996	27.82
1997	24.56
1998	27.12
1999	23.01
2000	20.6
2001	23.6
2002	15.18
2003	23.97
2004	30.88
2005	20.01
2006	13.35
2007	3.89
2008	7.41

Exhibit 6-6. PPPL Non-Potable Water Use from Delaware & Raritan Canal
[Kir08, 09]

CY	In million gallons
1995	67.2
1996	96.2
1997	32.8
1998	30.9
1999	41.55
2000	39.98
2001	38.71
2002	44.89
2003	24.87
2004	13.02
2005	14.65
2006	7.9
2007	8.69
2008	7.15

Exhibit 6-7. PPPL's Potable and Non-Potable Water Use from 1995 to 2008



C. *Process (Non-potable) Water*

In 1987, PPPL made a changeover from potable water to Delaware & Raritan (D&R) Canal non-potable water for the cooling-water systems. 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 500,000 gallons per day for process cooling and fire protection (Exhibits 6-6 & 6-7) [Kir08, Kir097].

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 19A and 19B). 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 13A and 13B summarize results of water quality analysis at the D&R Canal.

D. 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 and B2), Elizabethtown Water Co. (potable water supplier-E1), Delaware & Raritan Canal (C1), Millstone River (M1), and Plainsboro (P1 and P2) sampling points (Tables 11A -17A and 11B - 17B)—are not required by regulation, but are a part of PPPL's environmental surveillance program.

E. 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).

During 1994, due to malfunctioning metering devices, PPPL, South Brunswick Sewerage Authority, and the Township of Plainsboro agreed upon an estimated volume of sewage discharged. The estimated volume was based on historical data of approximate flow rates from PPPL. For 2007-2008, PPPL estimated a total annual discharge of 13.1 and 16.96 million gallons of sanitary sewage to the South Brunswick sewerage treatment plant [Kir08, Kir09**].** The total increase was due to the sanitary flow from a new adjacent office complex unrelated to PPPL operations.

Beginning in 1996, SBRSA required monthly measurement of radioactivity, flow, pH, temperature and chemical oxygen demand (COD) at the LEC tanks (designated compliance and sampling location) as stated in Industrial Discharge License (22-96-NC). In March 2004, SBRSA terminated the license and its requirements, except the quarterly reporting of total volume discharged from the LEC tanks. PPPL continued to periodically collect non-radioactive data (pH and temperature) during CY2007and 2008.

F. Spill Prevention Control and Countermeasure

PPPL maintains a Spill Prevention Control and Countermeasure Plan (SPCC), which was last updated in 2007 and certified by a Professional Engineer who works in the

PPPL Materiel & Environmental Services Division (M&ES). The SPCC was reviewed internally by organizations responsible for equipment covered by the SPCC. The current SPCC is approved by the Heads, M&ES and ES&H and Infrastructure Support [PPPL04a].

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, M&ES will complete a review every year and make any minor changes required to the SPCC.

G. Herbicides and Fertilizers

During 2007 and 2008, PPPL's M&O Division managed the use of herbicides by outside contractors. These materials are applied in accordance with state and federal regulations. Chemicals are applied by certified applicators.

The quantities applied during 2007 were as follows: herbicides – Roundup (5.8 gals.) and Dimension (3 qts.), insecticide - Sevin carbaryl (160 gal. diluted) and fertilizer – NPK (1600 lbs.) [Kin07b]. In 2008, herbicides - Roundup (5.9 gals.) and Dimension (6 qts..) were applied; the insecticide, Sevin Carbaryl (15 gals.) was applied; and fertilizers, lime (1500 lbs.), NPK (1500 lbs.) and 24-0-5 (1600 lbs.) was used [Kin09b]. No herbicides or fertilizers are stored on site; therefore, no disposal of these types of regulated chemicals is required by PPPL.

H. Polychlorinated Biphenyls (PCBs)

At the end of 2007 and 2008, PPPL's inventory of equipment included five-polychlorinated biphenyl (PCB)-regulated capacitors [MP09a].

I. Hazardous Wastes

PPPL submitted the Hazardous Waste Generator Annual Report (EPA ID No. NJ1960011152) to the NJDEP for 2007-2008. A description of Resource Conservation and Recovery Act (RCRA) compliance is found in Section 3.1.2 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. PPPL M&O Division replaced its petroleum-based cleaning fluids with all bio-based cleaning products.

6.2.2 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.

6.2.3 Environmental Occurrences

No unplanned release of petroleum substances in 2007 and two occurred in 2008.

Two spills were reported *via* the NJDEP Hotline in 2008: in March, the sump pump in the Neutral Beam transformer yard was manually activated, which emptied the entire contents of the sump. Mineral oil and storm water were released to the retention basin; oil sensors in the basin alarmed and personnel were notified. Under normal operations, only stormwater is released during a rain event while the oil remains in the sump. PPPL recovered to oil floating on the water surface and investigated the source of the oil. Having located the oil's source, PPPL with subcontractor assistance cleaned the sump. Oil detectors with alarms were installed in the sump in 2009. No further incidences of oil being released from the sump have occurred.

In September 2008, oil from a transformer located betweent the radio frequency (RF) and ESAT courtyards leaked overflowing its containment. PPPL removed the oil from the transformer, cleaned up the spilled oil and contaminated gravel/soil, and repaired the transformer. The transformer remains in its present location.

6.2.4 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 in March 2007 and 2008 [PPPL08a, 09a]. 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 3-21.

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 2007 or 2008.

Chapter

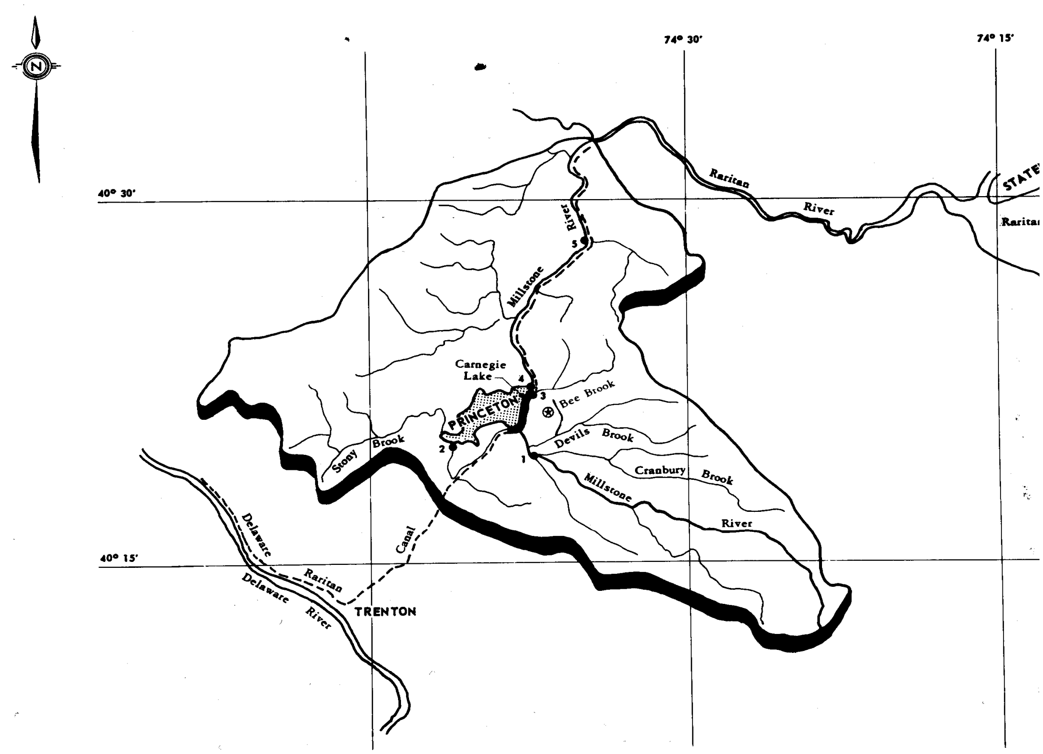
7

SITE HYDROLOGY, GROUND WATER, AND DRINKING WATER PROTECTION

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 7-1). 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 7-1. Millstone River Watershed Basin



PPPL is situated on the eastern edge of the Piedmont Physiographic Province, approximately one-half mile from the western edge of the Atlantic Coastal Plain Province. The site is underlain largely by gently dipping and faulted sedimentary rock of the Newark Basin. The Newark Basin is one of several rift basins that were filled with sedimentary material during the Triassic Period. At PPPL, bedrock is part of the Stockton Formation, which is reportedly more than 500 feet thick and consists of fractured red siltstone and sandstone [Lew87]. Regionally, the formation strikes approximately north 65 degrees east, and dips approximately 8 degrees to the northwest. The occurrence of limited amounts of clean sand near the surface indicates the presence of the Pennsauken Formation. This alluvial material was probably deposited during the Aftonian Interglacial period of the Pleistocene Ice Age.

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

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

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

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

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

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

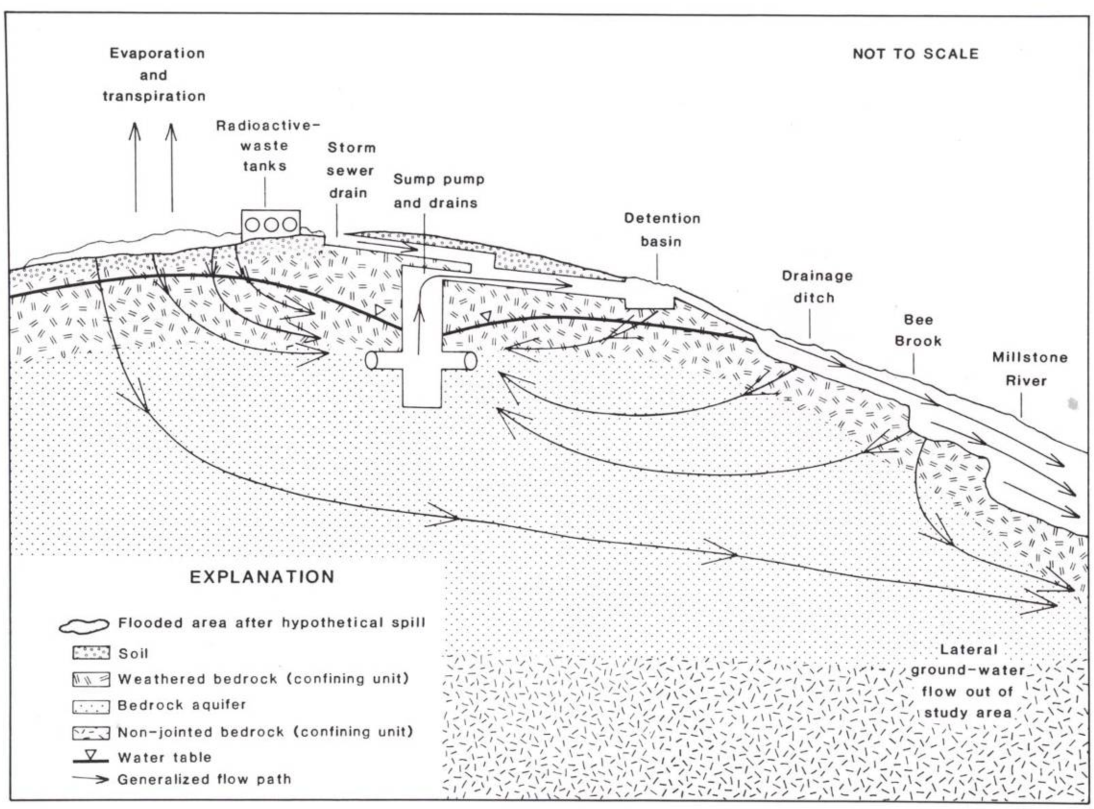
An upland forest type with dominant Oak forest characterizes vegetation of the site. Associated with the various oaks are Red Maple, Hickories, Sweetgums, Beech, Scarlet Oak, and Ash. Red, White, and Black Oaks are isolated in the lower poorly drained areas. Along the damp borders of Bee Brook, a bank of Sweetgum, Hickory, Beech, and Red Maple define the watercourse. The forest throughout most of the site has been removed either for farmland during the last century or recently for the construction of new facilities. Grass has replaced much of the open areas.

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

All of PPPL's storm water runoff flows to Bee Brook, either directly *via* the 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 (Exhibits 3-13, 3-14 & 3-18) [SE96].

Exhibit 7-2. 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 7-2).

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.

Under several regulatory programs administered by NJDEP, PPPL has performed ground water investigations to address potential impacts from former underground storage tanks (USTs), a formerly unlined retention basin, and in areas where spills occurred or may have occurred in the past.

In all, PPPL installed a total of 44 wells to monitor ground-water quality. Remedial Investigations and Remedial Alternative Assessment (RI/RAA) studies were conducted to delineate shallow ground water contamination and identify a suitable remedy as required by conditions of the Memorandum of Understanding (MOU) between Princeton University and NJDEP. A Remedial Action Work Plan was approved by NJDEP in 2000. Ground water monitoring continues as part of the selected remedy.

In September 2003, PPPL sealed 13 monitoring wells that were no longer needed for specific or site-wide monitoring programs. The wells were sealed by a New Jersey-licensed well driller using methods approved by NJDEP regulations. NJDEP approval was granted prior to the closure of these wells.

Exhibit 7-3. Ground Water Monitoring Equipment-Probe and Meter

Beginning in 2003, PPPL shifted to annual ground water monitoring from quarterly monitoring with NJDEP approval. Each fall - usually in September - PPPL monitors the groundwater wells. The type of equipment used by PPPL to sample the ground water is shown in Exhibits 7-3 and 7-4. Air 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 probes for pH, conductivity, dissolved oxygen, temperature, and turbidity. The water then 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, in order that the well does not go "dry" and to ensure the sample will be representative of the groundwater.

Exhibit 7-4.
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 (Exhibits 7-6 & 7-8). These VOCs are commonly contained in solvents or metal degreasing agents.

Foundation de-watering sumps located on D-site influence ground water flow across the site (Exhibits 7-5 & 7-7). 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 the foundation drains on D-Site ground water beneath the site is drawn radially toward the D site sumps.

During Phase 1 and 2 of the Remedial Investigation (RI), samples from wells and other ground water characterization activities lead to the identification of a new area of potential environmental concern (APEC) near the former Annex Building area (FABA). This finding expanded the site boundaries by 16.5 acres for a total of 88.5 acres. Characterization of soil and ground water in the FABA was conducted during 1997 and 1998 [HLA98].

Phase 3 activities were conducted to:

- Complete a Baseline Ecological Evaluation
- Investigate soil and ground water quality at FABA, and
- Further assess PCE and other VOC concentrations and distribution in ground water.

In the Remedial Action Selection Report, PPPL proposed to NJDEP that no active ground water remediation beyond the capture and extraction performed by the building dewatering system should be implemented at the site. Natural attenuation processes in the subsurface augments building foundation-dewatering system. In a letter dated March 28, 2000, NJDEP approved the Remedial Investigation and Remedial Action Selection Reports [Sh99]. In response, 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 [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. CEAs are granted for a specific area of an aquifer and for specific contaminants. The CEA for PPPL is shown on Figure 7-3 and only addresses specific VOCs in the shallow (<60 feet deep) aquifer. The CEA request was approved by NJDEP in August 2002. In 2007 PPPL recertified its Biennial Certification Monitoring Report for a Ground Water Classification Exception Area (CEA) (PPPL07c).

In 2007 and 2008, RAWP activities accomplished the following:

- 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.
- VOCs in ground water do not pose a risk to site workers or the surrounding public.
- Two inactive water supply wells (Well 4 and Well 5) were decommissioned and properly abandoned in February 2007 (PPPL08g).
- As proposed in the February 2008 *Remedial Action Progress Report* quarterly sampling is being conducted at the following additional locations to provide better definition of the distribution and fluctuation of contaminant concentrations in the FABA and CAS/RESA areas: MW-9S, MW-13S, MW-17, MW-18, MW-19S, MW-25 and D-Site MG Sump (PPPL08g).
- Well maintenance included replacing dedicated sampling bladder pumps at all current sampling well locations throughout 2007 and 2008 (PPPL09b).

Natural attenuation processes are active as evidenced by presence of degradation compounds in ground water down gradient of source. PCE is degraded into trichloroethylene (TCE) and cis-1,2-dichloroethlyene (c-1,2-DCE), and the presence of dissolved methane, reduced dissolved oxygen levels and negative oxidation-reduction potential (redox) values also provides definitive evidence of on-going biological degradation (Tables 38A to 39A and 38B to 39B) [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 (January 1998 and November 2000). Spring and summer results are generally lower (April 1998, July 1999 and May 2001). Monitoring results since October 2003 for sampling conducted in the fall have shown generally declining concentrations of PCE at location MW-19S and MW-13S. Results for the D-Site MG Building sump are less pronounced. An exception to this trend is a spike in trichloroethylene (TCE) of 431 μg/L at location MW-13S in 2004. Subsequent results at MW-13S show a declining trend in TCE with the recent results (11/14/2007, 9/24/08, and 12/18/2008) being 71.1, 50.9

and 88.6 µg/L. This spike is tentatively interpreted as a transient rise resulting from the slug flow of contaminants, including PCE breakdown products, from the Former Annex Building Area toward the D-Site MG Building sump, although additional monitoring in this area is proposed (PPPL08g).

