

## **MARINE CORPS BASE (MCB) CAMP LEJEUNE**

**was commissioned in 1941 with a mission that still holds true to this day: to maintain combat-ready warfighters for expeditionary deployment. Camp Lejeune is a training base that promotes combat readiness of the operating forces and missions of other tenant commands by providing training venues, facilities, services, and support in order to be responsive to the needs of Marines, sailors, and their families.**

### **Environmental, Geographical, and Regional Setting**

Camp Lejeune covers more than 156,000 acres in the Atlantic coastal plain of southeastern North Carolina in Onslow County, adjacent to the City of Jacksonville. The Base consists of a diverse environmental setting including approximately 72,000 acres of upland forests, 49,000 acres of wetlands, 26,000 acres of water, and 7,500 acres of urban/developed land with elevations ranging from sea level to 70 feet above mean sea level. The Base boundary includes approximately 14 miles of beach along the Atlantic Ocean. Beach frontage consists of a barrier island system and is separated from the mainland by salt marshes, small bays, and the Atlantic Intracoastal Waterway. Several large, publicly owned tracts of land, including Croatan National Forest, Hoffman Forest, and Hammocks Beach State Park, are located within 15 miles of the Base. The remaining surrounding land uses are a mix of urban, suburban, small town, and agricultural, as Onslow County has grown and developed with Camp Lejeune. Estuaries along the coast support commercial fishing, recreation, and tourism, and residential resort areas along the coast are important to the regional economy.

### **Community Setting**

Camp Lejeune and the surrounding community are home to a large concentration of Marines and Sailors, with an active duty, dependent, retiree, and civilian employee population of approximately 170,000 people. Camp Lejeune enjoys a close relationship with the Base community and neighboring civilian communities. Neighboring communities, cities, and towns include the City of Jacksonville, Verona, Holly Ridge, North Topsail Beach, Surf City, Piney Green, Sneads Ferry, and Swansboro.

### **BACKGROUND**

Historical operations, storage, and disposal practices at Camp Lejeune resulted in environmental impacts to soil and groundwater. As a result, Camp Lejeune has been actively engaged in environmental investigations and remediation programs since 1981. In 1989, the United States Environmental Protection Agency (USEPA) placed Camp Lejeune on the National Priorities List (NPL). Camp Lejeune is a leading Department of Defense (DoD) installation, operating at the forefront of environmental restoration programs. By maintaining collaborative relationships with regulatory agencies and the supportive local community, the team has

made tremendous progress in investigating and cleaning up over 500 sites to-date under several environmental programs; including Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) that covers the Installation Restoration Program (IRP) and Military Munitions Response Program (MMRP), Resource, Conservation, and Recovery Act (RCRA), and the Underground Storage Tank (UST) program; with a goal to ensure continued protection of those living and working aboard Camp Lejeune.

### **Organization, Staffing, and Management Approach**

Base Environmental Management Division (EMD) leads the environmental compliance and restoration programs to manage over 75 active sites. The Base is supported by technical, acquisition, and legal professionals across the Naval Facilities Engineering Systems Command (NAVFAC) organization. Experienced Partnering Teams for the CERCLA (formed in the 1990s) and for the UST programs consist of representatives of Camp Lejeune, NAVFAC, North Carolina Department of Environmental Quality (NCDEQ), and/or United States Environmental Protection Agency (USEPA). The teams meet quarterly and are supported by multiple environmental consulting firms supporting the environmental investigations and cleanup process. By bringing these key parties together in regular, structured meetings to discuss and resolve issues, the Partnering Team promotes trust and cooperation that enables the remediation process to move forward more quickly than possible under traditional procedures.

*Camp Lejeune Partnering Team meetings promote trust and cooperation.*

During this achievement period, the team installed over 200 monitoring wells, collected over 1,400 environmental samples (soil, groundwater, surface water, sediment, pore water, sewer vapor, soil gas, indoor air, outdoor air), investigated nature and extent of munitions items removing over 1,000 munitions items, managed over 4,200 acres of land use controls, and maintained and monitored four vapor intrusion mitigation systems. The team's key challenges during Fiscal Years 2020 and 2021 included:

Supporting Taskforce Florence for recovery efforts following the hurricane. The Base reviews and supports planning for capital improvement projects to ensure they meet environmental site requirements and Navy/Marine Corps per- and polyfluoroalkyl substances (PFAS) guidance prior to and during military construction (MILCON). Support has included sampling, risk screenings, munitions clearance, and vapor intrusion evaluations and mitigation to ensure protection of human health and the environment.

Focusing on emerging contaminant investigations for PFAS and identifying potential drinking water receptors surrounding Camp Lejeune through review of questionnaires, GIS utility line shapefiles, and well permits. The primary parcel uses within downgradient sampling areas were evaluated to identify potentially impacted stakeholders. Outreach was conducted followed by sampling to ensure drinking water is safe.

