Navy's Portfolio Optimization: In Situ Remediation Sites

Presented By
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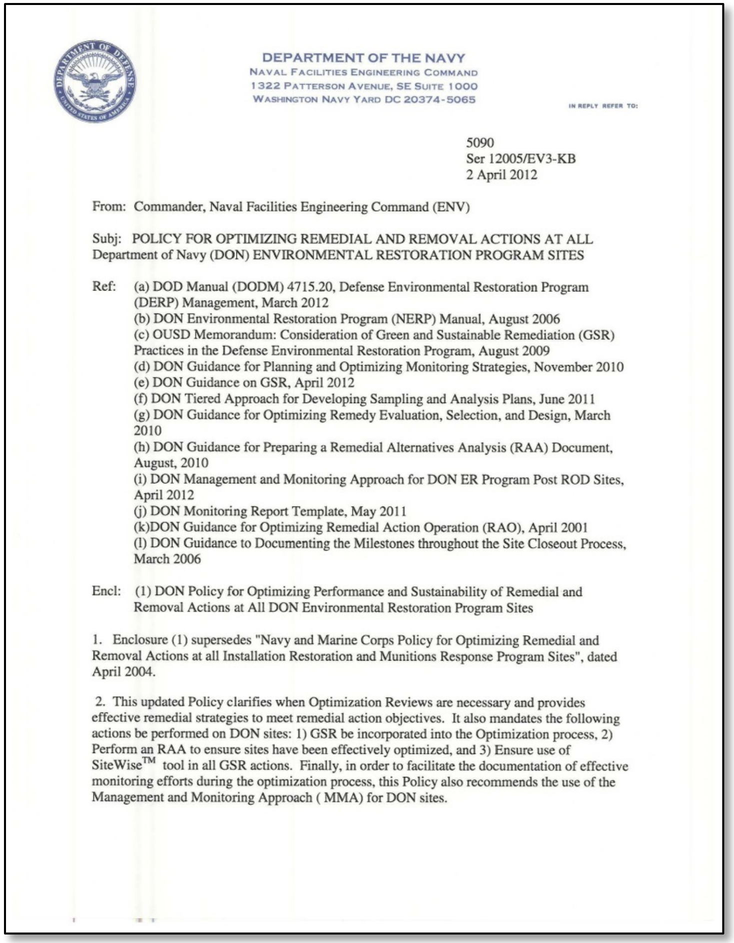
Overview

- Portfolio Optimization
  - Shift focus from individual site reviews to portfolio-wide evaluation of cleanup program
  - Develop common findings/themes
  - Identify focus areas for future optimization
- Discuss challenges complex sites pose to the Navy's Environmental Restoration Program
- Adaptive Site Management
  - Systematic approach to managing site uncertainty
  - Example site – Former NWIRP McGregor, TX

Navy Optimization Policy and Guidance

- DON Policy for Optimizing Remedial and Removal Actions at all DON Restoration Sites
  - ❖ April 2012
- Guidance for Optimizing Remedial Action Operation
  - ❖ October 2012
- Guidance for Planning and Optimizing Monitoring Strategies
  - ❖ November 2010
- Guidance for Optimizing Remedy Evaluation, Selection, and Design
  - ❖ March 2010



DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
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IN REPLY REFER TO:

5090
Ser 12005/EV3-KB
2 April 2012

From: Commander, Naval Facilities Engineering Command (ENV)

Subj: POLICY FOR OPTIMIZING REMEDIAL AND REMOVAL ACTIONS AT ALL Department of Navy (DON) ENVIRONMENTAL RESTORATION PROGRAM SITES

Ref: (a) DOD Manual (DODM) 4715.20, Defense Environmental Restoration Program (DERP) Management, March 2012
(b) DON Environmental Restoration Program (NERP) Manual, August 2006
(c) OUSD Memorandum: Consideration of Green and Sustainable Remediation (GSR) Practices in the Defense Environmental Restoration Program, August 2009
(d) DON Guidance for Planning and Optimizing Monitoring Strategies, November 2010
(e) DON Guidance on GSR, April 2012
(f) DON Tiered Approach for Developing Sampling and Analysis Plans, June 2011
(g) DON Guidance for Optimizing Remedy Evaluation, Selection, and Design, March 2010
(h) DON Guidance for Preparing a Remedial Alternatives Analysis (RAA) Document, August, 2010
(i) DON Management and Monitoring Approach for DON ER Program Post ROD Sites, April 2012
(j) DON Monitoring Report Template, May 2011
(k)DON Guidance for Optimizing Remedial Action Operation (RAO), April 2001
(l) DON Guidance to Documenting the Milestones throughout the Site Closeout Process, March 2006

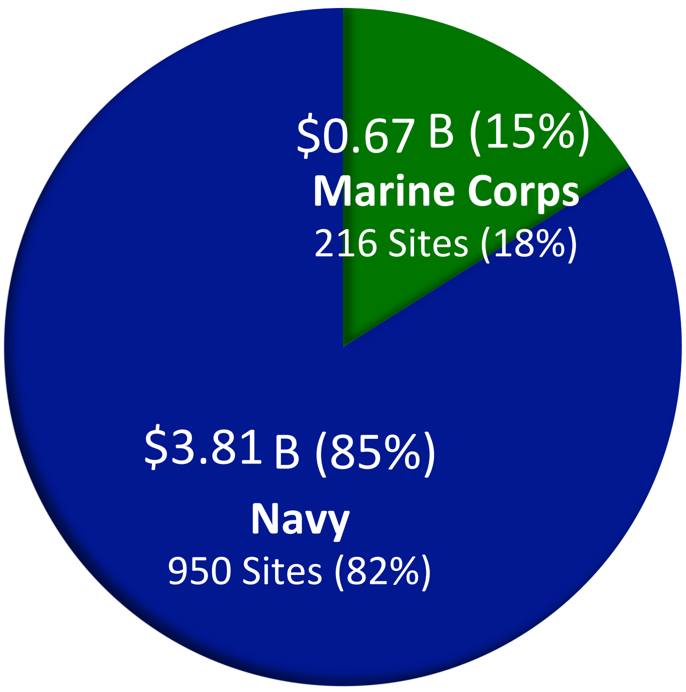
Encl: (1) DON Policy for Optimizing Performance and Sustainability of Remedial and Removal Actions at All DON Environmental Restoration Program Sites

1. Enclosure (1) supersedes "Navy and Marine Corps Policy for Optimizing Remedial and Removal Actions at all Installation Restoration and Munitions Response Program Sites", dated April 2004.

