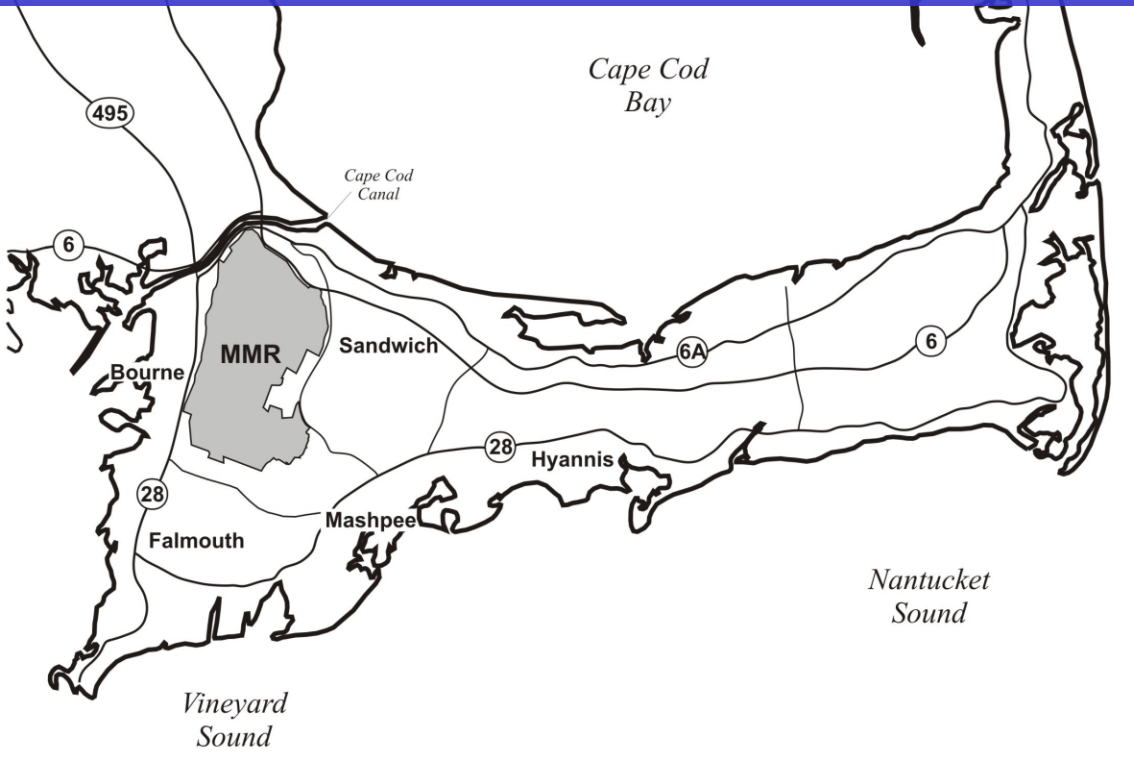


# The Installation Restoration Program at the Massachusetts Military Reservation (MMR)



The Air Force manages the Installation Restoration Program at the Massachusetts Military Reservation. The program began in 1982 and is jointly funded by the U.S. Air Force and U.S. Army.

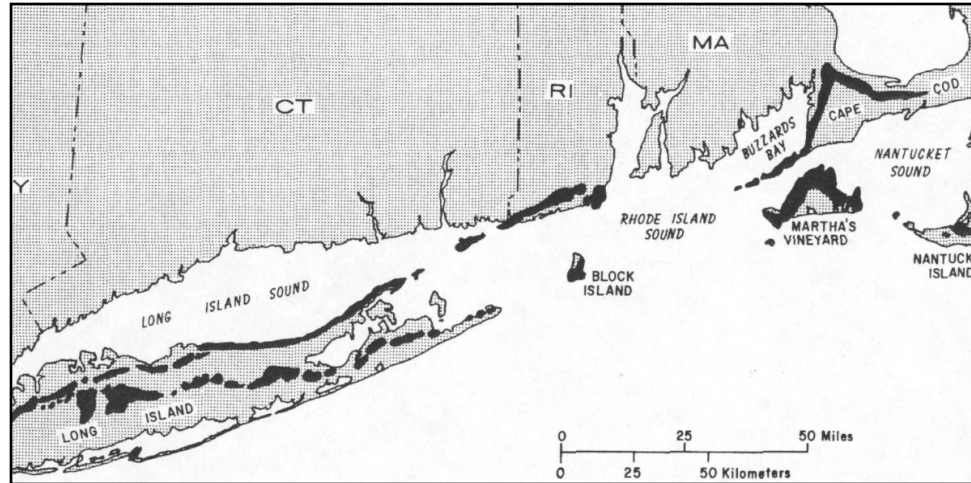
On November 2, 2009, the Air Force announced that all environmental cleanup decisions and remedies were in place for the Superfund program.



# The Installation Restoration Program at the Massachusetts Military Reservation (MMR)



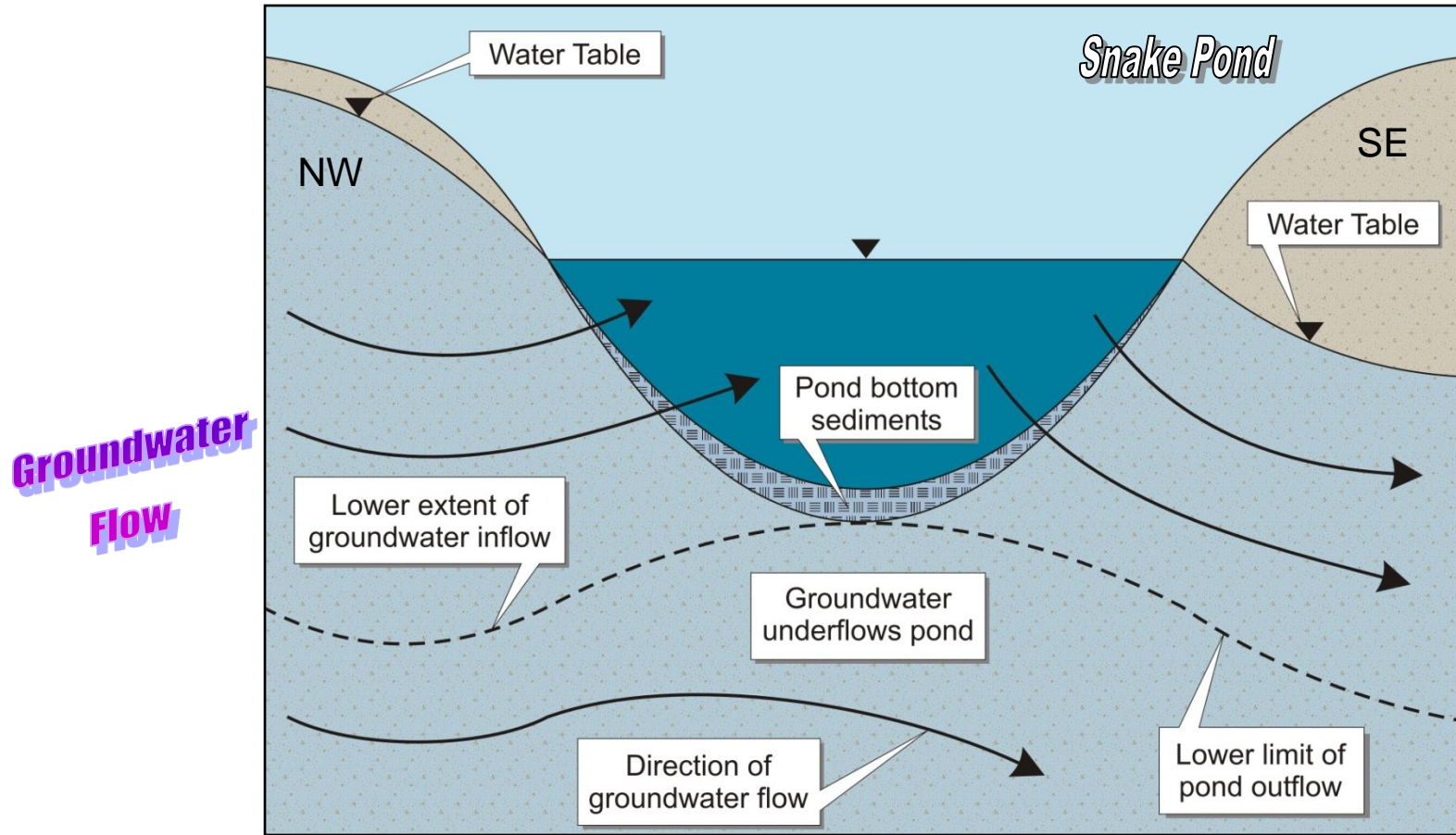
# Cape Cod Geology today



- ❖ In the Upper Cape, the geology is typically over 300 feet of sand on top of a granite **bedrock**. Some areas have silt, clay and rock deposits.
- ❖ Melted glaciers and snow fill much of the air space in the sandy soil. This area is called **groundwater**.
- ❖ Retreating glaciers also leave behind very flat areas and **kettle ponds**.

