

Navy's Environmental Restoration Program Boasts Successful Site Cleanups

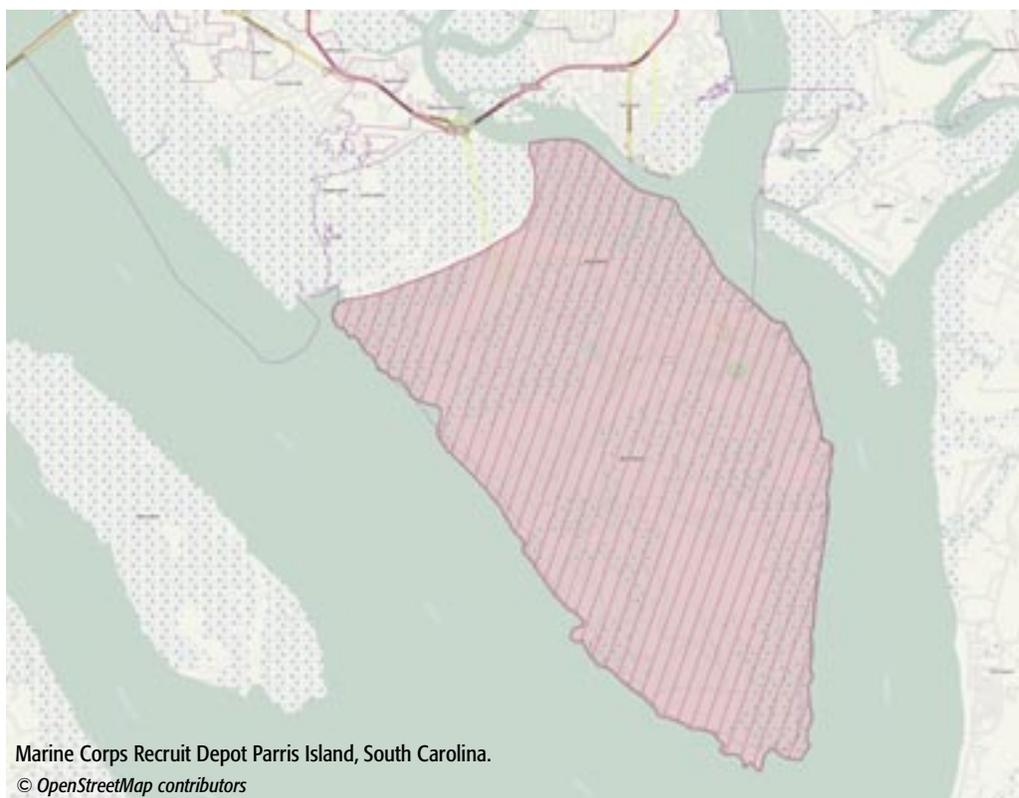
Program Applies Innovative Approaches to Complex Problems

TO CARRY OUT the Department of the Navy's (DON) mission, the Navy manages extensive facilities and lands throughout the country that provide services for everything from housing and training troops to maintaining ships, aircraft, weapons and vehicles. Over the years, various operations have occasionally resulted in the release of contaminants to soil, sediment, and groundwater at these sites. In many cases, the releases occurred decades ago—before the environmental hazards were recognized and before adequate control mechanisms were in place. However, the DON is committed to cleaning up these releases in a timely manner that protects human health and restores and preserves environmental quality for future generations. DON seeks to be a leader in the development of responsive, budget-conscious, and sustainable remediation solutions.

The DON's Environmental Restoration (ER) program was initiated in the early 1980s in response to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (also known as Superfund). In the early years, the program addressed only the cleanup

of chemical contamination. This part of the program is referred to as the Installation Restoration Program (IRP) and currently includes more than 3,900 sites. Significant progress toward cleanup of these sites has been made, and many of the IRP sites are in the final stages of cleanup.

As the IRP progressed, the DON also recognized the need for cleanup of sites having munitions and explosives of concern (MEC) and/or munitions constituents (MC). Thus, in 2001, a second phase of the ER program was initiated to address munitions-related contaminants. This program is referred



Marine Corps Recruit Depot Parris Island, South Carolina.

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to as the Munitions Response Program (MRP) and includes only sites that are no longer active, such as former practice ranges or former storage areas. The MRP has grown to more than 360 sites, most of which are in still the investigative stages of cleanup.

