

# BNLs Environmental Cleanup Program Progress

*Community Advisory Council Meeting  
March 13, 2014*



U.S. DEPARTMENT OF  
**ENERGY**

Office of  
Science


# Agenda

- History of Cleanup
- Groundwater
- Soil
- Peconic River Sediment
- Reactors
- Cost
- What Did We Learn?

# Overview

- The Laboratory is committed to protecting the environment, conserving resources, and preventing pollution – and to continually improving in those areas
- In partnership with the U.S. Department of Energy and our regulators - and thanks to more than \$560 million in DOE funding - we've made very significant cleanup progress over the past 20 years
- The community – including all of you – have played a crucial role, and your engagement and input has resulted in better solutions

Environmental, Safety, Security, and Health Policy



*This document is a statement of Brookhaven National Laboratory's (BNL) Environmental, Safety, Security, and Health (ESSH) policy. BNL is a world leader in scientific research and performs this work in an environmentally responsible and safe manner.*

*I expect every employee, contractor, and guest to take personal responsibility for adhering to the following principles:*

**Environment:** We protect the environment, conserve resources, and prevent pollution.

**Safety:** We maintain a safe workplace and we plan our work and perform it safely. We take responsibility for the safety of ourselves, coworkers, and guests.

**Security:** We protect people, property, information, computing systems, and facilities.


**Health:** We protect human health within our boundaries and in the surrounding community.

**Compliance:** We achieve and maintain compliance with applicable ESSH requirements.

**Community:** We maintain open, proactive, and constructive relationships with our employees, neighbors, regulators, DOE, and other stakeholders.

**Continual Improvement:** We continually improve ESSH performance.

*In addition to my annual review of BNL's progress on ESSH goals and adherence to this policy, I invite all interested parties to provide me with input on our performance relative to this policy, and the policy itself.*

Signed  April 15, 2013

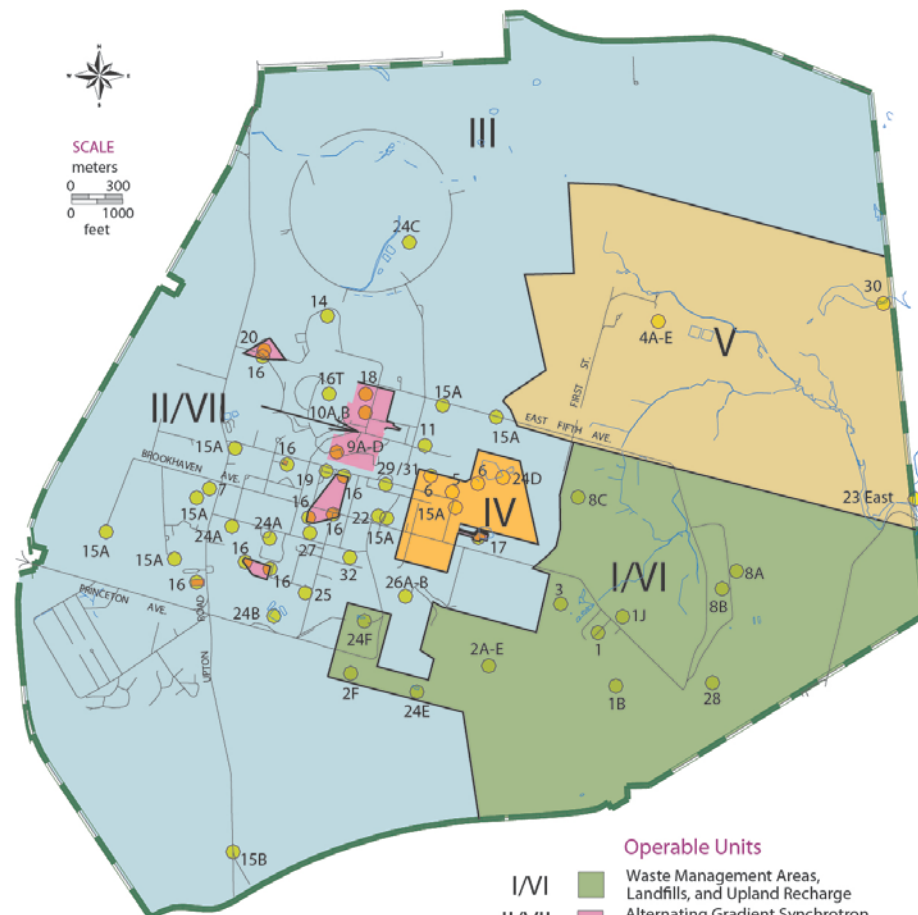
Doon Gibbs, Director

**BROOKHAVEN**  
NATIONAL LABORATORY

# History of Cleanup Program at BNL

- 1989 – Listed on Federal National Priorities (Superfund) List
- 1992 – Federal Facilities Agreement (DOE, EPA, DEC (and SCDHS) oversight) provides framework for cleanup
  - Site Investigation - 3,500 monitoring/temporary wells and 1,500 soil borings installed, Historical Site Review (interviews, review historical aerial photos, old records, etc.), Site Baseline Report completed
  - Areas of Concern – originally 24, now 32 includes groundwater, soil, sediment, reactors
  - Established a formal process for the cleanup
  - Investigate, design, construct, operate and maintain systems, reporting
  - Five-Year Reviews to ensure protectiveness

# Areas of Concern



## Operable Units and Areas of Concern

- Operable Units**
- I/VI Waste Management Areas, Landfills, and Upland Recharge
  - II/VII Alternating Gradient Synchrotron, Scrapyard, and Aerial Survey
  - III Potable and Supply Wells and Spills
  - IV Central Steam Facility
  - V Sewage Treatment Plant

