

Environmental Restoration Installation

Marine Corps Base Camp Lejeune

INTRODUCTION

Marine Corps Base, Camp Lejeune, NC is home to the largest single concentration of Marines in the world and supports the most complete amphibious training program on the east coast. Camp Lejeune was established in 1941 and named in honor of Lieutenant General John A. Lejeune, the 13th Commandant of the Marine Corps.

Location/Population

Located within Onslow County, Camp Lejeune occupies approximately 153,000 acres of land as follows:

| Land Cover | Acres |
|-----------------------|--------|
| Surface Waters | 24,000 |
| Forested Wetlands | 29,000 |
| Non-forested Wetlands | 20,000 |
| Upland forests | 72,000 |
| Urban/Developed | 7,500 |

The town of Jacksonville, North Carolina is located immediately northwest of MCB, Camp Lejeune. The majority of the surrounding land is used for agricultural purposes. Three large publicly owned forests are located within 15 miles of the facility and the marine estuarine environment along the coast supports commercial fishing and residential resort areas.

Camp Lejeune supports a large population of active duty, retiree, family members and civilian employees

Base Operations

MCB, Camp Lejeune's mission is to provide housing, training facilities, and logistical support for Fleet Marine Force Units and other assigned units. The Base conducts specialized training for approximately 42,000 Marines, Sailors and other military personnel, which includes over 50 courses ranging from entry-level skill to professional and

technical training. The Installation provides housing, training facilities, and logistical support for active and reserve Marine Expeditionary Force commands, as well as mobilization and deployment support to the units during exercises and contingencies.

BACKGROUND

Environmental Restoration Challenges

Camp Lejeune is one of the leading DoD facilities in restoration of natural resources affected by past waste disposal practices, environmental leaks and spills.

Camp Lejeune treats and distributes potable water from the Castle Hayne aquifer, which is the sole water supply source for the Installation. The aquifer lies beneath the sandy soils of the Coastal Plains which allow contaminants to infiltrate the aquifer. Therefore, cleanup of contamination is essential for protecting the health of Base residents and employees.

Organization/Staffing

The Installation Restoration (IR) and Underground Storage Tank (UST) Sections fall under the Environmental Quality Branch (EQB), Installations and Environment Department. The IR Section oversees the remediation and restoration of past and present hazardous waste sites and leaking USTs. The IR Section focuses on remedial actions under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) and the Resource Conservation and Recovery Act of 1976 (RCRA). The UST Section manages the remediation of soil and groundwater regulated under Subtitle I of RCRA. EQB participates in the Base Environmental Impact Review process performed under the National Environmental Policy Act (NEPA) to ensure that training and construction proposals do not affect, or are affected by, contaminated sites aboard the Installation.

Community Involvement

MCB, Camp Lejeune hosts a successful Restoration Advisory Board (RAB) that meets quarterly. The Camp Lejeune RAB was created in 1995 and is made up of members of the local community, local civic and business organizations, and civilian employees. The RAB provides tours, on-site demonstrations of new

technologies, and informative talks in the local community. The RAB provides additional information and posts quarterly meeting minutes on the EMD/RAB website.



Quarterly RAB Meetings held at Coastal Carolina Community College. Meeting minutes posted on Internet Web Site. Meeting notification placed in local newspaper with open invitation for community.

Restoration Agreements

Camp Lejeune entered into a Memorandum of Agreement on May 24, 1999, that established a Land Use Control Assurance Plan (LUCAP). Camp Lejeune has developed 21 Land Use Control Implementation Plans (LUCIPs) that stipulate controls to minimize or eliminate the potential for exposure. Controls include restrictions such as: industrial land use only, no intrusive activities or use of groundwater beneath the site, etc. EQB personnel perform quarterly inspections of LUCIP sites to ensure adherence to land use controls and provide plat maps of contaminated properties with State guidelines to the local county register of deeds. Camp Lejeune leads DoD facilities with signatures on 28 RODs and 3 Interim RODs (IRODs).