The DON ER program follows the CERCLA response action process for most IRP and MRP sites. This process provides a comprehensive cleanup approach from site identification and investigation through cleanup and closeout.

The following case studies illustrate some of the innovative approaches that have been implemented to solve complex remediation situations at DON sites throughout the country, ranging from vapor intrusion (VI) to time-critical asbestos removal to improving a remediation effort.

Evaluating Vapor Intrusion with Radon as a Tracer

Vapor intrusion is a form of indoor air pollution caused by the migration of chemical vapors from contaminated soil and groundwater into buildings. A 2010 survey identified 116 Navy sites (each site includes anywhere from one to 50 buildings) needing VI assessments. One of these sites, known as Site 45, contains former and current dry cleaning facilities at Marine Corps Recruit Depot (MCRD) Parris Island in South Carolina.

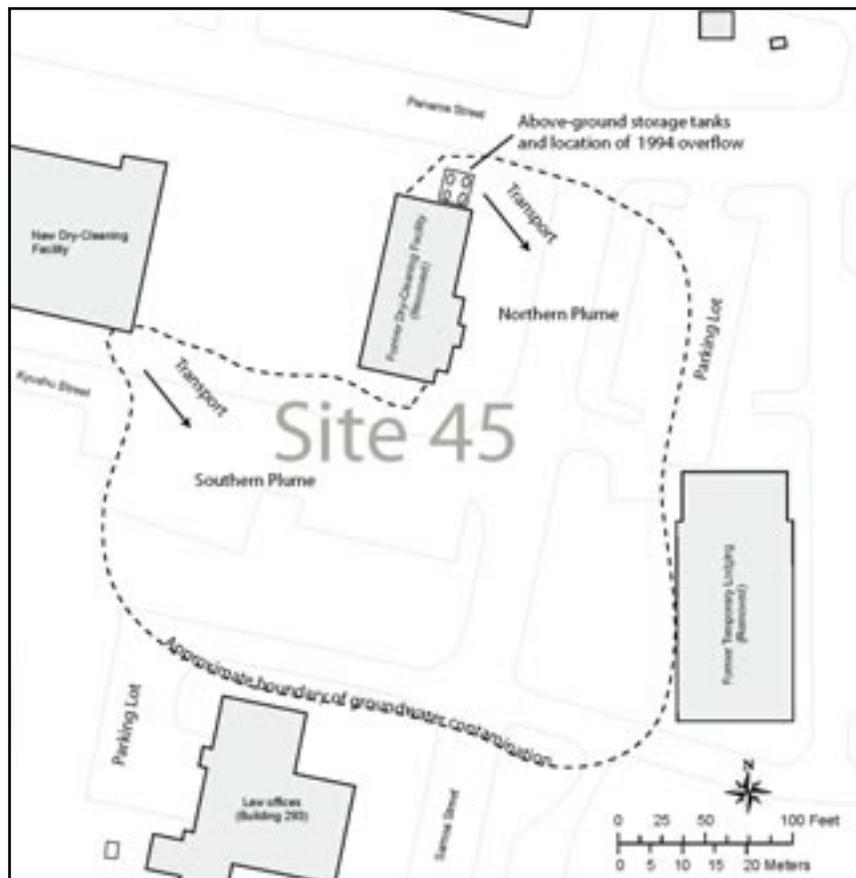
A CERCLA Remedial Investigation/Feasibility Study at the site concluded that remedial action was needed and a VI assessment was ordered due to the presence of chlorinated solvent contamination in shallow soil and groundwater near the site of the present dry

cleaning building (the contamination is presumed to have migrated from the former dry cleaning facility). The VI assessment included sub-slab soil gas and indoor air sampling and also used radon as a natural tracer to determine whether subsurface contamination was causing indoor air impacts above levels of regulatory concern.

The tracer study results were used to develop a building-specific attenuation factor. (The attenuation factor represents the reduction in vapor concentrations between the subsurface source and indoor air.) The assessment demonstrated that the likely source of tetrachloroethene (PCE) in indoor air could be tied to ongoing use of the building as a storage and transfer station for dry-cleaned clothes.

