RESTORATION ADVISORY BOARD MEETING
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT BETHPAGE
BETHPAGE COMMUNITY CENTER
BETHPAGE, NEW YORK
August 4, 2004

The twelfth meeting of the RAB began at approximately 7:00 pm. Meeting attendees included representatives from the Navy (Jim Colter, Mark Leipert, and Joe Kaminski), Town of Oyster Bay (Richard Pfaender), New York State Department of Environmental Conservation (Steve Scharf), and RAB community members: Jim McBride, Mike McEachern (for Mike Grello), Roy Tringali, Rosemary Styne, Charles Bevilacqua, and Ed Resch. The agenda for the meeting is attached (Attachment 1).

WELCOME AND AGENDA REVIEW

The Navy RAB Co-chair, Mr. Kaminski, Naval Air Systems Command, welcomed everyone to the RAB and reviewed the topics on the agenda.

A 3-day RAB workshop was held in July in Salt Lake City, Utah, which the Community RAB Co-chair, Mr. McBride, attended. At the workshop there were presentations on different remedial technologies, on Navy funding for remedial work, and recent Navy policy regarding remediation. Mr. McBride said he received a lot of information as well as contacts for getting additional information. He enjoyed the workshop, felt it was a positive experience, and a good opportunity to meet with other RAB Community Co-chairs. At the workshop, the Community Co-chairs agreed that one of the biggest challenges is how to get more community involvement in the RAB. The Community Co-chairs discussed other challenges associated with starting up the RAB and continuing with the RAB, many of which Mr. McBride indicated the Bethpage RAB has experienced and worked through.

The Community RAB members indicated overall satisfaction with the RAB, but would like more community involvement in the Bethpage RAB. The Community RAB members indicated that they would provide the Navy with a list of community organizations and other names to expand the RAB mailing list. The Navy will include these names and organizations on the mailing list for the next RAB meeting, which is scheduled for the first Wednesday in November.

Mr. McBride then indicated that a Navy representative gave a presentation regarding the Navy's new policy of not funding any new remedial systems that involve using a "pump and treat" technology. He asked Mr. Colter if he could elaborate some on this new policy. Mr. Colter responded that he would be giving a brief presentation of this issue shortly.

TRANSCRIPTS/MINUTES

Mr. Colter (EFANE) explained that the Navy was unable to mail out the previous RABs minutes and transcripts before the August RAB meeting because the stenographer's transcripts have not been completed. This has been an ongoing problem.

During the initial RAB meetings, because of potential disagreements about statements at the meeting, a stenographer was used to document everything said at the meetings. However, there has been difficulty getting the stenographer's transcripts in a timely manner and the Navy proposed having the meeting minutes prepared without a stenographer. Mr. Colter indicated

that the RAB meetings have been going smoothly and he does not think that word for word documentation is needed for the RAB meetings. Also, the minutes can be issued much quicker.

Ms. Jennifer Maue, the stenographer at the meeting, explained that it is difficult to prepare stenographer's transcripts for the RAB meetings because of the technical presentation and the multiple discussions that occur at the meetings. She also indicated that there it has been very difficult to find stenographers willing to do this type of work. Mr. McBride agreed that the meetings were going well but would like to discuss it further with the other RAB Community members and then get back to the Navy.

TECHNICAL PROGRESS

General Program

Mr. Colter explained the Navy's recent policy (effective April 23, 2004) on selection of pump and treatment remedies. The Navy policy requires approval from headquarters for any remedies that include a pump and treat component. The policy is meant to prevent long-term systems being installed and operated for 30 years or more with very little chance of meeting drinking water standards (MCLs). Mr. Colter noted that pump and treat systems can be effective when used for groundwater containment, such as the system that Northrop Grumman is running.

Mr. Colter explained that the new policy may impact the decision for GM-38, which includes a pump and treat component and, if so, the ROD for GM-38, signed in April 2003, would need to be re-opened. However, Mr. Colter stated that it was his intention to provide NAVFAC headquarters with enough data and information so as to defend the GM-38 remedy as the most appropriate and cost effective solution for this situation (see Attachment 2).

Mr. Scharf, NYSDEC, also indicated that the decision-makers at NAVFACHQ may not be aware of the State's policy that municipal wells are not to be used as part of the treatment system. Mr. Colter stated that it may be necessary for NYSDEC to provide a letter regarding this policy. Mr. Scharf said that he would do so upon request.

In the meantime, Mr. Colter stated that EFA Northeast is still moving forward with the selected remedy until the issue is resolved with headquarters. The community workshop to discuss potential impacts to the public during the installation and operation of the P&T system is planned for the third or fourth week of September (at this time the meeting has been scheduled for Thursday, September 23, 2004 from 5:30 p.m. to 9:00 p.m and will be held at the Bethpage Community Center). Mr. McBride indicated that NEHC may be able to provide risk communication support for the workshop if general questions on health impacts from the contamination in the groundwater come up at the workshop.

GM-38 Remedy

Mr. Patselas and Mr. Blanchard from Tetra Tech FW (formerly Foster Wheeler Environmental) provided an update on the status of the GM-38 Design and Implementation. Mr. Patselas explained that the work was being completed in two phases, a pre-design investigation (survey completed) and the second phase which involves the installation of injection and extraction wells. Treatment Plant design is at an early stage, and includes review of previous investigation and design documents. A public presentation is planned for mid to late September. Pending the outcome of the presentation, drilling will begin, with the wells to be installed this fall and winter.

In general, the two extraction wells and the injection wells will be installed as flush-mounted wells within a concrete vault with a steel, diamond plate cover. One of the extraction wells is to be placed within the Town of Oyster Bay's road right-of-way at the end of North Windhorst Avenue. The other extraction well and the injection wells were originally planned to be installed in the center of South Herman Street but are now planned to be placed within the New York State Department of Transportation right-of-ways along the Seaford-Oyster Bay expressway. This change will reduce the impacts to the residents along South Herman Street. The Navy/Tetra Tech FW will discuss architectural requirements for the plant building with the Town. Mr. Colter then elaborated on some of the community outreach activities that will be conducted to try to get people potentially impacted by this remedy to be at the September meeting. These activities will include putting a public notice in the local newspaper, mailing a fact sheet to nearby residents and also going door-to-door to personally invite residents to come to the meeting.

AOC 22 Pilot Study

Mr. Lohavanijaya (Arusi/Tierra Technologies) provided a overview of their company and introduced the team working on the project. Mr. Lohavanijaya explained that Tierra with Locus technologies is constructing a pilot scale study to evaluate a closed-loop in-situ bioremediation system that uses naturally occurring microorganisms to breakdown or degrade hazardous substances into less toxic or nontoxic substances (see Attachment 3). They will conduct continuous monitoring of the environment to ensure that the remedy remains effective. The Navy found merit in this technology and wanted to evaluate it as a possible remedial alternative for the AOC 22 site.

The test combines existing technologies into a closed loop system. Specifically, the technology extracts groundwater and discharges it to a bioreactor. In the bioreactor, nutrients are added and the mixture is reinjected into the aquifer in a closed loop. All additives are biodegradable. The technology has been demonstrated for petroleum hydrocarbon contaminants. Long-chain hydrocarbons are broken down to smaller chains accessible for bioremediation. The use of Fenton's Reagent will also be evaluated.

Mr. Peskin (Locus) summarized the site conditions. AOC 22 is a former UST site located south of Plant 3. It is primarily contaminated with No. 6 fuel oil, which is a heavy viscous material. It is found at depths of between 10 and 60 feet below ground surface. The Navy selected an active remediation approach based on NYSDEC comments to address contaminant mass (petroleum) removal from the soil. Volatile organics in groundwater are being addressed separately.

The pilot study includes well installation, baseline sampling (soil, groundwater, and microbiological sampling), bench testing, and treatment system infrastructure installation. During the study, they will identify indigenous microorganisms and culture the ones that will be used in treatment. Mr. Peskin illustrated where wells and piping will be located. The treatment equipment will be housed in an existing structure (GAC building).

Primary milestones for the project include:

Design: July 2004,
Mobilization/installation: August to September 4, 2004
System operation: October 4, 2004 to September 2005.
Report and close out: September 2005 to January 2006.

The potential for migration of soil vapors was questioned by NYSDEC. Mr. Peskin responded that foam injection and the soil vapor extraction system reduces concern. They will also conduct air monitoring, but don't plan on conducting soil gas testing.