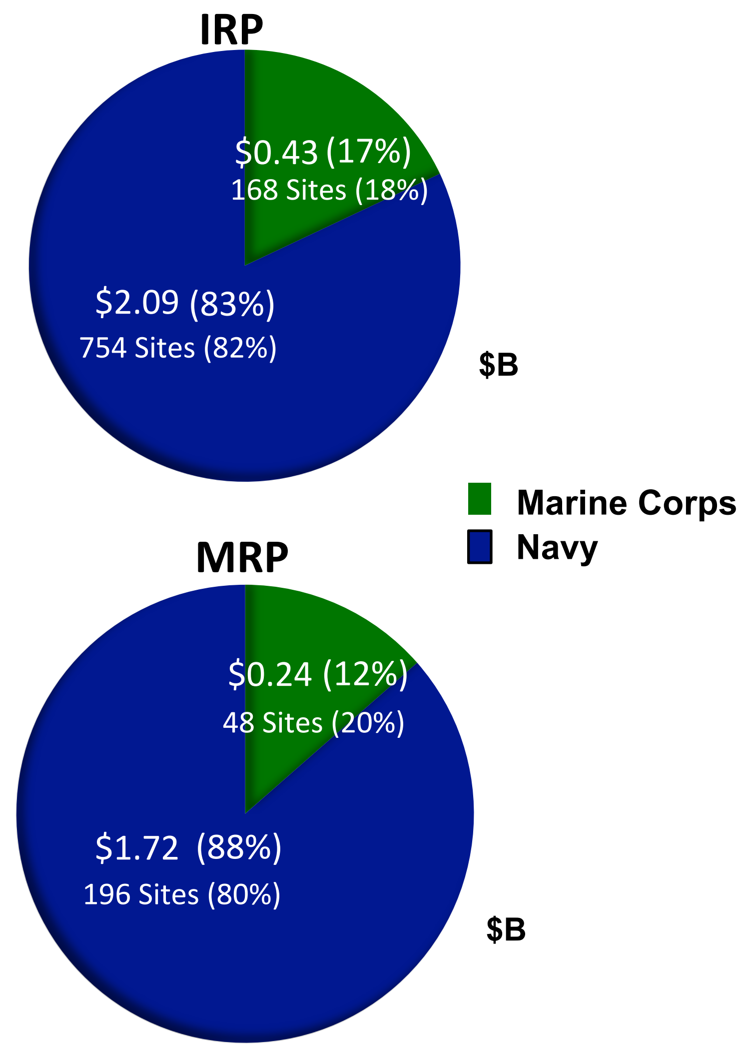
2. This updated Policy clarifies when Optimization Reviews are necessary and provides effective remedial strategies to meet remedial action objectives. It also mandates the following actions be performed on DON sites: 1) GSR be incorporated into the Optimization process, 2) Perform an RAA to ensure sites have been effectively optimized, and 3) Ensure use of SiteWise™ tool in all GSR actions. Finally, in order to facilitate the documentation of effective monitoring efforts during the optimization process, this Policy also recommends the use of the Management and Monitoring Approach (MMA) for DON sites.

Navy's Cost to Complete Status (FY17)

Total Marine Corps Sites: 1,104 (25%)



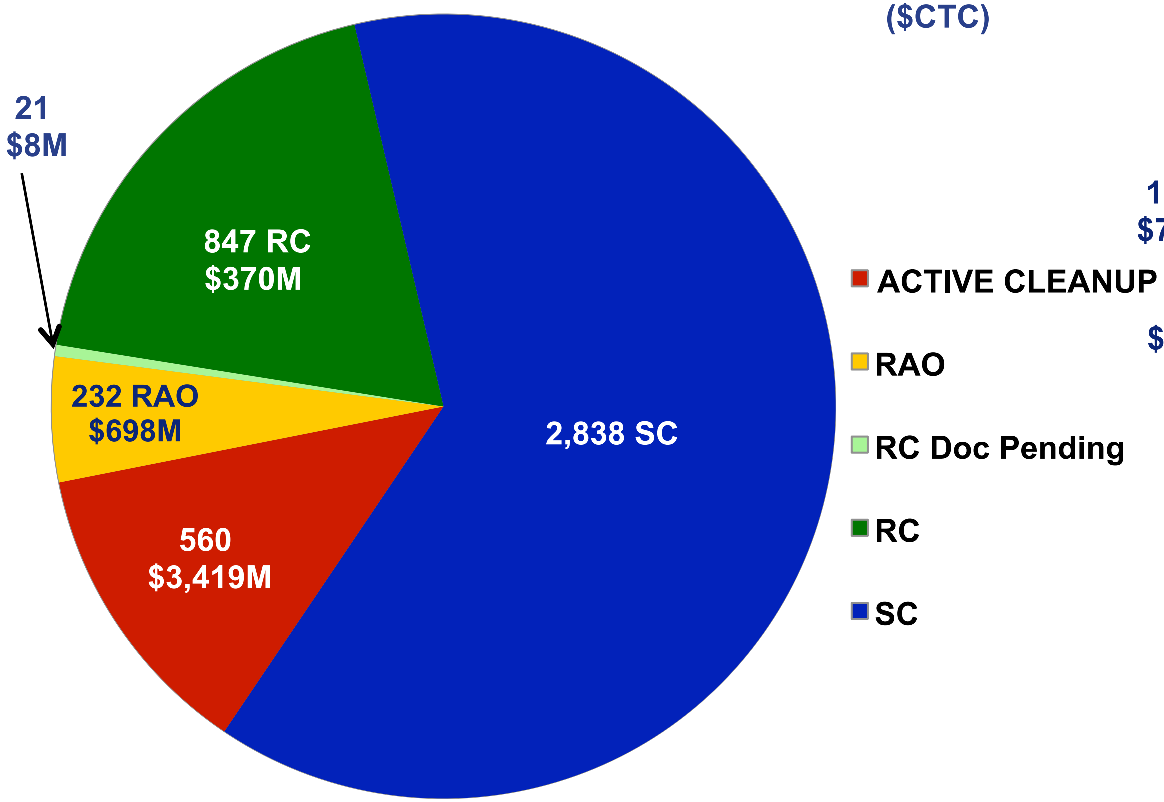
Total Navy Sites: 3,394 (75%)

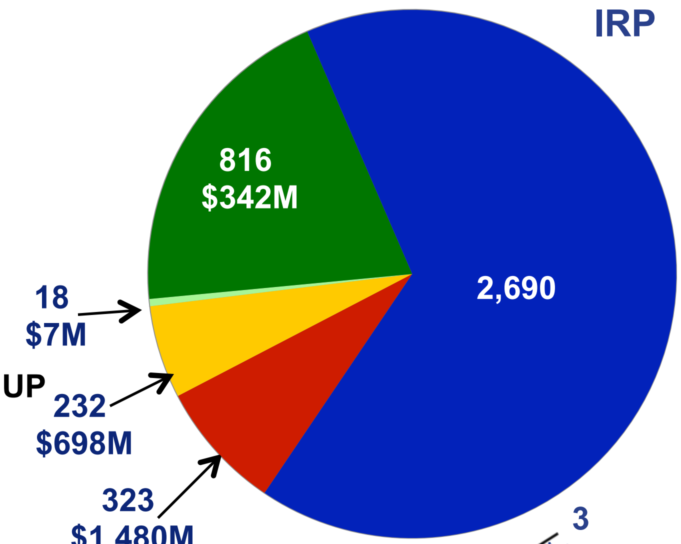


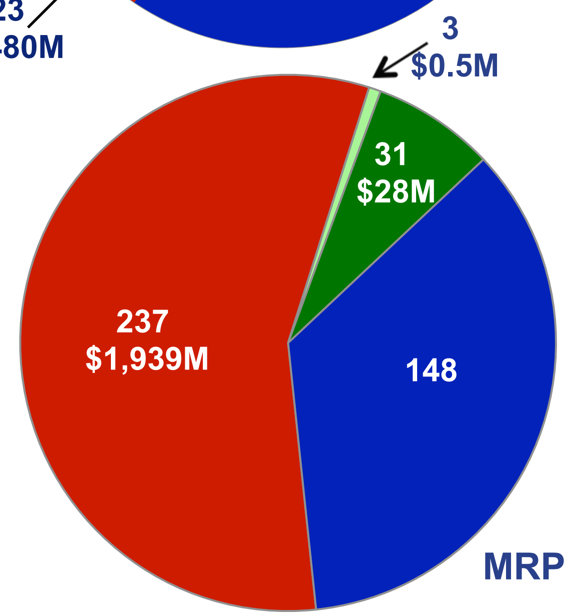
Projects Only

FY17 Snapshot of Navy Program

EOY FY2017
(# SITES)
($CTC)





