Background

The former Atlantic Fleet Weapons Training Area – Vieques is 23,000 acres, with another 12,000 acres of surrounding waters, just southeast of mainland Puerto Rico. The installation served as the Navy's premier training range for ensuring combat readiness of Atlantic Fleet Forces and for North Atlantic Treaty Organization (NATO) operations. From the mid-1940s until 2003, more than 300,000 munitions were fired from military training operations, including naval gunfire, air-to-ground bombing, marine artillery fire, amphibious landings, and rifle/grenade/rocket launcher ranges. Because the Commonwealth of Puerto Rico considered Vieques the highest priority facility for cleanup, in 2005 large portions of Vieques and the surrounding waters were placed on the National Priorities List (NPL).

Today, land within the former installation has been transferred to federal and local agencies, most for conservation as part of the Vieques National Wildlife Refuge. The refuge houses a variety of natural resources in the form of diverse plant and wildlife species, including sensitive habitats such as mangroves, subtropical dry forests, lagoons, and coral reefs, and endangered species such as sea turtles, manatees, least terns, and brown pelicans. In addition, portions of the former installation are open to the general public for recreational opportunities and for access to culturally significant areas.

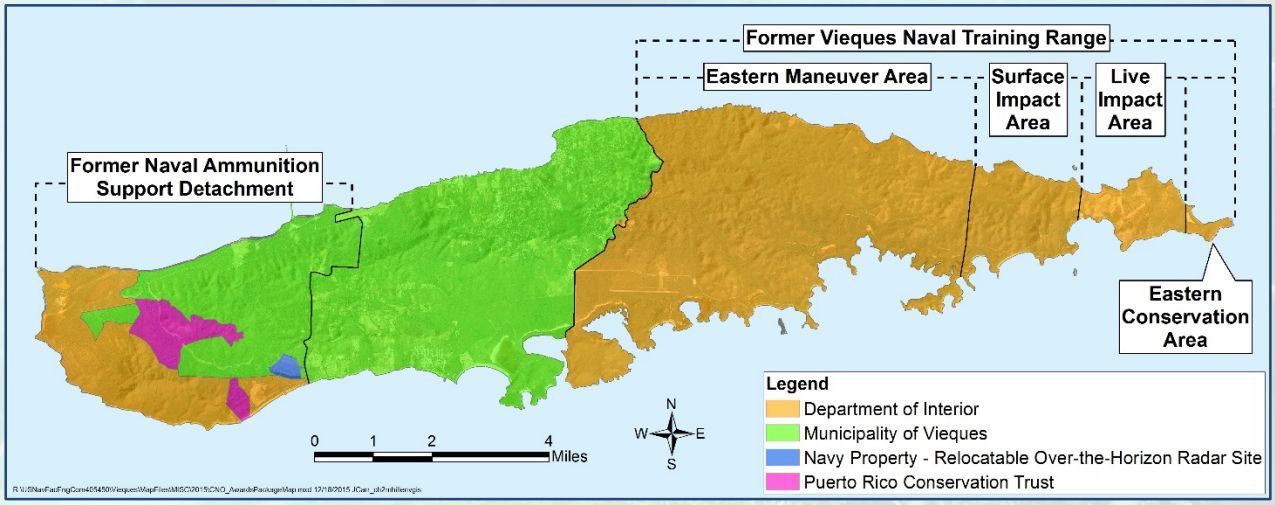

Figure 1: The Former Vieques Naval Training Range and Naval Ammunition Support Detachment were transferred to the Department of Interior, Municipality of Vieques, and Puerto Rico Conservation Trust. Partnerships with these and other stakeholders ensure the planned land use is integrated into the Navy's cleanup.

