APPENDIX F

Soil Moisture Content Data

Soil Grain-Size and Moisture Content

Makua Military Reservation, O'ahu, Hawai'i

October - December 2002

Sample ID	Control Number	Soil Classification	% Gravel	% Sand	% Fines	Moisture Content
MMRFOXSS 1-2	J050-02	CL	2	18	80	9.1
MMRWOLFSS 1-3	J050-07	SM	0	53	47	24.2
MMRDEEDSSS 1-1	J050-11	CL	10	20	70	7.7
MMR 105FASS BLANK	J050-16	ML	9	39	52	7.7
MMRPBPSS 1-1	J050-17	CL	9	41	50	8.6
MMRWSBPSS 1-1	J050-18	ML	2	7	91	12.9
MMRDPASS 1-2	J050-20	CL	1	7	92	8.1
MMRAGSS 1-2	J050-23	ML	0	5	95	7.5
MMRMTASS 1-5	J050-29	ML	0	13	87	11.6
MRMDB SS 1-2	J050-32	ML	0	13	87	7.3
MMRSSMW-3B-5.0	J198-01	ML	0	42	58	14.5
MMRSSMW-3B-10.0	J198-02	SM	4	53	43	16.9
MMRSSMW-3B -15.0	J198-03	SC	1	81	18	20.5
MMRSSMW-3C-10	K241-01	SM	17	42	41	18.5
MMRSSMW-3C-15	K241-02	SM	0	79	21	24.9
MMRSSMW-4C-5	K241-03	SM	0	51	49	8.1
MMRSSMW-4C-15	K241-04	SP	1	95	4	4
MMRSSWM-5-5	K241-05	ML	0	2	98	17.7
MMRSSMW-5-10	K241-06	SM	12	42	46	15.7
MMRSSMW-5-15	K241-07	ML	7	24	69	18.5
MMRSSMW-2-5	J165-01	CL	2	19	79	19.4
MMRSSMW-2-10	J165-02	CL	0	6	94	32.1
MMRSSMW-2-15	J165-03	CL	0	37	63	33.5
MMRSSMW-3A-5	J165-04	CL	1	43	56	11.9
M MRSSMW-3A-10	J165-05	SC	11	46	43	16.4
MMRSSW-3A-15	J165-06	CL	3	42	55	18.5
MMRCOYTESS 1-8	J083-07	ML	2	28	70	5.4
MRELKSS 1-4	J083-11	ML	0	5	95	8
MMRELKS 1-5	J083-12	ML	3	30	67	3.3
MMRBUFFALOS 1-2	J083-19	ML	3	6	91	6.7
MMRBUFFLOS 1-3	J083-20	ML	1	3	96	7.8
MMCAASS 1-12	J082-07	ML	1	8	91	5.8
MMRBADGERSS 1-6	J082-15	ML	4	42	54	7.6
MMRBADGERRS 1-10	J082-19	ML	2	13	85	5
MMRCOYOTESS 1-1	J082-20	ML	2	7	91	4.6
MMRDEERSS 1-4	J081-04	SP-SM	0	95	5	2.4
MMRDDEERSS 1-9	J081-09	ML	0	21	79	5.5

Soil Grain-Size and Moisture Content

Makua Military Reservation, O'ahu, Hawai'i

October - December 2002

Sample ID	Control Number	Soil Classification	% Gravel	% Sand	% Fines	Moisture Content
MMRDEERSS 1-13	J081-13	SM	0	86	14	4.3
MMRDEERSS 1-15	J081-15	SW-SM	0	90	10	3.2
MMRCAASS 1-2	J081-17	ML	0	7	93	7.2
MMRCAAASS 1-4	J081-19	CL	0	7	93	2.3
Average			2.7	33.4	64.0	11.6

APPENDIX G

Phytoremediation Summary

Appendix G

Summary of Preliminary Findings from Phytoremediation Research Project Conducted on OB/OD Unit Soils at the Makua Military Reservation Project

As part of evaluation of fate and transport for the Makua Military Reservation for the Environmental Impact Statement (EIS), the preliminary findings of the phytoremediation research project are summarized. This study provides an important evaluation of the levels of explosives in the shallow soils in the vicinity of the OB/OD area.

Greenhouse studies were performed to evaluate the ability of tropical plants to reduce concentrations (remediate) metals and energetic contaminated soils present at the Makua Military Reservation (MMR). A total of 12 plant species (8 native to Hawaii and 4 non-native) were tested for their ability to phytoaccumulate metals and phytodegrade energetic compounds during a three-month long greenhouse study conducted at the University of Hawaii.

The greenhouse study showed that none of the plants tested accumulated significant amounts of heavy metals (Table G-1). This finding was consistent with the metals concentrations measured in plant tissue sampled from the dominant species present within the OB/OD unit. These results were interpreted to reflect the non-bioavailable nature of the metals present in the Makua soils.

Table G-1. Metals Concentrations Measured in Plants Collected from the OB/OD Unit and in Plants Grown in OB/OD Soil During Greenhouse Study (Before and After 3-Month Growth Period in OB/OD Soil).

Metal	Concentration Start Greenhouse Study (ppm)[1]		Concentration End Greenhouse Study (ppm)[2]		Concentration Measured in Plants Collected from the OB/OD Unit (ppm)[3]		
	Koa Haole	Guinea grass	Koa Haole	Guinea grass	Koa Haole	Guinea grass	Klu
Cu	1.4	6.0	7.2	9.7	8.3	7.3	7.9
Ni	0	0	1.1	2.7	1.7	2.3	3.7
Pb	0	0	2.8	6.2	0.9	0.2	0.3
Zn	20.4	48.0	18.5	82.6	35.1	112	27.4

[1]Concentrations are average of 5 replicates

[2]Concentrations are average of 3 treatments (15 replicates)

[3]Guinea Grass concentration is average of 3 plants, Koa Haole is average of 2 plants and Klu is a single plant

The interpretation of the energetics experimental data was confounded by the low concentration and heterogeneous distribution of the energetics contamination present in the site soils at the start of the experiment (Figure G-1). Small reductions in some energetic compound concentrations were observed during the course of the three-month greenhouse study for some

plants compared to no-plant controls. For instance, the dominant grass species present within the OB/OD unit, Guinea Grass, appears to have reduced the concentration of RDX and HMX in site soils compared to both non-plant controls and the eleven other plant species tested (Figure G-1).

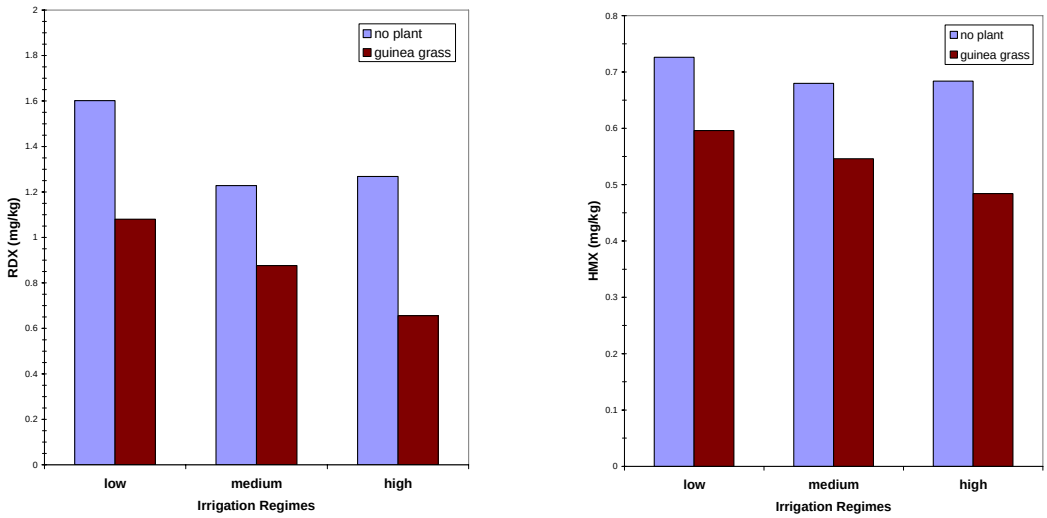

Figure G-1: RDX and HMX Concentration Measured in OB/OD Unit Soil (No-Plant Control and Guinea Grass) at the Conclusion of 3-Month Greenhouse Study

However, the small reductions observed in some energetic compound concentrations between the beginning and the end of the greenhouse experiment may not be solely due to phytodegradation. For instance, leaching tests conducted on the OB/OD unit soils showed that RDX can be mobilized from the soil (five individual leaching tests conducted on OB/OD soils yielded aqueous RDX concentrations ranging from 0.49-0.82 mg/L, from starting concentration in the soil that varied from 1.2 to 1.6 mk/kg) and it is also possible that some of these compounds may have been taken up to a limited degree into the plant's root and shoot during the course of the experiment.

The research found that one of the energetic compounds, DNT, was heterogeneously distributed within the soil matrix. It is believed that DNT is present in near-surface OB/OD unit soils in the form of small nuggets of various size and as a result, traditional sampling techniques may not adequately quantify the true concentration of this energetic present in site soils. A follow-on composite sampling experiment conducted on OB/OD soils verified the heterogeneous distribution of DNT within the soil matrix and researched sample preparation methods for reducing contaminant heterogeneity within the analyzed soil.

The concentration of some energetic compounds (RDX, HMX and TNT) appears to have declined by roughly an order of magnitude over levels measured within the unit while it was still actively used during the mid-1980s (Figure 2). This observation and the greenhouse study results suggest that the energetic contamination generated by range activity within Makua soils undergoes natural, perhaps plant mediated, degradation, with breakdown half-lives on the order of between two to five years. Figure 2 also shows that the RDX, TNT, and HMX concentrations

for 5 different studies of OB/OD soils all show an average value of less than 10 mg/kg, with most studies showing an average of less than 1 mg/kg

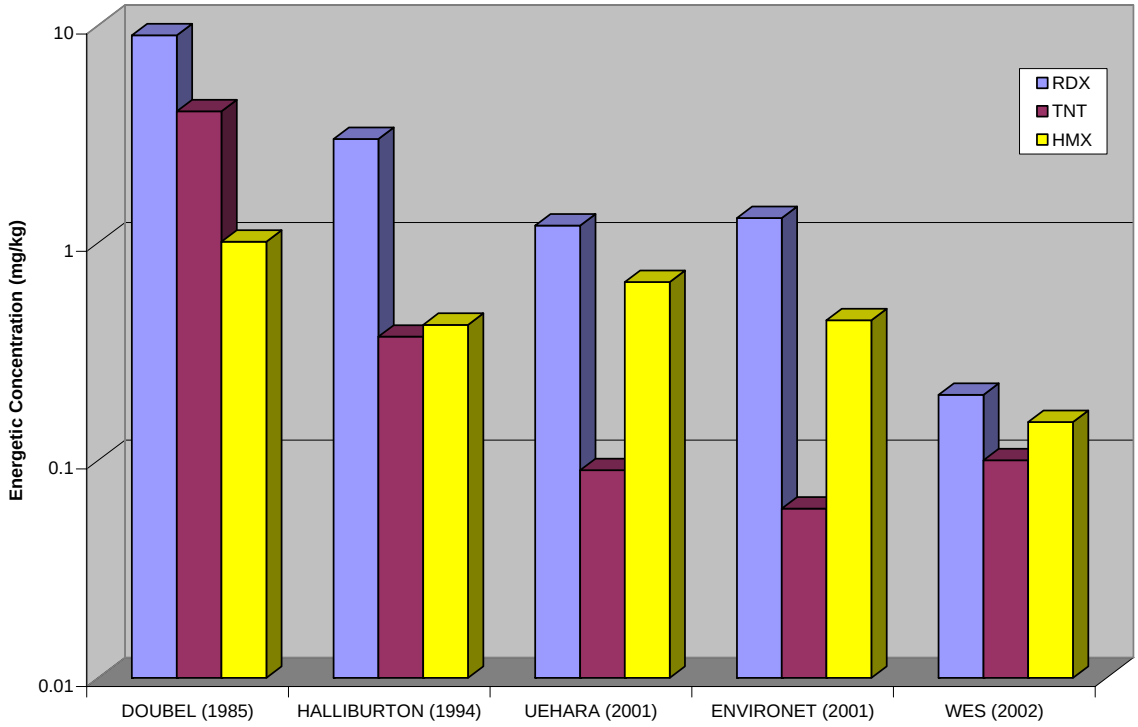

Figure G-2: Mean Energetic Concentrations Measured in OB/OD Unit

APPENDIX H-1

Makua Valley Geology and Numerical Model

Makua Valley Geology and Numerical Model

Executive Summary

A numerical model was constructed to simulate the groundwater flow and potential transport of explosives constituents within the groundwater system that underlies Makua Valley. The region that was modeled consisted of the roughly 4,170 acre hydrologic basin that includes the two major valleys (Makua and Kahanaha Iki) that drain into Makua stream and Koiahi Gulch. The numerical model created extended from the ridges that surround these valleys to the Waianae coast of the island of Oahu.

The U.S. Geological Survey models MODFLOW (McDonald and Harbaugh, 1986) and MT3D (Zheng, 1990) were used to simulate groundwater flow and transport, respectively. After calibrating the model by adjusting the hydraulic parameters of the various basalt and sedimentary units within the model domain to match measured water levels within the valley, the model was used to simulate groundwater flow and the migration of the energetics compound RDX (1,3,5-trinitro-1,3,5-triazine), which has been found in sub-surface soil and lysimeter samples collected from beneath two separate potentially impacted areas (i.e., the OB/OD Area and the Impact Area).

Conservative assumptions incorporated into the numerical simulations indicate that a plume of RDX emanating from the OB/OD unit area could be detected in the down-gradient monitoring well MW-5 as well as the near-coast nested arrays of wells that were installed during this investigation prior to migrating off the military reservation. The numerical simulation results indicate that there is a possibility for the development of a plume of energetic constituents (i.e. RDX) as a result of infiltration into the groundwater system that underlies the valley. In the worse case scenario, where no retardation or attenuation is assumed to occur to the RDX during transport through either the several hundred foot thick vadose zone beneath the OB/OD unit or within the underlying groundwater system, a roughly 750 meter wide plume containing 0.002 mg/L RDX is simulated to reach the Makua shoreline after 50 years of travel through the groundwater system. However, when the natural effects of attenuation and retardation within just the vadose zone are considered during contaminant transport, there is a considerable reduction in the size and concentration of the simulated plume, which results in the plume not reaching beyond a few thousand meters of the major impacted areas within the valley. It should also be noted that there is no evidence that groundwater in the inland portions of Makua is currently impacted by energetic constituents, or that groundwater reaching the shore has ever contained measurable levels of RDX or other energetic constituents.

Introduction

A numerical model was constructed to simulate the groundwater flow and potential transport of explosives constituents within the groundwater system that underlies Makua Valley. The objectives of this modeling effort are to:

- Simulate the groundwater flow direction beneath the valley;
- Simulate groundwater flow velocities; and
- Evaluate the potential for migration of explosive compounds in groundwater to the shoreline at Makua.

The following sections describe the background geologic and hydrogeologic information that was used to construct the numerical model and document the modeling activities and results.

1.0 Physical Setting

The region that was modeled consisted of the hydrologic basin that includes the two major valleys that drain into Makua stream and Koiahi Gulch. The model extends from the ridges that surround these valleys to the coastline along the western shore of the island of Oahu. The upper reaches of Kahanaha Iki and Makua valleys are separated by a volcanic ridge that extends approximately half-way down the military reservation. The two ephemeral streams that flow down these valleys join at the down-gradient end of the central ridge. Stream flow within the valley occurs only during infrequent intense rain events that typically occur no more than a few times a year.

1.1 Site Geology

Makua Valley is located within the eroded remnant of Waianae Volcano, which was active between 2.9 to 3.9 million years ago (Presley et al., 1997). The overall stratigraphy of the volcano consists of two volcanic formations; the shield building Waianae Volcanics and the post-shield building Kolekole Volcanics (Langenheim and Clague, 1987). The ridgelines surrounding Makua Valley are comprised of lava flows of the Lualualei and Kamaileunu Members of the Waianae Volcanics. The Lualualei flows are predominately comprised of olivine-phyric tholeiitic basalts while the late-shield stage Kamaileunu flows are comprised of more plagioclase-phyric basalts and hawaiites that form a caldera-filling sequence elsewhere on Waianae. The post-shield lava flows of the Palehua Member of the Waianae Volcanics cover the high-elevation portions of the ridgelines at the back of Makua Valley. Post-shield volcanism on Waianae lasted over a relatively brief 150,000 year period between 2.9 and 3.05 million years ago (Presley et al, 1997). Figure 1 shows the overall geology of Waianae Volcano.

Waianae Volcano had a well-developed caldera centered near the back of Lualualei and Waianae Valleys, and two major rift zones: a prominent north-west rift zone, well defined by a complex of sub-parallel dikes trending approximately N50^{o}W, and a more

diffuse south rift zone, trending between S20^{o}W to due south. The axis of the major northwest trending rift zone appears to be located just to the south of Makua Valley, with high densities of dikes prominently exposed in the ridgeline that separates Makua and Keaau valleys. Figure 2 shows the results of field measurements of dike width and orientation made in near-continuous exposures located along the shoreline and the ridgeline to the north of Makua Valley and along the ridgeline to the south of Makua on August 3, 2003. The dike intensity measured to the south of Makua is roughly 5% while the intensity throughout much of the rest of the valley is approximately 1%, suggesting that the main rift zone was located just to the south of Makua.

It is also notable that the mean width of dikes in the vicinity of Makua is quite wide. Figure 3 shows the variation in mean dike width measured at various outcrops on Waianae Volcano, including the three exposures measured north and south of Makua Valley. The density and width of dikes in the shield building stage volcanic flows that form the ridgelines to the north and south of Makua undoubtedly retard the seaward flow of groundwater within the ridgelines, creating somewhat elevated groundwater levels within the inland portions of these ridgelines.

Geologist originally assumed that valley formation on Hawaiian volcanoes was largely due to the work of erosion. However, recent seismic reflection and submersible vehicle observations have revealed that much of the western half of the original volcanic edifice of Waianae collapsed to the west in the form of at least three major blocks (Moore et al., 2001). These slump deposits are believed to have been formed by relatively slow, intermittent slip along fault planes of massive sections of the original western half of Waianae Volcano. Presley et al. (1997) speculate that the initial formation of large valleys on Waianae's leeward coast, including Makua, occurred at the same time (roughly 3 million years ago) as the onset of eruption of Kolekole Member lavas and that the two events were causally linked.

Figure 4 is a block diagram that depicts the sub-surface geology beneath Makua Valley. The basement rock beneath Makua is comprised of dike intruded, shield building lavas, with higher dike intensities being present in the shoreline areas of the valley. The middle portion of the valley is underlain by at least 110 m of weathered alluvium and detritus that covers the bedrock surface. Based on the boring log for Monitoring Well MW-5, located approximately 2300 m inland from shore, the thickness of the sediments extends from 70 m (235 ft) above mean sea level (msl) to at least -40 m (-125 ft) msl. Near shore sediment thickness is believed to extend to greater depths than observed in MW-5. The boring log for MW-05 shows fine-grained sediments (i.e., primarily terrigenous silts) overlying somewhat coarser grained terrigenous sediments (i.e., primarily silty and clayey sands).

The depth of erosion of the valley has been greatly impacted by Pleistocene era changes in sea level. Figure 5 shows the large variations in sea levels that have occurred within the Pleistocene era based in part upon fossil carbonate algal and coral reef complexes studied in Hawaii. The probable remnants from the Kaena high stand of sea level roughly 440,000 years ago are observed to the west of the dirt access road that runs into

the southern portion of the military reservation (above Kaiahi Gulch). At the time of the last maximum buildup of ice mass during the last Ice Age, approximately 18,000 years ago, sea level was approximately 120 to 130 meters below its current level. It is likely that the down cutting near the central portion of the shoreline at Makua extended to at least this depth. The rapid rise of sea level due to the melting and retreat of the great continental ice sheets largely dictated the stratigraphy of deposits present in the near-shore portions of Makua. The drilling that has been conducted in the coastal portion of the military reservation extended to a depth of approximately -25 m msl and revealed the presence of calcareous sands to a depth of approximately -15 m msl. Beneath these sands to a depth of at least -25 m are clays and basaltic boulders. During the period of greatest glacial melting, approximately 2,000 to 3,000 years ago, sea level reached a maximum elevation of between 1 and 2 meters above present sea-level. The fall of sea level over the period 2,000 years BP to its present elevation led to sandy accretion of strand plains that further extended Oahu's coastal plains. The lithified sand dunes and calcareous sand deposits encountered in the coastal portion of the Makua military reservation were likely deposited around the time of this former high stand of sea some 2,000 years ago.

1.2 Groundwater Occurrence and Quality

Groundwater is found within the Waianae Basalts and the valley sediments, with the direction of groundwater flow generally towards the shore (i.e., generally west) where it ultimately discharges into the ocean environment. The presence of dikes suggests that there may be areas of impounded water where the groundwater elevation is many feet above the elevations observed in monitoring wells in the alluvial areas. This has not been confirmed for Makua Valley; however, nearby Makaha Valley contains a shaft with groundwater elevations of approximately 300 m msl (Takasaki, 1971). Stearns and Vaksvik (1935) reported the presence of several small seeps within Makua Valley issuing from both the north and south side of the valley. Their combined average daily flow was estimated to be less than 10,000 gallons (Stearns and Vaksvik, 1935). These small seeps may simply reflect drainage from localized perched zones present within the inland portions of the valley.

According to the USGS (Nichols, et al., 1996), groundwater beneath the eastern flank of the Waianae Range in the vicinity of Makua Valley flows within the basalt aquifer towards the Schofield Plateau. It is believed that the ridge crest at the back of the valley roughly corresponds to the location of the groundwater divide where recharge occurring to the west of the ridge ultimately flows towards the western shoreline at Makua while that falling to the east of the ridge ultimately flows towards the coast in the vicinity of Mokuleia. For the purposes of the model discussed herein, it was assumed that the crest of the ridge forms the effective inland edge of the recharge area that contributes to groundwater flow beneath Makua.

The thick trough of terrestrial alluvium present within the central portion of Makua Valley is generally poorly permeable, with groundwater flow likely being concentrated in discontinuous lenses of stream gravel deposits. Few if any valley-floor groundwater bodies of any consequence are found in valley fill deposits on the island of Oahu, but rather they typically act chiefly as a water barrier to flow within the underlying or

adjacent basement rock (Wentworth, 1951). Monitoring wells located within a few hundred meters of shore at Makua indicate that groundwater elevations are a few feet above sea level. A monitoring well (MW-5) located within the alluvial sediments in the center of Makua Valley approximately 2,300 meters from shore has a groundwater elevation of approximately 4.6 m msl (15 ft). Assuming that the groundwater surface elevation reflects a shape that is consistent with that expected of a Ghyben-Herzberg lens, then the bottom of the fresh groundwater lens within the alluvium at MW-5 is approximately -180 m msl at this location (i.e., approximately 40 times the elevation of the water table above sea level).

The groundwater in near-shore wells at Makua have historically contained relatively low concentrations of total dissolved solids (TDS) and chloride ion compared to other coastal wells in the Waianae area. In well 3213-06 (also referred to as Oahu Well No. 277-101), the chloride concentration measured in 1967 was 218 mg/L (Takasaki, 1971). This well lies at the northern end of the mouth of Makua Valley, and it was drilled through alluvium in the upper 3.5 m (12 feet) and hard rock of the Waianae volcanics down to the bottom of the well at 15 m bgs (50 feet bgs). The highest and lowest water levels measured in this well since 1965 have ranged between 1.98 and 2.41 m msl (6.49 and 7.92 feet above mean sea level). The slightly elevated groundwater level measured in this well is consistent with an impounded groundwater system. Monitoring wells drilled near the center of the valley and penetrating only into alluvium show groundwater elevations of around 1 meter at distances of approximately 200 to 300 m inland from shore.

1.3 Hydraulic Characteristics

The ridgelines surrounding Makua Valley are composed of dike intruded basalt erupted during the shield building phase of volcanism on Waianae. The presence of these dikes may lead to conditions of groundwater impoundment, especially where the dike intensities are high and the dikes extend to elevations significantly above sea level. However, in areas where the dikes are cut by erosion to depths below sea level and have been subsequently buried by terrigenous sediments, impounded groundwater is likely to seep into the overlying sedimentary material through which it will eventually flow towards the coast. Along the northern and southern seaward boundaries of Makua Valley, the density of dikes is sufficiently dense to retard the seaward movement of groundwater.

There are no known direct measurements of the hydraulic characteristics of the basaltic rock within Makua Valley. The presence of dikes throughout much of Makua Valley suggests that the entire valley is located either within the northwest rift zone or within the marginal dike complex of Waianae Volcano. The dike complex basalts of the Waianae range are characterized by low-to-moderate permeability.

Slug test measurements made at the monitoring wells and clusters of monitoring wells at MW-1, -2, -3, and -4, yielded hydraulic conductivity values of between 0.12 to 23 m/d (0.4 to 75 ft/d, mean of 13 ft/d) for the near-coast sediments encountered in this area. Slug test results of valley filling sediments in MW-5 indicated an estimate for hydraulic

conductivity in this well of approximately 7 m/d (23 ft/d). The calcareous coastal sediments are expected to have a somewhat higher overall hydraulic conductivity than those of the valley filling sediment.

1.4 Water Balance

A water balance was performed for Makua Valley using annual estimates for rainfall, runoff, evapotranspiration, and recharge for the Makua and Waianae coast areas (Takasaki, 1971; Shade and Nichols, 1996). The estimate for annual rainfall within the watershed of Makua Valley is approximately 12 Mgal/d, with annual precipitation ranging from approximately 20 inches along the coastline to around 75 inches in the easternmost ridges of the valley. Figure 6 is an annual rainfall distribution map for the Makua Valley area (Takasaki, 1971) along with the location of tipping rain gauges that have been installed in and around Makua Valley over the past four years. The table below summarizes the monthly rainfall data collected over the past year at the rain gauges installed as part of this study.

Table 1: Makua Valley Monthly Rainfall Totals in Inches

Month	Makua 1	Makua 2	Makua 3	Makua 4	Makua 5	Makua 6	Makua 7	Makua 8
November-02	3.96	2.11	4.7	5.74	8.01	-	-	-
December-02	0.81	0.39	1.03	0.86	0.91	0.5	0.83	0.74
January-03	7.74	1.47	8.64	7.58	11.91	4.6	10.22	8.15
February-03	2.31	1.2	4.51	6.38	6.97	3.42	6.54	5.4
March-03	6.48	3.52	8.65	5.4	6.16	5.54	5.85	5.14
April-03	3.49	1.84	5.47	2.22	2.79	2.62	2.83	2.42
May-03	0.03	0.05	0.18	0.15	0.13	0.07	0.08	0.04
June-03	1.09	0.52	1.5	1.25	0.78	0.14	0.83	0.79
July-03	0.95	0.53	0.91	0.99	0.86	0.52	0.69	0.58
August-03	0.34	0.07	0.24	0.16	0.08	0.00	0.03	0.05
2003 Rain to Date	22.43	9.20	30.10	24.13	29.68	16.91	27.07	22.57

Runoff forms a relatively low percentage of the water balance, with an estimate of only 8% of rainfall becoming runoff (Shade and Nichols, 1996). Continuous streamflow records are available for gauging stations on streams in nearby Makaha Valley since July 1959. These records show that runoff is generated only during heavy rainfall events that occurs a maximum of a few times a year. Additionally, during relatively low rainfall events, runoff from the upper reaches of the valleys may infiltrate in the lower reaches of the valley and never enter the ocean as stream flow (Takasaki, 1971).

Evapotranspiration is a relatively large component of the water balance, comprising approximately 63% of the rainfall that falls over the Waianae region of Oahu (Shade and Nichols, 1996). The primary vegetation cover is kiawe in the lowlands and a mixture of haole koa, klu and various grasses in the inland portions of the valley floor. These plants are phreatophytes and are estimated to consume 6 million gallons of groundwater from the Waianae area daily.

The water budget analysis by Shade and Nichols (1996) indicated that approximately 32% of rainfall recharges the groundwater system over the Makua Valley area. With an estimated valley-wide rainfall amount of 12 Mgal/d, there is an estimated 4 Mgal/d of recharge entering the valley's aquifer system. In general, the distribution of recharge is greatest over the flanks of the ridges where soil is relatively thin and rainfall is greatest, especially over the higher elevations of the model area. Recharge is moderate over the valley sediments, and negligible over the lower elevation, coastal portions of the valley. The distribution of recharge in Makua is presented in Shade and Nichols (1996). Figure 7 depicts the distribution of recharge over the modeled area that has been extrapolated from this USGS report.

2.0 Model

The groundwater system beneath Makua Valley was simulated using a numerical model to estimate the timing and concentration of explosives constituents reaching the coast via groundwater flow. The U.S. Geological Survey models MODFLOW (McDonald and Harbaugh, 1986) and MT3D (Zheng, 1990) were used to simulate groundwater flow and transport, respectively. The Department of Defense Groundwater Modeling System (GMS) was used to construct the model mesh and served as a graphical processor that interfaced with MODFLOW and the MT3D module.

For the purpose of simulating the groundwater flow and transport that may be occurring in the center of the valley near the OB/OD area, it is assumed that the groundwater system boundaries are the same as the watershed area. Thus, the model domain contains the entire Makua Valley watershed that extends from the coast to the ridgelines that surround the valley. The entire model covers an area of approximately 6.5 square miles. Figure 8 shows the lateral extent of the numerical model along with the finite difference grid employed in the model.

A finite difference grid with rectangular cells was overlain onto the model area. The cell dimensions are each approximately 72 meters oriented in an east-west direction by 60 meters in a north-south direction. The grid cells overlying the watershed area were active in the model, while the cells lying outside the watershed were inactive in the model. There were twelve horizontal layers in the model of the following thicknesses:

- The upper model layer (L1) was 4.9 meters thick extending from 5 meters above msl to 0.1 m above msl.
- The second model layer (L2) was 5.1 meters thick extending from 0.1 m msl to -5 m msl.
- The third model layer (L3) was 7.5 m thick extending from -5 m to -12.5 m msl.
- The fourth layer (L4) was 10.5 m thick extending from -12.5 to -23 m msl.
- The fifth layer (L5) was 15 m thick extending from -23 to -38 m msl. This represented the bottom of the valley filling alluvium, occurring within the center of the valley.
- The sixth layer (L6) was 22 m thick extending from -38 to -60 m msl.
- The seventh layer (L7) was 30 m thick extending from -60 to -90 m msl.

- The eighth layer (L8) was 45 m thick extending from -90 to -135 m msl.
- The ninth layer (L9) was 65 m thick extending from -135 to -200 m msl.
- The tenth layer (L10) was 95 m thick extending from -200 to -295 m msl.
- The eleventh layer (L11) was 140 m thick extending from -295 to -435 m msl.
- The twelfth layer (L12) was 165 m thick extending from -435 to -600 m msl.

The bottom of the mesh, at -600 m msl, is considered to be below the active groundwater flow zone and below a depth that would influence the migration of contaminants that infiltrate into the groundwater system within Makua Valley.

Attempts were made to incorporate the variable-density groundwater flow model SEAWAT (Guo and Langevin, 2002) into these simulations to evaluate the effects of seawater intrusion in the coastal environment. However, it was not possible to link the MODFLOW/MT3D and SEAWAT models. Since the effects of variable-density flow on contaminant transport within the shallow groundwater system would only be of significance in the coastal areas of the valley, the non-density dependent simulations utilized in this investigation are considered sufficient to characterize the potential transport of energetic contaminants within the inland portion of Makua valley, including the area extending from the OB-OD unit to the military reservation boundary along Farrington Highway.

2.1 Boundary Conditions

The boundary conditions for the model are as follows:

- No flow boundaries were established along the ridgelines forming all but the western boundary.
- The western boundary was simulated as a drain that extended through the entire thickness of the model. The drain was set at a constant head elevation of 0.1 m. The conductance of the drain was varied during the calibration, as described below.
- No pumping wells were simulated since there are no active wells within the model domain. However, a well was placed in the center of the OBOD area to allow tracking of the direction of groundwater flow from that area.