Mr. McBride asked whether there are any potential health and safety concerns or exposure problems, also what are the negatives?

Mr. Peskin responded that the use of Fenton's reagent is the only thing that can cause a problem.

Mr. McBride suggested providing Material Safety Data Sheets for any materials on site to the Bethpage fire department. Mr. Peskin responded that the MSDS sheets are posted at site, but that they will provide them to the fire department so that they can be prepared. The Navy will follow-up on this action.

The potential use of this technology at the GM-38 area was questioned. Mr. Colter responded that there is bacteria that can be used for the GM-38 contaminants, but that it would not be effective for the GM-38 area.

The potential release of other chemicals to environment was questioned. Mr. Colter responded that there should not be any release of other chemicals, but at the request of the NYSDEC, the Navy is installing downgradient monitoring wells to ensure that this technology is a closed system.

Site 1 Soil Risk Evaluation

Based on a request from RAB members, the Navy evaluated potential risks to offsite residents associated with PCB-contaminated soils at Site 1. In particular there was concern regarding dust migration.

Mr. Brayack (TtNUS) explained that at Site 1, during the initial evaluation of the site in the early 1990's, a small soil area was found that contained elevated PCB concentrations. At that time, the area was covered with soils to prevent potential direct exposure and dust migration. The remaining soils at the site contain much lower concentrations of PCBs.

To evaluate this concern, TtNUS used the EPA screening guidance that considers potential risks associated with dust migration from a contaminated site. Mr. Brayack explained the input parameters and results (See Attachment 4). The evaluation indicated that fugitive dust is not currently a concern. In addition, it was noted that the site will be remediated to address the remaining PCBs at the site.

Mr. McBride asked whether this approach was reviewed by an industrial chemist. Mr. Brayack explained that the calculations were conducting using EPA's risk assessment guidanceand that this type of evaluation is outside the normal experience of an industrial chemist.

Administrative Record Web Page

Mr. Brayack indicated that the Navy tasked TtNUS to scan historical documents onto CDs and to put the information on a web page. The Bethpage documents are divided into pre-ROD and post-ROD documents. The pre-ROD documents are currently available on both disk (CD) and the web (see Attachment 5).

The address for the web page is:

Http://www.ttnus.com/bethpage

Once in the webpage, it will ask for a user name (Bethpage) and a password (Colter) (do not include the parenthesis for access).

The post-ROD documents are currently being finalized and should be available soon on the same web page.

Mr. Brayack explained that the CD- and web-based records contain the same information, but use of the records is not identical. The CD is fully searchable, whereas the web version is only searchable on the page illustrated. The Website has only been up for a week and he suggested that people try it. He also noted that when a document is large, it may take some time to download the file, depending on the computer hook up.

Mr. McBride requested a copy of the CDs. The Navy indicated that they will provide several copies to RAB members, as well as the local libraries. However, because of record keeping requirement, they will still provide the libraries with paper copies.

CLOSING REMARKS

Mr. Kaminski asked if there were additional questions or topics for discussion. There were none and the meeting was adjourned at approximately 9 pm.

Action Items:

1. The RAB community members are to provide a mailing list to increase public notification.
2. NYSDEC will also provide the State's mailing list.
3. The Navy will provide MSDSs (for AOC 22 testing) to the local fire department.
4. The RAB community members will discuss the future need for a stenographer at the meetings.
5. When they become available, the Navy will provide pre-and post-ROD CDs to the RAB.

ATTACHMENT 1

Agenda

Restoration Advisory Board
Naval Weapons Industrial Reserve Plant Bethpage

August 4, 2004
Bethpage Community Center, Bethpage, NY
7:00 p.m.

Welcome and Agenda Review
Joe Kaminski
Naval Air Systems Command

Transcripts/Minutes
All Members

Technical Progress

General Program - Jim Colter, Engineering Field Activity, Northeast

GM-38 Remedy - Stavros Patselas, Tetra Tech FW

AOC 22 Pilot Study - Dan Lohavanijaya, Arusi

Site 1 Soil Risk Evaluation - Dave Brayack, Tetra Tech NUS

Administrative Record Web Page - Dave Brayack, Tetra Tech NUS

Closing Remarks
Joe Kaminski
Naval Air Systems Command

Presenters will be available after the program for questions.

