Summer 1999 ☼

RPM News

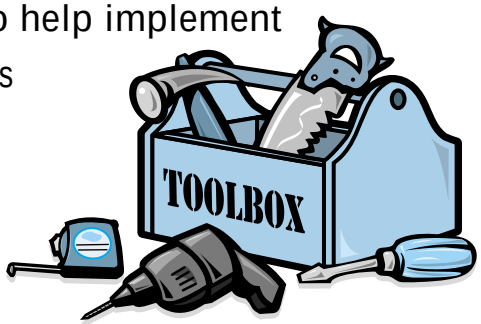
▲ Remedial Project Manager News ▲

"Communicating Navy Installation Restoration Program News and Information Among All Participants"

In This Issue:

New Tools for Natural Attenuation

A new package of tools is available to help implement natural attenuation for petroleum sites



A package to aid Remedial Program Managers (RPMs) implementing Natural Attenuation (NA) when dealing with petroleum hydrocarbon plumes has been put together by The Naval Facilities Engineering Service Center (NFESC) and Battelle Columbus Laboratories. The package is titled *Implementing Remediation by Natural Attenuation at Petroleum Release Sites.* It compliments an earlier document developed by the Alternative Restoration Technologies Team (ARTT) entitled *Technical Guidelines for Evaluating Monitored Natural Attenuation of Petroleum Hydrocarbons and Chlorinated Solvents in Groundwater at Naval and Marine Corps Facilities*. The new NFESC package includes:

- An Operation Manual
- Guidelines for Preparing Statements of Work
- A Computer Cost Estimating Tool

The Operation Manual details the steps involved in implementing NA. It contains practical approaches to determining in-situ contaminant degradation rates, methodologies for calculating future concentrations at downgradient receptors through modeling, and tools for estimating the time to reach cleanup goals. The *Guidelines for Preparing Statements of Work* (SOW) outline in a tabular form the technical information required to define tasks and performance standards when implementing NA. The document will assist in preparing a SOW that fosters timely, concise, cost-effective submissions from potential contractors.

The *Cost Estimating Program* was developed to guide RPMs in developing costs for the three main stages of NA system design and operation:

- Preliminary Assessment in Support of NA
- Detailed Site Evaluation of NA
- Performance Monitoring and Site Closure

The program runs on a Microsoft Excel platform (version 5.0 or higher). The package is currently available in hard copy only and will soon be available through *NFESC's Environmental Restoration Library* CD.

For further information, you may contact:
(805) 982-1616,
DSN 551-1616

RPM NEWS
Remedial Project Manager News

Published By
NFESC

Using Appropriated Funds

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1999 Navy and Marine Corps Site Cleanup Conference

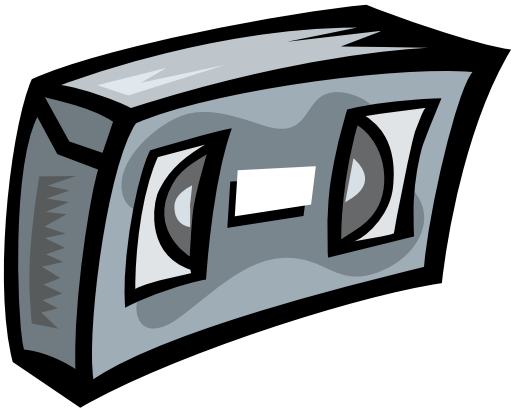
The Navy and Marine Corps Site Cleanup Conference was a huge success. It was held April 20-22, 1999 in Port Hueneme, California. Approximately 125 attendees were present representing all eight Engineering Field Divisions/Activities, Marine Corps, Air Force, Army, CNO, NAVFAC and other environmental personnel.

There were several environmental topics of interest each day of the conference including RPM Training sessions. Examples of these sessions include topics such as:

- Applying Weight of Evidence Approach to Risk Assessment
- TPH Forensics, Weathering, and Environmental Effects
- Ecological Risk Assessment
- Human Health Risk Assessment
- Comparison of Deterministic and Probabilistic Analysis for Evaluating Ecological Risk
- Innovative Technologies - MTBE
- Environmental Negotiations Workshop
- Natural Resources Damage Assessments
- Remedy Selection

Dave Olson, CNO, presented awards to Restoration Employees of the Year from several EFD/As. The awardees are as follows:

Left to right: Kate Landman (LANTDIV), Cliff Casey (SOUTHDIV), Ryan Mayer (CHESDIV), Terry Martin (SWESTDIV), Lou Ocampo (EFA WEST), Cindy O'Hare (EFA NW), Ruth Owens (NFESC), Phil Otis (NORTHDIV).



Video on Underground Storage Tank Cleanup

A video on a variety of innovative technologies used to address leaking underground storage tanks (USTs) and pipelines at the Naval Air Station (NAS), North Island Fuel Farm is now available. It was produced by Southwest Division, Naval Facilities Engineering Command (SWDIV), in a partnership with remediation contractors and the Navy Environmental Leadership Program (NELP).

The cleanup effort at NAS North Island incorporated many different methods and partners, therefore, a video was made to document (1) the innovative technologies used during the recovery process, (2) the time-critical engineering involved in the recovery process design, (3) the commitment to teamwork during the project, (4) the integration of innovative technologies and funding, and (5) the valuable lessons learned for future cleanup projects.

In order to effectively delineate a free product plume that was under the fuel farm at Naval Air Station (NAS) North Island, SWDIV partnered with Space and Naval Warfare (SPAWAR) Systems Center (formerly known as the Naval Command, Control, and Ocean Surveillance Center Research, Development, Test & Evaluation Division), on development of an in-situ petroleum detection system, the Site Characterization and Analysis Penetrometer System (SCAPS). SCAPS detects petroleum contaminants in the subsurface using laser-induced fluorescence (LIF) technology. SPAWAR Systems Center required a demonstration site; the fuel recovery project fit the required criteria. The SCAPS rig efficiently delineated the vertical and aerial extent of the plume. No project charges were incurred for the use of SCAPS because the LIF survey was conducted as part of an ongoing SPAWAR Systems Center research project. The availability and efficiency of the SCAPS saved an estimated $100,000 in project investigation costs.