The VI investigation was performed in part under an Environmental Security Technology Certification Program (ESTCP) project to evaluate new VI investigation technologies, including the use of radon as a natural tracer to estimate building-specific attenuation factors.

Radon has been recognized as an effective tracer for evaluating VI because it is naturally occurring and ubiquitous in soil gas, and there are no sources of radon in indoor air to act as a confounding factor. Therefore, radon has been used in VI practice to compare the attenuation and transfer of other volatile chemicals across building slabs. The attenuation factor represents the ratio of the indoor air concentration within a



Site 45 contains former and current dry cleaning facilities at MCRD Parris Island.

About the CERCLA Process

ANY SITE THAT has been identified to the U.S. Environmental Protection Agency (EPA) as the site of potential contamination goes through a specific set of steps known as the CERCLA or Superfund cleanup process. The process is as follows:



Preliminary Assessment/Site Visit. Site conditions are evaluated. If signs of contamination are in evidence, inspectors determine whether the situation requires an immediate response.

National Priorities List (NPL). If investigators determine that a sizeable hazard exists (based on a predetermined set of criteria), the site is entered on the NPL. This is a list of national priorities among the known or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories.

Remedial Investigation/Feasibility Study (RI/FS). This process includes data collection and planning; site characterization, which includes field sampling and laboratory analyses to determine the risk to human health; development and screening of alternative remedies; treatability investigations to reduce uncertainties involved with chosen remedies; and a thorough analysis of the alternative remedies based on nine criteria delineated by the EPA.

building to the vapor-phase concentration in subsurface media underlying or adjacent to a building. Lower attenuation factors represent greater attenuation or dilution across the slab of a building. Since the use of radon is a relatively new investigative tool, the Navy and EPA agreed to collect additional supporting data, including subslab and soil gas data, to validate the radon findings and to reduce uncertainty in the remedial design phase.

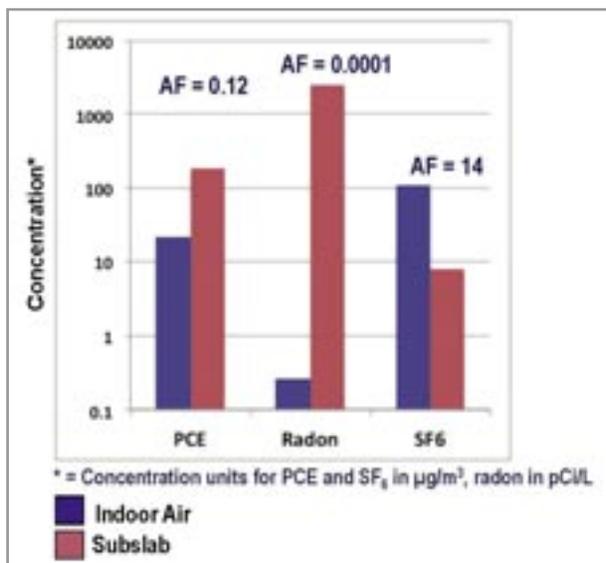
Applying the average building-specific attenuation factor of 0.0001 based on the radon data to the maximum PCE subslab concentration yielded a projected indoor air concentration that was below the EPA screening level for PCE in residential air. This building-specific attenuation factor and the fact that laundered garments (likely containing trace amounts of PCE) were brought into the building as a dry cleaning transfer station strongly suggest that the concentrations of PCE measured in indoor air came from the dry-cleaned clothes.

By estimating building-specific attenuation factors and considering other building factors, such as the storage of treated garments in the facility, the frequency of fresh air exchange in the building, and the low occupancy rate for staff in the part of the building nearest the groundwater

plume, the Navy and EPA moved forward to remedy selection without a further VI evaluation.

A proposed plan is currently being developed by the Navy and Marine Corps, and the remedy will likely include a combination of the following:

- Excavation and off-site treatment of contaminated soil



Record of Decision (ROD). A decision is made regarding which remediation method to use based on the RI/FS. All information collected during the investigation is included in this public document.



Remedial Design and Remedial Action. Under this phase, the chosen remediation effort is designed and implemented.

Construction Completion. This phase indicates that needed construction related to a remediation effort is either complete or deemed unnecessary. This is regardless of whether or not the cleanup process is complete.