ATTACHMENT 2

NAVFAC
Naval Facilities Engineering Command

EVALUATION OF GM-38 AREA REMEDY

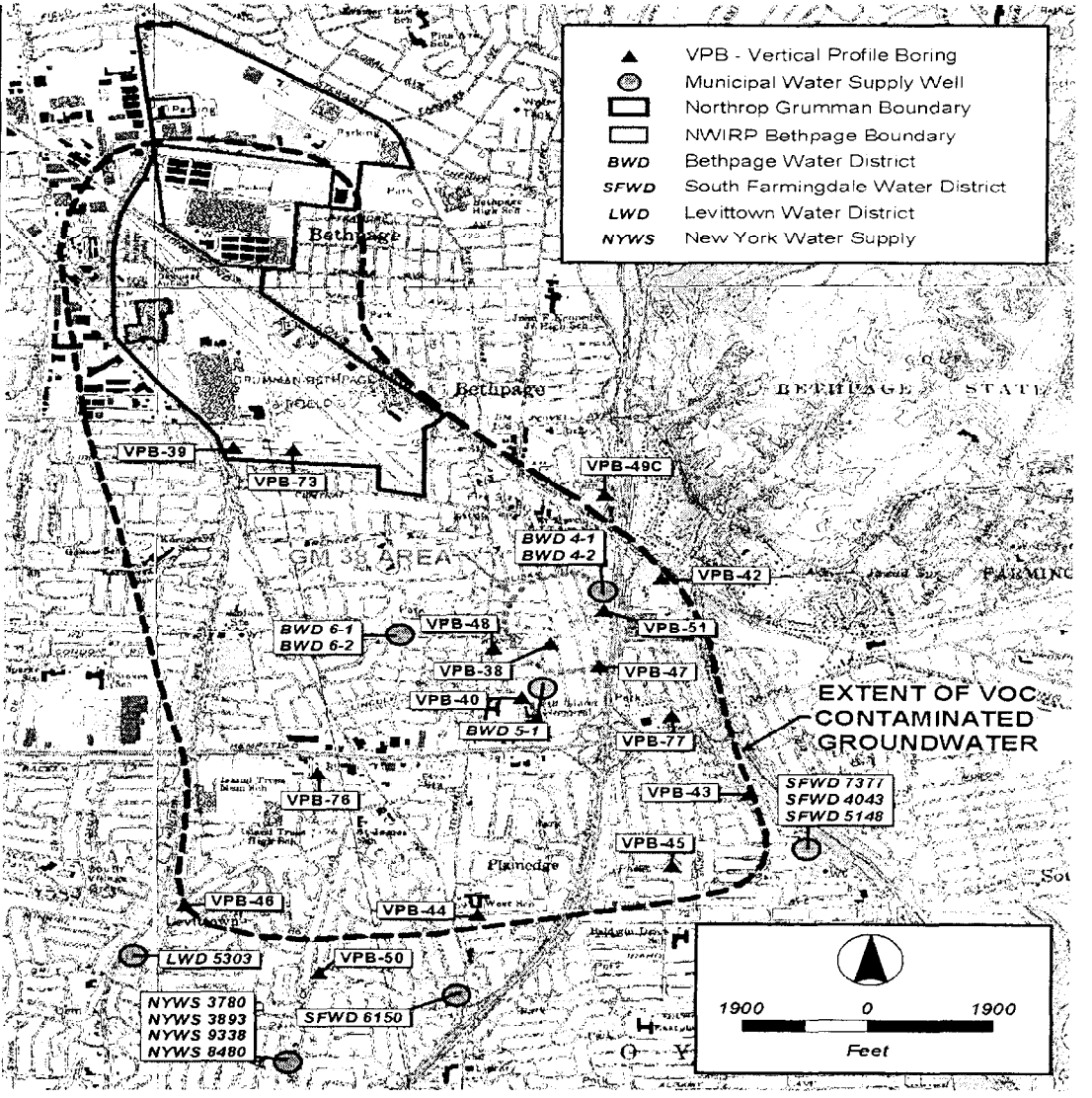
GROUNDWATER EXTRACTION AND TREATMENT VS. CHEMICAL DESTRUCTION

8/4/2004

EVALUATION OF GM-38 AREA REMEDY

NAVFAC

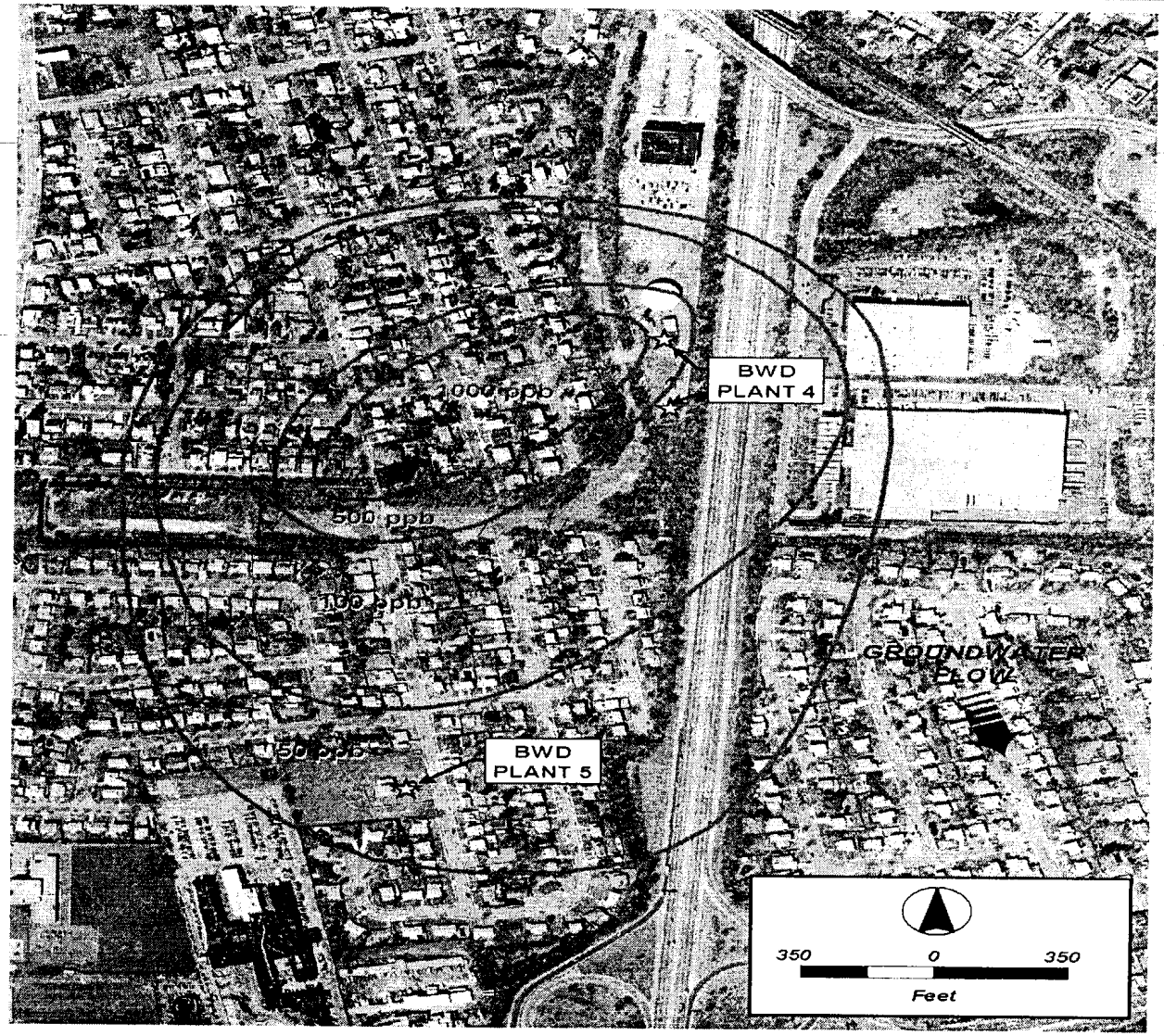
FIGURE 1
GM-38 AREA AND GROUNDWATER PLUME LOCATION MAP



EVALUATION OF GM-38 AREA REMEDY

NAVFAC

FIGURE 2
GM-38 AREA



EVALUATION OF GM-38 AREA REMEDY

- Current NAVFACHQ Policy
  - " . . . any plans to install new Pump & Treat systems on Navy/Marine Corps installation requires approval from Headquarters (HQ) at the Naval Facilities Engineering Command (NAVFAC)."
  - Effective Date: 23 April 2004

- Reasons for the new policy
  - P&T systems rarely meet the Remediation Goal of MCL (5 ppb)
  - Shortly after startup, P&T become very inefficient
  - NAVFACHQ no longer wants to run P&T's for a long time (i.e. 30 years) with little chance of meeting cleanup goals

EVALUATION OF GM-38 AREA REMEDY

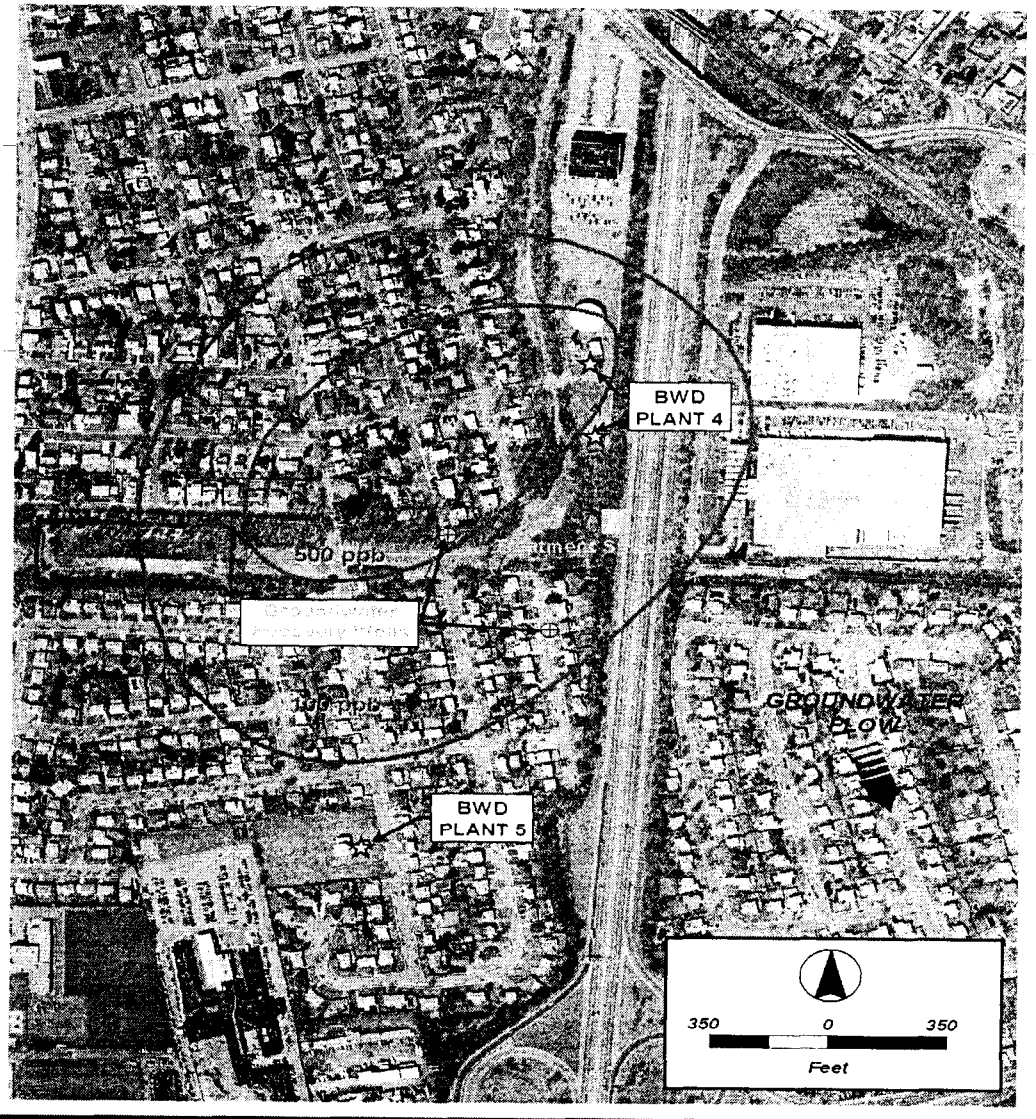
- Record of Decision (ROD) for GM-38 Area signed April 2003