In 2006 and 2007 MW-17 showed PCE concentrations higher than those found when that well was first installed in 1998; in 2008, PCE concentrations had decreased to 24 µg/L. MW-13I also has shown higher levels of PCE when compared to samples collected during the RI, although results have continued to decline since 2004. Results from the annual sampling and two rounds of quarterly sampling conducted in 2007 and 2008 indicate a continued downward trend of PCE and TCE at location MW-13S, with PCE having declined to 22.3 µg/L. In 2007 and 2008 samples, VOC concentrations at MW-18 were below NJGWQS. MW-25 continued to show PCE concentrations slightly above the NJGWQS of 1.0 µg/L. Additional quarterly sampling is necessary to determine if these patterns are seasonal in nature or are sustained throughout the year (PPPL09b).

Exhibit 7-5 PCE Concentration vs. Time (1991-2007)

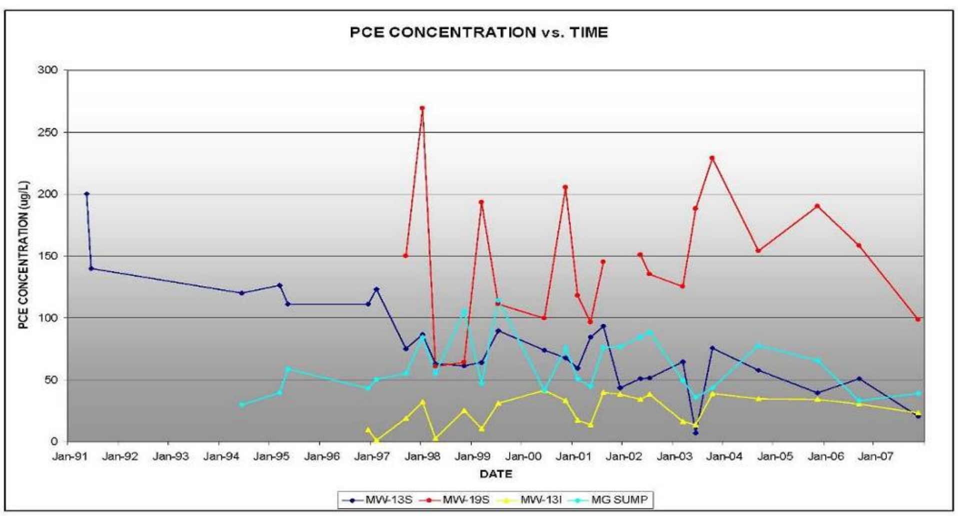


Figure 15 – PCE Concentration vs. Time MW-13S, MW-19S, MW-13I and MG Sump.

Princeton Plasma Physics Laboratory
Remedial Action Monitoring

Remedial Action Progress Report
February 2008

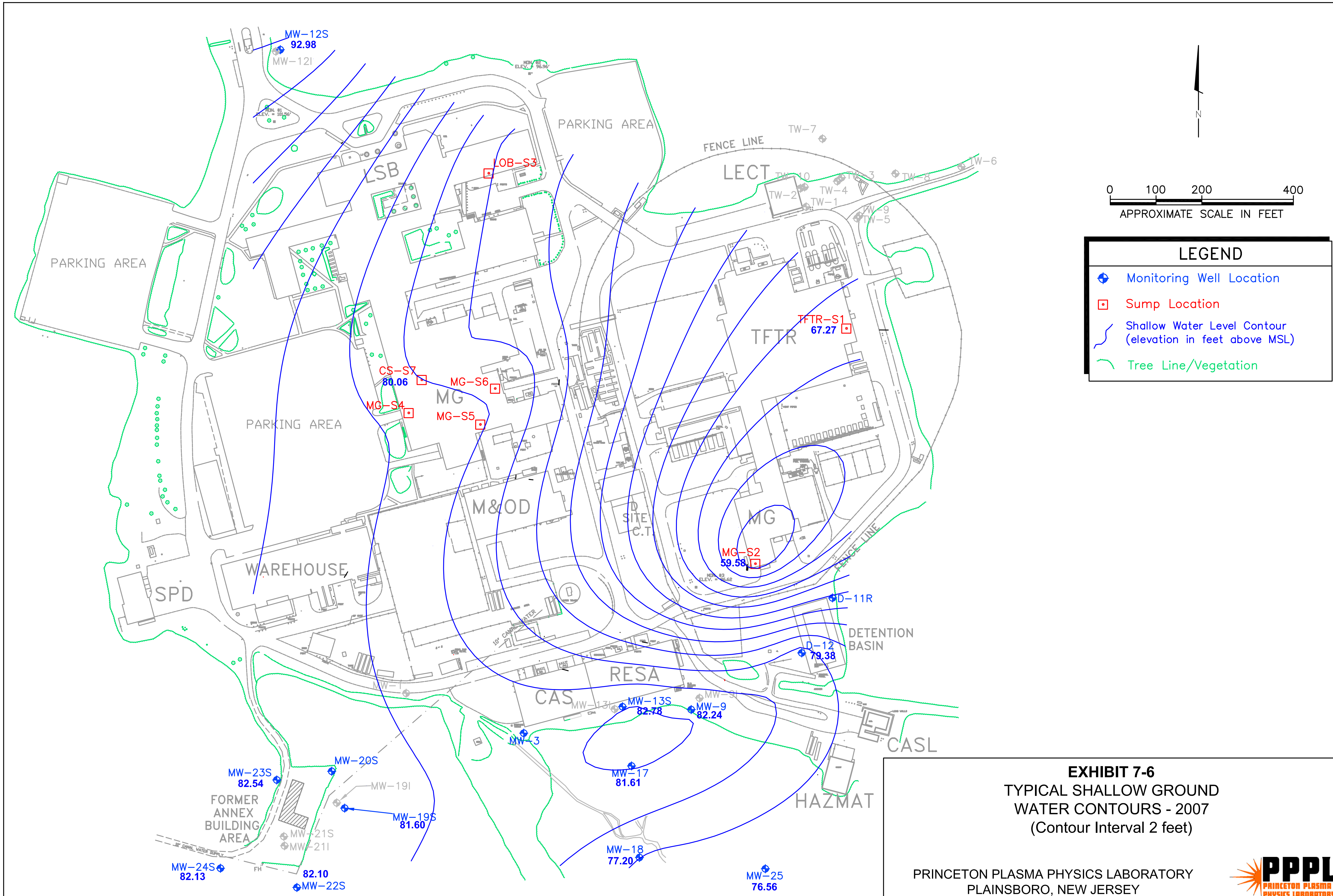


EXHIBIT 7-6
TYPICAL SHALLOW GROUND WATER CONTOURS - 2007
(Contour Interval 2 feet)

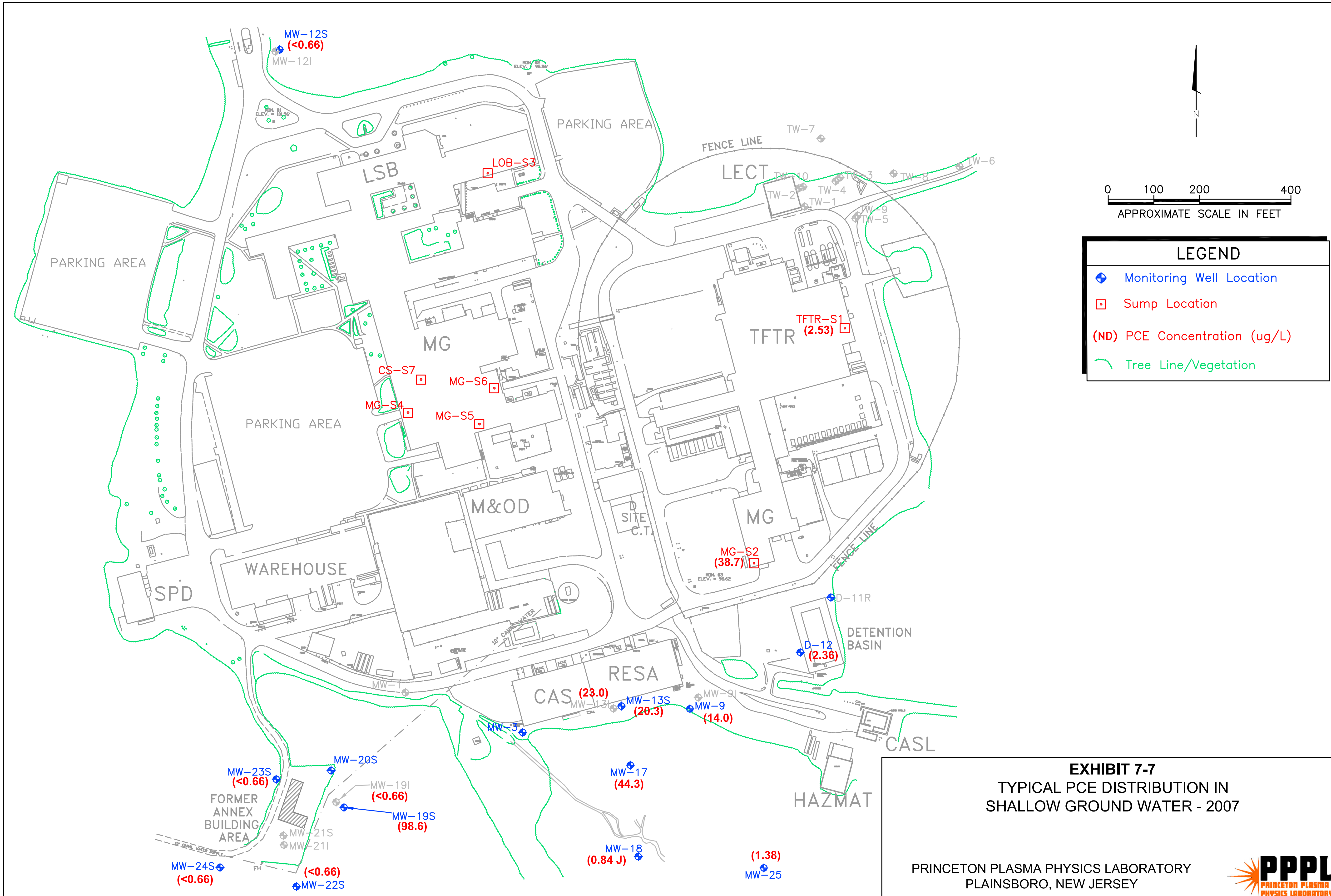


EXHIBIT 7-7
TYPICAL PCE DISTRIBUTION IN SHALLOW GROUND WATER - 2007

PRINCETON PLASMA PHYSICS LABORATORY
PLAINSBORO, NEW JERSEY

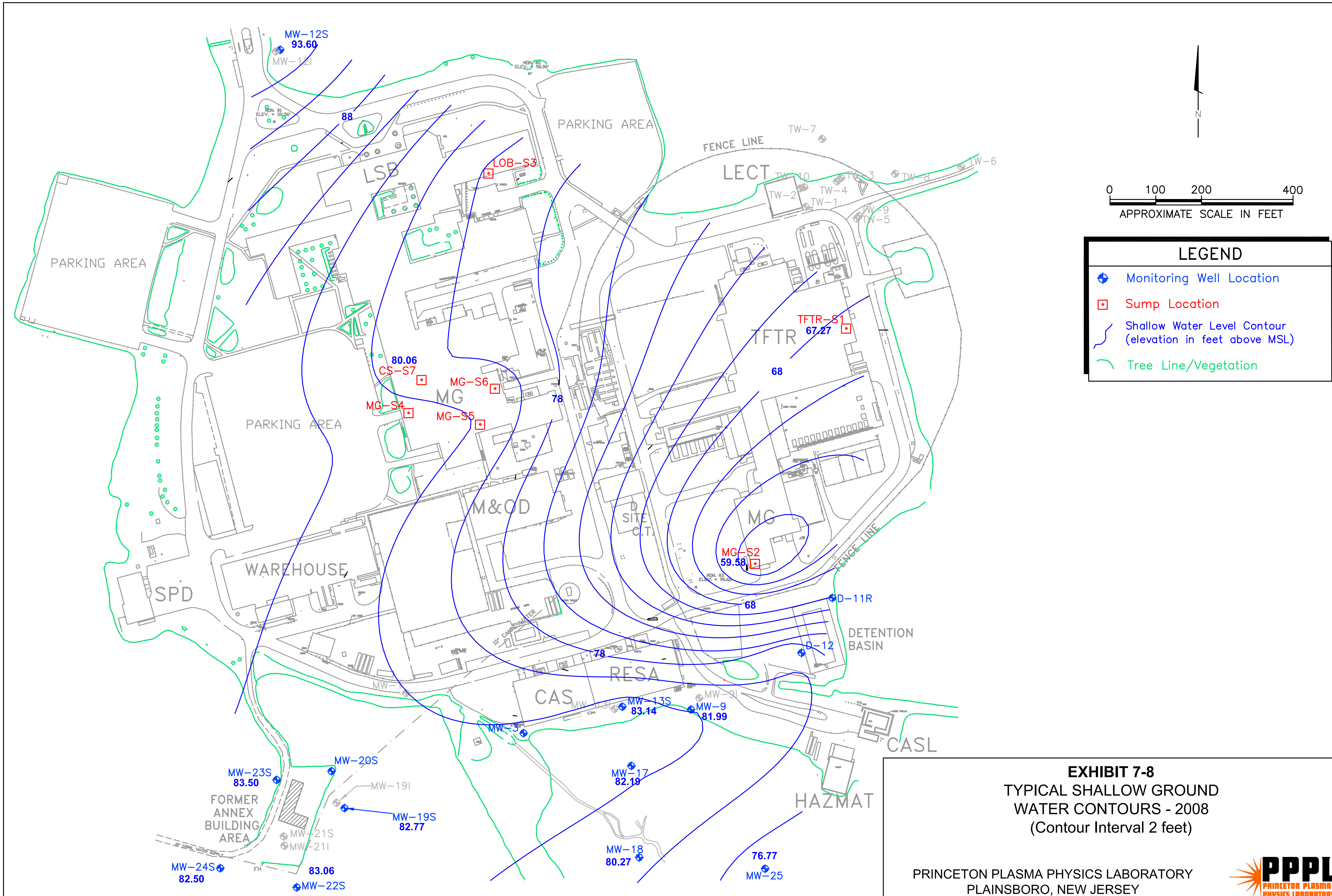


EXHIBIT 7-8

TYPICAL SHALLOW GROUND WATER CONTOURS - 2008

(Contour Interval 2 feet)

PRINCETON PLASMA PHYSICS LABORATORY
PLAINSBORO, NEW JERSEY

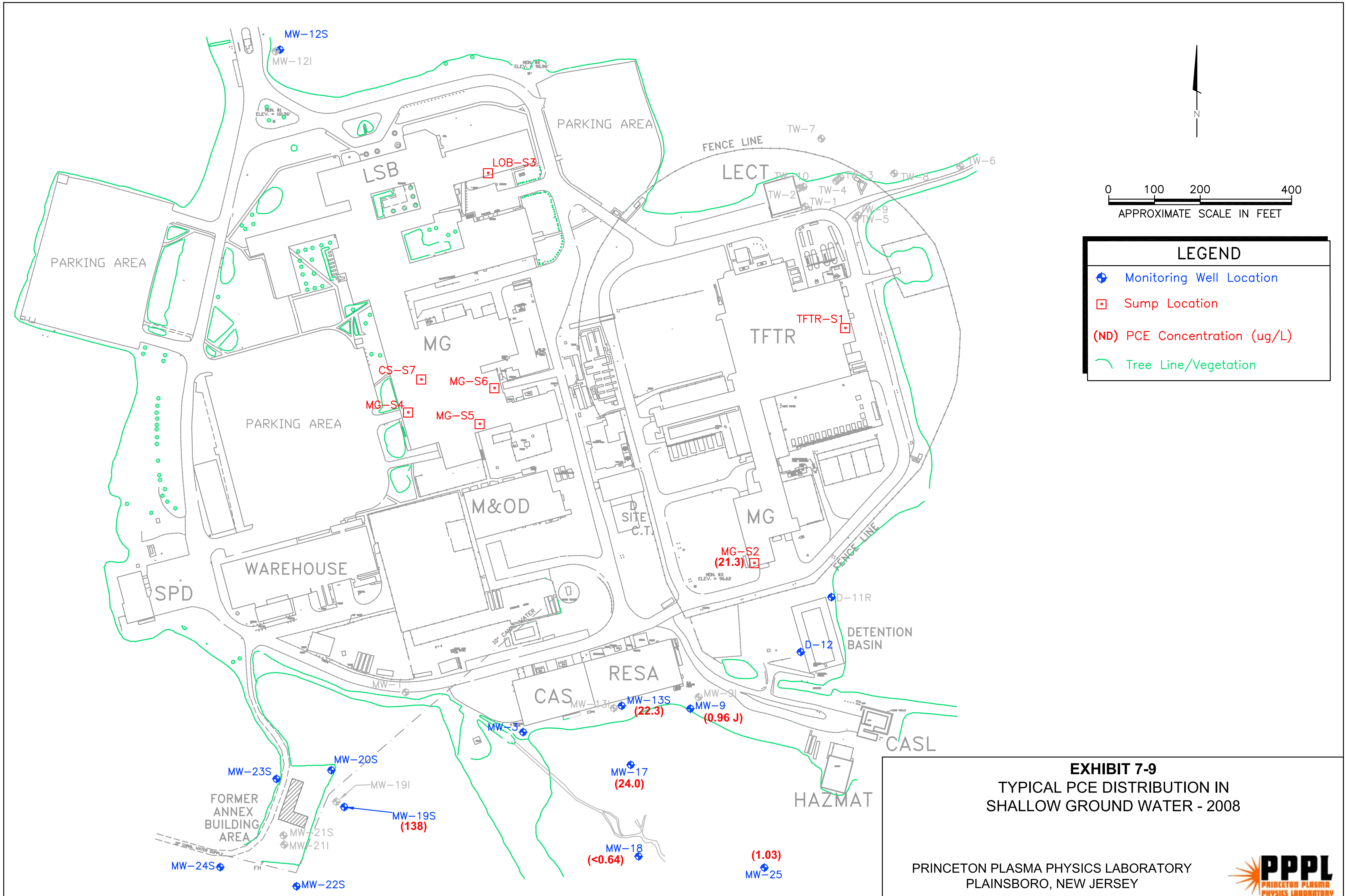


EXHIBIT 7-9
TYPICAL PCE DISTRIBUTION IN SHALLOW GROUND WATER - 2008

Chapter

8

QUALITY ASSURANCE

In 2007-2008, analyses of environmental samples for radioactivity and other parameters were conducted by PPPL's on-site analytical laboratory (Exhibits 8-1 & 8-2).

