U.S Army Installation Management Command

Environmental Radiation Monitoring Plan
For Depleted Uranium
From the M101 Spotting Round
For
Pohakuloa Training Area

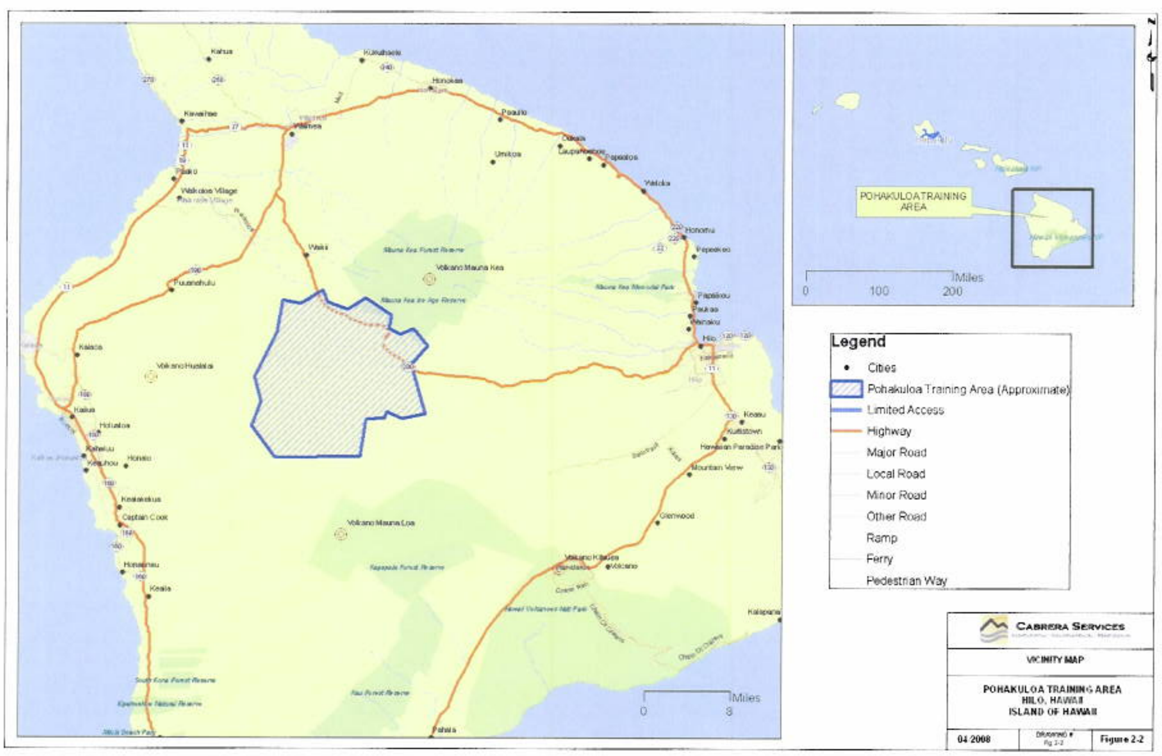
Enclosure 4

1.0 SITE DESCRIPTION - Pohakuloa Training Area

Physiography

PTA is in the Humuula Saddle between the two major peaks on the Island of Hawaii; Mauna Kea lies to the northeast, and Mauna Loa lies to the south. Elevations within PTA range from 4,030 to 8,650 feet above mean sea level (amsl). The slope of the Mauna Kea volcano rises steeply (about 26 percent) from Saddle Road to an elevation of 13,796 feet amsl over a distance of about 6 miles. The slope of Mauna Loa, by contrast, rises to the southwest at about a 4 percent slope to an elevation of 13,678 feet amsl over a distance of about 20 miles. To the west of these two peaks is the Hualalai volcano (about 8,690 feet amsl).