- 1 Hazardous Waste Management Facility
- 1B Groundwater
- 1J Perimeter Area
- 2A-E Former/Interim Landfills, Slit Trench, and Chemical/Animal/Glass Holes
- 2F Ash Pit
- 3 Current Landfill
- 4A-E Sewage Treatment Plant (A - Sludge Drying Beds; B - Sand Filter Beds; C - Imhoff Tanks; D - Hold-Up Ponds; E - Satellite Disposal Area)
- 5 Central Steam Facility
- 6 Building 650 Sump and Sump Outfall Area
- 7 Paint Shop
- 8A Upland Recharge/Meadow Marsh
- 8B Biology Fields
- 8C Gamma Field
- 9A-D Brookhaven Graphite Research Reactor (A - BGRR Canal; B - Underground Ductwork; C - Spill Sites; D - Pile Fan Sump)
- 10 Waste Concentration Facility (WCF)
- 10A Tanks D-1, D-2, D-3 at the WCF
- 10B Underground Pipes at the WCF
- 11 Building 830 Pipe Leak
- 12 Underground Storage Tanks (not shown)
- 13 Cesspools and Septic Tanks (not shown)
- 14 Bubble Chamber Spill Area
- 15A Potable/Supply Wells
- 15B Monitoring Well 130-02
- 16 Radiologically Contaminated Surface Soils
- 16T g-2 AGS Experimental Area
- 17 Area Adjacent to Former Low-Mass Criticality Facility
- 18 AGS Storage Yards
- 19 TCE Spill Area
- 20 Particle Beam Dump, North End of Linear Accelerator
- 21 Leaking Sewer Pipes (not shown)
- 22 Old Firehouse
- 23 East Eastern Tritium Plume
- 24A Process Supply Wells 104, 105
- 24B Recharge Basin HP
- 24C Recharge Basin HN
- 24D Recharge Basin HO
- 24E Recharge Basin HS
- 24F Weaver Drive Basin HW
- 25 Heavy Machine Shop (Building 479)
- 26A-B Warehouse Area (A - Building 208; B - Former Scrapyard/Drum Storage Area South of Building 96)
- 27 Building 464
- 28 EDB Plume and Tritium Plume
- 29 HFBR Spent Fuel Pool and Tritium Plume
- 30 Peconic River
- 31 HFBR
- 32 Building 452 Freon-11

Environmental Information Management System  
MLD - 9/19/03  
Graphics/Sitewide/AOC\_Handbook-r3b

# History of Cleanup

BNL Areas of Concern		
AOC	Title	Date Completed
1	Hazardous Waste Management Facility	2005(a)
2	Former Landfill Area	2005
3	Current Landfill	1995
4	Sewage Treatment Plant	2005
5	Central Steam Facility	2004
6	Reclamation Facility Building 650 Sump	2003
7	Paint Shop	2000
8	Upland Recharge Area/Meadow Marsh	2004
9	Brookhaven Graphite Research Reactor	2012
10	Waste Concentration Facility	2005
11	Building 830 Pipe Leak	2000
12	Underground Storage Tanks	2007
13	Cesspools	2000
14	Bubble Chamber Spill Areas	2000
15	Supply/Potable Wells	2003
16	Aerial Radioactive Monitoring System Results	2007
17	Area Adjacent to Former Low-Mass Criticality Facility	1999
18	AGS Scrapyard	1999
19	TCE Spill Area, Building T-111	2000
20	Particle Beam Dump, north end of Linear Accelerator	2000
21	Leaking Sewer Pipes	2001
22	Old Firehouse (Soil Remediation Project)	2000
23	Off-site Tritium Plumes (southern and eastern)	2001
24	Process Supply Wells 104 and 105	2002
25	Building 479	2000
26	Warehouse Area	2000
27	Building 464 Area Mercury Contaminated Soil	2000
28	EDB Groundwater Contamination	2004
29	HFBR Spent Fuel Pool and Tritium Plume	2000
30	Peconic River	2011
31	HFBR	2012(b)
32	Building 452 Freon-11 Source Area and Groundwater Plume	2012

a = Phase 3 cleanup of the Perimeter Area cleanup remains.

b = Stack to be removed by 2020. Reactor vessel, thermal and biological shields to be removed after a safe storage decay period <65 years.