Because wastewater disposal is costly, a Vacuum Enhanced Product Recovery (VEPR) process was tested to improve fuel recovery rates and reduce water disposal costs. The VEPR process, demonstrated by Metcalf & Eddy, applies a vacuum at the wellhead. This negative pressure enhances the migration of petroleum product into the well, which is then recovered by a subsurface pump. The technology is applied at typical fuel and groundwater recovery wells to improve fuel recovery rates. The pilot test of the VEPR was successful, increasing the fuel recovery rate from 1 and 2 percent to 20 percent by volume. The VEPR is being installed to enhance the remediation efforts at the fuel farm and will be operational in the summer of 1999.

A complication arose during the fuel recovery effort. During routine operation of the free product system, biofouling began to occur in the oil/water separator. It was discovered that 1 percent of the fuel in the subsurface was leaded aviation gasoline (AVGAS) which led to the biofouling. The lead concentration changed the classification of the recovered fuel from a recyclable product to a Resource Conservation and Recovery Act (RCRA) hazardous waste. This reclassification required that the recovered fuel be disposed of as a hazardous waste.

Through teamwork and the use of innovative technologies this project achieved three notable results: (1) full environmental regulatory compliance, (2) recovery of over 125,000 gallons of fuel in less than two years of operation, and (3) a quick reduction in free product volume at the fuel farm. Operation of the system and all subsequent phases of fuel recovery were turned over to the Navy Public Works Center (PWC) San Diego in 1997. It is anticipated that the cleanup operation will continue through 2001.

Department of Defense agencies can get a copy of the 15-minute video by contacting

SWDIV Remedial Project Manager

phone: (619) 556-9934 or

NELP Coordinator

phone: (619) 524-6357.

Updated Policy on Ecological Risk

Reduces Time and Cost

Most Navy Remedial Project Managers (RPMs) are familiar with the complexity and difficulties in conducting ecological risk assessments (ERAs). Time and time again we find ourselves in lengthy, costly, and otherwise undesirable assessments with no clear exit point in sight. But, fear not, we now have an updated and expanded Navy policy that should save you time, project funding, and much of the headaches and confusion generally associated with ERAs.

The U.S. Environmental Protection Agency's (EPA's) ecological risk assessment guidance for Superfund (ERAGS), which defines the eight-step process, has been helpful in performing ERAs but needed formal Navy interpretation for performing effective and consistent ERAs across the Environmental RestorationProgram (ERP). RPMs need amplification of the Navy's original ERA policy (Navy Environmental Policy Memorandum 97-04; Use of Ecological Risk Assessments).

In response to these pressing needs the Navy recently released policy for conducting ERAs (Navy Policy for Conducting Ecological Risk Assessments, ltr of 05April99). This document compliments the original Navy policy and is intended to ensure that our ERAs are "*scientifically based, defensible, and done in a manner that is cost effective while protecting human health and the environment.*"

Navy policy now follows an approach that is fully integrated with EPA's eight-step process. It emphasizes frequent interactions among the Navy cleanup team and concurrence with regulators at each step throughout the process. The eight steps are now organized under the three tiers (see page 5). Tier One, Screening Risk Assessment (SRA), covers steps one and two. Tier Two, Baseline Ecological Risk Assessment (BERA), covers steps three through seven. Tier Three, Evaluation of Remedial Alternatives, is consistent with step eight.

Exit opportunities are now provided to RPMs through formal decision points with specific exit criteria at the end of each tier and after step 3a. Step three is broken into steps 3a and 3b. This is designed to allow for a re-run and re-evaluation (exit opportunity) of the SRA with a refinement of the SRA's conservative assumptions (e.g. bioavailability).