Figure 8 shows an outline of the model area and the location of the drain within the model.

2.2 Model Area Attributes

Hydrogeologic parameters, such as recharge, hydraulic conductivity, storage coefficient, specific yield, and porosity, were distributed over the model domain. Each is described below.

Recharge. The distribution of recharge was taken from Shade and Nichols (1996), and Figure 7 presents this distribution. The amount of recharge input into the model was based on Takasaki's rainfall distribution (Takasaki, 1971) and totaled 4 Mgal/d. Using Shade and Nichols distribution, there were three recharge rates: high, medium, and low.

The high recharge rate was established to be double the medium rate, and the low recharge rate was established to be one-third the medium rate. Therefore, to obtain a regional recharge rate of 4 Mgal/d, the recharge rates for high, medium, and low areas were assigned values of 0.3 m/yr, 0.15 m/yr, and 0.05 m/yr.

Hydraulic Conductivity Values. Hydraulic conductivity values were distributed according to the type of geologic material present. The hydraulic characteristics were estimated from data used in previous modeling studies in the Hawaiian islands and were modified by varying them in the model to obtain acceptable agreement between measured and model-calculated water levels. The parameter distribution assigned to the model was as follows.

- Terrigenous valley sediments were found beneath Kahanahaiki and Makua Valleys, but only in the upper five model layers (L1 through L5, i.e., down to a depth of -38 m msl); the width of the valley sediments narrows in layer L5 to approximate the narrowing of the valley bottom. Due to the presence of coarser sediments in the lower 15 m of the boring log for MW-5, higher hydraulic conductivity values were assigned to the layer L5.
- Calcareous coastal sediments were found at the near-shore end of the valley, but only in the upper two model layers (L1 and L2, i.e., down to a depth of -30 m msl)
- Dike-complex and marginal dike complex basalts underlie the entire valley and coastal sediments (i.e., for layers L6 through L12), and they also comprises the surrounding ridges of the model (i.e., for all model layers, L1 through L5). In order to simulate the extremely high intensity of dikes observed in the southern flank of Makua Valley, much lower values were assigned, analogous to those used by Oki (1999) in Molokai. Similarly, since the northern coastal area trends sub-parallel to the orientation of the dikes, this narrow coastal area was also assign a low value for hydraulic conductivity.

Porosity, Specific Yield, Storage Coefficient, and Dispersivity. Porosity values were set at 0.1 for basalt material and 0.2 for sedimentary material. These values correspond with standard textbook values (Freeze and Cherry, 1979). Specific yield was estimated to be 75% of porosity, or 0.075 and 0.15 for basalt and sedimentary materials, respectively. Storage coefficient values used for dike-intruded basalt in this model were 0.02 (Williams and Soroos, 1973, as presented in Hunt, 1996). The storage coefficient value used for sedimentary material was 0.001, based on Freeze and Cherry (1979). Longitudinal dispersivity coefficient values, as estimates of aquifer material heterogeneity, were assigned as 50 m for the basalt material and 25 m for the sedimentary material. Values for transverse and vertical dispersivity were set at a tenth the value of the longitudinal dispersivity.

The values for the hydrogeologic framework parameters for each geologic material type (i.e., dike-complex basalts, valley sediments, and coastal sediments) are provided in Table 1.

Table 1: Calibrated Groundwater Flow Model Parameters, Makua Valley			
Parameter	**Near-Shore Sediments**	**Valley Sediments**	**Dike-Complex Basalt**
Horizontal K	25 m/d	10 m/d upper; 25 m/d lower	4 m/d
Vertical Anisotropy	0.1	0.1	1
Porosity	0.2	0.2	0.1
Specific Yield	0.15	0.15	0.07
Storage Coefficient	0.001	0.001	0.001
Longitudinal Dispersivity	25 m	25 m	50 m
Transverse Dispersivity	2.5 m	2.5 m	5 m
Vertical Dispersivity	2.5 m	2.5 m	5 m

Notes:

m = meters
m/d = meters per day

2.3 Sensitivity Analysis

A sensitivity analysis was performed in order to identify the set of hydraulic parameters (i.e., hydraulic conductivity and drainage conductance) that best represent the system and also identify those parameters that most affect the groundwater system. Through the sensitivity analysis, recharge was kept constant at 4 Mgal/d, as estimated from Takasaki's (1971) annual rainfall distribution and spatially distributed according to the map provided by Shade and Nichols (1996). All sensitivity analyses were conducted using flow simulations, where the simulation was run until steady state was achieved. The sensitivity analysis showed the following:

- Hydraulic conductivity values for the sediment areas had a significant impact on groundwater levels at the calibration points both near shore and inland. Because of the prevalence of dikes in the basalt material underlying the valley, groundwater flow in the center of the valley occurs primarily in the sedimentary fill material. Assignment of higher hydraulic conductivity values to the sedimentary material allows water to flow more freely through the sediments and into the ocean, leading to a reduction in simulated groundwater levels.
- Hydraulic conductivity values for the dike complex basalts significantly influence the groundwater levels in the sediments and at all the calibration points. The

interpretation is that the basalt material forms the bottom of the sedimentary fill, and more restrictive flow within the basalt also causes water levels to rise in the overlying sedimentary deposits.

- Hydraulic conductivity values in the coastal sediments most affect the simulated near-shore groundwater levels, but also somewhat affect groundwater elevations at inland locations within the sedimentary fill. Consequently, the value of hydraulic conductivity for coastal sediments most affects the simulated groundwater elevation in the near-shore calibration point.
- Drain conductance for the coastal discharge boundary had a relatively small influence on the simulated groundwater levels. This influence was most felt at the near-shore calibration point where it had only a small impact, unless very low (less than one m^2/d/m) or very high conductance values (greater than 1000 m^2/d/m) were used.
- The depth of the drain along the coastal boundary influenced the discharge of groundwater from the system, as a result of the assignment of a specified head to the boundary cells that were designated as a drain. The sensitivity analysis looked at the assignment of the drain either over the upper four layers, which would be analogous to discharge of freshwater down to a depth of -23 m, the approximate depth of the lens at the ocean boundary, or through the entire thickness of the model boundary. When simulating a four-layer drain, the discharge at the ocean boundary was constrained to the upper four layers, which lead to higher simulated inland heads than are observed. As a result, the hydraulic conductivity of the inland model mesh corresponding to the basalt was increased to lower the inland heads to the levels measured in Well MW-5. The resultant simulated travel times were a minimum of 20% longer than the times simulated when the entire coastal boundary was assigned to be a drain. The longer travel times resulted from the flatter nature of the simulated hydraulic gradient in the interior of the model mesh in the four layer thick drain simulation. In order to be conservative, the simulation results obtained by assigning the entire thickness of the coastal boundary as a drain were used since this resulted in shorter travel times through the valley.
- In order to raise groundwater levels within the northern coastal section of the model to match the groundwater elevations measured in well 3213-06, a zone of low permeability was included in this region of the model. This area corresponds to a relatively high concentration of dikes that outcrop along the shore and near the northern boundary of the simulated groundwater basin.

2.4 Calibration Criteria

During the calibration of the numerical model, values for hydraulic conductivity were varied in five zones, with the range in values and justification for this range presented as follows:

- Shallow valley-filling sediments (L1 to L4). Slug tests from shallow wells indicate values ranging from approximately 0.4 to 23 m/d. This formed the range tested during calibration. However, based on the boring log from MW-5 and the

geologic model, it is inferred that the shallow valley-filling sediments have lower permeability than deeper valley-filling sediments.

- Deep valley-filling sediments (L5, only). A slug test from MW-5 showed a value for hydraulic conductivity of approximately 7 m/d. Based on the boring log from MW-5 and the geologic model, it is inferred that the deeper valley-filling sediments have higher permeability that shallow valley-filling sediments. The range tested was from 7 to 50 m/d.
- Near-shore sediments (occurring in L1 to L5). Slug test indicate values ranging from approximately 0.4 to 23 m/d. This formed the range tested during calibration.
- Basal dike-complex and marginal dike complex basalts underlying the entire model area except near shore on the northern end of the valley, and a wedge trending approximately northwest-southeast beginning at the southern extent of the near-shore sediment outcrop. The value for the northern zones was modified to achieve a head elevation that corresponded to Well 3213-06. The value for the southern region was selected to be consistent with values used by Oki (1999) for the East Molokai dike complex (0.07 m/d); the value of this parameter used in the model had no practical effect on groundwater flow in the center of the valley.
- Recharge was held constant at 4 Mgal/d. Increases in recharge decreased the travel time of constituents to the shore, and decreases in recharge increased the travel time. When recharge was increased to 6 Mgal/d, the travel time to the shore was reduced by approximately 25%, and head values at calibration points moderately increased.

Three calibration points were established for the area based upon the location of existing monitoring and water supply wells in the valley.

- Monitoring well MW-3 is a cluster of monitoring wells located approximately in the center of the valley approximately 250 m from shore. The screened interval for the deepest well, MW-3C, lies within the coastal sediment zone and L4 of the model, and it extends from approximately -24 to -27 m msl. The target groundwater elevation for calibration was approximately 0.9 m (3 ft) msl.
- Well 3213-06 is located approximately 150 m from shore near the northern end of the valley. The screened interval for this well lies within the dike-intruded basalts and L2 of the model and extends from just above sea level to approximately -2.5 m msl. The groundwater elevation for calibration was approximately 2.3 m (7 ft) msl.
- Monitoring well MW-5 is located approximately 2,300 m inland within the approximate center of the model area. This well is located approximately 500 m west of the OB/OD unit. The screened interval for this well lies within the valley sediments and layer L2 of the model and extends from approximately -33 to -38 m msl. The groundwater elevation for calibration was approximately 4.5 m (15 ft) msl.

MW3 and MW-5 were installed as part of the overall environmental investigation of Makua Valley.

2.5 Calibration

During the calibration, recharge was held constant at 4 Mgal/d, based on the estimated annual recharge of 32% of total precipitation (Shade and Nichols, 1996). All simulations for calibration were run to steady state where groundwater elevations ceased changing with respect to time. The following provides a brief discussion of the calibration parameters and the justification for choosing the values ultimately considered as appropriate for the calibrated model. Figure 9 shows the distribution of groundwater elevations over the simulated area.

Dike-complex Basalts. The sensitivity analysis showed that water levels at the calibration points were very sensitive to changes in hydraulic conductivity values for the dike-complex basalts. The sensitivity analysis showed that the values for hydraulic conductivity were towards the lower end of the range presented in Hunt (1996). This is supported by the orientation of the dikes nearly parallel to shore. A hydraulic conductivity of 4 m/d (13 ft/d) was used to represent the dike-complex basalts. This unit was considered to have vertical isotropy, since the presence of vertically oriented dikes creates relatively low horizontal permeability. This parameter was not significantly sensitive to head distribution in the calibration points.

Coastal Sediments. The coastal marine and fluvial sediments are considered to have relatively high permeability compared to the upper layers of the fluvial and alluvial sediments of the valley, while the values of hydraulic conductivity for the coastal and valley sediments worked in concert to have a considerable impact on groundwater levels at the calibration points. During calibration, hydraulic conductivity values were maintained to be at least twice and no more than one order of magnitude the value for the shallow inland valley sediments. In order to get the relatively low groundwater elevations observed in MW-3, hydraulic conductivities had to be relatively high. The value of 25 m/d produced a calibration head of 1.1 m at a distance of 250 m from shore, and this value was considered sufficient for the model calibration where the criteria was 0.9 m.

Terrigenous Valley Sediments. Slug tests from MW-5 showed a value of approximately 7 m/d for the deeper valley sediments. Due to the nature of slug tests, this value was considered to be at the relatively low end of the range of possibilities for this unit. When values close to 7 m/d were used, groundwater levels were too high. The value producing the calibration criterion of 4.5 m occurred using the hydraulic conductivity value of 25 m/d, or a value that was the same as the coastal sediments. The hydraulic conductivity for the shallow valley sediments was lowered to 10 m/d to match the reduction in permeability inferred from the boring log.

Drain Conductance. Drain conductance was distributed over all twelve layers along the shoreline. The sensitivity analysis showed that this parameter value did not greatly affect the simulated inland head levels, and only moderately influenced the near shore simulated heads. A value of 5 m^2/d/m was found to produce groundwater levels close to the calibration criteria.

The results of the calibration indicated that the travel time for contaminants entering the groundwater system at the OB/OD area was approximately 12,000 days (33 years) to flow to shore. This travel time does not consider the time it may take for water or a contaminant to move through the unsaturated zone. Also, this time does not consider retardation and attenuation of a contaminant traveling within the groundwater system. Fine tuning the variations in hydraulic conductivity and conductance did not produce appreciable changes in the simulated travel time.

2.6 Contaminant Transport

Contaminant transport in the valley was simulated in order to evaluate the potential migration of explosives contaminants into the coastal environment. The following assumptions were made during the transport simulations:

- RDX is the only contaminant of concern for transport, as it is the most prevalently detected compound, and it is the only explosives constituent that appears to be mobile based on detections in soil leachate and lysimeter water collected from the OB/OD area in Makua Valley.
- The simulated RDX concentration in recharge was established from the detected concentration measured in lysimeters installed within the OB/OD area. The maximum concentration observed was 6 mg/L and the average measured concentration was 2.55 mg/L. This average concentration was used during simulation of potential impacts from the OB/OD area. A five-acre area of potential contamination was assumes as a practical worst case scenario for the model. In addition, a column numerical model was run to estimate the effects of retardation and attenuation in the vadose zone on contaminant concentrations (see Section 3.9.2 of the hydrogeologic investigation report). These results showed that the concentration of RDX diminished to 6.7% of the surface concentration during downward migration to the underlying groundwater flow system. Therefore, a second scenario was simulated considering the effects of attenuation and retardation which effectively lowered the recharge concentration to 0.16 mg/L (i.e., a concentration that is 6.7% of 2.55 mg/L).
- An area of potential environmental impact to groundwater is the Impact Area, consisting of a 35-acre area lying west of the OBOD area. Tetra Tech (Tom Whitehead, email communication, June, 2003) estimated up to 8 grams of RDX is generated each year from use of explosives in the Impact Area. Based on leachate tests, it would be expected that 43% of the 8 grams, or 3.44 grams, may be mobile in groundwater. Thus, the 3.44 grams of RDX was distributed over the Impact Area through recharge, yielding a recharge concentration for RDX of 0.156 mg/L. A second scenario was simulated considering the effects of attenuation and retardation which effectively lowered the recharge concentration to 0.01 mg/L (i.e., 6.7% of the 0.156 mg/L).
- Transport simulations were run for 18,250 days, or 50 years. This time was selected, in part, because this is approximately the length of time that explosives have been used in Makua Valley.

2.7 Results of Contaminant Transport

The results of the four contaminant transport simulations are shown in Figures 10 to 13 and described as follows:

1. For simulation of the OB/OD area where no retardation or degradation of the contaminant was assumed in the vadose zone (practical worst case scenario), transport simulations show levels of RDX reaching the shore at a maximum concentration of approximately 0.002 mg/L (i.e., approximately 3 times the US EPA Region IX PRG value of 0.00061 mg/L), and a plume width at the shore of approximately 750 meters (i.e., the width where concentrations exceed the PRG). The maximum simulated concentration in the plume was located directly beneath the OB/OD area and was 0.51 mg/L. Figure 10 shows the plume that develops from the 50-year practical worst case simulation of RDX contaminated recharge from the OB/OD Area.
2. For the simulation of the OB/OD area where attenuation and retardation within the vadose zone was applied, a small plume developed that extended slightly more than half-way to the shore. The maximum simulated concentration was 0.01 mg/L, or approximately 15 times the US EPA Region IX PRG value of 0.00061 mg/L. Figure 11 shows the plume that develops in the vicinity of the OB/OD Area from the 50-year simulation that considered the effects of attenuation and retardation during migration of the RDX through the vadose zone. Under this realistic simulation scenario, the simulated plume does not reach the shoreline after 50 years of travel time.
3. For the simulation of the Impact Area where no retardation of the contaminant was assumed in the vadose zone (practical worst case scenario), transport simulations show levels of RDX reaching shore at a maximum concentration of approximately 0.0015 mg/L (i.e., approximately 2.5 times the US EPA Region IX PRG value of 0.00061 mg/L), and a plume width at the shore of approximately 600 meters. The maximum simulated concentration in the plume was observed directly beneath the Impact Area and was 0.013 mg/L. Figure 12 shows the plume that develops from the 50-year practical worst case simulation of RDX contaminated recharge from the Impact Area.
4. For the simulation of the Impact Area where attenuation and retardation within the vadose zone was applied, a very small plume developed that extended no more than one-third the distance from the Impact Area to the shore. The maximum concentration was 0.0012 mg/L, or approximately 2 times the US EPA Region IX PRG value of 0.00061 mg/L. Figure 13 shows the plume that develops in the Impact Area from the 50-year simulation that considered the effects of attenuation and retardation during contaminant migration through the vadose zone.

The assumptions employed during the transport simulations that may affect the overall results are as follows:

- Conservative assumptions were used throughout these simulations in choosing values for hydraulic conductivity and initial concentrations in potentially impacted areas. For example, higher permeabilities were given to the deeper zone

of the terrigenous valley filling sediment (L5) compared to overlying horizons, thus concentrating the flow and hence migration in this horizon. Also, porosity values and specific yield for the sediments were chosen to represent the low end of the expected range for the sediments (i.e., the porosity values were 0.2 and the specific yield values were 0.15).

- All simulations did not consider fully the effects of unsaturated flow within the vadose zone. In all cases, the simulations considered contaminant transport to occur with concentrations starting at the water table. The ground surface at the OB/OD and Impact Areas lie at least 75 m (250 ft) above the water table. The travel time for contaminants to move through this thickness of sediments was not considered for the first scenario from each of the potential source areas. Only in the second of the pair of simulations for each source area are the effects of attenuation and retardation within the vadose zone considered.
- All simulations did not consider attenuation and retardation along the groundwater flow path (i.e., within the saturated groundwater flow system). Consideration of these effects would greatly reduce simulated concentrations and the size of the resultant plume.
- Recharge was held constant at 4 Mgal/d, with the spatial distribution of recharge being based on the work of Shade and Nichols (1996).

2.8 Model Conclusion

The numerical simulation results indicate that there is a possibility for a plume of energetics constituents (i.e. RDX) to develop within the alluvial sediments beneath Makua Valley. However, when the natural effects of attenuation and retardation are considered during contaminant transport through the vadose zone, there is a considerable reduction in the size and concentration of the simulated plume, which results in the plume not reaching the shore. It should also be noted that there has been no direct indication that groundwater in the inland portions of Makua is currently impacted by energetic constituents, or that groundwater reaching the shore has ever contained measurable levels of RDX or other energetic constituents. The numerical simulations suggest that the contaminant plume that would be generated if the energetic compounds were to reach the deep groundwater system underlying the OB/OD and Impact Areas would be detected at the array of monitoring wells installed during this investigation prior to reaching the shoreline.

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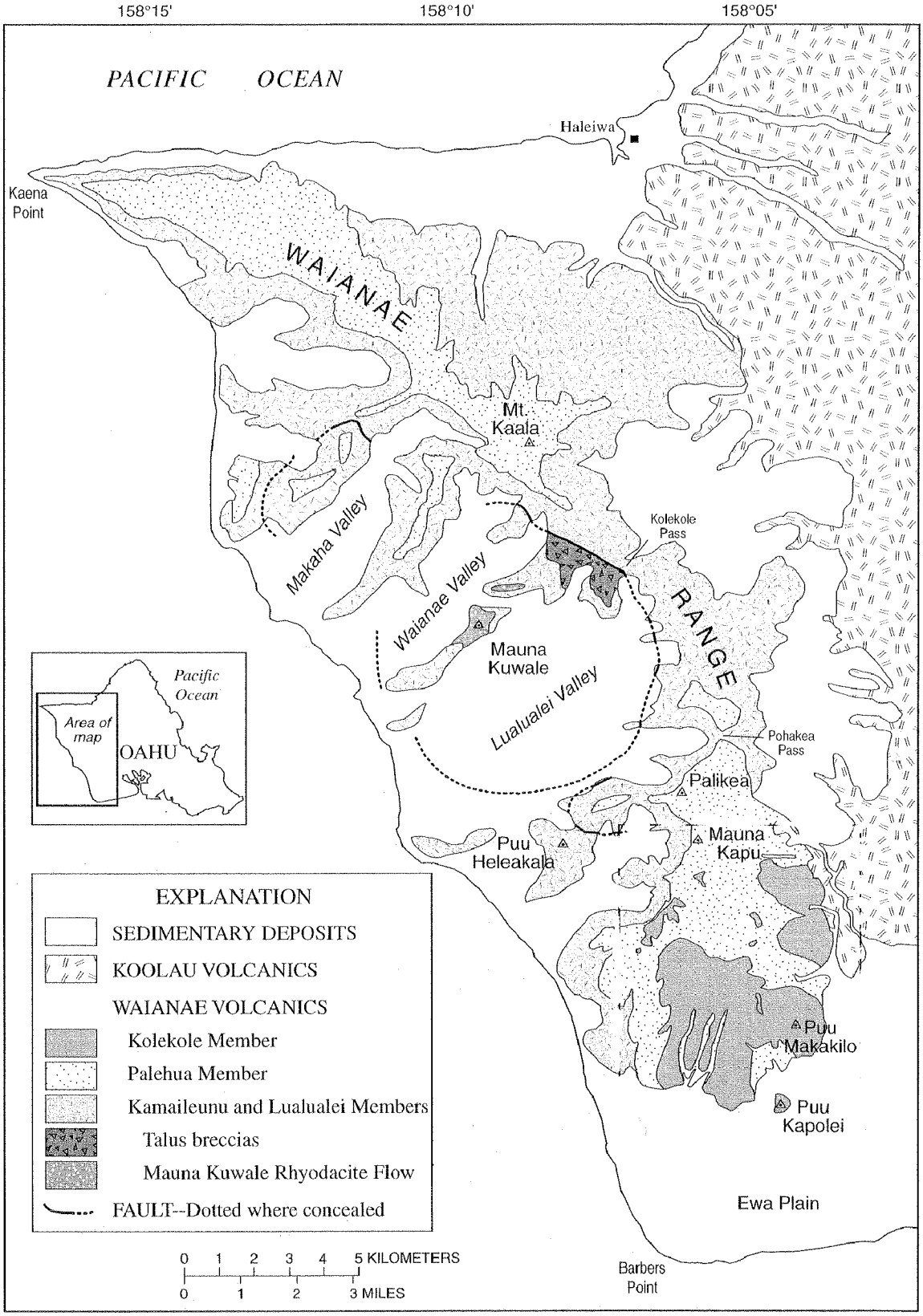

ENVIRONET, INC. PRESERVING EARTH'S RESOURCES FOR THE FUTURE	Project No: P02-008	MAKUA VALLEY TECHNICAL STUDIES
	Drawn By: E.D.	GEOLOGY MAP OF WAIANAE VOLCANO
	Ref:	FIGURE 1

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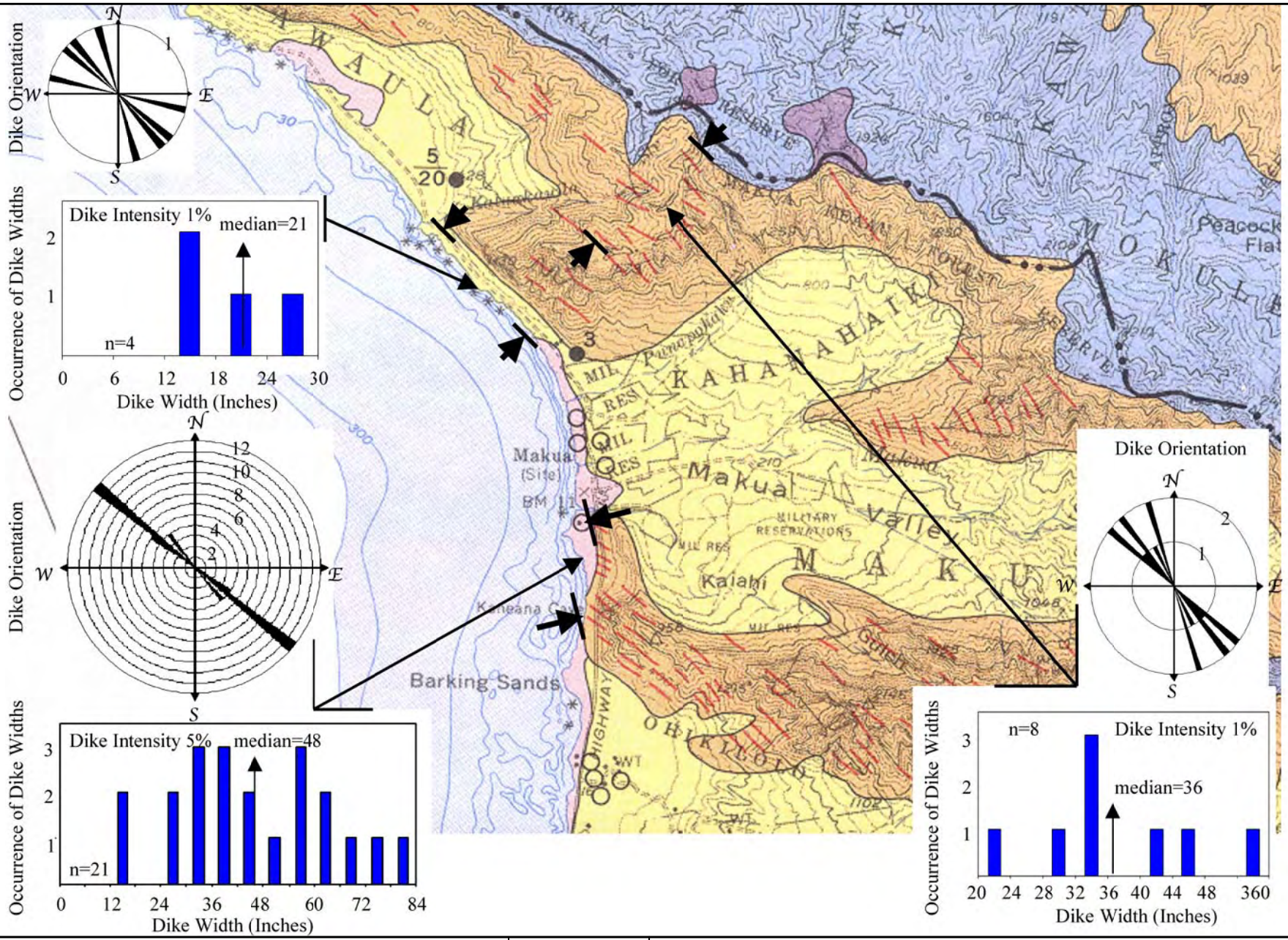

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Project No: P02-008	MAKUA VALLEY TECHNICAL STUDIES
Drawn By: E.D.	STRIKE, WIDTH, AND INTENSITY OF DIKES MEASURED IN OUTCROPS NORTH AND SOUTH OF MAKUA VALLEY
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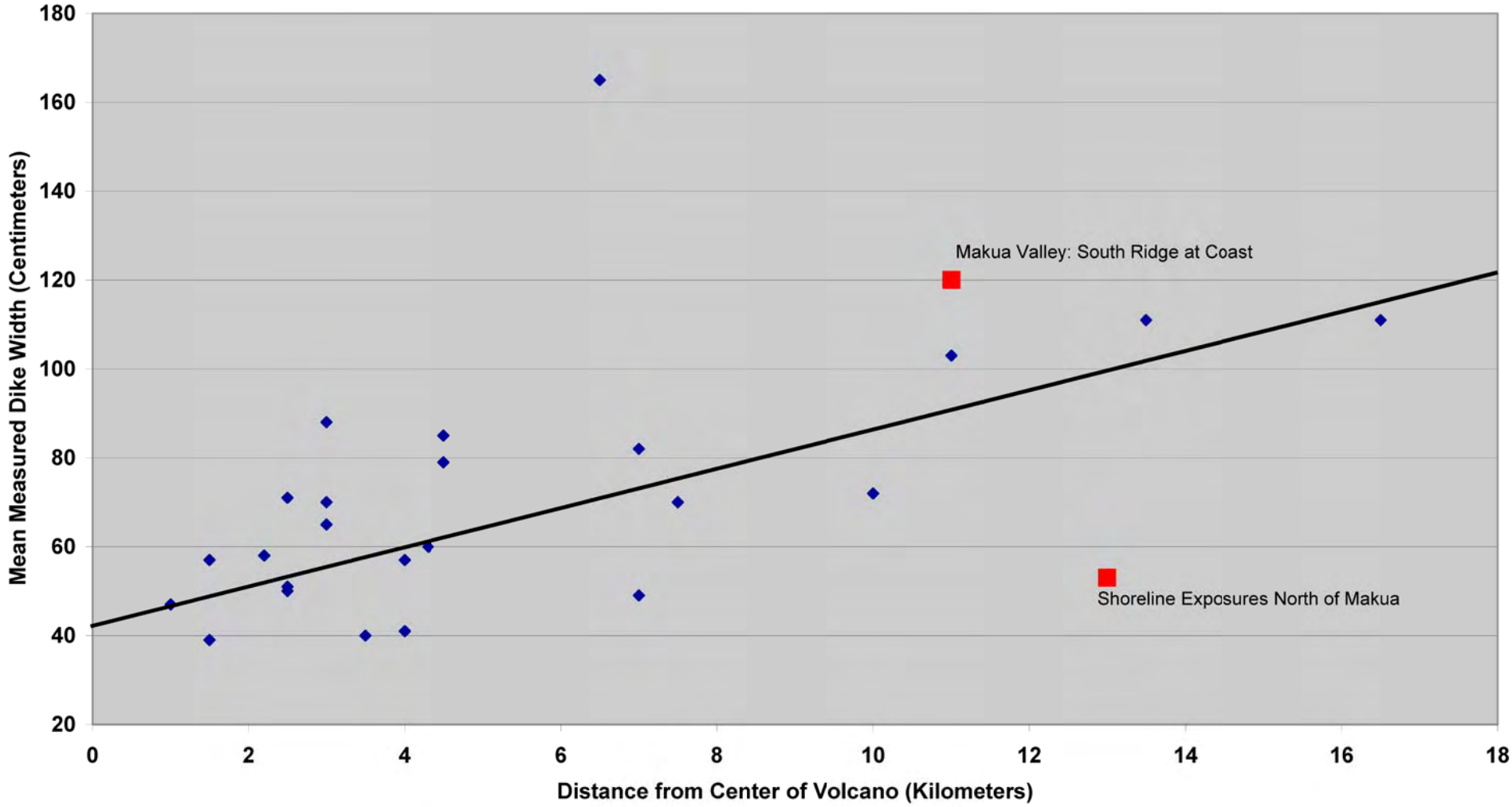