Post-Construction Completion. The goal of these activities is to ensure that CERCLA response actions provide for the long-term protection of human health and the environment. These activities also involve optimizing remedies to increase effectiveness and/or reduce cost without sacrificing long-term protection of human health and the environment.

Deletion from the NPL. This is an indication that no further action is required.

Site Reuse. Deletion from the NPL indicates that the site is safe for reuse or redevelopment.

- Treatment of contaminated groundwater through a combination of in situ enhanced bioremediation and chemical oxidation
- Monitored natural attenuation of the groundwater
- Land use controls to prevent exposure to subsurface contamination while the soil and groundwater remedy is being implemented.

In addition, long-term monitoring and land-use controls will likely be implemented to prevent exposure to contaminated groundwater entering the storm sewer system while the in situ groundwater remedy is being implemented.

Through this innovative approach to evaluating VI at Site 45, the need for building mitigation and delays associated with additional VI sampling and analysis were avoided enabling the soil and groundwater plume remedy selection efforts to proceed.

Time-Critical Asbestos Removal

Training activities at the Silver Strand Training Complex (SSTC) South stopped abruptly in 2009 after the discovery of asbestos contamination at this Southern California location. The Navy was able to resume training within





Map of affected area. Concrete pads are outlined in red. Asbestos floor tiles were observed throughout yellow areas.

CDM

15 months by conducting one investigation, implementing a Time Critical Removal Action (TCRA), and conducting activity-based sampling (ABS). This approach set a precedent that can be applied at similar asbestos sites at other Navy installations.

The SSTC South is located on the Silver Strand, which bridges Coronado

Island and Imperial Beach in southwestern San Diego County. SSTC South, encompassing about 450 acres, is bordered to the west by the Pacific Ocean and to the east by San Diego Bay. A small radio compass station was established at SSTC South in 1920 by the Navy, and operations continued under the Navy and Army through 1970, when virtually all build-

ings associated with a portion of the site called Fort Emory were demolished. Although these buildings were demolished, concrete pads (some with intact remnant linoleum floor tiles) remained throughout the site. The combined terrain of concrete pads and vegetation made SSTC South a preferred location for urban combat training.

During training exercises in 2009, Navy personnel came in contact with linoleum tiles, which were still attached to the concrete pads. Red dust from these tiles adhered to the trainees' clothing. The red dust triggered an investigation into the composition of the linoleum tiles, which were determined to be asbestos-containing material (ACM). As a result, training exercises were immediately halted and relocated while the Navy researched options for remediating the site. At this point, the site was entered into the Navy IRP and a TCRA was begun at IR Site 11.

The National Contingency Plan, which guides all CERCLA responses, classifies removals as either time-critical or non-time-critical depending on the extent and type of contamination. To prevent asbestos release into the environment, the linoleum tiles, mastic (used to adhere the tiles to the concrete pads), and surface soil adjacent to the concrete pads (containing fragments of linoleum tile) were removed. Engineering controls for dust suppression and best management practices were used to ensure that no asbestos was released into the environment during the removal, loading, and transportation of the ACM, soils, and vegetation. Perimeter air monitoring was also used to verify that asbestos was not released into the environment.



Some of the asbestos floor tile found at SSTC.

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To ensure protection of human health, confirmation sampling was required to verify that the TCRA removed asbestos from the site.

Analysis of asbestos in soil samples is not sensitive enough to reliably quantify asbestos below one percent. Also, there is no agreed-upon concentration of asbestos in soil that can be considered protective of human health because the relationship between asbestos levels in soil and the concentration in inhaled air seems to be highly variable. Based on these limitations, the EPA recommends an approach in which risk from asbestos in soil is evaluated on measurements of asbestos in air rather than soil. This approach uses ABS, in which air samples are collected from the breathing zone of personnel engaging in realistic and representative activities that could release asbestos fibers from soil, as the confirmation sampling method. This framework has been applied at other asbestos-contaminated sites such as Libby, Montana, and El Dorado Hills, California.

After the post-TCRA confirmation sampling, a technical memorandum was written with a human health risk assessment of Navy trainee and instructor ABS scenarios and an evaluation of Occupational Safety and Health Administration occupational exposure. It was determined based upon the ABS results that the TCRA was protective of human health. The Naval Medical Center in San Diego concurred with the findings and approved resumption of training exercises in April 2011 at IR Site 11.