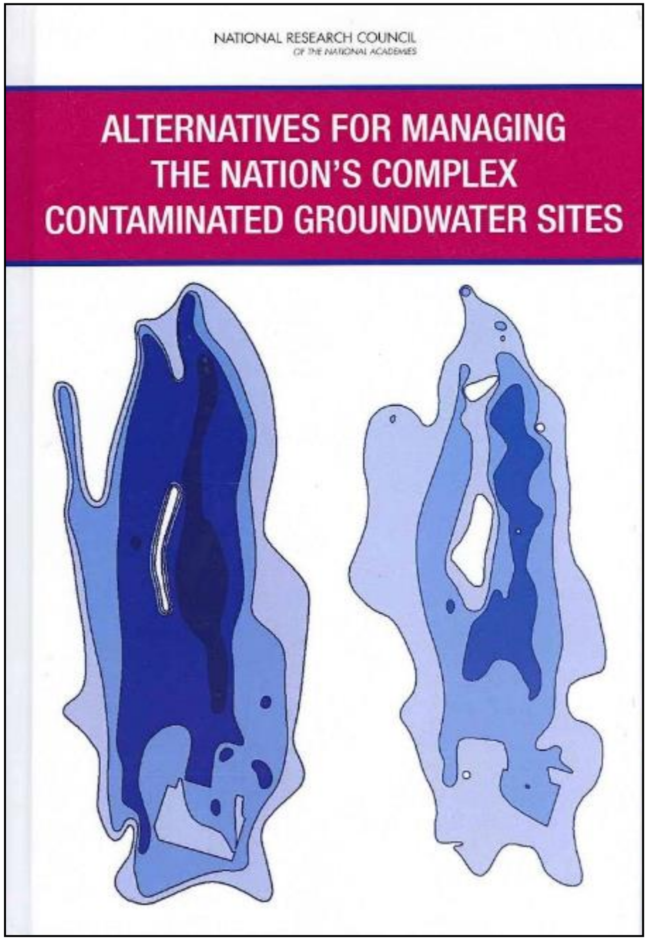


4,498 Sites (EOY16: 4,435 Sites)
RC: 3,685 (81.9%)
$4,495M CTC = $2,528M (IRP) + $1,967M (MRP)

Projects Only

Complex Sites Challenge

- Straightforward sites largely been addressed
- Remaining sites pose technical challenges to Navy's Environmental Restoration Program
- 2013 National Research Council (NRC)
    - Approximately 10% of sites are "complex"
    - Will not meet cleanup objectives in reasonable timeframe
    - Cost to remediate ~$127 billion
- Alternative management approaches needed



NRC 2013 on Achieving Site Closure

"…at complex sites characterized by multiple contaminant sources, large past releases of chemicals, or highly complex geologic environments, meeting the DoD's ambitious programmatic goals for remedy in place/ response complete seems unlikely and site closure almost an impossibility."

"Rather, the nation's cleanup programs are transitioning from remedy selection into remedy operation and long-term management (LTM), potentially over long timeframes."

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Site Challenges

Technical Challenges	Examples	Non-Technical Challenges	Examples
Geologic conditions	Fractured bedrock, karst geology, low-permeability sediments	***Site objectives***	Deviations from promulgated screening values or closure criteria (e.g. MCLs)
Hydrogeologic Conditions	Groundwater table fluctuations, groundwater-surface water interactions	***Managing changes that may occur over long time frames***	Phased remediation, multiple PRPs, loss of institutional knowledge
Geochemical Conditions	Low/high pH, alkalinity, elevated electron acceptors	***Overlapping regulatory responsibilities***	Federal/state cooperation, numerous stakeholders
Contaminant-related Conditions	LNAPL/DNAPL, emerging contaminants, back diffusion	***Institutional controls***	Tracking and managing ICs, enforcement
Large-scale site	Size and depth of plume, number and variety of receptors	***Changes in land use***	Site access, redevelopment, land/water use change
		Funding	Uncertain funding, politics

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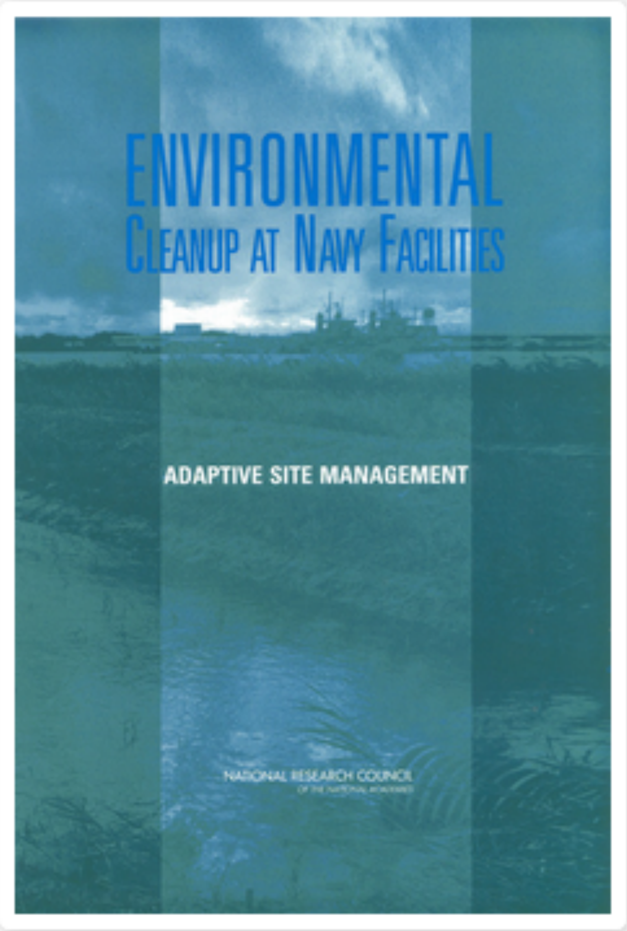
Source: Modified from ITRC 2017

2003 NRC Adaptive Site Management

- NRC 2003 study on latter stages of site remediation at Navy installations
- NRC report proposed comprehensive and flexible approach – "Adaptive Site Management"
- Express recognition that system responses will be monitored, interpreted, and used to adjust approach in iterative manner over time