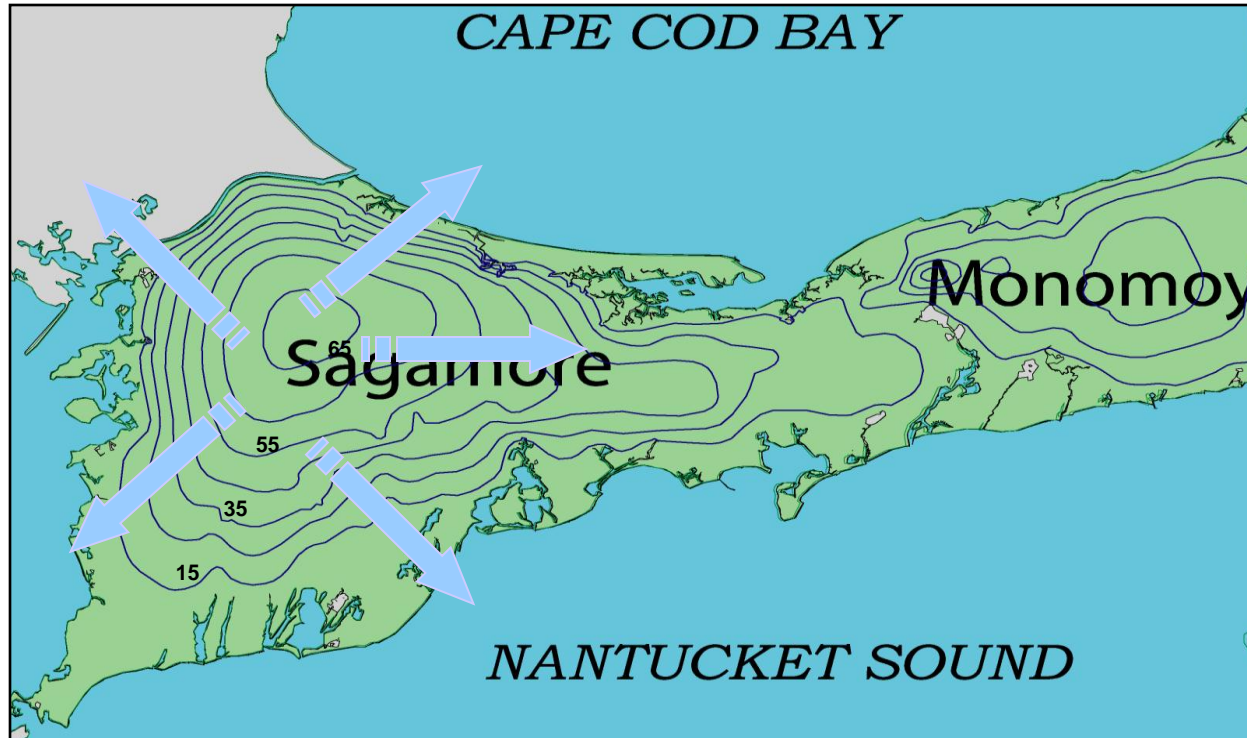


# Kettle ponds – a glacial remnant



- ❖ Ponds, such as Ashumet, Johns, and Snake are called **kettle ponds**.
- ❖ These ponds represent surface depressions where groundwater fills the area, yet continues to flow **through** the pond, at a rate of millions of gallons a day.

# Sagamore Lens

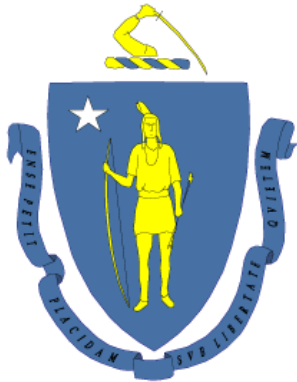


- ❖ The Sagamore Lens is the 300 feet of saturated sand (groundwater) that underlies all of the Upper Cape. This is where Upper Cape residents get their drinking water. The Town of Falmouth also uses Long Pond for drinking water.
- ❖ Groundwater flows from the top of the Sagamore Lens in all directions at about 1-2 feet per day.
- ❖ This flow is the movement of water through the sand particles. It is **NOT** a free-flowing river.

# Who oversees the AFCEC MMR cleanup project?

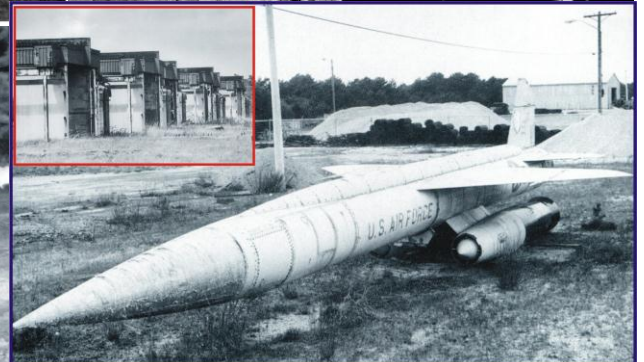
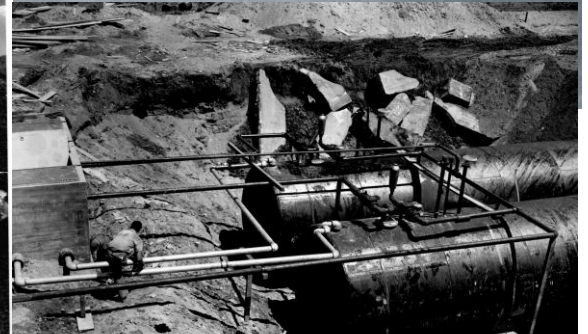


- **United States Environmental Protection Agency**



- **Massachusetts Department of Environmental Protection**
- **Massachusetts Department of Public Health**
  
- **Local Town Boards of Health**
- **Local Town Governments**
- **Volunteer committees**

# Where did the contamination at MMR come from?





- ❖ Chemical solvents
- ❖ Degreasers
- ❖ Lubricants
- ❖ Fuels
- ❖ Oils

What is a part per billion (ppb)?

It is 1 drop in 22,000 gallons

It is 1 inch in 16,000 miles

The Maximum Contaminant level is a risk based number developed by scientists at the EPA. The number, based on a particular chemical represents the  $10^6$  cancer-risk if you drank 2 liters of water a day for 70 years above the MCL.

❖ Solvents and degreasers:

❖ TCE = 5 ppb

❖ PCE = 5 ppb

❖  $\text{CCl}_4$  = 5 ppb

❖ 1,2 DCE = 70 ppb

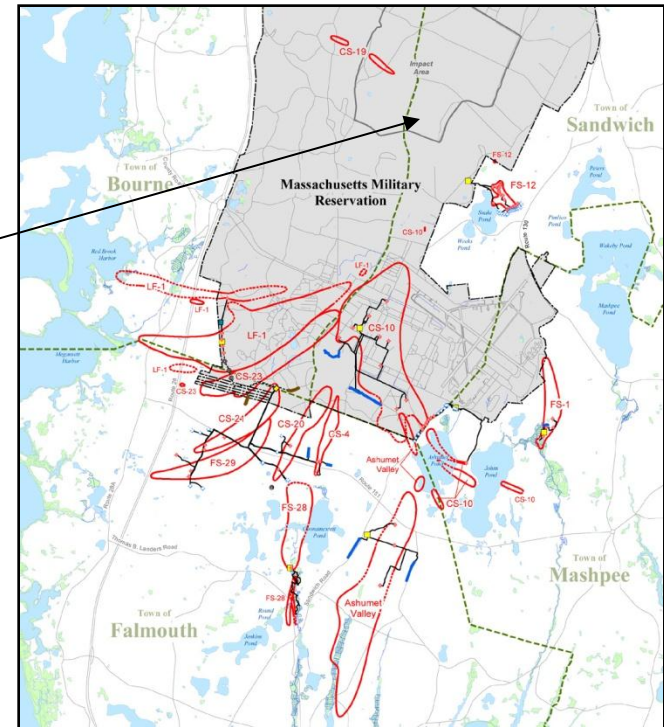
❖ Fuel-related:

❖ EDB = 0.02 ppb



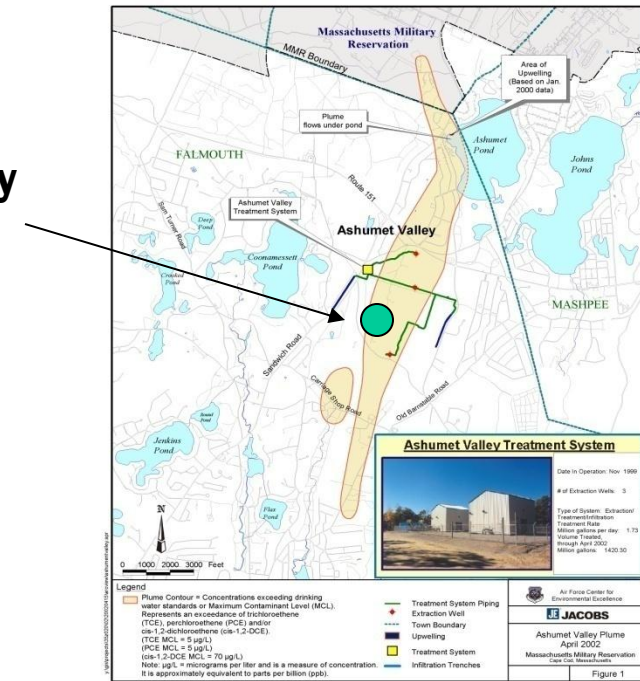
# The BIG PROBLEM!

The military base is located on the high spot of the Sagamore Lens where water flows in all directions. Past practices lead to fuels and cleaning solvents getting into the soil and eventually the groundwater, causing groundwater plumes. Much of the groundwater pollution has moved beyond base boundaries and underneath the surrounding communities.



# Early Community Reaction (1978-1990)

- In 1978, contamination was detected in a town of Falmouth water supply well, located over 1.5 miles away from MMR.
- There was mistrust and concern in the community, and virtually no opportunities for the public to be informed and involved in the process.