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Project No: P02-008	MAKUA VALLEY TECHNICAL STUDIES	
Drawn By: E.D.	VARIATION OF MEAN DIKE WIDTH WITH DISTANCE FROM CENTER OF WAIANAE VOLCANO	FIGURE 3
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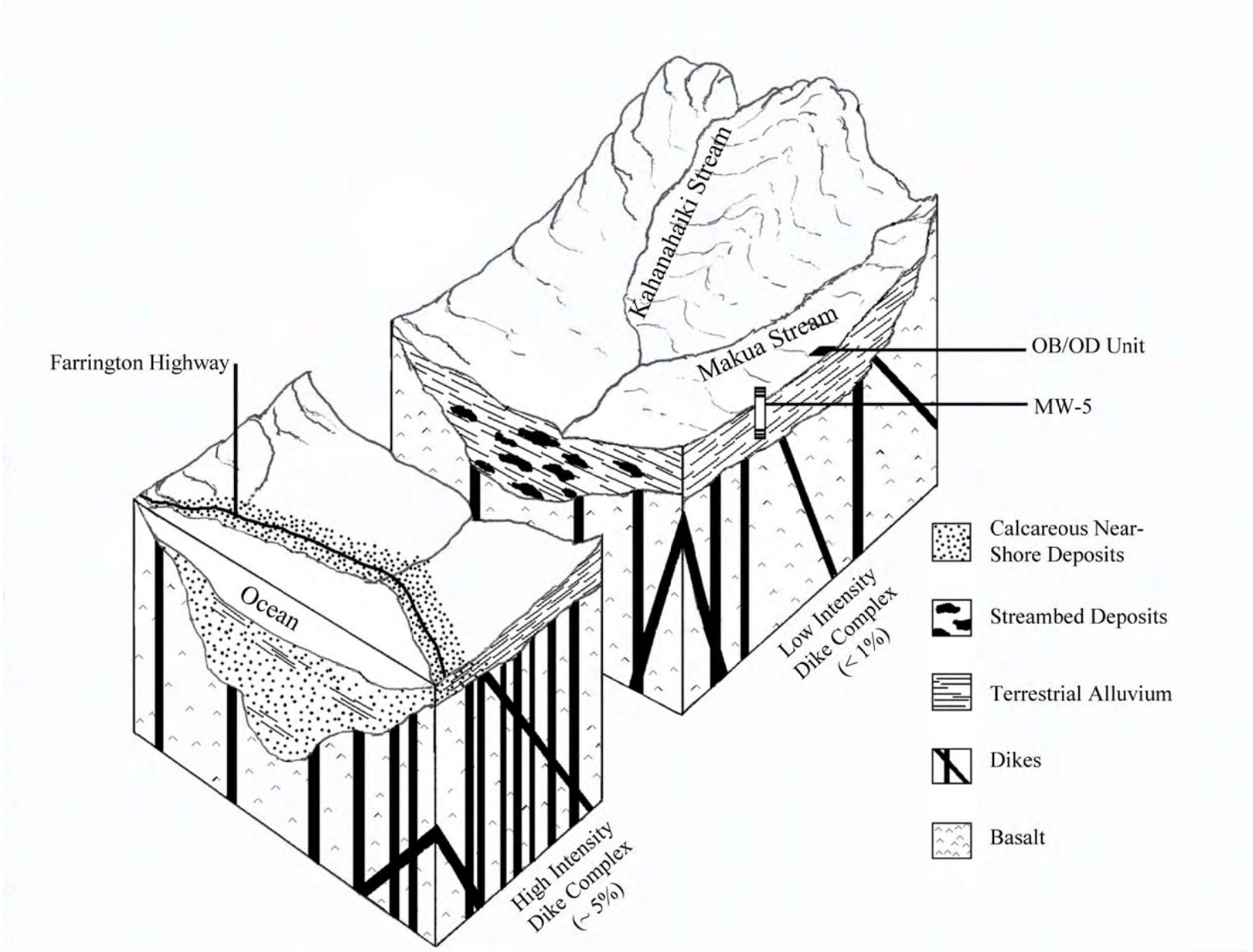

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Project No: P02-008	MAKUA VALLEY TECHNICAL STUDIES	
Drawn By: E.D.	BLOCK DIAGRAM DEPICTING THE SUB-SURFACE GEOLOGY BENEATH MAKUA VALLEY	FIGURE 4
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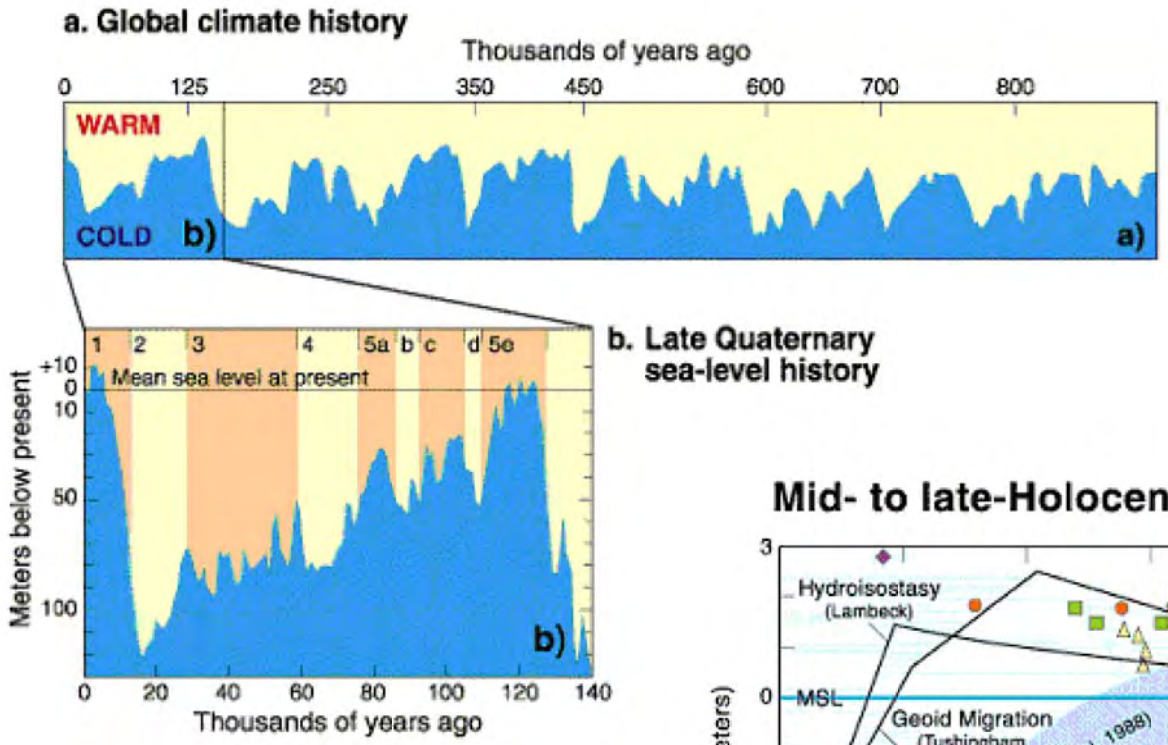

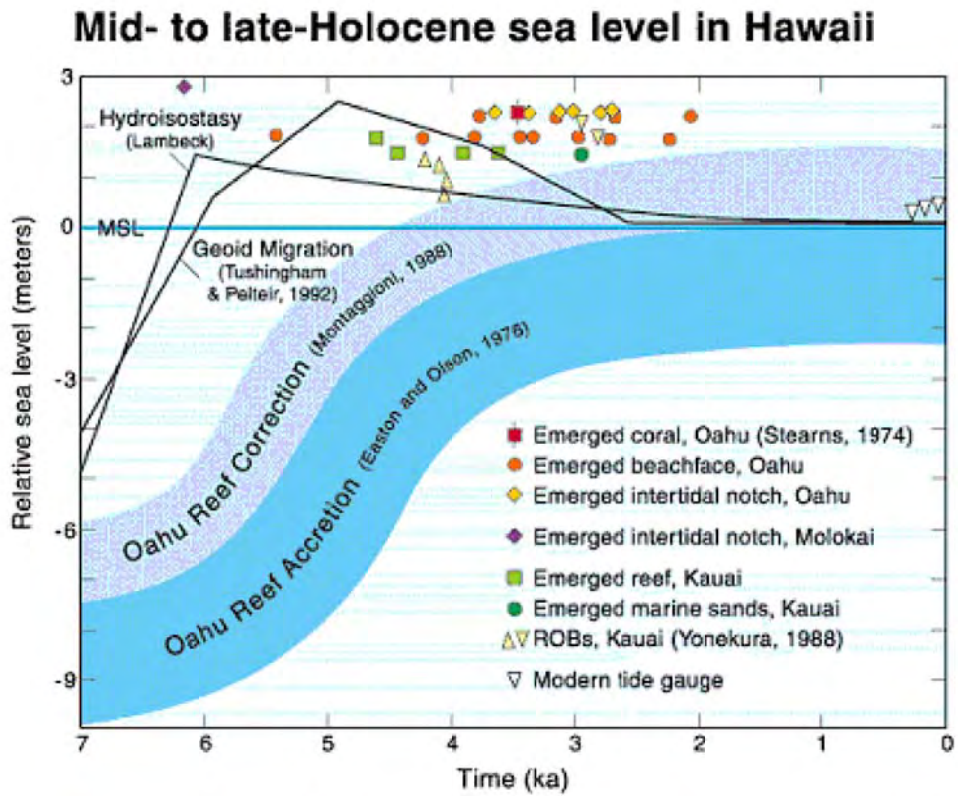

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Project No: P02-008	MAKUA VALLEY TECHNICAL STUDIES
Drawn By: E.D.	SEA LEVEL CHANGES OVER HOLOCENE AND QUATERNARY PERIODS IN THE PACIFIC
Ref: GROSSMAN ETAL,1998	FIGURE 5

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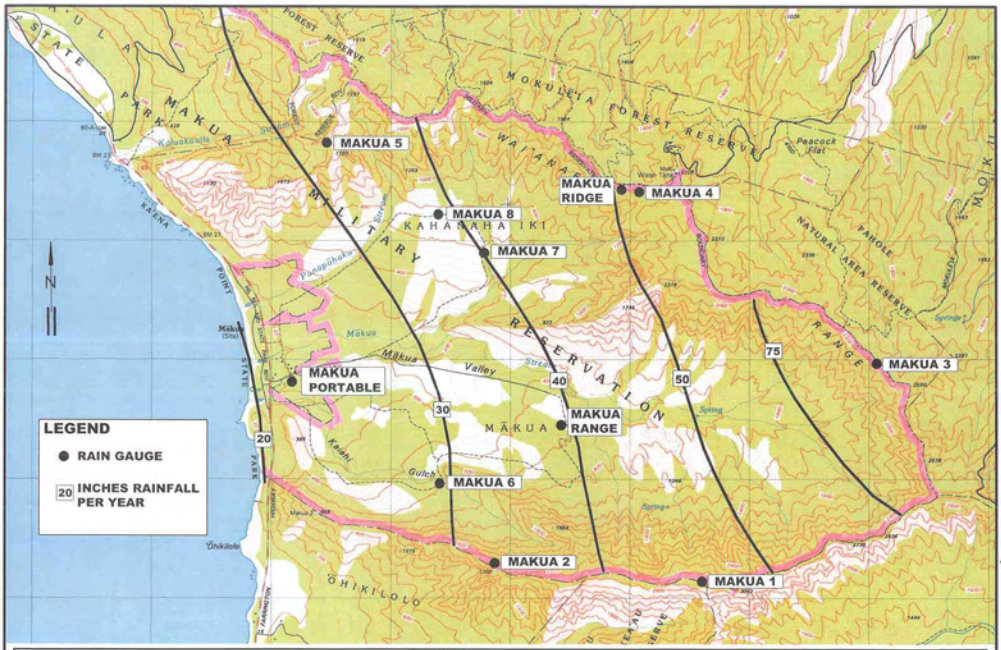

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PROJECT NO.:	P02-008
DRAWN BY:	CW
REFERENCE:	TAKASAKI 1971

MAKUA VALLEY GROUNDWATER MODEL

MEAN ANNUAL RAINFALL IN INCHES
WAIANAE COAST, HAWAII, USA

FIGURE 6

Y:\P02\P02-008 Makua Valley Technical Review\Drawings\FIGURE 6.dwg
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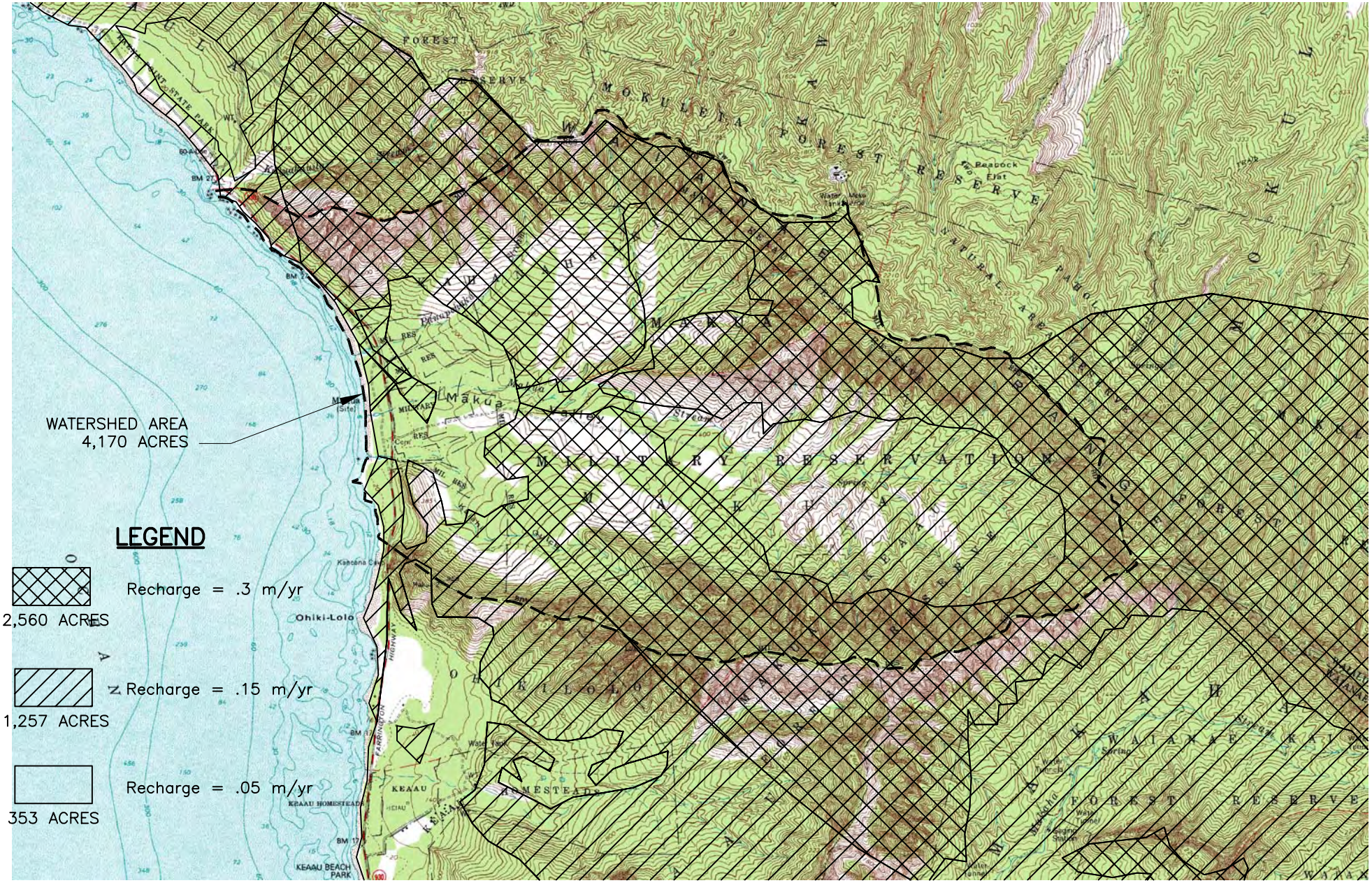

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MAKUA VALLEY

RECHARGE DISTRIBUTION FOR MODELED AREA

REF: SHADE AND NICHOLS, 1996

FIGURE 7

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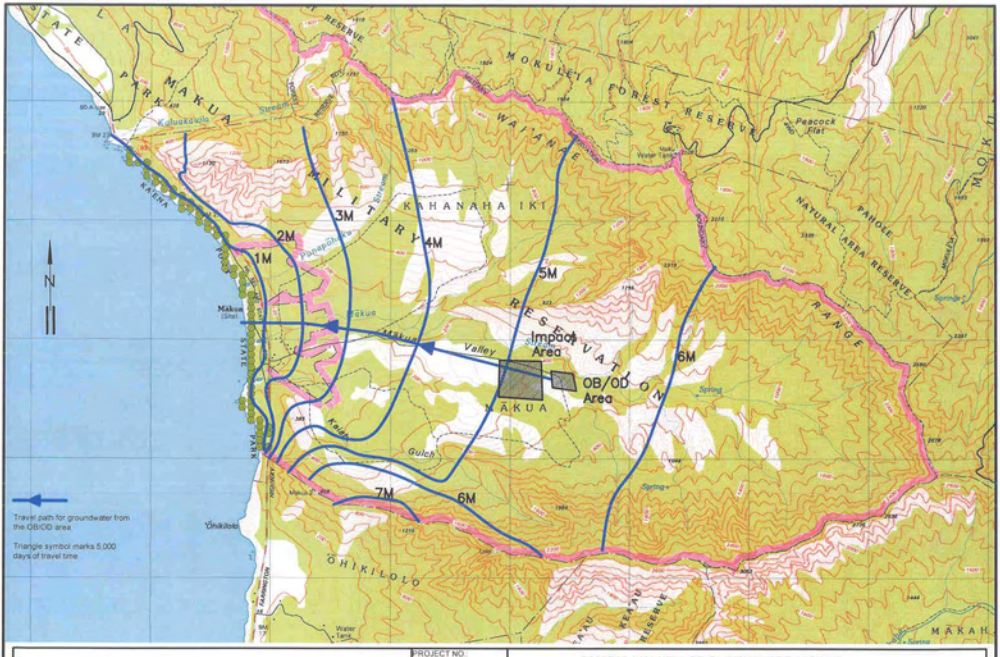

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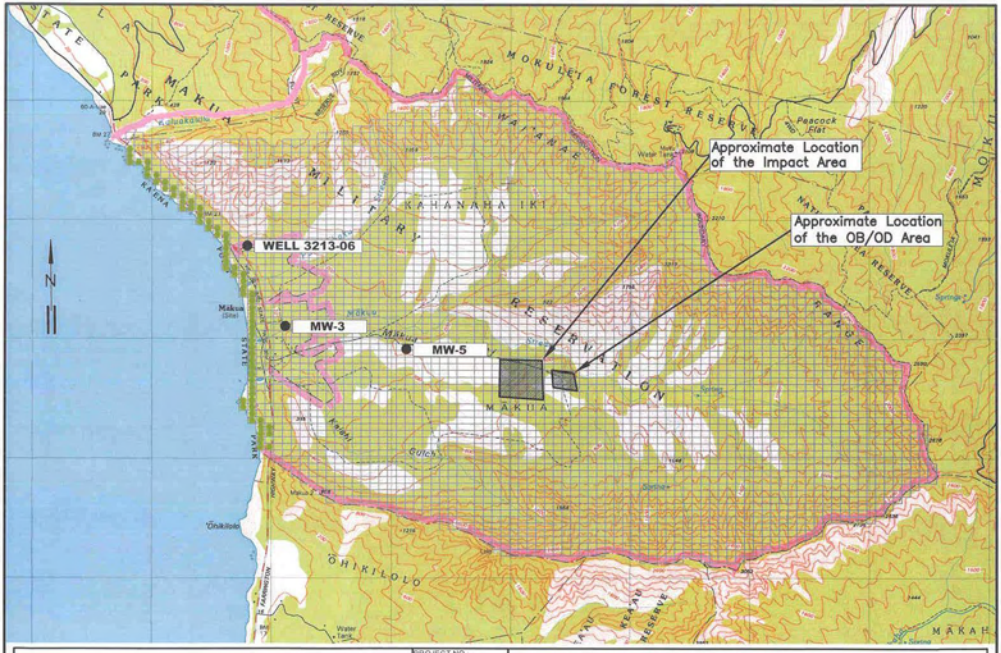
PROJECT NO.	MAKUA VALLEY GROUNDWATER MODEL	
P02-008		
DRAWN BY: GCL	SIMULATED GROUNDWATER ELEVATION CONTOURS FOR MAKUA VALLEY	FIGURE 9
SCALE: Not To Scale		

x:\P02\P02-008 Makua Valley Technical Studies\Drawings\FIG9STA.dwg
Oct 30, 2003 - 2:42PM



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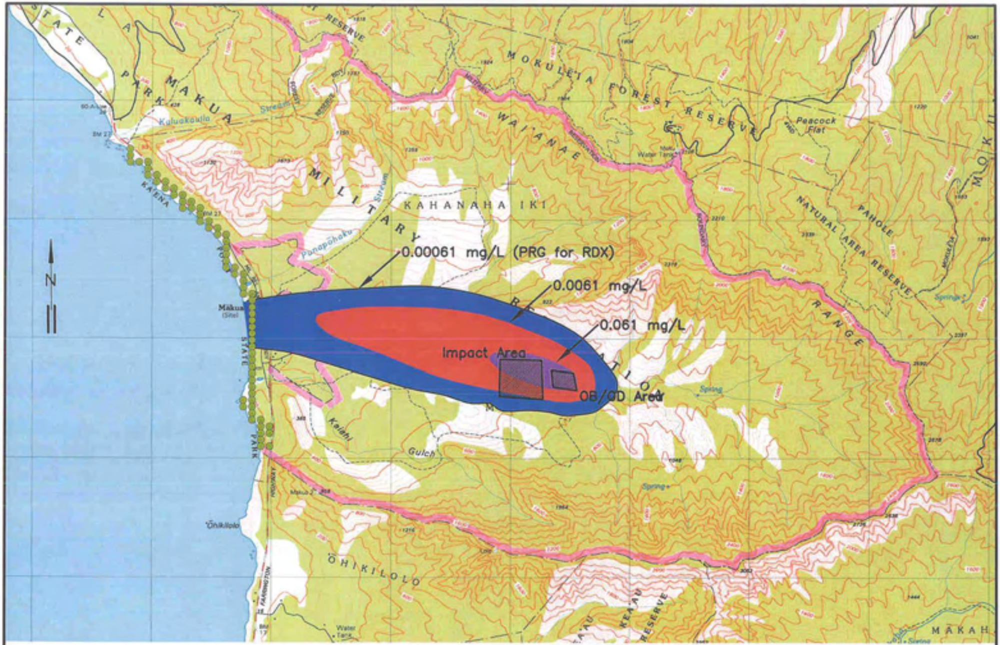
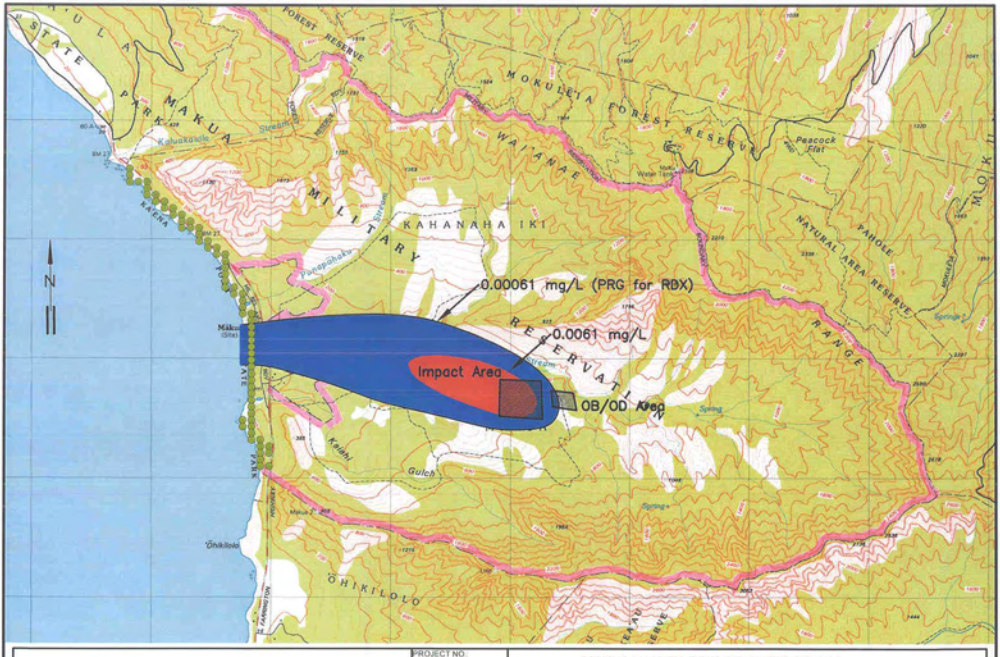
PROJECT NO.: P02-008	MAKUA VALLEY GROUNDWATER MODEL	
DRAWN BY: GCL	ACTIVE GRID AREA AND LOCATION OF CALIBRATION POINTS FOR MAKUA VALLEY GROUNDWATER MODEL	FIGURE 8
SCALE: NOT TO SCALE		

Y:\P102\P02-008 Makua Valley Technical Studies\Drawings\FIG-008.dwg
Oct 30, 2003 - 3:47PM



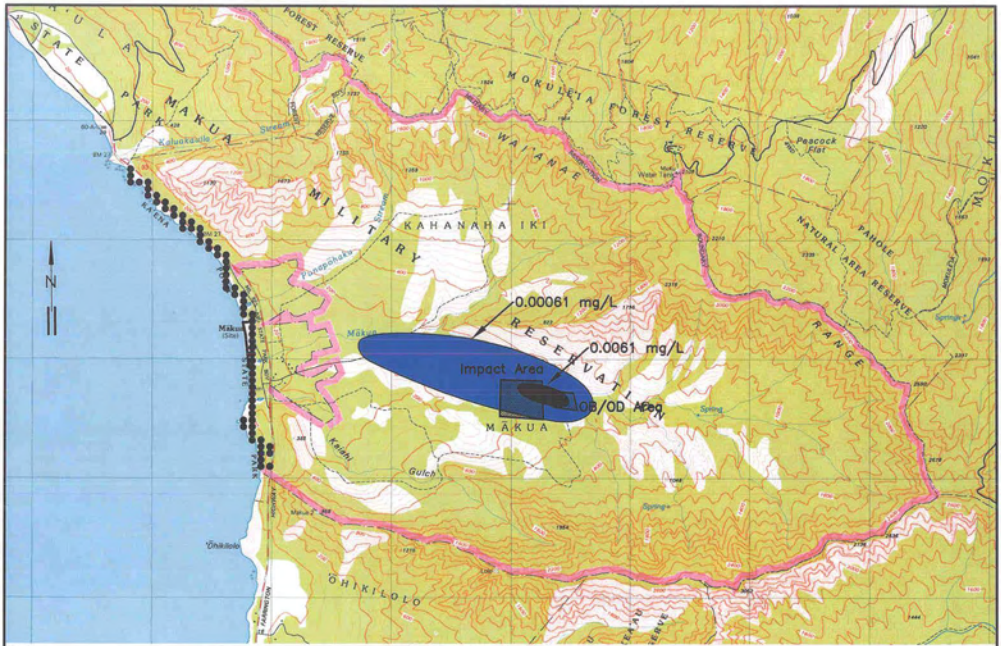
ENVIRONET, INC. PRESERVING EARTH'S RESOURCES FOR THE FUTURE	PROJECT NO: P02-008	MAKUA VALLEY GROUNDWATER MODEL	
	DRAWN BY: GCL	EXTENT OF GROUNDWATER PLUME FROM RECHARGE OF THE RDX OVER THE OB/OD AREA, NATURAL ATTENUATION AND RETARDATION NOT SIMULATED - 50 YEAR SIMULATION	FIGURE 10
	SCALE: Not To Scale		



ENVIRONET, INC.
PRESERVING EARTH'S RESOURCES FOR THE FUTURE

PROJECT NO:	MAKUA VALLEY GROUNDWATER MODEL	
P02-008		
DRAWN BY: GCL	EXTENT OF GROUNDWATER PLUME FROM RECHARGE OF THE RDX OVER THE IMPACT AREA, NATURAL ATTENUATION AND RETARDATION NOT SIMULATED - 50 YEAR SIMULATION	FIGURE 12
SCALE: Not To Scale		

J:\P02\P02-008 Makua Valley Technical Studies\Drawings\FIGURE 12.dwg
Oct 30, 2003 - 7:28pm



ENVIRONET, INC.
PRESERVING EARTH'S RESOURCES FOR THE FUTURE

PROJECT NO.: P02-008	MAKUA VALLEY GROUNDWATER MODEL	
DRAWN BY: GCL	EXTENT OF GROUNDWATER PLUME FROM RECHARGE OF THE RDX OVER THE OB/OD AREA, NATURAL ATTENUATION AND RETARDATION SIMULATED - 50 YEAR SIMULATION	FIGURE 11
SCALE: Not To Scale		

Y:\P02\P02-008 Makua Valley Technical Studies\Drawings\FIG#8 11.dwg
Oct 30, 2003 - 2:33pm

ENVIRONET, INC.
PRESERVING EARTH'S RESOURCES FOR THE FUTURE

PROJECT NO. P02-008	MAKUA VALLEY GROUNDWATER MODEL	
DRAWN BY: GCL	EXTENT OF GROUNDWATER PLUME FROM RECHARGE OF THE RDX OVER THE IMPACT AREA, NATURAL ATTENUATION AND RETARDATION SIMULATED - 50 YEAR SIMULATION	FIGURE 13
SCALE: Not To Scale		

Y:\P02-008 Makua Valley Technical Studies\Drawing\FIGURE 13.dwg
Nov 05, 2003 - 2:27PM

APPENDIX H-2

Groundwater Modeling with SEAWAT

1 APPENDIX H-2 Groundwater Modeling with SEAWAT

The original project workplan called for running numerical simulations for Makua Valley using a density-dependent code that would allow the transition from freshwater to seawater within the aquifer system to be simulated. Initial attempts to simulate the three dimensional flow of groundwater within Makua using the USGS code SEAWAT failed due to persistent numerical instabilities. As a result, the fate and transport analysis performed in the draft EIS document utilized the non-density dependent numerical codes MODFLOW and MT3D to simulate groundwater flow and contaminant migration within the valley. As a result of reviewers comments to the draft EIS, we have performed additional numerical simulations using the SEAWAT code. Instead of attempting to perform full three-dimensional simulations, groundwater flow within a representative cross section that extended from the back of the valley to two kilometers offshore and which ran through the OB/OD area was simulated using the code (Figure 1). The results of these density-dependent simulations are discussed in the following sections.

1.1 Cross-Sectional Model Construction

A cross-sectional model of Makua Valley was constructed to simulate the lateral and vertical flow field within the aquifer. The cross-sectional model used the three-dimensional finite-difference code SEAWAT-2000 (Langevin et al., 2003). The SEAWAT model was designed to simulate variable-density groundwater flow and solute transport in three dimensions. SEAWAT-2000 was designed by combining a modified version of the flow model MODFLOW-2000 and the transport model MT3DMS into a single computer program. Visual MODFLOW v.4.1 was used to construct the model mesh and served as a graphical pre-processor that interfaced with the SEAWAT model. The model was run in two dimensions by restricting the model to a single row. This allowed multiple simulations utilizing various combinations of hydraulic parameters and recharge values to be completed in a reasonable period of time. The initial set of hydraulic and recharge parameters utilized were the same as used in the MODFLOW/MT3D simulations reported in the draft EIS and are shown in Figure 2.

The two-dimensional model simulated the behavior of the basal aquifer beneath Makua Valley, which extends roughly 6.5 kilometers inland from the coast to the crest of the

Waianae range. The cross-sectional model was extended to run offshore two kilometers. Recharge was added to the top of the model using the distribution calculated by Shade and Nichols (1996) (see Figure 7 of original modeling report). All recharge to the model was assumed to have a concentration of 10 mg/L chloride.

1.1.1 Model Mesh

The finite-difference mesh used in the two-dimensional model is 8,500 meters long and 600 meters deep and consists of 5,100 cells. The typical grid cell was 100 meter long, 10 meter high and 10 meter wide. The mesh extends two kilometers off-shore and 6,500 meters inland.

1.1.2 Boundary Conditions

The on-shore perimeter of the active mesh was considered a no-flow boundary. The aquifer bottom was also treated as a no-flow boundary and was set at 600 meters depth. The aquifer bottom was deep enough to include the entire freshwater-lens thickness throughout the model. The top of the model was set at 0 meters elevation to assure that all of the cells in the model remained saturated. The profile of the contact between the aquifer and the Pacific Ocean was based upon bathymetric contours provided in the 7.5-minute United States Geological Survey map of the Makua/Kaena Point area.