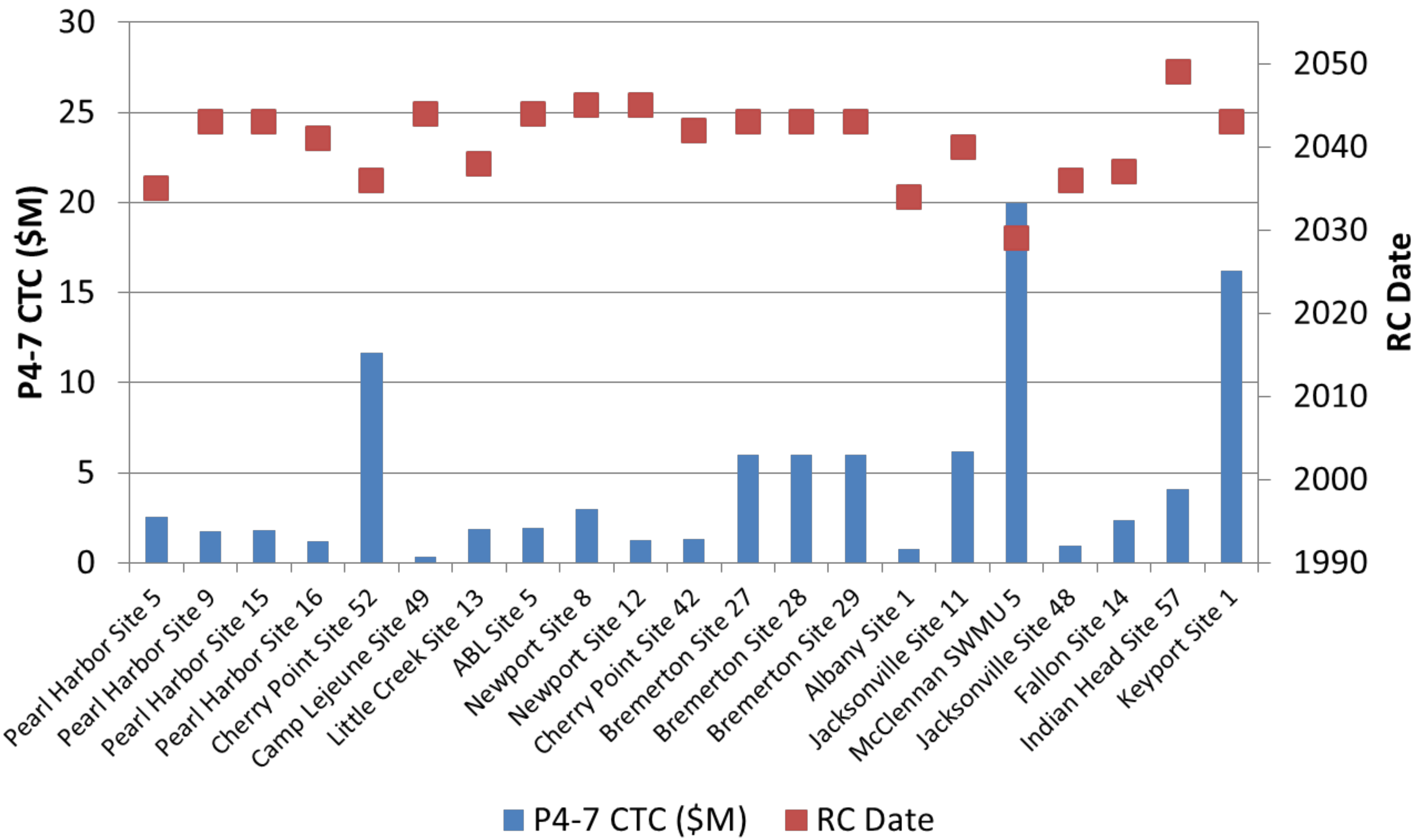


Source: NRC 2003

Navy Portfolio Optimization (P-OPT) Review of Complex Sites (2015-17)

- Primary objectives were to identify opportunities to reduce remediation timeframe (accelerate RC), improve remedy effectiveness, and achieve cost avoidance
- In-house Navy subject matter experts (SMEs) and outside consultants reviewed each site and developed preliminary findings and recommendations
- Portfolio-wide themes were developed
- Site findings and recommendations implemented by RPMs and adjusted based on additional insights from end users
- Common themes used to develop Navy policy and guidance to properly manage complex sites and to prioritize future optimization efforts

Complex Sites with In Situ Treatment Trains



Summary of Site Findings

- Restoration timeframes estimated at >30 years for all sites (actual timeframe typically greater)
- Source reduction technology (e.g. bioremediation, ISCO) typically implemented with natural attenuation and other passive technologies to treat/control downgradient plume
- Few opportunities to accelerate remediation timeframes
  - Inherent technical difficulties prevented site closure, meeting MCLs
  - DNAPL, complex geology, contaminant back diffusion
- Long-term monitoring/management drive costs
- Guidance needed to determine when to transition sites from active treatment to natural attenuation or long-term passive management

Key Site Management Questions

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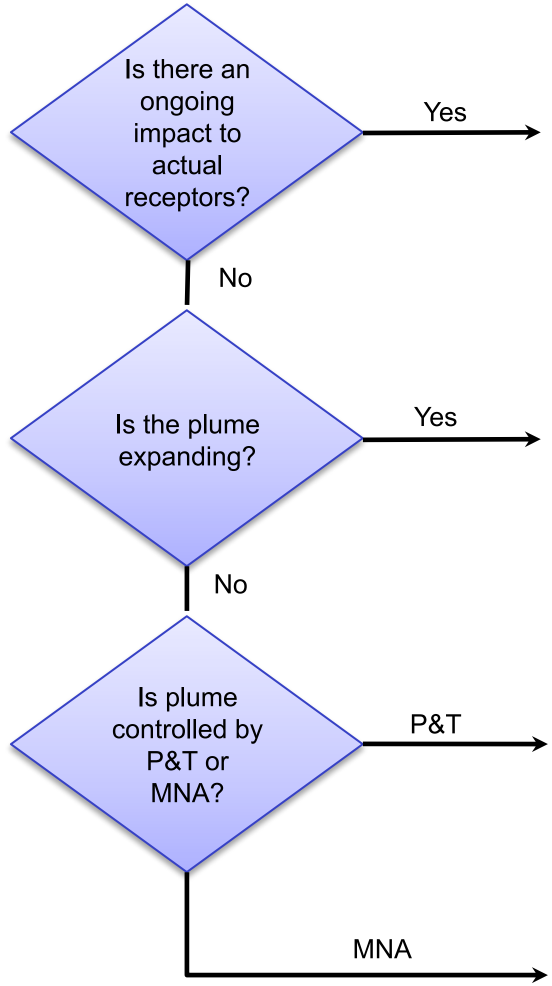
Tools and Analysis

- Vapor intrusion analysis
- Groundwater ingestion
- Groundwater to surface water discharge

- Mann-Kendall Analysis
- MAROS Tool
- Conc. vs. time plots and graphs
- Impacting off-site receptors?