By prioritizing the use of IR Site 11 for Navy training exercises and not unrestricted use, SSTC South was able to resume training Navy personnel as soon as possible. The approach used at SSTC South (minimal pre-removal investigation, TCRA, and confirmation sampling through ABS) was successful, and confirmed that the removal action was protective of human health.

The months (or potentially years) saved by initiating this time-critical action allowed crucial training to continue in a reasonable amount of time, allowing the Navy to help fulfill its mission to maintain, train, and equip combat-ready Naval forces.

Remediating the Remedy

The Navy and Department of Defense (DOD) policies require continual optimization of environmental remedies in every phase from remedy selection through site closeout. In August 2009, the DOD issued policy for



Asbestos samples were double bagged to prevent release of asbestos dust into the air.

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Contaminated soil was removed from the area.

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Workers polished concrete pads after tile removal.

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“Consideration of Green and Sustainable Remediation Practices in the Defense Environmental Restoration Program.” This policy, along with current Navy policy and guidance, requires that sustainability be considered throughout all phases of remediation at DOD and Navy facilities.



NAVFAC issued policy for “Optimizing Remedial and Removal Actions at all Department of Navy (DON) Environmental Restoration Program Sites” in April 2012 and the “DON Guidance on Green and Sustainable Remediation” in June 2011.

A sustainability evaluation at Marine Corps Logistics Base (MCLB) Albany, Georgia, found that optimizing the soil and groundwater remedy there significantly reduced total life-cycle greenhouse gas (GHG) emissions as well as costs.

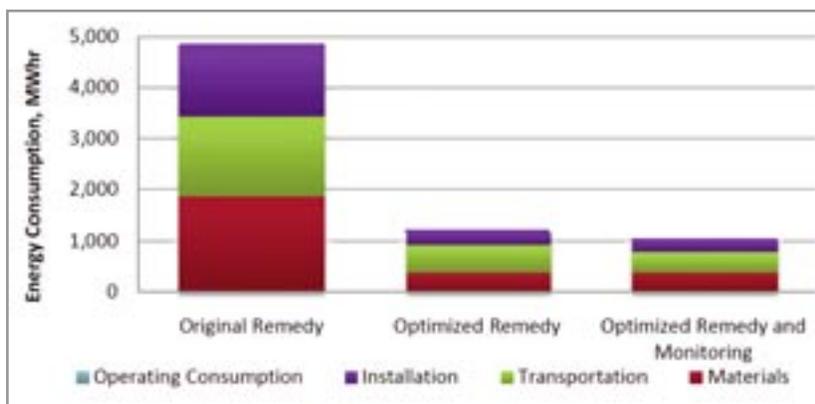
MCLB Albany is a 3,579-acre supply and logistics facility for the U.S. Marine Corps. Approximately 600 active-duty personnel and 3,870 civilians work on the base. Remedial activities have been ongoing for several years at a variety of locations on base. Contaminants of concern (COC) in groundwater throughout the site (referred to as Operable Unit (OU) 6) include PCE and trichloroethene (TCE), and the chemicals that result from degradation of these substances (daughter products), benzene, methylene chloride, antimony, thallium, cadmium and arsenic.

Under CERCLA, a Record of Decision (ROD) was issued for OU 6 in 2004. The ROD and subsequent Explanation of Significant Differences specified several remedies designed to remediate the site. Source control (soil) remedies included construction of an evapotranspiration cap in one area, maintaining pavement as a cap in another area, and a soil cover in a third area. Remedies for groundwater included injection of sodium permanganate or zero-valent iron at 190 locations. Monitored natural attenuation (MNA) was specified as a follow-on remedy for the entire site.

In accordance with Navy optimization policy, late in 2004, Naval Facilities Engineering Command Southeast (NAVFAC SE) optimized the remedial design, resulting in a more focused treatment, concentrating the chemical injections at 39 locations in only the high concentration zones. This design remained compliant with the ROD.

NAVFAC SE also performed an optimization of the groundwater long-term monitoring (LTM) program in 2010. The LTM optimization used a three-tiered approach including a qualitative, statistical and spatial analysis of the existing LTM program used to evaluate MNA. The monitoring optimization resulted in significant reductions in the number of monitoring locations, reductions in the analytical program to include only COCs identified in the ROD, and a reduction in the sampling frequency from semi-annual to annual at most wells.