Exhibit 8-1. Chemical Oxygen Demand Samples (including Quality Control Samples) at PEARL

Exhibit 8-2. 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.

To maintain its radiological certification, PPPL participates in a NIST NVLAP accredited radiochemistry proficiency testing program. For non-radiological parameters, PPPL participates in NJDEP Laboratory Certification program (NJ ID #12471). 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 (Tables 23A and 23B].

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.

In Tables 232A 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 in April 2008 and turbidity. Turbidity was not acceptable in the July 2007 and 2008 ERA test studies and December 2008, after which PPPL dropped turbidity certification. Gamma spectroscopy instruments were not operational in 2007-2008.

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 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.

In February 2008, PPPL's PEARL was audited by NJDEP Office of Quality Assurance. As a result of that audit, PPPL addressed the four findings and two recommendations: (1) PPPL requested certification for tritium analysis under the drinking water program instead of the wastewater program due to differences in Department specified analytical methods (DSAM); (2) PPPL provided the raw data for ERA RAD-70 PT study; (3) PPPL provided the certificate of analysis for the formazin turbidity standards; and (4) PPPL performed pH checks, for preservation of the water samples, prior to chemical oxygen demand analysis. The recommendation for cobalt 60 and zinc 65 gamma spectroscopy certification has not been added to the list of certified parameters, however, the new hardware/software for radiochemistry is reflected in the relevant HP procedures.

Chapter

9

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Chapter

10

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Appendix A

TABLES for 2007

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.

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[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 2007

START DATE	WEEK	INCH	INCH/MONTH	MONTH	ACCUMULATION
1-Jan-07	1	1.75	1.75		
8-Jan-07	2	0.25	2.00		
15-Jan-07	3	0.10	2.10		
22-Jan-07	4	0.00	2.10		
29-Jan-07	5	**0.15**	**2.25**	**JANUARY**	**2.25**
5-Feb-07	6	0.00	2.25		
12-Feb-07	7	0.575	2.825		
19-Feb-07	8	0.775	3.60		
26-Feb-07	9	**1.85**	**5.45**	**FEBURARY**	**3.20**
5-Mar-07	10	0.00	5.45		
12-Mar-07	11	2.25	7.70		
19-Mar-07	12	0.35	8.05		
26-Mar-07	13	**0.10**	**8.15**	**MARCH**	**2.70**
2-Apr-07	14	0.90	9.05		
9-Apr-07	15	9.95	19.00		
16-Apr-07	16	0.00	19.00		
23-Apr-07	17	3.20	22.20		
30-Apr-07	18	**0.25**	**22.45**	**APRIL**	**14.30**
7-May-07	19	0.40	22.85		
14-May-07	20	0.60	23.45		
21-May-07	21	0.45	23.90		
28-May-07	22	**0.19**	**24.09**	**MAY**	**1.64**
4-Jun-07	23	1.93	26.02		
11-Jun-07	24	0.30	26.32		
18-Jun-07	25	0.33	26.65		
25-Jun-07	26	**1.08**	**27.73**	**JUNE**	**3.64**
2-Jul-07	27	1.24	28.97		
9-Jul-07	28	1.00	29.97		
16-Jul-07	29	0.84	30.81		
23-Jul-07	30	1.79	32.60		
30Jul-07	31	**1.57**	**34.17**	**JULY**	**6.44**
6-Aug-07	32	0.06	34.23		
13-Aug-07	33	0.25	34.48		
20-Aug-07	34	1.70	36.18		
27-Aug-07	35	**0.62**	**36.80**	**AUGUST**	**2.63**
3-Sep-07	36	0.00	36.80		
10-Sep-07	37	0.00	36.80		
17-Sep-07	38	1.01	37.81		
25-Sep-07	39	**0.11**	**37.92**	**SEPTEMBER**	**1.12**
1-Oct-07	40	0.01	37.93		
8-Oct-07	41	0.00	37.93		
15-Oct-07	42	1.00	38.93		
22-Oct-07	43	0.59	39.52		
29-Oct-07	44	**2.86**	**42.38**	**OCTOBER**	**4.46**
5-Nov-07	45	0.32	42.70		
12-Nov-07	46	0.05	42.75		
19-Nov-07	47	0.76	43.51		
26-Nov-07	48	**0.61**	**44.12**	**NOVEMBER**	**1.74**
3-Dec-07	49	0.70	44.82		
10-Dec-07	50	0.28	45.1		
17-Dec-07	51	1.94	47.04		
24-Dec-07	52	0.78	47.82		
31-Dec-07	53	**1.27**	**49.09**	**DECEMBER**	**4.97**

Table 3. D–Site Tritium Stack Releases in Curies in 2007

Week Ending	HTO (Ci)	HT (Ci)	Weekly total (Ci)	Month	Annual Total (Ci)
10-Jan	0.1060	0.0152	0.1212		0.1212
17-Jan	0.0847	0.0087	0.0934		0.2146
24-Jan	0.0777	0.0153	0.0930		0.3076
31-Jan	0.0856	0.0086	0.0942	**January**	0.4018
7-Feb	0.0968	0.0011	0.0979		0.4997
14-Feb	0.0707	0.0089	0.0796		0.5793
21-Feb	0.0690	0.0149	0.0839		0.6632
28-Feb	0.0557	0.0121	0.0678	**February**	0.7310
7-Mar	0.0772	0.0071	0.0843		0.8153
14-Mar	0.0796	0.0103	0.0899		0.9052
21-Mar	0.0829	0.0078	0.0907		0.9959
28-Mar	0.0991	0.0076	0.1067	**March**	1.1026
4-Apr	0.0539	0.0214	0.0753		1.1779
11-Apr	0.0675	0.0101	0.0776		1.2555
18-Apr	0.0313	0.0019	0.0332		1.2887
25-Apr	0.0710	0.0124	0.0834	**April**	1.3721
2-May	0.0796	0.0100	0.0896		1.4617
9-May	0.0867	0.0255	0.1122		1.5739
16-May	0.1180	0.0231	0.1411		1.7150
23-May	0.1320	0.0079	0.1399		1.8549
30-May	0.1720	0.0152	0.1872	**May**	2.0421
6-Jun	0.1650	0.0166	0.1816		2.2237
13-Jun	0.1327	0.0124	0.1451		2.3688
20-Jun	0.0838	0.0018	0.0856		2.4544
27-Jun	0.1020	0.0138	0.1158	**June**	2.5702
5-Jul	0.1170	0.0116	0.1286		2.6988
11-Jul	0.1021	0.0103	0.1124		2.8112
18-Jul	0.1340	0.0074	0.1414		2.9526
25-Jul	0.1650	0.0103	0.1753	**July**	3.1279
1-Aug	0.1530	0.0076	0.1606		3.2885
8-Aug	0.1300	0.0100	0.1400		3.4285
15-Aug	0.1310	0.0085	0.1395		3.5680
22-Aug	0.1450	0.0125	0.1575		3.7255
29-Aug	0.1340	0.0080	0.1420	**August**	3.8675
5-Sept	0.1240	0.0111	0.1351		4.0026
12-Sept	0.1210	0.0078	0.1288		4.1314
19-Sept	0.1890	0.0111	0.2001		4.3315
26-Sept	0.1760	0.0075	0.1835	**September**	4.5150
3-Oct	0.1710	0.0104	0.1814		4.6964
10-Oct	0.1730	0.0065	0.1795		4.8759
17-Oct	0.1660	0.0092	0.1752		5.0511
24-Oct	0.1850	0.0093	0.1943		5.2454
31-Oct	0.1950	0.0112	0.2062	**October**	5.4516
7-Nov	0.1520	0.0068	0.1588		5.6104
14-Nov	0.1320	0.0105	0.1425		5.7529
21-Nov	0.1530	0.0068	0.1598		5.9127
28-Nov	0.1500	0.0073	0.1573	**November**	6.0700
5-Dec	0.1050	0.0046	0.1096		6.1796
12-Dec	0.1070	0.0062	0.1132		6.2766
19-Dec	0.1070	0.0062	0.1132		6.3898
26-Dec	0.1250	0.0094	0.1344	**December**	6.5242
2-Jan	0.1090	0.0047	0.1137	**Total**	6.6379

Table 4. Ranges of Air Tritium Concentrations (in pCi/m3) Collected On-Site (T1-T4) and Off-Site (R1-R6 & BM1) in 2007

Station	**HTO** pCi/m3	**HT** pCi/m3
T1	0.0109 – 2.05	0.0109 – 3.76
T2	0 – 6.95	0 – 9.22
T3	0.0945 – 0.76	0.0945 – 3.02
T4	0 – 0.557	0 – 1.6
R1	0 –0.473	0 – 4.46
R2	0 – 0.203	0 – 69.5
R3	0 – 0.184	0 – 1.28
R4	0 – 0.184	0 – 10.5
R5	0 – 0.293	0 – 0.604
R6	0 – 2.84	0 – 6.69
BM1	0 – 0.0798	0 – 0.0798

Table 5. Surface Water Tritium Concentrations for 2007 (in picoCuries/Liter)

Sample Location	**Bee Brook (B1)**	**Bee Brook (B2)**	**Basin (DSN001)**	**D&R Canal (C1)**	**D&R Canal (DSN003)**
January			<125	<125	<125
February	<88.9g		<88.9	<88.9	<88.9
March			<156	<156	<156
April			<117	<117	<117
May	<115	<105	<115	<115	<115
June			<136	<136	<136
July			<129	<129	<92.8
August	<109	<109	<109	<109	
September			**126**	**126**	<105
October					
November	<132	<132	<132	<132	<128
December			<118	<118	

Sample Location	**Potable Water (E1)**	**Millstone River (M1)**	**Cranbury Brook (P1)**	**Devil's Brook (P2)**
January				
February	<88.9			
March				
April				
May	<105	<105	<105	<105
June				
July				
August	<109	<109	<95.4	<95.4
September				
October				
November	<132	<132	<132	<132
December				

BOLD indicates above the level of detection.

Table 6. Ground Water Tritium Concentrations for 2007 (in picoCuries/liter)

Well No. or Sump Location	Well TW-1	Well TW-5	Well TW-8	Well MW-12S	Well D-12	Air Shaft Sump	D-site MG Sump
January						<88.9	<88.9
February	<150	<150	<150	<150	<150	<88.9	<88.9
March						<150	<150
April						<117	<117
May	**257**	**252**	<105	<105	<105	<115	<115
June						<136	<136
July						<129	<92.8
August	**198**	**167**	**158**	<106	**108**	<95.4	<95.4
September						**113**	<106
October							
November	**203**	<113	<113		<113	<132	<113
December						<118	<118

BOLD indicates concentrations above background (bkg) levels.

Table 7. Rain Water Tritium Concentrations (in picoCuries/liter) Collected On-Site (R1E – R2N) and Off-Site (REAM 5) in 2007

250 feet from Stack	R1E (East)	R1W (West)	R1S (South)	R1N (North)	R1ND (Duplicate)
2/23/07	**194**	<113	**221**	<113	<113
3/13/07	<150	**1,441**	**356**	<150	<156
4/20/07	<117	<117	**423**	<117	<117
5/31/07	**158**	<129	<129	<129	<129
6/11/07	<136	<92.8	<92.8	<136	<136
7/5/07	**131**	<129	<129	<129	<129
8/13/07	**311**	<106	**216**	<95.4	<95.4
9/21/07	**180**	**185**	**185**		**113**
10/19/07		**131**			
11/13/07	<128	<128	<128	<128	<128
12/21/07	**149**	<118	<118	<118	<118

500 feet from Stack	R2E (East)	R2W (West)	R2S (South)	R2N (North)	REAM 5 Off-site
2/23/07	**126**	<113	<113	<113	
3/13/07	<156	<156	<156	<156	
4/20/07	<115	<115	<115	<115	
5/9/07				<105	
5/31/07	**135**	<136	<129	<129	
6/11/07	**104**	<92.8	<92.8	<136	
7/5/07	<129	<109	<129	<129	
8/13/07	<95.4	<95.4	<95.4	<95.4	
9/21/07		**153**	**185**	**194**	
10/19/07	<113	<113	<113	<128	
11/1/07		<128	<128	<118	<113
12/21/07	<118	<110	<110		

BOLD indicates concentrations above background (bkg) levels.

Table 8. Annual Range of Tritium Concentration at PPPL in Precipitation from 1985 to 2007

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

Table 9. Surface and Ground Water Total Phosphorus Concentrations in 2007 (in mg/L)

Date	DSN001	D-site MG sump	D-site Air shaft sump	DSN003	C1
1/2/2007	0.062			0.062	
2/6/2007	<0.050	1.730	0.062	<0.050	<0.050
2/7/2007	<0.050				
duplicate	0.070				
3/6/2007	0.106	0.273	0.070		
3/13/2007	1.250			0.167	0.185
4/2/2007	<0.050	0.248	0.060	<0.050	<0.050
5/3/2007	0.052	0.057	<0.050	0.079	<0.050
duplicate	0.068				
6/5/2007	0.062	0.586	<0.050	0.138	0.106
7/3/2007	0.283	0.101	0.112	0.181	0.129
8/2/2007	0.055	0.141	0.055	0.101	0.107
duplicate	0.072				
9/5/2007	0.055	0.374	0.050	0.095	0.090
10/4/2007	0.096	0.203	<0.050	0.128	0.101
11/6/2007	0.251	0.155	0.050	<0.050	<0.050
12/10/2007	0.155	0.187	0.059	0.069	<0.050
duplicate	0.213				
2007 Average	**0.163**	**0.369**	**0.054**	**0.091**	**0.077**

Surface water quality criteria for FW2 (freshwater category 2) is 0.1 mg/L for total phosphorus.

Table 10. Liquid Effluent Collection Tank Release Data for 2007

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 Activity (pCi/L)	pH
1/11/2007	12,750	<20	222	7,910	0.000359	0.000359	<196	6.32
4/19/2007	11,250	543.5	226	14,500	0.000617	0.000976	<196	6.48
6/5/2007	12,750	30.9	235	18,100	0.000872	0.001848	<196	6.32
6/27/2007	12,750	*NS*	232	8,570	0.000413	0.002261	<196	5.90
7/10/2007	12,750	25.0	237	7,150	0.000345	0.002606	<197	*NS*
7/24/2007	12,750	20.5	246	5,850	0.000282	0.002888	<197	6.42
8/1/2007	12,750	*NS*	230	7,050	0.00034	0.003228	<197	6.45
8/13/2007	12,750	*NS*	244	5,400	0.00026	0.003488	<196	6.29
8/24/2007	12,300	*NS*	251	20,200	0.000941	0.004429	<196	6.51
9/10/2007	12,750	14.6	237	34,700	0.00167	0.006099	<196	5.57
10/01/2007	12,750	16.5	265	35,200	0.0017	0.007799	<197	6.50
10/10/2007	10,800	*NS*	246	29,000	0.00119	0.008989	<196	6.36

NS = No sample

Table 11. Surface Water Analysis for Bee Brook, B1, in 2007

Sample Date	2/7/07	5/3/07	8/2/07	11/6/07
Ammonia nitrogen as N, mg/L		<0.10	<0.10	
Biological Oxygen Demand, mg/L		<2.0	<2.0	
Chemical Oxygen Demand, mg/L	<5.0	19.16	22.92	<5.0
Nitrogen, total inorganic, mg/L		1.13	1.29	
Oxidation-Reduction Potential, mV	-22	-2.3	6.8	24.9
pH, standard units	7.15	6.56	7.02	6.66
Phosphorus, total, mg/L	<0.050	<0.050	0.135	0.085
Temperature, ^{o}C	0	14	24, 25.5	11 12.7
Total Suspended Solids, mg/L		6	6	3
Total Organic Carbon, mg/L	1.09	8.53	5.08	8.39
Total Dissolved Solids, mg/L		191	246	

Location B1 = Bee Brook upstream of PPPL basin discharge
See Exhibit 4-3 for location.

