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Innovative Hot Spot Remedial Approach For a Wood Treating Site in Mississippi

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Presentation Topics

- **Introduction**
- **Site Setting/Background**
- **Pentachlorophenol/Naphthalene Groundwater Plumes**
- **Project Objectives**
- **Treatability Testing Results & Work Plan**
- **Pilot Study Implementation & Results**

Introduction

- **What's a Hot Spot..?**
 - Recalcitrant contamination zones (“Hot Spots”),
 - Localized areas within plumes where high constituent concentrations impede the achievement of treatment and/or natural attenuation objectives,
 - Common problem at many sites undergoing corrective action,
 - Occurrence of “Hot Spots” can lengthen the time required for groundwater remediation and/or monitoring, and more importantly the time required for site closure.
- This presentation focuses on an innovative approach for addressing “Hot Spots” at an active wood treating facility in South Mississippi.

Relevant Plume Characteristics

- GW treatment system operated 13 years, MNA since 2002
- Persistent Creosote & PCP hotspots (mg/L range) at WC-5, WC-23, WC-40
- Free product “globules” at WC-5
- Acidic groundwater, pH 4-5
- Natural attenuation occurring, low dissolved oxygen with utilization of various electron acceptors

Site Map



LEGEND

-  Groundwater monitoring well
-  Groundwater extraction well
-  Groundwater injection well (no longer in use)
-  Abandoned well
-  Closed RCRA - regulated units (former SMNLUs)
-  Railroad tracks
-  Site boundary

Project Objectives

● Objectives

- MNA demonstrated to be effective at the site, but three “hot spots” identified proximal to WC-5, WC-23 & WC-40 needed attention
- Address Agency concerns about these three “hot spots”
 - Analyzed options for mass reductions at these areas
 - Any “hot spot” remediation would have to be compatible with existing natural attenuation
- Evaluate *in-situ* chemical oxidation (ISCO) and *in-situ* Bioremediation (Bio)

Treatability Study

- **Soil and Ground Water Samples Collected**
- **Results of Treatability Testing**
 - Chemical Oxidation
 - Conducted lab scale evaluation of a combination of sodium persulfate (for chemical oxidation) and calcium peroxide (to provide oxygen for aerobic degradation and act as a catalyst)
 - This combination provides a sequential reaction involving an initial chemical oxidation reaction and biodegradation enhancement
 - Biodegradation
 - Conducted lab scale evaluation of application of calcium peroxide formulation alone to enhance observed degradation

Treatability Study

- **Results of Treatability Testing (con't.)**
 - Chemical Oxidation Testing - Good Results
 - Tests indicated that chemical oxidation could be very effective in reduction of 40% of key site SVOCs observed over 29 days of treatment
 - Low pH of site groundwater (~ 5) may require pH adjustment to allow degradation to take place under ideal conditions
 - Biodegradation Testing – Good Results
 - Initial concern was that contaminant concentrations could be toxic to microbes
 - Healthy microbial population determined to be present at the site
 - Initial results positive
 - Degradation and population stability observed
 - Reduction of 50% of key site PAH constituents observed over 29 days of treatment

Treatability Study

- **Conduct Pilot Studies to replicate results of bench studies in the field**
- **Selected Products**
 - PermeOx Plus (POxP) – Timed oxygen release product consisting of engineered calcium peroxide, also acts as “conditioning agent” and activator for OBC
 - Klozur OBC (OBC) – Long-term oxygen release product, activated by POxP
- **Recipe**
 - WC-5 & 23 (primarily PCP) – combination of POxP and Klozur OBC, injection through direct push rig
 - WC-40 (primarily Naphthalene) POxP only, injection through monitoring wells – later direct-push