In 2010, NAVFAC SE performed a sustainability evaluation to assess

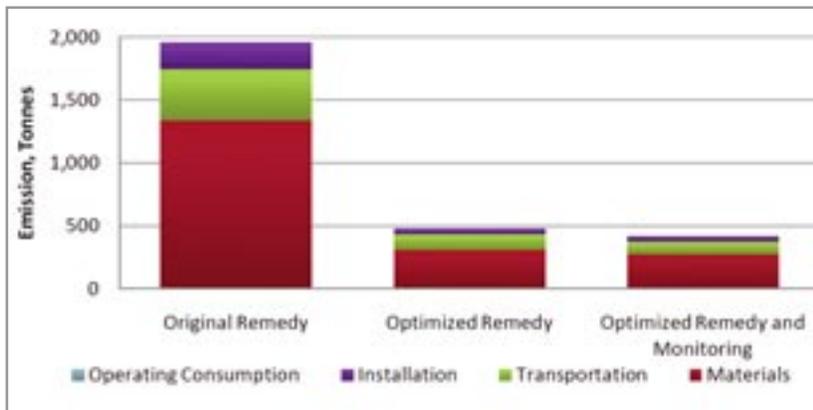


Energy consumption at MCLB Albany.
Tetra Tech NUS

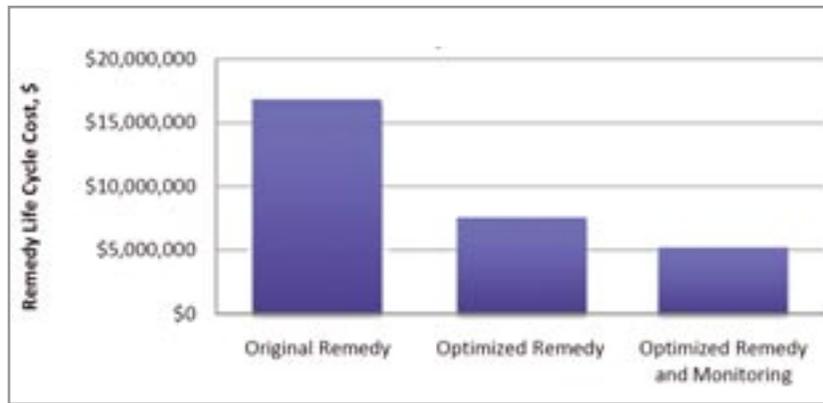
the impact of previous remedy and LTM optimization efforts on the lifecycle environmental footprint of the OU 6 ROD remedies. Sustainability metrics evaluated included GHG emissions, energy consumption, criteria pollutant emissions and water usage.

The sustainability evaluation determined that the remedy optimization resulted in a lifecycle net energy reduction of approximately 3,700 megawatt-hours, and the LTM optimization further reduced energy consumption by approximately 130 megawatt-hours.

The evaluation determined that optimizing the remedy reduced lifecycle total GHG emissions by approximately 1,475 tonnes (75 percent), and optimizing the LTM program further reduced the total GHG emissions by 57 tonnes. (Note: Tonne is a metric unit equaling 2,204.6 pounds.) The total GHG emissions include carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O). These were normalized to CO₂ equivalents (CO₂e) which is a cumulative method of weighing GHG emissions relative to global warming potential. The following chart shows the reductions in CO₂e emissions.



CO₂e emission reductions.
Tetra Tech NUS



Remedy lifecycle costs.
Tetra Tech NUS

The remedy optimization also decreased lifecycle water usage by approximately 1.1 million gallons. Optimizing the LTM further reduced water usage by approximately 90,000 gallons.

Lifecycle emissions of nitrogen oxide, sulfur oxide, and particulate matter less than 10 micrometers in diameter (PM₁₀) were also significantly reduced throughout the optimization process by decreasing material, transportation and installation demands.