- The only advisory committee at the time was closed to the media and general public.
- Sampling of local private drinking water wells begins, with some having MMR-related detections of contaminants in them.
- MMR added to the National Priorities List (Superfund)



Residents were afraid and concerned about the safety of their drinking water and area ponds, elevated cancer rates, and property values.



Homeowners in Falmouth receive a notice from the Air Force that their private wells may be contaminated, need to be tested, and bottled water is being delivered as a precaution



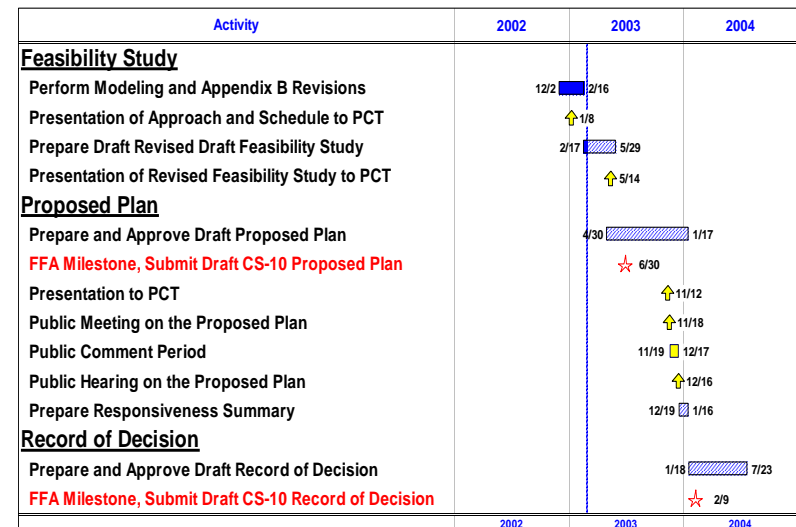
Residents place a sign where contamination was in the Coonamessett River, Falmouth

# The “word gets out” about MMR (1990-1996)

- The first community involvement plan was implemented in **1991**, which laid the groundwork for improving the relationship between the military and the community.
- The first-ever citizen advisory team was created in **1991**. It was made up of local citizen volunteers to advise the military on what should be done about testing local recreational ponds near the MMR.
- In **1991**, the Federal Facility Agreement between the Air Guard and U.S. EPA brought structure, time-lines and accountability to the process.
- By **1995**, Plume Response Plan issued by citizen advisory team and endorsed by DoD.



## CS-10 - Groundwater Operable Unit





## AFCEC's goals

- **Conduct cleanup of sole-source aquifer quickly**
- **Establish community-based program**
- **Develop a collaborative process in conjunction with regulatory agencies**
- **Regain public trust, by obtaining their approval of the process**

## versus what AFCEC was up against...

- **Negative public perception**
- **Extensive media coverage**
- **Intense political/regulatory reaction**



## What did AFCEC do to turn the tables around?

- **Established Decision-Criteria Matrix Process**
- **Established better working relationship with area news media and local residents**
- **Conducted 75-100 team and neighborhood meetings per year**
- **Gave numerous tours, speaking engagements, and other events**
- **Distributed hundreds of fact sheets, news releases, and neighborhood notices**
- **Created an IRP website ([www.mmr.org](http://www.mmr.org)) with an on-line Administrative Record**



## Triumph of cooperation:

### Residents, military celebrate plume treatment operation

Thursday, September 23, 1999

By JEFFREY BURT  
STAFF WRITER

MASSACHUSETTS MILITARY RESERVATION - Thomas McCall recalled that time a year ago, when the debate was raging over how to clean up the plume of contaminated ground water known as Landfill-1.

The Air Force believed the natural processes in the ground would get rid of the pollution in the plume just as quickly as if a treatment system was built.

Residents and regulators vocally opposed the idea of letting nature take care of the plume, which stretches from the base west through Cataumet and into Buzzards Bay.

"We had a scientifically valid, lower-cost, longer-term solution with natural attenuation that the

public just didn't buy," McCall, assistant secretary of the Air Force, said yesterday.

Air Force officials and engineers regrouped and came up with a system that treated the most contaminated parts of the plume and let the rest go, a proposal more palatable to residents and regulators.

Yesterday, in a tent next to the treatment plant for LF-1, more than 50 residents and regulators, local politicians and military officials, celebrated what they called a triumph of cooperation.

"It's all about people," said Bourne Selectman Haydon Coggeshall, who was praised for his work. "It's people who got it done."

The \$10 million system - which includes treatment wells along the MMR border that remove polluted water, which is treated and then put

back into the aquifer - is designed to remove most of the contamination within 20 years.

While both natural attenuation and a treatment system would clean up the aquifer within 40 years, treatment would remove 25 percent of the contamination within the first 10.

"I think we ought to invest in that," McCall recalled telling Air Force officials.

He said before the ribbon-cutting ceremony that it was important not only to ensure that the ground water be cleaned, but to also restore people's trust in the federal government.

He also pointed out that the LF-1 system marked a significant point in the cleanup of the MMR Superfund site. Currently nine treatment systems are working, and six more

are scheduled to go on line within the next three to four years.

George Seaver, a member of the Cataumet Civic Association and one of several residents applauded for their work, said he saw the work that led to the LF-1 treatment system in two phases.

The first was from 1993 to 1998, when "the whole process was wandering in the woods." There was no clear idea of what should be done, Seaver said.

It wasn't until last year, as military engineers and local residents began discussing ideas beyond natural attenuation, that things began to jell. Natural attenuation may work, Seaver said, but people with the civic association - including many who were engineers - were concerned about "hot spots" of high levels of contamination in the

plume. This compromise system addresses both issues, he said.

"I think it happened because it became a very local process," Seaver said.

Patricia Meaney, director of the Superfund program for the federal Environmental Protection Agency's Region 1, said the LF-1 system is an example of what can happen when local residents are given enough information to make informed decisions.

Meaney also said each treatment system is a step toward a better future with a cleaner environment.

"Twenty to 30 years from now, there will be a similar ceremony," she said. "Maybe some of you, or your children, or your children's children (will be there) and you'll be celebrating the closing down of these treatment plants."

CAPE COD TIMES

CAPE COD TIMES

IN OUR VIEW

## A triumph for teamwork

■ A new ground water treatment system at the Upper Cape base is a shining example of military-community cooperation.

After more than 20 years of frustration and anger, the Upper Cape community is finally beginning to reap the fruits of its vigilance and action at the Massachusetts Military Reservation.

One such sign of this turnaround was the recent activation of yet another treatment plant that will eventually clean contaminated ground water coming from the base's landfill.

The landfill treatment system is now one of nine such systems working on the Superfund site, and six more are scheduled to go on line within the next three to four years.

That's a far cry from just three years ago when only one ground-water treatment system was operating, and that was not working properly.

The about-face is due largely in part to the Air Force Center for Environmental Excellence, which arrived on base in May 1996. The Air Force took over the cleanup program from the National Guard Bureau, which had badly managed the program ever since it set up shop in 1982.

Much credit goes to Thomas "Tad" McCall, the assistant secretary of the Air Force, who could have looked the other way in 1996 and allowed the National Guard to continue its mismanagement. Instead, McCall, at great personal and professional risk, jumped into the fray at the Upper Cape base, which by then had become one of the largest and most complex Superfund sites in New England.

McCall tapped Jim Snyder, a civilian Air Force professional, to take over the cleanup. Snyder immediately began listening to the community's concerns and has since won even the most strident activists' respect and admiration.

One such example of this teamwork between the military and the community was the landfill treatment system.

Just a year ago, the Air Force believed the natural processes in the ground would get rid of the pollution in the plume just as quickly as a treatment system.

Residents and regulators opposed the idea of letting nature take care of the plume, which stretches from the base west through Cataumet and into Buzzards Bay.

Air Force officials and engineers regrouped and came up with a system that treated the most contaminated parts of the plume and let the rest go, a proposal more palatable to residents and regulators.

It was a triumph of cooperation.

The \$10 million system - which includes treatment wells along the MMR border that remove polluted water, which is treated and then put back into the aquifer - is designed to remove most of the contamination within 20 years.

Despite recent triumphs, the community must remain vigilant in the cleanup process.

Nevertheless, Patricia Meaney, director of the Superfund program for the federal Environmental Protection Agency's New England region, said the landfill system is an example of what can happen when local residents are given enough information to make informed decisions.

It's a lesson that has not been lost on McCall and Snyder, and for that reason, they deserve something they have long sought - our community's respect and trust.