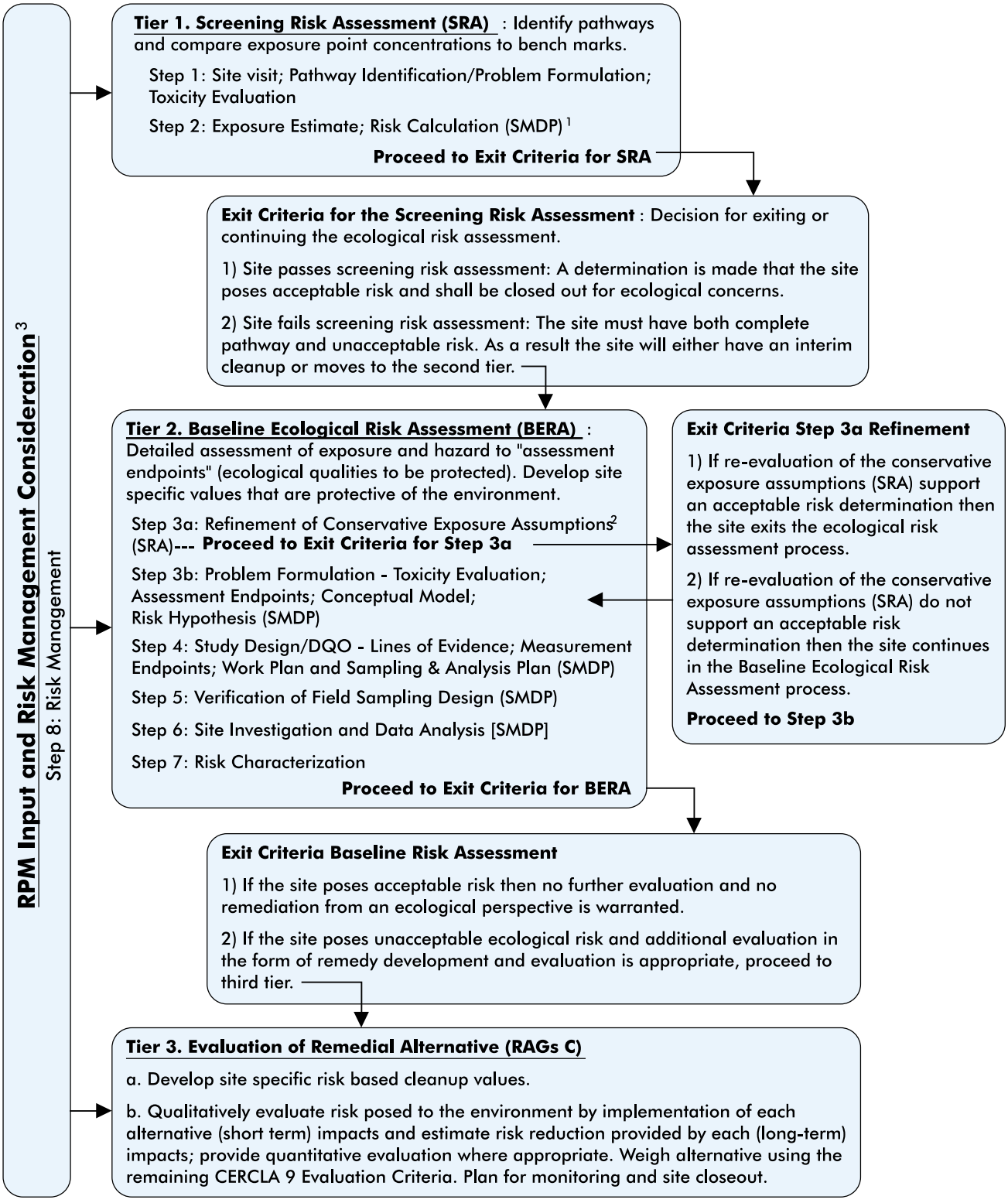
While the eight-step process includes several points for making scientific/management decisions, Navy policy formalizes, clarifies, and emphasizes the points at which exit opportunities exist. At these points, the exit criteria define specific conditions that must be met for determining if a site should be closed out for ecological concerns or if a continuation of the process is required.

In order to assist EFD/As with consistent, efficient implementation of this new policy, NAVFAC has established a centrally funded Ecological Risk Technical Assistance Team (ERTAT) (see Spring 1999 issue of the RPM News). The Team is available for one-on-one assistance with RPMs and Navy contractors to develop strategies to strengthen and focus ongoing ERAs and plan for upcoming assessments.

The three-tiered system should help focus your ERAs and provide added value to existing guidance and policy. Clearly documented exit criteria helps project managers recognize the opportunity to evaluate the ERA process at the appropriate time. The policy is consistent with ERAGS so it allows for easy integration and coordination with the Superfund Process.

For additional information or to access the technical assistance team, please contact the NFESC team coordinator:
(805) 982-4798/
DSN 551-4798

Navy Ecological Risk Assessment Tiered Approach

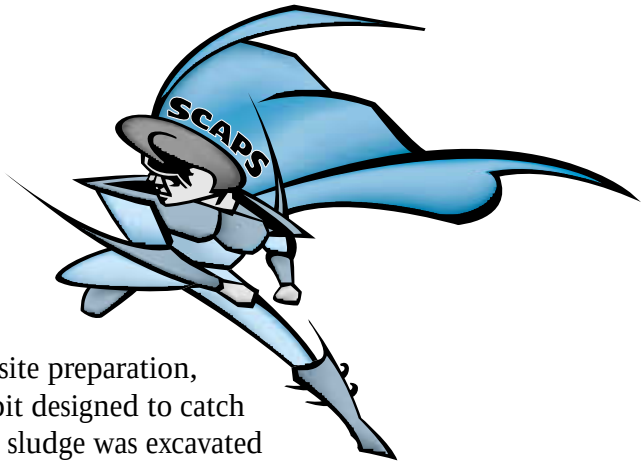


Notes: 1) See EPAs 8 Steps ERA Process for requirements for each Scientific Management Decision Point (SMDP).

2) Refinement includes but is not limited to background, bioavailability, detection frequency. Etc.

3) Risk Management is incorporated throughout the tiered approach.

SCAPS rapid deployment and investigation keeps property transfer on track



Introduction

Over the past four years, the Navy's Site Characterization and Analysis Penetrometer System (SCAPS) provided customers with an effective real time tool. This tool has helped to detect and delineate petroleum, oil, lubricant (POL) contaminant plumes in subsurface soil and to characterize geologic conditions.

The SCAPS program offers the Navy a streamlined procurement process, rapid deployment, and quick characterization service. On March 30, 1999, Southern Division used SCAPS to characterize a site at the Chicora Tank Farm, which is scheduled for transfer to Charleston County School District by December 1999. Because of SCAPS' rapid deployment and real time data, field delays due to unexpected contaminated soil uncovered during excavation were avoided. As a result, the property transfer is on schedule.

Tank Farm

The Chicora Tank Farm, closed since 1990, is located at the Charleston Naval Station, South Carolina. In operation since the 1940's, the facility was initially used to store #6 bunker "C" fuel. Later, in the 1960's, the fuel farm was converted to store diesel fuel marine or DFM.

Photo 1

During site preparation, a valve pit designed to catch fuel line sludge was excavated (refer to Photo 1). The pit was found to contain suspected DFM contaminated soil and groundwater. Because of this discovery, a detailed site characterization was needed.

SCAPS Investigation at Tank Farm

Coincidentally, SCAPS was characterizing another site. Accessing SCAPS's services was just a simple matter of submitting a work request (form 2275) to Public Works Center (PWC), Jacksonville (East Coast SCAPS now originates from PWC, Norfolk – refer to side bar on page 7). SCAPS was on the tank farm, performing a site characterization just three days after the work order was submitted. A conventional approach to accessing site characterization services would have required at least 30 days.