Pilot Study

1st Injection Event
May 2007



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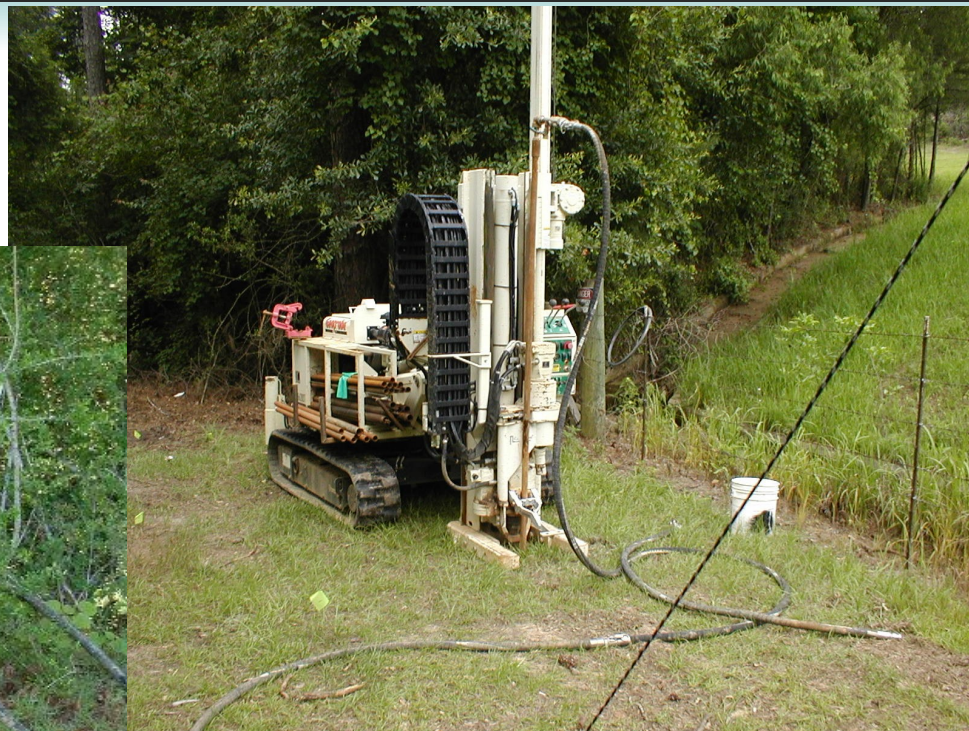