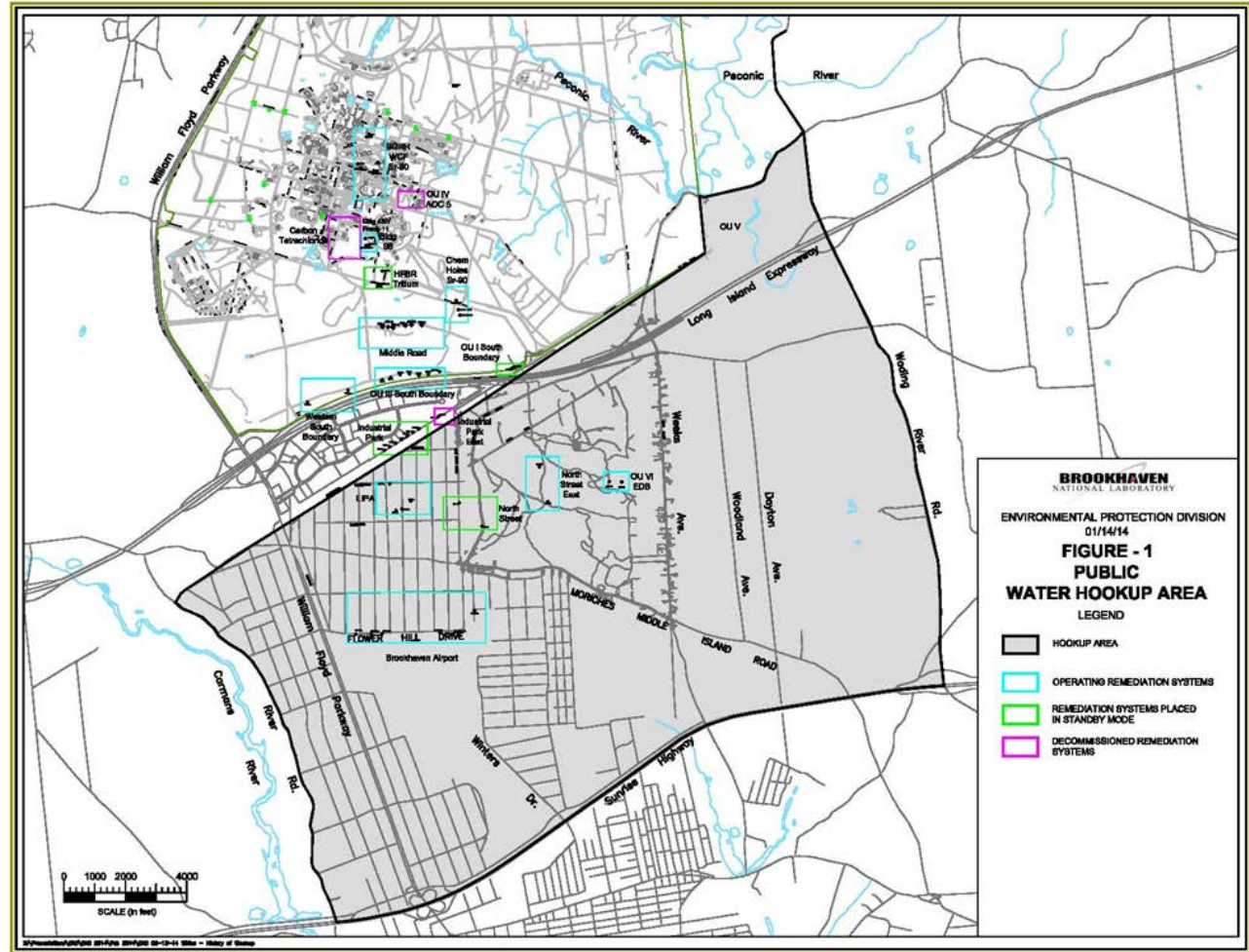
# Groundwater Cleanup

- Objective/Strategy
  - Protect human health and environment
  - Cut off plumes at site boundary, control source areas
  - Public water hook-ups as precautionary measure
  - Meet drinking water standards
- 17 treatment systems installed since 1996
  - 14 for volatile organic compounds, on and off-site
  - 3 for radiological, on-site
- Status
  - Three systems met their cleanup objective and were decommissioned (OU IV AS/SVE, Carbon Tetrachloride, Industrial Park East)
  - Four systems shut down and placed in standby mode (2013)
  - Approximately 7,000 pounds of solvents, 27 mCi of strontium-90 and 200 mCi of tritium removed from aquifer – more than 20 billion gallons of groundwater cleaned



# Public Water Hook-ups (1,500 homes 1996-1998)

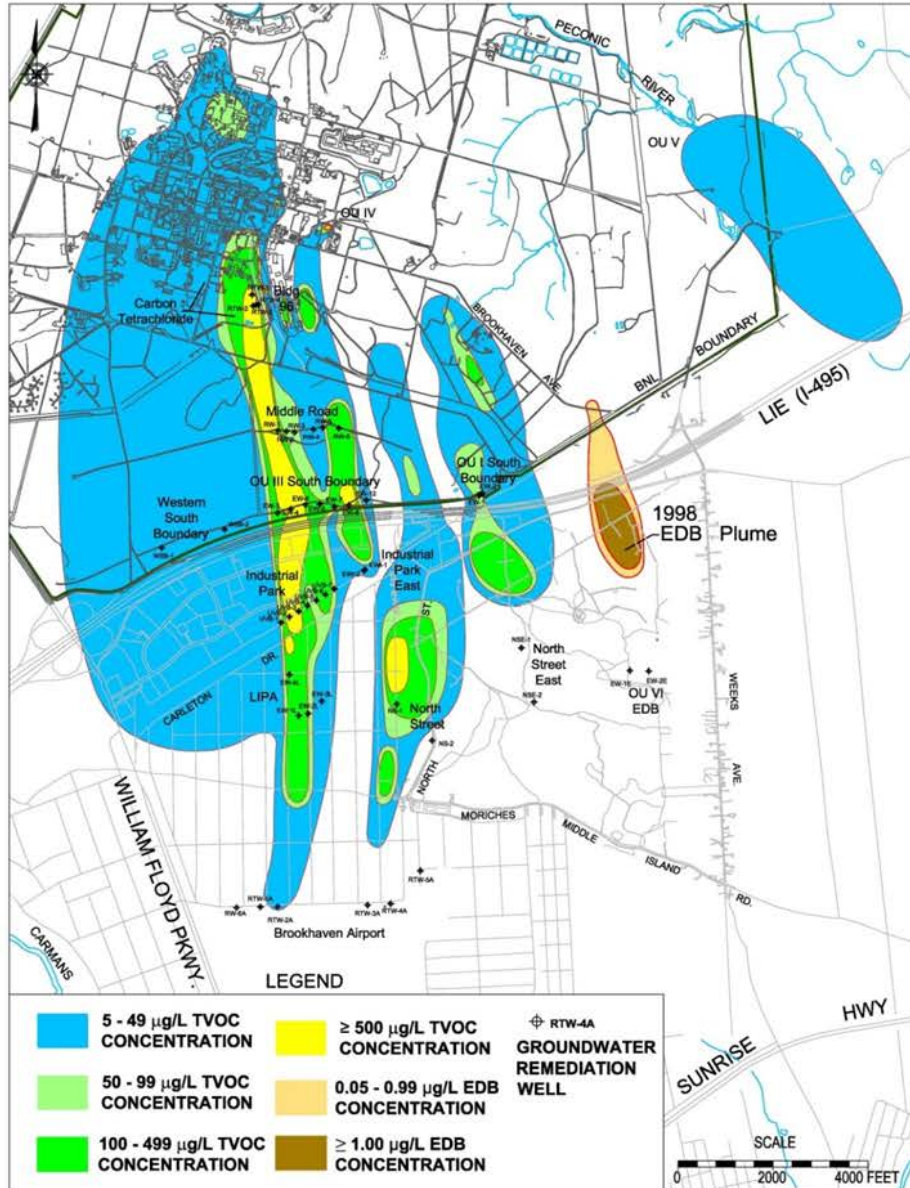
- Precautionary measure
- 800 private wells sampled by SCDHS, found no contamination attributable to BNL
- DOE offers free annual testing of remaining 7 private wells