The chart above displays the remedy lifecycle costs associated with the original remedy, the optimized remedy and the optimized remedy

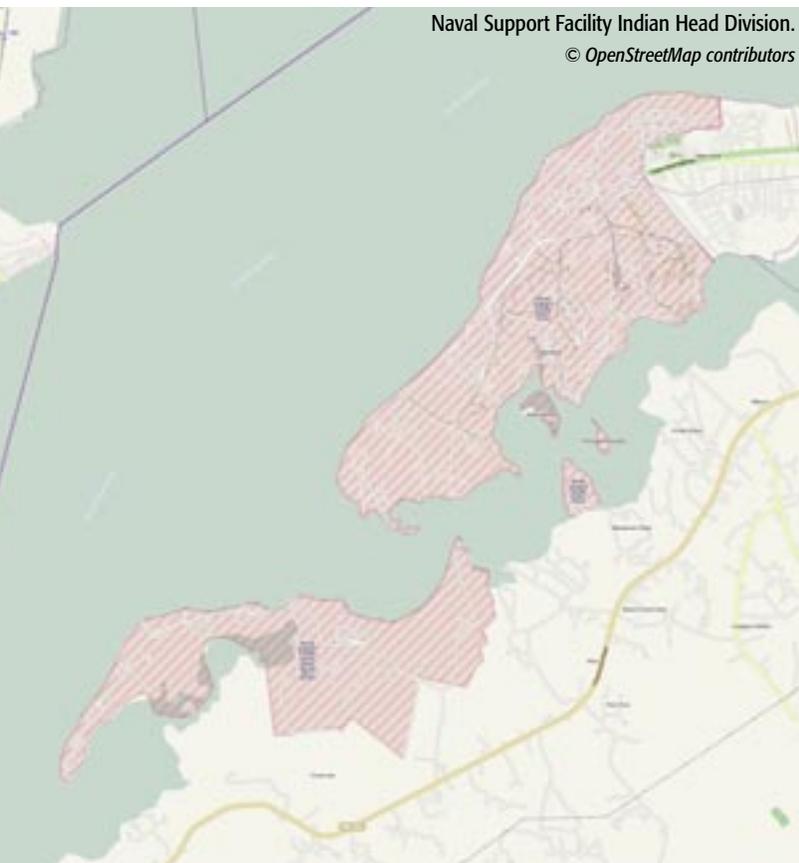
and monitoring activities. It illustrates a continued reduction of estimated lifecycle costs with each phase of optimization. The optimization measures undertaken have been estimated to yield a cost avoidance of \$10 million over the lifecycle of the remedy, including the LTM program.

NAVFAC SE has included optimization as standard practice for more than 15 years. Recently, sustainability has been included in this standard. The sustainability evaluation at MCLB Albany provided insight into the elements of the remedy that have the greatest impact on the environmental footprint. It demonstrated that optimization reviews and sustainability evaluations at each phase can continually improve remedy effectiveness, control lifecycle costs, and reduce the overall environmental footprint, including GHG emissions, energy usage and other resource consumption. The most significant improvements are possible from reviews during remedy selection and design, although periodic reviews during the Remedial Action Operation/Long-Term Monitoring phase will continue to reduce the overall lifecycle environmental footprint.



Current site conditions showing pipe storage at NSF IHD.

NAVFAC's 2012 policy requiring optimization reviews and sustainability evaluations during the feasibility study phase of every project, and 2011 sustainable remediation guidance—which incorporates sustainability evaluations as part of the traditional optimization review process—further facilitate remedies that take green and sustainable approaches into consideration.



Naval Support Facility Indian Head Division.
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Disposing of Potentially Explosive Material

A fairly standard cleanup of a Navy scrap yard in Maryland became more complicated after suspected explosives, or Materials Potentially Presenting an Explosive Hazard (MPPEH), were found. To address the issue, a labor-intensive screening operation along with a Contained Detonation Chamber (CDC) were used.

Naval Support Facility Indian Head Division (NSF IHD) is located in northwestern Charles County, Maryland, approximately 25 miles southwest of Washington, D.C. The facility's scrap yard, located along Mattawoman Creek, was originally a coal storage facility starting around 1900. It later became a storage area for materials such as metal scrap, transformers containing polychlorinated biphenyls (PCB), and lead-acid batteries from the 1960s until 1988. Items were placed in the scrap yard with the intention that they were inert, but a lack of archival information required that all ordnance items be treated as potentially live. Throughout the 1990s, investigations at the site identified PCBs, Polycyclic Aromatic Hydrocarbons (PAH), and metals in the soil as COC. A human health risk assessment found unacceptable risk for receptors exposed to soil.

