2.2 Air Force Marbo Groundwater Impacted by TCE and PCE

The groundwater table beneath the Andersen Air Force Base MARBO Annex ranges from approximately 281 to 400 feet below ground surface. There are water production wells within the MARBO Annex area. This water is blended with water from other production wells and is distributed to various villages. As a consequence of past Air Force activities at MARBO Annex, the groundwater beneath the Annex area has been impacted by trichloroethylene (TCE) in the northern portion and tetrachloroethene (PCE) in the vicinity of the former MARBO Laundry facility. This contamination was first detected in MARBO groundwater when appropriate groundwater sampling and analysis was initiated some 30 years ago. As a result, Andersen Air Force Base has been identified as the responsible party for the groundwater contamination and has since implemented some actions to address the situation.

In November of 2009, the United States Air Force (USAF) updated the original selected remedy, *Natural Attenuation with Wellhead Treatment*, for MARBO Annex Groundwater at AAFB, by amending certain aspects of the June 1998 MARBO Annex OU Record of Decision. The amended selected remedy is *Long-Term Groundwater Monitoring with Contingency for Wellhead Treatment.*

Since the implementation of 1998 selected remedy, semi-annual groundwater sampling and analysis has shown that natural attenuation has not been effective in reducing TCE and PCE concentrations in the deep portions of the freshwater aquifer. Therefore, the USAF concluded that specific fundamental changes are needed to modify the MARBO Annex Groundwater remedy of *Natural Attenuation with Wellhead Treatment* selected in the 1998 ROD.[4]

Navy Environmental Restoration Program

2.3. Tiyan – former NAS Agana

Groundwater beneath Tiyan has been investigated since 1986 under the DOD, IRP. Groundwater contamination beneath Tiyan has been detected in the form of TCE and PCE. One production well (NAS-1) exists on the former base and a water sample collected in January 1991 exceeded the MCL for TCE. Subsequent groundwater sampling of monitoring wells under the BRAC has shown the presence of an extensive area of contamination of PCE and TCE.

In July 1993, the (Base Realignment and Closure) BRAC Commission recommended closure of Naval Air Station (NAS) Agana. The installation was closed on March 31, 1995.

All cleanup work on BRAC sites is complete and the sites are in long-term management (Action conducted after cleanup to monitor effectiveness of the remedy and ensure site restrictions remain in place). All former NAS Agana property has been transferred,

[4] November 2009 AMENDMENT: Proposed Plan MARBO Annex Groundwater, MARBO Annex Operable Unit, AAFB, Guam

except for the Agana Power Plant.

Contamination in NAS-1 is currently being remediated through wellhead treatment through activated carbon filtration.

2.4 Construction Battalion Landfill – IRP Long-term Management Site

In 1998, a soil and synthetic liner system was completed. The site is now in long-term management. A five year review is planned for 2012. Annual reviews and landfill cover maintenance are ongoing.[5]

3.0 Ground Water Conditions in the Vicinity of the Orote "Landfill"

The Orote "Landfill" was an uncontrolled Navy dump throughout its operational history. Contaminants initially detected in soil and buried waste at the facility include PCBs, dioxins (including 2,3,7,8 TCDD) and furans, polychlorinated aliphatic hydrocarbons, volatile organic compounds (including TCE, PCE, TCA, DCA, and BTEX), metals, and pesticides. These same contaminants have also been detected in groundwater in monitoring wells in and around the dump, coastal fresh water springs and marine waters, and marine sediments and organisms (including fish).

In 2001 the beach area immediately adjacent to the dump was cleaned up of metallic debris, a sea wall was constructed to minimize further erosion of contaminated soil and buried waste, and an impermeable cap was constructed over the dump in an attempt to isolate contaminated waste from the groundwater and marine water beneath and adjacent to the dump.

Subsequent sampling of groundwater, spring and marine waters, and off-shore biota indicate that the contaminants persist in the local environment. A study of the effects of storm-induced waves, tides, and heavy rains on the water table in the vicinity of the capped dump has demonstrated that groundwater rises into buried waste and probably remobilizes contaminants thought to have been isolated from the groundwater and marine environment by the cap and seawall. It was also determined that storms cause temporary reversals of the water table and groundwater flow direction, thus continuing to disperse contaminants away from the dump through the groundwater pathway.

The site is now in long-term management. Fish sampling data evaluation is ongoing. Cap and seawall maintenance is ongoing. Groundwater monitoring is planned.

4.0 Other CERCLA Sites

There are several CERCLA sites located in the Southern Guam hydrogeologic province not over the NGL: the Ordot Landfill and numerous sites belonging to the Navy.

4.1 Ordot Dump

The Ordot Dump is listed on the NPL, but no groundwater contamination resulting from

[5] Fact Sheet 1: Navy's Guam Environmental Restoration Program – Site Status Update , November 2009

activities at the site has been documented. However, leachate impacts to the Lonfit River have been documented resulting in the impairment and 303(d) listing of this waterbody. It is suspected that the Lonfit River is hydraulically connected with the southern-most extension of the NGL; therefore, impacts to the NGL from Ordot leachate are possible.

4.2 Navy's Guam Environmental Restoration Program

The Environmental Restoration Program is organized into three programs based on the site type and location. Appendix I. provides Fact Sheet 1 dated November 2009. This document describes the status categories of the environmental cleanup sites on Guam by program.