PROGRAM SUMMARY

The Camp Lejeune Partnering Team, comprised of the Base, NAVFAC, US Environmental Protection Agency (USEPA), the North Carolina Department of Environment and Natural Resources (NCDENR), and support contractors, has the following mission statement:

Working together as a team with a commitment to continuous improvement, we will clean up hazardous waste sites with the appropriate use of innovative, quality, and cost effective technologies to protect human health and the environment.

This mission statement encompasses the three major objectives of the IR Program:

1. Work together as a team with a commitment to continuous improvement: The Partnering Team has a formal process for ensuring that environmental programs are conducted in full compliance with Federal and State requirements. The Team works closely to resolve complex issues that may impede the progress of the IR Program while expediting the restoration process by reducing the process from 65 to 39 months. The Team has undergone formal partnering training, uses a facilitator to achieve continuous improvement, and tracks improvement with a self-evaluation of various components of every meeting (productivity, technical quality, time management, etc.). Overall, the Team has achieved a high degree of success with this objective.

2. Clean up hazardous waste sites with the appropriate use of innovative, quality, and cost effective technologies: The Team has lowered remediation costs by using the Pilot Expedited Environmental Cleanup Program, allowing for the evaluation of innovative remedial technologies to identify the most cost-effective options.

The source zone removal project at Site 88, the former Base Dry Cleaner, was the largest use (and only the second time used) of soil mixing with zero valent iron (ZVI) and clay addition. This robust, innovative approach was the lowest cost of four alternatives evaluated to treat a site with 28,000 pounds of pure solvent.



Geoprobe investigations are a fast track approach to optimize the location and number of monitoring wells that are required to complete an investigation. Camp Lejeune seeks many ways to reduce investigation costs.

Other innovative, cost-effective technologies or approaches include horizontal sparge wells, membrane interface probes, optimizing the long-term groundwater monitoring program, and using risk-based approaches to develop the remedial goal. An excellent example of collaborative partnership between the Base and regulators is the use of risk-based action levels for Site 89. Contamination levels greater than the action level will be addressed with active remediation, while lower levels will rely on monitored natural attenuation (MNA). The Team has achieved outstanding success with this objective.

Protect human health and the environment:
This is the ultimate objective for the Program. MCB, Camp Lejeune has developed and maintained three remediation programs ensuring the effective and timely cleanup of varying types of contamination on Base. During the past year, the IR program has achieved “No Further Action (NFA)” for 2 sites and has obtained RODs for two additional sites reducing the IRP from 19 to 15 sites. Confirmatory sampling performed in 2006 under the Solid Waste Management Unit (SWMU) Program has also reduced the total number of SWMU sites, through NFA, from 59 to 23 sites. The Underground Storage Tank (UST) Program continues to achieve closure on numerous petroleum sites. During 2006, 10

UST sites achieved NFA, further reducing the total number of active sites on Base to 48.



Rotasonic drilling has been implemented at many sites at Camp Lejeune. This is a new technology that quickly advances soil borings in a relatively cleaner process. This approach used across Camp Lejeune has been effective in reducing investigation costs.

ACCOMPLISHMENTS

The most significant accomplishments of the year are highlighted below, with an emphasis on fast-track cleanup, cost-effective innovation, cleanup partnerships, the RAB, small business opportunities, and risk reduction:

Fast-Track Cleanup: A railroad right-of-way (ROW) borders Site 84 to the north. The railroad is no longer used and the Base plans to transfer a portion of the railroad ROW to the City of Jacksonville for development of a pedestrian/bicycle trail. A portion of this trail will be developed along the northern border of Site 84. Accordingly, an expedited site assessment and cleanup of the contaminated soils was imperative to allow the property to be reused by the local community.