Tuesday, October 5, 1999

- **The community *is* knowledgeable *and* interested in what happens.**
- **Involve all stakeholders as early as possible.**
- **Provide the bad information with the good as soon as possible.**
- **Be open, honest and forthcoming.**
- **The implementation of many cleanup actions will not be possible without stakeholder involvement and support.**

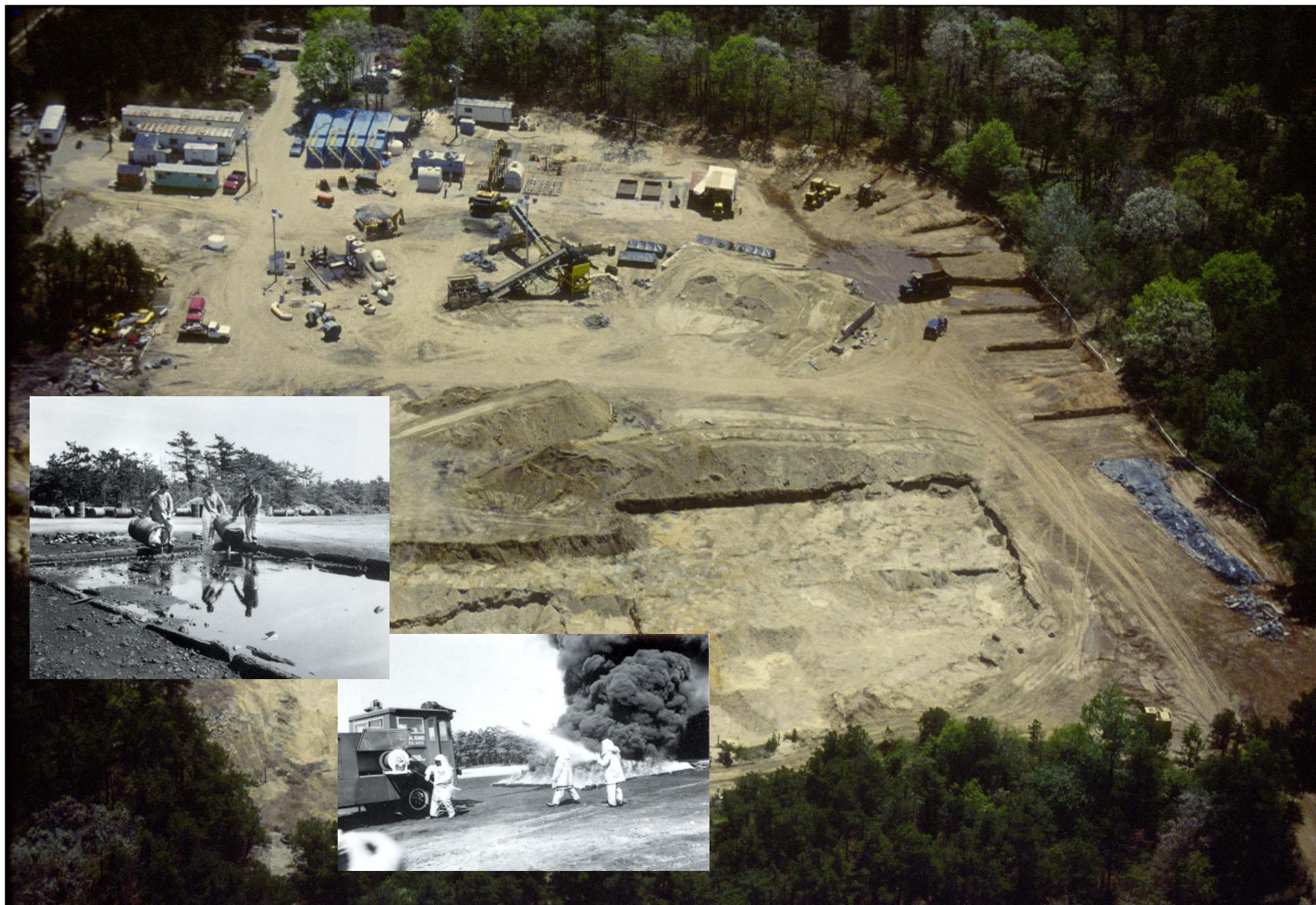
# Source areas on the Massachusetts Military Reservation



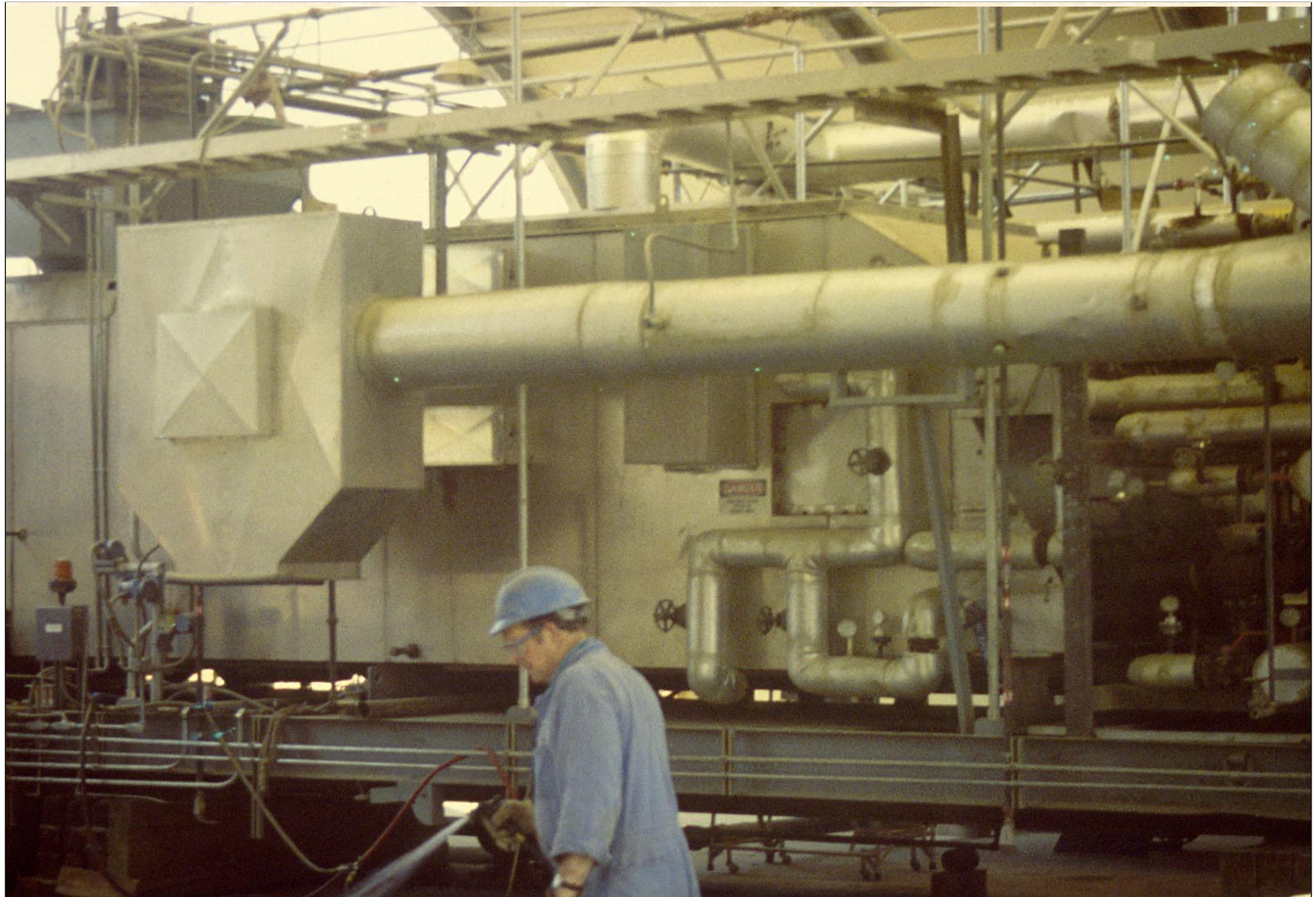
# Drum disposal procedures



# Excavation and on-site treatment of the former firefighter training area



# Close-up view of the thermal desorption plant at FTA-1



Cleaned soils after being processed in the thermal desorption unit at FTA-1



# Source areas on the Massachusetts Military Reservation





# Landfill capping



- ❖ Vegetation is stripped off the top of the landfill area to be capped



- ❖ Clean soils are added and graded to a slight incline. An impermeable liner is added and pressure tested at the seams.



# Landfill capping



- ❖ Clean soils are added above the impermeable liner, with grass seed added for slope stability.



- ❖ The landfill cap as it looks today.