Position Description

The Vieques Environmental Restoration Program faces unique challenges such as unexploded ordnance (and associated contaminants) across thousands of acres of land and sea floor, abundant ecologically and culturally sensitive resources, and the often disparate objectives of numerous stakeholders, including the local community, education and scientific organizations, and various advocacy groups. To meet these challenges, the Vieques Environmental Restoration Program Team comprises representatives from Naval Facilities Engineering Command (NAVFAC) Atlantic, the Environmental Protection Agency (EPA), Commonwealth of Puerto Rico Environmental Quality Board (PREQB) and Department of Natural and Environmental Resources (PRDNER), National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), Department of Interior (DOI), and United States Fish and Wildlife Service (USFWS). The 2007 Federal Facilities Agreement (FFA) establishes the framework for the stakeholder agencies to collaboratively implement the Environmental Restoration Program under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) to achieve the following objectives:

- Implement prompt actions to address imminent and substantial threats to human health, safety, and the environment
- Prioritize response actions, including investigations and removal/remedial actions, based on risk to human health and the environment, anticipated land use, and available funding
- Develop safe, cost-effective, and innovative cleanup approaches and technologies to maximize program efficiency
- Execute a novel community involvement program to promote public stakeholder participation in the cleanup process
- Maximize partnerships with federal, Commonwealth, and local authorities to accelerate achieving land use goals through interim actions and final decisions

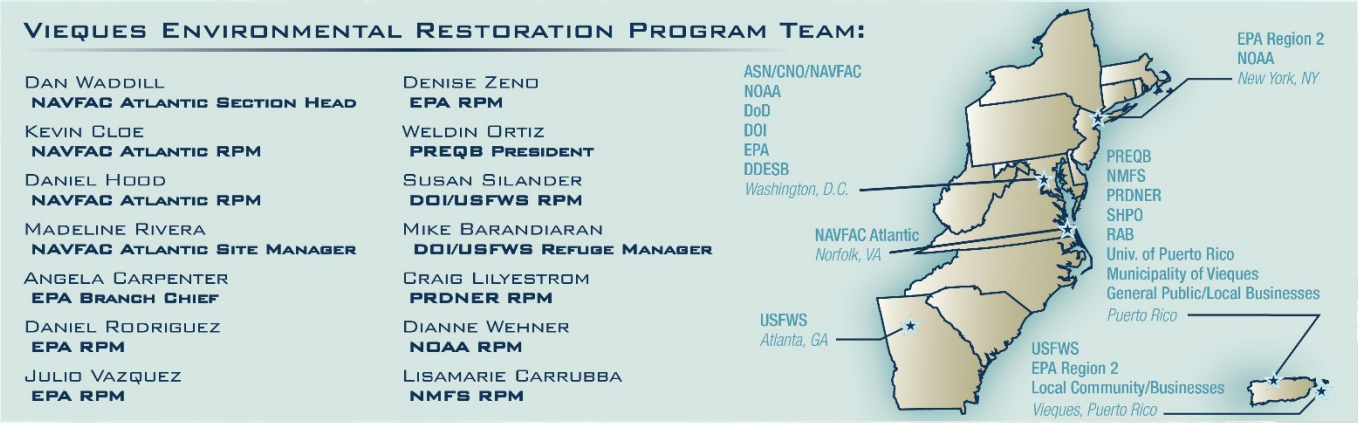

Figure 2: Due to unique regulatory, environmental, and natural and cultural resource conditions associated with Vieques, NAVFAC Atlantic teams with over a dozen Federal and Commonwealth agencies throughout the East Coast and Puerto Rico. To promote effective communications, the Vieques Environmental Restoration Team meets frequently among themselves and with the many other stakeholders, including the local community, academia, and scientific organizations.

Summary of Accomplishments

Accelerated Cleanup, Innovative Strategies, and Green Remediation: With input from the local community, the Governor of Puerto Rico, PREQB, and the USFWS, the Navy identified priority areas on both the land and offshore for accelerated cleanup to fast-track public access or other planned use. In addition to measures to accelerate land use, the Navy, in partnership with the other stakeholder agencies, has implemented innovative strategies that have reduced explosive hazards as well as the environmental footprint and cost of cleanup. Between October 2013 and September 2015, the following accomplishments were achieved that demonstrate the innovative approaches characteristic of the Vieques Environmental Restoration Program:

- *Public Beach (Playa La Chiva)* – A time-critical removal action (TCRA) was implemented to clear surface and subsurface munitions from a public beach and associated parking areas/trails while protecting threatened and endangered species and cultural resources in the area. The TCRA allowed unfettered public access to this popular beach immediately upon completion.
- *Records of Decision* – The first Vieques munitions response site ROD was finalized in FY15. The ROD preserves and enhances unique species (dwarf coastal vegetation) and nesting habitat (sea grape) used by the endangered hawksbill sea turtle while providing the mechanism by which USFWS can manage the 133-acre area as part of the Vieques National Wildlife Refuge.