Table12. Surface Water Analysis for Bee Brook, B2, in 2007

Sample Date	2/7/07	5/3/07	8/2/07	11/6/07
Ammonia nitrogen as N, mg/L		<0.10	<0.10	
Biological Oxygen Demand, mg/L		<2.0	<2.0	
Chemical Oxygen Demand, mg/L	<5.0	21.17	16.53	<5.0
Nitrogen, total inorganic, mg/L		1.07	0.95	
Oxidation-Reduction Potential, mV	-13	-44.7	8.4	2.1
pH, standard units	6.98	7.32	7.72	7.08
Phosphorus, total, mg/L	<0.050	<0.050	0.09	1.07
Temperature, ^{o}C	2.2	15.2	24.7	11.1
			24.8	10.9
Total Suspended Solids, mg/L	2.33	4.0	12.7	2.0
Total Organic Carbon, mg/L	0.50	5.31	3.30	7.68
Total Dissolved Solids, mg/L		271	346	

Location B2 = Bee Brook downstream of PPPL basin discharge

Table 13. Surface Water Analysis for Delaware & Raritan Canal, C1, in 2007

Sample Date	2/7/07	5/3/07	8/2/07	11/6/07
Ammonia nitrogen as N, mg/L		<0.10	<0.10	
Biological Oxygen Demand, mg/L		<2.0	<2.0	
Chemical Oxygen Demand, mg/L	<5.0	<5.0	<5.0	<5.0
Nitrogen, total inorganic, mg/L		0.09	0.77	
Oxidation-Reduction Potential, mV	-15.5	-16.6	-18.4	-1.8
pH, standard units	7.03	6.82	7.46	7.15
Phosphorus, total, mg/L	<0.050	<0.050	0.107	<0.050
Temperature, ^{o}C	1.5	18.2	28.8	11.4
			29.7	11.4
Total Suspended Solids, mg/L	<2.0	3	3.7	2.5
Total Organic Carbon, mg/L	1.95	2.96	2.99	3.95
Total Dissolved Solids, mg/L		114	151	

Location C1 = Delaware & Raritan Canal State Park at Mapleton Avenue, Plainsboro midway on pedestrian bridge
See Exhibit 4-3 for location.

Table 14. Surface Water Analysis for NJ American Water Co. (formerly Elizabethtown Water), E1, in 2007

Sample Date	2/7/07	5/3/07	8/2/07	11/6/07
Ammonia nitrogen as N, mg/L		0.19	0.14	
Biological Oxygen Demand, mg/L		<2.0	<2.0	
Chemical Oxygen Demand, mg/L	12.31	<5.0	<5.0	<5.0
Nitrogen, total inorganic, mg/L		0.96	0.80	
Oxidation-Reduction Potential, mV	-5.9	-25.9	4.0	7.6
pH, standard units	6.85	6.90	7.06	6.98
Phosphorus, total, mg/L	<0.050	0.392	0.397	0.448
Temperature, ^{o}C	6.9	14.1	26.5	19.0
			27.6	19.4
Total Suspended Solids, mg/L	<2.0	<2.0	<2.0	<2.0
Total Organic Carbon, mg/L	1.43	2.41	2.26	1.94
Total Dissolved Solids, mg/L		146	251	

Location E1 = NJ American Water Co. (potable) collected at Main Gate Security Booth
See Exhibit 4-3 for location.

Table 15. Surface Water Analysis for Millstone River, M1, in 2007

Sample Date	2/7/07 (NS)	5/3/07	8/2/07	11/6/07
Ammonia nitrogen as N, mg/L		1.18	0.1	
Biological Oxygen Demand, mg/L		<2.0	2.8	
Chemical Oxygen Demand, mg/L	*NS*	8.07	<5.0	119.63
Nitrogen, total inorganic, mg/L		1.89	1.672	
Oxidation-Reduction Potential, mV	*NS*	-8.8	23.1	22.1
pH, standard units	*NS*	6.69	6.73	6.71
Phosphorus, total, mg/L	*NS*	<0.050	0.346	0.405
Temperature, ^{o}C	*NS*	19.8	29.9	12.0
			31.3	11.7
Total Suspended Solids, mg/L	*NS*	6.7	21.7	46.7
Total Organic Carbon, mg/L	*NS*	5.1	33	6.19
Total Dissolved Solids, mg/L		134	154	

NS = No sample collected due to ice
Location M1 = Millstone River at Delaware & Raritan Canal State Park at Mapleton Road,

Table 16. Surface Water Analysis for Cranbury Brook (Plainsboro), P1, in 2007

Sample Date	2/7/07*	5/3/07	8/2/07	11/6/07
Ammonia nitrogen as N, mg/L		<0.10	<0.10	
Biological Oxygen Demand, mg/L		<2.0	<2.0	
Chemical Oxygen Demand, mg/L	*NS*	10.627	2.5	2.5
Nitrogen, total inorganic, mg/L		1.69	0.81	
Oxidation-Reduction Potential, mV	*NS*	0.6	35.2	36.8
pH, standard units	*NS*	6.53	6.52	6.44
Phosphorus, total, mg/L	*NS*	0.1	0.095	0.059
Temperature, ^{o}C	*NS*	23.1	29.4, 30	11.1, 11.2
Total Suspended Solids, mg/L	*NS*	24.3	7.7	8.7
Total Organic Carbon, mg/L	*NS*	5.34	5.34	3.92
Total Dissolved Solids, mg/L		114	103	

Location P1 = Cranbury Brook at George Davison Road, Plainsboro mid-span on bridge southbound
** NS = No sample collected due to ice and no flowing water.*

Table 17. Surface Water Analysis for Devil's Brook (Plainsboro), P2, in 2007

Sample Date	2/7/07	5/3/07	8/2/07	11/6/07
Ammonia nitrogen as N, mg/L		<0.10	<0.10	
Biological Oxygen Demand, mg/L		<2.0	<2.0	
Chemical Oxygen Demand, mg/L	<5.0	11.36	9.54	<5.0
Nitrogen, total inorganic, mg/L		0.92	1.6	
Oxidation-Reduction Potential, mV	21.3	10.1	32.4	38.6
pH, standard units	6.35	6.36	6.56	6.41
Phosphorus, total, mg/L	0.070	<0.050	0.107	<0.0500
Temperature, ^{o}C	2.4	21.4	26.2 27.5	11.2 11.3
Total Suspended Solids, mg/L	23.7	3.7	4.0	3.0
Total Organic Carbon, mg/L	3.45	8.93	10.50	8.88
Total Dissolved Solids, mg/L		83	111	

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

Table 18. DSN001 - Retention Basin Outfall
Surface Water Analysis (NJPDES NJ0023922) in 2007

Permit Limit	Units	Parameters	1/2/07	2/7/07	3/13/07	4/2/07	5/3/07	6/5/07
NA	mg/L	Ammonia-N					0.12	
NA	mg/L	Biological Oxygen Demand					<2.0	
50 mg/L	mg/L	Chemical Oxygen Demand	7.94 9.87	5.85 10.75	6.32 18.74	<5.0 7.09	27.75 30.30	<5.0 <5.0
NL	mg/L	Chlorine Produced Oxidants	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
NA	MGD	Flow, Avg. Monthly	0.326	0.282	0.309	0.467	0.155	0.158
NA	mV	Oxidation-Reduction Potential	-19.5 -29.7	-61.1	-100	-32.1	-32.9	-68.5
10 mg/L	mg/L	Petroleum Hydrocarbons	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
6.0-9.0	S.U.	pH	7.02 7.18 7.26	7.86	8.49	7.20	7.11 7.38	7.75
NA	mg/L	Nitrite as N					<0.020	
NA	mg/L	Nitrate as N					1.14	
NA	mg/L	Ortho Phosphate as P					0.124	
NA	mg/L	Phosphorus, Reactive Dissolved					0.080	
	mg/L	Phosphorus, Total	0.062	0.025	1.25	0.025	0.052	0.062
0.283	g/L	Tetrachloroethylene	0.71	<0.66	<0.66	0.7	<0.66	0.68 J
30 °C max.	°C	Temperature	13.4,12.9	7.1	18.9	13.6	18.0	22.2
NA	mg/L	Total Dissolved Solids					420	
NA	mg/L	Total Organic Carbon	1.38	<1.00	5.49	1.38	1.43	2.11
50 mg/L	mg/L	Total Suspended Solids	2.7	<2.0	8.7	16.5	5.0	7.2

Permit Limit	Units	Parameters	7/3/07	8/2/07	9/5/07	10/4/07	11/6/07	12/10/07
NA	mg/L	Ammonia-N		<0.10,<0.10				
NL	mg/L	Biological Oxygen Demand		<2.0, <2.0				
50 mg/L	mg/L	Chemical Oxygen Demand	16.86 18.42	<5.0 <5.0	16.12 21.25	<5.0 <5.0	<5.0 <5.0	5.60 6.62
0.016	mg/L	Chlorine Produced Oxidants	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
NA	MGD	Flow, Avg. Monthly	0.089	0.091	0.047	0.114	0.129	0.225
NL	mV	Oxidation-Reduction Potential	-66.2	-62.6	-105.5	-103.6	-69.9	-43.1
NA	mg/L	Nitrite as N		<0.02, <0.02				
NA	mg/L	Nitrate as N		0.680,0.700				
10 mg/L	mg/L	Petroleum Hydrocarbons	<0.50	<0.50	<0.50	<0.50	2.5	<0.50
6.0-9.0	S.U.	pH	7.42, 7.58	8.25	8.99	8.93	8.39	7.87
NA	mg/L	Ortho Phosphate as P		<0.05, <0.05				
NA	mg/L	Phosphorus, Reactive Dissolved		<0.05, <0.05				
	mg/L	Phosphorus, Total	0.283	0.055, 0.072	0.055	0.096	0.251	0.155
	μg/L	Tetrachloroethylene	<0.66	<0.66	<0.66	<0.66	<0.66	<0.66
30 °C max.	°C	Temperature	19.4	22.6	25.0	22.5	11.7	7.7
	mg/L	Total Dissolved Solids		420, 420				
NA	mg/L	Total Organic Carbon	1.93	1.26, 1.36	2.36	2.62	3.13	2.50
50 mg/L	mg/L	Total Suspended Solids	4.0	5.7, 3.7	10.3	8.5	2.5	4.0

*Blank indicates no measurement NA = not applicable NL = no limit * DSN-001 was duplicated as DSN004*

Table 19. D&R Canal Pump House - DSN003
Monthly Surface Water Analysis (NJPDES NJ0023922) in 2007

Permit Monthly Avg.	Limit Daily Max.	Units	Parameters	1/2/07	2/7/07	3/13/07	4/2/07	5/3/07	6/5/07
NA	NA	mg/L	Ammonia-N					<0.10	
NA	NA	mg/L	Biological Oxygen Demand					<2.0	
NA	NA	mg/L	Chemical Oxygen Demand	<5.0	<5.0	<5.0		<5.0	
NL	NL	mg/L	Chlorine Produced Oxidants	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
NA	NA	mg/L	Nitrite as N					<0.020	
NA	NA	mg/L	Nitrate as N					0.800	
NA	NA	mV	Oxidation-Reduction Potential	-16.5	-10.5	-31.5	-11.0	-47.2	-21.9
10 mg/L	15 mg/L	mg/L	Petroleum Hydrocarbons	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
NA	6.0-9.0	S.U.	pH	6.97	6.93	7.22	6.82	7.37	6.94
NA	NA	mg/L	Ortho Phosphate as P					0.069	
NA	NA	mg/L	Phosphorus, Reactive Dissolved					0.0660	
		mg/L	Phosphorus, Total	0.062	<0.050	0.167	<0.050	0.079	0.138
NA	NA	°C	Temperature	13.1	3.2	9.9	10.9	16.5	25.4
NA	NA	mg/L	Total Dissolved Solids					117	
NA	NA	mg/L	Total Organic Carbon	4.37	1.94	2.60	2.48	3.03	4.06
NL	NL	mg/L	Total Suspended Solids	4.3	<2.0	2.33	2.0	5.0	4.4

Permit Monthly Avg.	Limit Daily Max.	Units	Parameters	7/3/07	8/2/07	9/5/07	10/4/07	11/6/07	12/10/07
NA	NA	mg/L	Ammonia-N		<0.10				
NA	NA	mg/L	Biological Oxygen Demand		<2.0				
NA	NA	mg/L	Chemical Oxygen Demand	<5.0	<5.0		<5.0	<5.0	<5.0
NL	NL	mg/L	Chlorine Produced Oxidants	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
NA	NA	mg/L	Nitrite as N		<0.020				
NA	NA	mg/L	Nitrate as N		0.810				
NA	NA	mV	Oxidation-Reduction Potential	-45.4	-19.3	-14.2	-16.2	-7.2	15.5
10 mg/L	15 mg/L	mg/L	Petroleum Hydrocarbons	<0.50	<0.50	<0.50	<0.50	2.5	0.9
NA	6.0-9.0	S.U.	pH	7.21	7.47	7.36	7.38	7.25	6.78
NA	NA	mg/L	Ortho Phosphate as P		0.071				
NA	NA	mg/L	Phosphorus, Reactive Dissolved		0.065				
NA	NA	mg/L	Phosphorus, Total	0.181	0.101	0.095	0.128	<0.050	0.069
NA	NA	°C	Temperature	24.6	28.3	25.25	22.95	11.75	4.7
		mg/L	Total Dissolved Solids		154				
NA	NA	mg/L	Total Organic Carbon	2.84	2.94	2.99	2.21	4.09	2.72
NL	NL	mg/L	Total Suspended Solids	6.0	2.3	2.3	<2.0	2.0	3.0

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 20. Summary of Ground Water Sampling Results – 2002 to 2007
Target Chlorinated Volatile Organic Compounds (in µg/L)

Monitoring Locations	Date	PCE	TCE	c-1,2-DCE	1,1-DCE	1,1,1-TCA
NJ GWQS		**1.0**	**1.0**	**70.0**	**2.0**	**30.0**
D-12	10/21/2003	2.38	1.15	<1.0	1.22	<0.9
	9/22/2004	2.66	1.36	<0.5	<1.2	<0.9
	11/02/2005	2.35	1.47	<0.70	<0.70	<0.80
	9/25/2006	2.00	0.940 J	<0.50	0.780	<0.60
	11/14/2007	**2.36**	**1.39**		**<0.77**	**<0.62**
MW-9S	10/21/2003	43.7	0.97	<1.0	<1.2	1.68
	9/22/2004	25.0	5.65	<0.5	<1.2	<0.9
	11/02/2005	29.5	1.98	<0.70	<0.70	0.890 J
	6/25/2006	32.9	<0.20	<0.50	<0.30	0.860 J
	11/14/2007	**14.0**	**26.5**		**<0.77**	**<0.62**
MW-13I	7/29/2002	38.2	0.52 J	< 0.6	0.76 J	2.96 J
	10/20/2003	38.7	3.42	3.04 NJ	<1.2	2.9
	9/22/2004	34.8	<0.9	<0.5	<1.2	2.72
	11/02/2005	34.2	1.03	0.35	0.8	2.04
	9/26/2006	30.6	0.83	<0.70	0.790 J	0.86
	11/14/2007	**23.0**	**<0.66**		**<0.77**	**1.43**
	11/14/2007	**21.9**	**<0.66**		**<0.77**	**1.55**
MW-13S	7/29/2002	51.4	1.57 J	4.5 NJ	<0.4	1.72 J
	10/20/2003	75.5	315	10.4 NJ	<1.2	1.68
	9/22/2004	57.8	431	18	1.2J	1.35
	11/02/2005	39.2	292	15.9 NJ	<1.00	<1.40
	9/26/2006	50.6	179	26.7 NJ	1.09	0.86
	11/14/2007	**20.3**	**71.1**		**<3.85**	**<3.10**
MW-17	10/21/2003	39.9	1.33	<1.0	<1.1	0.55 J
	9/22/2004	45.9	1.85	4.28 NJ	<1.2	<0.9
	11/02/2005	32.2	1.97	<0.70	<0.70	<0.80
	9/25/2006	39.2	1.95	<0.50	<0.30	<0.60
	11/14/2007	**44.3**	**2.31**		**<0.77**	**0.71 J**
MW-18	7/30/2002	0.62 J	0.5 J	< 0.8	< 0.8	< 0.8
	10/20/2003	0.74J	0.54J	<0.7	<1.2	<0.7
	9/22/2004	0.83J	<0.5	< 0.5	< 1.2	< 0.9
	11/02/2005	0.5	0.25	0.35	0.35	0.4
	9/26/2006	0.670 J	0.540 J	<0.50	<0.3	<0.6
	11/14/2007	**0.84 J**	**<0.66**		**<0.77**	**<0.62**

Notes: "J" indicates a value that is greater than the MDL but lower than the lowest standard.
"N" indicates presumptive evidence of a compound.
NJ GWQS – New Jersey Ground Water Quality Standards
c-1,2-DCE – cis-1,2-Dichlorothylene
1,1-DCE – 1,1-Dichloroethylene
1,1,1-TCA – 1,1,1-Trichloroethane
PCE – Tetrachloroethylene
TCE – Trichloroethene

Table 20. Summary of Ground Water Sampling Results – 2002 to 2007
Target Chlorinated Volatile Organic Compounds (in µg/L) (continued)

