The Discovery of Emerging Contaminants at a Site Approaching Remedial Action Completion

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Presentation Overview

• Joint Base Cape Cod (JBCC) Background and Conceptual Site Model (CSM)
• Ashumet Valley Groundwater Plume CSM
• Remedial Progress/Site Closure on Schedule
• Investigation and Discovery of Emerging Contaminants
  – Perfluorinated Compounds (PFCs)
  – 1,4-Dioxane
• Impacts of Emerging Contaminants
• Challenges
Joint Base Cape Cod (JBCC) Background
(Formerly the Massachusetts Military Reservation [MMR])

• Located on Cape Cod, Massachusetts approximately 75 miles south of Boston
• Multi-agency tenant installation
• 22,000 Acres
• Crosses into 4 Cape Cod towns
• Use of base dates to early 1900s
• Training, maneuvers, military aircraft ops., maintenance & support
JBCC Background
(continued)

• Hazardous materials released to the environment – many groundwater plumes
• Contaminated a sole source aquifer used as drinking water supply
• CERCLA Superfund Site (1989)
• Oversight by U.S. Federal and State agencies
• Air Force Civil Engineer Center (AFCEC) responsible for clean up of the southern portion of base
JBCC CSM

• Over 80 Source Areas; majority closed without restriction
• 14 groundwater plumes (primarily trichloroethene [TCE], tetrachloroethene [PCE], ethylene dibromide [EDB], Fuels)
• On- and off-Base
• 20 billion gallons contaminated
• Large plumes (miles long; >100 feet thick)
• Relatively low concentrations but "hot-spots" identified
• Sandy aquifer
• Migration rates 1-2 feet/day
• Radial groundwater flow field
• Potential to impact public and private water supply wells, surface water bodies, and cranberry bogs
JBCC CSM - AFCEC Remedial Systems

- 9 groundwater treatment plants
- 27 miles of pipeline
- 105 extraction and 41 reinjection wells
- 49 20,000-pound (lb) granular activated carbon (GAC) vessels
- Treating ~11 million gallons/day
- Over 6,000 monitoring wells installed
- 3 on-site wind turbines offset electrical use
Ashumet Valley Groundwater Plume

- Located off-base to south of JBCC
- Sources:
  - Former Fire Training Area
  - Former Base Wastewater Treatment Plant
- Contaminants of Concern
  - PCE
  - TCE
- Plume Dimensions and Volume:
  - 3 miles long; 2,000 feet wide; 80 feet thick
  - Approximately 2.2 billion gallons above the Maximum Contaminant Level (MCL) of 5 micrograms per liter (µg/L)
- Private residential and agricultural wells in the area
- Plume discharges to active cranberry bog
- P&T Remedial System installed in 1999
Fire Training Area

- Primary source of contaminants in Ashumet Valley Plume

- training from 1958 to 1985
Former Wastewater Treatment Plant

- Primary and secondary treatment units
- Sand infiltration beds
- Sludge drying beds
- Operated from 1936 to 1995

- Secondary source of volatile organic compounds (VOCs) as well as wastewater-related contaminants
Fire Training Area Remedial Action

Excavation and on-site treatment of the contaminated soils

Source Area Treatment: 1995-1997
47,000 tons of soil treated
Remedial System Design
3 Wells - 1,200 gallons per minute (gpm)
2 Plants - 600 gpm each
2 Infiltration trenches – 600 gpm each

System Design Objective
*Restore the aquifer within 20 years and with minimal impacts to the surrounding environment*

Leading Edge of Plume not intended to be captured by Main Remedial System

Source Areas
- Fire Training Area
- Sewage Treatment Plant
Extraction wells are placed within a plume to pump contaminated groundwater from the aquifer to the treatment plant. Treatment plants remove contaminants from extracted groundwater by filtering it through granular activated carbon (GAC) held in large vessels. Treated water is returned to the aquifer using reinjection wells or infiltration galleries. Treatment facilities at river systems utilize bubblers.
Remedial Progress at Ashumet Valley 1999 - 2015