Working on Remedial Investigations for complex MMRP sites and planning for Feasibility Studies by identifying remedial alternatives in unification with the Base mission and future land use to minimize explosives hazards.

Evaluating the effectiveness of alternative treatment technologies to address volatile organic compound (VOC)-contaminated groundwater at long-term monitoring (LTM) sites to expedite site closure. Subgrade biogeochemical reactors treated almost 6 million gallons of groundwater; over 3,000 gallons of emulsified vegetable oil substrate was

injected as part of a biobarrier replenishment and recirculation system; and air sparging was conducted with operation time of over 9,000 hours. The studies were effective in reducing VOCs and will be considered for full-scale implementation.

***Site 93 Subgrade Biogeochemical Reactor treated over 90,000 gallons of groundwater.***

Making significant progress in moving UST program sites forward including: receiving no further action for two sites, assessing five emergent release sites, excavating and disposing of approximately 910 tons of petroleum-impacted soil, completing \$1.2 million for above ground storage tank repairs to protect from future releases, completing assessments on 12 of 26 historical UST removal sites to ensure no soil impacts remain, removing a land use restriction on sites AS-410 North and South, and working to improve land use restriction management by distributing fact sheets to building occupants. The UST program also supported operation of nine remediation systems and addressed PFAS including effluent treatment at sites AS-4141 and the Rapid Refueler, groundwater sampling of system effluent, follow-up assessment at an off-Base crash site, and soil sampling for Oil/Water Separator clean outs.

### **Community and Stakeholder Involvement**

The Base provides information regarding investigation and cleanup efforts to the public through the community relations program which includes a Community Involvement Plan, Restoration Advisory Board (RAB) (<http://www.lejeune.marines.mil/OfficesStaff/EnvironmentalMgmt/RestorationAdvisoryBoard>), public meetings, Administrative record (<http://go.usa.gov/Dy5T>), Information Repository file at the Onslow County Library, and public announcements. The first Community Involvement Plan was prepared for Camp Lejeune in 1990, following the Base's inclusion on the NPL, and is updated every five years.

The RAB was established in 1995 and meetings are held quarterly, and provide an information exchange among community members and the Partnering Team.

During this achievement period, the key successes include:

Publishing success stories on digital media addressing timely topics such as the LTM program overview, Operable Unit 2 treatment system success, and the Site 88 Remedial Action.

***Success Stories are posted to social media.***

Resuming in-person RAB meetings in August 2021 with a member of the *Jacksonville Daily News* present. An article “Camp Lejeune Restoration Advisory Board holds first meeting in 18 months” was published outlining the meeting and successes ([jdnews.com](http://jdnews.com)).

***In-person RAB Meetings resumed in August 2021.***

Sharing lessons learned through presenting “Subgrade Biogeochemical Reactors to Treat Source Areas with Dense Non-Aqueous Phase Liquid” at the Clemson symposium and “Ten Years of Optimization of the Environmental Restoration Program” at the Design and Construction of Hazardous Waste Sites seminar.

**Environmental Restoration Agreements and Plans**

This timeline shows the key environmental restoration agreements, dates of their preparation, and last revision.

1984	1989	1990	1991	1992	1999	2020	2020	2020	2020
RCRA Permit Issues	National Priorities List	First Community Involvement Plan	Federal Facility Agreement	First Site Management Plan	First Five-Year Review	Latest Five-Year Review	Latest Community Involvement Plan	Latest Site Management Plan	Latest RCRA Permit Update Submitted

During this achievement period, the Base initiated a RCRA hazardous and solid waste amendments (HSWA) update to develop a Microsoft Excel-based tool to enable the Base to efficiently generate the individual solid waste management unit (SWMU) tables that document the status of the over 700 SWMUs at Camp Lejeune. These tables are required for the RCRA HSWA Permit documentation. The tool will enable the Base to maintain the necessary SWMU data, and once updated, to generate the tables with just a push of a button. These updated tables can then be submitted to the State, as needed. This process improvement simplifies data entry, reduces the chance for errors, and dramatically reduces the time required to generate the tables.

**Relevant Environmental Restoration Documents**

The Camp Lejeune team has been developing the investigation and remediation strategies for the IRP, MMRP, RCRA, and UST Program, working to develop solutions that support the mission of the Marine Corps, while meeting Navy metrics and regulatory requirements.

**Environmental Restoration Work Plans and Reports Fiscal Years 2020–2021**

Program Management Documents and Schedules	6
Proposed Plans, Decision Document, Records of Decision (RODs), and post-ROD Documents	4
LTM Work Plans and Reports	14
Installation Restoration Program Investigations and Reports	9
Munitions Response Program Investigations and Reports	2
Pilot Studies	7
Emerging Contaminants	5
Vapor Intrusion	14
<b>TOTAL</b>	<b>61</b>

During Fiscal Years 2020 and 2021, 61 workplans and reports were approved by the regulatory agencies and finalized and included the key tabulated documents.