Monitoring Locations NJ GWQS	Date	PCE 1.0	TCE 1.0	c-1,2-DCE 70.0	1,1-DCE 2.0	1,1,1-TCA 30.0
MW-19I	7/30/2002	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
	10/20/2003	<0.4	<0.3	<1.0	<1.2	<0.9
	9/22/2004	< 0.4	< 0.5	< 0.5	<1.2	< 0.9
	11/03/2005	0.25	0.25	0.3	0.35	0.4
	9/26/2006	<0.30	<0.20	<0.50	<0.30	<0.60
	11/14/2007	**<0.66**	**<0.66**		**<0.77**	**<0.62**
MW-19S	11/20/2002	214	12.8	61.2	< 0.7	0.55 J
	10/21/2003	229	14.9	52.5	< 6.0	< 4.5
	9/22/2004	154	9.3	34.1	<1.2	<0.9
	11/03/2005	190	9.1	0.8	0.6	0.8
	9/26/2006	158	8.12	16.4 NJ	<0.30	<0.60
	11/14/2007	**98.6**	**3.63**		**<0.77**	**<0.62**
MW-22S	11/20/2002	< 0.6	0.25	< 0.6	< 0.7	0.84 J
	10/21/2003	< 0.8	< 0.8	< 0.8	< 0.8	0.68 J
	9/22/2004	<0.4	<0.5	<0.5	<1.2	<0.9
	11/03/2005	0.25	0.25	0.3	0.35	0.4
	9/26/2006	<0.3	<0.2	<0.50	<0.3	<0.6
	11/14/2007	**<0.66**	**<0.66**		**<0.77**	**<0.62**
MW-23	7/30/2002	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
	10/21/2003	< 0.8	< 0.8	< 0.8	< 0.8	0.68
	9/22/2004	<0.4	<0.5	<0.5	<1.2	<0.9
	11/03/2005	0.25	0.25	0.35	0.3	0.4
	9/26/2006	<0.30	<0.20	<0.50	<0.30	<0.60
	11/14/2007	**<0.66**	**<0.66**		**<0.77**	**<0.62**
MW-24S	7/30/2002	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
	10/21/2003	< 0.4	< 0.3	<1.0	< 1.2	<0.9
	9/22/2004	<0.4	<0.5	<0.5	<1.2	<0.9
	11/03/2005	0.25	0.3	0.35	0.3	0.4
	11/14/2007	**<0.66**	**<0.66**		**<0.77**	**<0.62**
MW-25	11/21/2002	0.90 J	< 0.6	4.21	< 0.6	< 0.7
	10/21/2003	0.90 J	0.5 0J	5.31NJ	0.6 J	< 0.7
	9/22/2004	0.79	<0.5	5.21 NJ	<1.2	<0.9
	11/02/2005	0.74	0.25	0.35	0.35	0.40
	9/26/2006	1.2	0.630 J	4.41 J	<0.30	<0.60
	9/25/2006	2.23	0.340 J	<0.50	<0.30	<0.60
	11/14/2007	**1.38**	**0.68 J**		**<0.77**	**<0.62**

Notes: "J" indicates a value that is greater than the MDL but lower than the lowest standard.
"N" indicates presumptive evidence of a compound.
NJ GWQS – New Jersey Ground Water Quality Standards
c-1,2-DCE – cis-1,2-Dichlorothylene
1,1-DCE – 1,1-Dichloroethylene
1,1,1-TCA – 1,1,1-Trichloroethane
PCE – Tetrachloroethylene TCE – Trichloroethene

Table 20. Summary of Ground Water Sampling Results – 2002 to 2007
Target Chlorinated Volatile Organic Compounds (in µg/L) (continued)

Monitoring Locations	Date	PCE	TCE	c-1,2-DCE	1,1-DCE	1,1,1-TCA
NJ GWQS		**1.0**	**1.0**	**70.0**	**2.0**	**30.0**
DSN001 - Basin	10/21/2003	0.51 J	0.15	<1.0	<1.2	<0.9
Outfall	9/22/2004	0.900 J	<0.5	<0.5	<1.2	<0.9
	11/02/2005	0.62 J	<0.5	<0.7	<0.7	<0.8
	9/26/2006	0.390 J	<0.2	<0.5	<0.3	<0.6
	11/15/2007	**<0.66**	**<0.66**		**<0.77**	**<0.62**
D-Site MG	7/29/2002	88.6	6.31	3.61 NJ	2.01 J	1.36 J
Building Sump	10/21/2003	77.5	5.76	3.81NJ	1.52	0.93J
	9/22/2004	65.4	6.63	7.08 NJ	1.52	<0.9
	11/02/2005	32.9	3.08	<0.7	<0.7	<0.8
	9/25/2006	43.2	4.36	3.13 NJ	0.76 J	<0.6
	11/15/2007	**38.7**	**4.21**		**0.84 J**	**<0.62**
D-site Air Shaft	7/29/2002	2.88 J	< 0.8	< 0.8	< 0.8	< 0.8
Building Sump	6/18/2003	5.19	<0.8	<0.7	<0.6	<0.7
	10/21/2003	2.73	<0.3	<1.0	<1.2	<0.9
	9/22/2004	1.89	<0.5	<0.5	<1.2	<0.9
	11/02/2005	2.27	<0.50	<0.7	<0.7	<0.8
	9/25/2006	2.23	0.34	<0.5	<0.3	<0.6
	11/152007	**2.53**	**<0.66**		**<0.77**	**<0.62**

Notes: "J" indicates a value that is greater than the MDL but lower than the lowest standard.
"N" indicates presumptive evidence of a compound.
NJ GWQS – New Jersey Ground Water Quality Standards
c-1,2-DCE – cis-1,2-Dichlorothylene
1,1-DCE – 1,1-Dichloroethylene
1,1,1-TCA – 1,1,1-Trichloroethane
PCE – Tetrachloroethylene
TCE – Trichloroethene

Table 21. Summary of Ground Water Sampling Results – 2003 to 2007
Natural Attenuation Indicators (mg/L unless noted)

Location	Date	Chloride 250 mg/L	Sulfate 250 mg/L	Alkalinity	Nitrate as N 10mg/L	Ferrous Iron	Dissolved Methane	Dissolved Ethane	pH ORP S.U., mVe*
D-12	10/20/2003	19.9	31.6	95	<0.50	<0.10	9.99		5.55, 16.3
	9/22/2004	18.1	31.3	61.7	<0.50	<0.10	0.42	0.14	5.26, 234.7
	11/02/2005	15.9	28.7	78.8	<0.50	<0.10	0.12	<0.10	5.00, 85.1
	9/26/2006	18.3	31.2	64.1	<0.50	<0.10	7.00	<.10	5.11, 51.7
	11/14/2007	**13.4**	**25.7**	**88.3**	**<0.50**	**<0.20**	**0.70**	**<0.12**	**5.53, 290.8**
MW-9S	10/21/2003	8.8	24	56.5	<0.5	<0.10	<0.10		5.28, 129.3
	9/22/2004	14.4	27.8	79.6	<0.5	<0.10	<0.10	<0.10	5.48, 152.7
	11/02/2005	8.73	21.0	25.6	<0.50	<0.10	<0.10	<0.10	5.32, 57.8
	9/26/2006	10.4	22	39.3	<0.50	<0.20	<0.10	<0.10	5.49, 36.1
	11/14/2007	**14.5**	**20**	**84.8**	**<0.50**	**<0.20**	**0.12**	**<0.12**	**6.06, 36.3**
MW-13I	6/03	<5.0,<5.0	15.8,15.8	126,132	<0.5,<0.5	<0.10<0.10	<0.10<0.10		6.81,- 78
	10/20/2003	6.60	22.5	90.9	<0.50	<0.10	<0.10		6.82, 55.8
	9/22/2004	6.00	19.6	91.5	<0.50	<0.10	<0.10	<0.10	4.98, 166.9
	11/02/2005	7.31	22.1	80.8	<0.50	<0.10	<0.10	<0.10	6.23, 7.4
	9/26/2006	9.43	21.8	91.9	<0.50	<0.20	<0.10	<0.10	5.82, -4.5
	11/14/2007	**8.79**	**18.6**	**101**	**<0.50**	**<0.20**	**<0.10**	**<0.12**	**6.65, 3.7**
MW-13S	6/2003	9.0	18.7	60.1	<0.50	<0.10	9.71		6.62, 6.2
MW-26	10/20/2003	10.7	21.5	51.5	<0.5,	0.85	30.4		6.02,
duplicate		6.1	29.2	20.2	<0.5	<0.10	1.47		65.1
	9/22/2004	11.7	19.9	47.	<0.5,	<0.10	21.5	<0.10	5.26
		11.7	20.3	58.7	<0.5	<0.10	20.8	<0.10	63.9
	11/02/2005	13.7, 13.8	13.8	52.2, 52.2	<0.5,<0.5	2.4, 2.4	25.1, 24.5	<0.10	5.72, 36.2
	9/26/2006	19.3	21.6	55.2	<0.50	6.0	40.9	<0.10	5.34, 45.7
MW-17	10/20/2003	8.70	21.6	20.2	<0.50	0.98			5.60, 15
	9/22/2004	7.5	19.2	20.9	<0.50	<0.10	0.25	<0.10	4.93, 101.3
	11/02/2005	8.93	20.1	19.7	<0.50	<0.10	2.15	<0.10	4.72, 66.5
	9/26/2006	11.7	21.8	15.5	<0.50	<0.20	0.97	<0.10	4.54, 14.1
	11/14/2007	**11.1**	**21.9**	**19.6**	**<0.50**	**<0.20**	**1.0**	**<0.12**	**5.49, 191.9**
MW-18	6/2003	<5.0	27.7	20.4	0.18	<0.10	<0.10		5.42, -113
	10/20/2003	8.00	24.4	25.3	<0.50	<0.10	2.09		5.74, 4.6
	9/22/2004	6.70	22.4	21.9	<0.50	<0.10	0.48	<0.10	4.84, 75.7
	11/03/2005	8.65,6.61	24,29.7	16.1,19.7	<0.50<0.5	<0.20, <0.1	1.14,<0.10	<0.10,<0.10	4.62, 95.2
	9/26/2006	19.2	21.6	55.6	<.0.<0.50	<<0.10	58.2	<0.10	4.53, 20.7
	11/14/2007	**7.47**	**20.7**	**23.4**	**<0.50**	**<0.20**	**1.2**	**<0.12**	**5.67, 204.2**
MW-19I	6/2003	24.4		45.6	0.750	<0.10	<0.10		6.98, 104.1
	10/21/2003	27	13.7	44	0.900	<0.10	<0.10		5.73, 187.8
	9/22/2004	28.9	12.3	45.8	0.87	<0.10	<0.10	<0.10	5.7, 180.2
	11/03/2005	32.4	11.0	38.4	0.85	<0.10	<0.10	<0.10	5.46, 69.8
	9/26/2006	41.5	11.8	34.6	1.05	<.20	<0.10	<0.10	5.07, 14.6
	11/14/2007	**45.7**	**9.41**	**41.9**	**0.89**	**<0.20**	**<0.10**	**<0.12**	**5.87, 333.7**
MW-19S	6/2003	5.72	30.9	19.4	<0.50	<0.10	<0.10		4.97,42
	10/21/2003	6.00	29.1	<2.0	<0.50	<0.10	1.97		4.9, 177.99
	9/22/2004	5.99	19.0	23.9	<0.50	4.30	3.98	<0.10	4.47, 187.7
	11/03/2005	5.65	27.3	21.7	<0.50	<0.10	<0.10	<0.10	5.46, 69.8
	9/26/2006	7.39	27.8	21.6	<0.50	<0.20	10.2	<0.10	4.51, 28.5
	11/14/2007	**<5.00**	**23.0**	**15.6**	**<0.50**	**<0.20**	**2.30**	**<0.12**	**5.41, 330.5**

***Note:** pH is measured in Standard Units (S.U.) ORP – oxidation reduction potential measured in milli Volts electric (mVe).

Table 21. Summary of Ground Water Sampling Results – 2003 to 2007
Natural Attenuation Indicators (mg/L unless noted) (continued)

Location	Date	Chloride 250 mg/L	Sulfate 250 mg/L	Alkalinity	Nitrate as N 10mg/L	Ferrous Iron	Dissolved Methane	Dissolved Ethane	pH ORP S.U., mVe*
MW-22S	6/2003	25.0	24.7	30.1	<0.50	<0.10	<0.10		5.48,-32
	10/21/2003	24.6	22.5	<2.0	1.00	<0.10	<0.10		5.32, 15.5
	9/22/2004	23.5	21.9	11.9	0.84	<0.10	<0.10	<0.10	4.82, 148.2
	11/03/2005	33.7	18.7	<2.0	0.97	<0.10	<0.10	<0.10	5.11, 73.5
	9/26/2006	31.6	20.9	6.85	0.960	<0.20	<0.10	<0.10	4.81, 73.6
	11/14/2007	**26.2**	**20.7**	**8.78**	**0.740**	**<0.20**	**<0.10**	**<0.12**	**5.25, 82.4**
MW-23S	6/2003	<5.0	57.8	4.4	<0.50	<0.10	<0.10		4.49, 8
	10/21/2003	13.4	56.2	<2.0	<0.5	<0.10	<0.10		4.65, 201.1
	9/22/2004	7.62	53.3	10.9	<0.5	0.75	<0.10	<0.10	4.53, 159.9
	11/03/2005	6.98	57.2	<2.0	<0.50	<0.10	<0.10	<0.10	4.31/104.8
	9/26/2006	8.69	51.6	11.5	<0.50	<0.20	<0.10	<0.10	4.33, 22.2
	11/14/2007	**6.31**	**43.4**	**7.63**	**<0.50**	**<0.20**	**<0.10**	**<0.12**	**5.27, 319.4**
MW-24S	6/2003	<5.0	16.5	31	<0.50	<0.10	<0.10		6.72, 106.8
	10/21/2003	<5.0	14.2	<2.0	<0.5	<0.10	<0.10		5.27, 21.2
	9/22/2004	<5.0	13.5	7.96	<0.5	<0.10	<0.10	<0.10	4.55, 160.1
	11/02/2005	<5.0	13.3	<2.0	<0.50	<0.10	<0.10	<0.10	5.2, 73.6
	9/26/2006	5.49	14.1	9.53	<0.50	<0.20	<0.10	<0.10	4.96, 65.6
	11/14/2007	**5.82**	**14.4**	**15.9**	**<0.50**	**<0.20**	**<0.10**	**<0.12**	**5.36, 371.6**
MW-25	6/2003	218	14.2	73.7	<0.50	0.46	6.48		6.32, -12.2
	10/21/2003	197	16.1	74.7	<0.5	0.39	16.0		6.01, 50.6
	9/22/2004	199	14.2	67.7	<0.5	<0.10	7.25	0.2	5.47, 2.8
	11/02/2005	175	17	67	<0.50	<0.40	7.89	0.12	5.62, 31.6
	9/26/206	171	19.5	73	<0.50	0.47	9.96	0.18	5.52, -10.2
	11/14/2007	**136**	**19.9**	**74.5**	**<0.50**	**<0.20**	**6.2**	**<0.12**	**6.18, 144.0**
D-Site MG Building Sump	6/2003	95.1	21.7	109	1.00	<0.20	1.34		
	10/21/2003	53.9	33.9	79.8	<0.5	0.46	3.62		
	9/22/2004	99.5	18.9	112	<0.5	<0.10	5.99	<0.10	
	11/02/2005	126	19.5	116	0.84	0.39	7.64		
	9/26/2006	157	19.9	110	0.72	<.10	0.2	<010	
	11/14/2007	**161**	**15.3**	**94.4**	**<0.50**	**0.47**	**8.3**	**<0.12**	
D-site Air Shaft Building Sump	6/2003	71.1	23.8	98.9	1.20	<0.20	0.20		
	6/18/2003	53.8	31.2	99	1.2	<0.10	0.17		
	9/22/2004	49.5	27.5	95.5	0.93	<0.10	0.16	<0.10	
	11/02/2005	82.6	25.7	98.5	1.35	<0.10	0.18		
	9/26/2006	97.5	22.3	113	1.21	<.010	4.12	<.10	
	11/14/2007	**91.2**	**18.8**	**120**	**1**	**<0.20**	**<0.10**	**<0.12**	
DSN001	6/2003	19.4	6.8	33	<0.50	<0.20	3.44		
	10/21/2003	53.9	29.2	79.8	1.00	<0.10	<0.10		
	9/22/2004	46.4	37.7	91.5	0.770	<0.10	<0.10	<0.10	
	11/02/2005	93.2	30.0	74.9	1.45	<0.10	0.41		
	9/26/2006	91.6	27.1	87.4	0.93	<0.10	0.21	<0.10	
	11/14/2007	**87.9**	**17.9**	**102**	**0.87**	**<0.20**	**0.31**	**<0.12**	

***Note:** pH is measured in Standard Units (S.U.)
ORP – oxidation reduction potential measured in milli Volts electric

Table 22. Quality Assurance Data for Radiological and Non-Radiological Samples for 2007

Laboratory, Program, and Parameter	Reported Value	Actual Value	Acceptance Range	Acceptable Not Acceptable
ERA (picoCuries/Liter)				
RAD 68	10,000	11,300	9,340-13,200	Acceptable
RAD 70	1510	1770	1180-2360	Acceptable
April 2007				
Chemical oxygen demand (mg/L)	174.053	163	125-186	Acceptable
Specific conductance (µmhos/cm)	374	345	305-380	Acceptable
pH (S.U.)	5.54	5.64	5.44-5.84	Acceptable
Total residual chlorine (mg/L)	0.61	1.66	1.19-2.05	Not Acceptable
July 2007 WP-149				
Chemical oxygen demand (mg/L)	102.77	101	75.0-118	Acceptable
Specific conductance (µmhos/cm)	316	320	284-356	Acceptable
pH (S.U.)	7.12	7.15	6.95-7.35	Acceptable
Total residual chlorine (mg/L)	0.96	1.11	0.798-2.38	Acceptable
Turbidity NTUs	3	10.3	8.72-11.6	Not Acceptable
December 2007 WP-155				
Turbidity NTUs	1.79	1.68	1.22-2.19	Acceptable

Table 23. Waste Characterization Report Results for DSN001 Surface Water Discharge Samples for September 2007 (all other parameters were below detention levels)