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Pilot Study

2nd Injection Event
November 2007



Pilot Study - 1st Injection

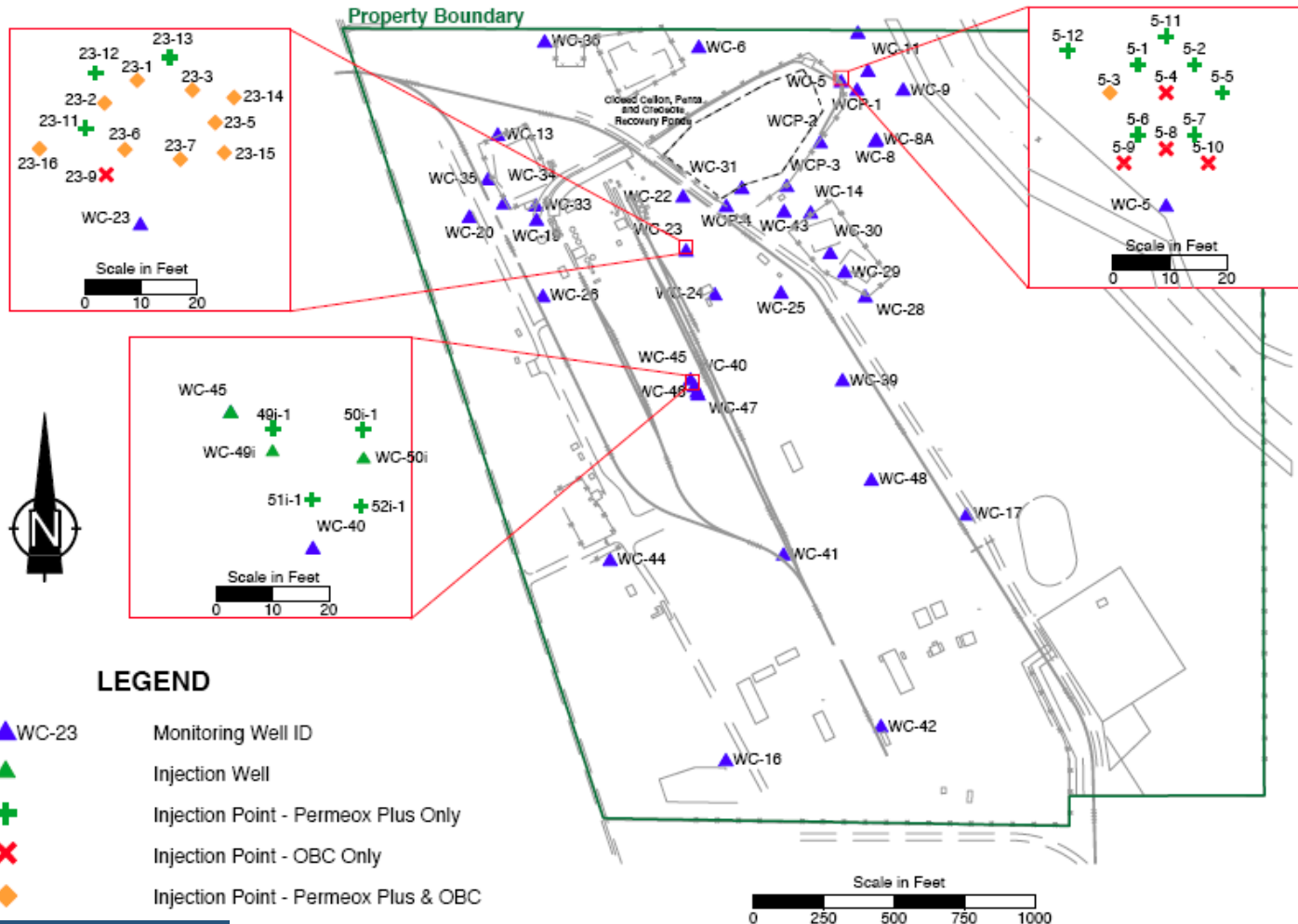
Pilot Study Approach

- Combination ISCO/Bio approach for WC-5, WC-23
- Bio approach only for WC-40
- Injection up-gradient of, and within, Hot-Spot areas; collection of post-treatment groundwater samples from Performance Assessment MWs @ ~ 60, 90, 120 days

Original Recipe

- WC-5 area
 - 5,200 #s POxP
 - 1,800 #s OBC
- WC-23 area
 - 5,000 #s POxP
 - 8,400 #s OBC
- WC-40 area
 - 1,500 #s POxP

Pilot Study Target Areas - 1st Injection



1st Injection Results

- **WC-5 and WC-23**

- Connection with both wells noted during injection, products injected via direct push methods.
- Concentrations of PCP and Naphthalene initially rise due to desorption from aquifer media, then decline
- pH increased to >11 and remains elevated in WC-5. Similar increase in WC-23, then started to drop off
- Globules of product no longer present in WC-5

- **WC-40**

- Connection not as evident, could not inject product in injection wells due to plugging, limited success with direct push methods.
- Slight pH increase, little change in naphthalene initially