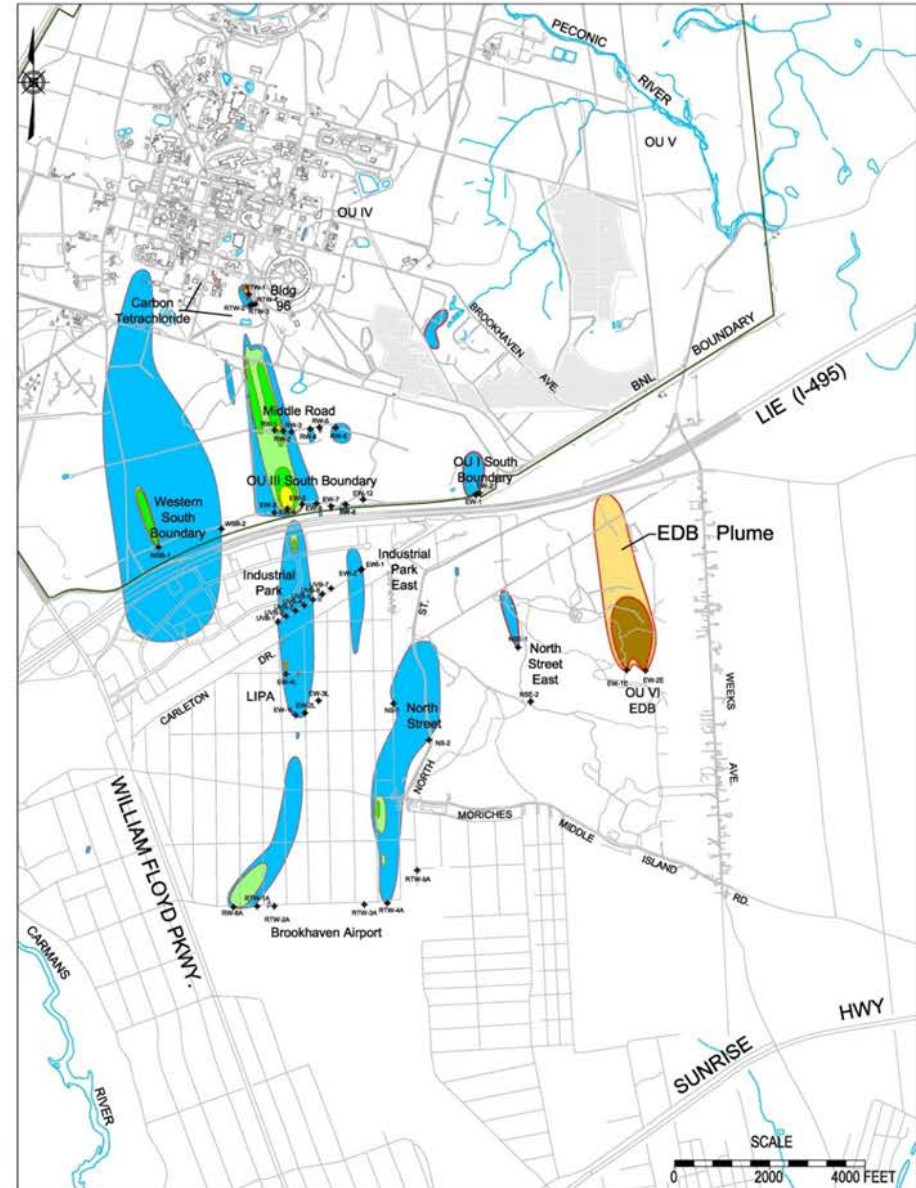


# VOC Remediation Progress 1997 to 2012

1997

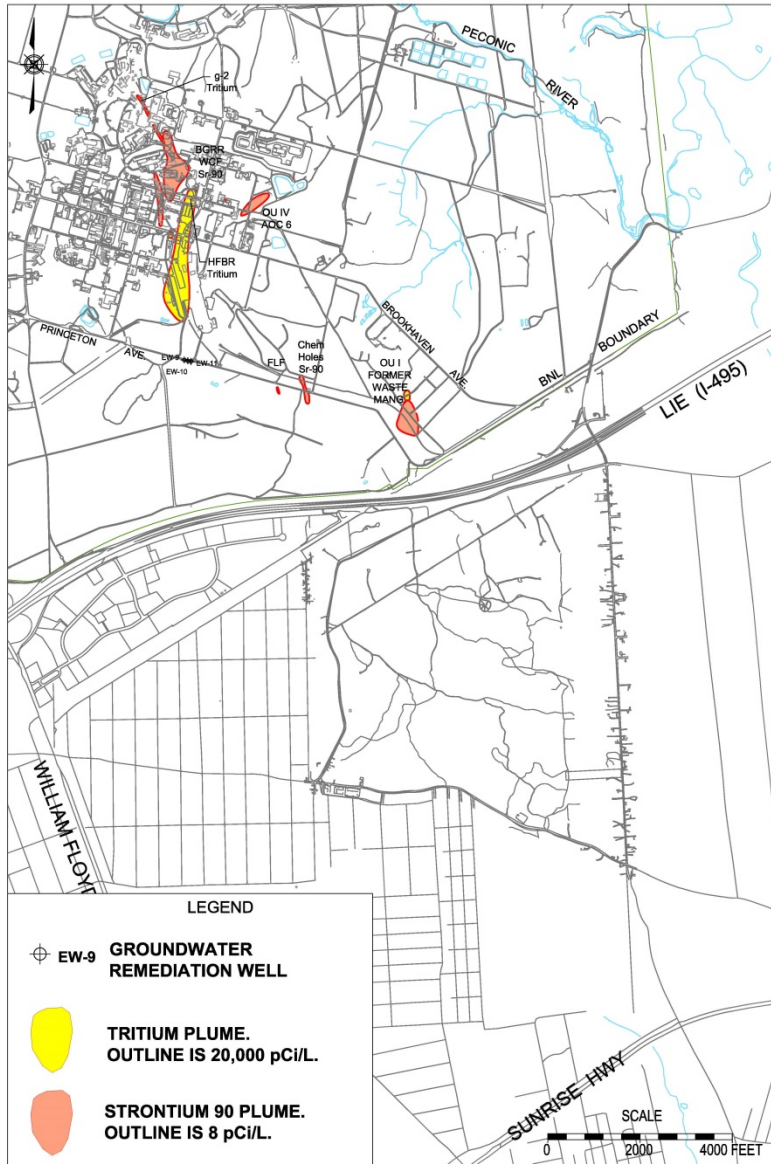


2012

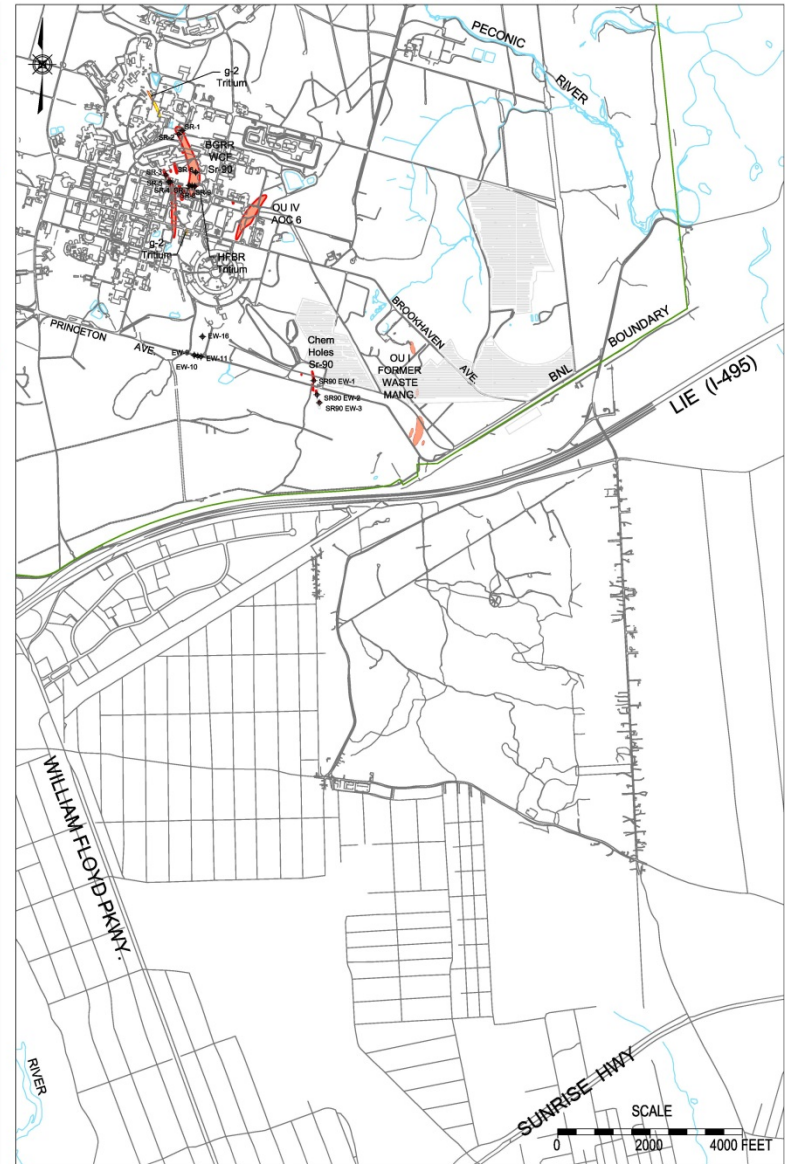


# Radiological Remediation Progress 2002 to 2012

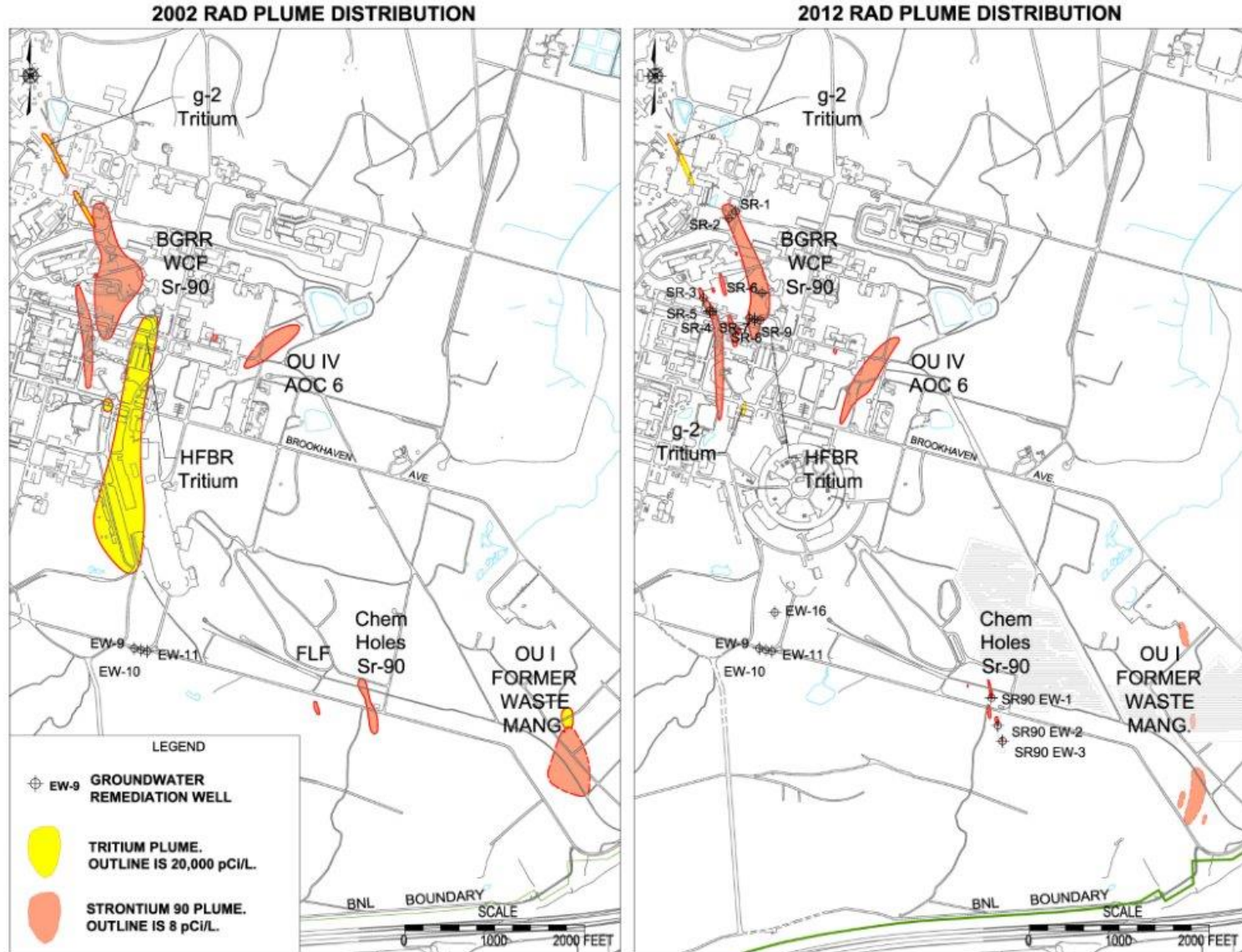
2002 RAD PLUME DISTRIBUTION



2012 RAD PLUME DISTRIBUTION