D. Summary of Ground Water Quality

The overall ground water quality of the NGL is good, however, it is significantly vulnerable to contaminants, including chloride contamination induced from over pumping of water supply wells. These threats increase the NGL's contamination potential.

During the last quarter of 2005 Guam EPA under the lead of its Safe Drinking Water Program, investigated requirements of "Ground Water Under the Direct Influence of Surface Water" because of the contamination of several GWA ground water wells and possibly U.S. Navy wells. Staff suspected that these wells were potentially influenced by surface water or raw sewage from leaking sewer pumps or sewer pipes. The Agency has formulated draft guidance to determine the source, if the groundwater is under the influence of surface water.

The preservation of the Northern Guam Lens Aquifer is a priority because of its designation as Guam's Sole Source Aquifer and because of the magnitude of incidences observed in which the levels of pollutants (Bacteria, Nutrients, Chlorides, and Toxic Contaminants) exceeded Guam Water Quality Standards. The Agency will facilitate assessment, planning, or pollution control activities necessary to improve water quality such that it complies with local standards. The degree of public interest in or concern about the water body is extremely high.

E. Summary of Groundwater-Surface Water Interactions

Guam EPA has a growing awareness of ground water-surface water interactions and their contribution to water quality problems.

Another aspect of groundwater is spring discharge along the coast in the inter- and sub-tidal zones. These springs comprise the discharge of the NGL aquifer. A completed study has characterized the chemistry of discharge from selected springs into Tumon Bay. The study consisted of sampling eight Tumon Bay springs during four discrete

sampling events. Total discharge estimated for the seven springs is 17 million gallons per day.

The two-year study consisted of four sample rounds (of eight springs along the Bay) during both the wet and dry seasons. Chemicals detected above Guam EPA water quality standards included Tetrachloroethene, Trichloroethylene, Aluminum, Antimony, Arsenic, Magnesium, Chloride, Sulfate, Oil & Grease, Total Coliform and Fecal Coliform. Pesticides Dieldrin, Alpha-Chlordane, and Gama Chlordane were also detected in spring discharge; however no Guam EPA water quality standards currently exist for these compounds. The study was funded with Clean Water Action Plan money through the Watershed Planning Committee.

Guam EPA intends to use the results of the spring discharge study and information from the recent Northern Watershed Bacteria TMDL to prioritize and mitigate documented impacts on Tumon Bay and other northern beaches.

- *Final Spring 2007 Groundwater Monitoring Report for Andersen AFB, Guam* (EA, 2007b)

- *Final Fall 2007 Groundwater Monitoring Report for Andersen AFB, Guam* (EA, 2008a)

- *Final Spring 2008 Groundwater Monitoring Report for Andersen AFB, Guam* (EA, 2008b)

- *Final FFS to Support a ROD Amendment with a TI Waiver for the MARBO Annex Operable Unit, Andersen AFB, Guam* (EA, 2008c).

Based on the results of the investigations completed for MARBO Annex groundwater, the USN has concluded that *Natural Attenuation with Wellhead Treatment* is a failed remedy and that specific fundamental changes are needed for the original groundwater remedy.

2.2.2 Occurrence, Fate, and Distribution of Groundwater Contamination

A complete description of the nature and extent of contamination in MARBO Annex groundwater is presented in the 2008 Focused Feasibility Study (FFS) (EA, 2008c).

Since the LTGM Program was initiated in 1995, 26 groundwater sampling events have been conducted at the MARBO Annex. Based on the results of the OU 2 Remedial Investigation and the LTGM Program, two potential contaminants of concern were identified: TCE and PCE (ICF, 1997; EA, 2008b). These contaminants of concern have historically been detected in deep groundwater samples collected from two monitoring wells, IRP-31 and IRP-29, at concentrations above their respective MCLs (5 µg/L, each). The historic distribution of TCE and PCE concentrations in groundwater exceeding the MCL are depicted on Figure 2-1.

The dissolved-phase TCE and PCE have been identified as being two immobile, geographically distinct plumes; therefore, a common source for contaminants is not plausible. The estimated volumes of TCE- and PCE-contaminated groundwater are 340 million gallons and 280 million gallons, respectively[2]. Though a significant number of potential sources have been investigated at IRP sites, no surface or subsurface sources for the TCE and PCE have been identified. Also, the fact that the shallow freshwater lens has shown a consistent decline in TCE and PCE concentrations over the past 15 years is indicative that there is not continued contaminant sourcing from the vadose zone (EA, 2008c).

TCE and PCE have either been non-detect or detected at concentrations below the MCL in all shallow monitoring wells, except IRP-14. In groundwater samples collected from IRP-14 PCE concentrations have decreased linearly over the past 11 years to concentrations below the

[2] The estimated volumes of TCE- and PCE-contaminated groundwater were calculated by multiplying the plume volumes by the soil porosity using the following assumptions:

PCE Plume: Length = 2,500 feet
Width = 1,000 feet
Height = 50 feet
Porosity = 30% (ICF, 1997)

TCE Plume: Length = 3,000 feet
Width = 1,000 feet
Height = 50 feet
Porosity = 30% (ICF, 1997)