- EFANE still submitted Purpose for GM-38 Remedy to NAVFACHQ for review IAW new policy stating:
  - Goal for GM-38 Remedy is for mass removal of VOCs from aquifer
  - Goal IS NOT the remediation of groundwater within the GM-38 Area to drinking water standards
  - System to operate for a period of time until the contaminant concentration of the GM-38 Area resembles the remainder of the TVOC plume (specific concentration = ??)
  - Computer model indicates that the GM-38 Area can be remediated to concentrations below 100 ppb in around 5 years and to 50 ppb in around 10 years

EVALUATION OF GM-38 AREA REMEDY

NAVFAC

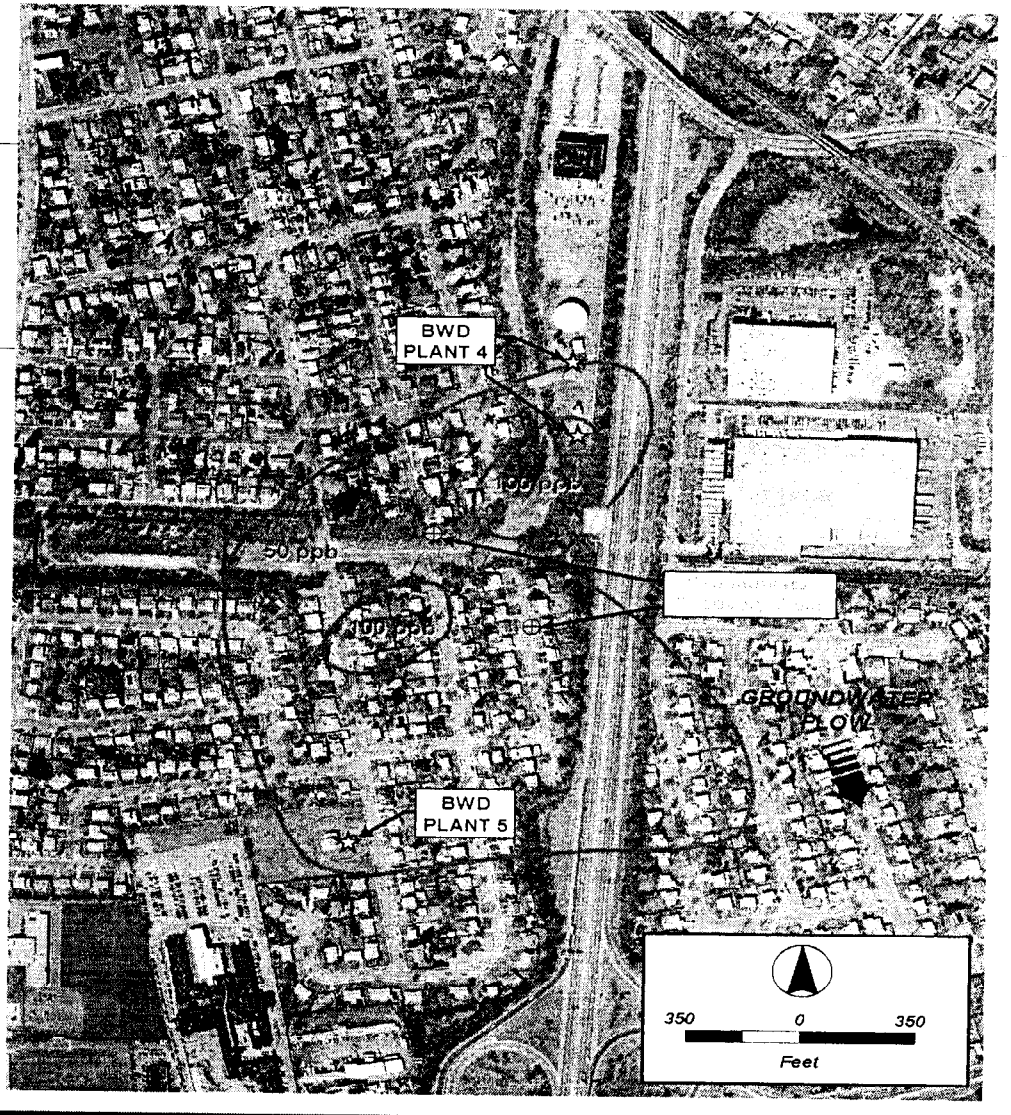
FIGURE 3
GM-38 REMEDY
CURRENT CONDITIONS



EVALUATION OF GM-38 AREA REMEDY

NAVFAC

FIGURE 4
GM-38 REMEDY
5 YEARS OF OPERATION



EVALUATION OF GM-38 AREA REMEDY

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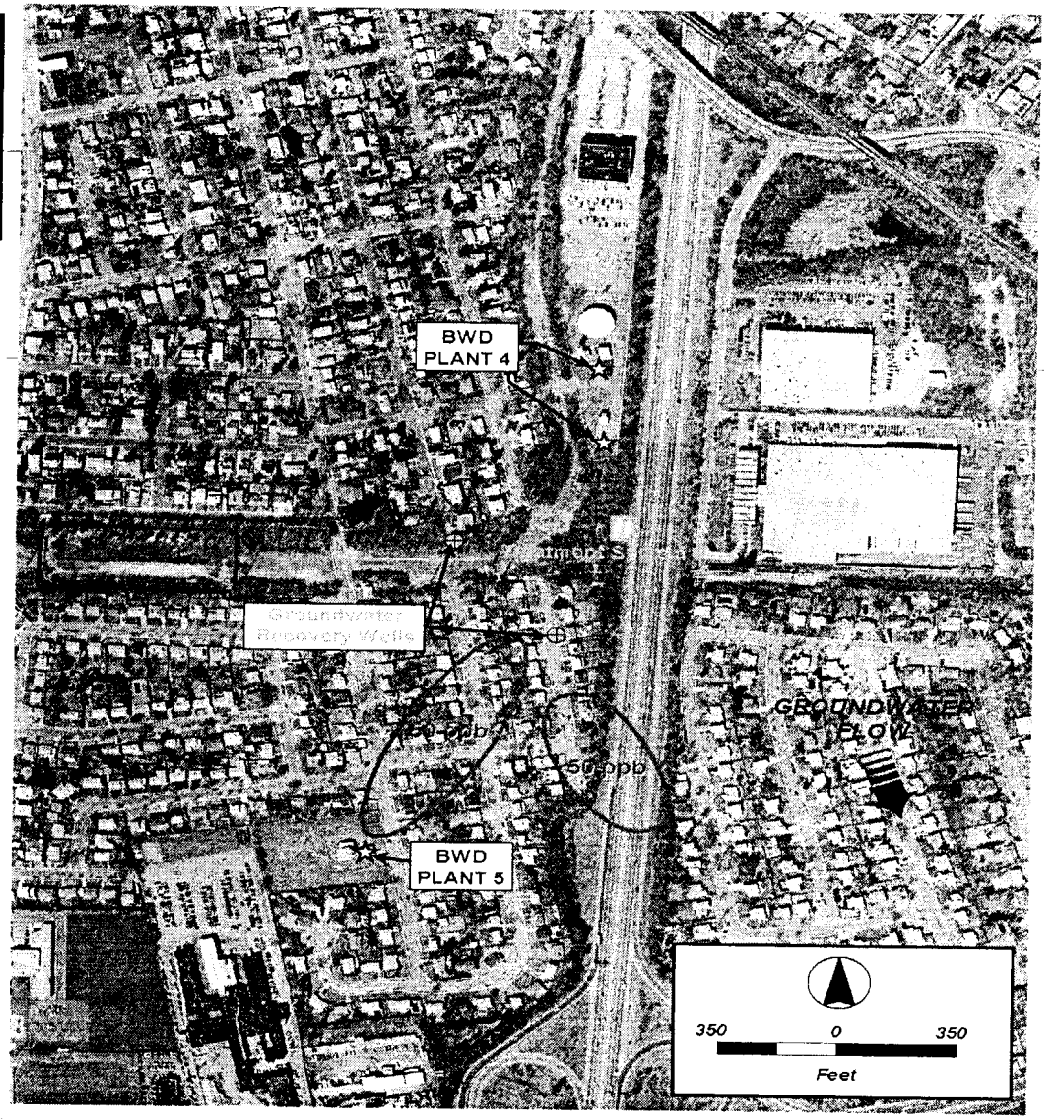
FIGURE 5
GM-38 REMEDY
10 YEARS OF OPERATION