**Accelerated Environmental Cleanup: Site 78 Rebound Study Conducted to Optimize the Selected Remedy**

IRP Site 78 encompasses approximately 590 acres of industrial land within the Hadnot Point Industrial Area (HPIA). Because of the industrial nature of the HPIA and the Hadnot Point Fuel Farm, also located within the HPIA and Site 78, spills and leaks of petroleum-related products and chlorinated solvents have occurred over the years.

In the ROD (1994), the selected remedy for Site 78 included the installation of two groundwater extraction and treatment systems in the northern and southern portions of Site 78 to address VOCs and metals in groundwater. The last three Five-Year Reviews (2010, 2015, and 2020) concluded that contaminant removal of the groundwater extraction and treatment system had become asymptotic and that the LTM network did not encompass the extent of contaminated groundwater. Supplemental investigations conducted between 2011 and 2014 indicated VOCs are present in deeper aquifer zones at higher concentrations and more widespread that the existing remedy was designed to address. A Feasibility Study Amendment is being prepared to evaluate alternate treatment technologies for the site.

In 2020, extensive MILCON was initiated in the vicinity of one of the groundwater extraction and treatment system and associated conveyance lines. To prevent a potential release of contaminated groundwater resulting from construction activities, and with regulatory concurrence, the Site 78 South system was temporarily shut down in March 2020. Following Partnering Team discussion, the Site 78 North system was also shut down in April 2020 as part of a rebound study to evaluate plume stability and the potential for natural attenuation without the influence of groundwater extraction. Groundwater samples were collected from LTM monitoring wells and recovery wells six months (Fiscal Year [FY] 2020) and 12 months (FY 2021) post- shutdown for analysis of site-specific VOCs. Additionally, select wells were sampled for natural attenuation indicator parameters (NAIPs), microbial genes, and compound specific isotope analysis (CSIA).

Minimal fluctuations in the areal extent of the plumes were observed between system operation and shutdown. To further analyze the influence of the groundwater extraction on plume stability, statistical analysis was performed. VOC trends during system operation were evaluated using the Theil-Sen method. Analytical results for the samples collected following system shutdown were then evaluated to determine if the same trend pattern was present. In general, this evaluation indicated that there are no operational trends, suggesting groundwater extraction was not significantly influencing mass removal and/or plume removal. Further, the natural attenuation evaluation indicated that geochemical conditions are generally reducing within the plume extents. These results were supplemented by the CSIA, which concluded that degradation of site-specific VOCs can be attributed to biological degradation and not physical attenuation processes.

#### *Site 78 South Treatment Plant*

The rebound study suggests that the plume is stable and natural attenuation is occurring. The results of the rebound study will be used to justify a transition away from the groundwater extraction and treatment systems, as currently required by the ROD, in favor of an optimized remediation strategy.

#### **Innovative Technology Demonstration/ Validation and Implementation: Air Sparge Pilot Study**

A pilot study is underway at Site 49 to evaluate air sparge technology to reduce trichloroethene and vinyl chloride concentrations in surficial aquifer groundwater and pore water that exceed the clean-up criteria. The air sparge technology is under evaluation to potentially accelerate the remediation timeframe relative to that of the current LTM and land use controls remedy.

Remediation equipment from a closed RCRA corrective action site on-Base was reutilized, thereby reducing capital costs and the carbon-footprint relative to transporting leased or new equipment to the site. The resulting cost avoidance was \$40,000.

#### *Reuse of Remediation Equipment*

#### **Partnerships Addressing Environmental Restoration Issues Between DoD and Other Entities: PFAS Drinking Water Outreach**

At Camp Davis Forward Arming and Refueling Point (FARP) Activities South, in surficial aquifer groundwater, perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) was detected above the screening level. Based on these results, an evaluation was conducted to identify whether off-Base drinking water wells were present within a 1-mile radius around the potential PFAS release area, if present, to collect drinking water samples from these wells to be analyzed for PFAS. Potential drinking water receptors surrounding

Camp Lejeune were identified through review of questionnaires, geographic information system utility line shapefiles, and well permits. The primary parcel uses within downgradient sampling areas were evaluated to identify potentially impacted stakeholders. Proactive identification facilitated communication during prep sessions to avoid disputes and ensure consistent messaging during public meetings. The prep sessions gathered stakeholders to develop the community outreach approach around Camp Lejeune and develop outreach materials for use in virtual public meetings. These sessions were attended by the Navy, Base, NCDEQ, North Carolina Department of Health, USEPA, local health departments, local water purveyors, and other agencies.