- Is active P&T containment required?
- Continued effectiveness of P&T over long timeframes?
- Can MNA continue to prevent plume migration?
- MNA long-term sustainability?



Potential Actions

- Control risk by controlling source, pathway, and/or exposure
- Benefit to further source treatment? (e.g. predictive modeling of remedial options)

- Will a treatment barrier stop plume expansion?
- What are impacts if plume expands?

- Do shut-down test – rebound occur?
- Convert to “toe-only” pumping?
- Redesign P&T for long haul?
- Will further source treatment help?

- Pursue risk-based closure (e.g. low-threat closure guidance)
- Reduce long-term monitoring costs, continue optimization

Key Messages on Complex Sites

- Approximately 10% of all sites classified as complex (NRC 2013)
  - Navy P-OPT identified a subset of complex sites where it will be difficult to meet restoration goals within 30 years
  - P-OPT identified few opportunities to accelerate remediation timeframes
- Adaptive Site Management most suitable approach for addressing complex sites
  - P-OPT recommended phased technical approach prioritizing sites exhibiting unacceptable risk to human health and environment
  - Life cycle CSM used to guide decision-making throughout restoration process
- Long-term passive management appropriate long-term goal for most complex sites
  - Focus remedial efforts on sites with uncontrolled risks
  - Long-term cleanup goals (e.g. MCLs) achieved through natural attenuation
  - Interim institutional controls to prevent exposure
  - Continuously update CSM and optimize remedy

Key Messages (Cont.)

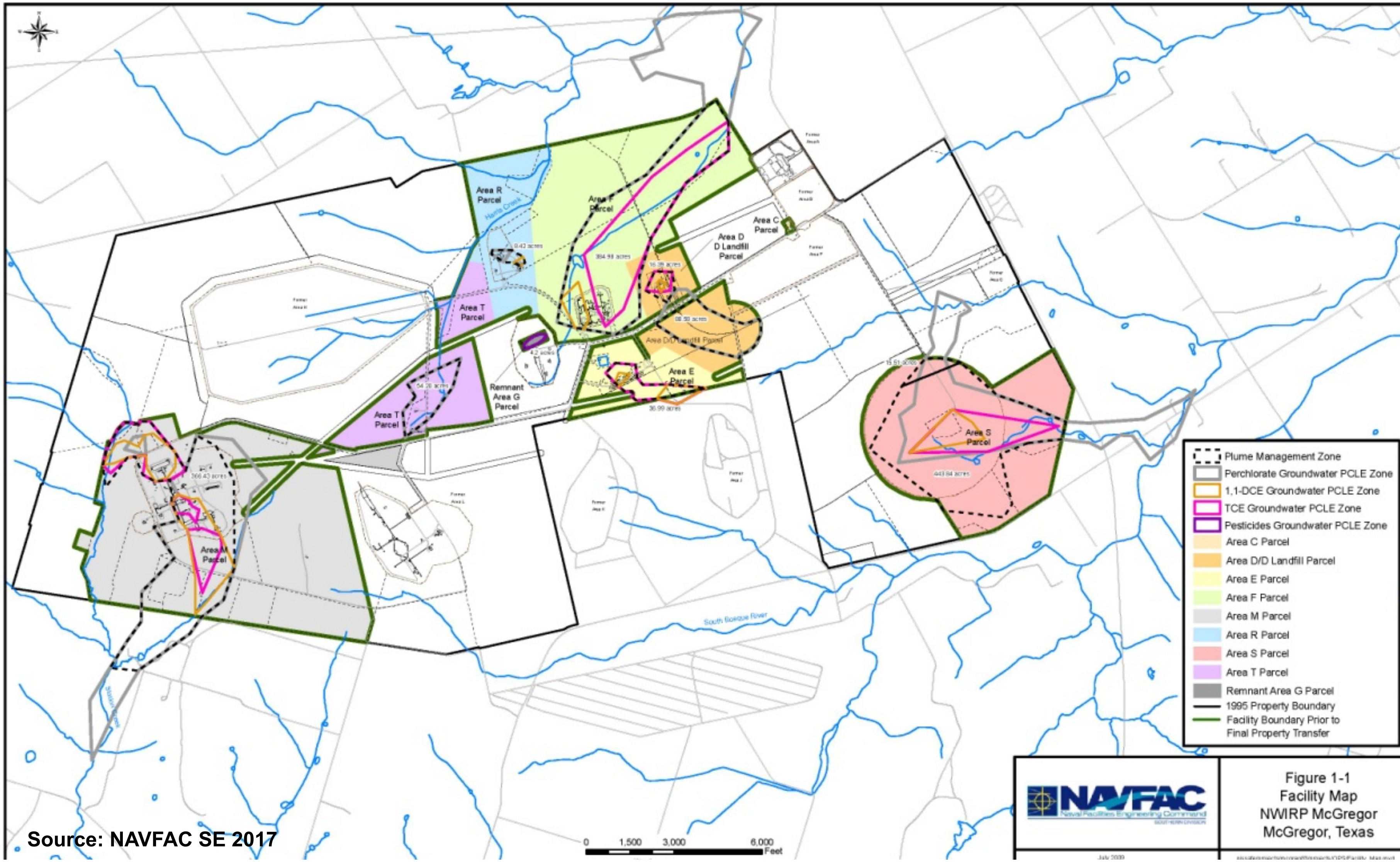
- Interim goals often necessary to guide progress towards overall site objectives
  - P-OPT recommended use of transition goals to focus initial remedial efforts on sites with unacceptable risks
  - Phased remediation approaches – feedback loop, updated CSM
- Transition assessments to select new remedies or transition to long-term management
  - P-OPT recommended additional RPM guidance on transition assessments and development of new tools
  - Case studies demonstrating successful transition assessments (e.g. NWIRP McGregor)

Adaptive Site Management Example - Former NWIRP McGregor, TX

NWIRP McGregor Background

- Naval Weapons Industrial Reserve Plant (NWIRP) McGregor used until 1995 as a bomb and rocket motor manufacturing facility
- Isolated industrial sites located on 9,700 acres, 20 miles west of Waco, Texas
- Ammonium perchlorate was released into the environment through “hog out” operations of rocket motors
- Property transferred property to City of McGregor in 1995
- Leased portions of property to industrial and agricultural companies
    - SpaceX static rocket test and launch/landing facility
- Navy maintains cleanup responsibility/liability and continues active remediation and long-term monitoring on properties through access agreements