SCAPS's collected laser induced fluorescence (LIF) data from locations adjacent to the excavated valve pit and along the path of the fuel line. Approximately 14 pushes were performed by SCAPS to a depth of 6 feet below the water table or 20 feet bgs (below ground surface).

Results/Benefits of Using SCAPS at the NEX Service Station

Contamination was identified beyond the boundaries of the excavation. SCAPS data showed significant contamination along the path of the fuel line (refer to photo 2) and the highest LIF data response occurred in an area approximately 30 – 35 feet from the pipeline.

SCAPS's real-time data collection capabilities allowed for continuous excavation without the need for extended work stoppages. In the absence of SCAPS, the customer's fallback option would have been to use an

Photo 2

Organic Vapor Analyzer (OVA). The OVA process necessitates suspending excavation activities until the associated laboratory analysis is completed. The subsequent suspension of excavation would then require the demobilization/remobilization of the excavation equipment to avoid leaving the equipment inactive on site.

Conclusion

SCAPS proved itself to be easily procured and subsequently deployed in a rapid manner. In case of the Chicora Tank Farm, SCAPS was on site within three days after receiving the work request from the customer. In contrast, it may take up to several weeks before a contractual agreement can be drawn up to acquire comparable services outside of the Navy. The real-time aspect of SCAPS allows for delineation of site contamination in one deployment and helped to avoid costly excavation stoppages associated with more conventional characterization methods. Finally, SCAPS's rapid procurement, quick deployment, and timely issuance of characterization data kept the site on schedule for transfer.

For more information about SCAPS or its scheduling into your process, please contact:
West Coast
(619) 556-9506
East Coast
PWC Norfolk, VA (757) 445-4885 x400
PWC Norfolk, VA (757) 445-4885 x208

East Coast SCAPS operations moves to PWC Norfolk

The Navy's Site Characterization and Analysis Penetrometer System (SCAPS) relocated its East Coast operations from Public Works Center (PWC) Jacksonville, Florida to PWC Norfolk, Virginia. The Environmental Management Branch (Code 333), a section of PWC Norfolk's Facility Engineering Department, will operate and manage the SCAPS program. The move to PWC Norfolk provides a more central location, improving SCAPS's access and availability, and parallels the recommendation of the SCAPS marketing plan.

Continuing with the new SCAPS Team in Norfolk is Program Manager George Steffen. Mr. Steffen, was the PWC Jacksonville SCAPS program manager since the inception of the Navy's production program in 1994. His transfer insures continuity in the program and allows PWC Norfolk to move immediately into a production mode.

The transition is additionally aided by PWC Norfolk's familiarity with SCAPS's laser induced fluorescence technology. The team already completed two site investigations for Southern Division at Naval Complex Charleston in April (see accompanying story).

Due to the team's successful transition, additional projects for the new SCAPS program are already in planning. Projects include investigating a fuel pipeline at Fleet Industrial Supply Center (FISC) Cheatham Annex and the former Fire Fighting School located at Naval Station (NS) Norfolk. PWC Norfolk is confident they will continue to serve the Navy's site characterization needs, and serve an important role in the Navy's technology transfer process.

For more information concerning SCAPS technology, contact:
(805) 982-2631

To schedule SCAPS or obtain details regarding services, contact:
West Coast
(619) 556-9506
East Coast
(757) 445-4885 x400
(757) 445-4885 x408

Effective Source Reduction with Chemical Oxidation

Results from NSB Kings Bay and NAS Pensacola

Source areas of chlorinated solvents in groundwater have been effectively remediated using In-Situ Chemical Oxidation at the Naval Submarine Base (NSB) Kings Bay Landfill site and the Naval Air Station (NAS) Pensacola Industrial Wastewater Treatment Plant Sludge Drying Bed/Surge Pond site. Source area concentrations of Chlorinated Volatile Organic Compounds (CVOCs) were reduced by more than 95% at each site.

The objective of the source reduction at each site was to:

- Ensure protection of downgradient receptors.
- Ensure the effectiveness of natural attenuation as the final, polishing remedy.
- Minimize Remedial Action Operation (RAO)/Long Term Monitoring (LTM) costs and accelerate site closeout by allowing the existing pump and treat remedies to be permanently turned off.

The use of Chemical Oxidation and other aggressive source reduction technologies (e.g., bioslurping for petroleum free product) is a key element of a cost-effective plume management strategy being implemented by Southern Division NAVFAC for groundwater sites impacted by chlorinated and petroleum hydrocarbons. Other elements of the strategy include monitored natural attenuation for lower concentration areas and, if necessary, less aggressive technologies (e.g. bioenhancement of CVOCs with carbon source addition) for moderate concentration areas downgradient of the source area.

At the NSB Kings Bay and NAS Pensacola sites, the efficiency of natural attenuation was assessed with quarterly sampling for approximately two years. Results indicated that effective source reduction would ensure natural attenuation processes would be protective of downgradient receptors (a residential neighborhood at Kings Bay and Pensacola Bay at Pensacola) and greatly accelerate site remediation.

Site and contaminant conditions were similar at the two sites – relatively flat topography, shallow water table, and soils consisting primarily of sand and silty sand. Direct Penetration Technology sampling indicated relatively discrete areas of high concentration chlorinated hydrocarbons at each site. At the Kings Bay site the source area to be targeted for Chemical Oxidation was a 150-foot by 75-foot source area, 35 to 40 feet depth interval. At the Pensacola site the source area to be targeted was an 80-foot by 30-foot area, 35 to 40 feet depth interval, where concentrations of trichloroethylene (TCE) had accumulated just above a clay confining layer.

At each site, In-Situ Chemical Oxidation using the Fenton's Reagent method was selected as the technology for source reduction. The process involved injecting a solution of hydrogen peroxide and ferrous sulfate. Hydroxide radicals produced from a solution of hydrogen peroxide and the catalyst, ferrous sulfate, oxidize the chlorinated hydrocarbons in an exothermic reaction. The hydroxide radicals are strong non-specific oxidizers that transform the hydrocarbons to carbon dioxide, water, and chlorides without any intermediate products. The Fenton's Reagent method has been used in the wastewater industry for many years, but until recently effective subsurface injection methods were unavailable.