# Radiological Remediation Progress 2002 to 2012

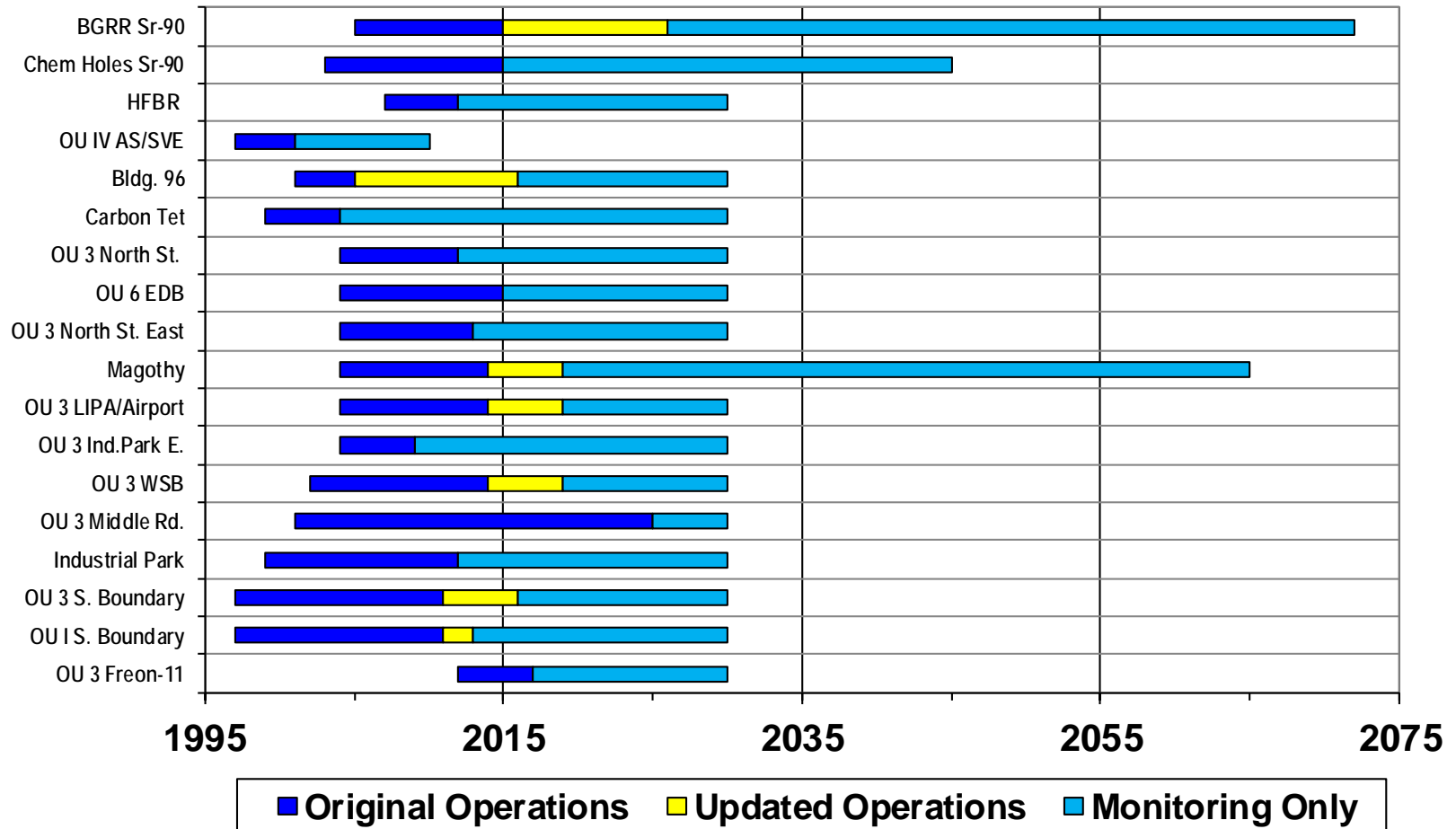


# Groundwater Cleanup

- Remediation system enhancements based on monitoring program data:
  - 12 additional extraction wells installed (1999 through 2013)
  - G-2 and BLIP Tritium Plumes identified – ROD in 2007
  - Freon-11 plume identified, treatment system installed 2012 (AOC 32)
  - Source area soil remediation at Bldg. 96
- What's left?
  - Continue to operate and maintain remaining treatment systems, monitor plumes to meet drinking water standards, maintain caps, communicate progress to stakeholders, maintain institutional controls
  - Perform Five Year Reviews, regulator and CAC input