Pilot Study - 2nd Injection

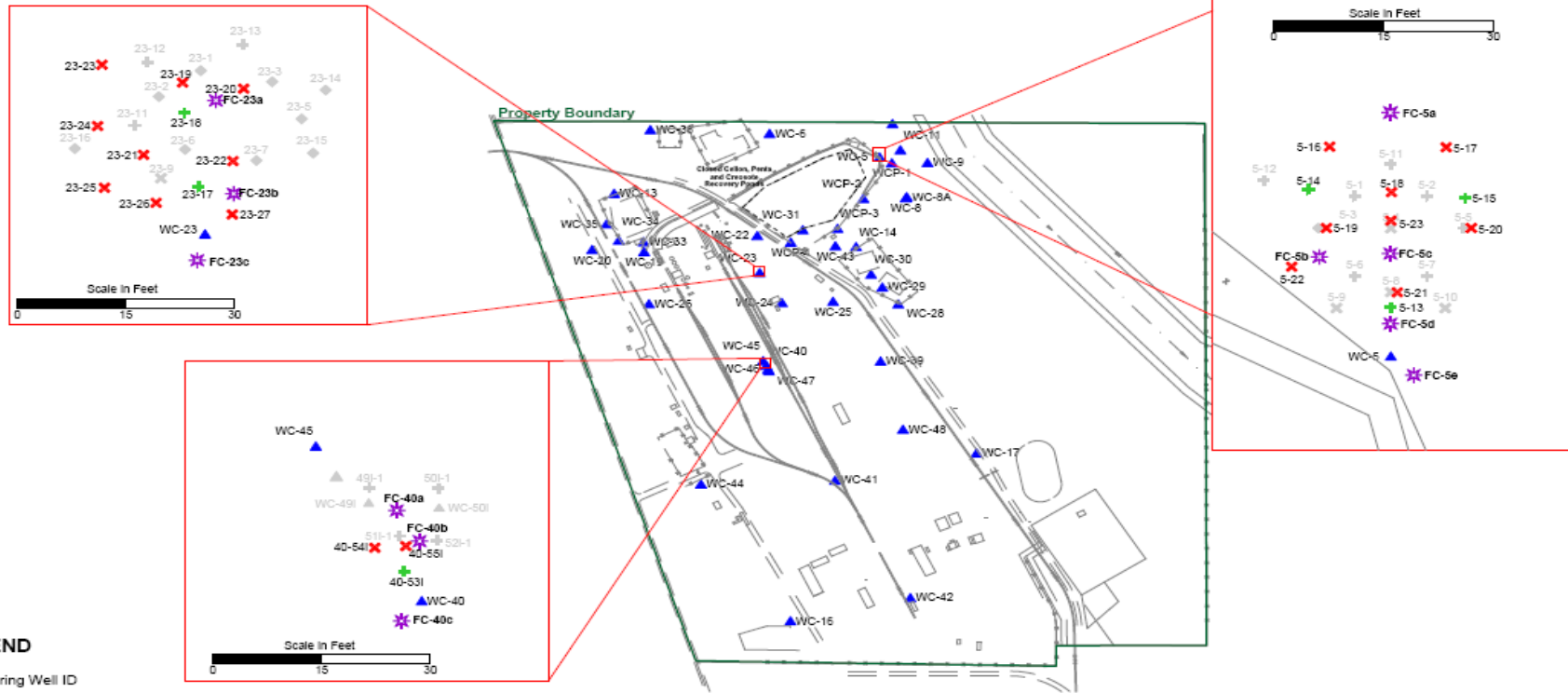
Pilot Study Approach – 2nd Injection

- Combination ISCO/Bio approach for all hot spots
- Direct-push for WC-40 area
- Injection up-gradient of, and within, Hot-Spot area; collection of post-treatment groundwater samples from Performance Assessment MWs @ ~ 60, 90, 120 days

Recipe

- WC-5 area
 - 1,333 #s POxP
 - 2,200 #s OBC
- WC-23 area
 - 1,000 #s POxP
 - 4,500 #s OBC
- WC-40 area
 - 222 #s POxP
 - 1000#s OBC