Former NWIRP McGregor



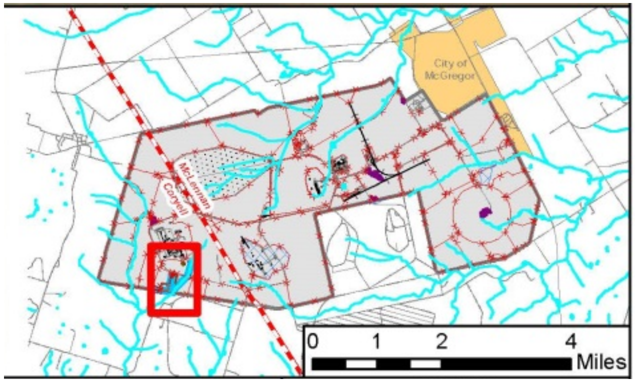
Source: NAVFAC SE 2017

Life-Cycle Optimization Timeline

- Initial optimization efforts to improve automation and remote monitoring of fluidized bed reactor (FBR) ***(2004-05)***
- Long-term monitoring optimization ***(2005–17)***
- Evaluate attenuation capacity of groundwater to surface water pathway ***(2014-15)***
- Change groundwater classification from Class II to Class III (raising cleanup level X100) and reducing size of Plume Management Zone (PMZ) ***(2016)***
- Risk evaluation of ecological surface water exposure to perchlorate ***(2016)***
- Transition groundwater collection and FBR system to a series of passive in situ bio-barriers ***(2017-2020)***

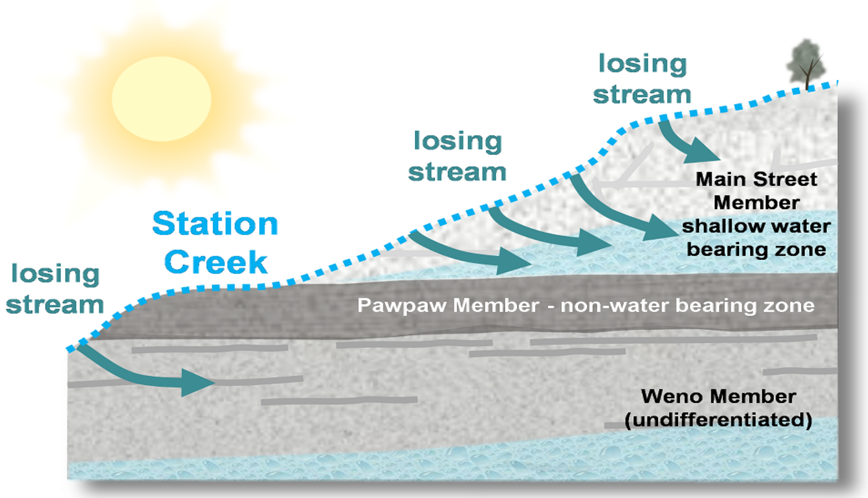
NWIRP McGregor

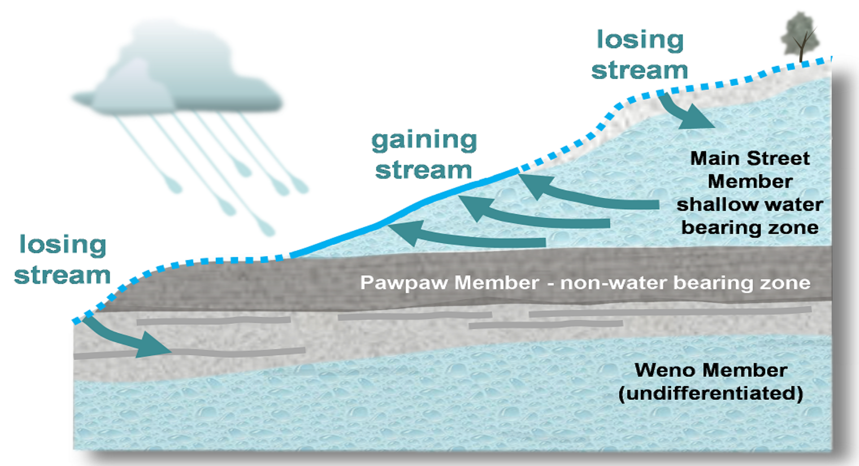
- A-Line Trench – 1,680' long, 20-25' deep
- B-Line Trench – 2,950' long, 12-15' deep
- C-Line Trench - 1,425' long, 15-18' deep
- Pump station maintains groundwater elevation to prevent discharge to unnamed tributary



Conceptual Site Model

- Streams and tributaries at the facility experience both gaining and losing conditions
- Majority of precipitation occurs in Spring
- Perchlorate effectively attenuated through dilution and mixing within dynamic system
- Dilution study conducted in 2014-15 to evaluate perchlorate concentrations along GW/SW flow path





Source: NAVFAC SE 2017

Groundwater Treatment System

Interceptor trench system and aboveground water storage

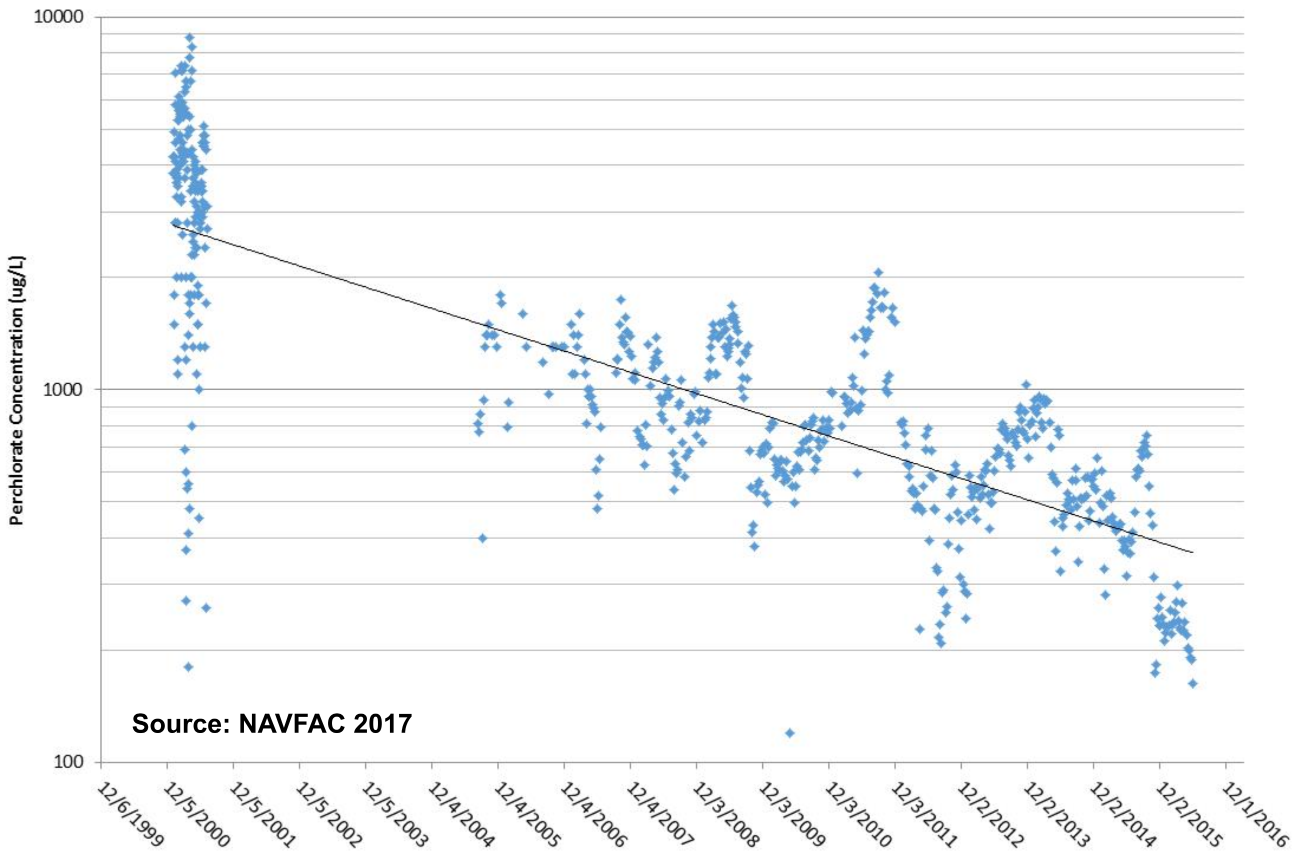
- Lagoon A – 10.8M Gal
- Soil Cell A – 1.2M Gal
- Soil Cell B – 1.5M Gal
- Soil Cell C – 1.7M Gal