The PTA trail from Kawaihae Harbor to PTA runs south inland of Highway 270 and rises to an elevation of about 250 feet amsl near the junction with Highway 19. The trail continues east, paralleling Highway 19 along the foot of the Kohala Mountains to the western edge of Waimea (Kamuela). This segment rises to an elevation of about 2,500 feet amsl over a distance of about 10 miles. Near Waiaka, on the outskirts of Waimea, the trail turns south and runs west of Highway 190, approximately following the 2,400-foot amsl elevation contour to the junction with Saddle Road (Route 200). The trail crosses Highway 190 west of a small volcanic cone called Nahonaoahe and continues upslope, roughly parallel to Saddle Road, until it reaches PTA at a point near the Puu Keekee cinder cone.



Geology

Most of PTA is on lava flow deposits erupted from Mauna Loa, the last eruption of which (1984) covered 16 square miles of land in 3 weeks. The lava erupted from the Northeast Rift Zone, which extends northeast from the Mauna Loa crater and skirts the southeast boundary of PTA (USAG-HI, 2004). Below these lava flow deposits are overlapping historic basalt flows erupted from Mauna Loa and Mauna Kea.

The lower half of the Keamuku Parcel (also known as the WPAA) is within the Waimea Plains, which were formed by lava flows from Mauna Kea that butted up against the older Kohala Mountains. These mountains are now covered with a blanket of volcanic ash soils. The lava is predominantly pahoehoe and aa basalt flows, scoria (cinder), and ash deposits of the Hamakua Volcano (USAG-HI, 2004). Keamuku Parcel is dotted with Mauna Kea volcano cinder cones lying on the upper layer of the Hamakua basalts, which is covered by a layer of up to about 3 feet of Pahala ash deposited mainly on the southern flanks of the island by an explosive eruption period from Mauna Kea about 39,000 years ago (USAG-HI, 2004).

Soils

Soils on PTA are thin and poorly developed. Recent lava flows cover about 80 percent of the land surface. The low precipitation, rapid runoff, and high elevation reduce the rate of weathering, and the steep slopes and wind tend to prevent soils from accumulating. About 88,000 acres of PTA are classified by the U.S. Natural Resource Conservation Service (NRCS) as lava flows, of which about half are aa flows and half are pahoehoe flows (USAG-HI ,2004). An additional 1,400 acres are classified as cinder land. About 12,500 acres are classified as either rock land or very stony land. The remaining approximately 10,000 acres, almost all of which is along the northern boundary of PTA near Saddle Road within training areas 1 through 17 and 22, are classified as soils formed on volcanic deposits. The predominant soil is Keekee loamy sand on 0 to 6 percent slopes, which is a mildly to strongly alkaline soil consisting of stratified sand developed in alluvium from volcanic ash and cinders. Permeability is rapid, and runoff is slow. The hazard of wind erosion is moderate to severe. Similar sandy soils developed on slightly steeper slopes are found in the same general vicinity, including Huikau extremely stony loamy sand on 12 to 20 percent slopes, and Kilohana loamy fine sand on 12 to 20 percent slopes.

Surface Water Occurrence

On the Island of Hawaii, there are few defined watersheds because the young, highly permeable rock and soil deposits generally absorb the precipitation without forming stream channels. The exception is along the island's northern coast, where streams are better defined.

The climate at PTA is classified as cool and tropical. The average annual precipitation at PTA ranges from 10 to 16 inches. PTA lies within the Northwest Mauna Loa and the West Mauna Kea watersheds, which drain to the northern Hualalai and southern Kohala coasts, respectively (Mink and Lau, 1993).

The two watersheds are underlain by aquifer "sectors" of the same name. There are no surface streams, lakes, or other bodies of water within PTA boundaries due to low rainfall, porous soils, and lava substrates. Rainfall, fog drip, and occasional frost are the main sources of water that sustain plants and animals in the dryland habitat of PTA and Keamuku Parcel. There are no perennial streams within 15 miles of PTA.