The technology vendor contracted for the work at Kings Bay and Pensacola was Geo-Cleanse International, Inc. Geo-Cleanse had previously demonstrated the success of

Chemical Oxidation Process Controls in Tractor Trailer and Hydrogen Peroxide in Tanker Truck (injection well, foreground)

the Fenton's Reagent method on a TCE plume at Department of Energy's (DOE's) Savannah River Site (SRS) in Aiken, South Carolina. Southern Division employed two different contract mechanisms. For the Kings Bay project, Southern Division subcontracted the vendor through Bechtel, a Remedial Action Contract (RAC) for Southern Division and the contractor for DOE that subcontracted and monitored the demonstration project at DOE's SRS. For the Pensacola site the vendor was contracted through the Broad Agency Announcement maintained by the Naval Facilities Engineering Service Center (NFESC) to demonstrate new technologies.

The Chemical Oxidation work proceeded concurrently at the two sites with initial injection at the NSB Kings Bay and NAS Pensacola sites occurring in November and December 1998, respectively. All work, including the second phase of injection, was completed by June 1999. The field operation basically involved:

- Sample groundwater to assess site geochemistry and verify contaminant concentrations
- Install 1.25-inch carbon steel injection wells with a standard drill rig (approximately one week).
- Allow the grout in the annular space of injection wells to cure (approximately one month).
- Mobilize injection trailer and hydrogen peroxide tanker to site and inject 50% technical grade hydrogen peroxide, ferrous sulfate, pH adjustment and buffering agents (approximately one to three weeks).
- Collect confirmation samples 4 days and 30 days after injection.

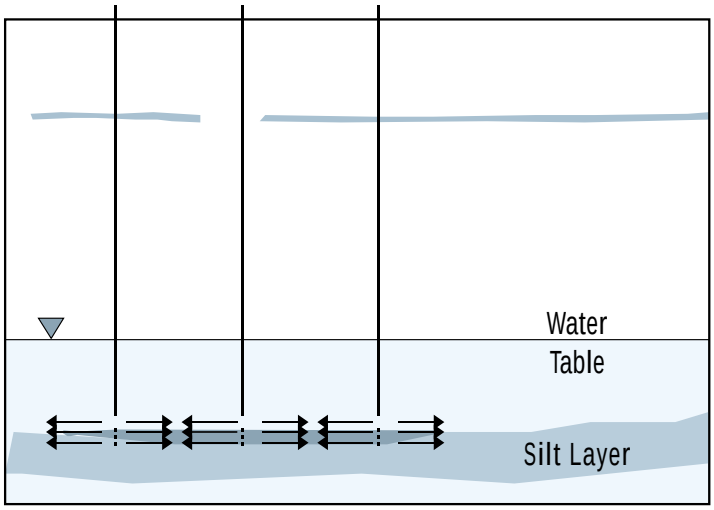
Two phases of injection were required to meet the remedial objectives at each site. A total of approximately 10,000 gallons of hydrogen peroxide was injected at each site.

At the NSB Kings Bay site, the remedial objective was to reduce total VOCs in the source area to less than 100 µg/L. Initial concentrations of perchloroethylene (PCE) exceeded 9000 µg/L in the source area. Low concentrations of dichloroethylene (DCE) had been detected in groundwater beneath the residential neighborhood downgradient from the landfill before the pump and treat containment system was installed. Predictive groundwater modeling based on parameters derived from the natural attenuation assessment indicated the plume from the landfill would collapse in less than five years if the remedial objective was met. After the second phase of injection, total VOCs measured 9 µg/L in the source area with no rebound in concentrations 30 days after injection – a reduction of more than 99%. As a result, regulators have withdrawn the compliance order, operation of the pump and treat system has been discontinued, and monitored natural attenuation has been accepted as the remedy specified in the Record of Decision (ROD). The net present value of life-cycle cost savings exceed $3.3 million and site remediation has been accelerated by more than 20 years.

The NSB Kings Bay project recently won the State of Georgia Chamber of Commerce's Award for Environmental Excellence. The nomination for the award was submitted by the Georgia Department of Environmental Protection.

At the NAS Pensacola site, the remedial objective was to substantially reduce concentrations of chlorinated hydrocarbons in the source area to ensure natural attenuation would be an effective remedy for VOC's in downgradient groundwater. Initial concentrations of TCE historically exceeded 3000 µg/L in the source area. The natural attenuation assessment indicated the TCE and its degradation products were completely destroyed within 250 feet downgradient primarily as a result of reductive dechlorination. Although natural attenuation appeared to be protective of the Pensacola Bay approximately 600 feet downgradient, substantial reduction of chlorinated hydrocarbons in the source area was established as the remedial objective to meet regulator concerns and accelerate site closeout. After the second phase of injection, TCE concentrations in the source area ranged from less than 1 µg/L to 100 µg/L with no rebound – a reduction of more than 96%. Based on these results, a corrective action plan will be prepared to propose monitored natural attenuation as the final remedy and to permanently discontinue the pump and treat system. The net present value of life-cycle cost savings will exceed $2 million and site remediation has been accelerated by more than 20 years.

In conclusion, the In-Situ Chemical Oxidation using the Fenton's Reagent method was very successful at the NSB Kings Bay and NAS Pensacola sites. The discrete, limited size of the source areas and fairly homogeneous sandy soils were important characteristics contributing to the cost effectiveness of the technology at these sites. The technology proved to be relatively inexpensive (approximately $250 K at each site) and was very effective for the given site conditions.