- *Historic Spanish Lighthouse* – Public access to a 19th-century lighthouse erected by the Spanish government, closed to the public for years due to its location within a 535-acre munitions site, was made possible by implementing an innovative non-time-critical removal action (NTCRA). The interim action primarily comprised land use controls, such as educational kiosks and markers, to safely guide visitors along access routes to the lighthouse while avoiding areas still under investigation. USFWS opened access to the lighthouse 7 years ahead schedule with a ceremony attended by over 250 people from the community and various stakeholder agencies.

Figure 3: Public access to the 19th-century Spanish lighthouse was a priority for the Governor of Puerto Rico and the community of Vieques. An innovative interim action concept developed by the Navy and embraced by all stakeholders resulted opening access 7 years ahead of schedule.

Figure 4: Munitions response divers search the ocean floor for munitions to accelerate opening a planned public recreational area at the adjacent former OB/OD site at the request of USFWS.

Figure 5: In FY14 and FY15, implementing a continual program of identifying new technologies and enhancing existing processes, such as use of remotely operated equipment, has increased worker safety and cut munitions cleanup costs.

- *Former Open Burn/Open Detonation Site* – An NTCRA was implemented at a former open burn/open detonation (OB/OD) site planned for public recreational use. The interim action included surface and subsurface munitions clearance from planned parking and picnic areas, observation tower, and hunting and land crabbing areas. This work completed the interim actions necessary to allow public use of the site several years ahead of schedule. Because the public will also utilize the waters offshore of the former OB/OD site for boating, wading, and swimming, an accelerated underwater munitions investigation was performed. Munitions response divers located, identified, and recovered munitions from across 200 acres of the seafloor while scientific divers ensured threatened and endangered corals and other sensitive species/habitats were protected.

- *Range Wide* – Because reducing explosive hazards to protect the public is a top priority for the Vieques Environmental Restoration Program, NTCRAs for some of the most dangerous areas continued in FY14 and FY15. During this time, over 560 acres were cleared of munitions, resulting in over 7,000 munitions removed and more than 1 million pounds of scrap metal shipped to a recycling facility. Proceeds from the recycling were used to partially offset the cost of the metal processing. Over $1M in cost savings was realized in FY15 due to implementing efficiency measures such as use of remotely operated equipment.

- *Landfill* – During implementation of the Record of Decision (ROD) at the 50-acre former facility landfill, a significant quantity of surface debris was identified. As a result, an Explanation of Significant Differences was prepared to remove the surface debris and make use of the existing soil and vegetation as a natural landfill cover. This unique, green-remediation approach preserved natural resources by eliminating the need to import the soil cover planned in the ROD and resulted in a cost savings of over $10M.
- *Unique Lagoon* – At this former waste disposal site, a shallow estuarine lagoon was targeted for remediation by dredging, which would have destroyed the habitat that had developed since the removal action. However, in 2014, a focused sediment investigation and concurrent lagoon ecosystem evaluation were conducted that demonstrated no unacceptable risks remain and that a vibrant and diverse community of marine fish, macroinvertebrates, wading birds, and mangroves has become established. Based on this, a no further action ROD is planned, thereby preserving the unique lagoon ecosystem and saving over $1M.

Figure 6: A focused sediment study and lagoon ecosystem evaluation conducted in 2014 demonstrated a vibrant lagoon ecology has become established on a former waste disposal site and that no further action is necessary, saving over $1M in planned remedial action costs.

Groundbreaking Technologies: By far the most costly aspect of the Vieques Environmental Restoration Program is munitions cleanup, estimated to be well over $100M at completion. These munitions also pose the highest level of risk to workers performing the cleanup, USFWS personnel performing land management, and to the general public utilizing the lands. Therefore, identifying and implementing groundbreaking technologies to reduce both risk and cost is fundamental to the program. Key technologies have been identified that will save tens of millions in cleanup costs, including:

Figure 7: Finding and discriminating subsurface anomalies with TEMTADS. Successful testing in Vieques has helped support the use of this technology at other bases, and the TEMTADS is planned for full-scale implementation in Vieques in 2016.