Groundwater Occurrence

Groundwater occurrence on the Island of Hawaii is not well studied due to the younger age of the island, continuing volcanic activity, and the greater thickness of the volcanic deposits. Rainfall is the primary source of groundwater recharge on the Island of Hawaii. The geology of the island is characterized by highly permeable lavas from which little or no runoff occurs. Most of the precipitation percolates relatively quickly to the underlying groundwater body and then moves seaward, discharging into the coastal waters (Stearns and MacDonald, 1946). The Island of Hawaii has the highest recharge rate among the Hawaiian Islands, with a rate of 188.4 cubic meters per second (Lau, 1983). Sustainable yields for each of the island's aquifers are considerably less and are described below for each aquifer system underlying PTA (USAG-HI, 2004).

According to the classification scheme proposed by Mink and Lau (1993), PTA lies above two aquifer systems: the Northwest Mauna Loa and the West Mauna Kea aquifer sectors. The northern portion of PTA and PTA Trail lie within the Waimea aquifer system of the West Mauna Kea aquifer sector. A basal groundwater lens reaches to about four miles inland in the area. Beyond this point, the water becomes high-level groundwater, although the mode of occurrence is not understood. The majority of PTA lies within the Northwest Mauna Loa aquifer sector (HDLNR, 1995). The Anaehoomalu aquifer system comprises the entire Northwest Mauna Loa aquifer sector. Based on regional hydrogeological information, it is believed that the groundwater beneath PTA occurs primarily as deep basal water within the older Pleistocene age basalts (USACE, 1997).

2.0 PATHWAY ANALYSIS

According to the *Archives Search Report* (ASR) *On the Use of Cartridge, 20MM Spotting M101 For Davy Crockett Light Weapon M28, Schofield Barracks and Associated Training Areas, Islands of Oahu and Hawaii* (USACE, 2007), training with the Davy Crockett weapons system was likely conducted at PTA between 1962 and 1968. Historical documents contained no reference explicitly identifying a specific range used for Davy Crockett system training. Available shipment records indicate that 714 rounds (approximately 298 lbs of depleted uranium [DU]) were shipped to Hawaii for use at either the PTA or the nearby Schofield Barracks Military Reservation (SBMR). The number of rounds used at each SBMR and PTA is unknown, but the combined number of rounds fired at these areas cannot exceed 714. In the interest of being conservative and to ensure that modeling represents worst-case estimates, it is assumed that the full shipment of 714 rounds (298 lbs) of DU was used on each range.

The Army has conducted a scoping survey (Cabrera, 2008) which confirmed the presence of DU from the M101 spotting round on PTA and an aerial and limited ground walkover survey (Cabrera, 2009) which only pinpointed two additional M101 fragments. To this point, the Army has only found three DU rounds at PTA. This is not surprising given the geological conditions at the site. If any significant quantity of DU was fired at PTA, it is expected to have quickly migrated through the pahoehoe and aa basalt flows and is no longer detectable at the surface.

Another characteristic of the DU found at PTA is the relative pristine condition of the DU spotting rounds that were found. These rounds were in relatively large pieces or in nearly intact rounds. There was minimal oxidation present on the rounds because of the low humidity and lack of moisture available at PTA.

The Army has completed air quality studies around the impact area at PTA. The filters from this study were analyzed for DU and were indistinguishable from background (Cabrera, 2008). Air monitoring studies are continuing through 2009, but to date, no DU has been identified.

Human Health Risk Assessment

A Baseline Human Health Risk Assessment (BHHRA) has not been performed for Pohakuloa Training Area. Only a few fragments were found as discussed above, and presented little evidence of oxidation. The only measurements above natural background were in the immediate vicinity of these fragments.

Surface water within the installation is limited to intermittent streams because of permeable lava substrates, densely vegetated washes, and relatively low rainfall amounts. These factors contribute to the limited flow of surface water to off range areas. Although the area within the vicinity of PTA exhibits permeable lava substrates, the combination of limited precipitation and great depth to the aquifer make it unlikely that DU will impact groundwater.

Although soil may be considered a source media at PTA, the absence of release mechanisms results in incomplete pathways. Soil samples taken during the previously mentioned surveys indicated no increased levels of DU.