Pilot Study Target Areas – 2nd Injection

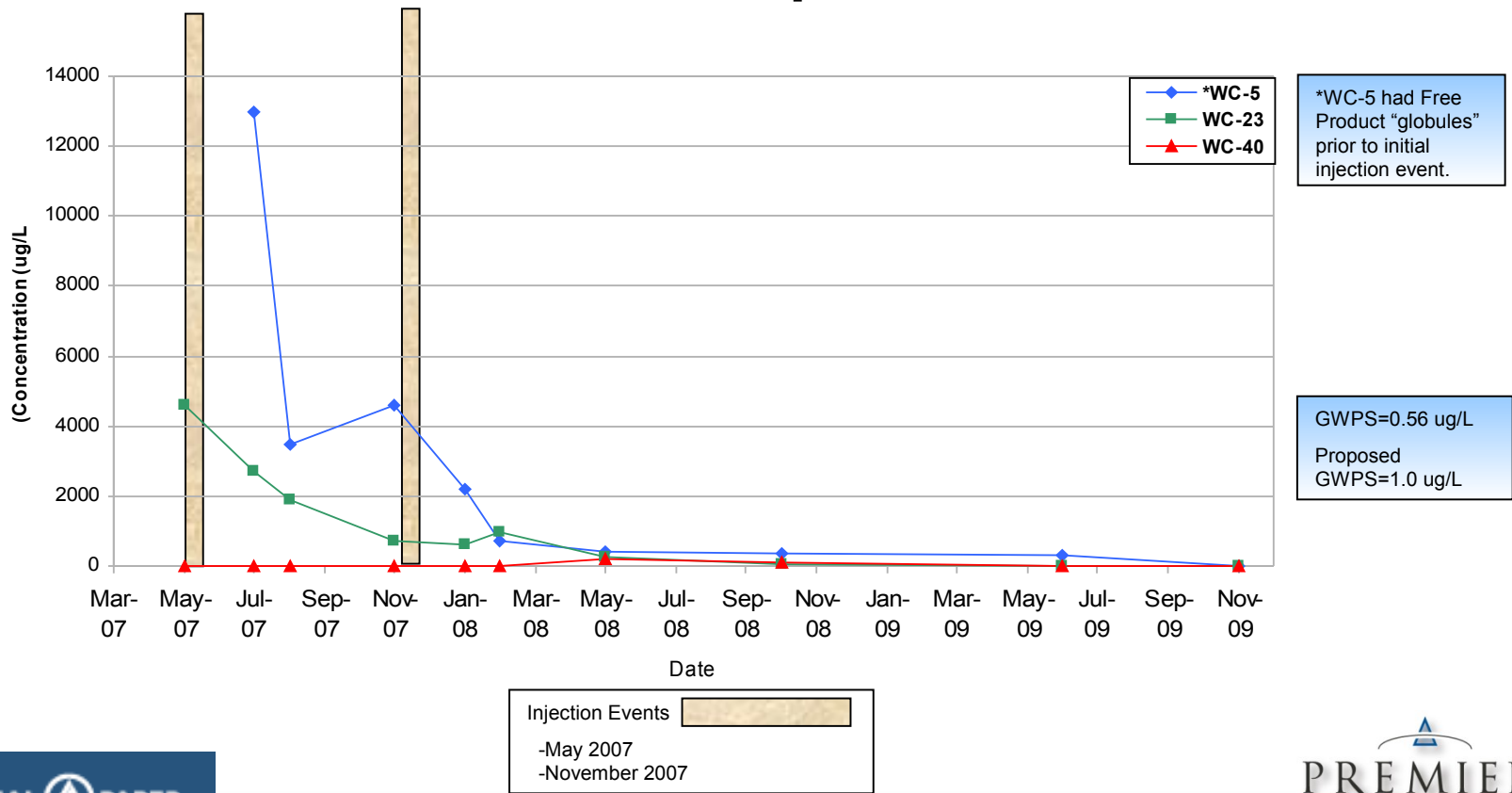


LEGEND

- ▲ WC-23 Monitoring Well ID
- ▲ Injection Well
- + Injection Point - Permeox Plus Only
- × Injection Point - OBC Only
- ◆ Injection Point - Permeox Plus & OBC
- ✱ Field Chemistry Direct Push Boring