A Proposed Plan and Action Memorandum were completed that identified soil removal as the preferred alternative. Consequently, scrap removal began in 2002, utilizing a water jet cutter. The purpose of that effort was to clear the site of all materials down to the concrete pad and gain access to PCB-contaminated soils. At this point however, large munitions and explosives of concern were discovered, which required a specialized Explosive Safety Submission (ESS). Suspect items included a 220-pound frag bomb, an eight-inch projectile, and submunitions. (Note: Submunitions include bomblets, grenades, and mines filled with explosives or chemical agents.) Approval of the ESS was needed prior to commencement of the last phase of soil and munitions removal.

The last removal phase (May 2010 through May 2011) included the identification, certification, demilitarization, and disposal of MEC and MPPEH, and use of a CDC for items with less than 13 pounds of trinitrotoluene. In a CDC, the energetic or toxic item to be disposed of is imploded using a specifically designed explosive donor charge. The donor charge fragments the item and initiates the energetic content, while the resulting fireball decomposes the toxic agent, if any.

To accomplish this work, Unexploded Ordnance (UXO) technicians performed a visual and hand inspection to identify MPPEH and suspect MEC. All items that were found needed to be classified as either scrap metal, 5X, or safe to move. (5X is a designation for munitions items in which all cavities and surfaces can be seen and inspected.) Items were moved to a designated ordnance processing area or to the CDC for proper demolition.

Soil piles contained thousands of small cartridge actuated devices/propellant actuated devices (CAD/PAD) that required a two-phase screening process. UXO technicians monitored screening operations from a distance of 14 feet behind a protective two-inch thick Plexiglas plate. CADs/PADs as well as other MPPEH items were screened out and staged at a processing area.

Eventually, all munitions items were demilitarized and removed from the site. Quality control checks of screened soil were completed to confirm that munitions items would not be sent off-site with the waste. Once complete, the removal action eliminated risks and returned the site to a beneficial use area for the installation.

There were a number of challenges at the scrap yard site. First, MEC items were present with large Explosive Safety Quantity-Distance (ESQD) arcs, or standoff distances, that required a waiver from the Chief of Naval Operations Supply, Ordnance, and Logistics Operations (CNO N41) to conduct removal operations. The ESQD arcs would have required evacuation and shutdown of nearby buildings and facilities. Without the waiver, installation activities could have been severely impacted. Secondly, a Memo-



randum of Agreement (MOA) was required which required numerous signatures and concurrence between NAVFAC Washington, Naval Support Activity South Potomac, and Naval Surface Warfare Center (NSWC) Indian Head Division (a tenant of NSF IHD). Finalization of the MOA required much coordination and time. Another challenge was the high visibility of the scrap yard cleanup. The site was adjacent to an office building and next to the Mattawoman Creek, which is popular with boaters and anglers. Entry control points needed constant monitoring. The last challenge was time-of-year work restrictions based on the bald eagle nesting season. A portion of the site was near an eagle's nest and slightly delayed the project start.

Despite these challenges, an ESS was approved, outlining a cost-effective approach for addressing the situation. Supporting documentation such as the CNO waiver and MOA were processed in a timely fashion, allowing work to proceed with minimal impacts to the base's mission. In all, over a ton of miscellaneous CADs/PADs were recovered by

screening and transferred to NSWC Indian Head Division for treatment. Over 2,400 munitions items were demilitarized, including 87 MEC items treated in the CDC. In addition, 4,900 tons of contaminated soil was removed from the site, and 164 tons of non-munitions scrap metal was sent offsite for recycling.

The site was returned to the installation for their use and is currently being utilized for pipe storage to support a military construction project. [↴](#)

CONTACTS

Jay Newbaker
Chief of Naval Operations Energy and
Environmental Readiness Division
703-695-5266
DSN: 225-5266
edward.newbaker@navy.mil

Kim Parker Brown
Naval Facilities Engineering Command
202-685-0096
DSN: 325-0096
kim.brown@navy.mil

Josh Fortenberry
Naval Facilities Engineering and
Expeditionary Warfare Center
805-982-4990
DSN 551-4990
josh.fortenberry@navy.mil