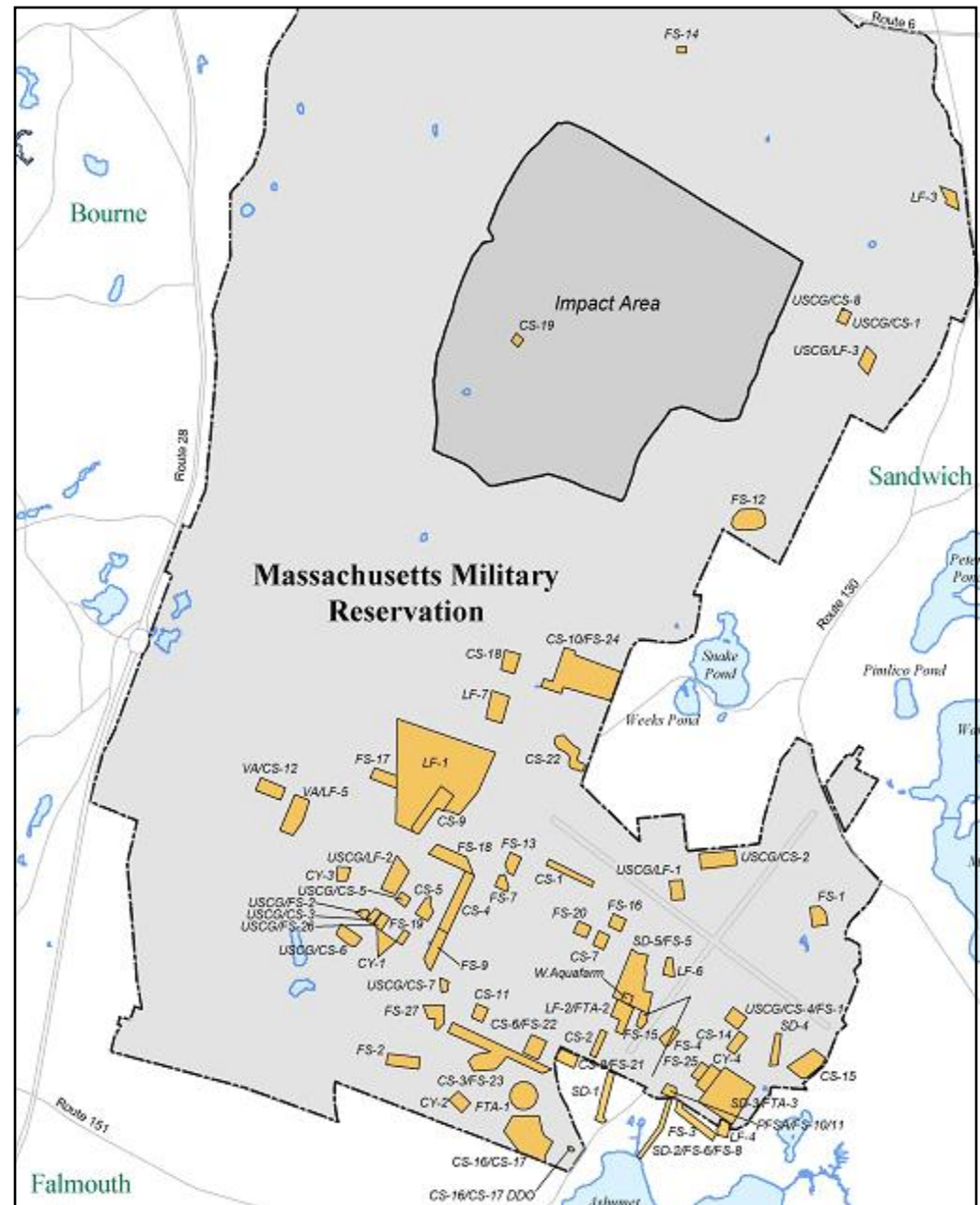
# Map of IRP source areas on the MMR

AFCEC has identified 80 source areas on the MMR. They are noted in orange on the map and include:

- ❖ Chemical Spills
- ❖ Coal Yards
- ❖ Fuel Spills
- ❖ Landfills
- ❖ Storm Drains

Investigation/cleanup completed (77)  
Monitoring (3)

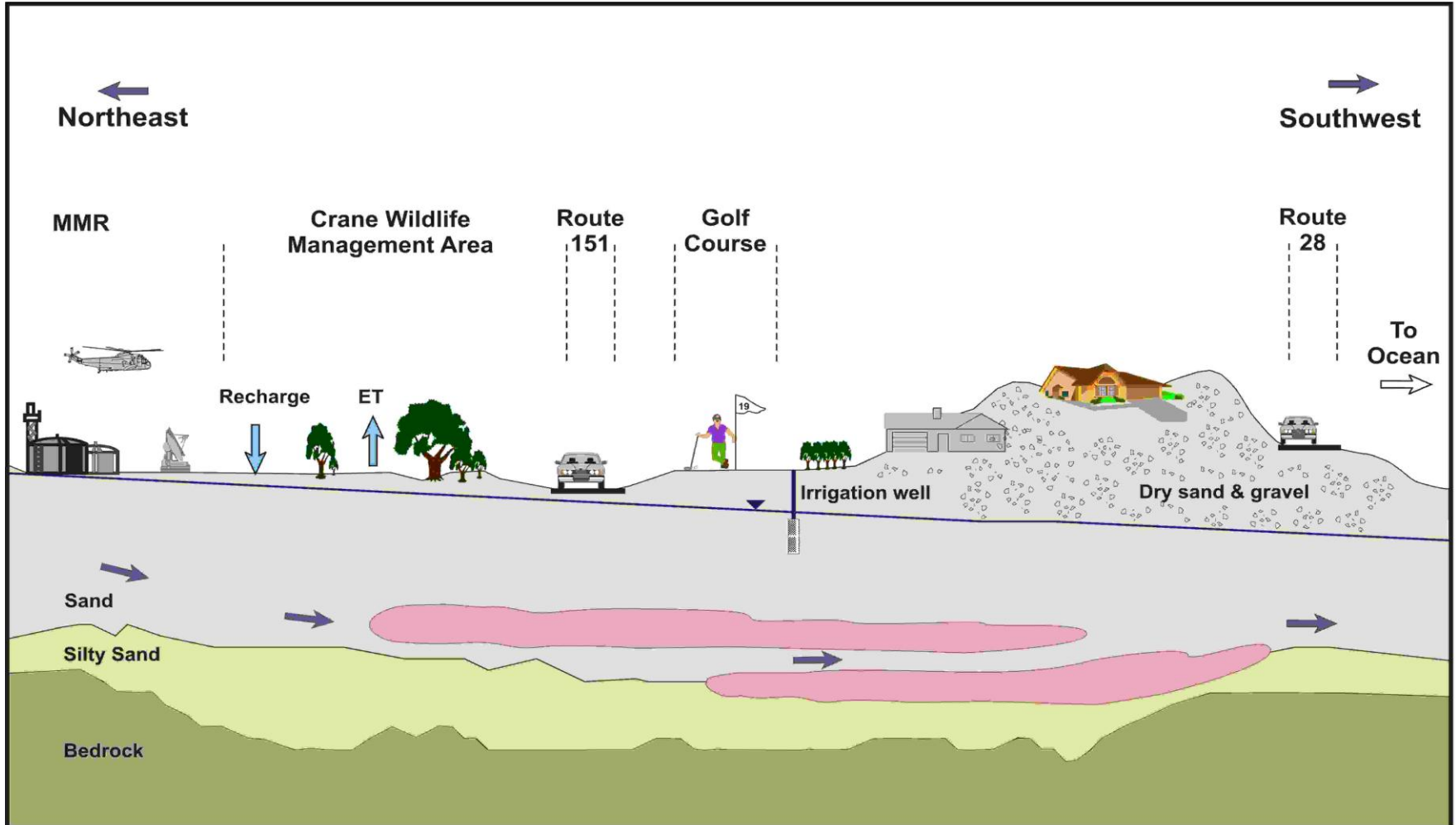
**Note:** 61 source areas were formally “delisted” from the EPA Superfund Program in late 2007



# How do we investigate groundwater contamination?



# Conceptual model



## Legend



Recharge



ET= Evaporation/Transpiration



Plumes



Groundwater Flow

**JE JACOBS**

Western SWOU  
Conceptual Model  
(Not to Scale)

Massachusetts Military Reservation  
Cape Cod, Massachusetts

4/7/04 jp FS28con2.cdr

Figure

# Groundwater plumes

Primarily PCE, TCE, and EDB

Concentrations less than 4 ppm

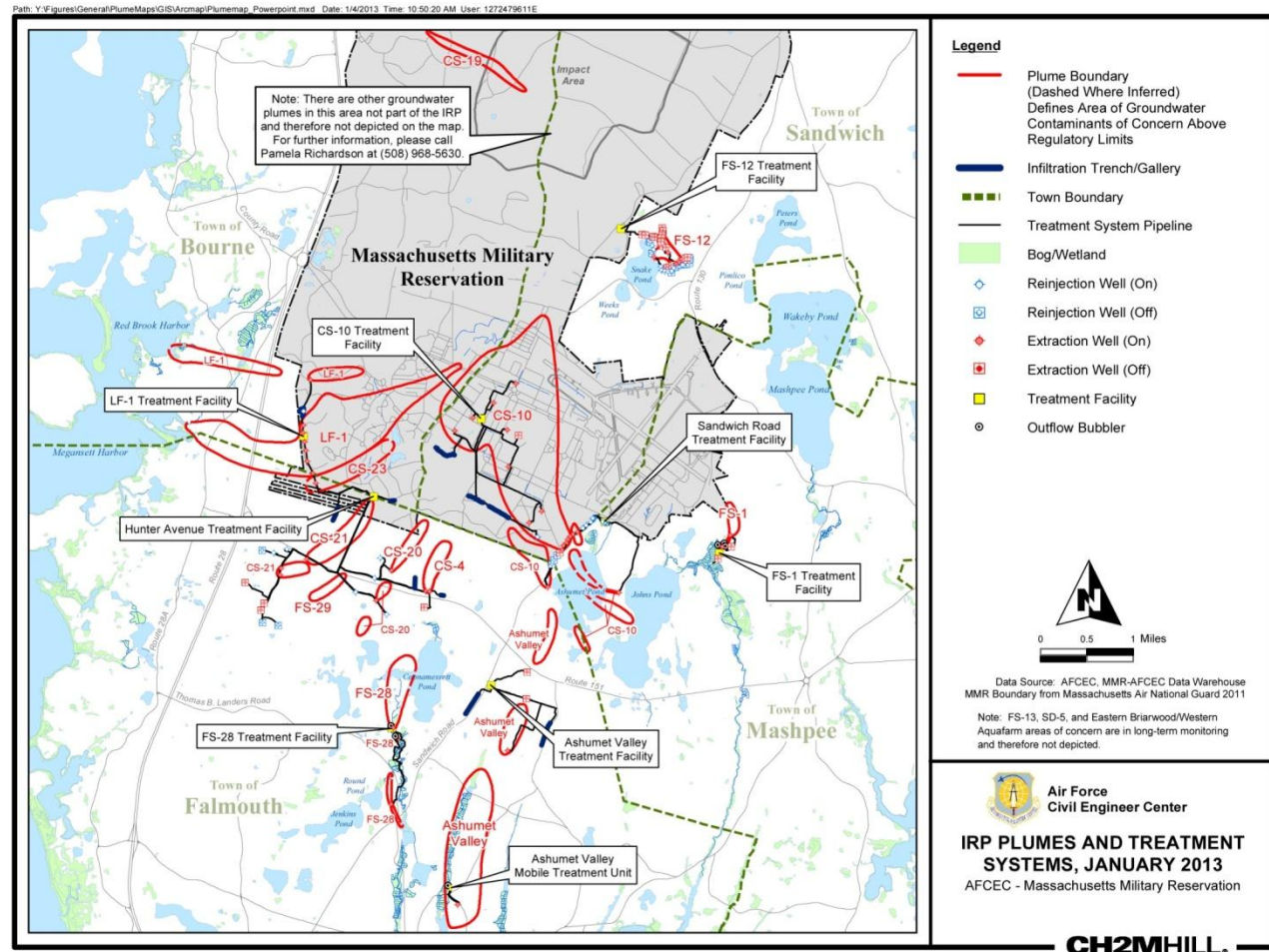
Plumes are typically deep (>100 ft) and thick (>100 ft)