# Groundwater Treatment System Timelines



# Soil Cleanup

- Objective/Strategy
  - Protect human health and environment
  - Remove possible sources of groundwater contamination by removal or capping
- Capped
  - 3 landfills, Ash pits
  - G-2/BLIP activated soils
  - BGRR area
- Removed Soil & Structures (55,000 cu yds)
  - Former HWMF soil and structures
  - Landscape soils
  - Waste Concentration & Reclamation Facility soils
  - Chemical pits
  - Meadow Marsh sediment
  - Above and below ground storage tanks/cesspools
  - PCB and mercury soils



# Soil Cleanup

- Additional actions taken based on surveillance and monitoring program data:
  - Removal of former hazardous waste management facility perimeter soils, Phases 1 and 2
  - Excavation of VOC-contaminated soil near Bldg. 96
  - Minor repairs to landfill caps
- What's Left?
  - Complete Phase 3 perimeter soil removal
  - Continue long term surveillance and maintenance, and maintain institutional controls
  - Perform Five Year Reviews, regulator and CAC input



# Peconic River Cleanup

- Objective/Strategy
  - Protect human health and environment
  - Mercury was driver, other contaminants co-located
  - A number of technologies were evaluated (vacuum guzzler, electrochemical, phytoremediation, excavation)
  - Strong community involvement (CAC Peconic Working Group)
  - Balanced cleanup considering ecological/sensitive habitats impact
- Excavated mercury-contaminated sediment from portions of the River on and off of BNL property
  - 2004/2005 ~21,000 cubic yards removed for off-site disposal
- Restored wetlands and met State equivalency permit and federal requirements for vegetative cover and invasive species control





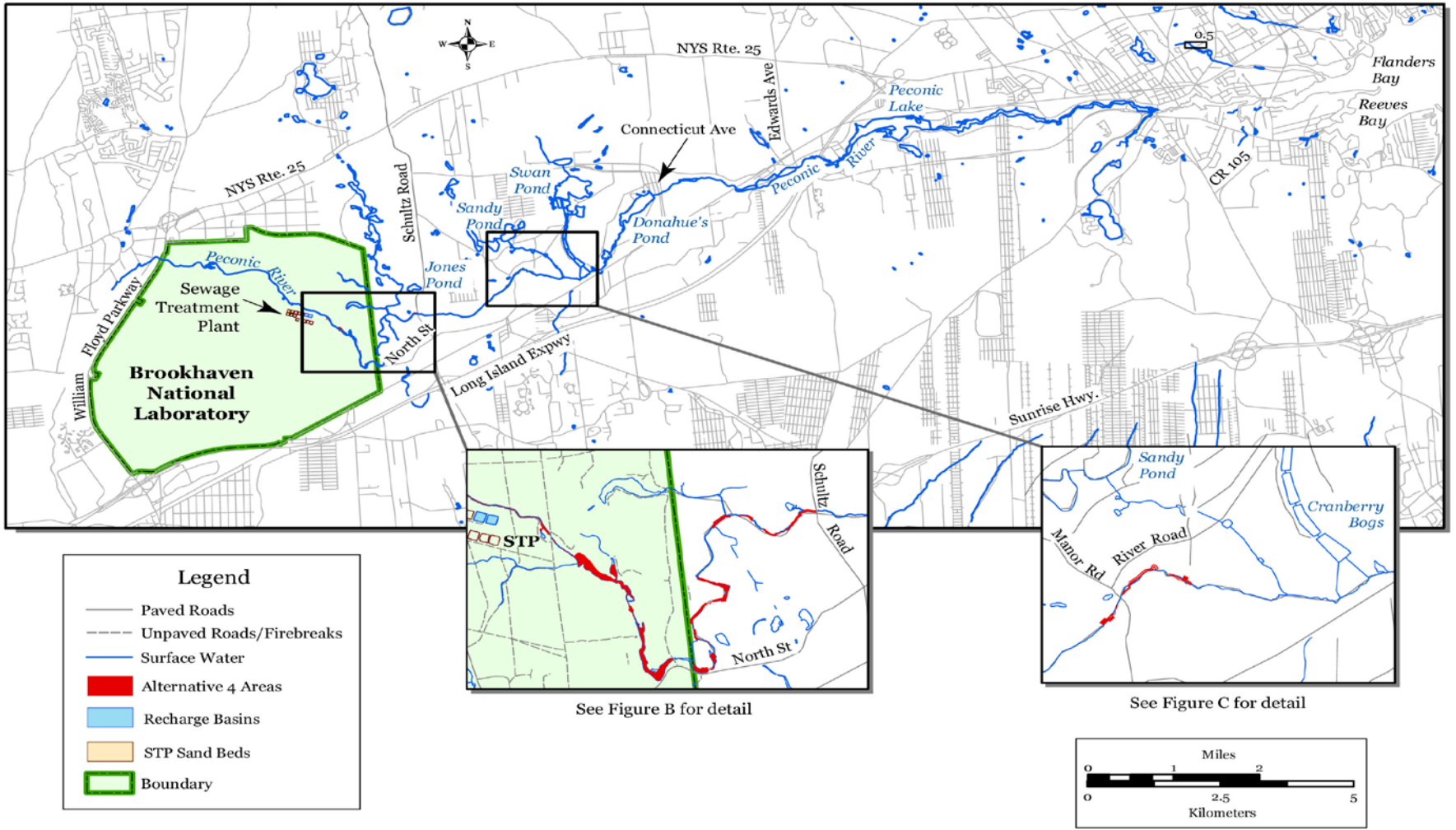


Figure A.  
The Peconic River

Reference scale for main map only

# Peconic River Cleanup

- Monitoring results
  - Overall monitoring program – 2004/2005 cleanup was effective and goals met as determined by 2,379 confirmatory samples
    - Reduced monitoring requirements following 2011 Five Year Review
  - Three small areas needed supplemental cleanup, in 2011 ~ 800 cubic yards of sediment removed for off-site disposal, sediment trap removed, wetlands restored
- What's Left?
  - Continue monitoring and control invasive species at the three areas through 2014
  - Continue to monitor sediment, surface water and fish, maintain institutional controls
  - Perform Five Year Reviews, regulator and CAC input