Fluidized bed reactor

- Treats up to 400 gpm
- Discharges directly to outfall or to aboveground storage

Source: NAVFAC SE 2017

Perchlorate Influent History



- Perchlorate influent concentrations from 2000 to 2016 show overall decreasing concentrations
- Combination of source removal, natural flushing, and mixing with un-impacted groundwater resulted in perchlorate attenuation over time

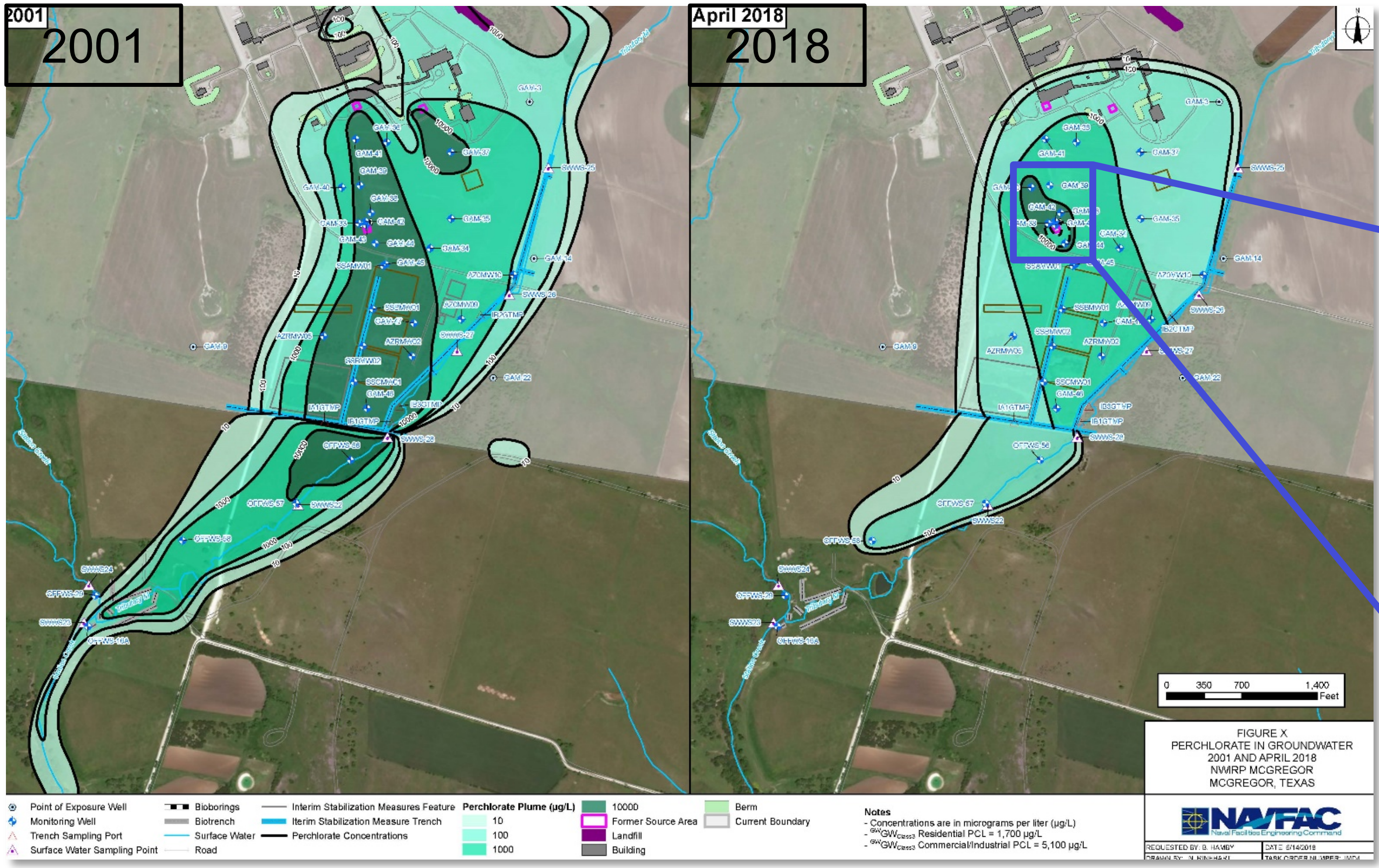
Transition Assessment

- Goal to transition from aggressive pump and treat technology to passive in situ remediation
    - Reduce O&M, monitoring, and energy costs
    - Rely on in situ containment of the perchlorate plume
- Navy negotiated with TCEQ to temporarily shut down treatment system during 2016-17
- Continue to monitor groundwater and surface water quality in evaluating attenuation capacity
- Pilot test in situ bio-borings to control perchlorate migration from source

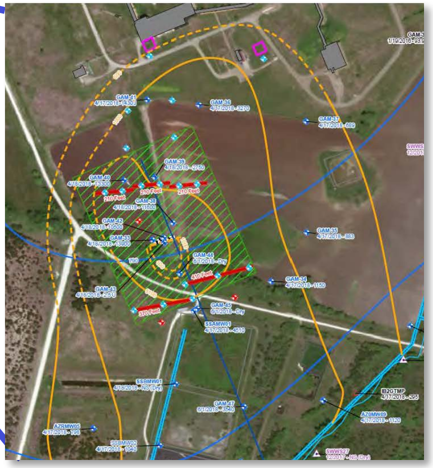
Fluidized Bed Reactor

Source: NAVFAC SE 2017

Transition Assessment (Cont.)