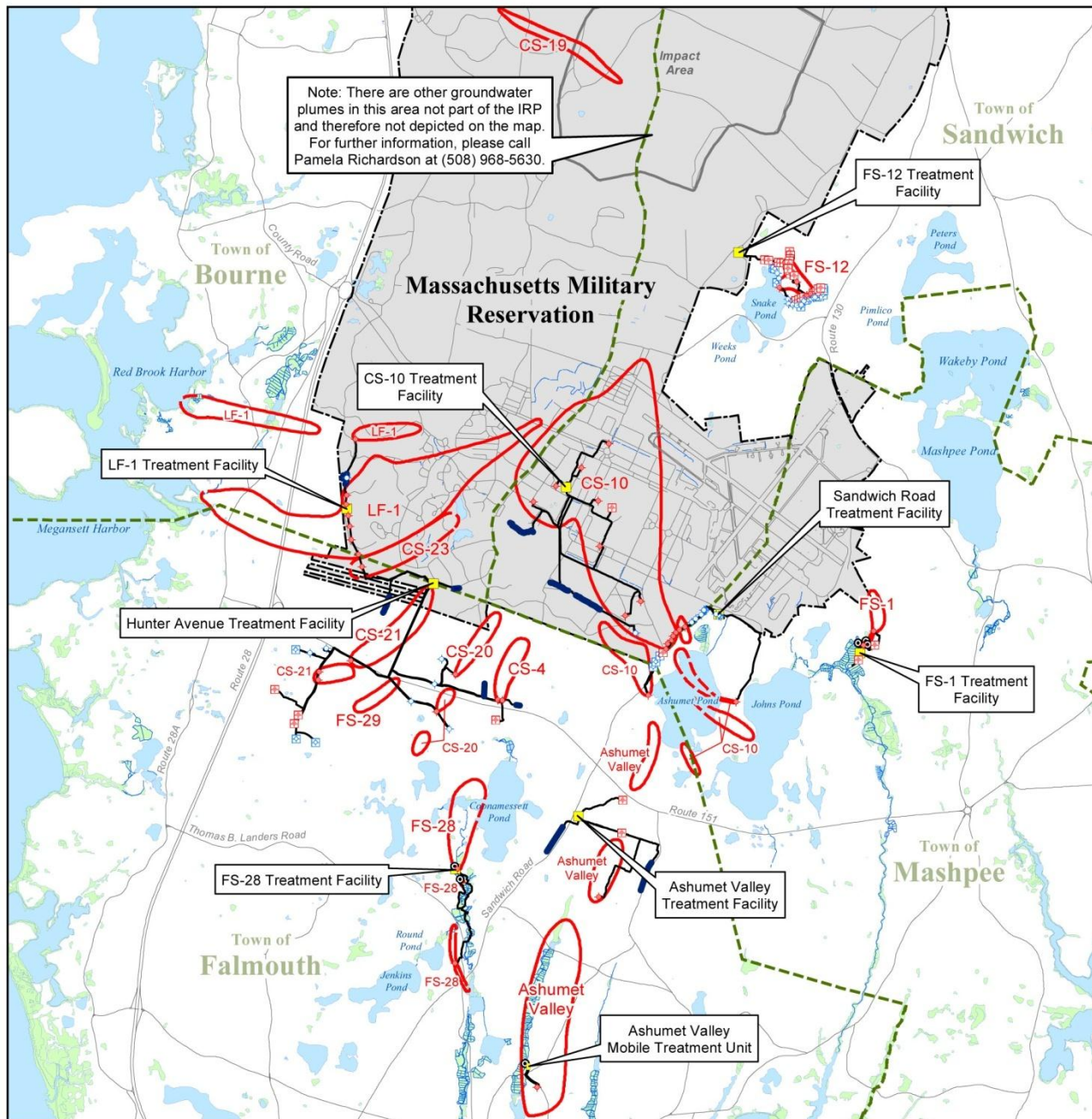
9 treatment plants treating 12.3 million gallons per day

Over 27 miles of pipeline












Over 100 pumping and reinjection wells

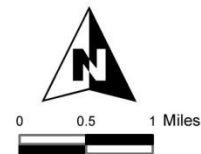
Over 3,000 mw's





**Legend**

-  Plume Boundary (Dashed Where Inferred) Defines Area of Groundwater Contaminants of Concern Above Regulatory Limits
-  Infiltration Trench/Gallery
-  Town Boundary
-  Treatment System Pipeline
-  Bog/Wetland
-  Reinjection Well (On)
-  Reinjection Well (Off)
-  Extraction Well (On)
-  Extraction Well (Off)
-  Treatment Facility
-  Outflow Bubbler



Data Source: AFCEC, MMR-AFCEC Data Warehouse  
MMR Boundary from Massachusetts Air National Guard 2011

Note: FS-13, SD-5, and Eastern Briarwood/Western Aquafarm areas of concern are in long-term monitoring and therefore not depicted.



**Air Force  
Civil Engineer Center**

**IRP PLUMES AND TREATMENT  
SYSTEMS, JANUARY 2013**

AFCEC - Massachusetts Military Reservation

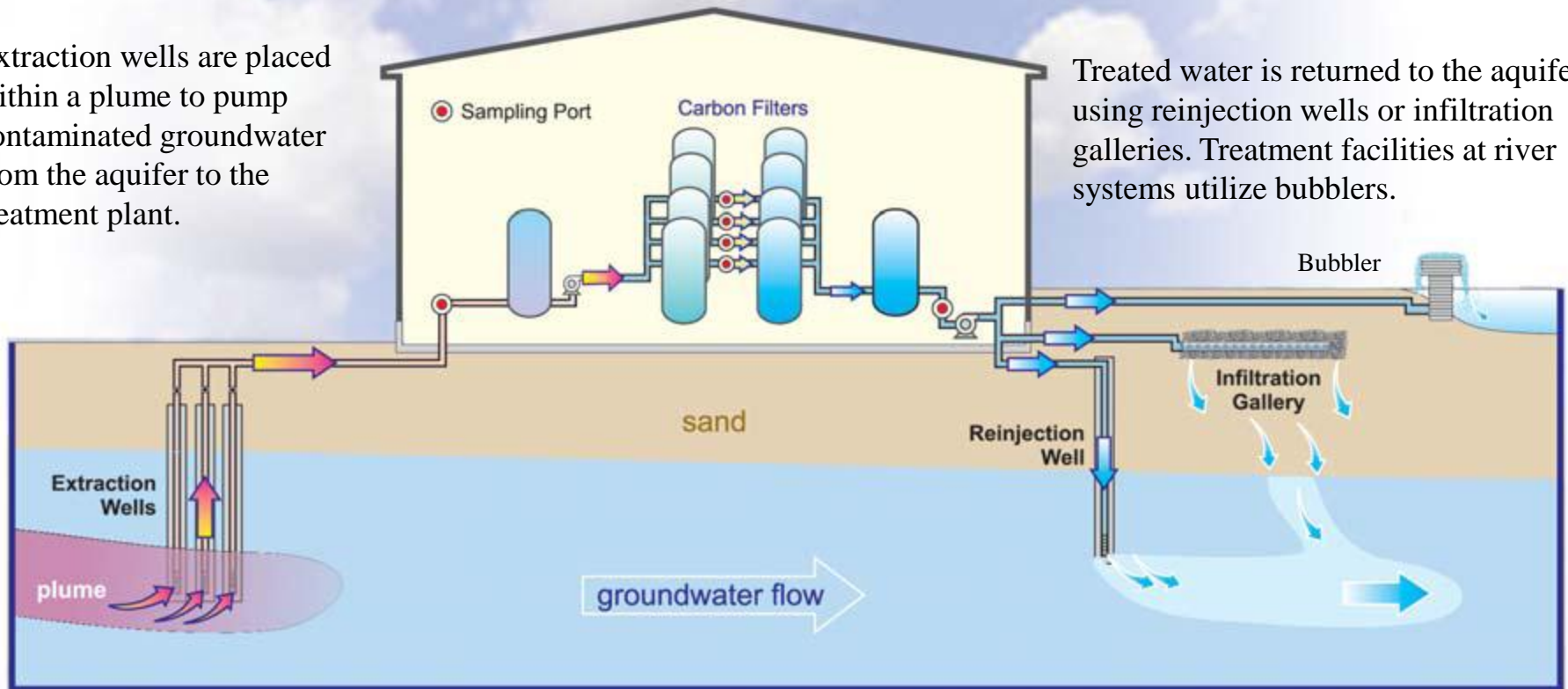
# How do the treatment plants work?