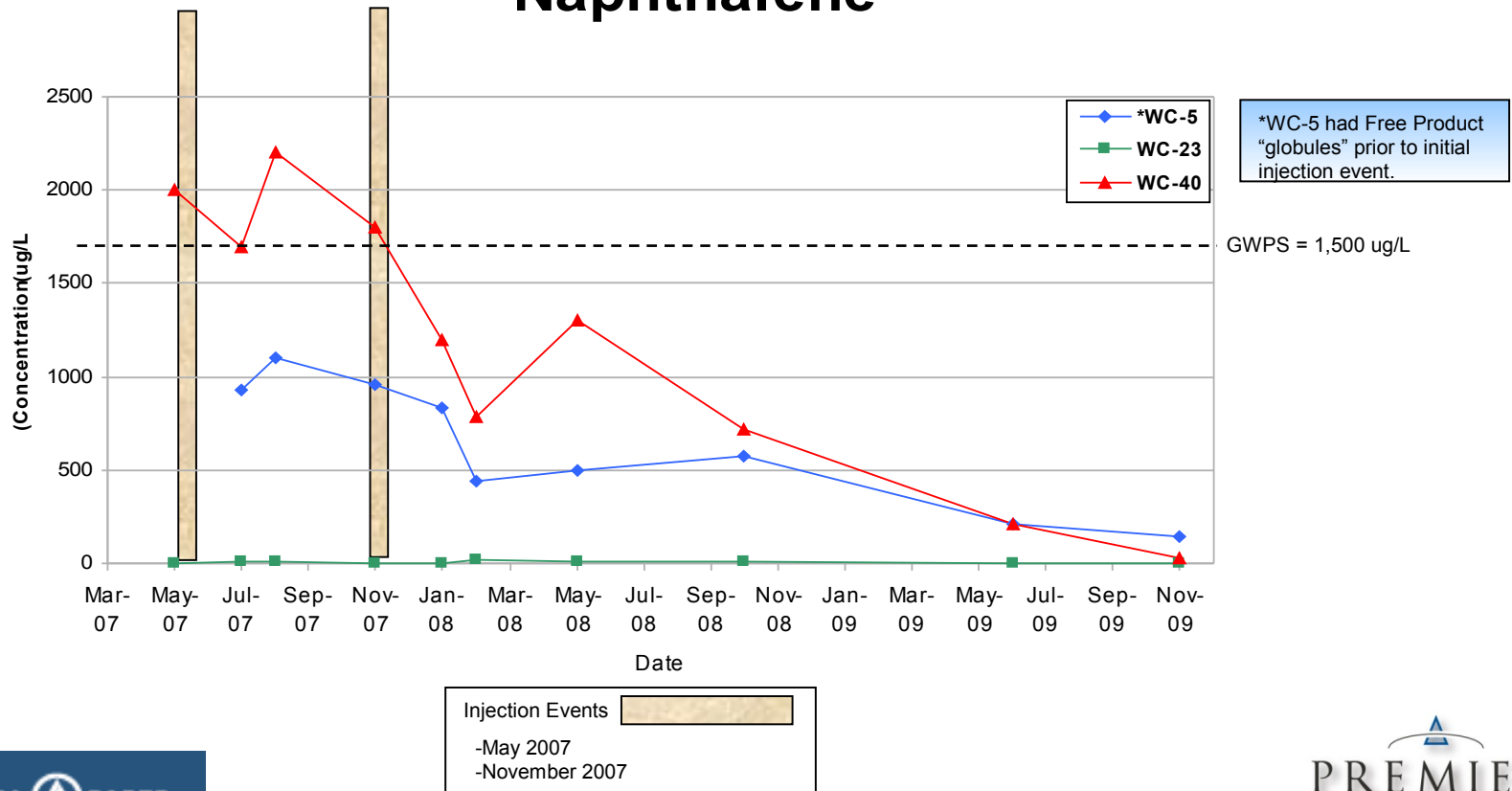
Pilot Study Results + Long Term

Pentachlorophenol



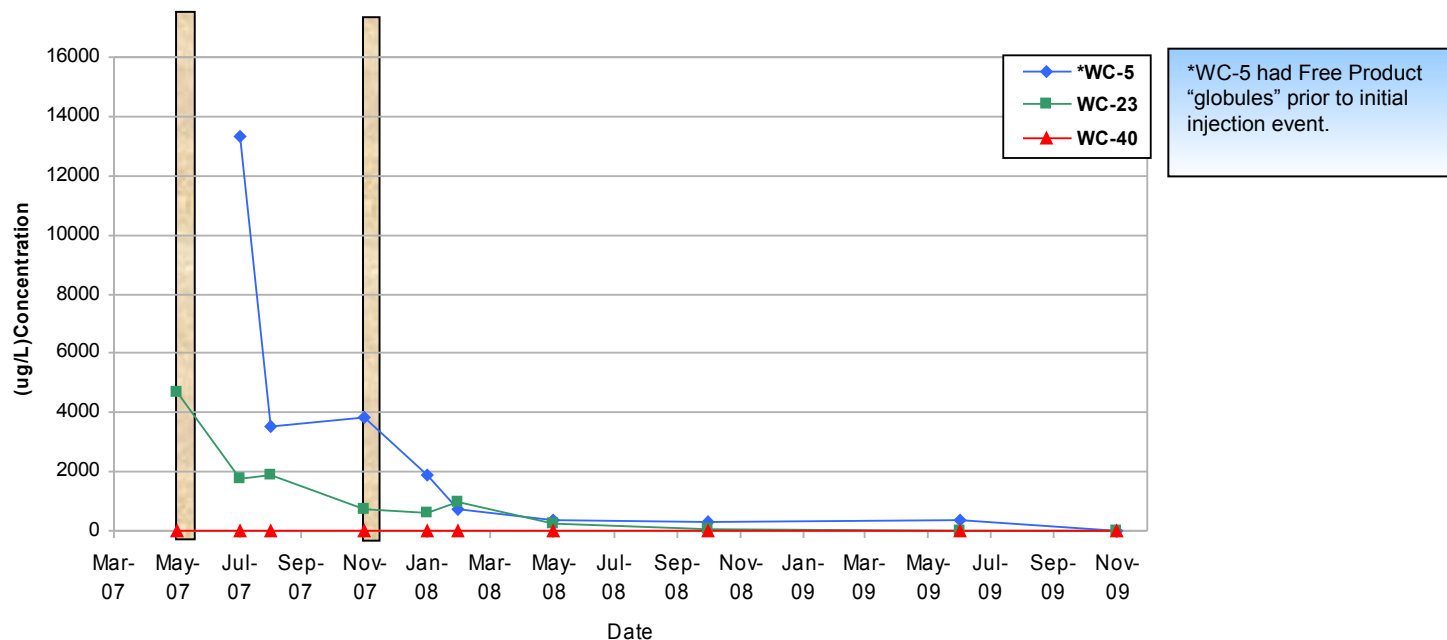
Pilot Study Results + Long Term

Naphthalene



Pilot Study Results + Long Term

Total PCP and Breakdown Products

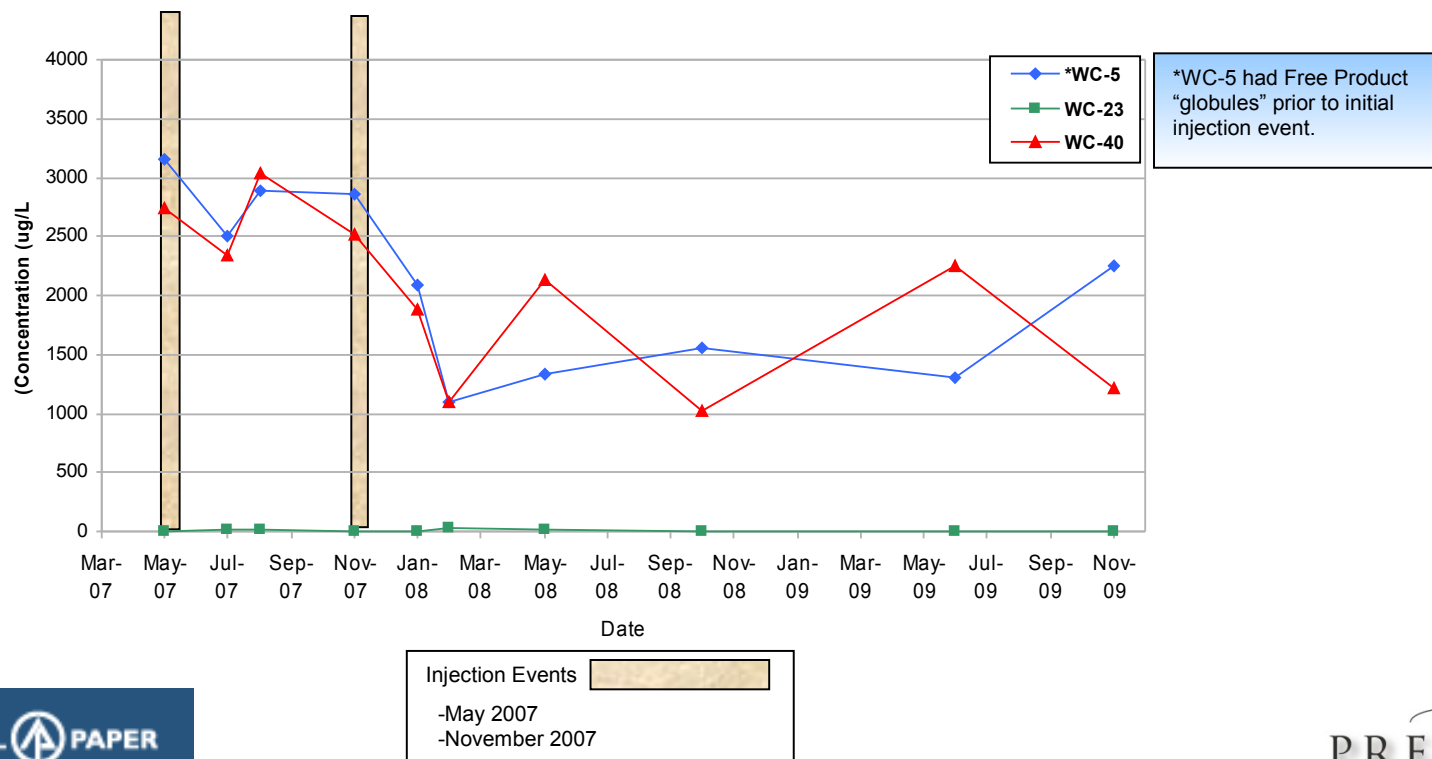


*WC-5 had Free Product "globules" prior to initial injection event.

Injection Events 
-May 2007
-November 2007

Pilot Study Results + Long Term

Total Creosote Constituents



Pilot Study Results

- **ISCO/Bio treatment effective for “hot spots”**
 - Product “globules” eliminated at WC-5
