



# Munitions Constituents

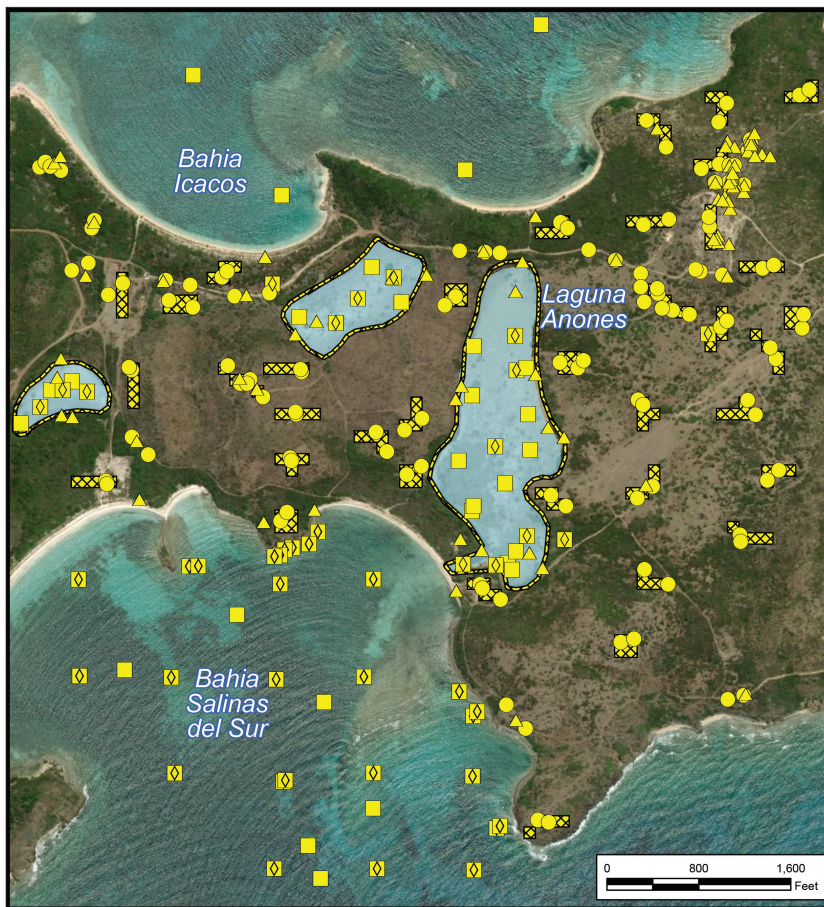
VIEQUES ENVIRONMENTAL RESTORATION  
FACT SHEET

## What are munitions constituents?

Munitions constituents are chemical contaminants associated with discarded or on unexploded military munitions. The main categories of munitions constituents are explosive compounds, organic chemicals, and metals.

## What samples have been collected on Vieques?

- The Navy has sampled Vieques soil, sediment, groundwater, and surface water for the presence of munitions constituents. Since 2005, over 1,500 samples have been collected across 18 munitions sites on land and one site underwater.
- Samples were collected at target locations, gun positions, drainage ditches, lagoons, and other areas where munitions constituents are most likely to be found. In order to identify the highest concentrations, many samples were collected underneath or next to unexploded munitions.
- All Navy sampling followed the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), using methods that have worked successfully at thousands of other contaminated sites across the United States.
- All Navy sampling was performed with collaboration and oversight by the US Environmental Protection Agency, the Puerto Rico Department of Natural and Environmental Resources, and the US Fish and Wildlife Service.



**Soil, sediment, surface water, and groundwater sample locations shown in yellow**

## How were the samples evaluated?

- Samples were analyzed for the following munitions constituents:
  - 19 explosive compounds, including TNT, HMX, RDX, nitroglycerin, PETN, tetryl, and perchlorate
  - 235 organic chemicals, including naphthalene, acetone, benzene, toluene, and solvents
  - 27 metals, including lead, mercury, cadmium, iron, zinc, aluminum, and copper
- Since each sample was analyzed for many munitions constituents, the Navy has obtained over 25,000 individual results for explosive compounds, over 30,000 results for organic chemicals, and over 25,000 results for metals.
- Using the sample results, the Navy has performed CERCLA risk assessments to determine whether or not cleanup of munitions constituents would be needed.



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## What do the sample results show?

Explosive compounds and organic chemicals were detected in approximately 2% of the sample results. Since metals are part of the natural environment, metals were detected in most of the sample results.

- The Navy has performed CERCLA risk assessments for nine munitions sites on land and a small portion of the underwater site.
  - The risk assessments have not identified any chemicals of concern in sediment, soil, or surface water at any of these ten munitions sites.
  - In groundwater, only one chemical of concern (perchlorate) has been identified at one land site (SWMU 4 in west Vieques).
- Risk assessments are still in progress for the other nine munitions sites on land and the remaining areas of the underwater site.

## Cleanup of munitions constituents

- In soil, sediment, and surface water, the CERCLA risk assessments indicate that cleanup is not needed for any munitions constituents at any of the ten munitions sites.
- In groundwater, cleanup is needed for perchlorate at SWMU 4, but not at the other nine munitions sites. Since drinking water on Vieques comes by pipeline from mainland Puerto Rico, there is no human exposure to perchlorate in groundwater at SWMU 4.

## What happened to the munitions constituents?

- When munitions detonate, the explosive compounds are transformed into non-toxic gases (nitrogen, carbon dioxide, hydrogen, and water vapor), plus small amounts of carbon monoxide, nitrogen oxides, organic chemicals, and metal compounds (EPA, 1998 and SEESAC, 2004). The extreme heat of a detonation immediately destroys many of the organic chemicals. Over time, sunlight and microbes also break down explosive compounds and organic chemicals.
- Even though thousands of munitions were fired at Vieques, the overall amount of metal in these munitions is extremely small compared to the large amount of metal that exists naturally in the environment. Therefore, the munitions did not cause a measurable increase in the natural concentration of metals on Vieques.

## REFERENCES

1. *Site Characterization for Munitions Constituents*, US Environmental Protection Agency, EPA-505-S-11-001, 2012.
2. *Emission Factors for the Disposal of Energetic Materials by Open Burning and Open Detonation (OB/OD)*, US Environmental Protection Agency, EPA/600/R-98/103, 1998.
3. *SALW Ammunition Destruction – Environmental Releases from Open Burning (OB) and Open Detonation (OD) Events*, South Eastern Europe Clearinghouse for the Control of Small Arms and Light Weapons (SEESAC), 2004.

## Summary

- Explosive compounds and organic chemicals associated with munitions are rarely detected on Vieques, and the few detections occur at very low concentrations. Metals are commonly detected at naturally occurring concentrations.
- CERCLA risk assessments have been performed for approximately half of the munitions sites on Vieques. The risk assessments show that cleanup is not needed for munitions constituents in soil, sediment, or surface water. In groundwater, cleanup of perchlorate is required at only one munitions site (SWMU 4 in west Vieques).
- At munitions sites on Vieques, the important concern is the explosive hazard, not the chemical risk from munitions constituents.
- The findings for munitions constituents on Vieques are similar to other military training ranges across the United States (EPA, 2012).

## Follow the 3Rs of Explosives Safety



**If you did not drop it,  
do NOT pick it up!**