## The Groundwater Treatment Process

Treatment plants clean up extracted contaminated groundwater by filtering it through carbon held in large vessels.

Extraction wells are placed within a plume to pump contaminated groundwater from the aquifer to the treatment plant.

Treated water is returned to the aquifer using reinjection wells or infiltration galleries. Treatment facilities at river systems utilize bubblers.





# Groundwater plumes, restoration timeframes and funding

## 10 Plumes with treatment:

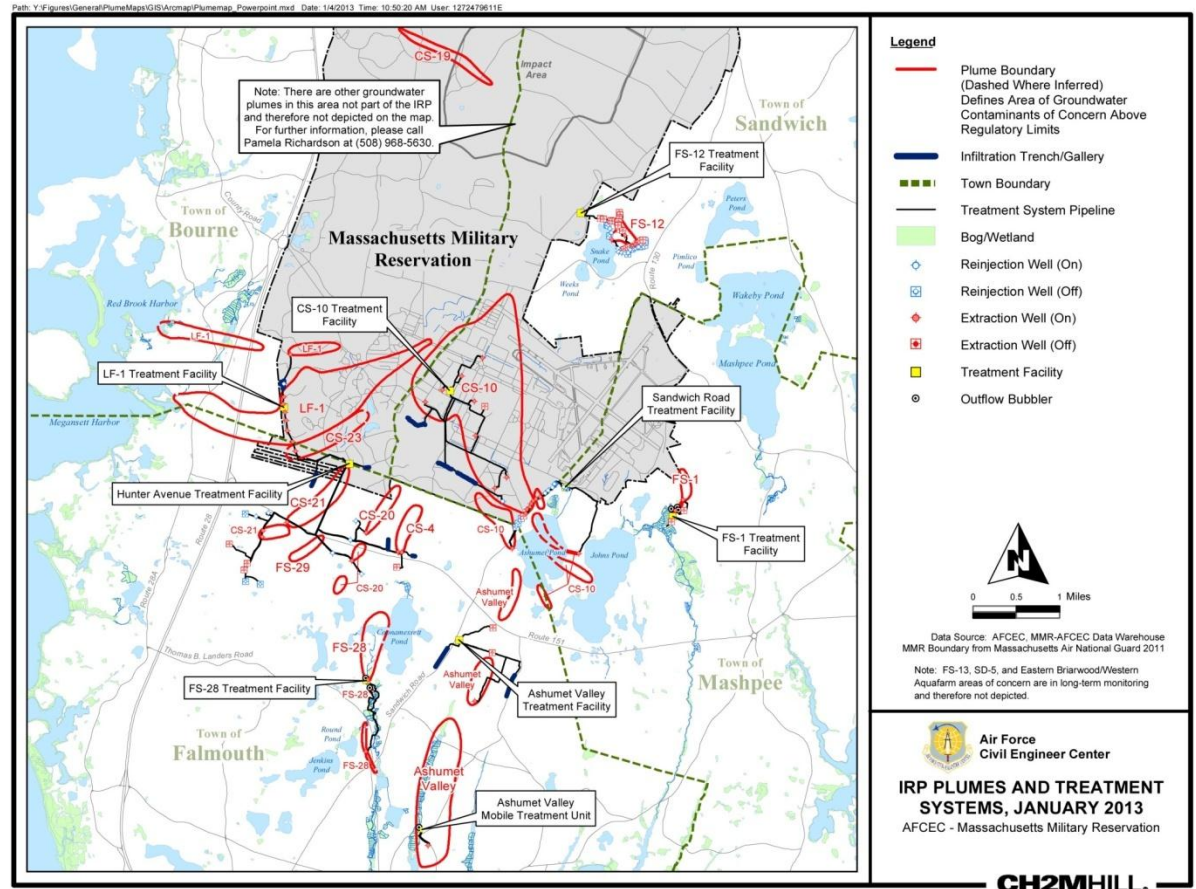
- ❖ **CS-20** (2017)
- ❖ **CS-21** (2027)
- ❖ **CS-23** (2018)
- ❖ **FS-28** (2047)
- ❖ **LF-1** (2047)
- ❖ **CS-4** (2014)
- ❖ **CS-10** (2055)
- ❖ **FS-12** (2048)
- ❖ **Ashumet Valley** (2018)
- ❖ **FS-1** (2020)

## Two plumes under monitoring:

- ❖ **CS-19**
- ❖ **FS-29**

## Two Sites in long-term monitoring:

- ❖ **LF-2**
- ❖ **SD-5**



### ARMY/AIR FORCE FUNDING

Purple: Joint

Green: Army

Blue: Air Force

# Snake Pond (Fuel Spill 12)

Early 1990s: An investigation near the Snake Pond area of Sandwich reveals the presence of fuel-related contamination.







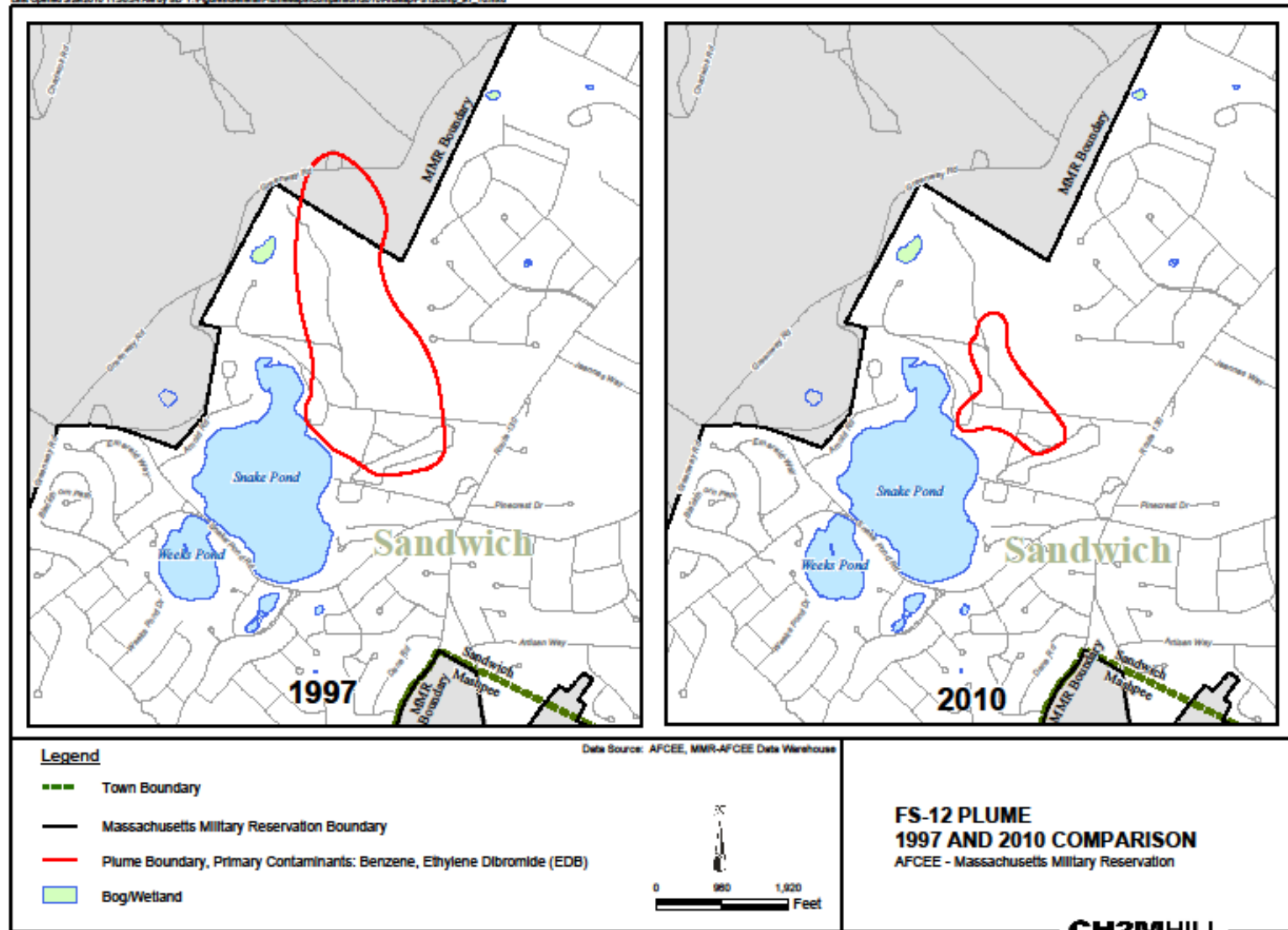
## Snake Pond (Fuel Spill 12)



**2012: A legal settlement resulted in \$20 million being provided to the Army restoration account as compensation for FS-12 cleanup actions.**

# Groundwater pump and treat action reduces a plume's size and toxicity over time

Last Opened 3/29/2010 11:30:34 AM by SD Y:\Projects\General\PlumeMap\Comparison\2010\ArdMap\F512comp\_KT\_10.mxd