 - Complements active natural attenuation at site
 - PCP concentrations reduced at both “PCP hotspots”
 - WC-5 - >99.9% reduction (13 to 0.0039 mg/L)
 - WC-23 - >99.9% reduction (4.9 to 0.0031 mg/L)
 - (WC-40 - remains in low ug/L range (0.0012 mg/L))
 - PCP & breakdown products reduced at both “PCP hotspots”
 - WC-5 - >99.9% reduction (13.35 to 0.0039 mg/L)
 - WC-23 – >99.9% reduction (5.05 to 0.0031 mg/L)
 - (WC-40 - remains in low ug/L range (0.0012 mg/L))

Pilot Study Results

- Naphthalene concentrations reduced at both “naphthalene hotspots”
 - WC-5 - 90% reduction (1.4 to 0.14 mg/L)
 - WC-40 – 99.8% reduction (2.0 to 0.0029 mg/L)
 - (WC-23 - remains in low ug/L range (0.0009 mg/L))
- Creosote constituents reduced at both “naphthalene hotspots”
 - WC-5 - 29% reduction (3.150 to 2.246 mg/L)
 - WC-40 - 53% reduction (2.289 to 1.209 mg/L)
 - (WC-23 – remains in low ug/L range (0.0009 mg/L))

Conclusions

- ISCO/Bio effective treatment for “hotspots”
- Significant concentration reductions achieved
- Approach is compatible with active natural attenuation at site
- Periodic ISCO/Bio injection likely to be incorporated into CAP under RCRA post closure permit