Expedited Cleanup: Numerous chlorinated solvent and petroleum hydrocarbon groundwater plumes exist at Camp Lejeune. The plumes range in size from 4 to 70 acres and are complicated by complex geologic and hydrogeologic conditions, as well as challenging physical site constraints within active operational

areas. The Partnering Team developed a strategy which assembled the descriptions of site contaminants and their physical conditions at all IR sites. Innovative technology evaluations for the highest-priority sites were performed to identify potential remedial options. By using a comprehensive approach, the Team is assessing a variety of technologies and their effectiveness within a 1-year time frame, enabling future remedial actions at other Bases, IR sites, or contaminated sites (e.g., UST) to benefit from the Team's lessons learned.



Removal action at Site 84 to address PCB contamination. This property underwent remediation to industrial standards with the goal of eventually turning the property over to the community or potentially serve as a military museum.

Expedited RCRA Interim Measures (IMs):

IMs under the Base's RCRA program led to accelerated removal actions at several SWMUs on Base. The sites were impacted by a variety of mixed wastes including POL and metals from disposal areas, tanks, and oil/water separators. IMs were completed under an expedited schedule and resulted in significant cost savings by eliminating the need to complete further RCRA investigations. These removals have reduced potential exposure risks from contaminated surface soils and have enabled the Base to reuse these properties for military operations.

Innovative Technology

Demonstration/Validation and Implementation:

Camp Lejeune, one of the leading DoD facilities in cleanup, strives for advancement in innovative assessment and remedial technologies. Due to the

large number of sites and types of contamination present, the IRP encounters situations where existing technologies will not remediate effectively. The Base has completed implementation and evaluation of several innovative technologies and pilot studies: (1) soil stabilization method and ZVI mixing achieving greater than 92% contaminant reduction of dense, non-aqueous phase liquid (DNAPL); (2) horizontal well ozone-enhanced air sparging achieving 99% contaminant reduction; (3) chemical oxidation using Modified Fenton's and permanganate with pneumatic fracturing to achieve 98% contaminant reduction; and (4) horizontal well hydrogen injections. In addition to evaluating the effectiveness of the various technologies, these approaches are useful in evaluating the application of reducing source



Site 88 soil mixing with ZVI-clay addition. Soil was mixed with zero valent iron and clay to treat and bind contaminants, resulting in 92% contaminant reduction, equivalent to 26,000 pounds of solvent.

level contamination so that the overall site can be remediated with natural bioremediation, thereby reducing overall remedial costs, time, and impacts to the Base mission, while still being protective of human health and the environment.

Innovative Source Zone Remediation and Property Reuse:

At Site 88, the Former Base Dry Cleaner, Camp Lejeune was faced with a source area containing free product perchlorethylene (PCE). Through innovative investigation methods such as Membrane Interface Probe (MIP), the source area was

delineated. Soil mixing with ZVI and clay addition was selected by the Partnering Team and approved by the community through a well attended public meeting. This action was estimated to result in a savings of \$3.6 million compared to excavation. A Native Alaskan Joint Venture completed the work. The treatment volume was 7,000 cubic yards, with an average PCE concentration of 1,100 milligrams per kilogram (mg/kg). Actual soil mixing was conducted in just 17 days. Monitoring has indicated a 92% reduction in PCE, a removal of approximately 26,000 pounds of solvent.

Innovative Pilot Study with Promising Results, RAB Involvement, and Potential Applications across the Base: At Site 86, a horizontal well was used for an air sparging project. The project, implemented by a Native Alaskan Joint Venture, resulted in a 99% reduction of trichloroethene (TCE) in groundwater. Much of the contaminant reduction was achieved in the first 3 months of operation.



Site 86 horizontal well installation. This successful technology has been implemented at two other locations at the Base. The sparging through a horizontal well was extremely effective with 99% contaminant reduction.

The 950-foot well had a screen that was 350 feet long and was able to treat over 3 million gallons of water. Lessons learned from this project were presented at the Battelle Chlorinated Solvent Conference. The Camp Lejeune RAB was continually updated on the project's progress.