EVALUATION OF GM-38 AREA REMEDY

- **NAVFACHQ sent package out for technical review**
  - **6 technical reviews submitted from NAVFAC family**
  - **Most comments mentioned their skepticism with the model predictions**
  - **They question the need for "hot-spot" treatment and suggested**
    - Plan to install additional stripping units for wells where the concentration of the influent may exceed that treatment system's design criteria
    - Plan for the installation treatment systems on downgradient supply wells
  - **Suggest if "hot-spot" treatment is insisted upon, then to use enhanced bioremediation (chemical injection)**

EVALUATION OF GM-38 AREA REMEDY

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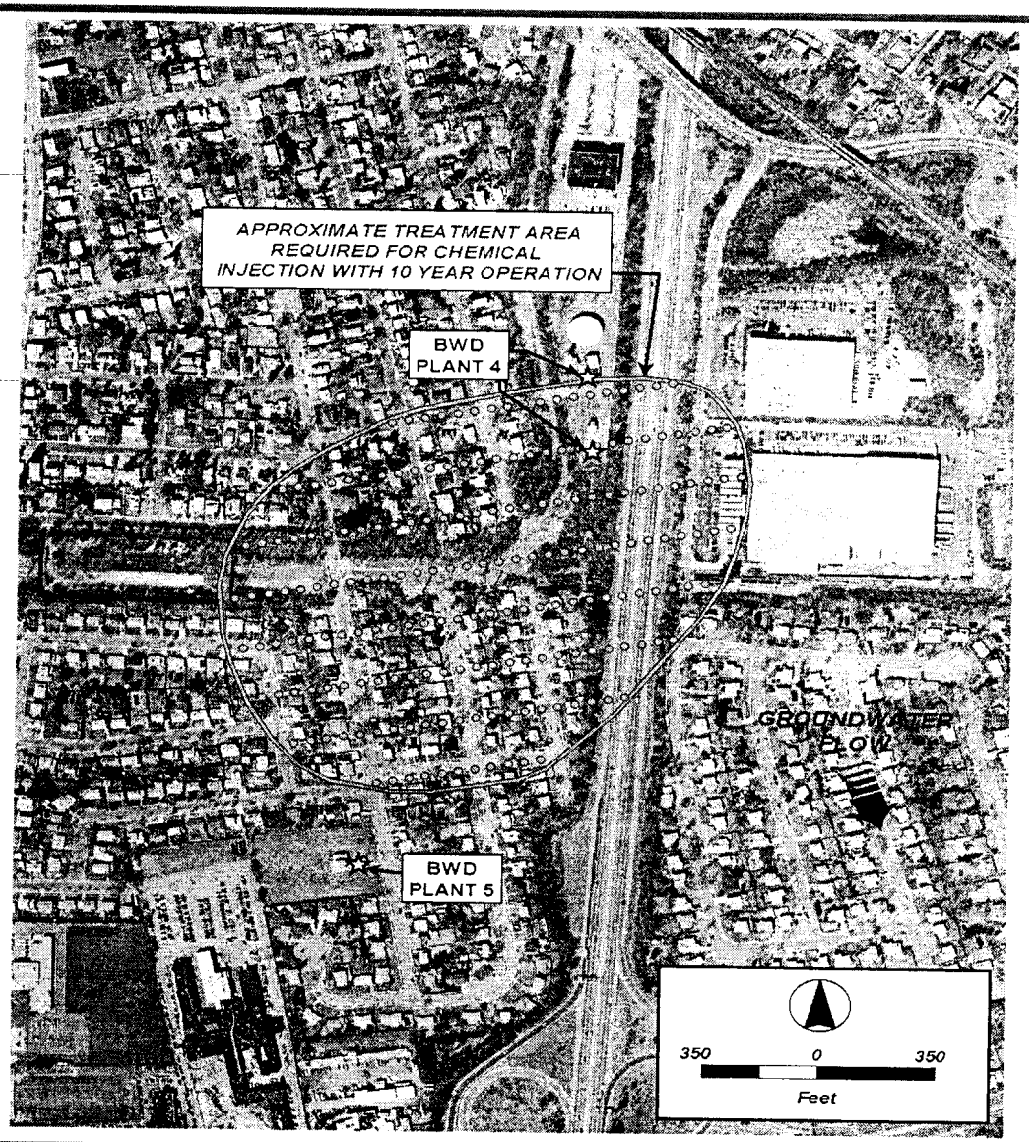
FIGURE 6
GM-38 AREA
CHEMICAL DESTRUCTION



EVALUATION OF GM-38 AREA REMEDY

- **EFANE Position**
  - **P&T is still the best approach to achieve the goal of this remedy**
  - **NAVFACHQ Policy mandated "after" Navy ROD signing of April 2003 for this action which is also consistent with NYSDEC's OU 2 ROD of March 2001 (State Acceptance Unlikely)**
  - **Other Alternative (Chemical Injection) unimplementable**
    - Securing Real Estate Interests for 160 to 200 homes unlikely
    - Drilling on or near Seaford-Oyster Bay Expressway is not practical
- **Capital Costs associated with the P&T alternative ($5.7M) are not more expensive than Chemical Destruction alternative ($14.4M)**

EVALUATION OF GM-38 AREA REMEDY

- CONCLUSIONS
  - EFANE agreed to submit the Remedial Design Report for P&T to an independent third-party for an "optimization" review
  - NAVFACHQ will approve expenditure for the construction of the GM-38 Remedy only if the RD includes an "Exit Strategy"

ATTACHMENT 3

tierra technologies
A DIVISION OF AR UTILITY SPECIALISTS, INC.

Locus

THE CLOSED-LOOP *IN SITU* BIOREMEDIATION SYSTEM

Agenda

- Company Overview
- The Closed Loop *In-Situ* Bioremediation System
  - Description
  - Operation
  - Additives
  - Case Studies
  - Advantages
- NWIRP Bethpage Area of Concert (AOC) 22 Project Overview
- Questions and Discussion

Company Overview

Who we serve:

The Closed-Loop *In-Situ* Bioremediation System

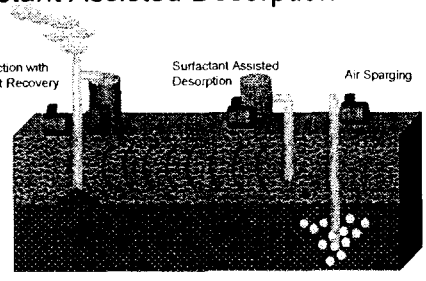
What is Bioremediation?

- A process that uses naturally occurring microorganisms to breakdown or degrade, hazardous substances into less toxic or nontoxic substances.
- A cost effective, natural process application to many common organic wastes, include hydro-carbon contaminates.
- Techniques that can be conducted on-site.
- Technology useful where rapid remediation is a high priority.

The Closed-Loop *In-Situ* Bioremediation System

System Description

- Combines Proven Technologies:
  - Vapor Extraction with Free Product Recovery
  - Air Sparging
  - Surfactant Assisted Desorption



The Closed-Loop *In-Situ* Bioremediation System

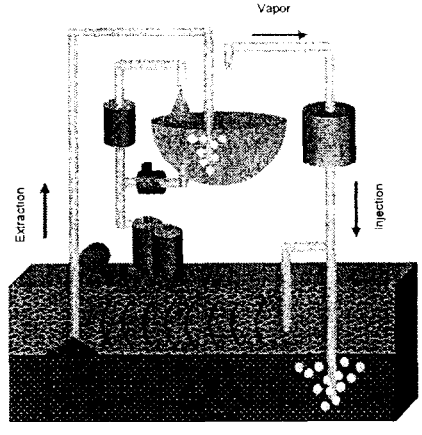
System Operation

Liquid media is recirculated through the bioreactor O2 and nutrients are added to promote growth of desired microorganisms

Soil vapor is sparged into the adsorption tank

Soil vapor is extracted from Subsurface bioreactor

Prior to starting the system, Any existing free product is recovered



Vapor containing the desired microorganism, moisture, nutrients and heat exits the adsorption tank

Nutrients, heat, and surfactant are added and injected into the subsurface environment

A subsurface bioreactor Is created and maintained

Vapor from the above-ground Bioreactor oxygenates the groundwater and volatizes the contaminant