Laboratory Parameter	Reported Value (µg/L)
Barium	183
Copper	6.4
Manganese	62.4
Zinc	32.4

Appendix

B

TABLES for 2008

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 2008

START DATE	WEEK	INCH	ACCUMULATION	TOTAL	MONTH
1-Jan-08	1	0.00	0.00		
8-Jan-08	2	0.20	0.20		
15-Jan-08	3	0.98	1.18		
22-Jan-08	4	0.620	1.80		
29-Jan-08	5	0.00	1.80	1.80	JANUARY
5-Feb-08	6	1.69	3.49		
12-Feb-08	7	0.15	3.64		
19-Feb-08	8	2.36	6.00		
26-Feb-08	9	0.48	6.48	4.68	FEBRUARY
4-Mar-08	10	0.14	6.62		
11-Mar-08	11	2.62	9.24		
18-Mar-08	12	0.15	9.39		
25-Mar-08	13	0.94	10.33	3.85	MARCH
1-Apr-08	14	0.27	10.60		
8-Apr-08	15	0.31	10.91		
15-Apr-08	16	0.71	11.62		
22-Apr-08	17	0.00	11.62		
29-Apr-08	18	1.52	13.14	2.81	APRIL
6-May-08	19	0.05	13.19		
13-May-08	20	2.03	15.22		
20-May-08	21	1.61	16.83		
27-May-08	22	0.84	17.67	4.53	MAY
3-Jun-08	23	0.00	17.67		
10-Jun-08	24	1.16	18.83		
17-Jun-08	25	0.00	18.83		
24-Jun-08	26	1.88	20.71	3.04	JUNE
1-Jul-08	27	0.85	21.56		
8-Jul-08	28	0.40	21.96		
15-Jul-08	29	0.25	22.21		
22-Jul-08	30	0.15	22.36		
29-Jul-08	31	2.42	24.78	4.07	JULY
5-Aug-08	32	0.76	25.54		
12-Aug-08	33	0.58	26.12		
19-Aug-08	34	1.42	27.54		
26-Aug-08	35	0.00	27.54	2.76	AUGUST
2-Sep-08	36	0.55	28.09		
9-Sep-08	37	3.40	31.49		
16-Sep-08	38	0.97	32.46		
23-Sep-08	38	0.02	32.48		
30-Sep-08	39	2.95	35.41	7.89	SEPTEMBER
7-Oct-08	40	0.00	35.41		
14-Oct-08	41	0.17	35.58		
21-Oct-08	42	0.00	35.58		
28-Oct-08	44	3.23	38.81	3.40	OCTOBER
4-Nov-08	45	0.00	38.81		
11-Nov-08	46	0.76	39.57		
18-Nov-08	47	1.69	41.26		
25-Nov-08	48	1.54	42.80	3.99	NOVEMBER
2-Dec-08	49	0.06	42.86		
9-Dec-08	50	0.08	42.94		
16-Dec-08	51	2.86	45.80		
23-Dec-08	52	1.74	47.54		
30-Dec-08	53	0.61	48.15	5.35	DECEMBER

Table 3. D–Site Tritium Stack Releases in Curies in 2008

Week Ending	HTO (Ci)	HT (Ci)	Weekly total (Ci)	Month	Annual Total (Ci)
9-Jan	0.0641	0.0118	0.0759		0.0759
16-Jan	0.0714	0.0033	0.0747		0.1506
23-Jan	0.0846	0.0059	0.0905		0.2411
30-Jan	0.1010	0.0122	0.1132	**January**	0.3543
6-Feb	0.0682	0.0043	0.0725		0.4268
13-Feb	0.0594	0.0046	0.0640		0.4908
20-Feb	0.0856	0.0082	0.0938		0.5846
27-Feb	0.0671	0.0072	0.0743	**February**	0.6589
5-Mar	0.0410	0.0028	0.0438		0.7027
12-Mar	0.0090	0.0012	0.0102		0.7129
19-Mar	0.0470	0.0026	0.0496		0.7625
26-Mar	0.0144	0.0022	0.0166	**March**	0.7791
2-Apr	0.0258	0.0027	0.0285		0.8076
9-Apr	0.0271	0.0032	0.0303		0.8379
16-Apr	0.0319	0.0024	0.0343		0.8722
23-Apr	0.0447	0.0046	0.0493		0.9215
30-Apr	0.0123	0.0021	0.0144	**April**	0.9359
7-May	0.0348	0.0042	0.0390		0.9749
14-May	0.0696	0.0035	0.0731		1.0480
21-May	0.0027	0.0006	0.0033		1.0513
28-May	0.0172	0.0024	0.0196	**May**	1.0709
4-Jun	0.0239	0.0025	0.0264		1.0973
11-Jun	0.0682	0.0051	0.0733		1.1706
18-Jun	0.0846	0.0066	0.0912		1.2618
25-Jun	0.0639	0.0063	0.0702	**June**	1.3320
2-Jul	0.1020	0.0100	0.1120		1.4440
8-Jul	0.0906	0.0074	0.0980		1.5420
16-Jul	0.0026	0.0006	0.0032		1.5452
23-Jul	0.0021	0.0019	0.0040		1.5492
30-Jul	0.0023	0.0009	0.0032	**July**	1.5524
6-Aug	0.0047	0.0042	0.0089		1.5613
13-Aug	0.0033	0.0021	0.0054		1.5667
20-Aug	0.0013	0.0012	0.0025		1.5692
27-Aug	0.0011	0.0007	0.0018	**August**	1.5710
3-Sept	0.0010	0.0007	0.0017		1.5727
10-Sept	0.0021	0.0009	0.0030		1.5757
17-Sept	0.0025	0.0014	0.0039		1.5796
24-Sept	0.0022	0.0009	0.0031	**September**	1.5827
1-Oct	0.0020	0.0011	0.0031		1.5858
8-Oct	0.0883	0.0093	0.0976		1.6834
15-Oct	0.0903	0.0077	0.0980		1.7814
22-Oct	0.1080	0.0115	0.1195		1.9009
29-Oct	0.0846	0.0081	0.0927	**October**	1.9936
5-Nov	0.0676	0.0079	0.0755		2.0691
12-Nov	0.1140	0.0071	0.1211		2.1902
19-Nov	0.0880	0.0090	0.0970		2.2872
26-Nov	0.1120	0.0087	0.1207	**November**	2.4079
3-Dec	0.1320	0.0053	0.1373		2.5452
10-Dec	0.0645	0.0052	0.0697		2.6149
17-Dec	0.0668	0.0039	0.0707		2.6856
23-Dec	0.0685	0.0042	0.0727		2.7583
31-Dec	0.0560	0.0027	0.0587	**December**	2.8170
				Total	2.8170

Table 4. Ranges of Air Tritium Concentrations (in pCi/m3) Collected On-Site (T1-T4) and Off-Site (R1-R6 & BM1) in 2008

Station	HTO pCi/m3	HT pCi/m3
T1	**0 - 3.03**	**0 - 3.65**
T2	**0 – 1.04**	**0 – 3.71**
T3	**0.546 – 1.78**	**1.85 – 6.35**
T4	**0 – 1.23**	**0 – 5.06**
R1	**0 – 0.545**	**0 – 73.4**
R2	**0.0315 – 0.275**	**0.0699 – 1.3**
R3	**0.0444 – 0.607**	**0.0967 – 2.27**
R4	**0 – 1.35**	**0 – 1.63**
R5	**0 – 1.13**	**0 – 2.26**
R6	**0 – 0.897**	**0 – 2.28**
BM1	**0.0649 – 0.384**	**0.37 – 1.45**

Table 5. Surface Water Tritium Concentrations for 2008 (in picoCuries/Liter)

BOLD indicates above the level of detection.

Sample Location	Bee Brook (B1)	Bee Brook (B2)	Basin (DSN001)	D&R Canal (C1)	D&R Canal (DSN003)
January			<110	<110	<110
February	<141	<141	<141	<141	<143
March			<124	<124	<124
April			<128	<128	<128
May	<129	<129	<129	<129	<129
June			<127	<127	<131
July			<119	<119	**523**
August	<146	<146	<146	<146	<151
September			<145	<145	<145
October			**144**	<123	
November	<106	<106	<123	<106	
December			**155**		

Sample Location	Potable Water (E1)	Millstone River (M1)	Cranbury Brook (P1)	Devil's Brook (P2)
January				
February	<141	<141	<141	<141
March				
April				
May	<129	<129	<129	<129
June				
July				
August	<146	<146	<146	<146
September				
October				
November	<123	<123	<123	<123
December				

Table 6. Ground Water Tritium Concentrations for 2008 (in picoCuries/liter)

Well No. or Sump Location	Well TW-1	Well TW-5	Well TW-8	Well MW-12S	Well D-12	Air Shaft Sump	D-site MG Sump
January						<110	<110
February	**189**	<141	**171**	<141	<141	<143	<143
March						<124	**126**
April						**180**	**149**
May						**135**	<129
June	**5473**	**4000**	**234**	<140	<140	<127	<127
July						<119	<140
August	**162**	**189**	**185**	<151	<151	<146	<146
September						<127	**153**
October						**158**	**149**
November	**185**	**173**	**179**	<129	<129	,123	<123
December						**151**	**178**

BOLD indicates highest concentrations above background levels.

Table 7. Rain Water Tritium Concentrations (in picoCuries/liter) Collected On-Site in 2008

250 feet from Stack	R1E (East)	R1W (West)	R1S (South)	R1N (North)	R1ND (Duplicate)
1/18/08	<110	**162**	<143	<110	<110
2/18/08	<141	<141	<141	<141	<141
3/25/08	<124	<124	**135**	**171**	**167**
4/29/08	<128	<129	<129	<129	<129
5/28/08	<129	<131	<131	<131	<131
6/17/08	<127	<127	<127	<127	<127
7/25/08	<141	<119	<119	<119	<141
7/29/08		**167**	<126		
8/15/08	<151	**158**	**185**	<151	**153**
9/15/08	<127		<128	<127	<127
10/9/08	<106		<128	<128	<128
11/12/08	**748**	<131	**275**	<131	<131
12/15/08	**146**	<103	<103	<103	<103

500 feet from Stack	R2E (East)	R2W (West)	R2S (South)	R2N (North)
1/18/08	<143	<143	**1,212**	<143
2/18/08	<141		<141	<141
3/25/08	**140**	**140**	<128	<128
4/29/08	<129	<129	<129	<129
5/28/08	<131	<131	**153**	<131
6/17/08	<140	**153**	<140	<140
7/25/08	<119	<146	<119	<119
7/29/08	<141	<141	<141	<141
8/15/08	<145	<145	<145	<145
9/15/08	<127	<128	**167**	<127
10/9/08	<106	<106	<128	<106
11/12/08	**374**	<131	**135**	<131
12/15/08	**164**	<103	<103	<103

BOLD indicates highest concentrations above background levels.

Table 8. Rain Water Tritium Concentrations (in picoCuries/liter) Collected Off-Site in 2008

	REAM 1	REAM 2	REAM 4	REAM 5	REAM 6
6/11/08		<127	<127		
8/5/08				<151	
9/5/08	<127	<127			
10/10/08	<106	<106		<106	<106
11/11/08			<123	<123	<131
12/19/08		<103		<103	

Table 9. Annual Range of Tritium Concentration at PPPL in Precipitation from 1985 to 2008

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

Table 10. Liquid Effluent Collection Tank Release Data for 2008

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)
01/02/2008	12,600	65.785	228	22,800	0.001090	0.001090	213	<213
02/18/2008	12,750	46.429	270	6,600	0.000318	0.001408	213	<213
05/05/2008	12,750		249	7,850	0.000379	0.001787	212	<212
06/10/2008	9,300	14.959	267	10,900	0.000382	0.002169	213	<213
06/13/2008	9,000	75.44	354	9,230	0.000314	0.002483	213	<213
06/25/2008	10,500	NS	332	7,360	0.000293	0.002776	212	<212
07/07/2008	12,000	39.762	254	6,590	0.000299	0.003075	213	<213
07/22/2008	12,300	NS	300	6,860	0.000319	0.003394	213	<213
08/01/2008	12,150	23.781	294	8,990	0.000413	0.003807	212	<212
08/14/2008	10,950	NS	251	8,830	0.000366	0.004173	212	<212
09/05/2008	10,500	53.317	278	21,600	0.000860	0.005033	213	<213
09/17/2008	1,800	NS	267	22,100	0.000151	0.005184	213	<213
10/15/2008	11,100	22.377	312	37,400	0.001570	0.006754	213	<213
11/24/2008	12,750	95.017	298	8,070	0.000390	0.007144	213	<213
12/18/2008	9,000	343.72	271	6,640	0.000226	0.007370	213	<213

Table 11. Surface Water Analysis for Bee Brook, B1, in 2008

Sample Date	2/05/08	5/08/08	8/05/08	11/06/08
Ammonia nitrogen as N, mg/L		<0.1	<0.1	<0.1
Biological Oxygen Demand, mg/L		3.55	<2.55	
Chemical Oxygen Demand, mg/L	<5	<5	<5	<5
Nitrogen, total inorganic, mg/L			<0.5	
Oxidation-Reduction Potential, mV	52.4	15.3	19.1	23.2
pH, standard units	6.05	6.69	6.55	6.42
Phosphorus, total, mg/L	0.0710	0.214	0.125	0.132
Temperature, ° C	5.6,6.9	17.0, 17.7	21.6, 21.8	14.4, 15.5
Total Suspended Solids, mg/L	<2.0	3.6	3.0	4.0
Total Organic Carbon, mg/L	7.01	7.22	7.53	12.9
Total Dissolved Solids, mg/L		180	103	

Location B1 = Bee Brook upstream of PPPL basin discharge
See Exhibit 4-3 for location.

Table12. Surface Water Analysis for Bee Brook, B2, in 2008

Sample Date	2/05/08	5/08/08	8/08/08	11/06/08
Ammonia nitrogen as N, mg/L		0.190	<0.1	<0.1
Biological Oxygen Demand, mg/L		2.77	<1.91	
Chemical Oxygen Demand, mg/L	<5	<5	<5	<5
Nitrogen, total inorganic, mg/L				
Oxidation-Reduction Potential, mV	5.8	-15.0	-52.1	20.2
pH, standard units	6.92	7.24	7.82	6.47
Phosphorus, total, mg/L	<0.05	0.177	0.083	0.107
Temperature, ^{o}C	7.4, 8.8	18.0, 19.0	22.5, 22.7	14.6, 15.7
Total Suspended Solids, mg/L	<2.0	5.2	9.6	8.0
Total Organic Carbon, mg/L	4.62	5.13	2.56	8.42
Total Dissolved Solids, mg/L		257	280	

Location B2 = Bee Brook downstream of PPPL basin discharge

Table 13. Surface Water Analysis for Delaware & Raritan Canal, C1, in 2008

Sample Date	2/05/08	5/08/08	8/08/08	11/06/08
Ammonia nitrogen as N, mg/L		<0.1	<0.1	<0.1
Biological Oxygen Demand, mg/L		<2.29	<1.91	
Chemical Oxygen Demand, mg/L	<5	<5	<5	<5
Nitrogen, total inorganic, mg/L			0.794	
Oxidation-Reduction Potential, mV	40.7	-14.3	-11.4	7.3
pH, standard units	6.27	7.23	7.09	6.71
Phosphorus, total, mg/L	0.088	0.085	0.062	0.050
Temperature, ^{o}C	5.2, 6.8	19.3, 20.0	28.5, 28.2	12.7, 14.1
Total Suspended Solids, mg/L	10.0	4.4	2.8	3.3
Total Organic Carbon, mg/L	5.34	3.51	3.81	4.63
Total Dissolved Solids, mg/L		123	111	

Location C1 = Delaware & Raritan Canal State Park at Mapleton Avenue, Plainsboro midway on pedestrian bridge
See Exhibit 4-3 for location.

Table 14. Surface Water Analysis for Elizabethtown Water, E1, in 2008

Sample Date	2/05/08	5/08/08	8/08/08	11/06/08
Ammonia nitrogen as N, mg/L		0.18	0.25	0.19
Biological Oxygen Demand, mg/L		<2.29	<1.90	
Chemical Oxygen Demand, mg/L	<5	<5	<5	<5
Nitrogen, total inorganic, mg/L			0.925	
Oxidation-Reduction Potential, mV	22.7	9.9	13.8	3.9
pH, standard units	6.62	6.79	6.65	6.77
Phosphorus, total, mg/L	0.532	0.904	<0.050	0.112
Temperature, ^{o}C	14.4, 13.9	18.5, 17.4	25.3	16.3, 18
Total Suspended Solids, mg/L	<2.0	<2.0	<2.0	2.0
Total Organic Carbon, mg/L	2.01	1.89	2.10	2.39
Total Dissolved Solids, mg/L		220	220	

Location E1 = Elizabethtown Water (potable) collected at Main Gate Security Booth
See Exhibit 4-3 for location.