Chemical Oxidation Injection wells targeted into thin DNAPL accumulation zone using a robust pattern of overlapping injection, hydrogen peroxide and iron II are added to "burn" the DNAPL source in the ground

Applicability of the technology at other sites should be examined on a site-specific basis. The general effectiveness and cost efficiency of the technology depends on the volume to be treated and other site-specific conditions, as do other technologies. For example, the buffering capacity of carbonate aquifers would prevent pH adjustment required to facilitate the Fentons Reagent reaction. Likewise, the cost-effectiveness of remediating low permeability zones will be lowered by the reduced ability to distribute the chemicals in tight soils.

As part of its overall plume management strategy, Southern Division is pursuing the use of In-Situ Chemical Oxidation for source reduction at several other naval installations where site conditions are favorable.

As a result of project updates and shared lessons learned by the Alternative Restoration Technology Team (ARTT), Chemical Oxidation is now being implemented at several Navy sites including those within Engineering Field Division (EFD) Southwest and Engineering Field Activity (EFA) North. EFD Atlantic has completed a Chemical Oxidation project for remediation of a petroleum hydrocarbon site.

Before Treatment	After 1st Phase	After 2nd Phase
NSB Kings Bay Landfill Site (Total VOCs, µg/L)		
9074	93	9
NAS Pensacola IWTP Sludge Drying Bed Site (TCE, µg/L)		
2440	485	< 1

Chemical Oxidation Source Reduction Results

Additional Information

A detailed technology demonstration report, including cost and performance data, will be prepared by NFESC and Southern Division for the Chemical Oxidation project at NAS Pensacola. The report is expected to be available by the end of August 1999. (The Chemical Oxidation project at NAS Pensacola is one of two technology demonstration projects funded by NAVFAC in FY98 under the Y0817 program. Southern Division and Morrison and Knudsen, Inc, a RAC for Southern Division, originally proposed to demonstrate the technology at a Naval Air Warfare Center (NAWC) Indianapolis site. The technology was selected for demonstration by a team of technical and Remedial Project Manager (RPM) representatives from the ARTT and NFESC. During the project planning phase, Southern Division moved the demonstration project to a more suitable site at NAS Pensacola because of regulatory concerns and potential geologic limitations at the NAWC Indianapolis site.)

A similar technology demonstration report is being prepared by Environmental Protection Agency (EPA's) Technology Innovation Office based on data provided from the NSB Kings Bay project.

Southern Division NAVFAC contacts:

NAS Pensacola IWTP Sludge Drying Bed/Surge Pond Site: (843)820-7422

(843)820-7322

NSB Kings Bay Landfill Site: (843)820-5561

(843)820-7339

NFESC contact for Y0817 Program, Technology Cost & Performance Report for NAS Pensacola (available end of August 1999):

(805)982-4191

Natural Attenuation for Commingled Plume

Moffett Federal Airfield

Natural attenuation (NA) is the preferred remediation approach for commingled plumes (the combined presence of both fuel and chlorinated hydrocarbons) both in terms of cost and contaminant destruction. Commingled plumes provide the perfect stage for NA to occur since:

- The presence of fuel hydrocarbons depletes oxygen and further creates nitrate-, sulfate-reducing and methanogenic zones. These anaerobic zones provide the setting required for reductive dechlorination to occur.

- Fuel hydrocarbon biotransformation produces volatile fatty acids, which serve as electron donors in the dechlorination of PCE, TCE, DCE and VC (vinyl chloride).

Nonetheless, NA has limitations. Electron acceptors (nitrate, iron and sulfate) and electron donors (BTEX, acetate, benzoic acid, H_2, and anthropogenic carbon) are often depleted resulting in the cessation of NA. Even in cases where electron acceptors and donors concentrations are adequate, NA will not be protective of human health and the environment if there is incomplete mixing resulting in mass transfer limitations and inadequate bioavailability.

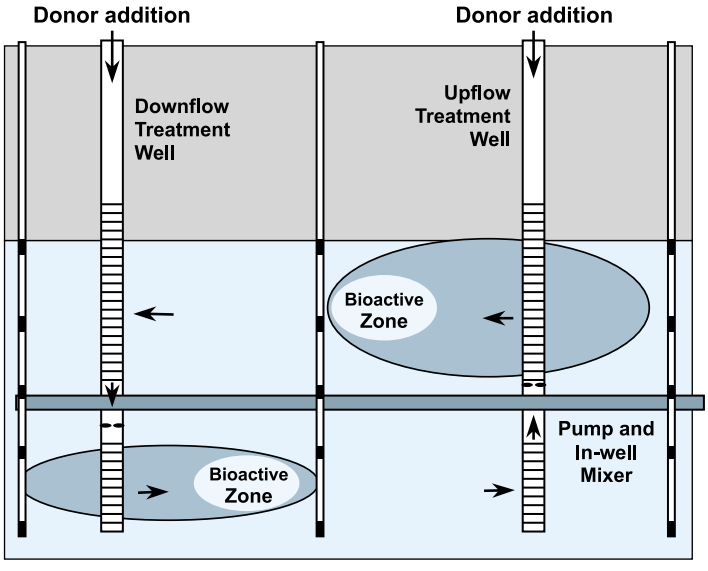
In a joint effort, the Naval Facilities Engineering Service Center (NFESC), Engineering Field Activity, West (EFA West), and Stanford University will install and operate an *in-situ* mixing well pair system to deliver effective mixing and if needed, introduce supplemental electron donors and acceptors in a commingled plume undergoing NA. The plume, located at the Moffett Federal Airfield (MFA) commingled as a result of dry-cleaning activities and fuel operations in close proximity.

During the first phase of this project initial rates of contaminant degradation under existing NA conditions will be evaluated. Then the aquifer will be homogenized to redistribute electron donor and electron acceptors and measure changes in degradation rates. New biodegradation rates will be obtained to determine the effects of homogenizing. If those results indicate that indeed electron acceptors and donors are rate-limiting factors, the groundwater will be augmented with electron acceptor and/or electron donors.