The Closed-Loop *In-Situ* Bioremediation System

The Biotreatment Additives

- Meta-Boost^{SM} – Enhances the metabolic rate of bacteria
- Nitro-Boost^{SM} – Provides nitrogen, phosphorus, and other nutrients
- Desorb-A^{SM} – Foam surfactant that emulsifies adsorbed hydrocarbons, transports nutrients, oxygen, and microorganisms
- Deep-Treat^{SM} – Provides an oxygen rich environment, removes competitive microorganisms
- All additives are completely biodegradable

The Closed-Loop *In-Situ* Bioremediation System

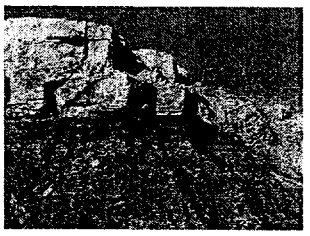
Meta-Boost ^{SM}

- Metabolic and growth stimulator for bacteria
- Promotes bacteria reproduction
- Contains slow release carbons (humic and fulvic acids) and alkaloids
  - Slow release carbons provide a ready food source to support and promote bacterial growth
  - Alkaloids promote rapid cell growth resulting in accelerated bacterial reproduction
- Completely biodegradable

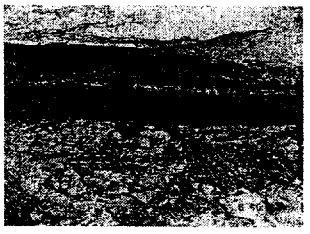
The Closed-Loop *In-Situ* Bioremediation System

Key Ingredient

- Key ingredient in additives derived from Leonardite deposit aged 75 million years
- Optimum quality due to unique geologic history
- 12% Humic Acid
- 2-3% Fulvic Acid



Sealed Rock Cap Covering Humic Deposit



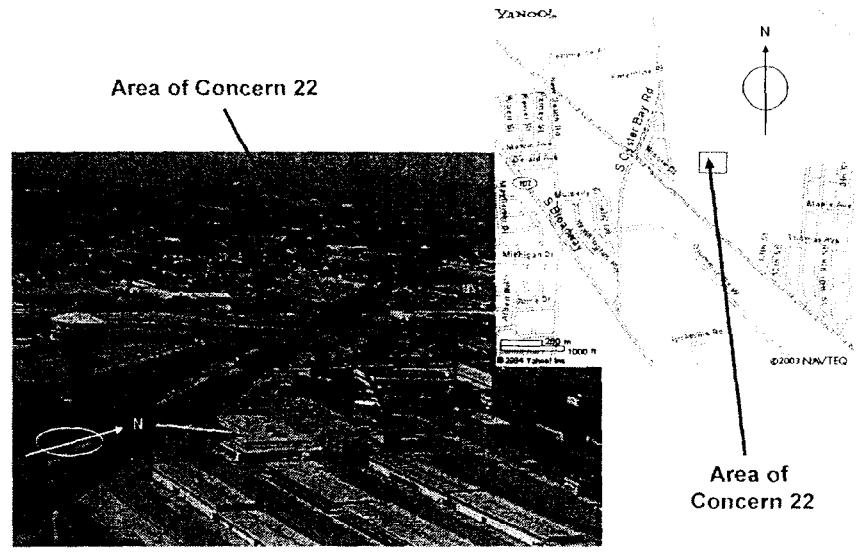
Humic Shale Deposit

The Closed-Loop *In-Situ* Bioremediation System

Desorb-A SM

- Biosurfactant wetting agent
- Foam surfactant that emulsifies adsorbed hydrocarbons
- Acts as the transport media for nutrients, oxygen, and microorganisms to the subsurface bioreactor
- Contains mixture of ionic and neutral surfactants including naturally generated surfactant from *pseudomonas aeruginosa* bacteria
- Completely biodegradable

NWIRP Bethpage AOC 22 Project Overview



NWIRP Bethpage AOC 22 Project Overview

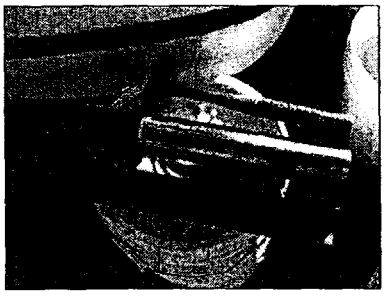
Project Background

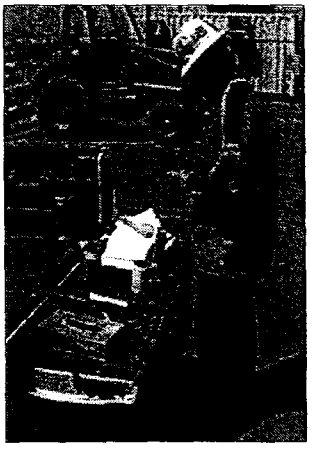
- Former underground storage tank (UST) site located south of Plant 3.
- Investigations between 1997-2002 confirmed the presence of petroleum product in soils at 10-60 ft below ground surface (bgs)

NWIRP Bethpage AOC 22 Project Overview

Project Approach – Infrastructure

- The Closed-Loop Bioremediation System uses bacteria cultured from the contaminated site to achieve remediation.

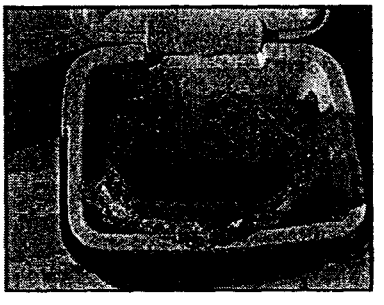




NWIRP Bethpage AOC 22 Project Overview

Project Approach – Infrastructure

- Isolation of indigenous hydrocarbon degrading species
- Species identification



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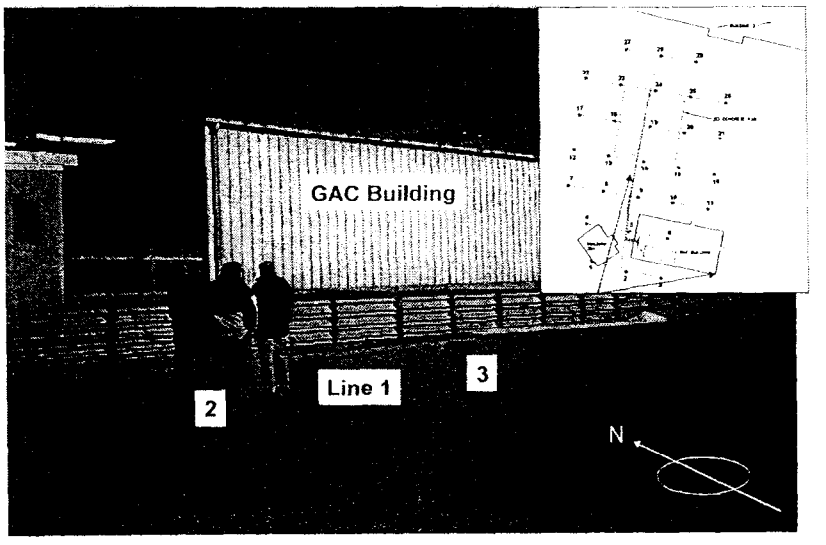
NWIRP Bethpage AOC 22 Project Overview



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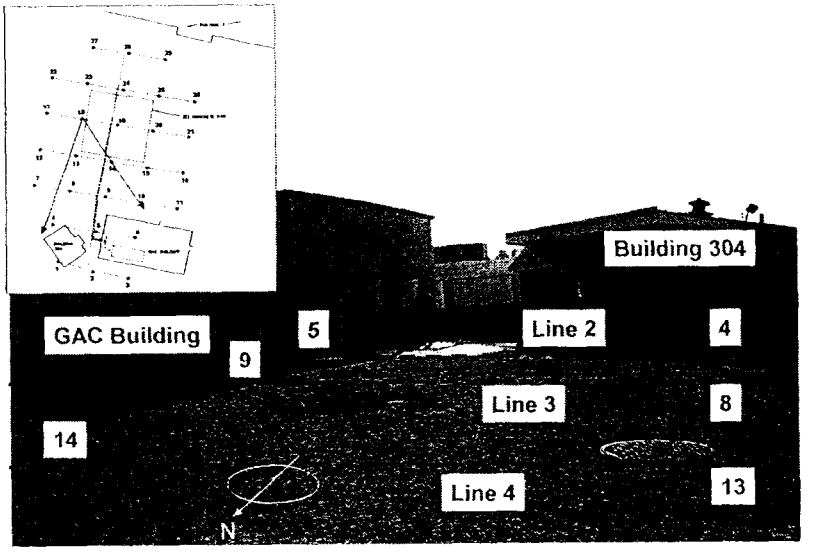
NWIRP Bethpage AOC 22 Project Overview