Potential Source-Human Interaction Pathway Analysis

Due to the incomplete surface water/sediment and groundwater pathways, potential source-human (exposure media, exposure routes and receptors) interaction pathways were not evaluated.

Potential Source-Ecological Interaction Pathway Analysis

Due to the incomplete surface water/sediment and groundwater pathways, potential source-human (exposure media, exposure routes and receptors) interaction pathways were not evaluated.

Summary

Site survey data (Cabrera, 2009) demonstrates that very little DU at PTA is on the ground surface. Only a few fragments were found during aerial and ground surveys. Any DU at PTA is expected to have filtered into cracks in the lava and is not accessible to surface detection. The limited rainfall and minimal amounts of soil limit potential pathways at PTA. DU has not been detected in air monitoring programs.

2.0 Sampling Plan

Periodic Sampling Program

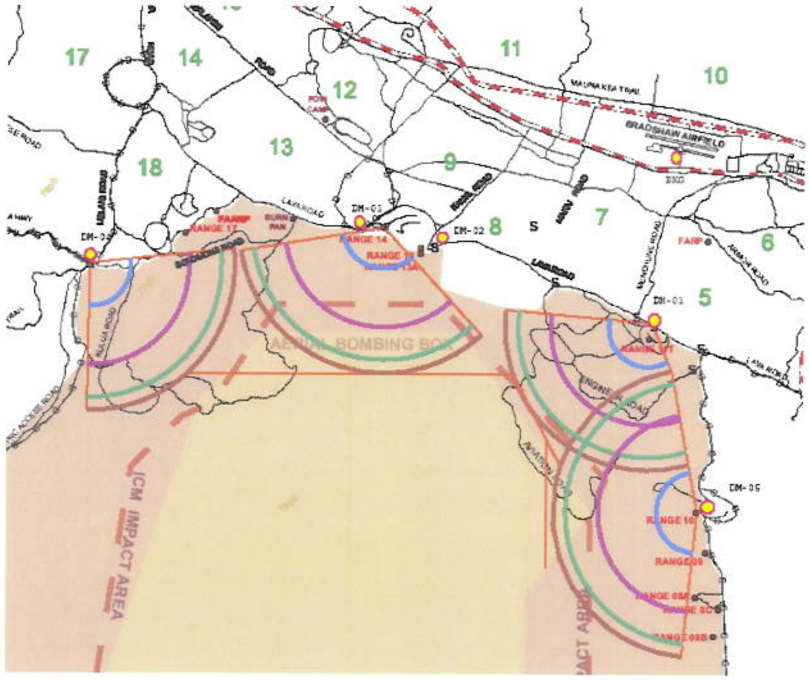
All sampling, analysis, and resulting actions performed under this ERM Plan will adhere to the requirements outlined in the US Army Installation Management Command *Environmental Monitoring Plan for Depleted Uranium from the M101 Spotting Round*.

The DU on PTA is contained within the impact area of the range which contains other hazards such as unexploded ordnance (UXO). Access to this area is tightly controlled by range control personnel and only trained personnel are authorized access.

Because of the limited soil and surface water at PTA, soil and water sampling is not feasible. To ensure that DU is not migrating off site, direct measurements will be performed using a pressurized ion chamber or micro-R meter capable of environmental level measurements. Measurements will be compared to background and long term trend data will be maintained.

Direct Measurement Locations	
Sample Identifier	MGS Coordinates
BKG	32496 86650
DM-01	32110 84267
DM-02	28708 85471
DM-03	27398 85722
DM-04	23324 85193
DM-05	32878 81542

Action Levels. The purpose of the direct measurement is to ensure that releases of contaminated material to the environment are as low as reasonable achievable. Action levels are provided to establish a limit which, if exceeded, will require a mitigative investigation be initiated. Based on the results of the investigation, the radiation safety officer will recommend corrective actions to be undertaken. The NRC will also be notified when action levels are exceeded. Action levels for the direct measurement will be twice ambient background. In addition, trends will be monitored to ensure the background site is not inadvertently subjected to increasing background levels.



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