Table 15. Surface Water Analysis for Millstone River, M1, in 2008

Sample Date	2/05/08	5/08/08	8/05/08	11/06/08
Ammonia nitrogen as N, mg/L		0.480	<0.1	0.580
Biological Oxygen Demand, mg/L		2.55	<2.55	
Chemical Oxygen Demand, mg/L	<5	<5	6.581	<5
Nitrogen, total inorganic, mg/L			2.45	
Oxidation-Reduction Potential, mV	39.4	10.9	-4.6	17.7
pH, standard units	6.30	6.77	6.97	6.52
Phosphorus, total, mg/L	0.098	0.096	0.210	0.096
Temperature, ^{o}C	6.7, 7.4	20.3, 20.2	29.6, 29.6	13.9, 14.8
Total Suspended Solids, mg/L	8.7	6.0	14.4	9.5
Total Organic Carbon, mg/L	4.46	4.86	7.58	4.86
Total Dissolved Solids, mg/L		174	154	

Location M1 = Millstone River at Delaware & Raritan Canal State Park at Mapleton Road,
NS = Not sampled

Table 16. Surface Water Analysis for Cranbury Brook (Plainsboro), P1, in 2008

Sample Date	2/05/08	5/08/08	8/05/08	11/06/08
Ammonia nitrogen as N, mg/L		0.10	<0.10	<0.10
Biological Oxygen Demand, mg/L		3.13	<2.55	
Chemical Oxygen Demand, mg/L	<5	<5	<5	<5
Nitrogen, total inorganic, mg/L			3.02	
Oxidation-Reduction Potential, mV	88.3	72.2	41.0	68.5
pH, standard units	5.38	5.68	6.17	5.59
Phosphorus, total, mg/L	0.120	0.128	0.052	0.076
Temperature, ^{o}C	7.0, 8.4	19.9, 20.0	26.3, 26	14.5, 15.8
Total Suspended Solids, mg/L	24.0	20.0	6.0	3.0
Total Organic Carbon, mg/L	4.71	4.68	3.74	4.84
Total Dissolved Solids, mg/L		143	140	

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

Table 17. Surface Water Analysis for Devil's Brook (Plainsboro), P2, in 2008

Sample Date	2/05/08	5/08/08	8/05/08	11//08
Ammonia nitrogen as N, mg/L		<0.10	<0.10	<0.10
Biological Oxygen Demand, mg/L		<2.29	<2.55	
Chemical Oxygen Demand, mg/L	<5	<5	<5	7.43
Nitrogen, total inorganic, mg/L			2.94	
Oxidation-Reduction Potential, mV	51.3	33.5	33.3	149.8
pH, standard units	6.07	6.37	6.30	4.14
Phosphorus, total, mg/L	<0.050	<0.050	0.062	<0.050
Temperature, ^{o}C	6.8, 8.3	19.0, 18.6	22.8, 24	16.7, 15
Total Suspended Solids, mg/L		7.0	3.0	8.0
Total Organic Carbon, mg/L	5.97	6.58	8.61	9.62
Total Dissolved Solids, mg/L		94	129	

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

Table 18. DSN001 - Retention Basin Outfall
Surface Water Analysis (NJPDES NJ0023922) in 2008

Permit Limit	Units	Parameters	1/08/08	2/05/08	3/04/08	4/01/08	5/08/08	6/04/08
NA	mg/L	Ammonia-N					<0.10<0.10	
	mg/L	Biological Oxygen Demand					2.29 2.43	
50 mg/L	mg/L	Chemical Oxygen Demand	<5, <5	<5,18	27.315	<5	<5	<5
NL	mg/L	Chlorine Produced Oxidants	<0.10	<0.10 <0.10	<0.10	<0.10	<0.10	<0.10
NA	MGD	Flow, Avg. Monthly	0.198	0.268	0.480	0.181	0.216	0.145
NA	mV	Oxidation-Reduction Potential	-42.5 1.5	-14.5	-27.9	-9.1	-62.6	-19.7
10 mg/L	mg/L	Petroleum Hydrocarbons	<5	<5	<5	<5	<5	<5
6.0-9.0	S.U.	pH	7.01 7.81	7.30	7.53	7.12	8.09	6.91
	mg/L	Ortho Phosphate as P					0.101,0.105	
	mg/L	Phosphorus, Reactive Dissolved					0.095 0.101	
	mg/L	Phosphorus, Total	0.142 0.077	0.066 0.066	0.055	0.133	0.155 0.160	0.069
	µg/L	Tetrachloroethylene	0.66	0.54	0.74	0.74	0.54	0.54
30 °C max.	°C	Temperature	13.4 10.9	11.7	14.7	15.0	19.6	19.4
NA	mg/L	Total Dissolved Solids					331, 343	
	mg/L	Total Organic Carbon	1.49 2.05		0.5	1.5	2.53 2.54	2.84
50 mg/L	mg/L	Total Suspended Solids	<2.0	2.0,<2.0	2.0	2.0	6.0, 6.4	7.7

Permit Limit	Units	Parameters	7/03/08	8/05/08	9/02/08	10/1/08	11/6/08	12/1/08
NA	mg/L	Ammonia-N		<0.10 0.23			0.05	
	mg/L	Biological Oxygen Demand		0.9, 0.9				
50 mg/L	mg/L	Chemical Oxygen Demand	<5	<5	<5	36.1	14.9	17.5
0.016	mg/L	Chlorine Produced Oxidants	<0.10 <0.10	<0.10	<0.10	<0.10	<0.10	<0.10
NA	MGD	Flow, Avg. Monthly	0.142	0.096	0.169	0.159	0.222	0.359
NL	mV	Oxidation-Reduction Potential	-49.3	-86.7	112.7	-47.9	-29.5 -48.6	-0.5
10 mg/L	mg/L	Petroleum Hydrocarbons	2.5	2.5	2.5	2.5	2.5	2.5
6.0-9.0	S.U.	pH	7.83	8.44	8.86	7.72	7.38, 7.75	7.48
	mg/L	Ortho Phosphate as P		<0.050 <0.050				
	mg/L	Phosphorus, Reactive Dissolved		<0.050 <0.050				
	mg/L	Phosphorus, Total	0.194	<0.050 <0.050	<0.050	0.060	0.076	0.055
	µg/L	Tetrachloroethylene	0.54	0.54	0.54 ,0.54	0.64	0.54, 0.64	0.64
30 °C max.	°C	Temperature	21.1	22. 5	24.7	18.8	16.4, 7.5	11.4
	mg/L	Total Dissolved Solids		289 294				
NA	mg/L	Total Organic Carbon	3.22	1.94 1.88		2.19	2.68	0.5
50 mg/L	mg/L	Total Suspended Solids	5.2	8.4, 3.6	4.4	2.4	<2.0	4.0

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

Table 19. D&R Canal Pump House - DSN003
Monthly Surface Water Analysis (NJPDES NJ0023922) in 2008

Permit Monthly Avg.	Limit Daily Max.	Units	Parameters	1/8/08	2/5/08	3/5/08	4/1/08	5/8/08	6/4/08
NA	NA	mg/L	Ammonia-N					<0.100	
		mg/L	Biological Oxygen Demand					<2.3	
NA	NA	mg/L	Chemical Oxygen Demand	<5.0	<5.0 18	<5.0	<5.0	<5.0	
NL	NL	mg/L	Chlorine Produced Oxidants	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
NL	NL	mV	Oxidation-Reduction Potential	34.6	25.7	10	4.3	40.5	3.2
10 mg/L	15 mg/L	mg/L	Petroleum Hydrocarbons	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
NA	6.0-9.0	S.U.	pH	6.38	6.55	6.83, 6.84	6.87	6.29	6.90
NA		mg/L	Phosphorus, Total	<0.050	0.088	<0.050	<0.050	0.069	0.085
NA	NA	°C	Temperature	6.1	5.8	7.8	10.6	20.0	22.4
		mg/L	Total Dissolved Solids					131	
NA	NA	mg/L	Total Organic Carbon	2.67	5.38	2.2	2.33	2.7	2.72
NL	NL	mg/L	Total Suspended Solids	<2.0	13	<2.0	<2.0	4.7	3.5

Permit Monthly Avg.	Limit Daily Max.	Units	Parameters	7/3/08	8/5/08	9/2/08	10/1/08*	11/6/08*	12/12/8*
NA	NA	mg/L	Ammonia-N		<0.10				
		mg/L	Biological Oxygen Demand		<1.8				
NA	NA	mg/L	Chemical Oxygen Demand	<5.0	<5.0	<5.0			
NL	NL	mg/L	Chlorine Produced Oxidants	<0.10	<0.10	<0.10			
NL	NL	mV	Oxidation-Reduction Potential	-9.3	-15.8	8.1			
10 mg/L	15 mg/L	mg/L	Petroleum Hydrocarbons	<5.0	<5.0	<5.0			
NA	6.0-9.0	S.U.	pH	7.12	7.17	6.74			
NA	NA	mg/L	Phosphorus, Total	0.067	0.073	0.067			
NA	NA	°C	Temperature	28.6	27.8	24.1			
		mg/L	Total Dissolved Solids		100				
NA	NA	mg/L	Total Organic Carbon	2.37	1.88	3.87			
NL	NL	mg/L	Total Suspended Solids	2.8	5.6	2.4			

Note: *Delaware & Raritan Canal pump house did not operate during October through December 2008.
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 20. Summary of Ground Water Sampling Results – 2002 to 2008
Target Chlorinated Volatile Organic Compounds (in µg/L)

Monitoring Locations	Date	PCE	TCE	c-1,2-DCE	1,1-DCE	1,1,1-TCA
NJ GWQS		**1.0**	**1.0**	**70.0**	**2.0**	**30.0**
D-12	10/21/2003	2.38	1.15	<1.0	1.22	<0.9
	9/22/2004	2.66	1.36	<0.5	<1.2	<0.9
	11/02/2005	2.35	1.47	<0.70	<0.70	<0.80
	9/25/2006	2.00	0.940 J	<0.50	0.780	<0.60
	11/14/2007	2.36	1.39		<0.77	<0.62
	9/22/2008	**1.48**	**0.72J**		**<0.75**	**<0.52**
MW-9S	10/21/2003	43.7	0.97	<1.0	<1.2	1.68
	9/22/2004	25.0	5.65	<0.5	<1.2	<0.9
	11/02/2005	29.5	1.98	<0.70	<0.70	0.890 J
	6/25/2006	32.9	<0.20	<0.50	<0.30	0.860 J
	11/14/2007	14.0	26.5		<0.77	<0.62
	9/24/2008	**17.1**	**31.3**	**4.00 JN**	**<0.75**	**<0.52**
	12/18/2008	**1.16**	**0.96**		**<0.68**	**<0.70**
	12/18/2008	**1.04**	**1.20**		**<0.68**	**<0.70**
MW-12S	**9/22/2008**	**<0.54**	**<0.66**		**<0.75**	**<0.52**
MW-13I	7/29/2002	38.2	0.52 J	< 0.6	0.76 J	2.96 J
	10/20/2003	38.7	3.42	3.04 NJ	<1.2	2.9
	9/22/2004	34.8	<0.9	<0.5	<1.2	2.72
	11/02/2005	34.2	1.03	0.35	0.8	2.04
	9/26/2006	30.6	0.83	<0.70	0.790 J	0.86
	11/14/2007	23.0	<0.66		<0.77	1.43
	11/14/2007	21.9	<0.66		<0.77	1.55
	9/24/2008	**24.8**	**<0.66**		**<0.75**	**1.57**
	9/24/2008	**24.1**	**<0.66**		**<0.75**	**1.53**
MW-13S	7/29/2002	51.4	1.57 J	4.5 NJ	<0.4	1.72 J
	10/20/2003	75.5	315	10.4 NJ	<1.2	1.68
	9/22/2004	57.8	431	18	1.2J	1.35
	11/02/2005	39.2	292	15.9 NJ	<1.00	<1.40
	9/26/2006	50.6	179	26.7 NJ	1.09	0.86
	11/14/2007	20.3	71.1		<3.85	<3.10
	9/24/2008	**18.1**	**50.9**	**33.5 JN**	**<3.75**	**<2.60**
	12/18/2008	**22.3**	**88.6**	**37.8 JN**	**<1.36**	**<1.40**
MW-17	10/21/2003	39.9	1.33	<1.0	<1.1	0.55 J
	9/22/2004	45.9	1.85	4.28 NJ	<1.2	<0.9
	11/02/2005	32.2	1.97	<0.70	<0.70	<0.80
	9/25/2006	39.2	1.95	<0.50	<0.30	<0.60
	11/14/2007	44.3	2.31		<0.77	0.71 J
	9/23/2008	**30.0**	**1.48**		**<0.75**	**<0.52**
	12/18/2008	**24.0**	**1.09**		**<0.68**	**<0.70**

Notes: "J" indicates a value that is greater than the MDL but lower than the lowest standard.
"N" indicates presumptive evidence of a compound.
c-1,2-DCE – cis-1,2-Dichlorothene
1,1-DCE – 1,1-Dichloroethene
PCE – Tetrachloroethene
TCE – Trichloroethene
1,1,1-TCA – 1,1,1-Trichloroethane

Table 20. (Continued). Summary of Ground Water Sampling Results – 2002 to 2008
Target Chlorinated Volatile Organic Compounds (in µg/L)

Monitoring Locations	Date	PCE	TCE	c-1,2-DCE	1,1-DCE	1,1,1-TCA
NJ GWQS		**1.0**	**1.0**	**70.0**	**2.0**	**30.0**
MW-18	7/30/2002	0.62 J	0.5 J	< 0.8	< 0.8	< 0.8
	10/20/2003	0.74J	0.54J	<0.7	<1.2	<0.7
	9/22/2004	0.83J	<0.5	< 0.5	< 1.2	< 0.9
	11/02/2005	0.5	0.25	0.35	0.35	0.4
	9/26/2006	0.670 J	0.540 J	<0.50	<0.3	<0.6
	11/14/2007	0.84 J	<0.66		<0.77	<0.62
	9/23/2008	**<0.54**	**<0.66**		**<0.75**	**<0.52**
	12/18/2008	**<0.64**	**<0.78**		**<0.68**	**<0.70**
MW-19I	7/30/2002	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
	10/20/2003	<0.4	<0.3	<1.0	<1.2	<0.9
	9/22/2004	< 0.4	< 0.5	< 0.5	<1.2	< 0.9
	11/03/2005	0.25	0.25	0.3	0.35	0.4
	9/26/2006	<0.30	<0.20	<0.50	<0.30	<0.60
	11/14/2007	<0.66	<0.66		<0.77	<0.62
	9/23/2008	**<0.54**	**<0.66**		**<0.75**	**<0.52**
MW-19S	11/20/2002	214	12.8	61.2	< 0.7	0.55 J
	10/21/2003	229	14.9	52.5	< 6.0	< 4.5
	9/22/2004	154	9.3	34.1	<1.2	<0.9
	11/03/2005	190	9.1	0.8	0.6	0.8
	9/26/2006	158	8.12	16.4 NJ	<0.30	<0.60
	11/14/2007	98.6	3.63		<0.77	<0.62
	9/23/2008	**69.9**	**2.78**	**5.41JN**	**<0.75**	**<0.52**
	12/18/2008	**138**	**7.09**	**20.8 JN**	**<0.68**	**<0.70**
MW-22S	11/20/2002	< 0.6	0.25	< 0.6	< 0.7	0.84 J
	10/21/2003	< 0.8	< 0.8	< 0.8	< 0.8	0.68 J
	9/22/2004	<0.4	<0.5	<0.5	<1.2	<0.9
	11/03/2005	0.25	0.25	0.3	0.35	0.4
	9/26/2006	<0.3	<0.2	<0.50	<0.3	<0.6
	11/14/2007	<0.66	<0.66		<0.77	<0.62
	9/23/2008	**<0.54**	**<0.66**		**<0.75**	**<0.52**
MW-23	7/30/2002	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
	10/21/2003	< 0.8	< 0.8	< 0.8	< 0.8	0.68
	9/22/2004	<0.4	<0.5	<0.5	<1.2	<0.9
	11/03/2005	0.25	0.25	0.35	0.3	0.4
	9/26/2006	<0.30	<0.20	<0.50	<0.30	<0.60
	11/14/2007	<0.66	<0.66		<0.77	<0.62
	9/24/2008	**<0.54**	**<0.66**		**<0.75**	**<0.52**
MW-24S	7/30/2002	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
	10/21/2003	< 0.4	< 0.3	<1.0	< 1.2	<0.9
	9/22/2004	<0.4	<0.5	<0.5	<1.2	<0.9
	11/03/2005	0.25	0.3	0.35	0.3	0.4
	11/14/2007	<0.66	<0.66		<0.77	<0.62
	9/23/2008	**<0.54**	**<0.66**		**<0.75**	**<0.52**

Notes: "J" indicates a value that is greater than the MDL but lower than the lowest standard.
"N" indicates presumptive evidence of a compound.
c-1,2-DCE – cis-1,2-Dichlorothene 1,1-DCE – 1,1-Dichloroethene
PCE – Tetrachloroethene TCE – Trichloroethene 1,1,1-TCA – 1,1,1-Trichloroethane

Table 20. (Continued). Summary of Ground Water Sampling Results – 2002 to 2008
Target Chlorinated Volatile Organic Compounds (in µg/L)