The cells corresponding to ocean water were treated as river cells. Each ocean cell was assigned a constant concentration of 19,000 mg/L chloride, a river/ocean “stage” of 0 meters, a stream bed bottom elevation of -20 meters (top two layers were assigned a bottom elevation of -9 meters), and an overall conductance of 10,000 m^2/day. The conductance value was adjusted between values of 0.01 to 50,000 m^2/day during the simulations to match the head levels measured in near-shore wells. Simulations were also run where the offshore ocean/land contact was simulated as a constant head (0 meters) and constant concentration (19,000 mg/L) boundary. The use of these two different coastal boundary conditions resulted in only minor differences in simulated head and concentration in the immediate vicinity of the shoreline when a river layer conductance value of greater than 500 m^2/day was used.

1.1.3 Model Zones

The same spatial distribution of hydraulic properties used in the original MODFLOW/MT3D simulations was used in this model. The modeled zones correspond to terrigenous valley sediments, calcareous coastal sediments, dike complex basalts and marginal dike complex basalts. The terrigenous valley sediments were subdivided into a lower permeability upper unit and a higher permeability lower unit. Figure 2 shows the distribution of the various hydrologic zones used in the model.

1.1.4 Recharge

Recharge was applied to the model from the top layer. The lateral distribution of recharge applied to the model was taken from the USGS water budget analysis performed for the island of Oahu by Shade and Nichols (1996) as well as on Takasaki's rainfall distribution in the area (Takasaki, 1971). Three recharge rates were applied to the area with the high recharge areas being assigned a value of 0.3 m/year, the medium recharge area being assigned a value of 0.15 m/year and the low recharge area being assigned a value of 0.05 m/year (Figure 2).

1.1.5 Hydraulic Characteristics Used in Model

The following set of hydraulic parameters was initially evaluated in the cross-sectional model:

- Coastal Sediments = $K_x = K_y = 25$ m/day; $K_z = 2.5$ m/day
- Valley Sediments (Shallow) = $K_x = K_y = 10$ m/day; $K_z = 1$ m/day
- Valley Sediments (Deeper) = $K_x = K_y = 25$ m/day; $K_z = 2.5$ m/day
- Marginal Dike Zone Basalt = $K_x = K_y = 3.5$ m/day; $K_z = 3.5$ m/day
- Dike Zone Basalt = $K_x = K_y = 0.1$ m/day; $K_z = 0.1$ m/day
- Longitudinal Dispersivity = 25 m
- Horizontal/Longitudinal Dispersivity = 0.1
- Vertical/Longitudinal Dispersivity = 0.1

These parameters were the same parameters that were used in the three dimensional MODFLOW/MT3D model constructed for the valley for the draft EIS. Slight differences

in simulated heads from those obtained by the MODFLOW model were expected for the following reasons: 1) in the vicinity of the coastline different boundary conditions were employed (the MODFLOW model terminated at the coast at a drain while the SEAWAT model extends two kilometers offshore); 2) the MODFLOW model was a three dimensional model while the SEAWAT simulation was run as a two-dimensional cross sectional model; and 3) the SEAWAT model simulates the movement of groundwater resulting from the difference in densities of freshwater and saltwater.

1.1.6 Simulated Development of Freshwater Lens in Makua Valley

The SEAWAT model was run until a steady-state basal lens developed within the aquifer from recharge with 10 mg/L chloride being applied to an initially salt filled aquifer (19,000 mg/L chloride). Hydraulic head and salinity levels stabilized after roughly 100,000 days of simulation time. The steady state model was run for 150,000 days to generate initial head and chloride files to "hot-start" the transient simulations that evaluated the travel time for particles released from the vicinity of the OB/OD unit (located 2,500 meters inland) to reach the shoreline.

When the hydraulic/recharge parameters used in the original MODFLOW/MT3D model were input into SEAWAT, a simulated head of 1.1 meters at 300 meters inland and 3.3 meters 2,200 meters inland from the shoreline were generated. The simulated head in the vicinity of the shoreline (300 meters) was close to the measured value of 1.0 meters in near-shore monitoring wells installed on the Makua Military Reservation during the sampling investigation conducted for the EIS but significantly lower than the head measured in monitoring well MW-5 (4.6 meters) located 2,200 meters inland. The simulated travel time for a conservative particle released from the OB/OD area (2,500 meters inland) to reach the shoreline was greater than 100 years using the same parameters as used in the original EIS model. Figure 3 shows the fresh water lens that developed along with the travel path taken by a particle released from the OB/OD area for this set of recharge and aquifer hydraulic properties.

In order to more closely match the simulated head with the measured head at MW-5, the recharge to the model was increased until the simulated head at 2,200 meters inland from the shoreline reached 4.6 meters. The overall recharge to the model was increased by

50% to increase the inland heads to 4.6 meters. This also led to an elevated simulated head of 1.3 meters at a point 300 meters inland from the shoreline (i.e. greater than the 1.0 meter water level measured). This simulation result was used as the base-case simulation which was used to compare the effect of changing various hydraulic parameters on simulated travel times.

The base-case simulation resulted in a travel time of 90 years from the OB/OD area to the shoreline (Figure 4). The effect of decreasing/increasing the hydraulic conductivity, decreasing/increasing the anisotropy and decreasing the porosity/specific yield of the shallow valley sediments on the simulated travel times of particles released from the OB/OD unit are compiled in Table 1 and depicted in Figures 5 to 7. These alternative simulations resulted in travel times ranging from 45 to greater than 100 years for a conservative particle to travel from the OB/OD area to the shoreline. As the hydraulic conductivity of the upper valley sediments is reduced, the released particle tends to travel in a more downward direction in order to reach the underlying higher conductivity layer associated with the lower valley sediments. The high K simulation depicted in Figure 5 shows the travel path resulting from assigning the same hydraulic conductivity to the upper and lower valley sediments. Increasing the anisotropy of the hydraulic conductivity of the upper valley sediments leads to the released particle traveling in a more horizontal direction. Reduction of the porosity of the upper valley sediments from 0.2 to 0.1 and the specific yield from 0.15 to 0.07 resulted in the simulated travel time being reduced by half (from 90 to 45 years).

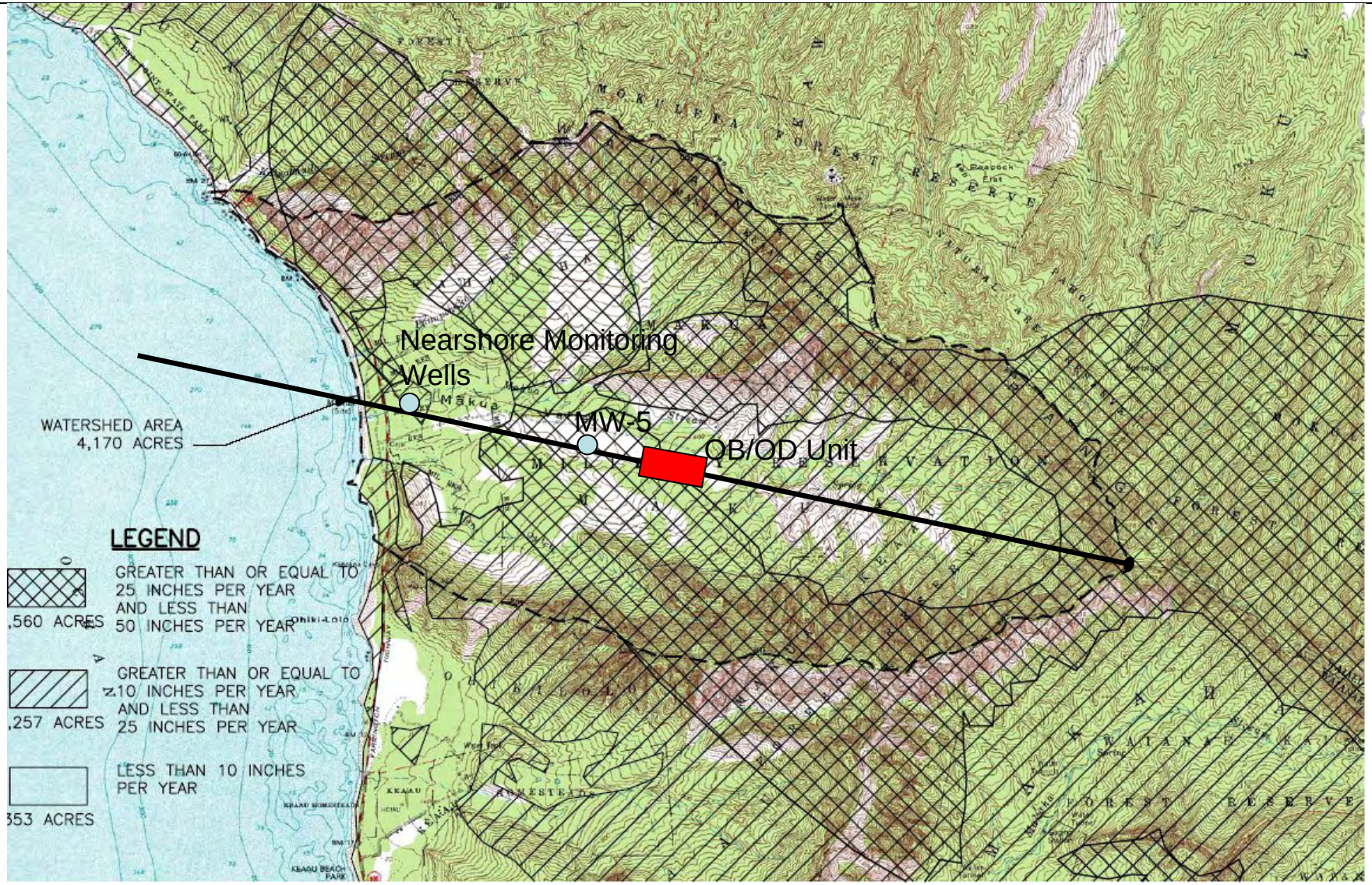
Table 1: Simulated Travel Times Resulting from Changing Hydraulic Conductivity of Shallow Valley Sediment

Shallow Valley Sediment Parameter Adjusted	Travel Time (Year)	Hydraulic Property of Shallow Valley Sediment				
		K_x	K_y	K_z	S_y	Porosity
Base Case	90	10	10	1	0.15	0.2
High Conductivity	63	25	25	2.5	0.15	0.2
Low Conductivity	>100	5	5	0.5	0.15	0.2
No Anisotropy	93	10	10	10	0.15	0.2
High Anisotropy	79	10	10	0.1	0.15	0.2
Decrease Porosity	45	10	10	1	0.07	0.1

1.1.7 Simulated Migration of RDX Plume

The stable freshwater lens developed using the base-case hydraulic/recharge parameters was used as initial head/concentration conditions for a 100-year simulation of RDX migration from the OB/OD area. These simulations assumed that 0.16 mg/L RDX continuously entered the water table in a 100-meter wide (4,300 to 4,400 meters in the model grid) area associated with the OB/OD area at a flux rate of 0.00082 m/day. The RDX concentration used in this simulation was the same value assumed in the previous MODFLOW/MT3D simulations performed for Makua Valley. These concentration and flux estimates are very conservative and likely greatly overestimate the actual amount of RDX likely to enter the groundwater system beneath the OB/OD area. For instance, the Draft Environmental Impact Statement prepared for Makua estimates that 8 grams per year of RDX residue would be generated in near-surface soils within the Company Combined-Areas Assault Course at Makua as a result of live-fire exercises. In comparison, this modeling simulation assumes that approximately 47.9 grams of RDX per year enter the aquifer system in the vicinity of the OB/OD area.

No retardation of the RDX was assumed during the simulation. Figures 8 and 9 show the RDX plume simulated to develop from the OB/OD area source. The simulation indicates that RDX would reach the shoreline at a concentration equal to the tap water preliminary remediation goal (0.61 µg/L) after roughly 50 years of travel within the aquifer due to the effects of dispersion. However, the high concentration (>0.4 µg/L) portion of the plume is simulated to have only migrated roughly 500 meters down-gradient of the OB/OD source area after 100 years. Again, this is a worse case scenario that is simulated to provide information on what the plume might look like should it reach off-site receptors. A review of this simulation also suggests that the wells installed within the valley in conjunction with preparation of the EIS would have detected RDX had this compound reached the aquifer beneath the OB/OD area at the concentrations and flux rates assumed in the model.



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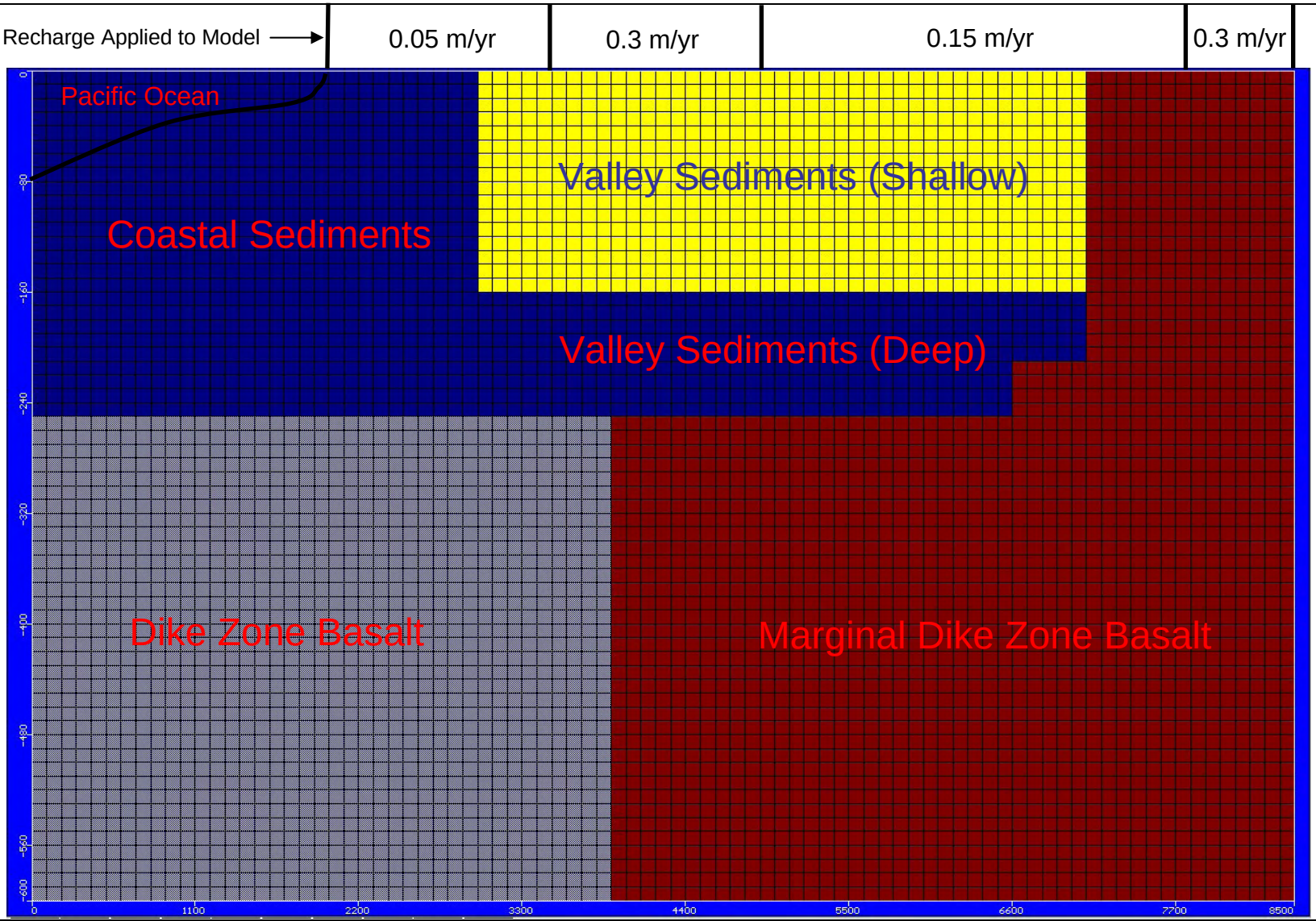
Project Number:	MAKUA VALLEY MODELING STUDY	
Drawn by:	Orientation of Cross-Section Across Makua Valley that was Modeled Using SEAWAT	Figure 1
Reference:		



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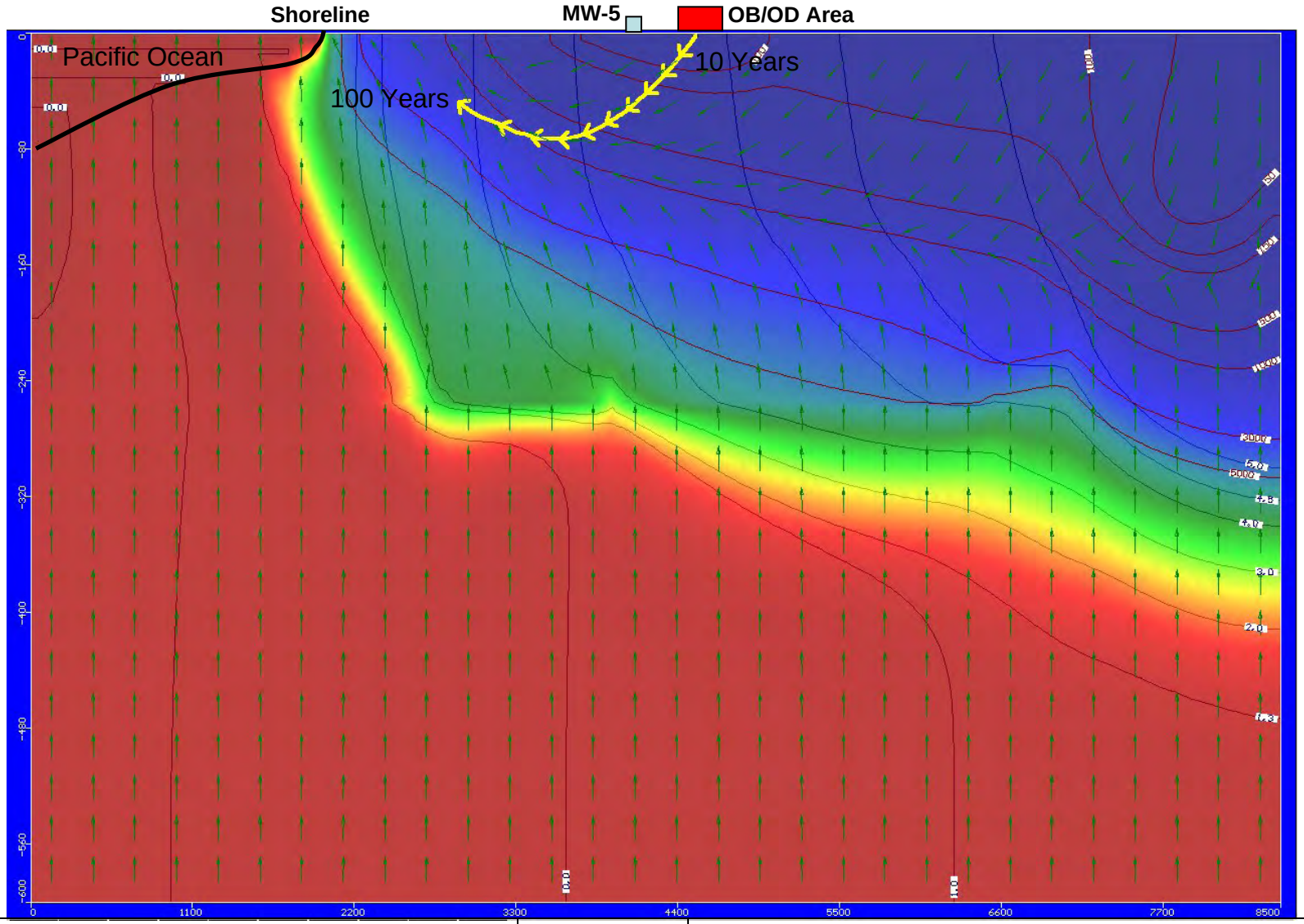
Project Number:	MAKUA VALLEY MODELING STUDY	
Drawn by:	Model Zones Used in Cross Sectional SEAWAT Simulations	Figure 2
Reference:		



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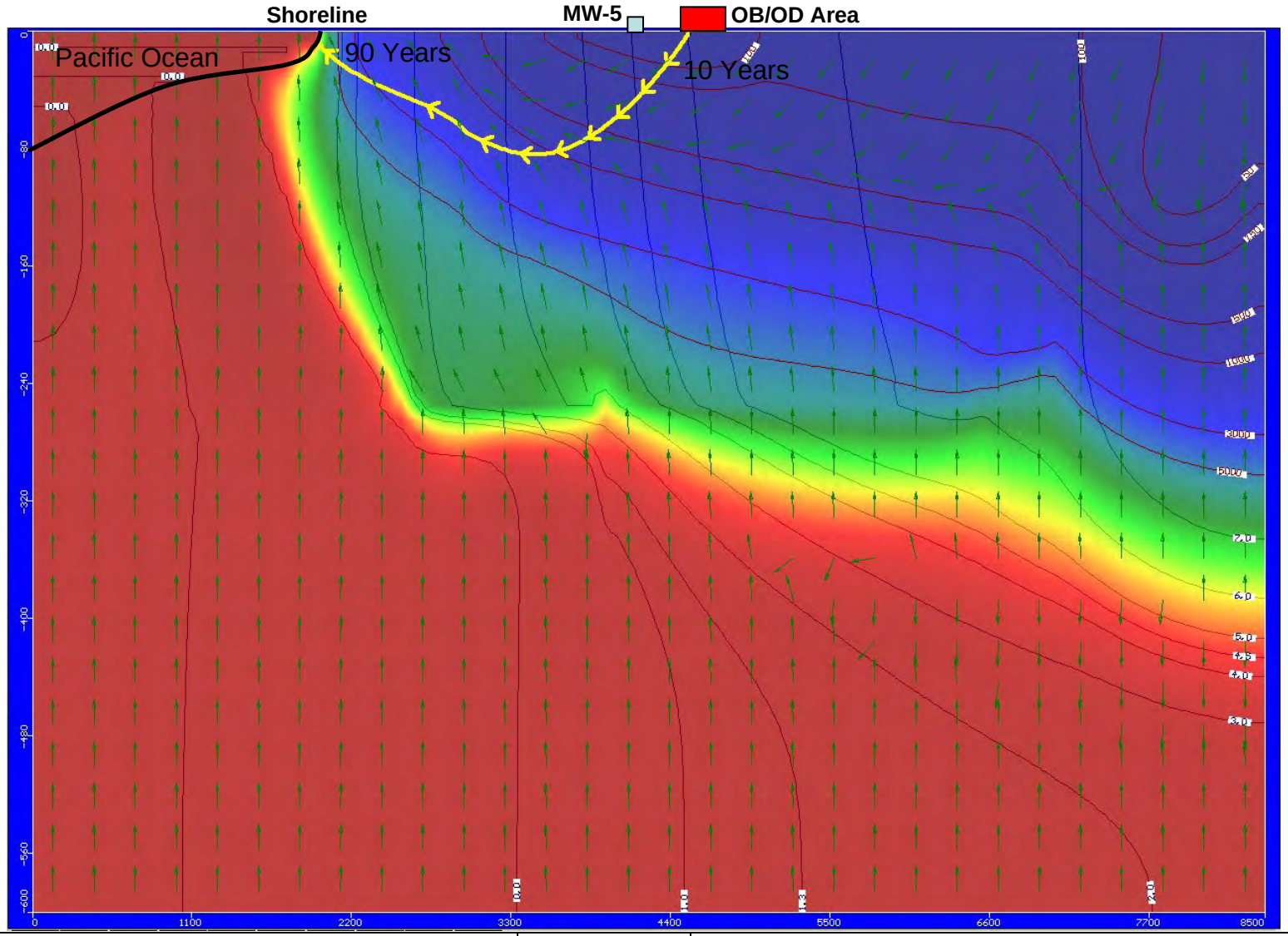
Project Number:	MAKUA VALLEY MODELING STUDY	
Drawn by:	Simulated Flow Field With Recharge Used in the MODFLOW/MT3D Model	Figure 3
Reference:		



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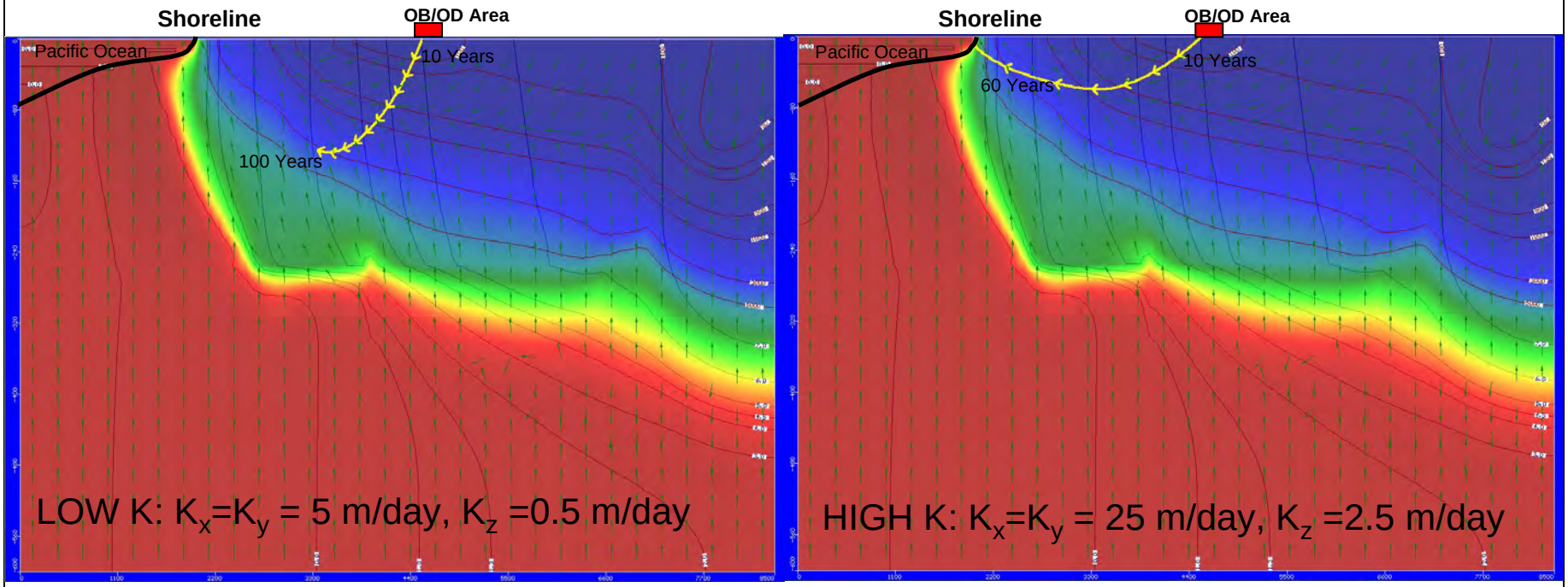
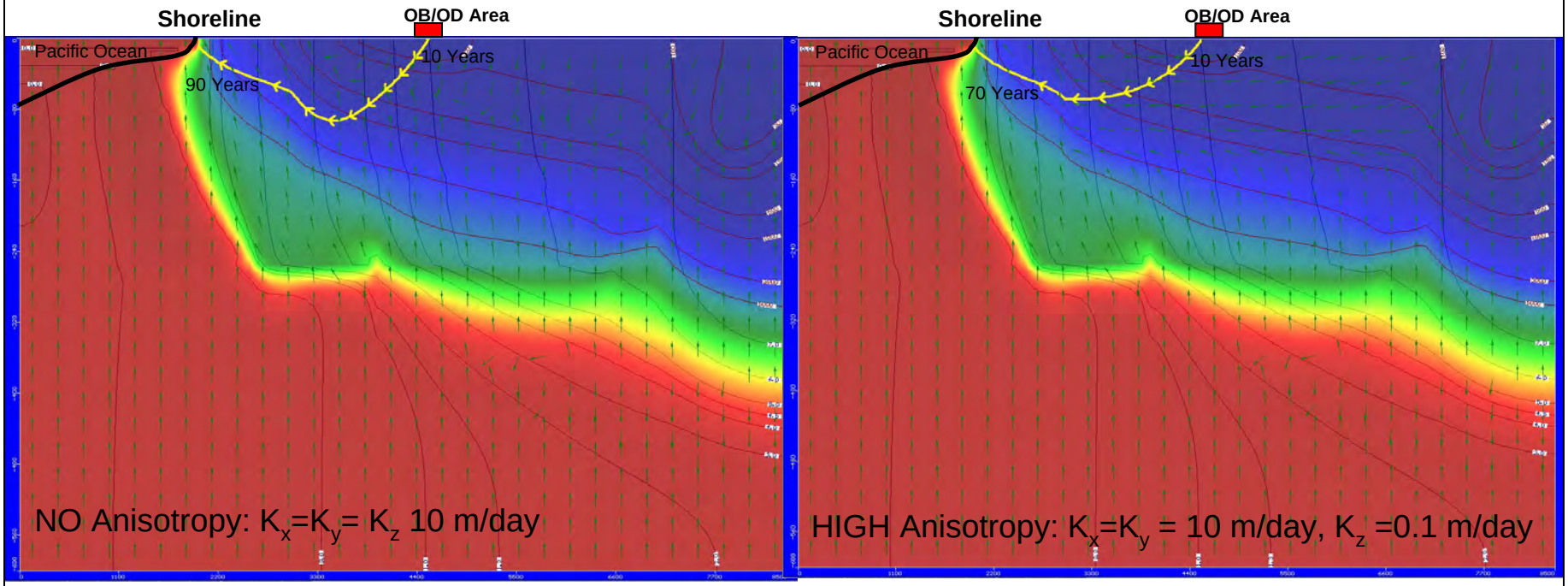
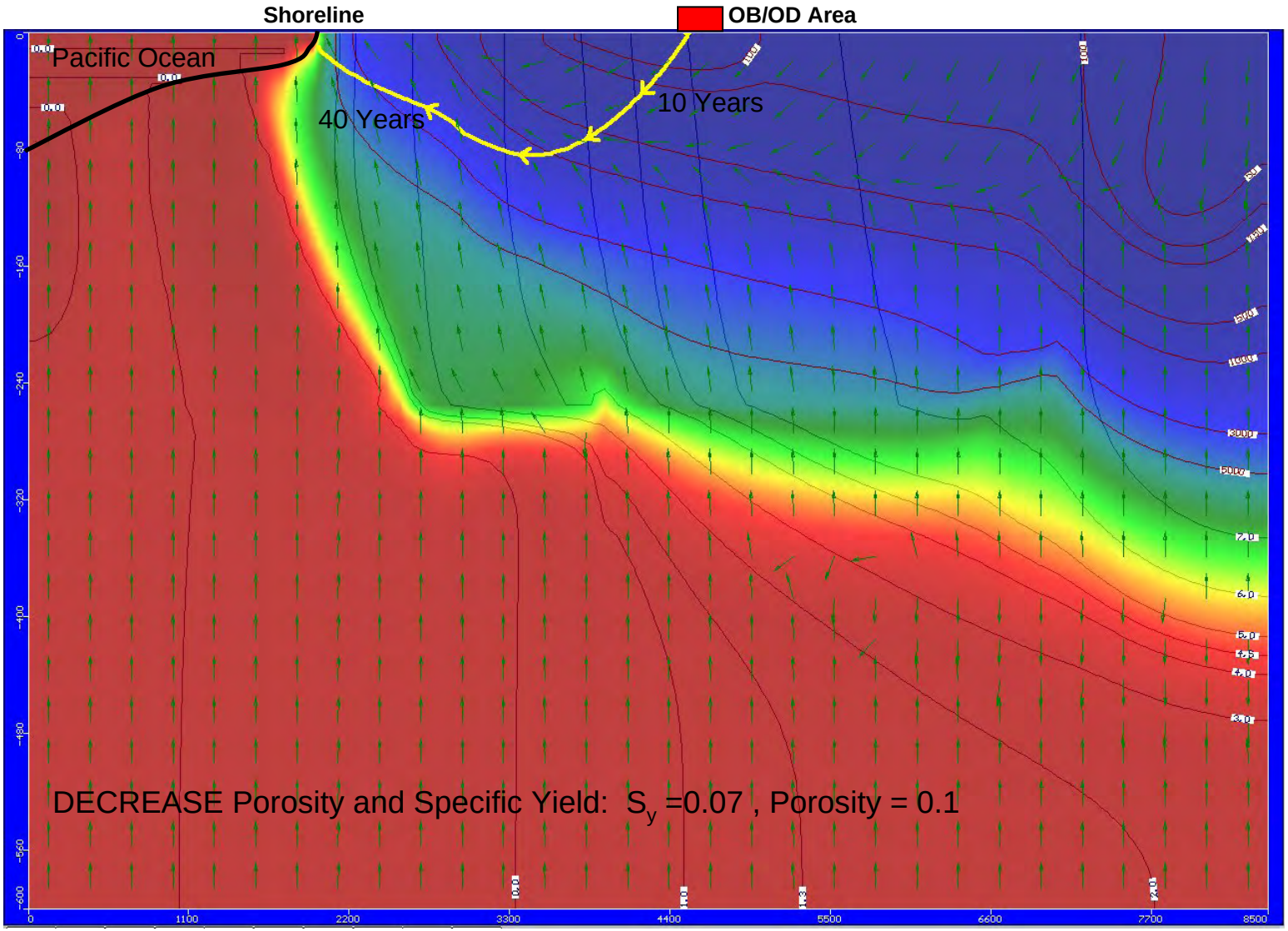
Project Number:	MAKUA VALLEY MODELING STUDY	
Drawn by:	Simulated Flow Field with High Recharge that Matches Measured Head at MW-5	Figure 4
Reference:		