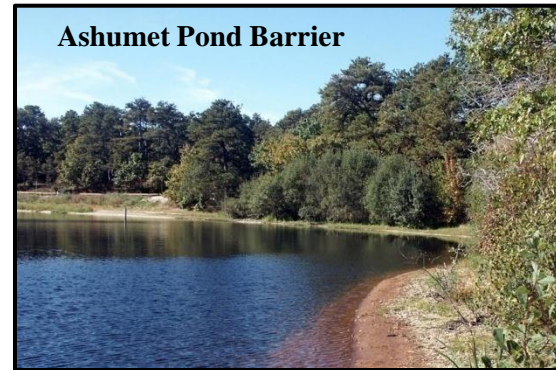
**Ashumet Valley Treatment System**



**FS-1/Quashnet Bog Treatment System**



**Ashumet Pond Barrier**



**CS-10 In Plume Treatment System**



**FS-28/Coonamessett Bog Treatment System**



Cleaning **12.3 million** gallons of water per day

**Sandwich Road Treatment System**



**LF-1 Treatment System**



**Hunter Avenue Treatment System**



**FS-12 Treatment System**



**Ashumet Valley Mobile Treatment Unit**

Massachusetts Military Reservation  
**REPLACEMENT WATER AGREEMENTS**  
 Installation Restoration Program  
**Total DOD Funding \$53,410,500**

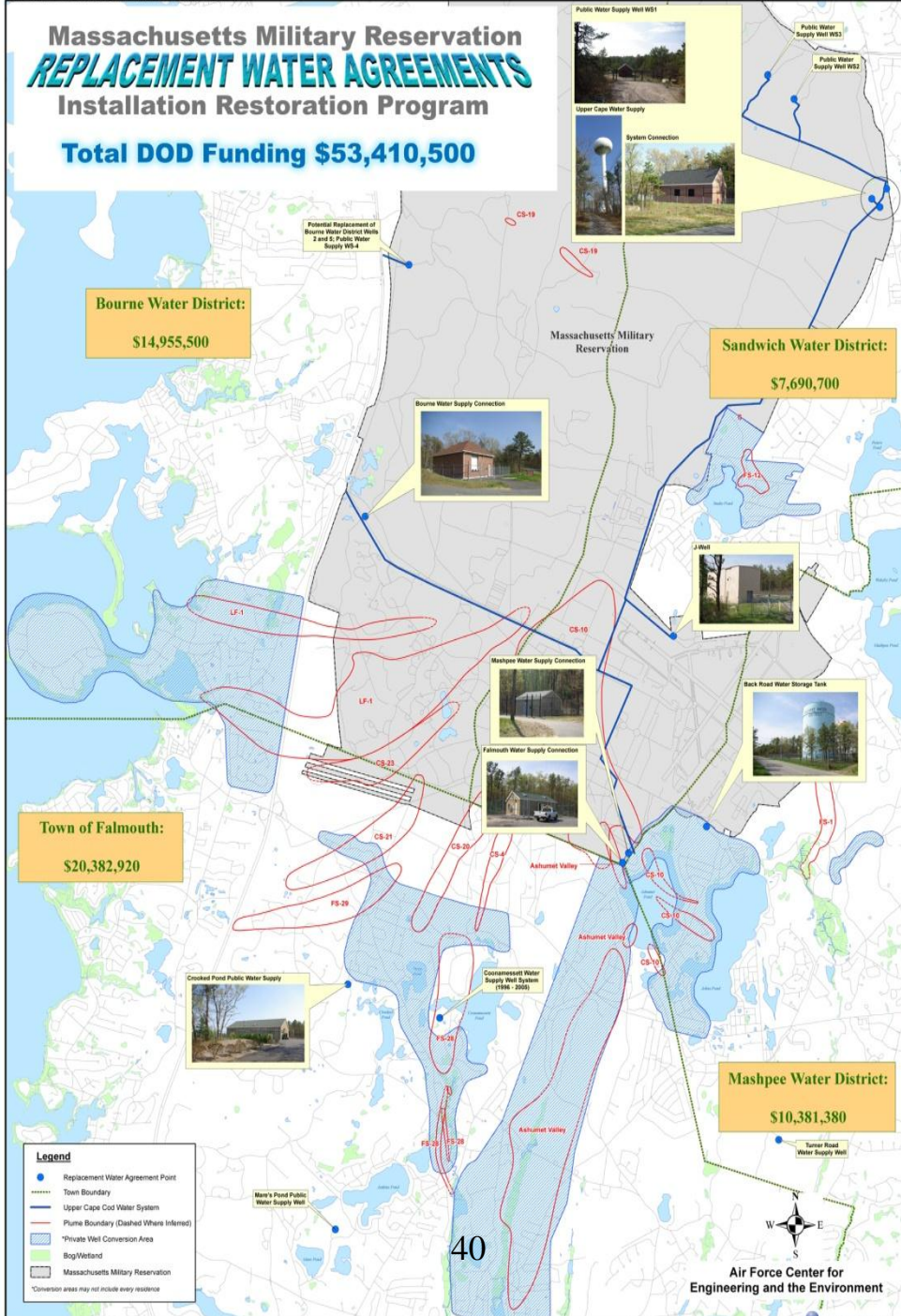
**Bourne Water District:**  
**\$14,955,500**

**Sandwich Water District:**  
**\$7,690,700**

**Town of Falmouth:**  
**\$20,382,920**

**Mashpee Water District:**  
**\$10,381,380**

- Legend**
- Replacement Water Agreement Point
  - Town Boundary
  - Upper Cape Cod Water System
  - - - - - Plume Boundary (Dashed Where Inferred)
  - \*Private Well Conversion Area
  - Bog/Wetland
  - Massachusetts Military Reservation
- \*Conversion areas may not include every residence



Air Force Center for  
 Engineering and the Environment











U.S. ARMY



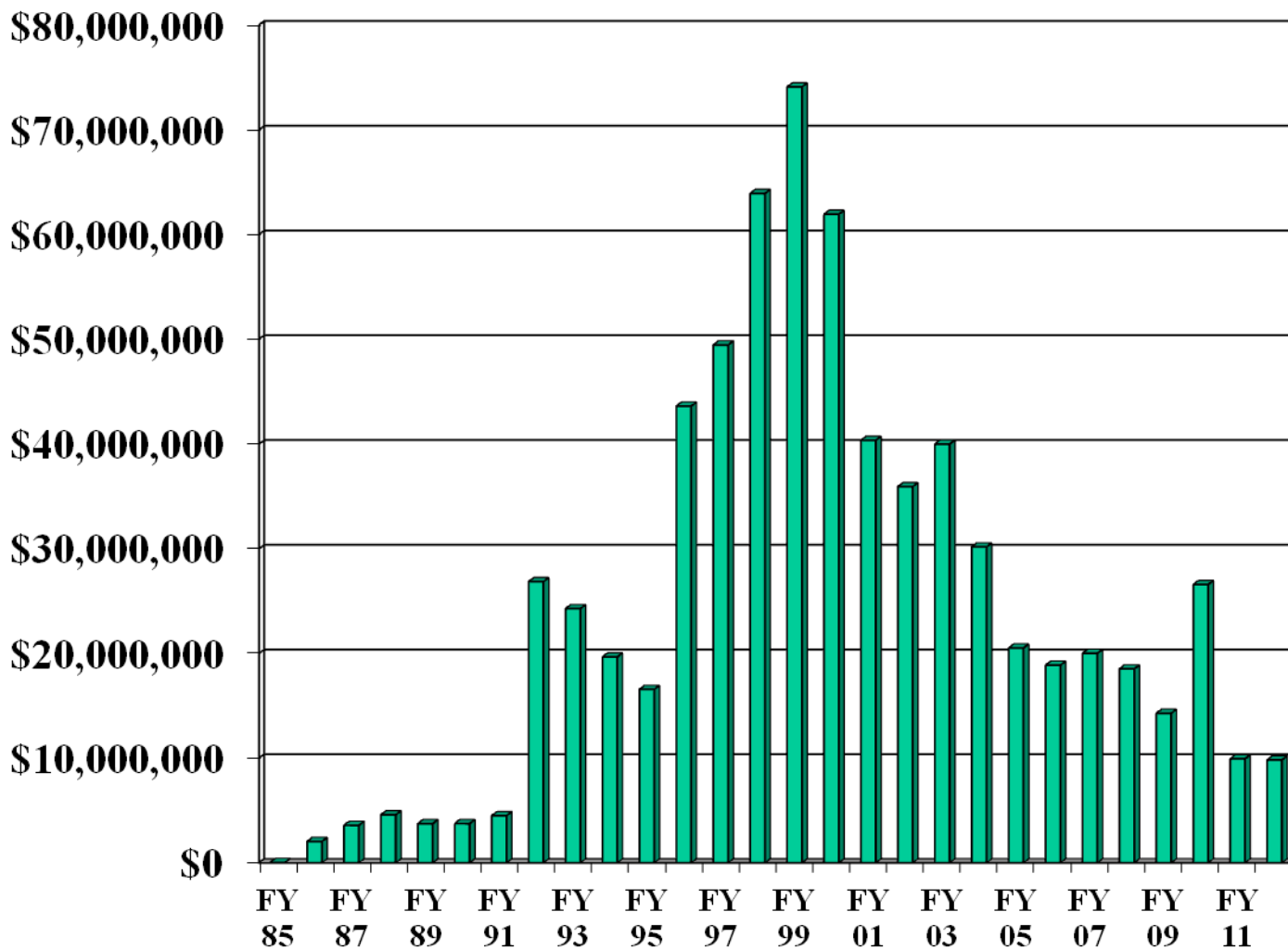




AFCEC's three wind turbines at MMR are estimated to soon pay for the entire electricity costs for the program (around \$1.5 million per year) and offset emissions from power plants.

# Program Funding

## FY 85-12: \$686,376,000





- **Plume booklet, news releases, notices**
- **Continuing with periodic citizen advisory team meetings**
- **Continued operation and maintenance of cleanup systems**
- **Decommissioning of monitoring wells**
- **System shutdowns**
- **Private and irrigation well verification program**
- **Sustainable remediation**