- Source area remedial actions successfully addressed VOCs in soils.
- Groundwater plume fully detached from source.
- Final Record of Decision (ROD) and Remedy in Place reached by 2009.
- Private well monitoring program in place by 2011; no unacceptable exposure risks identified.
- Risk management strategy for cranberries in place with large stakeholder group.
- 352 lbs of PCE/TCE removed through treatment of 5.9 billion gallons.
- Plume footprint reduced from over 1,200 acres in 1999 to less than 350 acres in 2015.
- P&T System Optimizations:
  - Shut down 3 of 4 extraction wells and 2 treatment plants
  - Reduced flow from 1,375 gpm to 350 gpm
  - Remedy relies more on monitored natural attenuation (MNA) to reach remedial goals
- Remedial system on schedule for shutdown in 2019 and aquifer restoration by 2021.
Remedial Progress at Ashumet Valley 1999 - 2015
Investigation of Emerging Contaminants

• Emerging contaminants are chemicals that evolving science has identified as a potential risk to human health or the environment.

• The JBCC CERCLA Five Year Review recommended investigation of Emerging Contaminants due to nature of the plume sources at Ashumet Valley:
  • PFCs due to past fire training activities
  • 1,4-dioxane due to presence of solvents in the plume
What are PFCs?

- Coatings and products that resist heat, oil, and stains
- Clothing, furniture, food packaging, cookware
- Aqueous film forming foam (AFFF) contains PFCs
  - Fire-fighting foam used by many fire departments and at military bases including JBCC
  - Used by the U.S Air Force since 1970
- PFCs are soluble and mobile in groundwater and chemically and biologically persistent in the environment.
- There are U.S. Federal provisional Health Advisories for just two PFC compounds:
  - Perfluorooctane Sulfonate (PFOS) at 0.2 µg/L
  - Perfluorooctanoic Acid (PFOA) at 0.4 µg/L
What is 1,4-Dioxane?

• Used in industry since the 1920s.

• Minor constituent of many consumer products such as paints and paint strippers, dyes, detergents, coolants, deicers, adhesives, cosmetics, and shampoo.

• Added as a stabilizer in 1,1,1-trichloroethane (1,1,1-TCA) found at low concentrations in the plume.

• 1,4-Dioxane is soluble and mobile in groundwater and biologically persistent in the environment.

• The Massachusetts Department of Environmental Protection has a risk-based standard for 1,4-dioxane of 0.3 µg/L.
Discovery of Emerging Contaminants

- Monitoring well sampling identified PFCs and 1,4-dioxane in groundwater above health advisories/standards.
  - Distribution of PFCs and 1,4-dioxane similar to PCE/TCE
- PFCs and 1,4-dioxane detected in surface water but at low concentrations; cranberry crop not impacted.
- PFCs and 1,4-dioxane detected in treatment system influent at concentrations close to health advisories/standards.
  - PFC treatment by GAC relatively effective
  - GAC poor at treating 1,4-dioxane – detections close to standards in plant effluent
- Private residential wells located near infiltration trenches contain detectable levels of PFCs and 1,4-dioxane.
Impacts of Emerging Contaminants

• Mitigation Actions
  – Discontinue use of infiltration trench near residential wells.
  – Increase outreach to community.
  – Quarterly monitoring of residential wells.
  – Provide bottled water if health advisories/standards exceeded.

• Supplemental Remedial Investigation/Feasibility Study proceeding
  – Fully assess nature and extent.
  – Re-evaluate site risk and remedy protectiveness.
  – Evaluate remedial alternatives/additional treatment.
  – Restoration timeframe impacts.

• ROD Amendments

• Increase in remedial lifecycle cost
Challenges Assessing and Addressing Emerging Contaminants

- Assessment costly and technically challenging.
- Renewed community and media interest.
- PFOS/PFOA provisional Health Advisories expected to decrease during 2016.
- Few standards and guidelines for the other PFCs.
- Many PFC species not being investigated; environmental fate highly complex.
- Development of risk-based concentrations for non-drinking water exposures.
- Indication of ongoing source of PFC contamination.
- Existing system not treating 1,4-dioxane.
- Differentiating between site-related releases from other sources and determination of background.
Thank you!

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