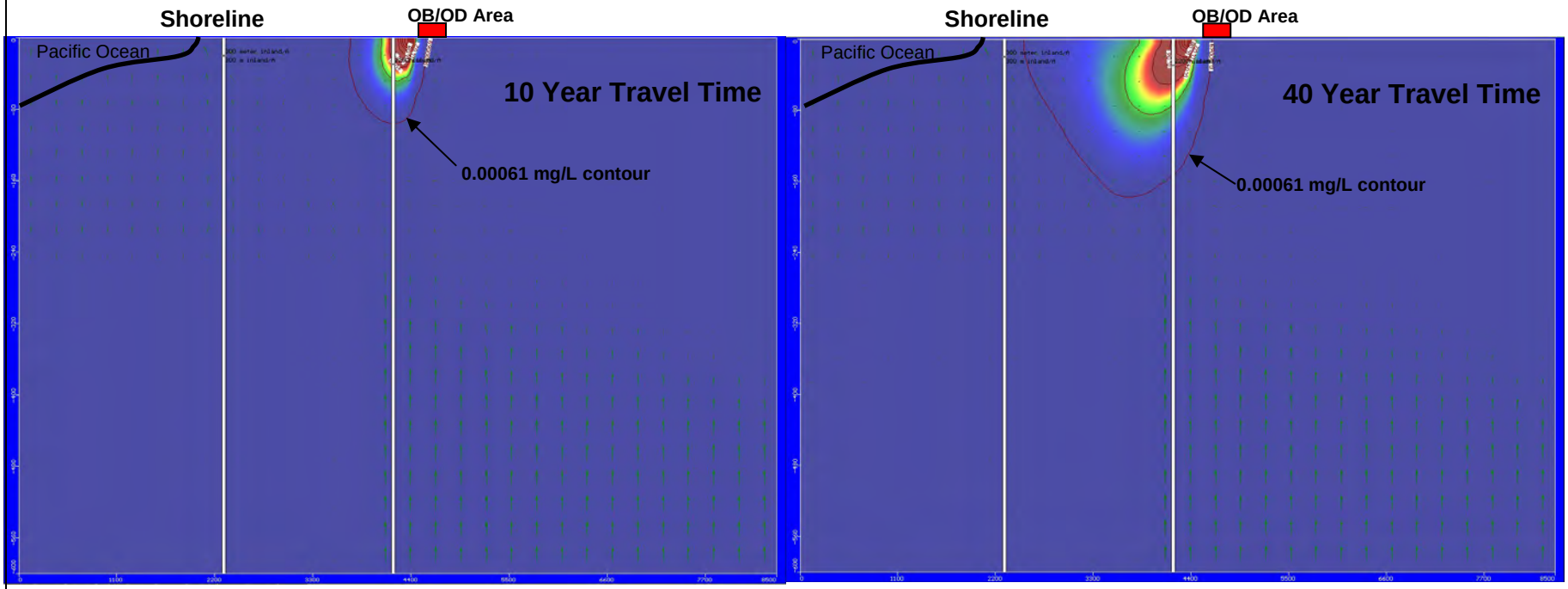
Environet, Inc. PRESERVING EARTH'S RESOURCES FOR THE FUTURE	Project Number:	MAKUA VALLEY MODELING STUDY	
	Drawn by:	Effect of Increasing and Decreasing Hydraulic Conductivity of Shallow Valley Sediments on Simulated Travel Times	Figure 5
	Reference:		



Environet, Inc. PRESERVING EARTH'S RESOURCES FOR THE FUTURE	Project Number:	MAKUA VALLEY MODELING STUDY	
	Drawn by:	Effect of Increasing and Decreasing Anisotropy of Shallow Valley Sediments on Simulated Travel Time	Figure 6
	Reference:		

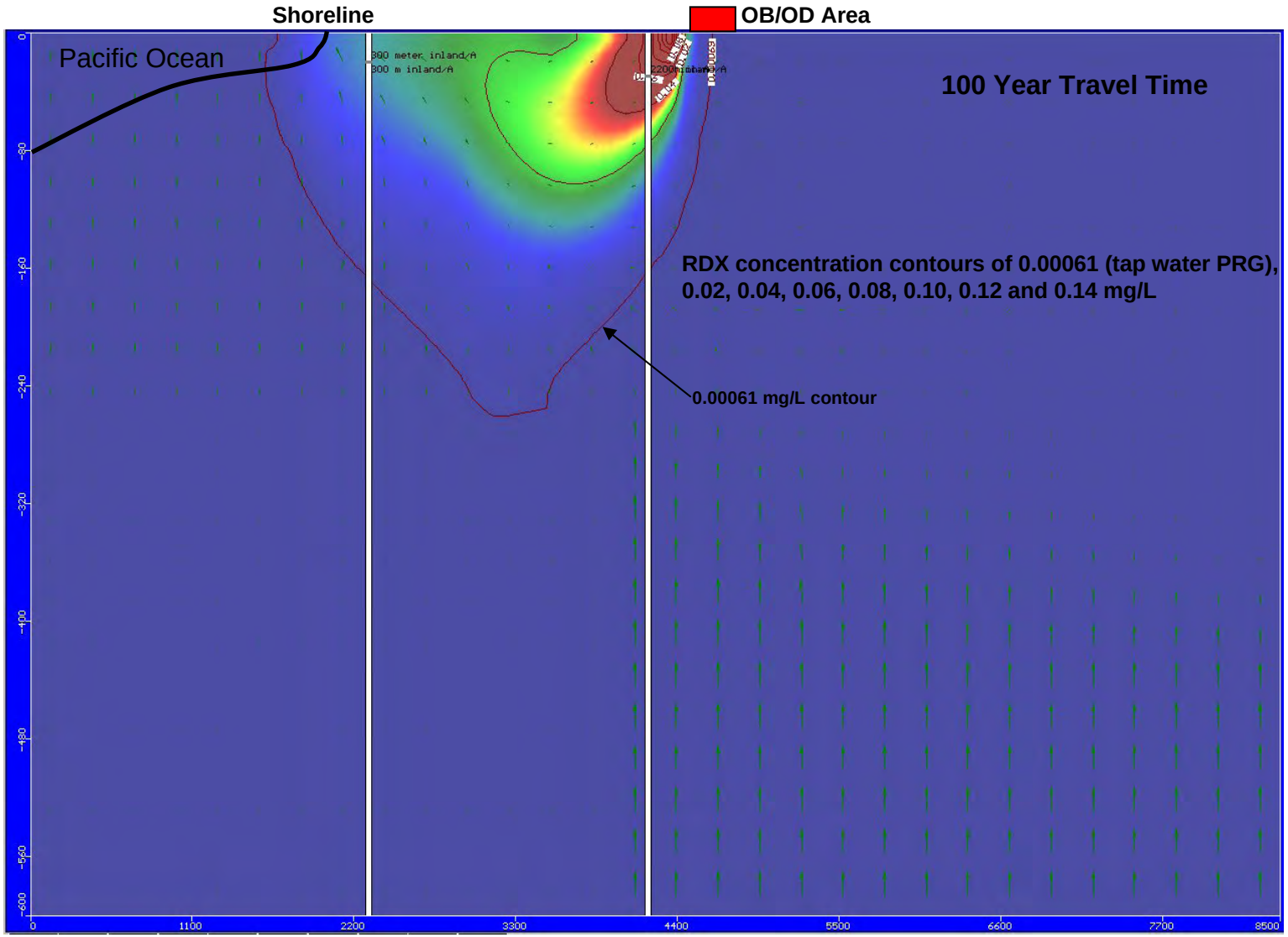


Environet, Inc. PRESERVING EARTH'S RESOURCES FOR THE FUTURE	Project Number:	MAKUA VALLEY MODELING STUDY	
	Drawn by:	Effect of Decreasing Porosity and Specific Yield of Shallow Valley Sediments on Simulated Travel Time	Figure 7
	Reference:		



RDX concentration contours of 0.00061 (tap water PRG), 0.02, 0.04, 0.06, 0.08, 0.10, 0.12 and 0.14 mg/L

Environet, Inc. PRESERVING EARTH'S RESOURCES FOR THE FUTURE	Project Number:	MAKUA VALLEY MODELING STUDY	
	Drawn by:	Contaminant Plume Developed after 10 and 40 Years from a Continuous RDX Source at OB/OD of 0.16 mg/L	Figure 8
	Reference:		



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Project Number:	MAKUA VALLEY MODELING STUDY	
Drawn by:	Contaminant Plume Developed after 100 Years from a Continuous RDX Source at OB/OD of 0.16 mg/L	Figure 9
Reference:		

APPENDIX I

Vadose Zone Modeling

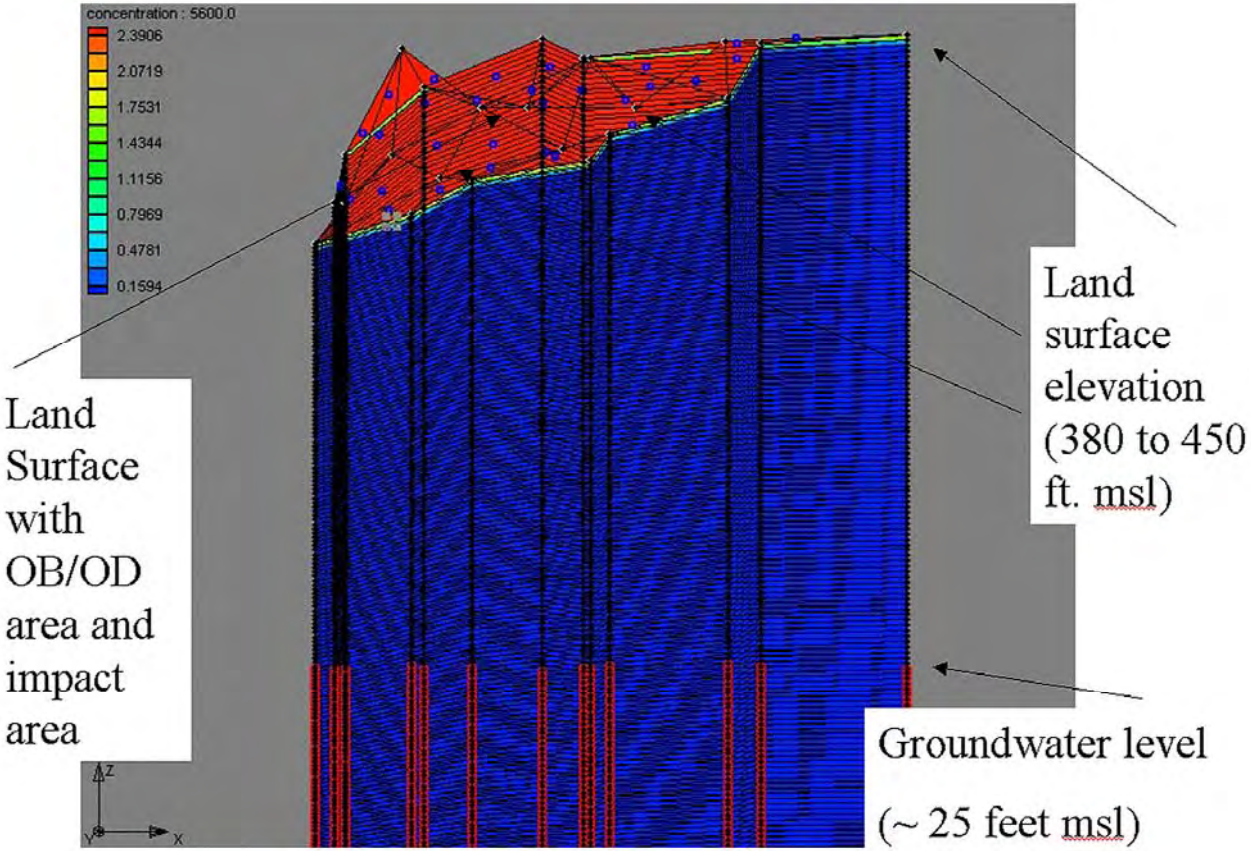
Appendix I
Unsaturated Zone Modeling

As part of the groundwater modeling effort for the Makua Military Reservation EIS a vadose zone (unsaturated zone) model was completed. This was done to estimate the impact of retardation on RDX concentration. It is possible that as water infiltrates downward from the OB/OD area or the impact area that RDX, which was detected in the shallow lysimeters at the OB/OD area, could travel with the groundwater. However, the concentration would be reduced by retardation of RDX in the soil matrix.

It is estimated that the groundwater beneath both the OB/OD area and the impact area has an elevation of approximately 25 feet. With and elevation of the OB/OD area of 450 feet, this would result in a 425 feet thick unsaturated zone. The vadose zone model is created to evaluate retardation of RDX in this thick unsaturated zone.

This vadose zone model is created as a column model as shown in Figure I-1. The FEMWATER model along the Groundwater Modeling System (GMS) pre- and post-processor was used. Recharge on the top of the model was assumed to be 18 cm/yr (7.2 inches), which assumes 3 large rainfall events equal to the February 14, 2003 rainfall event. Dispersion coefficient in the lateral and transverse direction were 100 and 10 feet, respectively. Effective porosity was assumed at 0.20, with a hydraulic conductivity of 0.10 feet/day, which is indicative of the clay/silt material encountered in the OB/OD area. A distribution coefficient of 1.8 Liter/Kg is used with a percent organic carbon of approximately 1%. The RDX concentration for the input infiltrating water was taken as 2.55 mg/l, which is the approximate average RDX concentration of the lysimeter samples. The model was run for 15 years, a time period necessary for the model to reach steady-state conditions.

Figure I-1 shows the distribution of RDX from top to bottom in the column model. The concentration on the top of the model are 2.55 mg/l, with the concentrations on the bottom of the model being 0.16 mg/l. These results are used as input into the MODFLOW and MT3D modeling, for runs that include retardation of RDX, that are described in Appendix H and Section 3.9.2



US Army Corps of Engineers®		Makua Military Reservation	
	DR BY: RSS	Unsaturated Zone Modeling Results	FIGURE I-1
	CHK BY: SJT	(Including retardation of RDX in the Vadose Zone)	

Figure 1.1

APPENDIX J

Laboratory Quality Assurance/Quality Control Data Review

Quality by Design

Laboratory Quality Assurance Consulting

97 Puhili Street
Hilo, Hawaii 96720

Phone: (808) 969-9424
Fax: (808) 969-9094
e-mail: qbdhilo@gte.net

Data Validation Summary

Makua Military Reservation
2002 & 2003 Sampling Events

January, 2005

An EPA Level 3 data verification report was performed for DIMCO, a contractor to the Army Engineer Research and Development Center Waterways Experiment Station, which described the quality of 73 sets of laboratory testing data for the subject project. The validation was performed on the analyses of:

- Volatile Organic Compounds (VOCs) by EPA Method 8260B and 8021,
- Semivolatile organic compounds by EPA Method 8270C,
- Polynuclear aromatic hydrocarbons (PAHs) by EPA Method 8270C/SIMS and EPA Method 8310,
- Dioxins and furans by EPA Method 8290,
- Chlorinated pesticides by EPA Method 8081A,
- Polychlorinated biphenyls (PCBs) by EPA Method 8082,
- Chlorphenoxy herbicides by EPA Method 8151A,
- Total petroleum hydrocarbons by EPA Method 8015,
- Explosives by EPA Methods 8330 and 8332,
- Total metals by EPA Method 3050/1311/6010C, 7470A, and 7471A, and
- Common anions and physical inorganic parameters by ion chromatography, probe, and/or colorimetric wet chemistry.

This verification report consists of this narrative, which describes the criteria used by *Quality by Design* (QBD) for each analysis that was reviewed; a summary of data qualifier flags; copies of the laboratory reports with any corrections marked in red ink; updating of the electronic data deliverable with any data qualifier flags, and copies of any communications with the laboratory that occurred during the validation process.

Validation Criteria

The validation was performed using the reporting format and criteria for recommending data qualifying flags for the data sets as described in EPA's *"Functional Guidelines for Evaluating Inorganics Analyses,"* as revised, 1994; EPA's *"Functional Guidelines for Evaluating Organics Analyses,"* as revised, 1999; the *"Hydrogeologic Investigation Work Plan, Makua Military Reservation*, October, 2002 (QAPP); or using criteria listed in the method referenced. Validated data may have been qualified for any of several reasons:

1. By the laboratory before receipt by the reviewer;
2. Because of laboratory deviation from the designated method;
3. Because the data might not meet the criteria listed in the reference above; or
4. By the professional judgment of the reviewer.

The data verification was a check of the laboratory's typewritten report and consisted only of the items below:

1. **Timeliness and a Check for Errors**, including requested deliverables, preservation, cooler temperatures, holding times, and chain-of-custody.
2. **A Review of the Laboratory Report**, checking the narrative, pagination, and for signature.
3. **Blank Results and Checks for Contamination**, including trip blanks and both field and laboratory checks for contamination.
4. **Surrogate Recovery**, where appropriate.
5. **Laboratory Control Sample (LCS) Analysis**, including Quality Control Check Samples or Laboratory Control Samples.
6. **Duplicate Sample/Matrix Spike/Matrix Spike Duplicate Analysis**, reviewed against precision and accuracy criteria specified by the method or by project DQOs.
7. **Reported Detection Limits**, checking reporting limits against the contract required limits.
8. **Field Duplicates and Other Quality Control**. For samples that were identified as field duplicates or co-located collections, reproducibility was evaluated by calculating the relative percent difference.
9. **Laboratory Contact**, in which communications with the laboratory, if any, were identified.

Issues

QBD has flagged 5,114 of 43,857 points (11.7 percent) with data qualifiers for the following reasons:

- A total of 230 data points (4.5 percent of the total number of qualifiers) were flagged as "R" to indicate that the result is unusable because more than one result was reported for the sample. In order to consolidate the results into a single set of results for each sample, data for which more technically valid results were available were flagged “R".

- 29.5 percent of the total number of qualifiers were from 790 data points that were flagged as "J" and 719 data points that were flagged “R" because of holding time or preservation issues. Some samples were delivered to the laboratory after being held for up to two months, and some water samples for VOC analysis were collected in wide-mouth jars with headspace and later transferred into 40 ml VOA vials.

- A total of 1,909 data points (37.3 percent of the total number of qualifiers) were detected at levels above the detection limit but less than the laboratory’s quantitation/reporting limit, and were flagged “J".

- A total of 222 data points (4.3 percent of the total number of qualifiers) were revised to be not-detected due to blank contamination, as described in the “five-times” and “ten-times” rules for common and uncommon laboratory contaminants in Functional Guidelines.

- Of the remaining 1,244 data points that were flagged (24.3 percent of the total number of qualifiers), no obvious patterns were noted. Small numbers of qualifiers were applied due to serial dilution exceedences; to surrogate, blank spike, or matrix spike failures due to matrix issues; and to miscellaneous but non-systematic problems.

Data Quality Objectives

Precision is a measure of the agreement or reproducibility of analytical results under a given set of conditions. The overall replicate results, consisting of matrix spike/matrix spike duplicate (MS/MSD), blank spike/blank spike duplicate (BS/BSD), and sample/sample duplicate results indicate that the level of field and analytical precision described in the QAPP was attained.

Accuracy is a measure of the agreement of an experimental determination and the true value of the parameter being measure. It is used to identify bias in a given measurement system. Although some MS/MSD or BS/BSD results were out of criteria, it is the reviewer’s opinion that these did not represent systematic exceedences. The overall compliance with the QAPP indicates that the level of analytical accuracy described in the QAPP was attained.

Representativeness is a qualitative parameter that expresses the degree to which the sample data are characteristic of a population. It is evaluated by reviewing the QC results of blank samples, in the quality control of sampling, and in the statistical evaluation of the data. Trip, method, and reagent blanks were overall acceptable. Except for problems that were noted with holding times and preservation, and with occasional laboratory blanks, no systematic problems were identified which would indicate that the laboratory analyses were not representative of the samples. The overall compliance with the QAPP indicates that representativeness as described in the QAPP was attained.

Comparability is a qualitative expression of the confidence with which one data set may be compared to another. It provides an assessment of the equivalence of the analytical results to data obtained from other analyses. Based upon indicators such as the preservation of the samples, holding times, the use of approved methods, the reporting limits, and the Quality Control reported for this data package, the data from this package is expected to be comparable to other data packages that are validated against the same criteria. The overall compliance with the QAPP indicates that comparability as described in the QAPP was attained.

Completeness is defined as the percentage of acceptable sample results compared to the total number of sample results. Completeness is evaluated to determine if an acceptable amount of usable data were obtained so that a valid scientific site assessment can be completed. The completeness of this data set is 97.7 percent, which is compliant with the criteria of greater than 90 percent that is listed in the QAPP.

Conclusion

The analytes on hard copy and in the electronic database that are qualified with an “R” are unusable under all circumstances. All other data, as qualified, are acceptable for use. The analyses were generally within the requirements of both the referenced method and the QAPP.

Attachment 1 Data Qualifier Flag Definitions

Organics

U = The analyte was analyzed for but not detected above the numerical quantitation limit.

J = The analyte was analyzed for and was positively identified, but the associated numerical value is an estimated quantity.

UJ = The analyte was analyzed for but was not detected above the reporting level, but the reporting level is an estimated level.

R = The data are unusable for all purposes. The analyte was analyzed for, but the target analyte might not be present.

N = The analysis indicates presumptive evidence of the presence of the analyte.

NJ = The analysis indicates presumptive evidence of the presence of the analyte, but the numerical value is an estimated quantity.

Inorganics

U = The analyte was analyzed for but not detected above the numerical quantitation limit. The numerical value may be either a detection limit or a quantitation limit.

J = The analyte was analyzed for and was positively identified, but the associated numerical value is an estimated quantity.

UJ = The analyte was analyzed for but was not detected above the reporting level, but the reporting level is an estimated level.

R = The data are unusable for all purposes. The analyte was analyzed for, but the target analyte might not be present.

Attachment 2.
DATA ASSESSMENT SUMMARY

Case/SAS No. Makua Military Reservation 2002, 2003, & 2004 Sampling Events

Laboratories: EMAX, Sequoia Analytical

SDG No.: Summary of All SDGs

Data User: ERDC/DIMCO

Methods: Several

Review Completion Date: January, 2005

Number of Tests: 43,857

Reviewer: Quality by Design

QC ITEM	VOA	SVOC	PAHs	Dioxin	Pests.	PCBs
Holding Times	X	X			X	
GC/MS Performance						
Initial & Continuing Calibration						
Field Blanks		NA	NA	NA	NA	NA
Laboratory Blanks	X			X		
Surrogates					X	
Accuracy (MS, LCS)						
Precision (Duplicate Analysis)						
Internal Standards				X		
Compound Identification						
Compound Quantitation	X				X	
System Performance						
Overall Assessment						

Blank = No problems or minor problems that do not affect data usability.
X = No more than 5% of the data points are qualified as either estimated or unusable.
M = More than 5% of the data points are qualified as either estimated or unusable.
Z = More than 5% of the data points are qualified as unusable.

Attachment 2 (continued).
DATA ASSESSMENT SUMMARY

Case/SAS No. Makua Military Reservation 2002, 2003, & 2004 Sampling Events

Laboratories: EMAX, Sequoia Analytical

SDG No.: Summary of All SDGs

Data User: ERDC/DIMCO

Methods: Several

Review Completion Date: January, 2005

Number of Tests: 43,857

Reviewer: Quality by Design

QC ITEM	Herb.	Explosives	TPH	Metals	Inorganics	
Holding Times	X	X			X	
GC/MS Performance						
Initial & Continuing Calibration						
Field Blanks	NA	NA	NA	NA	NA	
Laboratory Blanks	X			X		
Surrogates				NA	NA	
Accuracy (MS, LCS)	X			X		
Precision (Duplicate Analysis)				X		
Internal Standards						
Compound Identification						
Compound Quantitation	X			X	X	
System Performance						
Overall Assessment						

Blank = Not applicable, no problems, or minor problems that do not affect data usability.
X = No more than 5% of the data points are qualified as either estimated or unusable.
M = More than 5% of the data points are qualified as either estimated or unusable.
Z = More than 5% of the data points are qualified as unusable.

Areas of Concern: Preservation and holding times, blank contamination. Note: Compound quantitation flags are from values less than reporting limit but greater than MDL.

Attachment 3.
DATA EVALUATION SUMMARY
Summary of All Sample Delivery Groups

Date: January, 2005

Site Name: Makua Military Reservation, 2002, 2003 & 2004 Sampling Events

Lab Names: EMAX, Sequoia Analytical

Type of Review: EPA Level 3

Number of Tests: 43,857

Analytes Flagged as Estimated Due to Exceeding Review Criteria for:

Analysis	Surrogates	Holding Time	Calibra-tion	Contamin-ation	Accuracy (MS, LCS)	Precision (Dups.)	Value less than RL	Other	Total # of Flags *	Total # Analytes	% Analytes Flagged
VOCs	15	450		49	10		110	181	815	10,774	7.6
SVOCs		72		1			8		81	7,851	1.0
PAHs							17	14	31	1,520	2.0
Dioxins				24		5		37	66	1,214	5.4
Pesticides	42	42		1	2	10	172	169	438	2,289	19.1
PCBs	7	14							21	581	2.9
Herbicides		20	2	22	24	2	59	83	212	1,130	18.8
Explosives		112		2	6			54	174	4,968	3.5
TPH									-0-	6	0.0
Metals		10		123	69	139	1,499	284	2,124	11,956	17.8
Inorganics		70			2	1	38	47	158	1,414	11.2
Total Flags	**64**	**790**	**2**	**222**	**113**	**157**	**1,909**	**863**	**4,120**	**43,857**	**9.4**

* Total may add to a number greater than the actual samples flagged because of multiple flags on some samples.

Attachment 3 (continued).
DATA EVALUATION SUMMARY
Summary of All Sample Delivery Groups

Date: January, 2005

Site Name: Makua Military Reservation, 2002, 2003 & 2004 Sampling Events

Lab Names: EMAX, Sequoia Analytical

Type of Review: EPA Level 3

Number of Tests: 43,857

Analytes Flagged as Rejected Due to Exceeding Review Criteria for:

Analysis	Surrogates	Holding Time	Calibra-tion	Contamin-ation	Accuracy (MS, LCS)	Precision (Dups.)	Internal Standards	Other	Total # of Flags *	Total # Analytes	% Analytes Flagged
VOCs	18	599						10 **	627	10,774	5.8
SVOCs								67 **	67	7,851	0.9
PAHs								16 **	16	1,520	1.1
Dioxins				7			18		25	1,214	2.0
Pesticides									-0-	2,289	0.0
PCBs									-0-	581	0.0
Herbicides								20 **	20	1,130	1.8
Explosives		112						106 **	218	4,968	4.4
TPH									-0-	6	0.0
Metals		8			2			11	21	11,956	0.2
Inorganics									-0-	1,414	0.0
Total Flags	**18**	**719**		**7**	**2**		**18**	**230**	**994**	**43,857**	**2.3**

* Total may add to a number greater than the actual samples flagged because of multiple flags on some samples.

** Due to re-analysis or dilution of sample, in which more than one result was reported for the sample. When more technically valid data were available, less valid results were flagged “R".