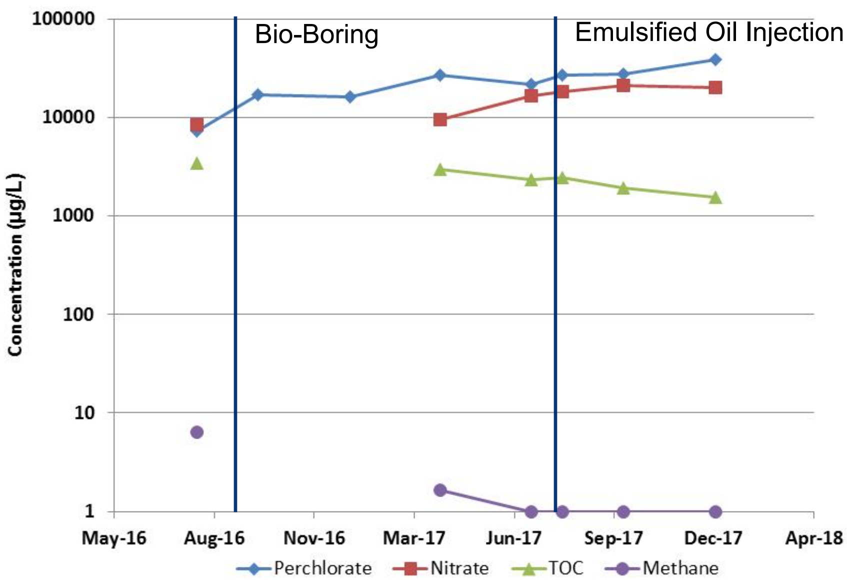
Focused treatment on remaining perchlorate hot spot



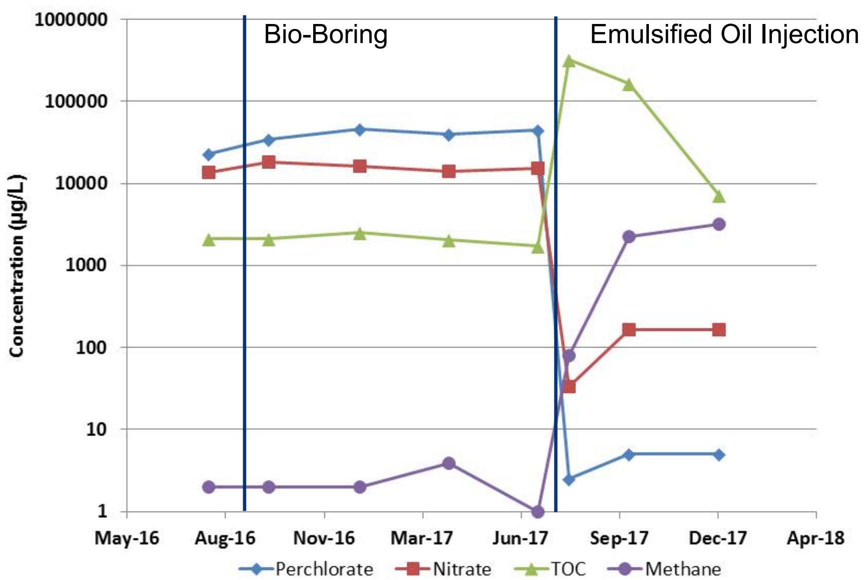
- Two rows of bio-borings installed for a total of 25 wells in August 2016
- Injected emulsified oil in July 2017
- Reductions of perchlorate and nitrate and increase in methane concentrations

Bio-Boring Performance Monitoring

GAM-42 (Upgradient Well)



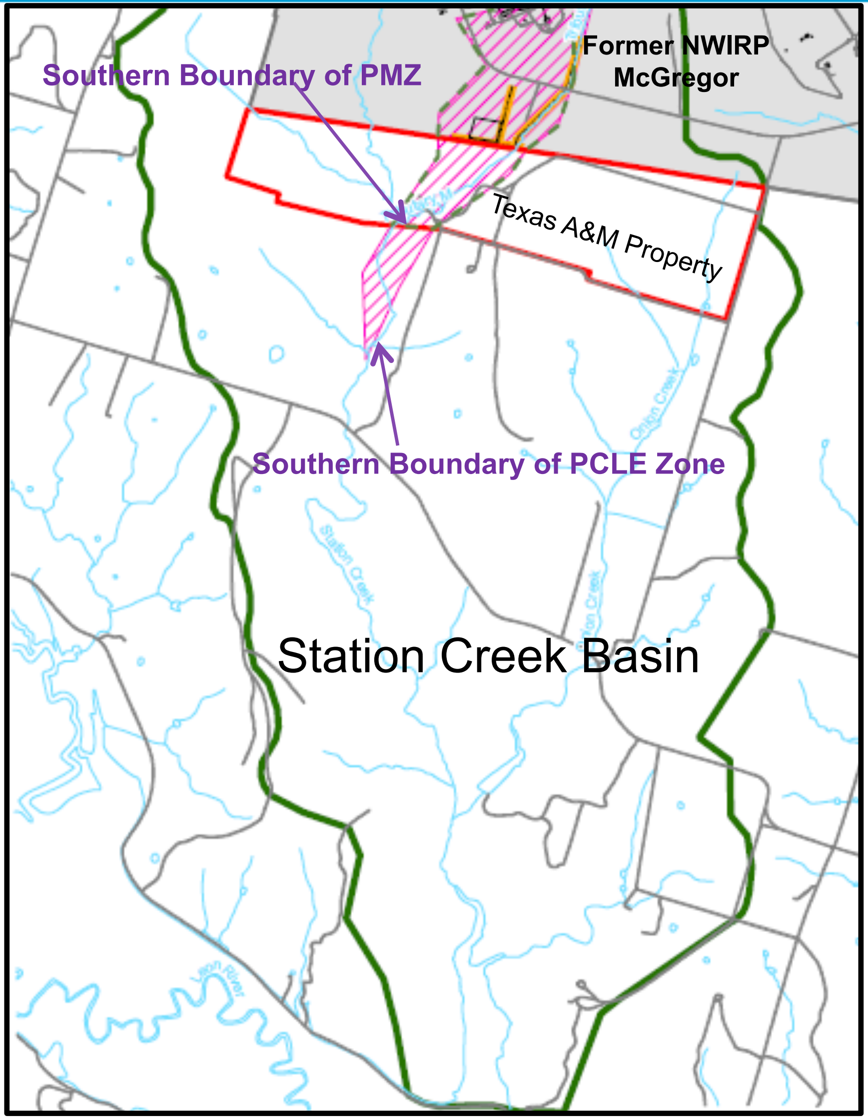
GAM-43 (Downgradient Well)



Source: NAVFAC SE 2017

- **Following injection of emulsified oil, rapid perchlorate and nitrate reduction, methane production**
- **Bio-borings will likely require frequent emulsified oil replenishment to maintain containment of residual perchlorate source**

Groundwater Reclassification



TCEQ's PCLs Onsite Area PMZ		
Medium	Commercial/Industrial (µg/L)	Ecological (µg/L)
Class II Groundwater Classification * TRRP §350.52	51.1	>8,000
Class III Groundwater Classification ** TRRP §350.52	5,110	>8,000
Surface Water	--	>8,000

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Source: NAVFAC 2014

Adaptive Site Management Example Summary

- Life-cycle optimization achieved through a combination of management approaches
  - Groundwater re-classification resulted in less stringent perchlorate cleanup standard (5,100 μg/L vs. 51 μg/L)
  - Developed natural attenuation conceptual model (e.g. flushing and mixing in groundwater/surface water system)
  - Transitioned pump and treat system to passive in situ bioremediation of plume
  - Ecological risk assessment documented no adverse impacts to sensitive receptors from exposure to perchlorate in surface water
- Long-term adaptive site management approach will result in significant annual cost avoidance while maintaining protection of human health and environment

Contacts and Questions

Points of Contact

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Questions ?