- *TEMTADS* – An advanced geophysical technology, Time-domain Electromagnetic Multi-sensor Towed Array Detection System (TEMTADS), was tested to determine the ability of the technology to not only detect subsurface metallic anomalies but to differentiate munitions items from munitions-related debris and scrap metal. The test results revealed that TEMTADs can reduce the number of anomalies requiring excavation and associated costs by as much as 50%. Based on the estimated remaining areas to be subsurface cleared, planned TEMTADs use on Vieques, beginning in 2016, is anticipated to save over $7M. In addition, information gathered from successful testing at Vieques set the standard for its use in cleanup activities at other Naval and Marine Corps bases.

- *Remotely-Operated Excavator for Munitions Clearance* – An un-manned, remotely-operated, long-reach excavator was used to help safely remove highly dangerous sub-munitions within heavily vegetated areas and to excavate subsurface munitions from roads and beaches intended for public use and Refuge management. The excavator included a mower head to cut dense vegetation, a 50-inch magnet to remove large munitions from the surface, and a rotating sifting bucket to separate munitions from excavated soil. A command center containing the operator and control system was safely located outside the explosive safety arc during operation. The evaluation demonstrated that the remotely controlled excavator can clear vegetation and munitions at a cost of up to 60% below manual methods. The technology will be placed into full-scale operation in 2016, with an anticipated savings of over $10M in munitions clearance costs.

Figure 8: Magnetic attachment on excavator removing bombs from the roadbed. In areas where it is too dangerous and/or too costly to remove munitions by traditional methods, remotely operated equipment has been shown on Vieques to significantly reduce explosive hazards to workers and cut costs by more than half.

- *Beach Dynamics Investigation* – Beaches are the most critical areas for cleanup planning and implementation because they: (1) are the most sought-after locations by the public, (2) constitute the entire perimeter of the former Navy lands, and (3) are the most complex and dynamic areas with respect to munitions presence and movement. Because of this, it is critical to understand and predict how the beaches (and therefore munitions on, under, and offshore of) transform over time. In 2015, a first-of-its-kind study at 11 beaches was conducted to evaluate the dynamic nature of the beaches and how munitions may move between the beaches and adjacent underwater areas. Elevations of the seabed and beaches along numerous transects are being coupled with oceanographic and weather data to model the amount of change that can be anticipated over time. Data collected to date include effects of tropical storms on the beaches and near-shore areas, which will be critical to understanding how weather and sea conditions affect movement of on-shore and near-shore munitions, bury munitions previously exposed, or expose previously buried munitions. In addition, over 60 munitions surrogates with acoustic “pingers” were placed just offshore of the beaches to assess mobility and potential for burial. This information will be used to best plan clean up and long-term monitoring of the beaches and near-shore areas.

Figure 9: Diver placing a munitions surrogate on the ocean floor (left photo). Survey team measuring monthly changes in beach conditions (right photo). The combined information from this first-of-its-kind beach dynamics investigation will be crucial in predicting changes in beach conditions and the munitions that reside on, under, and adjacent to them. This information will then be used to plan the most cost-effective remedial actions.

Figure 10: ROVs are being used in Vieques to reduce the dangers of diving on munitions sites, significantly cutting the need for divers and the associated costs. FY14 and FY15 uses include underwater structure inspections, marine ecology surveys, and munitons tracking. Future planned uses include underwater geophsyics and sample collection.

- *Underwater Remotely Operated Vehicle* – Diving is an inherently dangerous and costly activity, especially when it is conducted in areas containing underwater munitions, such as those around Vieques. To increase safety and reduce cost, the Navy has implemented the use of remotely operated vehicles (ROVs) where they can replace or supplement activities normally conducted by munitions, construction, and scientific divers, while providing the same or enhanced information. ROVs are currently being used to perform underwater land use control inspections, survey marine ecology for threatened and endangered species, identify and inspect underwater munitions for removal action planning, and track the movement of underwater munitions. The technology is minimizing diver exposure to the hazards of diving and underwater munitions and significantly reducing costs. Based on current and anticipated applications, use of the ROV is expected to reduce diver use by over 50% and save more than $200K per year for the next decade.