Monitoring Locations	Date	PCE	TCE	c-1,2-DCE	1,1-DCE	1,1,1-TCA
NJ GWQS		**1.0**	**1.0**	**70.0**	**2.0**	**30.0**
MW-25	11/21/2002	0.90 J	< 0.6	4.21	< 0.6	< 0.7
	10/21/2003	0.90 J	0.5 0J	5.31NJ	0.6 J	< 0.7
	9/22/2004	0.79	<0.5	5.21 NJ	<1.2	<0.9
	11/02/2005	0.74	0.25	0.35	0.35	0.40
	9/26/2006	1.2	0.630 J	4.41 J	<0.30	<0.60
	9/25/2006	2.23	0.340 J	<0.50	<0.30	<0.60
	11/14/2007	1.38	0.68 J		<0.77	<0.62
	9/23/2008	**0.81J**	**<0.66**	**4.49 JN**	**<0.75**	**<0.52**
	12/18/2008	**1.03**	**<0.78**	**3.43 JN**	**<0.68**	**<0.70**
DSN001 - Basin	10/21/2003	0.51 J	0.15	<1.0	<1.2	<0.9
Outfall	9/22/2004	0.900 J	<0.5	<0.5	<1.2	<0.9
	11/02/2005	0.62 J	<0.5	<0.7	<0.7	<0.8
	9/26/2006	0.390 J	<0.2	<0.5	<0.3	<0.6
	11/15/2007	<0.66	<0.66		<0.77	<0.62
	9/22/2008	**<0.54**	**<0.66**		**<0.75**	**<0.52**
D-Site MG	7/29/2002	88.6	6.31	3.61 NJ	2.01 J	1.36 J
Building Sump	10/21/2003	77.5	5.76	3.81NJ	1.52	0.93J
	9/22/2004	65.4	6.63	7.08 NJ	1.52	<0.9
	11/02/2005	32.9	3.08	<0.7	<0.7	<0.8
	9/25/2006	43.2	4.36	3.13 NJ	0.76 J	<0.6
	11/15/2007	38.7	4.21		0.84 J	<0.62
	9/23/2008	**27.9**	**3.42**	**3.55 JN**	**<0.48**	**<0.52**
	12/18/2008	**21.3**	**2.19**		**<0.68**	**<0.70**
D-site Air Shaft	7/29/2002	2.88 J	< 0.8	< 0.8	< 0.8	< 0.8
Building Sump	6/18/2003	5.19	<0.8	<0.7	<0.6	<0.7
	10/21/2003	2.73	<0.3	<1.0	<1.2	<0.9
	9/22/2004	1.89	<0.5	<0.5	<1.2	<0.9
	11/02/2005	2.27	<0.50	<0.7	<0.7	<0.8
	9/25/2006	2.23	0.34	<0.5	<0.3	<0.6
	11/15/2007	2.53	<0.66		<0.77	<0.62
	9/23/2008	**1.93**	**<0.66**		**<0.48**	**<0.52**

Notes: "J" indicates a value that is greater than the MDL but lower than the lowest standard.
"N" indicates presumptive evidence of a compound.
c-1,2-DCE – cis-1,2-Dichlorothene 1,1-DCE – 1,1-Dichloroethene
PCE – Tetrachloroethene TCE – Trichloroethene 1,1,1-TCA – 1,1,1-Trichloroethane

Table 21. Summary of Ground Water Sampling Results – 2003 to 2008
Natural Attenuation Indicators (mg/L unless noted)

Location	Date	Chloride 250 mg/L	Sulfate 250 mg/L	Alkalinity	Nitrate as N 10mg/L	Ferrous Iron	Dissolved Methane	Dissolved Ethane,Ethene	pH ORP S.U., mVe*
D-12	10/20/2003	19.9	31.6	95	<0.50	<0.10	9.99		5.55, 16.3
	9/22/2004	18.1	31.3	61.7	<0.50	<0.10	0.42	0.14	5.26, 234.7
	11/02/2005	15.9	28.7	78.8	<0.50	<0.10	0.12	<0.10	5.00, 85.1
	9/26/2006	18.3	31.2	64.1	<0.50	<0.10	7.00	<0.10	5.11, 51.7
	11/14/2007	13.4	25.7	88.3	<0.50	<0.20	0.70	<0.12	5.53, 290.8
	9/22/2008	**25.7**	**11.4**	**134**	**1.95**	**<0.20**	**1.2**	**<0.12**	**5.43, 76.0**
MW-9S	10/21/2003	8.8	24	56.5	<0.5	<0.10	<0.10	<0.10	5.28, 129.3
	9/22/2004	14.4	27.8	79.6	<0.5	<0.10	<0.10	<0.10	5.48, 152.7
	11/02/2005	8.73	21.0	25.6	<0.50	<0.10	<0.10	<0.10	5.32, 57.8
	9/26/2006	10.4	22	39.3	<0.50	<0.20	<0.10	<0.10	5.49, 36.1
	11/14/2007	14.5	20	84.8	<0.50	<0.20	0.12	<0.12	6.06, 36.3
	9/24/2008	**14.0**	**21.3**	**85.4**	**<0.50**	**<0.20**	**0.12**	**<0.12**	**5.94, 80.2**
	12/18/2008	**<10.0**	**9.21**	**68.7**	**<0.50**	**<0.20**	**0.14**	**<0.12,<0.16**	**6.00, 97. 0**
	12/18/2008	**13.1**	**9.36**	**67.8**	**<0.50**	**<0.20**	**0.14**	**<0.12,<0.16**	
MW-12S	**9/22/2008**	**13.4**	**25.5**	**84.7**	**<0.50**	**<0.20**	**<0.10**	**<0.12**	**6.76, 55.4**
MW-13I	6/2003	<5.0	15.8	126	<0.5	<0.10	<0.10		
	6/2003	<5.0	15.8	132	<0.5	<0.10	<0.10		6.81,- 78
	10/20/2003		22.5	90.9	<0.50	<0.10	<0.10		6.82, 55.8
	9/22/2004		19.6	91.5	<0.50	<0.10	<0.10	<0.10	4.98, 166.9
	11/02/2005	7.31	22.1	80.8	<0.50	<0.10	<0.10	<0.10	6.23, 7.4
	9/26/2006	9.43	21.8	91.9	<0.50	<0.20	<0.10	<0.10	5.82, -4.5
	11/14/2007	8.79	18.6	101	<0.50	<0.20	<0.10	<0.12	6.65, 3.7
	9/24/2008	**10.7**	**21.0**	**98.8**	**<0.50**	**<0.20**	**<0.10**	**<0.12**	**6.46, 68.8**
	9/24/2008	**10.0**	**19.7**	**102**	**<0.50**	**<0.20**	**<0.10**	**<0.12**	
MW-13S	6/2003	9.0	18.7	60.1	<0.50	<0.10	9.71		6.62, 6.2
MW-26	10/20/2003	10.7	21.5	51.5	<0.5,	0.85	30.4		6.02,
	9/22/2004	11.7	19.9	47.	<0.5,	<0.10	21.5	<0.10	5.26
	11/02/2005	13.7, 13.8	13.8	52.2, 52.2	<0.5,<0.5	2.4, 2.4	25.1, 24.5	<0.10	5.72, 36.2
	9/26/2006	19.3	21.6	55.2	<0.50	6.0	40.9	<0.10	5.34, 45.7
	11/14/2007	25.3	19.1	140	<0.50	7.4	47.3	<0.12	5.80
	9/24/2008	**35.2**	**22.4**	**66.9**	**<0.50**	**7.3**	**74.9**	**<0.12**	**5.73, 65.0**
	12/18/2008	**37.1**	**18.5**	**57.9**	**<0.50**	**5.1**	**77.1**	**<0.12,<0.16**	**5.73, 33.4**
MW-17	10/20/2003	8.70	21.6	20.2	<0.50	0.98			5.60, 15
	9/22/2004	7.5	19.2	20.9	<0.50	<0.10	0.25	<0.10	4.93, 101.3
	11/02/2005	8.93	20.1	19.7	<0.50	<0.10	2.15	<0.10	4.72, 66.5
	9/26/2006	11.7	21.8	15.5	<0.50	<0.20	0.97	<0.10	4.54, 14.1
	11/14/2007	11.1	21.9	19.6	<0.50	<0.20	1.0	<0.12	5.49, 191.9
	9/23/2008	**14.2**	**23.3**	**14.1**	**<0.50**	**<0.20**	**1.0**	**<0.12**	**5.28, 154.0**
	12/18/2008	**15.0**	**23.9**	**16.4**	**<0.50**	**<0.20**	**0.24**	**<0.12,<0.16**	**5.69, 55.5**
MW-18	6/2003	<5.0	27.7	20.4	0.18	<0.10	<0.10		5.42, -113
	10/202003	8.00	24.4	25.3	<0.50	<0.10	2.09		5.74, 4.6
	9/22/2004	6.70	22.4	21.9	<0.50	<0.10	0.48	<0.10	4.84, 75.7
	11/03/2005	8.65,6.61	24,29.7	16.119.7	<0.50<0.5	<0.20<0.	1.14<0.10	<0.10<0.10	4.62, 95.2
	9/26/2006	19.2	21.6	55.6	<.0.<0.50	<<0.10	58.2	<0.10	4.53, 20.7
	11/14/2007	7.47	20.7	23.4	<0.50	<0.20	1.2	<0.12	5.67, 204.2
	9/23/2008	**8.35**	**23.4**	**23.9**	**<0.50**	**<0.20**	**1.2**	**<0.12**	**5.36, 141.3**
	12/18/2008	**20.7**	**27.4**	**17.7**	**<0.50**	**<0.20**	**<0.10**	**<0.12,<0.16**	**5.80, 49.7**
MW-19I	6/2003	24.4		45.6	0.750	<0.10	<0.10		6.98, 104.1
	10/21/2003	27	13.7	44	0.900	<0.10	<0.10		5.73, 187.8
	9/22/2004	28.9	12.3	45.8	0.87	<0.10	<0.10	<0.10	5.7, 180.2
	11/03/2005	32.4	11.0	38.4	0.85	<0.10	<0.10	<0.10	5.46, 69.8
	9/26/2006	41.5	11.8	34.6	1.05	<.20	<0.10	<0.10	5.07, 14.6
	11/14/2007	45.7	9.41	41.9	0.89	<0.20	<0.10	<0.12	5.87, 333.7
	9/23/2008	**52.0**	**9.81**	**35.0**	**1.03**	**<0.20**	**<0.10**	**<0.12**	**6.36, 39.6**

*Note: pH is measured in Standard Units (S.U.) and ORP is oxidation-reduction potential in milli Volts electric.

Table 21 (continued) Summary of Ground Water Sampling Results – 2003 to 2008
Natural Attenuation Indicators (mg/L unless noted)

Location	Date	Chloride 250 mg/L	Sulfate 250 mg/L	Alkalinity	Nitrate as N 10mg/L	Ferrous Iron	Dissolved Methane	Dissolved Ethane,Ethene	pH ORP SU, mVe*
MW-19S	6/2003	5.72	30.9	19.4	<0.50	<0.10	<0.10		4.97,42
	10/21/2003	6.00	29.1	<2.0	<0.50	<0.10	1.97		4.9, 177.99
	9/22/2004	5.99	19.0	23.9	<0.50	4.30	3.98	<0.10	4.47, 187.7
	11/03/2005	5.65	27.3	21.7	<0.50	<0.10	<0.10	<0.10	5.46, 69.8
	9/26/2006	7.39	27.8	21.6	<0.50	<0.20	10.2	<0.10	4.51, 28.5
	11/14/2007	<5.00	23.0	15.6	<0.50	<0.20	2.30	<0.12	5.41, 330.5
	9/23/2008	**5.71**	**2.59**	**14.8**	**<0.50**	**<0.20**	**0.36**	**<0.12**	**5.92, 56.9**
	12/18/2008	**15.0**	**23.7**	**27.4**	**<0.50**	**<0.20**	**26.3**	**<0.12,<0.16**	**5.41, 69.3**
MW-22S	6/2003	25.0	24.7	30.1	<0.50	<0.10	<0.10		5.48,-32
	10/21/2003	24.6	22.5	<2.0	1.00	<0.10	<0.10		5.32, 15.5
	9/22/2004	23.5	21.9	11.9	0.84	<0.10	<0.10	<0.10	4.82, 148.2
	11/03/2005	33.7	18.7	<2.0	0.97	<0.10	<0.10	<0.10	5.11, 73.5
	9/26/2006	31.6	20.9	6.85	0.960	<0.20	<0.10	<0.10	4.81, 73.6
	11/14/2007	26.2	20.7	8.78	0.740	<0.20	<0.10	<0.12	5.25, 82.4
	9/23/2008	**40.4**	**19.6**	**5.58**	**0.990**	**<0.20**	**<0.10**	**<0.12**	**5.74, 63.1**
MW-23S	6/2003	<5.0	57.8	4.4	<0.50	<0.10	<0.10		4.49, 8
	10/21/2003	13.4	56.2	<2.0	<0.5	<0.10	<0.10		4.65, 201.1
	9/22/2004	7.62	53.3	10.9	<0.5	0.75	<0.10	<0.10	4.53, 159.9
	11/03/2005	6.98	57.2	<2.0	<0.50	<0.10	<0.10	<0.10	4.31/104.8
	9/26/2006	8.69	51.6	11.5	<0.50	<0.20	<0.10	<0.10	4.33, 22.2
	11/14/2007	6.31	43.4	7.63	<0.50	<0.20	<0.10	<0.12	5.27, 319.4
	9/24/2008	**6.54**	**46.4**	**9.89**	**<0.50**	**<0.20**	**<0.10**	**<0.12**	**5.83, 60.5**
MW-24S	6/2003	<5.0	16.5	31	<0.50	<0.10	<0.10		6.72, 106.8
	10/21/2003	<5.0	14.2	<2.0	<0.5	<0.10	<0.10		5.27, 21.2
	9/22/2004	<5.0	13.5	7.96	<0.5	<0.10	<0.10	<0.10	4.55, 160.1
	11/02/2005	<5.0	13.3	<2.0	<0.50	<0.10	<0.10	<0.10	5.2, 73.6
	9/26/2006	5.49	14.1	9.53	<0.50	<0.20	<0.10	<0.10	4.96, 65.6
	11/14/2007	5.82	14.4	15.9	<0.50	<0.20	<0.10	<0.12	5.36, 371.6
	9/23/2008	**6.23**	**14.0**	**11.5**	**<0.50**	**<0.20**	**<0.10**	**<0.12**	**5.18, 163.3**
MW-25	6/2003	218	14.2	73.7	<0.50	0.46	6.48		6.32, -12.2
	10/21/2003	197	16.1	74.7	<0.5	0.39	16.0		6.01, 50.6
	9/22/2004	199	14.2	67.7	<0.5	<0.10	7.25	0.2	5.47, 2.8
	11/02/2005	175	17	67	<0.50	<0.40	7.89	0.12	5.62, 31.6
	9/26/206	171	19.5	73	<0.50	0.47	9.96	0.18	5.52, -10.2
	11/14/2007	136	19.9	74.5	<0.50	<0.20	6.2	<0.12	6.18, 144.0
	9/23/2008	**123**	**22.3**	**80.5**	**<0.50**	**<0.20**	**8.4**	**0.14**	**5.97, 142.0**
	12/18/2008	**268**	**21.5**	**76.1**	**<0.50**	**<0.20**	**1.7**	**<0.12,<0.16**	**6.09, 34.4**
D-Site MG Building Sump	6/2003	95.1	21.7	109	1.00	<0.20	1.34		
	10/21/2003	53.9	33.9	79.8	<0.5	0.46	3.62		
	9/22/2004	99.5	18.9	112	<0.5	<0.10	5.99	<0.10	
	11/02/2005	126	19.5	116	0.84	0.39	7.64		
	9/26/2006	157	19.9	110	0.72	<.10	0.2	<010	
	11/14/2007	161	15.3	94.4	<0.50	0.47	8.3	<0.12	
	9/23/2008	**152**	**17.4**	**108**	**0.674**	**0.38**	**13.6**	**<0.12**	
	12/18/2008	**134**	**20.2**	**128**	**1.28**	**<0.20**	**5.7**	**<0.12,<0.16**	
D-site Air Shaft Building Sump	6/18/2003	71.1, 53.8	23.8, 31.2	98.9, 99	1.2, 1.2	<0.2,<0.1	0.20, 0.17		
	9/22/2004	49.5	27.5	95.5	0.93	<0.10	0.16	<0.10	
	11/02/2005	82.6	25.7	98.5	1.35	<0.10	0.18		
	9/26/2006	97.5	22.3	113	1.21	<.010	4.12	<.10	
	11/14/2007	91.2	18.8	120	1	<0.20	<0.10	<0.12	
	9/23/2008	**88**	**19.9**		**1.17**	**<0.20**	**<0.10**	**<0.12**	
DSN001	6/2003	19.4	6.8	33	<0.50	<0.20	3.44		
	10/21/2003	53.9	29.2	79.8	1.00	<0.10	<0.10		
	9/22/2004	46.4	37.7	91.5	0.770	<0.10	<0.10	<0.10	
	11/02/2005	93.2	30.0	74.9	1.45	<0.10	0.41		
	9/26/2006	91.6	27.1	87.4	0.93	<0.10	0.21	<0.10	
	11/14/2007	87.9	17.9	102	0.87	<0.20	0.31	<0.12	
	9/22/2008	**89.4**	**20**	**114**	**0.89**	**<0.20**	**2.3**	**<0.12**	

*Note: pH is measured in Standard Units (S.U.) and ORP is oxidation-reduction potential in milli Volts electric.

Table 22. Quality Assurance Data for Radiological and Non-Radiological Samples for 2008

Laboratory, Program, and Parameter	Reported Value	Actual Value	Acceptance Range	Acceptable Not acceptable
ERA (picoCuries/Liter)				
RAD 73	12,534	12,000	10,400-13,200	Acceptable
RAD 75	2296	2220	1830-2460	Acceptable
April 2008				
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 2008 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 2008 WP-167				
Turbidity (NTUs)	10.34	9.08	7.66-10.3	Not acceptable
Dropped Turbidity certification				

Table 23. Waste Characterization Report Results for DSN001 Surface Water Sampling in November 2008 (all other parameters were below detention levels)

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

Appendix

C

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