Quality by Design

Attachment 4.
Field Sample Identifications and Analyses

Makua Military Reservation
2002, 2003, and 2004 Sampling Events
January, 2005

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMRBHSS1-4	302182-01							X				X	X
MMRBHSS2-2	302182-02							X				X	X
MMRMW3B-R4-DUP	306588-01		X	X	X		X	X	X	X	X	X	X
MMROB/OD RINSE BLANK	50989.10					X							
MMR RINSATE 2	50989.11					X							
MMP RINSATE 3	50989.12					X							
ERDC-BK-4A	52581.01					X							
ERDC-BK-4B	52581.02					X							
ERDC-BK-2A	52581.03					X							
ERDC-BK-2B	52581.04					X							
ERDC-BK-6A	52581.05					X							
ERDC-BK-6B	52581.06					X							
MMRMW4A-R6	A002-01		X		X		X		X		X	X	X
MMRMW4B-R6	A002-02		X		X		X		X		X	X	X
MMRMW4C-R6	A002-03		X		X		X		X		X	X	X
Trip Blank	A002-04		X										
MMRSNFBR-1	A005-01							X				X	

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMRSNFBR-2	A005-02							X				X	
MMRSNFBR-3	A005-03							X				X	
MMRSNFBR-4	A005-04							X				X	
MMRSNFBR-5	A005-05							X				X	
MMRSNFBR-6	A005-06							X				X	
MMRMW3A-R2	A110-01		X		X		X	X	X		X	X	X
Trip Blank 1	A110-02		X										
MMRMW4A-R2	A110-03		X		X		X	X	X		X	X	X
Trip Blank 2	A110-04		X										
MMRMW1-R1	A119-01		X		X		X	X	X		X	X	X
Trip Blank 1	A119-02		X										
MMRMW2-R2	A119-03		X		X		X	X	X		X	X	X
Trip Blank 2	A119-04		X										
MMRMW3B-R2	A129-01		X		X		X	X	X		X	X	X
Trip Blank 1	A129-02		X										
MMRMW4B-R2	A129-03		X		X		X	X	X		X	X	X
Trip Blank 2	A129-04		X										
MMRMW4C-R2	A145-01		X		X		X	X	X		X	X	X
Trip Blank 1	A145-02		X										
MMRMWSP7-R2	A145-03		X		X		X	X	X		X	X	X
Trip Blank 2	A145-04		X										
MMRW3C-R2	A164-01		X		X		X	X	X		X	X	X

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
Trip Blank	A164-02		X										
MMR-SFBR1-08	A165-01							X				X	
MMR-SFBR1-07	A165-02							X	X			X	
MMR-SFBR1-16	A165-03							X				X	
MMR-SFBR1-14	A165-05							X				X	
MMR-SFBR1-13	A165-06							X				X	
MMR-SFBR1-12	A165-07							X				X	
MMR-NFBR1-11	A165-08							X				X	
MMR-NFBR1-10	A165-09							X				X	
MMR-NFBR1-9	A165-10							X				X	
MMR-NFBR1-8	A165-11							X				X	
MMR-NFBR1-7	A165-12							X	X			X	
MMRS-Background 1-1	A165-13											X	
MMRS-Background 1-2	A165-14											X	
MMR-SFBR1-15	A165-4							X				X	
MMRMWS4A	A172-01					X		X		X		X	
MMRMWS4L	A172-02					X		X		X		X	
MMRSFBRSS 1-19	A1811-01							X				X	
MMR BACKGROUND 1-3	A1811-02											X	
MMRNFBRSS 1-20	A1811-03							X	X			X	
MMRBACKGROUND 1-4	A1811-04											X	
MMRBACKGROUND 1-5	A1811-05											X	

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMRNFBRSS 1-21	A1811-06							X				X	
MMRBACKGROUND	A1811-07											X	
MMRSFBRSS 1-22	A1811-08							X	X			X	
MMRSSWOLF 1-5	A1811-09								X				
MMRSSCOYOTE 1-2	A1811-10								X				
MMRSSMTA 1-3	A1811-11								X				
MMRSSBUFFALO 1-3	A1811-12								X				
MMRSSBADGER 1-5	A1811-13								X				
MMRSSAREAG 1-2	A1811-14								X				
MMRSSCAA 1-1	A1811-15								X				
MMRSSELK 1-7	A1811-16								X				
MMRSSDRMOPI 1-1	A1811-17								X				
MMRSSDEER 1-5	A1811-18								X				
MMRSSDEERBERM 1-1	A1811-19								X				
WSBPSS 1-1	A1811-20								X				
MMRSSDEEDS 1-2	A1811-21								X				
MMRSSFOX 1-3	A1811-22								X				
MMRSS105FA 1-1	A1811-23								X				
MMRSSPBP 1-1	A1811-24								X				
MMRSSMSFA 1-1	A1811-25								X				
MMRSSOB/OD 1-5	A1811-26								X				
MMRBACKGROUND 1-7	A207-01											X	

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMRBACKGROUND 1-8	A207-02											X	
MMRBACKGROUND 1-9	A207-03											X	
MMRBACKGROUND 1-10	A207-04											X	
MMRSSOB-OD1-1	B034-01								X				
MMRSSOB-OD1-1	B034-02								X				
MMRSSOB-OD1-1	B034-03								X				
MMRSSOB-OD1-1	B034-04								X				
MMRBHSS1-1	B043-01							X				X	
MMRBHSS1-3	B043-02							X				X	
MMRBHSS1-4	B043-03							X				X	
MMRBHSS1-5	B043-04							X				X	
MMRBHSS1-6	B043-05							X				X	
MMRBHSS1-7	B043-06							X				X	
MMRBHSS1-8	B043-07							X				X	
MMRBHSS1-9	B043-08	Cancelled											
MMRBHSS1-2	B043-09	51988.06				X		X				X	X
MW-48/5-PSW-1	B044-01							X		X		X	
MW-48/5-PSW-1	B044-01							X		X		X	
MW-3-PSIN-2	B044-02							X		X		X	
MW-3-PSIN-2	B044-02							X		X		X	
MW-1/2PSW-3	B044-03							X		X		X	
MW-1/2PSW-3	B044-03							X		X		X	

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMRBHSS2-1	B093-01	51988.07				X		X				X	X
MMRBHSS2-2	B093-02							X				X	
MMRBHSS2-3	B093-03	51988.08				X		X				X	
MMRBHSS2-4	B093-04							X				X	
MMRBHSS1 Rinsate	B093-05							X				X	
MMRBHSS2-Rinsate	B093-06							X					
MMRMW5-R2	B111-01	51988.05				X		X				X	X
MMRMW5RIN-R2	B111-02							X					
Trip Blank	B111-03		X										
MMRBHSS2-3	B111-04							X				X	X
MMRBHSS2-5	B111-05							X				X	
MMRBHSS2-6	B111-06							X				X	
MMRBHSS2-7	B111-07							X				X	
MMRBHSS2-8	B111-08							X				X	
MMRISCOR-1	B130-01							X				X	X
MMRISCORI-COMP	B130-01										X		X
MMRISCOR-2	B130-02		X		X				X				X
MMRISCOR-3	B130-03							X				X	X
MMRISCOR-4	B130-04											X	X
MMRISCOR-5	B130-05		X									X	
MMRISCOR-6	B130-06				X			X	X			X	X
MMRISCOR-7	B130-07		X										X

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMRISCOR-8	B130-08							X				X	X
MMRISCOR-9	B130-09											X	X
MMRISCOR-10	B130-10		X		X				X				X
MMRISCOR-11	B130-11							X				X	X
MMRISCOR-12	B130-12		X		X			X	X			X	
MMRISCOR-13	B130-13											X	X
MMRISCOR-14	B130-14												X
MMRISCOR-15	B130-15							X				X	X
MMRISCOR-16	B130-16												X
MMRISCOR-17	B130-17												X
MMRISCOR-18	B130-18							X				X	X
MMRISCOR-19	B130-19											X	X
MMRISCOR-20	B130-20												X
MMRISCOR-21	B130-21							X				X	X
MMRISCOR-22	B130-22												X
MMRISCOR-23	B130-23												X
MMRISCOR-24	B130-24												X
MMRISCOR-25	B130-25											X	X
MMRISCOR-26	B130-26							X				X	X
MMRISCOR-27	B130-27												X
MMRISCOR-28	B130-28												X
MMRISCOR-29	B130-29												X

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMRISCOR-30	B130-30												X
MMRISCOR-31	B130-31							X				X	X
MMRISCOR-32	B130-32											X	X
MMRISCOR-33	B130-33												X
MMRISCOR-34	B130-34												X
MMRISCOR-35	B130-35												X
MMRISCOR-36	B130-36							X				X	X
MMRISCOR-37	B130-37												X
MMRISCOR-38	B130-38											X	X
MMRISCOR-39	B130-39		X		X				X				X
MMRISCOR-40	B130-40							X				X	X
MMRBHSS3-1	B137-1		X		X						X		X
MMRBHSS3-2	B137-2												
MMRMSSWR5	B138-01							X				X	
MMRPSSWR5	B138-02							X				X	
MMRKASSWR5	B138-03							X				X	
MMRPSSW-R6	B138-04							X				X	
MMRKASSW-R6	B138-05							X				X	
MMRPSBS-0.5	B202-01	D2060.01	X		X	X	X	X	X		X	X	X
MMRPSBS-1.0	B202-02	D2060.02	X		X	X	X	X	X		X	X	X
MMRPSBS-1.5	B202-03	D2060.03	X		X	X	X	X	X		X	X	X
MMRMSBS-0.5	B202-04	D2060.04	X		X	X	X	X	X		X	X	X

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMRMSBS-1.0	B202-05	D2060.05	X		X	X	X	X	X		X	X	X
MMRMSAS-1.5	B202-06	D2060.06	X		X	X	X	X	X		X	X	X
MMRKSBS-0.5	B202-07	D2060.07	X		X	X	X	X	X		X	X	X
MMRKSBS-1.0	B202-08	D2060.08	X		X	X	X	X	X		X	X	X
MMRKSBS-1.5	B202-09	D2060.09	X		X	X	X	X	X		X	X	X
MMRKASBS-0.5	B202-10	D2060.10	X		X	X	X	X	X		X	X	X
MMRKASBS-1.0	B202-11	D2060.11	X		X	X	X	X	X		X	X	X
MMRSBS-RB	C001-01							X					
MMRMW1-R3	D022-01		X		X		X	X	X		X	X	X
MMRMW2-R3	D022-02		X		X		X	X	X		X	X	X
MMRMW3A-R3	D022-03		X		X		X	X	X		X	X	X
MMRMW4A-R3	D022-04		X		X		X	X	X		X	X	X
MMRMW14B-R3	D022-05		X		X		X	X	X		X	X	X
Trip Blank 1	D022-06		X										
Trip Blank 2	D022-07		X										
MMRSP7-R3	D032-01		X		X		X	X	X		X	X	X
MMRMW3B-R3	D032-02		X		X		X	X	X		X	X	X
MMRMW3C-R3	D032-03		X		X		X	X	X		X	X	X
MMRDUP-R3	D032-04		X		X		X	X	X		X	X	X
MMRMW4C-R3	D032-05		X		X		X	X	X		X	X	X
Trip Blank 3	D032-06		X										
Trip Blank 4	D032-07		X										

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMRMW5-R3	D040-01		X		X		X	X	X		X	X	X
MMRSB1A	D040-02		X					X	X				
MMRSB1B	D040-03		X										
MMRSB2B	D040-04		X										
MMRSB3A	D040-05		X					X	X				
MMRRINSATE-RB	D040-06							X	X				
Trip Blank 5	D040-07		X										
MMRSWE2B01	F020-01							X				X	X
MMRSWE2B02	F020-02												X
MMRSWE2B03	F020-03							X				X	X
MMRSWE2B04	F020-04							X				X	X
MMRSWE2B05	F020-05							X				X	X
MMRSWE2B06	F020-06												X
MMRSWE2B07	F020-07												X
MMRSWE2B08	F020-08												X
MMRSWE2B09	F020-09												X
MMRSWE2B10	F020-10							X				X	X
MMRSWE2B11	F020-11												X
MMRSWE2B12	F020-12												X
MMRSWE2B13	F020-13												X
MMRSWE2B14	F020-14							X				X	X
MMRSWE2B15	F020-15												X

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMRSWE2B16	F020-16												X
MMRSWE2B17	F020-17												X
MMRSWE2B18	F020-18							X				X	X
MMRSWE2B19	F020-19												X
MMRSWE2B20	F020-20												X
MMRSWE2B21	F020-21												X
MMRSWE2B22	F020-22												X
MMRSWE2B23	F020-23												X
MMRSWE2B24	F020-24							X				X	X
MMRMW1-R1	F140-01		X		X		X		X		X	X	X
Trip Blank 1	F140-02		X										
MMRMW2-R4	F153-01		X		X		X		X		X	X	X
Trip Blank 2	F153-02		X										
MMRSP7-R4	F153-03		X		X		X		X		X	X	X
MMRMW3A-R4	F153-04		X		X		X		X		X	X	X
MMRMW3B-R4	F161-01		X		X		X	X			X	X	X
MMRMW3B-R4-RIN	F161-02		X					X					
Trip Blank	F161-03		X										
MMRMW3CR4	F172-01		X		X		X		X		X	X	X
MMRMW4BR4	F172-02		X		X		X		X		X	X	X
Trip Blank	F172-03		X										
MMRMW4A-R4	G002-01		X		X		X	X			X	X	X

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMRMW4C-R4	G002-02		X		X		X	X			X	X	X
Trip Blank	G002-03		X										
MMRMW5-R4	G023-01		X		X		X	X			X	X	X
Trip Blank	G023-02		X										
MMRSB1A-R2	G023-03							X	X				
MMRSB1B-R2	G023-04							X	X				
MMRSB2A-R2	G023-05							X	X				
MMRSB2B-R2	G023-06							X	X				
MMRSB1A-R1	G061-01		X										
MMRSB1B-R1	G061-02		X										
MMRSB2B-R1	G061-03		X										
Trip Blank	G061-04		X										
MMR-MW2-R5	J007-01		X		X		X	X			X	X	X
MMR-MW31-R5	J007-02		X		X		X	X			X	X	X
TRIP BLANK	J007-03		X										
MMRDEERSS 1-1F	J049-01			X	X	X		X			X	X	X
MMRDEERSS 1-4F	J049-02			X	X	X		X			X	X	X
MMRCASS 1-1F	J049-03			X	X	X		X			X	X	X
MMRCASS 1-7F	J049-04			X	X	X		X			X	X	X
MMRDBSS 1-1F	J049-05			X	X	X		X			X	X	X
MMRFOXSS 1-3F	J049-06			X	X	X		X			X	X	X
MMRDEEDSS 1-1F	J049-07			X	X	X		X			X	X	X

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMRWSBPSS 1-1F	J049-08			X	X	X		X			X	X	X
MMRCOYOTESS 1-2F	J049-09			X	X	X		X			X	X	X
MMRWOLFSS 1-5F	J049-10			X	X	X		X			X	X	X
MMRAREAGSS 1-2F	J049-11			X	X	X		X			X	X	X
MMRDEMOPITSS 1-1F	J049-12			X	X	X		X			X	X	X
MMRELKSS 1-7F	J049-13			X	X	X		X			X	X	X
MMRBADGERSS 1-10F	J049-14			X	X	X		X			X	X	X
MMRMTASS 1-3F	J049-15			X	X	X		X			X	X	X
MMRBUFFALOSS 1-6F	J049-16			X	X	X		X			X	X	X
MMRMMRPBSS 1-1F	J049-17			X	X	X		X			X	X	X
MMR105FASS 1-1F	J049-18			X	X	X		X			X	X	X
MMR105FASS 1-2F	J049-19			X	X	X		X			X	X	X
MMRFOXSS 1-1	J050-01							X				X	
MMRFOXSS 1-2	J050-02							X				X	X
MMRFOXSS 1-3	J050-03							X				X	
MMRFOXSS 1-4	J050-04							X				X	
MMWOLFSS 1-1	J050-05							X				X	
MMWOLFSS 1-2	J050-06							X				X	
MMWOLFSS 1-3	J050-07							X				X	X
MMWOLFSS 1-4	J050-08							X				X	
MMWOLFSS 1-5	J050-09							X				X	
MMWOLFSS 1-6	J050-10							X				X	

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMRDEEDSSS 1-1	J050-11							X				X	X
MMRDEEDSSS 1-2	J050-12							X				X	
MMRDEEDSSS 1-3	J050-13							X				X	
MMR105FASS 1-1	J050-14							X				X	
MMR105FASS 1-2	J050-15							X				X	
MMR105FASS 1-3	J050-16							X				X	X
MMRPBSS 1-1	J050-17							X				X	X
MMRWSBPSS 1-1	J050-18							X				X	X
MMRDPASS 1-1	J050-19							X				X	
MMRDPASS 1-2	J050-20							X				X	X
MMRDPASS BLANK	J050-21							X				X	
MMRAGSS 1-1	J050-22							X				X	
MMRAGSS 1-2	J050-23							X				X	X
MMRAGSS 1-3	J050-24							X				X	
MMRMTASS 1-1	J050-25							X				X	
MMRMTASS 1-2	J050-26							X				X	
MMRMTASS 1-3	J050-27							X				X	
MMRMTASS 1-4	J050-28							X				X	
MMRMTASS 1-5	J050-29							X				X	X
MMRMTASS BLANK	J050-30							X				X	
MMRDBSS 1-1	J050-31							X				X	
MMRDBSS 1-2	J050-32							X				X	X

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMRDBSS 1-3	J050-33							X				X	
MMRDBSS 1-4	J050-34							X				X	
MMRDBSS 1-5	J050-35							X				X	
MMRDBSS BLANK	J050-36							X				X	
MMROB/ODSS1-1F	J080-01	50989.01				X							
MMROB/ODSS1-2F	J080-02	50989.02				X							
MMROB/ODSS1-3F	J080-03	50989.03				X							
MMROB/ODSS1-4F	J080-04	50989.04				X							
MMROB/ODSS1-5F	J080-05	50989.05				X							
MMPMSFASSI-1F	J080-06	50989.06				X							
MMROB/OD BLIND BLANK	J080-08					X							
Trip Blank	J080-09	50989.09											
MMRDEERSS1-1	J081-01							X				X	
MMRDEERSS1-2	J081-02							X				X	
MMRDEERSS1-3	J081-03							X				X	
MMRDEERSS1-4	J081-04							X				X	X
MMRDEERSS1-5	J081-05							X				X	
MMRDEERSS1-6	J081-06							X				X	
MMRDEERSS1-7	J081-07							X				X	
MMRDEERSS1-8	J081-08							X				X	X
MMRDEERSS1-9	J081-09							X				X	
MMRDEERSS1-10	J081-10							X				X	

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMRDEERSS1-11	J081-11							X				X	
MMRDEERSS1-12	J081-12							X				X	
MMRDEERSS1-13	J081-13							X				X	X
MMRDEERSS1-14	J081-14							X				X	
MMRDEERSS1-15	J081-15							X				X	X
MMRCAASS 1-1	J081-16							X				X	
MMRCAASS 1-2	J081-17							X				X	X
MMRCAASS 1-3	J081-18							X				X	
MMRCAASS 1-4	J081-19							X				X	X
MMRCAASS 1-5	J081-20							X				X	
MMRCAASS 1-6	J082-01							X				X	
MMRCAASS 1-7	J082-02							X				X	
MMRCAASS 1-8	J082-03							X				X	
MMRCAASS 1-9	J082-04							X				X	
MMRCAASS 1-10	J082-05							X				X	
MMRCAASS 1-11	J082-06							X				X	
MMRCAASS 1-12	J082-07							X				X	X
MMRCAASS 1-13	J082-08							X				X	
MMRCAASS 1-14	J082-09							X				X	
MMBADGERSS 1-1	J082-10							X				X	
MMBADGERSS 1-1	J082-11							X				X	
MMBADGERSS 1-1	J082-12							X				X	

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMBADGERSS 1-1	J082-13							X				X	
MMBADGERSS 1-1	J082-14							X				X	
MMBADGERSS 1-1	J082-15							X				X	X
MMBADGERSS 1-1	J082-16							X				X	
MMBADGERSS 1-1	J082-17							X				X	
MMBADGERSS 1-1	J082-18							X				X	
MMBADGERSS 1-1	J082-19							X				X	X
MMRCOYOTESS 1-1	J082-20							X				X	X
MMRCOYOTESS 1-2	J083-01							X				X	
MMRCOYOTESS 1-3	J083-02							X				X	
MMRCOYOTESS 1-4	J083-03							X				X	
MMRCOYOTESS 1-5	J083-04							X				X	
MMRCOYOTESS 1-6	J083-05							X				X	
MMRCOYOTESS 1-7	J083-06							X				X	
MMRCOYOTESS 1-8	J083-07							X				X	X
MMRELKSS 1-1	J083-08							X				X	
MMRELKSS 1-2	J083-09							X				X	
MMRELKSS 1-3	J083-10							X				X	
MMRELKSS 1-4	J083-11							X				X	X
MMRELKSS 1-5	J083-12							X				X	X
MMRELKSS 1-6	J083-13							X				X	
MMRELKSS 1-7	J083-14							X				X	

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMRELKSS 1-8	J083-15							X				X	
MMRELKSS 1-9	J083-16							X				X	
MMRELKSS 1-10	J083-17							X				X	
MMRBUFFALOSS 1-1	J083-18							X				X	
MMRBUFFALOSS 1-2	J083-19							X				X	X
MMRBUFFALOSS 1-3	J083-20							X				X	X
MMRBUFFALOSS 1-4	J084-01							X				X	X
MMRBUFFALOSS 1-5	J084-02							X				X	X
MMRBUFFALOSS 1-6	J084-03							X				X	X
ERDLMW-1 5.0’-6.5’	J084-04												X
ERDLMW-1 10.0’-11.5’	J084-05												X
ERDLMW-4A 5.0’-6.5’	J084-06												X
ERDLMW-4A 10.0’-11.5’	J084-07												X
ERDLMW-4B 5.0’-6.5’	J084-08												X
ERDLMW-4B 10.0’-11.5’	J084-09												X
MMRDEERBLIND BLANK	J084-10							X				X	X
MMRCAABLIND BLANK	J084-11							X				X	X
MMRCOYOTEBLIND BLANK	J084-12							X				X	X
ELKBLIND BLANKMMR	J084-13							X				X	X
MMRBUFFALOBLIND BLANK	J084-14							X				X	X
MMRBADGERBLIND BLANK	J084-15							X				X	X
MMRDEER RINSATE	J084-16							X				X	

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMRCAA RINATE	J084-17							X				X	
MMRCOYOTE RINSATE	J084-18							X				X	
MMRELK RINSATE	J084-19							X				X	
MMRBUFFALO RINSATE	J084-20							X				X	
MMRBADGER RINSATE	J084-21							X				X	
MMROB/ODRINSEBLANK	J113-01												X
MMRMSFASS 1-2F	J113-02			X	X			X			X	X	X
MMRMSFASS 1-3F	J113-03			X	X			X			X	X	X
MMRSSMW-2-5.0’	J165-01												X
MMRSSMW-2-10.0’	J165-02												X
MMRSSMW-2-15.0’	J165-03												X
MMRSSMW-3A-5.0’	J165-04												X
MMRSSMW-3A-10.0’	J165-05												X
MMRSSMW-3A-15.0’	J165-06												X
MMRSSMW-3B-5.0	J198-01												X
MMRSSMW-3B-10.0	J198-02												X
MMRSSMW-3B-15.0	J198-03												X
MMRSSMW-3C-10.0’	K241-01												X
MMRSSMW-3C-15.0’	K241-02												X
MMRSSMW-4C-5.0’	K241-03												X
MMRSSMW-4C-15.0’	K241-04												X
MMRSSMW-5-5.0’	K241-05												X

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMRSSMW-5-10.0’	K241-06												X
MMRSSMW-5-15.0’	K241-07												X
MMPMW1-R1	L077-01	51641.01				X							
Trip Blank	L077-02		X										
MMRMW2-R1	L089-01	51651.01				X							
MMRMW3A-R1	L089-03	51651.02				X							
MMRMW4A-R1	L110-01	51677.03	X		X	X	X	X			X	X	X
Trip Blank 1	L110-02		X										
MMRMW4B	L110-03	51677.04	X		X	X	X	X			X	X	X
Trip Blank 2	L110-04		X										
MMRMW-3B	L121-01	51677.01	X		X	X	X	X	X		X	X	X
Trip Blank 1	L121-02		X										
MMRMW-3CR	L121-03	51677.02	X		X	X	X	X	X		X	X	X
Trip Blank 2	L121-04		X										
MMRPSP-7	L137-01	51688.01				X							
MMRMW-4C	L137-03	51688.02				X							
MW-5-R1	L150-01		X		X		X	X			X	X	X
Trip Blank	L150-02		X										
MMR Badger SS-1-1	P210219-01							X			X		
MMR Elk SS 1-7	P210219-02							X			X		
MMR Buffalo SS 1-6	P210219-03							X			X		
MMR Coyote SS 1-7	P210219-04							X			X		

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMR Deer SS 1-1	P210219-05							X			X		
MMR CAA SS 1-10	P210219-06							X			X		
MMRMW-4C	P212420-01		X		X	X		X			X	X	X
Trip Blank	P212420-02		X										
MMRNFBRSS1-20	P301401-01											X	
MMRBACKGROUND1-4	P301401-02											X	
MMRSFDRSS1-22	P301401-03											X	
MMRCAASS1-7F	P301417-01				X						X	X	
MMRDEERBERM1-1F	P301417-02				X						X	X	
MMRBHSS1-4	P302182-01							X					
MMRBHSS2-2	P302182-02							X				x	
MMRMW5-R2	P302208-01	104255450				X							
MMRMWS-R2	P302208-01	G3B150155-001	X		X			X			X	X	X
MMRPSSSW-R6-S	P302270-01							X				X	X
MMRKASSW-R6-S	P302270-02							X				X	X
MMRMSBS-1.5	P302433-01		X	X	X	X	X	X	X	X	X	X	X
MMRMW3B-R3	P304109-01		X	X	X	X	X	X	X	X	X	X	X
Trip Blank	P304109-02		X										
MMR-MW2-R5	P310094-01		X		X		X	X			X	X	X
TB	P310094-02		X										
MMRMW3A-R6	P401114-01		X		X		X	X			X	X	X

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
Trip Blank	P401114-02		X										
MMRK6SR2-3	P401430-01							X				X	X
MMR-KGS-R3-3	P403076-01							X				X	
MMR-MW1-R5	03I161-01		X		X		X	X			X	X	X
TRIP BLANK	03I161-02		X										
MMRSP7-R6	03L172-01		X		X		X		X		X	X	X
MMRMW1-R6	03L172-02		X		X		X		X		X	X	X
Trip Blank	03L172-03		X										
MMRMW3C-R6	04A007-01		X		X		X	X			X	X	X
TRIP BLANK	04A007-02		X										
MMRMW2-R6	04A019-01		X		X		X	X			X	X	X
MMRMW5-R6	04A019-02		X		X		X	X			X	X	X
TRIP BLANK	04A019-03		X										
MMRMW3B-R6	04A033-01		X		X		X	X			X	X	X
MMRMW3A-R6	04A033-02		X		X		X	X			X	X	X
Trip Blank 1/7/04	04A033-03		X										
MMRMW3A-R6-RINSATE	04A033-04							X					
Drum3A-R5	04A033-05											X	
MMRSOURCE WATER	04A033-06		X					X				X	X
MMR-SW-E3-B01	04A062-01											X	X
MMR-SW-E3-B02	04A062-02							X					X

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMR-SW-E3-B03	04A062-03											X	X
MMR-SW-E3-B04	04A062-04							X					X
MMR-SW-E3-B05	04A062-05											X	X
MMR-SW-E3-B06	04A062-06							X					X
MMR-SW-E3-B07	04A062-07											X	X
MMR-SW-E3-B08	04A062-08							X					X
MMR-SW-E3-B09	04A062-09											X	X
MMR-SW-E3-B10	04A062-10							X					X
MMR-SW-E3-B11	04A062-11											X	X
MMR-SW-E3-B12	04A062-12							X					X
MMR-SW-E3-B13	04A062-13											X	X
MMR-SW-E3-B14	04A062-14							X					X
MMR-SW-E3-B15	04A062-15											X	X
MMR-SW-E3-B16	04A062-16							X					X
MMR-SW-E3-B17	04A062-17											X	X
MMR-SW-E3-B18	04A062-18							X					X
MMR-SW-E3-B19	04A062-19											X	X
MMR-SW-E3-B20	04A062-20							X					X
MMR-SW-E3-B21	04A062-21											X	X
MMR-SW-E3-B22	04A062-22							X					X
MMRKGSR2-1	04A138-01	53862.01	X		X	X	X	X	X		X	X	X

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMRKGSR2-TRIP	04A138-02		X										
MMRMSR2-1	04A138-03	53862.02	X		X	X	X	X	X		X	X	X
MMRPSR2-1	04A138-04	53862.03	X		X	X	X	X	X		X	X	X
MMRKASR2-1	04A138-05	53862.04	X		X	X	X	X	X		X	X	X
MMRKGSR2-2	04A138-06							X				X	X
MMRKGSR2-3	04A138-07							X				X	X
MMRKGSR2-5	04A138-08							X				X	X
MMRKASR2-2	04A138-09							X				X	X
MMRKGSR2-4	04A138-10							X				X	X
MMR-SW-E4-B01	04A145-01							X					X
MMR-SW-E4-B02	04A145-02											X	X
MMR-SW-E4-B03	04A145-03							X					X
MMR-SW-E4-B04	04A145-04											X	X
MMR-SW-E4-B05	04A145-05							X					X
MMR-SW-E4-B06	04A145-06											X	X
MMR-SW-E4-B07	04A145-07												X
MMR-SW-E4-B08	04A145-08												X
MMR-SW-E4-B09	04A145-09												X
MMR-SW-E4-B10	04A145-10												X
MMR-SW-E4-B11	04A145-11											X	X
MMR-SW-E4-B12	04A145-12							X					X

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMR-SW-E4-B13	04A145-13												X
MMR-SW-E4-B14	04A145-14												X
MMR-SW-E4-B15	04A145-15												X
MMR-SW-E4-B16	04A145-16												X
MMR-SW-E4-B17	04A145-17												X
MMR-SW-E4-B18	04A145-18												X
MMR-SW-E4-B19	04A145-19												X
MMR-SW-E4-B20	04A145-20												X
MMR-SW-E4-B21	04A145-21												X
MMR-SW-E4-B22	04A145-22												X
MMR-SW-E4-B23	04A145-23												X
MMR-SW-E4-B24	04A145-24											X	X
MMR-SW-E4-B25	04A145-25							X					X
MMR-SW-E4-B26	04A145-26												X
MMR-SW-E4-B27	04A145-27												X
MMR-SW-E4-B28	04A145-28												X
MMR-SW-E4-B29	04A145-29												X
MMR-SW-E4-B30	04A145-30												X
MMR-SW-E4-B31	04A145-31												X
MMR-SW-E4-B32	04A145-32												X
MMR-SW-E4-B33	04A145-33												X

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMR-SW-E4-B34	04A145-34												X
MMR-SW-E4-B35	04A145-35												X
MMR-SW-E4-B36	04A145-36												X
MMR-SW-E4-B37	04A145-37												X
MMR-SW-E4-B38	04A145-38												X
MMR-SW-E4-B39	04A145-39												X
MMR-SW-E4-B40	04A145-40												X
MMR-SW-E4-B41	04A145-41												X
MMR-SW-E4-B42	04A145-42												X
MMR-SW-E4-B43	04A145-43												X
MMR-SW-E4-B44	04A145-44												X
MMR-KGS-R3-1	04C023-01	53993.01	X		X	X	X	X	X		X	X	X
MMR-MS-R3-1	04C023-02	53993.02	X		X	X	X	X	X		X	X	X
MMR-KAS-R3-1	04C023-03	53993.04	X		X	X	X	X	X		X	X	X
MMR-PS-R3-1	04C023-04	53993.03	X		X	X	X	X	X		X	X	X
MMR-KGS-R3-2	04C023-05							X				X	X
MMR-MS-R3-2	04C023-06							X				X	X
MMR-KAS-R3-2	04C023-07							X				X	X
MMR-PS-R3-2	04C023-08							X				X	X
MMR-KGS-R3-3	04C023-09											X	
MMR-KGS-R3-4	04C023-10							X				X	X

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMR-MSISCO-B11-1	04C023-11											X	X
MMR-MSISCO-B12-1	04C023-12												X
MMR-MSISCO-B13-1	04C023-13												X
MMR-MSISCO-B14-1	04C023-14												X
MMR-MSISCO-B15-1	04C023-15												X
MMR-MSISCO-B16-1	04C023-16												X
MMR-MSISCO-B17-1	04C023-17												X
MMR-MSISCO-B18-1	04C023-18												X
MMR-MSISCO-B19-1	04C023-19												X
MMR-MSISCO-B20-1	04C023-20												X
Trip Blank 2/28/04	04C023-21		X										X
MMR-MSISCO-B21-1	04C024-01												X
MMR-MSISCO-B22-1	04C024-02												X
MMR-MSISCO-B23-1	04C024-03												X
MMR-MSISCO-B24-1	04C024-04												X
MMR-MSISCO-B01-2	04C024-05												X
MMR-MSISCO-B02-2	04C024-06												X
MMR-MSISCO-B03-2	04C024-07												X
MMR-MSISCO-B04-2	04C024-08												X
MMR-MSISCO-B05-2	04C024-09												X
MMR-MSISCO-B06-2	04C024-10												X

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMR-MSISCO-B01-1	04C024-11												X
MMR-MSISCO-B02-1	04C024-12												X
MMR-MSISCO-B03-1	04C024-13												X
MMR-MSISCO-B04-1	04C024-14												X
MMR-MSISCO-B05-1	04C024-15												X
MMR-MSISCO-B06-1	04C024-16												X
MMR-MSISCO-B07-1	04C024-17												X
MMR-MSISCO-B08-1	04C024-18												X
MMR-MSISCO-B09-1	04C024-19												X
MMR-MSISCO-B10-1	04C024-20							X					X
MMR-MSISCO-B07-2	04C024-21												X
MMR-MSISCO-B01-3	04C024-22												X
MMR-MSISCO-B02-3	04C024-23												X
MMR-MSISCO-B03-3	04C024-24												X
MMR-MSISCO-B04-3	04C024-25												X
MMR-MSISCO-B05-3	04C024-26												X
MMR-MSISCO-B06-3	04C024-27												X
MMR-MSISCO-B07-3	04C024-28												X
MMR-MS-R3-3	04C024-29							X				X	X
MMR-MSISCO-B01	04C067-01												X
MMR-MSISCO-B02	04C067-02												X

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMR-MSISCO-B03	04C067-03												X
MMR-MSISCO-B04	04C067-04												X
MMR-MSISCO-B05	04C067-05												X
MMR-MSISCO-B06	04C067-06												X
MMR-MSISCO-B07	04C067-07												X
MMR-MSISCO-B08	04C067-08												X
MMR-MSISCO-B09	04C067-09												X
MMR-MSISCO-B10	04C067-10												X
MMR-MSISCO-B11	04C067-11												X
MMR-MSISCO-B12	04C067-12												X
MMR-MSISCO-B13	04C067-13												X
MMR-MSISCO-B14	04C067-14												X
MMR-MSISCO-B15	04C067-15												X
MMR-MSISCO-B16	04C067-16												X
MMR-MSISCO-B17	04C067-17												X
MMR-MSISCO-B18	04C067-18												X
MMR-MSISCO-B19	04C067-19												X
MMR-MSISCO-B20	04C067-20												X
MMR-MSISCO-B21	04C067-21												X
MMR-MSISCO-B22	04C067-22												X
MMR-MSISCO-B23	04C067-23												X

Sample Identification	Primary Laboratory Identification	Subcontracting Laboratory Identification	Method 8260	Method 8021	Method 8270C	Method 8290	Method 8270C/SIMS/8310	Method 8330	Method 8332	Method 8015	Methods 8151A/8081A/8082	Methods 6010C, 7470A, 7471A	Inorganics
MMR-MSISCO-B24	04C067-24												X
MMR-M65-R3-5	04C067-25							X					X
MMR-MSISCO-B01-5	04C088-01												X
MMR-MSISCO-B02-5	04C088-02												X
MMR-MSISCO-B03-5	04C088-03												X
MMR-MSISCO-B04-5	04C088-04												X
MMR-MSISCO-B05-5	04C088-05												X
MMR-MSISCO-B06-5	04C088-06												X
MMR-MSISCO-B07-5	04C088-07												X
MMR-MSISCO-B08-5	04C088-08												X
MMR-MSISCO-B09-5	04C088-09												X
MMR-MSISCO-B10-5	04C088-10												X
MMR-MSISCO-B11-5	04C088-11												X
MMR-MSISCO-B12-5	04C088-12												X

Key:

Method 8260B	=	Volatile organic compounds by GC/MS
Method 8270C	=	Semivolatile organic compounds by GC/MS
Method 8270C/SIMS/8310	=	Polynuclear aromatic hydrocarbons by GC/MS/SIMS or HPLC
Method 8021	=	Volatile organic compounds by GC
Method 8330	=	Explosives by HPLC
Method 8332	=	Nitroglycerine by HPLC
Method 8015	=	Total petroleum hydrocarbons by GC
Methods 8151A, 8081A, 8082	=	Chlorphenoxy herbicides, chlorinated pesticides, and/or polychlorinated biphenyls by GC
Methods 6010B, 7470A, 7471A	=	Metals by ICP and CVAA
Inorganics	=	Bromide, chloride, cyanide, fluoride, nitrate, nitrite, orthophosphate, perchlorate, sulfate, and sulfide by IC or classical wet chemistry methods

Attachment 5.
Field Sample Splits Relative Percent Difference (RPD)

Samples Submitted to EMAX and Sequoia Laboratories

Makua Military Reservation
2002, 2003, and 2004 Sampling Events
January, 2005

Field splits were collected and analyzed. Test results were reviewed, and where positive results were found, the RPD was calculated. All analytes, except those listed in the tables below, were reported as not detected.