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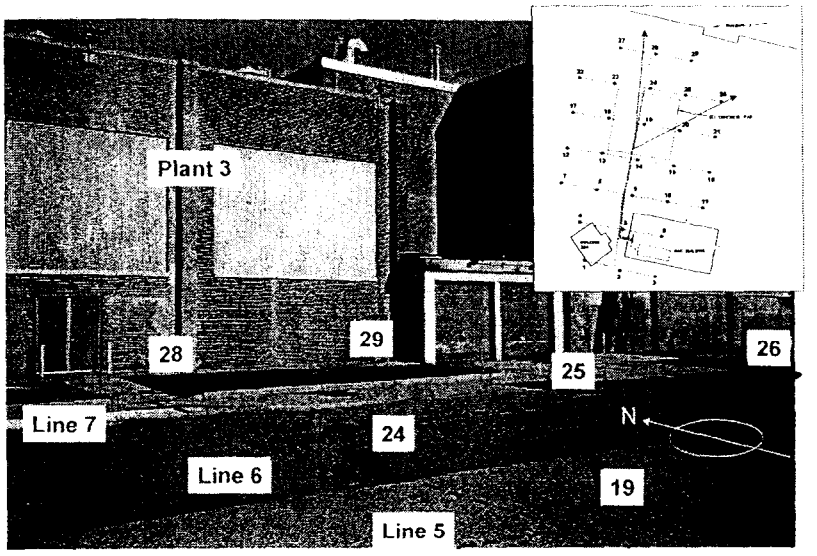
NWIRP Bethpage AOC 22 Project Overview



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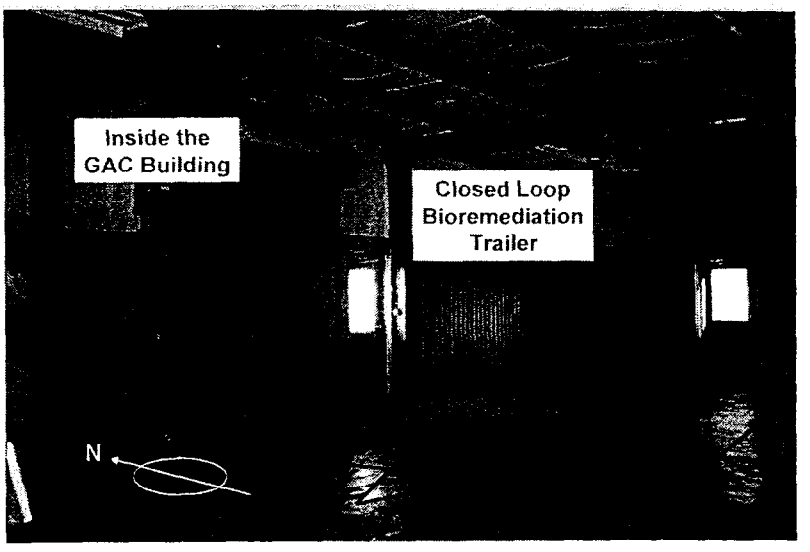
Proprietary

NWIRP Bethpage AOC 22 Project Overview



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NWIRP Bethpage AOC 22 Project Overview

Project Approach – Monitoring (cont.)

- Soil Sampling Program
  - Collect soil samples every other month
  - Analyze samples for VOCs, SVOCs, and TPH

NWIRP Bethpage AOC 22 Project Overview

Project Milestones

Design, Plans, Permits	2/04 – 7/04
Mobilization, System Installation	8/04 – 10/04
System Operation	10/04 – 9/05
- Groundwater Sampling & Analysis	Monthly
- Soil Sampling & Analysis	Every 2 Months
Final Report / Closeout	9/05 – 1/06
Site Restoration	2/06 – 3/06

The Closed-Loop Bioreactor System for *In-Situ* Bioremediation of Contaminated Soil and Groundwater

ABSTRACT

This abstract is in response to the Broad Agency Announcement (BAA) for Innovative Technologies and Methodologies Addressing Various Environmental Problems, solicitation number N47408-03-R-2406. The Closed-Loop Bioreactor Technology is Category 6.3B demonstration and validation, and addresses Topic 1: Environmental Assessment, Restoration, and Cleanup.

Brief Description of Technology/Methodology

The Closed-Loop *In-Situ* Bioreactor system is an innovative enhanced bioremediation process. It remediates existing adsorbed, dissolved, and phase separated hydrocarbon (PSH) contamination in soil and groundwater. It is an engineered solution to the creation and maintenance of an *in-situ* bioreactor, promoting and sustaining rapid biodegradation at the contamination source. It combines standard technologies (vapor extraction, air sparging, vacuum enhanced free-product extraction, and surfactant assisted desorption) with enhancement products to accelerate hydrocarbon degradation. A well-controlled and monitored above ground bioreactor maintains peak efficiency at the source.

A system of remediation wells extract soil vapors and indigenous microorganisms from the contaminated media. An above ground bioreactor is initiated, screening and activating the hydrocarbon degrading microorganisms. The optimum mixture of energized microorganisms, nutrients, oxygen, and heat are then injected into the contamination zone. The sub-surface bioreactor is continually recharged as the resultant vapors are extracted and returned to the above ground bioreactor, completing the closed-loop process.

Innovativeness and Scientific/Technical Merits

The Closed-Loop *In-Situ* Bioreactor system is different than more conventional technologies because it offers all of the following benefits within one system:

- Sustained accelerated biodegradation of VOCs, heavy end fuels, and other common organic contaminants.
- Fast remediation time and cost competitive relative to other more conventional technologies.
- Effective for remediation of soil and/or groundwater.
- Produces no residual waste products and no air emissions.
- *In-situ* process allows for on-site remediation with minimal site disruption.
- Enables very low regulatory limits to be obtained with one remedial program.

ARUSI was formed in 1987 in Phoenix, Arizona. The firm is classified 8(a) by the SBA. ARUSI's core competencies in project management and engineering have led to specialization in design-build projects for numerous private and public entities, including the U.S. Department of Defense. Recent Department of Defense customers include:

- Yuma Marine Corps Air Station, Arizona
- China Lake Naval Air Weapons Station, California
- El Centro Naval Air Facility, California
- Luke Air Force Base, Arizona
- Space Track Observation Facility, White Sands Missile Range, New Mexico

The Environmental Services division began offering its environmental services package in 2000, featuring the Closed-Loop Bioreactor process. Since that time the Closed-Loop Bioreactor process has been deployed successfully at various privately owned sites across the Western USA. Some clients include:

- Texaco Inc.
- Chevron Products Co.
- Kaibab Industries
- Kinder-Morgan Energy Partners

Previous deployment of the Closed-Loop *In-Situ* Bioreactor system has repeatedly demonstrated effective remediation of contaminated soil and groundwater and resulted in successfully achieving remediation goals. The typical time to achieve remediation goals is 6 – 9 months.

ARUSI – Environmental Services operates in cooperation with highly experienced and respected key subcontractors MCC Technology, Inc., and Locus Technologies. MCC has 12 years of experience successfully designing, deploying, and operating the Closed-Loop Bioreactor system. MCC engineers and scientists also specialize in the development of proprietary products including, surfactants, nutrients, sterilents and other additives for application in the Closed-Loop Bioreactor system. Locus Technologies is an ENR 200 Firm with long standing client relationships and a diverse client base spanning numerous federal state and industrial entities since 1982. Locus is a recognized leader in innovative technologies including environmental information management, remedial system automation, database management and numerous web-based environmental tools.