- *Unmanned Aerial Vehicle* - In 2015, the Navy demonstrated that an unmanned aerial vehicle (UAV) can be used to visually inspect areas that have limited accessibility by land due to the presence of dangerous munitions and/or steep terrain, and to identify the presence of near- shore underwater munitions. The demonstration also showed the UAV can more effectively ensure all personnel, including the public, are at safe distances prior to controlled detonations and to verify conditions are safe before the workers return to locations of controlled detonations. Use of this technology will not only increase safety, but will facilitate a more effective and efficient cleanup plan for these areas.

Figure 11: Like ROVs, UAVs significantly reduce dangers associated with working around munitions by providing information that would otherwise have to be gathered by workers in close proximity. In FY15, UAVs documented site conditions in particularly dangerous areas in Vieques to more effectively and safely plan future actions.

Partnerships with Government, Academic, Scientific, and Community Stakeholders: Due to the unique and complex site conditions (widespread munitions, environmental contamination, cultural artifacts, endangered species, and sensitive habitats – on land and in the surrounding waters; multiple land owners; and various land uses) and large volume of restoration work executed (approximately $20M/year) there are more than 20 stakeholder groups that participate in the cleanup process on Vieques. To ensure effective planning by such a large stakeholder group and accelerate cleanup decision making, regular meetings are held by the Vieques Environmental Restoration Program Team and technical support staff. These meetings often involve joint scoping sessions to reach consensus on work plans and resolve technical issues for a wide range of topics in environmental restoration, compliance, munitions cleanup, community involvement, and risk assessment. The meetings are typically supplemented with site visits and joint participation at the community Restoration Advisory Board (RAB) meetings. This approach results in enhanced relationships and accelerated progress toward achieving the goals of all stakeholders. Examples of significant partnership activities and accomplishments in FY14 and FY15 are:

- *Commitment to Safety of Local Workers* – Much of the workforce for the cleanup work comprises local residents. Committed to their safety as the number one priority, the Navy conducted weeklong annual safety training to ensure the workers have the most up-to-date training on proper procedures and tools.
- *Commitment to Disseminating Information to the Community* – At the request of the community, the Navy developed a Facebook page to provide weekly updates of the status of the cleanup. In addition, project updates and announcements are shared through newsletters and flyers mailed directly to over 2,500 local homes and businesses. A novel CERCLA process flowchart was developed and is regularly updated and shared online and at RAB meetings to show stakeholders how each site is advancing through the cleanup process.
- *National Wildlife Refuge Environmental Fair* – The Navy provided over 200 Vieques community members, including local preschool, elementary and middle school children, and community organizations, with interactive munitions safety education as part of the USFWS-sponsored fair.
- *Site Visits for the Public* – The Navy led site visits to two sites – lagoon (former waste disposal site) and former OB/OD site – to allow members of the RAB and public the opportunity to see cleanup work in progress, ask questions, and provide input.
- *Natural and Cultural Resource Protection* – To help meet the missions of USFWS, NMFS, and Puerto Rico State Historic Preservation Office (SHPO), the Navy embedded biologists and archaeologists with the munitions removal teams to ensure the protection of both threatened and endangered species and cultural resources during investigation and cleanup activities.
- *Vieques Sustainability Task Force* – Created by the White House to promote sustainable economic development and to advance the cleanup, the Task Force consists of political appointees and senior leaders from EPA, Department of Energy, DOI, Navy, Puerto Rico, and Vieques. The EPA Region 2 Administrator leads the task force and participates in the CERCLA process for Vieques. The Vieques restoration team has provided site visits and regular updates to the Task Force, and this effort has led to improved understanding and support for the cleanup program on Vieques.

Figure 12: Numerous innovative tools are used to disseminate information to the local community. Site visits, munitions safety education, social media, and community meetings are examples of techniques used to foster two-way interaction between the stakeholder agencies and the public.