Analysis for BTEX by EPA 8021

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRDBSS1-1F	MMRDEERBERM1-1F	
Benzene	53	ND	NC
Toluene	0.9	ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRCAASS 1-7F	MMRCAASS1-7F	
Toluene	2.3	ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMROB/ODSS1-5F	MMROB/ODSS1-5	
Toluene	0.84	Not Reported	NC
Benzene	6.5	Not Reported	NC

Analysis for VOCs by EPA 8260B

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW-4C	MMRMW-4C	
1,2,4-Trimethylbenzene	0.4	0.3	28.6
m/p-Xylenes	0.47	0.61	25.9
Toluene	0.31	0.44	34.7
Bromomethane	ND	0.81	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW-4C	MMRMW-4C	
Ethylbenzene	ND	0.14	NC
o-Xylene	ND	0.23	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW5-R2	MMRMW5-R2	
Toluene	0.78	0.63	21.3
m/p-Xylenes	0.41	0.4	2.5
Benzene	ND	0.09	NC
o-Xylene	ND	0.11	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMR-MW2-R5	MMR-MW2-R5	
Chloroform	ND	0.21	NC
Methy-tert-butyl-ether	ND	0.12	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW3A-R6	MMRMW3A-6R	
Chloromethane	All ND	0.21	NC

Analysis for SVOCs by EPA 8270C

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRCAASS 1-7F	MMRCAASS1-7F	
2,4,6-Tribromophenol	ND	4060	NC
Benzo(a)pyrene	ND	59	NC
Benzo(b+k)fluoranthene (total)	ND	62	NC
Benzo(g,h,i)perylene	ND	280	NC
Benzoic acid	ND	430	NC
Chrysene	ND	50	NC
Dibenz(a,h)anthracene	ND	240	NC
di-n-octyl Phthalate	ND	94	NC
Indeno(1,2,3-cd)pyrene	ND	240	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRDBSS1-1F	MMRDEERBERM1-1F	

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRDBSS1-1F	MMRDEERBERM1-1F	
Benzo(g,h,i)perylene	ND	210	NC
Benzoic acid	Not Reported	300	NC
Dibenzo(a,h)anthracene	ND	230	NC
Indeno(1,2,3-cd)pyrene	ND	190	NC
n-Nitrosodimethylamine	ND	2760	NC
Pyridine	Not Reported	3310	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW-4C	MMRMW-4C	
SVOCs	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW5-R2	MMRMW5-R2	
SVOCs	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMROB/ODSS1-5F	MMROB/ODSS1-5	
2,4-Dinitrotoluene	320	570	56.2
di-n-Butylphthalate	660	1400	71.8
Benzo(g,h,i)perylene	ND	450	NC
Dibenz(a,h)anthracene	ND	440	NC
n-Nitrosodiphenylamine	ND	60	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMR-MW2-R5	MMR-MW2-R5	
SVOCs	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW3A-R6	MMRMW3A-6R	
SVOCs	All ND	All ND	NC

Analysis for PAHs by EPA 8270C/SIMS or EPA 8310

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRCAASS 1-7F	MMRCAASS1-7F	
Benzo(a)anthracene	ND	24	NC
Benzo(a)pyrene	ND	43	NC
Benzo(b)fluoranthene	ND	40	NC
Benzo(b+k)fluoranthene (total)	ND	63	NC
Benzo(g,h,i)perylene	ND	30	NC
Benzo(k)fluoranthene	ND	23	NC
Dibenz(a,h)anthracene	ND	35	NC
Indeno(1,2,3-cd)pyrene	ND	71	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRDBSS1-1F	MMRDEERBERM1-1F	
Benzo(a)pyrene	ND	8	NC
Benzo(b)fluoranthene	ND	7.5	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW-4C	MMRMW-4C	
PAHs	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW5-R2	MMRMW5-R2	
PAHs	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMROB/ODSS1-5F	MMROB/ODSS1-5	
Benzo(a)pyrene	ND	10	NC
Benzo(b)fluoranthene	ND	13	NC
Benzo(b+k)fluoranthene (total)	ND	13	NC
Dibenz(a,h)anthracene	ND	7.5	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMR-MW2-R5	MMR-MW2-R5	
PAHs	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW3A-R6	MMRMW3A-6R	
PAHs	All ND	All ND	NC

Analysis for Pesticides by EPA 8081A

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRCAASS 1-7F	MMRCAASS1-7F	
Endosulfan I	6.1	ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRDBSS1-1F	MMRDEERBERM1-1F	
Pesticides	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW-4C	MMRMW-4C	
Pesticides	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW5-R2	MMRMW5-R2	
Pesticides	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMROB/ODSS1-5F	MMROB/ODSS1-5	
alpha-BHC	12	ND	NC
Dieldrin	3.5	ND	NC
Endrin aldehyde	38	ND	NC
Heptachlor	50	ND	NC
Heptachlor epoxide	1.7	ND	NC
Methoxychlor	53	ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMR-MW2-R5	MMR-MW2-R5	
Pesticides	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW3A-R6	MMRMW3A-6R	
Pesticides	All ND	All ND	NC

Analysis for PCBs by EPA 8082

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRCAASS 1-7F	MMRCAASS1-7F	
PCBs	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRDBSS1-1F	MMRDEERBERM1-1F	
PCBs	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW-4C	MMRMW-4C	
PCBs	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW5-R2	MMRMW5-R2	
PCBs	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMROB/ODSS1-5F	MMROB/ODSS1-5	
PCB-1254	24	ND	NC
PCB-1260	ND	42	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMR-MW2-R5	MMR-MW2-R5	
PCBs	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW3A-R6	MMRMW3A-6R	
PCBs	All ND	All ND	NC

Analysis for Herbicides by EPA8151A

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRCAASS 1-7F	MMRCAASS1-7F	
Herbicides	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRDBSS1-1F	MMRDEERBERM1-1F	
Herbicides	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW-4C	MMRMW-4C	
Herbicides	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW5-R2	MMRMW5-R2	
Herbicides	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMROB/ODSS1-5F	MMROB/ODSS1-5	
Dinoseb	8.8	ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMR-MW2-R5	MMR-MW2-R5	
Herbicides	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW3A-R6	MMRMW3A-6R	
Herbicides	All ND	All ND	NC

Analysis for Explosives

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRCAASS 1-7F	MMRCAASS1-7F	
Explosives	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRBADGERSS 1-1	MMR BADGERSS1-1	
Explosives	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRBUFFALOS 1-6	MMR BUFFALOSS1-6	
Explosives	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRCAASS 1-2	MMR CAASS1-2	
Explosives	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRCOYOTESS 1-7	MMR COYOTESS1-7	
Explosives	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRDEERSS 1-1	MMR DEERSS1-1	
Explosives	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRELKSS 1-7	MMR ELKSS1-7	
Explosives	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRCOYOTESS 1-2	MMRCOTOTESS1-2	
Explosives	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRDEEDSS1-3	MMRDEEDSSS1-3	
Explosives	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRDBSS1-1F	MMRDEERBERM1-1F	
2,4,6-TNT	340	ND	NC
4-AM-2,6-DNT	140	ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRDBSS1-1F	MMRDEERBERM1-1F	
Tetryl	20000	ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRKASSW-R6	MMRKASSW-R6-S	
Explosives	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW-4C	MMRMW-4C	
Explosives	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW5-R2	MMRMW5-R2	
Explosives	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRNFBRSS 1-20	MMRNFRSS1-20	
Explosives	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMROB/ODSS1-5F	MMROB/ODSS1-5	
HMX	370	ND	NC
RDX	400	ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRPSSW-R6	MMRPSSW-R6-S	
Explosives	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRSFDRSS 1-22	MMRSFDRSS1-22	
Explosives	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRWOLFSS1-3	MMRWOLFSS1-3	
Explosives	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRWSBPSS1-1	MMRWSBPSS1-1	
Explosives	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMR-MW2-R5	MMR-MW2-R5	
Explosives	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW3A-R6	MMRMW3A-6R	
Explosives	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRKGR2-3	MMRK6SR2-3	
Explosives	All ND	All ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
		MMR-KGS-R3-3	
Explosives	Not Reported	All ND	NC

Analysis for Metals

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMR BADGERSS 1-1	MMR BADGERSS1-1	
Aluminum	39300	30000	26.8
Antimony	2.87	5.1	56.0
Arsenic	3.88	4.5	14.8
Barium	116	130	11.4
Beryllium	0.887	0.67	27.9
Boron	9.42	6.6	35.2
Calcium	2850	4700	49.0
Chromium	264	320	19.2
Cobalt	72.4	95	27.0
Copper	91.8	100	8.6
Iron	86600	110000	23.8
Lead	21.8	24	9.6
Magnesium	894	1000	11.2

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMR BADGERSS 1-1	MMR BADGERSS1-1	
Manganese	2430	3000	21.0
Molybdenum	ND	2.7	NC
Nickel	141	130	8.1
Potassium	1140	930	20.3
Selenium	3.8	1.8	71.4
Sodium	328	280	15.8
Strontium	26.7	29	8.3
Tin	ND	11	NC
Titanium	4490	5500	20.2
Vanadium	194	260	29.1
Zinc	126	150	17.4
Mercury	0.227	0.14	47.4

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRBUFFALOS 1-6	MMR BUFFALOSS1-6	
Aluminum	53900	46000	15.8
Antimony	7.67	11	35.7
Arsenic	1.27	3.1	83.8
Barium	198	210	5.9
Beryllium	1.15	0.79	37.1
Boron	12	6.6	58.1
Cadmium	ND	0.85	NC
Calcium	2220	2100	5.6
Chromium	281	320	13.0
Cobalt	64.3	79	20.5
Copper	126	120	4.9
Iron	96100	100000	4.0
Lead	10.7	7.8	31.4
Magnesium	2790	1500	60.1
Manganese	3110	3200	2.9
Molybdenum	ND	2.2	NC
Nickel	185	170	8.5
Potassium	2240	2400	6.9
Selenium	4.29	2.6	49.1
Sodium	361	270	28.8
Strontium	41.9	39	7.2
Titanium	6140	6600	7.2
Vanadium	220	280	24.0

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRBUFFALOS 1-6	MMR BUFFALOSS1-6	
Zinc	152	150	1.3
Mercury	0.369	0.13	95.8

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRCAASS 1-2	MMR CAASS1-2	
Aluminum	58600	32000	58.7
Antimony	7.92	ND	NC
Arsenic	4.64	5.9	23.9
Barium	151	250	49.4
Beryllium	1.43	1	35.4
Boron	11.3	5.6	67.5
Cadmium	ND	1.1	NC
Calcium	1190	1600	29.4
Chromium	266	220	18.9
Cobalt	102	150	38.1
Copper	91.8	110	18.0
Iron	105000	100000	4.9
Lead	41.1	14	98.4
Magnesium	1050	930	12.1
Manganese	3360	6500	63.7
Molybdenum	ND	3.1	NC
Nickel	226	220	2.7
Potassium	1100	980	11.5
Selenium	4.73	3.9	19.2
Sodium	455	310	37.9
Strontium	26.8	21	24.3
Thallium	ND	0.26	NC
Titanium	5580	4500	21.4
Vanadium	215	200	7.2
Zinc	126	160	23.8
Mercury	0.228	0.11	69.8

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRCOYOTESS 1-7	MMR COYOTESS1-7	
Aluminum	54300	35000	43.2
Antimony	3	3.7	20.9
Arsenic	6.46	4.6	33.6
Barium	224	240	6.9

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRCOYOTESS 1-7	MMR COYOTESS1-7	
Beryllium	1.43	1	35.4
Boron	10.3	6.2	49.7
Cadmium	ND	0.86	NC
Calcium	4250	3500	19.4
Chromium	220	240	8.7
Cobalt	101	110	8.5
Copper	113	110	2.7
Iron	93400	96000	2.7
Lead	78.9	30	89.8
Magnesium	1170	1100	6.2
Manganese	4890	5200	6.1
Molybdenum	ND	3.1	NC
Nickel	221	180	20.4
Potassium	1910	1400	30.8
Selenium	3.73	3.6	3.5
Sodium	426	280	41.4
Strontium	41.9	33	23.8
Thallium	0.4	ND	NC
Titanium	4310	4400	2.1
Vanadium	172	200	15.1
Zinc	179	170	5.2
Mercury	0.0816	0.077	5.8

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRDEERSS 1-1	MMR DEERSS1-1	
Aluminum	61500	34000	57.6
Antimony	6.83	ND	NC
Arsenic	5.23	1	136
Barium	121	110	9.5
Beryllium	1.42	1	34.7
Boron	12	4.4	92.7
Calcium	2210	2300	4.0
Chromium	219	190	14.2
Cobalt	88.4	110	21.8
Copper	93.3	61	41.9
Iron	95100	72000	27.6
Lead	11.9	8.4	34.5
Magnesium	1310	830	44.9

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRDEERSS 1-1	MMR DEERSS1-1	
Manganese	2830	3100	9.1
Molybdenum	ND	1.1	NC
Nickel	206	120	52.8
Potassium	1100	570	63.5
Selenium	5.09	1.9	91.3
Sodium	434	310	33.3
Strontium	37.2	26	35.4
Thallium	ND	0.14	NC
Titanium	4390	2300	62.5
Vanadium	190	140	30.3
Zinc	112	62	57.5
Mercury	0.0816	0.1	20.3

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRELKSS 1-7	MMR ELKSS1-7	
Aluminum	46400	32000	36.7
Antimony	6.18	4.8	25.1
Arsenic	5.67	3.6	44.7
Barium	207	210	1.4
Beryllium	1.44	1	36.1
Boron	10.3	6.4	46.7
Cadmium	ND	0.64	NC
Calcium	1020	1100	7.5
Chromium	233	250	7.0
Cobalt	115	130	12.2
Copper	110	100	9.5
Iron	103000	100000	3.0
Lead	10.4	9.5	9.0
Magnesium	851	790	7.4
Manganese	6220	5900	5.3
Molybdenum	ND	2.5	NC
Nickel	205	160	24.7
Potassium	1060	740	35.6
Selenium	4.09	4.6	11.7
Sodium	369	240	42.4
Strontium	21.3	18	16.8
Thallium	0.36	0.13	93.9
Titanium	4580	4600	0.4

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRELKSS 1-7	MMR ELKSS1-7	
Vanadium	202	230	13.0
Zinc	148	130	12.9
Mercury	0.267	0.19	33.7

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRBACKGROUND1-3	MMRBACKGROUND1-4	
Aluminum	49900	15000	108
Antimony	4.31	4.5	4.3
Arsenic	1.2	0.2	143
Barium	89.3	35	87.4
Beryllium	0.879	0.43	68.6
Boron	13.7	2	149
Calcium	13900	500	186
Chromium	186	61	101
Cobalt	35.1	9.7	113
Copper	67.1	24	94.6
Iron	67400	31000	74.0
Lead	8.01	1.9	123
Magnesium	3580	1800	66.2
Manganese	1120	210	137
Molybdenum	ND	0.78	NC
Nickel	112	46	83.5
Potassium	1740	190	161
Selenium	2.13	0.71	100
Sodium	311	260	17.9
Strontium	87.6	12	152
Titanium	4300	2000	73.0
Vanadium	161	150	7.1
Zinc	80.5	22	114.1
Mercury	0.0604	0.052	14.9

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRCAASS 1-7F	MMRCAASS1-7F	
Aluminum	37700	45000	17.7
Antimony	7.69	12	43.8
Arsenic	3.45	4.6	28.6
Barium	148	140	5.6
Beryllium	1.11	1.5	29.9

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRCAASS 1-7F	MMRCAASS1-7F	
Boron	9.57	7.4	25.6
Cadmium	ND	0.76	NC
Calcium	4160	3400	20.1
Chromium	214	360	50.9
Cobalt	71.3	140	65.0
Copper	82.1	96	15.6
Iron	131000	140000	6.6
Lead	25.1	43	52.6
Magnesium	1190	1300	8.8
Manganese	3060	3400	10.5
Molybdenum	ND	4	NC
Nickel	132	170	25.2
Potassium	1100	1100	0.0
Selenium	5.71	2.4	81.6
Sodium	302	390	25.4
Strontium	46.9	34	31.9
Thallium	0.737	0.35	71.2
Tin	ND	19	NC
Titanium	4140	5800	33.4
Vanadium	172	310	57.3
Zinc	101	130	25.1
Mercury	0.193	0.13	39.0

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRCOYOTESS 1-2	MMRCOTOTESS1-2	
Aluminum	40000	33000	19.2
Antimony	ND	5.9	NC
Arsenic	1.07	1.2	11.5
Barium	72.3	93	25.0
Beryllium	1.15	0.87	27.7
Boron	11	6.5	51.4
Cadmium	ND	0.37	NC
Calcium	4320	2200	65.0
Chromium	217	280	25.4
Cobalt	58.2	61	4.7
Copper	69.9	68	2.8
Iron	89500	99000	10.1
Lead	42.3	13	106

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRCOYOTESS 1-2	MMRCOTOTESS1-2	
Magnesium	1070	1100	2.8
Manganese	1660	1600	3.7
Molybdenum	ND	1.7	NC
Nickel	113	100	12.2
Potassium	1460	1400	4.2
Selenium	4.16	1.6	88.9
Sodium	276	200	31.9
Strontium	38.2	28	30.8
Thallium	ND	0.14	NC
Tin	ND	12	NC
Titanium	3450	4600	28.6
Vanadium	168	230	31.2
Zinc	70.9	82	14.5
Mercury	0.0527	0.049	7.3

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRDEEDSS1-3	MMRDEEDSSS1-3	
Aluminum	52500	29000	57.7
Antimony	8	10	22.2
Arsenic	1.58	2.9	58.9
Barium	155	160	3.2
Beryllium	1.15	0.85	30.0
Boron	12.1	7.1	52.1
Cadmium	ND	0.85	NC
Calcium	29200	41000	33.6
Chromium	217	240	10.1
Cobalt	50.8	59	14.9
Copper	91.4	82	10.8
Iron	81400	87000	6.7
Lead	324	360	10.5
Magnesium	2840	3200	11.9
Manganese	1860	2100	12.1
Molybdenum	ND	1.9	NC
Nickel	165	110	40.0
Potassium	1300	970	29.1
Selenium	2.37	1	81.3
Sodium	536	440	19.7
Strontium	238	310	26.3

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRDEEDSS1-3	MMRDEEDSSS1-3	
Thallium	ND	0.14	NC
Tin	ND	10	NC
Titanium	4390	4900	11.0
Vanadium	162	210	25.8
Zinc	112	130	14.9
Mercury	0.0527	0.05	5.3

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRDBSS1-1F	MMRDEERBERM1-1F	
Aluminum	48500	32000	41.0
Antimony	6.33	3.4	60.2
Arsenic	5.7	2.5	78.0
Barium	229	140	48.2
Beryllium	1.36	1.2	12.5
Boron	9.18	6.7	31.2
Cadmium	ND	0.79	NC
Calcium	2370	1700	32.9
Chromium	216	250	14.6
Cobalt	100	120	18.2
Copper	122	100	19.8
Iron	98800	100000	1.2
Lead	32	20	46.2
Magnesium	1170	750	43.8
Manganese	4950	4900	1.0
Molybdenum	ND	3.2	NC
Nickel	199	150	28.1
Potassium	1740	860	67.7
Selenium	4.69	3.4	31.9
Sodium	361	240	40.3
Strontium	33.1	22	40.3
Thallium	ND	0.24	NC
Tin	ND	380	NC
Titanium	4490	3100	36.6
Vanadium	190	220	14.6
Zinc	179	130	31.7
Mercury	0.181	0.078	79.5

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRKASSW-R6	MMRKASSW-R6-S	
Aluminum, Dissolved	759	770	1.4
Arsenic, Dissolved	ND	2.4	NC
Barium, Dissolved	8.5	7.5	12.5
Beryllium, Dissolved	ND	0.18	NC
Boron, Dissolved	78.4	71	9.9
Calcium, Dissolved	11900	11000	7.9
Copper, Dissolved	ND	2.7	NC
Iron, Dissolved	1020	860	17.0
Magnesium, Dissolved	13100	11000	17.4
Manganese, Dissolved	4.83	3.5	31.9
Nickel, Dissolved	ND	3	NC
Potassium, Dissolved	3890	3700	5.0
Sodium, Dissolved	46100	41000	11.7
Strontium, Dissolved	97	89	8.6
Thallium, Dissolved	ND	0.12	NC
Titanium, Dissolved	37.7	30	22.7
Vanadium, Dissolved	ND	2.3	NC
Zinc, Dissolved	12.5	ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRKASSW-R6	MMRKASSW-R6-S	
Aluminum, Total	1610	850	61.8
Barium, Total	8.57	7.3	16.0
Beryllium, Total	ND	0.18	NC
Boron, Total	79.8	66	18.9
Calcium, Total	12300	9700	23.6
Iron, Total	1410	1000	34.0
Magnesium, Total	13200	11000	18.2
Manganese, Total	5.14	4.1	22.5
Nickel, Total	ND	2.9	NC
Potassium, Total	4560	3300	32.1
Sodium, Total	46600	38000	20.3
Strontium, Total	99.7	84	17.1
Titanium, Total	103	35	98.6
Vanadium, Total	ND	2.9	NC
Zinc, Total	5.5	ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW-4C	MMRMW-4C	
Barium, Total	6.71	8.8	27.0
Boron, Total	109	120	9.6
Cadmium, Total	2.37	ND	NC
Calcium, Total	36400	38000	4.3
Iron, Total	39.6	14	95.5
Magnesium, Total	30600	31000	1.3
Manganese, Total	3.35	6.0	56.7
Potassium, Total	10700	10000	6.8
Selenium, Total	ND	5	NC
Silver, Total	ND	1.5	NC
Sodium, Total	111000	100000	10.4
Strontium, Total	272	260	4.5
Titanium, Total	2.32	2.3	0.9
Vanadium, Total	28.3	22	25.0
Mercury, Total	ND	0.012	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW5-R2	MMRMW5-R2	
Aluminum, dissolved	324	ND	NC
Barium, dissolved	10.6	10	5.8
Beryllium, dissolved	ND	0.26	NC
Boron, dissolved	59.2	79	28.7
Cadmium, dissolved	ND	2.9	NC
Calcium, dissolved	35500	35000	1.4
Chromium, dissolved	16.7	14	17.6
Iron, dissolved	624	23	186
Magnesium, dissolved	46200	46000	0.4
Manganese, dissolved	27.4	16	52.5
Nickel, dissolved	14.3	5.8	84.6
Potassium, dissolved	4720	4800	1.7
Selenium, dissolved	ND	3.4	NC
Sodium, dissolved	67900	69000	1.6
Strontium, dissolved	230	240	4.3
Thallium, dissolved	ND	0.19	NC
Titanium, dissolved	61.9	ND	NC
Vanadium, dissolved	25.1	27	7.3
Zinc, dissolved	35.5	37	4.1

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW5-R2	MMRMW5-R2	
Mercury, dissolved	ND	0.035	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW5-R2	MMRMW5-R2	
Aluminum, total	113	790	150
Barium, total	10.6	13	20.3
Beryllium, total	ND	0.22	NC
Boron, total	60	72	18.2
Calcium, total	37700	34000	10.3
Chromium, total	22.6	23	1.8
Copper, total	ND	2.7	NC
Iron, total	182	1000	139
Magnesium, total	48300	44000	9.3
Manganese, total	20.5	33	46.7
Nickel, total	11	7.5	37.8
Potassium, total	5110	4500	12.7
Selenium, total	5.55	6.4	14.2
Sodium, total	71800	71000	1.1
Strontium, total	241	240	0.4
Titanium, total	13	92	151
Vanadium, total	26.3	26	1.1
Zinc, total	37.7	35	7.4

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRNFBRSS 1-20	MMRNFRSS1-20	
Aluminum	44000	24000	58.8
Antimony	12	3	120
Arsenic	0.473	0.25	61.7
Barium	53	35	40.9
Beryllium	0.431	0.29	39.1
Boron	11.1	3	115
Calcium	2180	1500	37.0
Chromium	172	120	35.6
Cobalt	16.9	12	33.9
Copper	35.8	27	28.0
Iron	87400	60000	37.2
Lead	2.26	2.5	10.1

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRNFBRSS 1-20	MMRNFRSS1-20	
Magnesium	2290	1700	29.6
Manganese	665	480	32.3
Molybdenum	ND	0.68	NC
Nickel	63.2	36	54.8
Potassium	902	590	41.8
Selenium	2.87	0.55	136
Sodium	183	110	49.8
Strontium	34.9	22	45.3
Thallium	ND	0.017	NC
Titanium	3080	2100	37.8
Vanadium	205	160	24.7
Zinc	35.5	23	42.7
Mercury	0.191	0.072	90.5

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMROB/ODSS1-5F	MMROB/ODSS1-5	
Aluminum	33000	28000	16.4
Antimony	5.84	12	69.1
Arsenic	0.418	4.3	165
Barium	58.9	57	3.3
Beryllium	0.547	0.13	123
Boron	7.57	5	40.9
Cadmium	ND	2.1	NC
Calcium	4490	3300	30.6
Chromium	218	250	13.7
Cobalt	24.4	29	17.2
Copper	226	240	6.0
Iron	81800	120000	37.9
Lead	235	170	32.1
Magnesium	1920	1900	1.0
Manganese	685	780	13.0
Molybdenum	ND	2.3	NC
Nickel	62.8	64	1.9
Potassium	474	420	12.1
Selenium	3.87	0.95	121
Sodium	275	210	26.8
Strontium	50.7	44	14.1
Tin	ND	35	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMROB/ODSS1-5F	MMROB/ODSS1-5	
Titanium	2260	2900	24.8
Vanadium	178	290	47.9
Zinc	236	280	17.1
Mercury	0.157	0.069	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRPSSW-R6	MMRPSSW-R6-S	
Aluminum, dissolved	ND	27	NC
Barium, dissolved	9.45	8.1	13.8
Boron, dissolved	126	110	13.6
Calcium, dissolved	33900	29000	15.6
Copper, dissolved	ND	3.1	NC
Iron, dissolved	53	13	121
Magnesium, dissolved	21400	18000	17.3
Nickel, dissolved	ND	3	NC
Potassium, dissolved	13400	11000	19.7
Sodium, dissolved	48500	42000	14.4
Strontium, dissolved	201	180	11.0
Thallium, dissolved	ND	0.38	NC
Titanium, dissolved	ND	1.3	NC
Vanadium, dissolved	5.83	4.5	25.8
Zinc, dissolved	11	ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRPSSW-R6	MMRPSSW-R6-S	
Aluminum	ND	38	NC
Arsenic	ND	2.7	NC
Barium	9.06	8	12.4
Beryllium	ND	0.21	NC
Boron	129	100	25.3
Calcium	34500	27000	24.4
Copper	ND	3.1	NC
Iron	63.9	ND	NC
Magnesium	21000	17000	21.1
Manganese	ND	0.86	NC
Molybdenum	7.9	ND	NC
Nickel	ND	3.1	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRPSSW-R6	MMRPSSW-R6-S	
Potassium	12800	9900	25.6
Selenium	ND	2	NC
Sodium	48400	40000	19.0
Strontium	202	170	17.2
Titanium	3.17	2.1	40.6
Vanadium	5.81	4	36.9
Zinc	7.5	ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRSFDRSS 1-22	MMRSFDRSS1-22	
Aluminum	36800	8600	124
Antimony	5.28	2.2	82.4
Barium	65.1	50	26.2
Beryllium	0.576	0.45	24.6
Boron	11.4	4.4	88.6
Calcium	7630	4900	43.6
Chromium	142	48	98.9
Cobalt	37.4	28	28.7
Copper	63.7	43	38.8
Iron	46300	17000	92.6
Lead	8.43	5.4	43.8
Magnesium	7080	4800	38.4
Manganese	1010	780	25.7
Molybdenum	ND	0.68	NC
Nickel	124	75	49.2
Potassium	1230	720	52.3
Selenium	1.22	0.61	66.7
Sodium	882	500	55.3
Strontium	57.3	37	43.1
Thallium	ND	0.0086	NC
Titanium	3060	2000	41.9
Vanadium	114	97	16.1
Zinc	72.8	50	37.1
Mercury	ND	0.028	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRWOLFSS1-3	MMRWOLFSS1-3	
Aluminum	33500	10000	108
Antimony	ND	4.3	NC
Arsenic	1.55	3.7	81.9
Barium	53	36	38.2
Beryllium	0.577	0.3	63.2
Boron	17.5	16	9.0
Calcium	195000	290000	39.2
Chromium	102	60	51.9
Cobalt	20.5	14	37.7
Copper	109	100	8.6
Iron	35900	23000	43.8
Lead	191	220	14.1
Magnesium	10400	12000	14.3
Manganese	635	510	21.8
Molybdenum	ND	0.74	NC
Nickel	88.6	29	101
Potassium	674	340	65.9
Selenium	0.577	1.4	83.3
Sodium	1270	1500	16.6
Strontium	1320	1800	30.8
Titanium	2580	1500	52.9
Vanadium	81.3	57	35.1
Zinc	56.9	40	34.9
Mercury	ND	0.018	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRWSBPSS1-1	MMRWSBPSS1-1	
Aluminum	59400	29000	68.8
Antimony	6.8	5	30.5
Arsenic	1.82	1.9	4.3
Barium	185	130	34.9
Beryllium	1.4	1.1	24.0
Boron	11.2	5	76.5
Cadmium	ND	0.49	NC
Calcium	2380	2900	19.7
Chromium	245	250	2.0
Cobalt	69.1	110	45.7