Cost of the Proposed Approach

Actual costs of remediation are greatly dependent upon the characteristics of the site, extent of contamination, and regulatory limits. However, typical remediation costs for the Closed-Loop *In-Situ* Bioreactor technology ranges from $7-15 per cubic yard of treated volume, not including the cost of infrastructure, site assessment, preparation, sampling, and testing. The following are sample costs based on a previous, successful remediation project in the Phoenix metropolitan area:

- Total Treated Volume: 50,000 cubic yards
- Permitting: $5,000
- Well Infrastructure: $60,000
- Surface Infrastructure: $40,000
- Operation & Maintenance: $240,000
- Monthly Monitoring (12 Months): $60,000
- Confirmation Borings & Analyses: $15,000
- Treatment Costs: $8.40 per cubic yard

The cost advantage of the Closed-Loop In-Situ Bioreactor system is derived from the reduced time to achieve soil and groundwater remediation goals due to the accelerated remediation rate. The resulting economic benefits include:

- Lower project life cycle costs
- Faster return of the property to productivity

ATTACHMENT 4

CALCULATION WORKSHEET

CLIENT: BETHPAGE		**JOB NUMBER:** 9845
SUBJECT: CALCULATION OF INCREMENTAL LIFETIME CANCER RISK RESULTING FROM THE INHALATION OF FUGITIVE DUST EMISSIONS CONTAINING PCBS		
BASED ON: USEPA, 1989; USEPA, 1996.		
BY: R. JUPIN	**CHECKED BY:**	**DATE:** 8/02/2004

EQUATION:

$$ILCR = Cs \times \frac{1}{PEF} \times \frac{EF \times ED}{AT} \times URF$$

Where:

ILCR	=	Incremental Lifetime Cancer Risk
Cs	=	Chemical concentration in soil (mg/kg)
PEF	=	Particulate Emissions Factor (kg/m^3)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
AT	=	averaging time (days)
URF	=	Unit Risk Factor (m^3/mg)

ASSUMPTIONS:

Cs	=	10	mg/kg
PEF	=	1.06E+10	m^3/kg
EF	=	350	days/year
ED	=	30	years
AT	=	25550	days
URF	=	5.7E-01	m^3/mg

$$ILCR = 10\frac{mg}{kg} \times \frac{1}{1.06 \times 10^{10}\frac{m^3}{kg}} \times \frac{350\ days/yr \times 30\ yr}{25550\ days} \times 0.57\frac{m^3}{mg}$$

ILCR = 2.21E-10

CLIENT: BETHPAGE		JOB NUMBER: 9845
SUBJECT: CALCULATION OF INCREMENTAL LIFETIME CANCER RISK RESULTING FROM THE INHALATION OF FUGITIVE DUST EMISSIONS CONTAINING PCBS		
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AT	=	averaging time (days)
URF	=	Unit Risk Factor (m^3/mg)

ASSUMPTIONS:

Cs	=	100	mg/kg
PEF	=	1.06E+10	m^3/kg
EF	=	350	days/year
ED	=	30	years
AT	=	25550	days
URF	=	5.7E-01	m^3/mg

$$ILCR = 100 \frac{mg}{kg} \times \frac{1}{1.06 \times 10^{10} \frac{m^3}{kg}} \times \frac{350 \text{ days / yr} \times 30 \text{ yr}}{25550 \text{ days}} \times 0.57 \frac{m^3}{mg}$$

ILCR = 2.21E-09

U.S. Environmental Protection Agency

Superfund

Soil Screening Guidance for Chemicals

Equation Values for Inhalation of Fugitive Dust

Particulate Emission Factor Parameter	Value	Noncarcinogenic Parameter	Value	Carcinogenic Parameter	Value
Surface Area (acres)	0.5	Target Hazard Quotient (unitless)	1	Target Risk (unitless)	1.0E-6
City (climate zone)	Hartford(VIII)	Exposure Duration (yr)	30	Exposure Duration (yr)	30
Q/C (g/m^2-s per kg/m^3)	71.35	Exposure Frequency (day/yr)	350	Exposure Frequency (day/yr)	350
Fraction of vegetative cover (unitless)	0.5			Average Lifetime (yr)	70
Mean annual windspeed (m/s)	3.84				
Equivalent threshold value of windspeed at 7m (m/s)	11.32				
Function dependent on U_m/U_t (unitless)	0.0345				

Soil Screening Levels for Inhalation of Fugitive Dust (mg/kg)

Analyte	Cas Number	Inhalation RfC	Inhalation Unit Risk	Particulate Emission Factor	Noncarcinogenic	Carcinogenic
Polychlorinated Biphenyls (high risk)	1336363		5.7E-04 u	1.06E+10		4.51E+04

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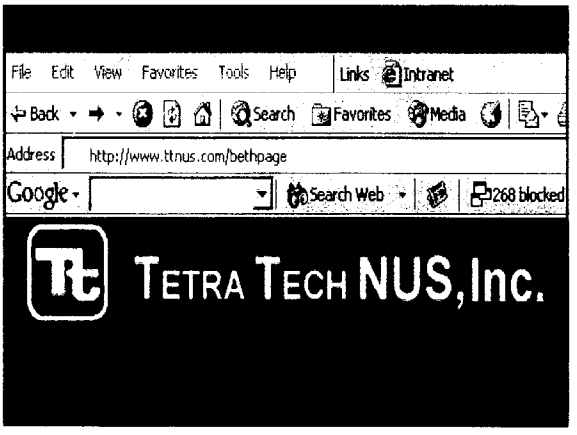
Last updated on Wednesday, December 31st, 1969
URL: http://risk.lsd.ornl.gov/cgi-bin/epa/ssl2.cgi

ATTACHMENT 5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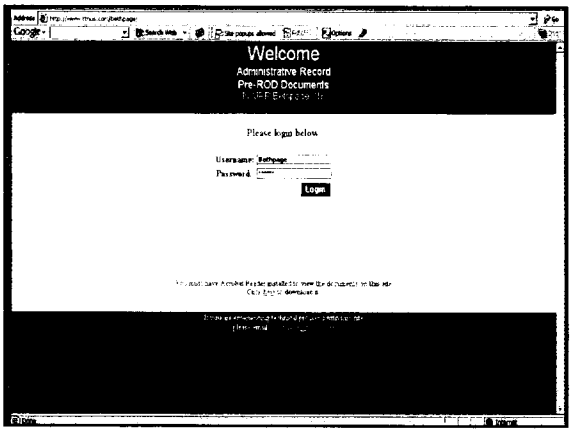
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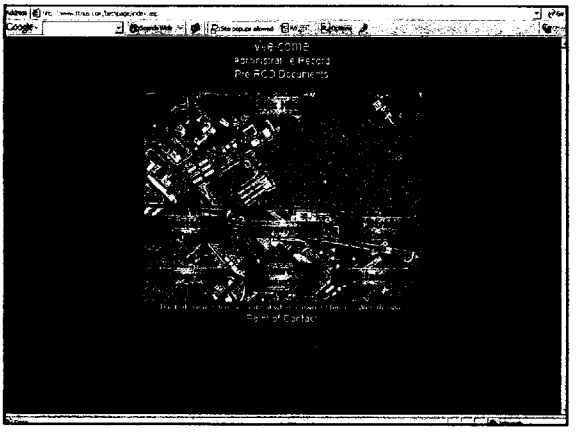
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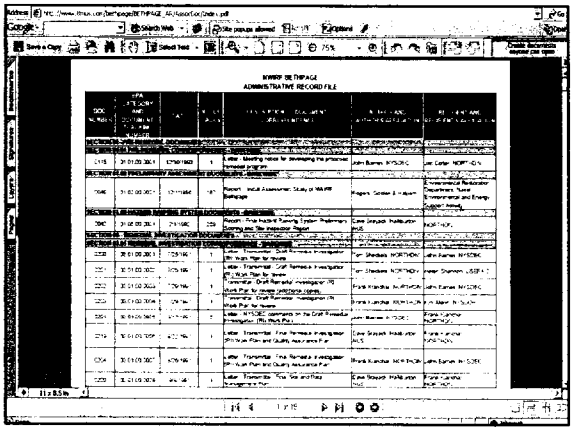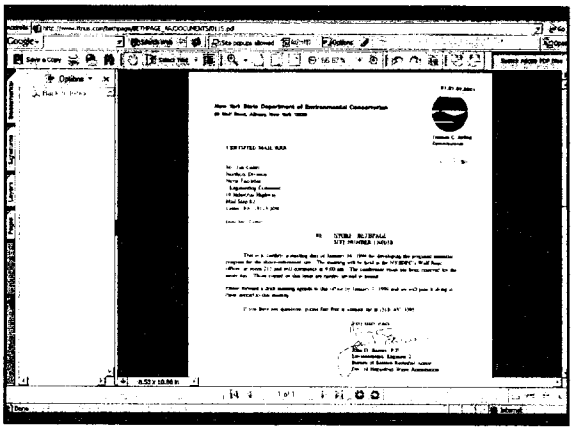
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