# Reactor Decontamination & Decommissioning - BGRR

- Objective/Strategy
  - Protect human health and environment
  - Remove possible sources of groundwater contamination by removal or capping
  - Remove ancillary structures and preserve building (as a cap)
- Removed the pile fan sump, above-ground air ducts, fuel canal, canal house, below-ground duct exhaust filters and contaminated liner
- Dismantled the graphite pile, fan house, and removed the biological shield
- Installed engineered cap and water infiltration monitoring system
- Placed building and structures in long-term safe storage - 2012

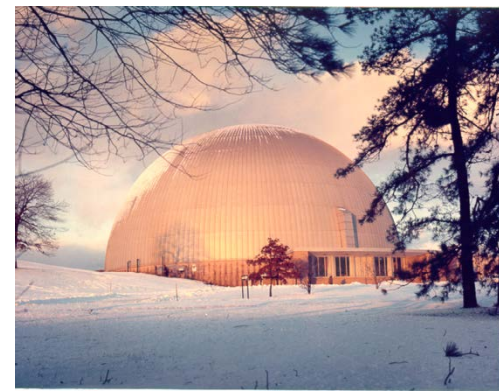


# Reactor Cleanup – BGRR

- Additional actions taken based on surveillance program:
  - Replaced windows
  - Repaired leak detection
  - Evaluating building repairs
  
- What's Left?
  - Continue long-term surveillance and maintenance of structures, cap, water infiltration monitoring, maintain institutional controls, perform Five Year Reviews



# Reactor Cleanup - HFBR



- Objective/Strategy
  - Protect human health and environment
  - Remove possible sources of groundwater contamination
  - Remove ancillary structures and preserve building
- Confinement structure and spent fuel pool were modified to meet the requirements of Article 12 of the Suffolk County Sanitary Code
- Removed spent fuel and tritiated water, control rod blades and beam plugs, waste transfer lines, underground utilities, fan houses, water treatment house, and stack silencer baffles
- Scientific equipment was removed for reuse or has been sent to an off-site disposal facility
- Placed confinement structure in long-term safe storage - 2010



# Reactor Cleanup – HFBR

- Changes made based on surveillance program:
  - Stack inspection completed 12/2013
  - Minor safety enhancements being considered for stack
- What's Left?
  - Continue long-term surveillance and maintenance of structures and grounds, maintain institutional controls, perform Five Year Reviews
  - Removal of the HFBR stack and associated components by 2020
  - Removal and disposal of HFBR reactor vessel, thermal and biological shields after a safe storage decay period <65 years (before 2072)

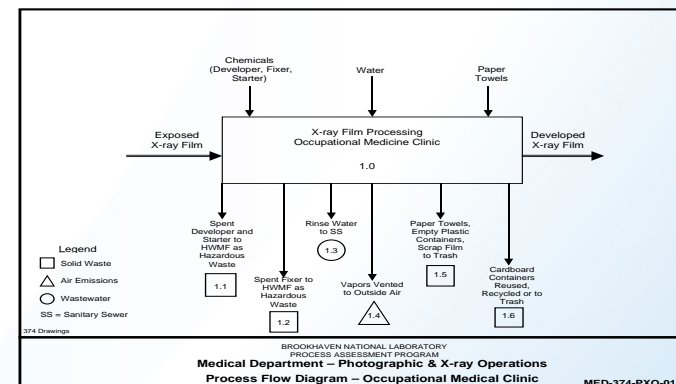


# Cost

- To date, the U.S. Department of Energy has invested approximately \$567M to complete the work
  - Groundwater/Soil/Peconic River - \$350M
  - Reactors - \$217M (includes \$71M of ARRA costs)
- Projected On-going Annual Costs
  - Groundwater/Soil/Peconic River – approx. \$6M/year includes system operations and maintenance, monitoring, project management
  - Reactors – approx. \$1.5M/year (not including HFBR stack and reactor vessel)

# What did we learn?

- Put effort up front when planning clean up
  - Comprehensive characterization performed up-front significantly helped in the performance of an effective long-term cleanup
  - Engage stakeholders early and often – and listen!
- Proactively manage environmental risks
  - ISO 14001 Environmental Management System
  - Pollution Prevention program
  - Groundwater Monitoring at facilities
  - Process Assessments
  - Occupational & Exit Readiness Reviews
- Take actions to understand and reduce risks
  - Facility Review Disposition Project
    - Inspection of every facility, cesspool, drains to ensure there were no unknown problems
  - BMRR, Bldg 650, Bldg 810/811
  - Chemistry Bldg. piping system upgrades
  - Lab clean outs
  - Source disposal



- 65 USTs removed
- 87 cesspools closed out
- Mercury inventory reduced by 77%
- 98% PCB's eliminated



# What did we learn?

- It's much easier and less expensive to prevent pollution than to clean it up!
  - 7000 lbs of VOCs removed from the aquifer at a cost of millions
  - Eliminated the use of chlorinated solvents for less than \$200K
- Proactive outreach to our environmental regulators helps build trust and cooperation
  - We continue to provide annual briefings and engage frequently with local, state, and federal regulators (monthly teleconference calls)
- Informing and engaging the community in Lab operations and decision making results in better solutions
  - CAC engagement in remediation planning, design, and execution
  - Outreach with local civic organizations
  - A foundation of transparency and trust