Risk-Based Remedial Action Objectives (RAOs) Developed by Partnering Team to Reduce Contamination Risk: Significant chlorinated solvent contamination is present across Site 89, the former Defense Reutilization and Marketing Office (DRMO). The Remedial Investigation (RI) used many innovative tools, including MIP and a real-time onsite laboratory. As part of the Feasibility Study, the Partnering Team agreed to a risk-based approach to determine RAOs. Using the risk-based approach is resulting in remedial actions only being required in areas that are several hundred times the state groundwater standard. This will eliminate the need to actively remediate half of the site. Using active remediation in high-concentration areas and MNA across the other half of the site will result in a cost savings on the order of \$5 to \$15 million.

Overcoming Development Constraints: Camp Lejeune is continually looking for areas to develop. Contaminated sites were once excluded from development regardless of the contaminant levels. Site 88 has been remediated under a Non-Time-Critical Removal Action with a parking lot constructed to cover the area and provide additional spaces in a congested portion of the Base. Site 89 is being reused as a Battalion staging area in support of troop deployments and Site 28 is being reused as a contractor equipment laydown area.

Reducing Risk to Human Health and the Environment: To ensure compliance with the LUCAP, the Base has implemented a comprehensive Intrusive Training Program (ITP) to prevent construction, maintenance, and training activities from impacting or being impacted by contaminated sites within the Base. To reduce the risk to human health, a number of Public Works personnel have received the 40-Hour HAZWOPER training and are certified. This process has reduced construction delays and associated costs often experienced by contractors who inadvertently work in contaminated areas.

Summary Narrative Camp Lejeune Environmental Restoration – Installation

Camp Lejeune faces a significant challenge of environmental restoration to remedy past disposal practices. The success of the Camp Lejeune IR Program is attributed to effective partnerships with Federal and State regulators, site investigation/remediation contractors and local stakeholders. Camp Lejeune's IR Program leads DoD facilities with signatures on 28 Record of Decisions and 3 Interim RODs and continues to be at the forefront of DoD's environmental restoration programs.

Camp Lejeune is one of the first Installations to have a formal LUCAP signed between representatives of the Marine Corps, Department of the Navy, USEPA Region IV, and NCDENR. To ensure the effective implementation of the LUCAP, a formal process by which current and future contaminated properties are managed through the Base Master Planning Process, incorporating geographical information systems (GIS) to facilitate mapping and other essential information. This process has reduced construction delays and associated costs often experienced by contractors who inadvertently work in contaminated areas.

In addition to successfully managing over 90 active contaminated sites at Camp Lejeune and inventing new approaches to solve problems, an emphasis is placed on the sharing of information. The Base manages to keep all of the sites moving through the various stages of the remediation process while maintaining outstanding relationships with other government entities, regulators, members of the partnering team and the local community. To achieve this relationship with the community, Camp Lejeune established a Restoration Advisory Board (RAB). Representatives from a cross section of the community compose the diverse group which reviews the various cleanup activities as they progress. RAB members have been instrumental in passing along information they learn to the community while providing Camp Lejeune with valuable ideas, opinions, and community insight regarding the studies and cleanup options.

The Base has implemented and evaluated several innovative technologies and pilot studies useful in evaluating source level contamination reducing overall remedial costs, time, and impacts to the Base mission. Recent technologies include: (1) Soil Mixing with Zero Valent Iron (ZVI); (2) Horizontal Well Ozone-Enhanced Air Sparging; (3) Chemical Oxidation using Modified Fenton's; (4) Permanganate with Pneumatic Fracturing; and (5) Horizontal Well Hydrogen Injections.

The Base IR program continues to strive to remediate and close all contaminated sites on Camp Lejeune to ensure the continued protection of human health and the environment for Base personnel and the surrounding community.