The system consists of two treatment wells placed in the area where the plumes commingle as shown in the attached figure. One of the wells operates in a down-flow mode and the other operates in an up-flow mode. Pumps are placed within the wells to induce horizontal gradients. Feeding lines may be used to effectively supply electron donors and acceptors to the aquifer if supplemental amendment is required. Upon supplemental addition of electron donors and acceptors, a bioactive zone is formed in the area surrounding the discharge point around the well. These bioactive zones, consisting of the PCE contaminated water, the native bacteria, and the electron donors and acceptors, resides in the aquifer for incubation. Residence times in the mixing zone can be controlled through pumping rates to achieve optimal dechlorination.

In a follow-on phase (not currently funded), NFESC proposes to switch from anaerobic conditions to aerobic conditions in order to accelerate TCE, DCE and VC biodegradation. The approach proposed is to create a biologically active zone around the discharge of the injection/treatment wells and create aerobic pulses, rather than oxygenating the entire aquifer.

Points of contact for the on-going effort are: at NFESC (805) 982-1616 and at EFA/W (650) 244-2539.



New sampling method cuts time and costs

NSA Mid-South

A new groundwater sampling method is yielding better quality analytical data at a lower cost for Naval Support Activity (NSA) Mid-South in Millington, Tennessee.

When data from the new groundwater sampling technique — contaminant diffusion — were compared to historically collected standard pumping method data, the new method produced similar, if not more representative results.

The U.S. Environmental Protection Agency (EPA) brought this method to the BRAC Cleanup Team's (BCT) attention in August 1998. After researching the method, the Navy's CLEAN contractor, EnSafe Inc., performed a pilot project using this technology to determine its accuracy and applicability.

In September 1998, diffusion samplers were installed in three wells at NSA Mid-South where chlorinated solvents had been detected historically using conventional sampling methods (i.e., three well-volume purge and low-flow techniques). The finding that the analytical data from the diffusion sampling method was similar, if not more representative, was consistent with the results of the developers of this sampling method, D.A. Vroblesky of the U.S. Geological Survey, and W.T. Hyde of General Electric Gas Turbine.

How It Works

The diffusion sampler — a weighted, polyethylene, slightly less than 2-inch diameter bag containing deionized/organic-free water, is placed in a well at a selected depth and left long enough to allow equilibrium to be achieved between the naturally occurring groundwater and the water in the sampler (See Figure 1). Equilibrium can occur in as little as 48 hours, but the sampler may be left in place longer.

Because contaminant concentrations may differ within the screened interval, diffusion samplers of discrete lengths (e.g. 1 or 2 foot) may be "stacked" from the bottom of the screen to the top to provide a vertical profile of concentrations.

Figure 1

When the diffusion sampler is retrieved, the sample is collected by filling an appropriate sample container (in this case, a 40-milliliter glass vial) (See Figure 2). The stainless-steel weights may be either dedicated to the well or decontaminated for use at another location. Also, a new diffusion apparatus may be installed as the old one is being removed.

The Science Behind The Method

The basis for diffusion sampling is the molecular movement of contaminants from a region of high concentration to one of low concentration. The effectiveness of the diffusion samplers is also based on the fact that as groundwater travels through the screened portion of a well, mixture with the water in the well casing is minimal (Robin and Gillham, 1987). Therefore, it is implied that flow through the well across the screened interval is horizontal and laminar. In 1992, Kearl et al. showed that movement of water by advection occurred across a screened interval. Powell and Puls (1993) found that flow across the screened interval of a well was often horizontal, layered, and representative of formation water. These studies led Barcelona et al. (1994) and Shanklin et al. (1995) to determine that samples representative of formation water could be obtained if drawdown were eliminated by

Figure 2

pumping at a very slow rate, thus minimizing the disturbance of the water column above the screened interval.

These studies were the basis for the low-flow sampling technique that NSA Mid-South has used for the past few years. Also, these studies are the premise for diffusion sampling, which allows a more representative sample to be collected because the groundwater is disturbed the least.

Cost And Time Efficiency

Even though low-flow techniques decreased the cost of groundwater sampling compared to the conventional three-volume purging technique, considerable costs were still incurred through the rental or purchase of pumps, portable electric generators, and water-quality monitoring instruments. Also, the labor costs incurred from extended time in the field were significant.

Diffusion sampling virtually eliminates many of these costs and greatly diminishes others. For example, the equipment cost, using standard low-flow purging, to sample 20 wells averaging 80 feet deep, excluding labor and investigation derived waste (IDW) costs, initially would be approximately $118 per well (rental of electric generator, pump, water-quality instruments, purchase of sample tubing to be dedicated to each well, etc.) using the standard sampling methods, and about $34 per well (excluding sample tubing) including only the rental costs in follow-up sampling.

Conversely, sampling the same 20 wells using the diffusion method would cost approximately $7 per well (purchase of roll of polyethylene sampler sleeving, protective sleeving, nylon twine, and stainless-steel weights to be dedicated to each well) the first time, and approximately $1 per well (purchase of protective sleeving and twine) thereafter.

Labor costs and time in the field also decrease greatly when the diffusion method is employed because the samplers can be installed in 15 to 30 minutes per well. Standard sampling methods using pumps can take anywhere from 60 to 90 minutes per well to set up the equipment and conduct the sampling. For example, 65 diffusion samplers were installed/retrieved in monitoring wells by four people in four days. To collect the same amount of samples using a pumping method would take no less than two weeks.

Standard pumping methods also require equipment to be decontaminated after each well is sampled, consequently increasing the chances for cross-contamination. Using the diffusion method, only the stainless-steel weights that hold the bag in place need to be decontaminated, but this is only if the weights are no longer dedicated to the well.

NSA Mid-South's Pilot Project

The diffusion samplers were installed in three wells (labeled A, B, and C) with a history of chlorinated solvent detections in groundwater samples. These wells were historically sampled using primarily low-flow techniques.

The objective of the pilot study was to determine if Volatile Organic Compound (VOC) data obtained from diffusion samplers is similar to the historical data associated with the wells.