A geospatial dashboard was developed for tracking simultaneous outreach sampling efforts around Camp Lejeune. The geospatial dashboard tracked water sources, resident contact information, sampling requests, sample IDs, and sampling results. This platform allowed for rapid results communication and evaluation of the site conceptual model to identify other potentially impacted areas or samples that had already been collected.

Prior to any drinking water sampling, public outreach efforts were required to identify specific off-Base drinking water wells for potential sampling. Due to COVID restrictions for in-person gatherings, innovative 3-D virtual public meetings were implemented to ensure residents were informed of the investigation and results despite restrictions on in-person meetings.

*The Camp Davis PFAS Investigation Virtual Open House attracted almost 300 users.*

The virtual outreach included an interactive find-my-property map that allowed residents to locate their property and confirm if they were in the sampling area. The outreach effort had community response consistent with in-person meetings and outreach efforts despite the limitations due to COVID.

### **Reducing Risk to Human Health and the Environment: Basewide Vapor Intrusion Update**

Camp Lejeune initiated a Basewide Vapor Intrusion Evaluation in 2007 to identify buildings where vapor intrusion might be occurring and to evaluate potential risks to building occupants from where vapor intrusion related to surficial aquifer groundwater impacts. The Basewide Vapor Intrusion Evaluation was updated in FY 2021 to evaluate potential changes since the last update in 2013. A desktop evaluation was conducted including data from 15 IRP sites to identify buildings where surficial aquifer groundwater concentrations exceed vapor intrusion screening levels (VISLs) within 100 feet of a building between 2013 and 2018. The desktop evaluation results indicated the need to collect additional vapor intrusion data in eight buildings located at the IRP sites. Data collection activities included collection of concurrent subslab soil gas, indoor air, and outdoor air samples, along with differential pressure monitoring.

The results indicated the VOCs were above risk-based screening levels at one building (Building 626) and additional investigation was needed to determine if the concentrations of VOCs detected in indoor air were related to vapor intrusion or an indoor source. Building 626 is currently used as a groundwater treatment facility. Potential indoor sources of VOCs observed during the investigation included groundwater treatment processing equipment, paint, fuel containers, oil rag drums, degreasers, and cleaning supplies.

A field portable Hazardous Air Pollutants Onsite (HAPSITE) gas chromatograph/mass spectrometer was used for screening outdoor air, indoor air, and potential vapor entry points under baseline (ambient) and varying pressure (pressure cycling) conditions at Building 626. The results of the

HAPSITE investigation pointed to the existence of multiple potential background sources related to the operation of the treatment plant. These sources included the Reaction Tank, Inclined Plate Clarifier, Head Tank, and the Air Stripper located in the interior of the treatment plant. An additional background source identified was the Used Oil Overpack Barrel located at the south side of the plant. The results of the investigation indicated that VOC concentrations detected in the indoor air samples are related to groundwater treatment activities. In response, the treatment process was modified to by-pass the reaction and clarification tanks sending shallow influent (and sump collection) directly to a closed tank. The reaction and clarification tanks were the only open-top tanks in the plant and the suspected primary sources for high VOC concentrations. A follow-up investigation is planned in FY 2022 to confirm that the modifications to the treatment process have reduced indoor air concentrations of VOCs.

*Field screening of VOCs identified their source.*

### **Green Remediation: Tracking Sustainability Metrics**

Cleaning up sites improves environmental conditions, but cleanup activities also use energy, water, and natural resources; cost money, and affect the community. Camp Lejeune sets a standard of excellence in implementing best

management practices into each phase of cleanup activities. During this achievement period this excellence was recognized by the USEPA with publication of a Contaminated Site Clean-Up Information (CLU-IN) Green Remediation Focus Profile.

Additionally, the following best practices were implemented:

- Installed a new treatment system powered solely by solar power to complement an existing system. At these two systems, 50,000 gallons of contaminated groundwater were treated using only solar power.

- Reused 70 cubic yards of soil.

- Recycled 7,530 pounds of metal.

- Used passive sampling techniques to reduce remediation derived waste by an estimated 3,000 gallons.

- Held 7 virtual partnering meetings.

- Injected a certified carbon neutral substrate vs a traditional carbon substrate.

- Reduced paper waste and increased efficiency by using digital data capture devices in the field.

*Digital Data  
Capture in the Field*

These actions saved over 52 metric tons of carbon dioxide emissions. This is equivalent to the carbon dioxide emissions from powering six homes for one year.

Also, as part of the Site 96 Feasibility Study, a footprint analysis was prepared for each alternative using SiteWise Version 3.1. The results of this assessment were included in the detailed analysis of alternatives as part of short-term effectiveness. The alternative presented in the Proposed Plan had the lowest environmental footprint in all categories (greenhouse gases, energy use, water use, air emissions, and accident risk) when compared to the other remedies.