The results from the pilot project, as outlined in a Technical Memorandum by EnSafe dated 10 November 1998, showed that the diffusion sampler results were found to be similar to the historical data.

	Depth to Screened Interval in Feet	Detected Concentration of TCE in mg/L
Diffusion Method	60-62	2,900
	62-64	3,000
	64-66	2,100
	66-68	1,400
	68-70	900
Low-flow Method	Mid-screen (~ 65)	3,300

Table 1

A second phase pilot project was conducted at Well B, which historically had significant variation of trichloroethylene (TCE) concentrations.

The objective of this test was to determine whether the historical variability in TCE concentrations was attributable to possible variations in sample collection depths, and to compare TCE concentrations between samples collected by low-flow purging and diffusion methods when similar intervals are sampled.

Five, two-foot diffusion samplers were positioned in the 10-foot well screen of Well B. After three weeks, the diffusion samplers were retrieved, and the well was sampled using standard low-flow methods for comparison (See Table 1).

The pilot test results indicate that diffusion sampling data compares favorably with low-flow sampling at similar depths, and therefore, that diffusion sampling is a viable alternative for groundwater sampling.

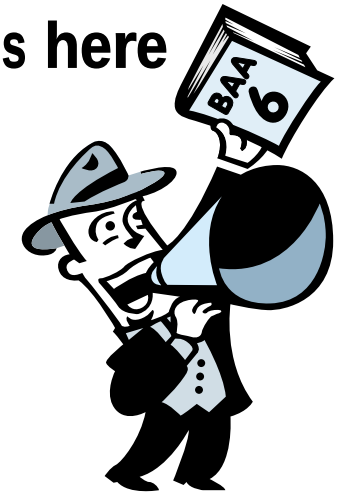
Conclusions

In summary, the primary advantages of the new technique are:

✓ Lower labor and equipment costs due to shortened field time and little or no standard sampling method related equipment purchases/rentals.
✓ Less IDW since well purging prior to sample collection is unnecessary.
✓ Hard-to-reach wells become more accessible because very little equipment needs to be taken to a well in order to conduct sampling.
✓ The potential for cross-contamination is virtually eliminated because no decontamination procedures are necessary between sampling at wells.
✓ Improved quality of the resulting analytical data. In some cases, the diffusion method allowed for the detection of compounds that either had not previously or consistently been detected using pumping methods.
✓ Vertical profiling of contaminants by using short length diffusion samplers (i.e. 1 or 2 foot) "stacked" within the screened interval of a well.
✓ New diffusion samplers can be installed as the old ones are retrieved for analysis.

Results from the pilot tests of NSA Mid-South demonstrate that diffusion sampling should be considered as part of an overall long-term groundwater monitoring optimization strategy for VOCs.

BAA Book 6 is here



The sixth Broad Agency Announcement (BAA) Book of Abstracts has recently published by NFESC electronically on its DENIX web site:

http://denix.cecer.army.mil/denix/DOD/News/Navy/BAA/baa.html

This web site contains over 300 abstracts (19 newly published) that give you immediate access to innovative cleanup and pollution prevention technologies and methodologies. All abstracts on the web site may be used for awarding a field application contract at environmental cleanup or pollution prevention sites in your area.

Access to the web site is limited to government personnel only. Passwords are available through DENIX at (217) 373-6790 or electronically through the DENIX home page at:

http://denix.cecer.army.mil/denix/reg_form.html

For more information on how you can apply one of these technologies or methodologies at your site, please contact the BAA program director,

at (805) 982-1488, DSN 551-1488

Navy conducts evaluation of chemistry and toxicity data

At the request of Northern Division, the Naval Facilities Engineering Service Center (NFESC) contracted with Science Applications International Corporation (SAIC), to conduct a specialized environmental study of Goss Cove, located on the Naval Submarine Base (NSB) in New London, Connecticut. The cove had been placed on the National Priorities List (NPL) because of concerns over chemical contamination found in the cove, and lack of aquatic life in the cove sediments. The chemicals may have come from a nearby Navy landfill and or runoff from the base. However, it was also apparent that water circulation between the Cove and nearby Thames River was highly restricted because of a railroad embankment. Hence, a study was needed to determine whether site-related chemicals, or natural factors (such that as reduced oxygen), might have been the cause of poor habitat conditions.

To address this problem, SAIC scientists designed and implemented a sampling and analysis program involving a procedure called Toxicity Identification Evaluation (TIE). Samples collected from the site are manipulated to fractionate the chemicals into various classes (i.e., metals, organics, and ammonia) and each fraction is tested for toxicity. Traditional measurements of sediment chemistry and toxicity were also performed. Results of the study proved that chemicals in cove sediments were not the cause of toxicity, but rather, the effects were from high ammonia.

"A key element to the success of the TIE was the preparation of the fractions in series as opposed to in parallel, as is usually done per the Environmental Protection Agency (EPA) method" reported Dr. Greg Tracey, SAIC's Principal Investigator on the project. "The data was straight forward and easily understood by the regulators and public" he added. EPA and State regulators concurred, resulting in a finding of no further action for the site, representing a savings of approximately $2M dollars in remediation costs.

NFESC is in the unique position to immediately provide these specialized contract services to activities on a cost reimbursable basis.

To discuss SAIC's environmental assessment services, please contact:
SAIC, at (401) 848-4631

For further information or to discuss the possibility of utilizing this contract, the NFESC point of contact is:
Contracting Officer's Representative,
NFESC, DSN: 551-4840 or (805) 982-4840

Calendar Of Events

DATE	COURSE NAME	LOCATION	PHONE
Aug 16-18	Environmental Negotiation Workshop	Philadelphia, PA	(805) 982-2877
Aug 24-25	Remedy Selection and Closure	Silverdale, WA	(805) 982-2877
Sep 1-3	Environmental Negotiation Workshop	Port Hueneme, CA	(805) 982-2877
Sep 13-16	Advanced Environmental Restoration	Norfolk, VA	(805) 982-2877

DEPARTMENT OF THE NAVY

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