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRWSBPSS1-1	MMRWSBPSS1-1	
Copper	80	80	0.0
Iron	99100	100000	0.9
Lead	7.05	5.3	28.3
Magnesium	1800	900	66.7
Manganese	3320	4000	18.6
Molybdenum	ND	2.3	NC
Nickel	223	130	52.7
Potassium	1150	480	82.2
Selenium	3.37	1.9	55.8
Sodium	399	270	38.6
Strontium	32.9	22	39.7
Thallium	ND	0.17	NC
Titanium	5030	3100	47.5
Vanadium	196	220	11.5
Zinc	179	130	31.7
Mercury	0.139	0.094	38.6

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMR-MW2-R5	MMR-MW2-R5	
Arsenic, total	ND	2.5	NC
Barium, total	23.1	22	4.9
Boron, total	86.4	78	10.2
Calcium, total	44,700	37,000	18.8
Iron, total	62.7	ND	NC
Magnesium, total	47,600	41,000	14.9
Manganese, total	241	210	13.7
Nickel, total	18.6	2.8	147.7
Potassium, total	3,490	2,200	45.3
Sodium, total	77,800	75,000	3.7
Strontium, total	221	220	0.5
Vanadium, total	11.3	9.5	17.3
Zinc, total	7.64	9.1	17.4

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMR-MW2-R5	MMR-MW2-R5	
Barium, dissolved	22.2	22	0.9
Boron, dissolved	85.7	87	1.5
Cadmium, dissolved	ND	2.4	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMR-MW2-R5	MMR-MW2-R5	
Calcium, dissolved	43,400	43,000	0.9
Iron, dissolved	63.3	57	10.5
Magnesium, dissolved	47,500	45,000	5.4
Manganese, dissolved	205	200	2.5
Molybdenum, dissolved	ND	8.2	NC
Nickel, dissolved	13.5	2.7	133.3
Potassium, dissolved	2,700	2,100	25.0
Sodium, dissolved	77,000	76,000	1.3
Strontium, dissolved	218	220	0.9
Vanadium, dissolved	14.5	17	15.9
Zinc, dissolved	5.96	12	67.3
Mercury, dissolved	ND	0.083	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW3A-R6	MMRMW3A-6R	
Arsenic, total	ND	5.5	NC
Barium, total	3.76	4.3	13.4
Boron, total	57.6	57	1.1
Calcium, total	66,400	61,000	8.5
Magnesium, total	22,400	20,000	11.3
Manganese, total	18.3	16	13.4
Nickel, total	ND	2.3	NC
Potassium, total	1,790	2,200	20.6
Sodium, total	32,700	30,000	8.6
Strontium, total	345	340	1.5
Vanadium, total	13.7	14	2.2
Zinc, total	ND	15	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW3A-R6	MMRMW3A-6R	
Arsenic, dissolved	ND	5.3	NC
Barium, dissolved	4.21	4.4	4.4
Boron, dissolved	66.8	61	9.1
Calcium, dissolved	68,500	62,000	10.0
Magnesium, dissolved	23,000	21,000	9.1
Manganese, dissolved	18.2	16	12.9
Nickel, dissolved	ND	2.0	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW3A-R6	MMRMW3A-6R	
Potassium, dissolved	2,480	2,100	16.6
Sodium, dissolved	33,900	31,000	8.9
Strontium, dissolved	354	340	4.0
Vanadium, dissolved	14.7	14	4.9
Zinc, dissolved	7.29	20	93.2
Mercury, dissolved	ND	Not Reported	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRKGR2-3	MMRK6SR2-3	
Aluminum, total	3,700	3,300	11.4
Arsenic, total	ND	3.8	NC
Barium, total	14.5	14	3.5
Boron, total	53.9	14	118
Calcium, total	29,600	26,000	12.9
Chromium, total	11.5	11	4.4
Copper, total	ND	7.2	NC
Iron, total	4,850	4,400	9.7
Lead, total	ND	1.2	NC
Magnesium, total	15,100	13,000	14.9
Manganese, total	40.3	36	11.3
Nickel, total	12.4	5.9	71.0
Potassium, total	4,570	3,500	26.5
Sodium, total	29,500	27,000	8.8
Strontium, total	127	120	5.7
Titanium, total	328	240	31.0
Vanadium, total	10.8	13	18.5
Zinc, total	26.1	7.5	111
Mercury, total	ND	0.081	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMR-KGS-R3-3	MMR-KGS-R3-3	
Aluminum, total	2,700	5,600	69.9
Barium, total	14.3	14	2.1
Beryllium, total	ND	0.18	NC
Boron, total	52.5	52	1.0
Calcium, total	24,900	23,000	7.9
Chromium, total	17.2	17	1.2
Copper, total	10.8	14	25.8

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMR-KGS-R3-3	MMR-KGS-R3-3	
Iron, total	5,590	6,200	10.3
Magnesium, total	11,900	12,000	0.8
Manganese, total	59.8	55	8.4
Nickel, total	ND	9.2	NC
Potassium, total	3,730	4,600	20.9
Sodium, total	24,800	25,000	0.8
Strontium, total	105	120	13.3
Titanium, total	277	270	2.6
Vanadium, total	15.2	18	16.9
Zinc, total	109	14	155

Analysis for Inorganics

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRCAASS 1-7F	MMRCAASS1-7F	
Chloride	54.7	67	20.2
Nitrate-n	27.9	34	19.7
Orthophosphate	ND	64	NC
Perchlorate	ND	ND	NC
Sulfate	68.2	69	1.2
Cyanide	.751	1.8	82.2

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRDBSS1-1F	MMRDEERBERM1-1F	
Chloride	25	12	70.3
Nitrate-N	17	8.2	69.8
Orthophosphate-	ND	360	NC
Sulfate	51.2	65	23.8
Cyanide	0.733	ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW-4C	MMRMW-4C	
Bromide	0.742	ND	NC
Chloride	173	170	1.7
Fluoride	0.402	ND	NC
Nitrate-N	2.09	2.5	17.9

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW-4C	MMRMW-4C	
Orthophosphate	0.331	Not Reported	NC
Sulfate	35.5	Not Reported	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW5-R2	MMRMW5-R2	
Bromide	0.639	Not Reported	NC
Chloride	157	Not Reported	NC
Fluoride	0.342	Not Reported	NC
Nitrate-N	1.22	1.7	32.9
Orthophosphate	0.511	Not Reported	NC
Sulfate	88.2	Not Reported	NC
Bicarbonate alkalinity	118	Not Reported	NC
Silica	110	Not Reported	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMROB/ODSS1-5F	MMROB/ODSS1-5	
Chloride	48.7	25	64.3
Fluoride	1.34	ND	NC
Nitrate-N	6.15	4.6	28.8
Orthophosphate	ND	250	NC
Perchlorate	89.5	ND	NC
Sulfate	28.7	15	62.7

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMR-MW2-R5	MMR-MW2-R5	
Cyanide	ND	ND	NC
Sulfide	ND	4.5	NC
Chloride	185	Not Reported	NC
Fluoride	0.577	Not Reported	NC
Nitrate-N	0.2	0.18	10.5
Orthophosphate	0.384	Not Reported	NC
Perchlorate	ND	ND	NC
Sulfate	12.8	Not Reported	NC
Conductivity	Not Reported	910	NC
Bromide	0.763	Not Reported	NC
Nitrite-N	ND	ND	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRMW3A-R6	MMRMW3A-6R	
Chloride	50.2	51	1.6
Fluoride	0.164	ND	NC
Nitrate-N	0.731	0.71	2.9
Orthophosphate	0.268	Not Reported	NC
Perchlorate	ND	2.9	NC
Sulfate	13.2	13	1.5
Conductivity	Not Reported	510	NC
Cyanide	ND	Not Reported	NC
Sulfide	ND	Not Reported	NC

Compound	EMAX Sample Result	Sequoia Duplicate Result	RPD
	MMRKGSR2-3	MMRK6SR2-3	
Total Suspended Solids (TSS)	26	10	88.9

Key:
NC = Not able to calculate
ND = Not-detected

APPENDIX K

Soil and Water Levels Compared to Ecological Screening Levels, National Recommended Water Quality, and Hawai'i 11-54 Rules

Appendix K
Soil and Water Levels Compared to Ecological Screening Levels, National Recommended Water Quality, and Hawai'i 11-54 Rules

Throughout this hydrogeologic assessment for the Makua Military Reservation, the laboratory analytical data were compared to EPA Region IX Industrial Preliminary Remediation Goals (PRGs) for Soils, and Tap Water PRGs and Maximum Contaminant Limits for Water. In addition to these standards (which are also listed below), a number of additional guidelines have been developed for comparison of the laboratory analytical data. These parameters include the following:

a. Groundwater and Surface Water Risk Based Screening Levels

- Federal Maximum Contaminant Levels (MCLs), or federal drinking water standards.
- USEPA Region 9 (Region 9 includes Hawai'i) Preliminary Remediation Goals (PRGs) for Tap Water published October 2002.
- Hawai'i State Department of Health Hawai'i Administrative Rules (HAR) Title 11 (Hawai'i Title 11-281 Tier I Action Levels for Rainfall Less than 200 cm/yr drinking water source not threatened, and 11-54-4 Basic Water Quality Criteria Applicable to All Waters**).
- USEPA Region 5 Ecological Data Quality Levels (EDQLs) for Surface Water (Also called Ecological Screening Levels (ESLs).
- Federal Ambient Water Quality Criteria (AWQC) for Freshwater** (Also called National Recommended Water Quality Criteria – 2002).

***(The "Federal Ambient Water Quality Criteria (AWQC) for Freshwater" and "11-54-4 Basic Water Quality Criteria Applicable to All Waters" are nearly the same lists).*

b. Soil And Sediment Risk Based Screening Levels

- USEPA Generic Soil Screening Levels (SSLs) for Ingestion, Inhalation, and Migration to Groundwater published October 2004.
- USEPA Region 9 Preliminary Remediation Goals (PRGs) for Industrial Land Use Published October 2002.
- Hawai'i State Department of Health Hawai'i Administrative Rules (HAR) Title 11 (Hawai'i Title 11-281 Tier I Action Levels for Rainfall Less than 200 cm/yr drinking water source not threatened)

- USEPA Region 5 Ecological Data Quality Levels (EDQLs) for Soil (applicable to surface soil samples only), also called Ecological Screening Levels (ESLs).

- USEPA Region 5 Ecological Data Quality Levels (EDQLs) for Sediment (applicable to surface soil samples only), also called Ecological Screening Levels (ESLs).

The Federal guidelines (Site Screening levels for soils and sediment, and Ambient Water Quality Criteria) are not regulations, but guidelines that should be handled on a case-by-case basis.

Results of the soil sampling performed by the analytical laboratory were also compared to USEPA Generic Soil Screening Levels (SSLs) for Ingestion, Inhalation, and Migration to Groundwater. Consideration of these USEPA Generic Soil Screening Levels (SSLs) for Ingestion and Inhalation are included and used in developing the Region IX PRGs, so no separate comparison to these values are necessary (EPA, 2004).

A comparison of the Generic soil screening levels (SSLs) for the protection of groundwater have been included for 100 most common contaminants at Superfund Sites. The SSLs were developed using a default dilution-attenuation factor (DAF) of 20 to account for natural processes that reduce contaminant concentrations in the subsurface such as dilution, chemical decay, and biodegradation. The geologic conditions at Makua are conducive to these processes due to the long travel paths for groundwater, and the long distances from the impact area and Open Burning/Open Detonation Area (OB/OD) to off site receptors. Therefore, the SSL with a DAF of 20 are used for comparison. In general, if an SSL is not exceeded for the migration to groundwater pathway, the user may eliminate this pathway from further investigation (EPA, 2004).

Soil and water samples are also compared to Hawai'i Title 11-281 Tier 1 Action Levels for Groundwater (Rainfall $\leq$ 200 cm/year, drinking water source not threatened). These regulations essentially are for underground storage tanks containing products like gasoline and diesel fuel. And while there are no records of underground tanks in the Makua area, these Tier 1 values are used for comparison as a guideline if remediation of the soil would be necessary.

To evaluate the potential for ecological impacts, a comparison of soil and water samples is made to the USEPA Region V Ecological Data Quality Levels (or Ecological Screening Levels) for soil and sediment. Ecological values similar to PRGs are not published for Region IX, so in this vacuum the Region V Ecological Screening Levels are used to provide an indication of potential impacts. The Region V ESLs have been used outside of Region V (such as the Blackbird Mine in Idaho), and the Tri-Service (Army, Navy, Air Force) Remedial Project Manager's Handbook for Ecological Risk Assessment also listed these as a source for comparison of Soil Values for ecological risk (Simini, Checkai, and Maly, 2000). They are used to provide a general indication if additional work is necessary to evaluate ecological impacts.

Table K-1 through K-14 listed in this appendix contain a comparison of the analytical laboratory samples for both soil and groundwater. These tables list only the analytes that have an alternative screening level that is more stringent than the PRG or MCL values.

A review of the tables shows that mostly metal compounds are shown to be above these guidelines, and nearly all of the compounds are likely naturally occurring. Table K-1, K-2, and K-3 listed values above the EPA Region 5 Ecological Screening Levels (ESLs) developed by the EPA. Table K-1 lists all type of compounds found in soil samples reported by the analytical laboratory (EMAX, Inc.), and Table K-2 lists all non-metal compounds reported by the analytical laboratory (EMAX, Inc.). Table K-3 lists values of compounds above ESLs reported by Sequoia laboratory. A few compounds such as acetone, 1,3-DNB, and aldrin are above these screening levels. A review of these compounds listed does not indicate that additional assessment of ecological risk is required, as only a few non-metal compounds were reported by the laboratory. Levels of chromium, copper, nickel (Table K-1) are naturally occurring minerals in Hawaiian soils.

Tables K-4, K-5, K-6, and K-7 list values above the Ecological Soil Screening Criteria developed by the EPA. Some compounds such as di-n-butlylphthalate and 2,6-DNT, and PCB-1260 were reported by the analytical laboratory above these screening values (Table K-5). Di-n-butlylphthalate is a manufactured chemical added to common plastics, wire insulation, paint products, glue, hair spray and other household products. It is commonly found in the environment, and most people are exposed to low levels in water, food, and air (ATSDR, 2004). Other compounds above ESLs, such as explosives 2,6-DNT and 2,6 Dinitrotoluene were limited to the OB/OD area, so that ecological risk would be limited to that area (Tables K-5 and K-7). Based on the few number of compounds, and the low level of these compounds, additional assessment of ecological risk is not deemed necessary.

Tables K-8, K-9, and K-10 list values for water quality samples compared to Ecological Screening, National Recommended Water Quality, and Hawai'i 11-54 levels. Mostly metal compounds that are naturally occurring were listed, with a few detections reported by the laboratory for pesticides, such as lindane and Endosulfan. Table K-9 lists the non-metal compound of carbon disulfide, and the pesticides of heptachlor and lindane. Analytical results reported by the laboratory of water well samples that represent the chemistry of discharging groundwater contain non-metal compounds of chloride and endosulfan (a pesticide) above ESLs. Based on the few number of compounds, and the low level of these compounds, additional assessment of ecological risk is not deemed necessary.

Table K-11, K-12, K-13, and K-14 list a comparison of the EPA Region IX Generic Soil Screening Levels (SSLs) for Ingestion, Inhalation, and Migration to Groundwater published October 2004. Only compounds with a more stringent SSL than the Industrial Soil PRG are listed. Table K-11 and K-13 list samples that exceeded these SSLs for the metals of antimony, chromium, nickel, and selenium reported by EMAX and Sequoia analytical laboratory, respectively. Chromium and nickel are listed as naturally occurring in Waianae Range basalts (Presley, 1997), and antimony and

selenium are also naturally occurring. It is not anticipated that additional assessment of ecological risk from these compounds is necessary.

Table K-12 and K-14 list non-metal compounds reported by the laboratory at concentrations above SSL values for EMAX and Sequoia analytical laboratory, respectively. Compounds above SSL are limited largely to the OB/OD area, and include 2,4-Dinitrotoluene, 2,4-DNT, 2,6-DNT, and the pesticides of dieldrin and Alpha-BHC. . Based on the few number of compounds, the low level of these compounds, and that they are limited to the Open Burning/Open Detonation area, additional assessment of ecological risk is not deemed necessary for this study.

Table K-1 Sediment Levels Above Ecological Screening Levels - EMAX Laboratory

		Compound					
		1,3-DNB	ACETONE	ALDRIN	CHROMIUM	COPPER	NICKEL
Unit		UG/KG	UG/KG	UG/KG	MG/KG	MG/KG	MG/KG
Screening Level		Ecol Scr. Sed.	Ecol Scr. Sed.	Ecol Scr. Sed.	Ecol Scr. Sed.	Ecol Scr. Sed.	Ecol Scr. Sed.
Value		8.61	9.90	2.00	43.4	31.6	22.7
Sample Label	**Location of Sample**						
MMRKASBS-0.5	Kaluakauila Stream		71		138	52	118
MMRKASBS-1.0	Kaluakauila Stream		60		149	54.9	159
MMRKSBS-0.5	Koiahi Gulch		130		191	72.2	139
MMRKSBS-1.0	Koiahi Gulch		95	2.9	145	54.4	121
MMRKSBS-1.5	Koiahi Gulch		78		172	63.6	143
MMRMSBS-0.5	Makua Stream		150		154	45.6	312
MMRMSBS-1.0	Makua Stream		21		142	48.3	336
MMRMSBS-1.5	Makua Stream	190J	21		159	48.3	382
MMRPSBS-0.5	Punapohaku Stream		130		147	54.6	110
MMRPSBS-1.0	Punapohaku Stream		60		157	56.8	122
MMRPSBS-1.5	Punapohaku Stream		65		162	55.8	122

J = Semiquantified Results

Ecol. Scr. Sed. = Ecological Screening Levels (ESLs) Developed by Region V EPA for Sediment

Table K-2 Sediment Levels Above Ecological Screening Levels - EMAX Laboratory - Non-Metal Results				
		Compound		
		1,3-DNB	ACETONE	ALDRIN
Unit		UG/KG	UG/KG	UG/KG
Screening Level		Ecol Scr. Sed.	Ecol Scr. Sed.	Ecol Scr. Sed.
Value		8.61	9.90	2.00
Sample Label	**Location of Sample**			
MMRKASBS-0.5	Kaluakauila Stream		71	
MMRKASBS-1.0	Kaluakauila Stream		60	
MMRKSBS-0.5	Koiahi Gulch		130	
MMRKSBS-1.0	Koiahi Gulch		95	2.9
MMRKSBS-1.5	Koiahi Gulch		78	
MMRMSBS-0.5	Makua Stream		150	
MMRMSBS-1.0	Makua Stream		21	
MMRMSBS-1.5	Makua Stream	190J	21	
MMRPSBS-0.5	Punapohaku Stream		130	
MMRPSBS-1.0	Punapohaku Stream		60	
MMRPSBS-1.5	Punapohaku Stream		65	

J = Semiquantified Results

Ecol. Scr. Sed. = Ecological Screening Levels (ESLs) Developed by Region V EPA for Sediment

Table K-3 Sediment Levels Above Ecological Screening Levels - Sequoia Laboratory					
		Compound			
		Acetone	Chromium	Copper	Nickel
Unit		UG/KG	MG/KG	MG/KG	MG/KG
Screening Level		Ecol Scr. Sed.	Ecol Scr. Sed.	Ecol Scr. Sed.	Ecol Scr. Sed.
Value		9.90	43.4	31.6	22.7
Sample Label	**Location of Sample**				
MMRMSBS-1.5	Makua Stream	29.00	120.00	48.00	190.00
J = Semiquantified Results					
Ecol. Scr. Sed. = Ecological Screening Levels (ESLs) Developed by Region V EPA for Sediment					

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory - Metal Results								
		Compound						
		ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CHROMIUM	COBALT	COPPER
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		5.7	1.04	1.06	0.00222	0.4	0.14	5.4
Sample Label	**Location**							
MMR105FASS 1-1	105 Firing Area		23.7			43		15.4J
MMR105FASS 1-1F	105 Firing Area		103			121	38.9	62.4
MMR105FASS 1-2	105 Firing Area		78.4			92.3	24.3	44.9
MMR105FASS 1-2F	105 Firing Area		15.8			29.6	9.64J	9.06J
MMR105FASS BLANK	105 Firing Area		89.1			114	29.2	61.5
MMR105FASS1-1F	105 Firing Area							
MMRAGSS 1-1	Area G		134	1.25		281	55	92.1
MMRAGSS 1-2	Area G		157	1.45		245	80.9	81.1
MMRAGSS 1-3	Area G		156	1.23		265	121	85.7
MMRAGSS1-1	Area G							
MMRAGSS1-2	Area G							
MMRAGSS1-3	Area G							
MMRAREAGSS 1-2F	Area G		131			230	80.9	67.7
MMRAREAGSS1-2F	Area G							
MMRBACKGROUND 1-10	North Fire Break Road		73.8			105	11.3	22
MMR-BACKGROUND 1-2	Background		61.5			170	32.9	57.2
MMRBACKGROUND 1-3	Background		89.3			186	35.1	67.1
MMRBACKGROUND 1-4	Background		61.8			183	13.8	45.7
MMRBACKGROUND 1-5	Background		172			118	41.1	34.6
MMRBACKGROUND 1-6	Background		59.4			154	37.5	61.9
MMRBACKGROUND 1-7	North Fire Break Road		78.1	1.37		339	71.4	99.6
MMRBACKGROUND 1-8	North Fire Break Road		63.6			221	45.8	76.6
MMRBACKGROUND 1-9	North Fire Break Road		86.3			117	29.4	28.6

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory - Metal Results								
		Compound						
		ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CHROMIUM	COBALT	COPPER
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		5.7	1.04	1.06	0.00222	0.4	0.14	5.4
Sample Label	**Location**							
MMRBACKGROUND1-3	Background							
MMRBACKGROUND1-4	Background							
MMRBACKGROUND1-5	Background							
MMRBACKGROUND1-6	Background							
MMRBADGERBLIND BLANK	Badger		129	1.09J		293	99.5	106
MMRBADGERBLINDBLANK	Badger							
MMRBADGERSS 1-1	Badger		116			264	72.4	91.8
MMRBADGERSS 1-10	Badger		122			267	70.8	113
MMRBADGERSS 1-10F	Badger		131			248	76.2	111
MMRBADGERSS 1-2	Badger		146			320	80.6	97.5
MMRBADGERSS 1-3	Badger		70.3			223	62.6	109
MMRBADGERSS 1-4	Badger		92.3			250	62.2	143
MMRBADGERSS 1-5	Badger	5.79	147			263	102	136
MMRBADGERSS 1-6	Badger		123			218	76.7	141
MMRBADGERSS 1-7	Badger		18.4			89.3	21.7	87.7
MMRBADGERSS 1-8	Badger	7.23	127	1.3		317	137	144
MMRBADGERSS 1-9	Badger		52.9			124	34.6	126
MMRBADGERSS1-1	Badger							
MMRBADGERSS1-10	Badger							
MMRBADGERSS1-10F	Badger							
MMRBADGERSS1-2	Badger							
MMRBADGERSS1-3	Badger							

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory - Metal Results								
		Compound						
		ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CHROMIUM	COBALT	COPPER
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		5.7	1.04	1.06	0.00222	0.4	0.14	5.4
Sample Label	**Location**							
MMRBADGERSS1-4	Badger							
MMRBADGERSS1-5	Badger							
MMRBADGERSS1-6	Badger							
MMRBADGERSS1-8	Badger							
MMRBHSS1-1	Borehole		31.3			250	14	81.8
MMRBHSS1-2	Borehole		74.8	2.63		91.1	17.1	28.8
MMRBHSS1-3	Borehole		127	2.91		44.7	131	10.2
MMRBHSS1-4	Borehole		127	1.82		134	40.3	50.4
MMRBHSS1-5	Borehole		126	1.27J		153	65.3	58.2
MMRBHSS1-6	Borehole		116	1.55		114	46.1	51.4
MMRBHSS1-7	Borehole		99.8			170	40.6	85.3
MMRBHSS1-8	Borehole		206			209	65.8	78.5
MMRBHSS2-1	Borehole		451			228	17.9	93.6
MMRBHSS2-2	Borehole		91.6	1.14J		306	15.7	99.6
MMRBHSS2-3	Borehole		86	2.43		490	25.8	100
MMRBHSS2-4	Borehole		152	2.11		227	81.5	72.3
MMRBHSS2-5	Borehole		114	1.76		130	60.7	60.2
MMRBHSS2-6	Borehole		113	1.49		144	57.8	64.3
MMRBHSS2-7	Borehole		456	1.31J		139	116	67.1
MMRBHSS2-8	Borehole		119			74.5	53.1	43.9
MMRBHSS3-1	Borehole		129	1.2		153	41.2	47.3
MMRBHSS3-2	Borehole		54.1	1.32		206	29.3	54.7
MMRBUFFALOBLIND	Buffalo		187	1.18		288	64.8	124

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory - Metal Results								
		Compound						
		ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CHROMIUM	COBALT	COPPER
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		5.7	1.04	1.06	0.00222	0.4	0.14	5.4
Sample Label	**Location**							
BLANK								
MMRBUFFALOBLINDBLANK	Buffalo							
MMRBUFFALOSS 1-1	Buffalo		81.1			313	37.1	89.2
MMRBUFFALOSS 1-2	Buffalo		239	1.26		293	79.1	125
MMRBUFFALOSS 1-3	Buffalo		164	1.16		357	41.4	84
MMRBUFFALOSS 1-4	Buffalo		134	1.17		282	74.2	93.3
MMRBUFFALOSS 1-5	Buffalo		139			285	62.3	83
MMRBUFFALOSS 1-6	Buffalo		198	1.15		281	64.3	126
MMRBUFFALOSS 1-6F	Buffalo		195			292	66.9	143
MMRBUFFALOSS1-2	Buffalo							
MMRBUFFALOSS1-3	Buffalo							
MMRBUFFALOSS1-4	Buffalo							
MMRBUFFALOSS1-5	Buffalo							
MMRBUFFALOSS1-6	Buffalo							
MMRBUFFALOSS1-6F	Buffalo							
MMRCAABLIND BLANK	Counter Attack Area	6.88	259	1.28		183	122	111
MMRCAABLINDBLANK	Counter Attack Area							
MMRCAASS 1-1	Counter Attack Area	6.47	172			182	79.4	115
MMRCAASS 1-10	Counter Attack Area	7.75	258	1.39		236	109	120
MMRCAASS 1-11	Counter Attack Area		131	1.16		236	94	97.3
MMRCAASS 1-12	Counter Attack Area	5.92	139	1.21		203	114	103
MMRCAASS 1-13	Counter Attack Area	6.65	124	1.32		193	123	90.6

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory - Metal Results								
		Compound						
		ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CHROMIUM	COBALT	COPPER
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		5.7	1.04	1.06	0.00222	0.4	0.14	5.4
Sample Label	**Location**							
MMRCAASS 1-14	Counter Attack Area		73.5			247	36.5	66.1
MMRCAASS 1-1F	Counter Attack Area		177			173	87.6	108
MMRCAASS 1-2	Counter Attack Area		151	1.43		266	102	91.8
MMRCAASS 1-3	Counter Attack Area		96			266	53.5	92.6
MMRCAASS 1-4	Counter Attack Area		53.1	1.11		263	51.3	79.7
MMRCAASS 1-5	Counter Attack Area		154	1.39		271	68.9	110
MMRCAASS 1-6	Counter Attack Area	8.77	289	1.79		324	137	156
MMRCAASS 1-7	Counter Attack Area		158	1.12		228	65	74.9
MMRCAASS 1-7F	Counter Attack Area		148	1.11J		214	71.3	82.1
MMRCAASS 1-8	Counter Attack Area	7.23	241	1.38		210	129	120
MMRCAASS 1-9	Counter Attack Area	9.04	275	1.7J		289	146	170
MMRCAASS1-1	Counter Attack Area							
MMRCAASS1-10	Counter Attack Area							
MMRCAASS1-11	Counter Attack Area							
MMRCAASS1-12	Counter Attack Area							
MMRCAASS1-13	Counter Attack Area							
MMRCAASS1-14	Counter Attack Area							
MMRCAASS1-1F	Counter Attack Area							
MMRCAASS1-2	Counter Attack Area							
MMRCAASS1-3	Counter Attack Area							
MMRCAASS1-4	Counter Attack Area							
MMRCAASS1-5	Counter Attack Area							
MMRCAASS1-6	Counter Attack Area							

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory - Metal Results								
		Compound						
		ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CHROMIUM	COBALT	COPPER
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		5.7	1.04	1.06	0.00222	0.4	0.14	5.4
Sample Label	**Location**							
MMRCAASS1-7	Counter Attack Area							
MMRCAASS1-7F	Counter Attack Area							
MMRCAASS1-8	Counter Attack Area							
MMRCAASS1-9	Counter Attack Area							
MMRCOYOTEBLIND BLANK	Coyote		218	1.24		200	95.2	103
MMRCOYOTEBLINDBLANK	Coyote							
MMRCOYOTESS 1-1	Coyote		99.2	1.21		260	58.5	70.5
MMRCOYOTESS 1-2	Coyote		72.3	1.15		217	58.2	69.9
MMRCOYOTESS 1-2F	Coyote		83.5	1.11		234	57.5	72.7
MMRCOYOTESS 1-3	Coyote		34.9			190	9.98	53.8
MMRCOYOTESS 1-4	Coyote		28.2			206	20.4	55
MMRCOYOTESS 1-5	Coyote		122	1.21		231	53.9	90.5
MMRCOYOTESS 1-6	Coyote		94.9			199	43.8	124
MMRCOYOTESS 1-7	Coyote	6.46	224	1.43		220	101	113
MMRCOYOTESS 1-8	Coyote		187	1.33		250	69.7	87.6
MMRCOYOTESS1-1	Coyote							
MMRCOYOTESS1-2F	Coyote							
MMRDBSS 1-1	Deer Berms	6.13	224	1.67		228	99.2	124
MMRDBSS 1-1F	Deer Berms		229	1.36		216	100	122
MMRDBSS 1-2	Deer Berms	5.79	210	1.69		222	108	138
MMRDBSS 1-3	Deer Berms		176	1.78		231	122	111
MMRDBSS 1-4	Deer Berms		113	1.71		247	95.5	105

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory - Metal Results								
		Compound						
		ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CHROMIUM	COBALT	COPPER
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		5.7	1.04	1.06	0.00222	0.4	0.14	5.4
Sample Label	**Location**							
MMRDBSS 1-5	Deer Berms		126	1.65		254	90.1	105
MMRDBSS BLANK	Deer Berms		113	1.76		253	108	104
MMRDBSS1-1	Deer Berms							
MMRDBSS1-1F	Deer Berms							
MMRDBSS1-2	Deer Berms							
MMRDBSS1-3	Deer Berms							
MMRDBSS1-4	Deer Berms							
MMRDBSS1-5	Deer Berms							
MMRDBSSBLANK	Deer Berms							
MMRDEEDSSS 1-1	Deeds		151	1.1		217	44.4	70.1
MMRDEEDSSS 1-1F	Deeds		151			208	49.1	68.8
MMRDEEDSSS 1-2	Deeds		98.8			138	32.9	82.4
MMRDEEDSSS 1-3	Deeds		155	1.15		217	50.8	91.4
MMRDEERBLIND BLANK	Deer		110	1.43		208	93.8	77.7
MMRDEERBLINDBLANK	Deer							
MMRDEERSS 1-1	Deer		121	1.42		219	88.4	93.3
MMRDEERSS 1-10	Deer		139	1.43		228	121	95.3
MMRDEERSS 1-11	Deer		69.1	1.21		246	36.3	56
MMRDEERSS 1-12	Deer		143	1.71		264	110	100
MMRDEERSS 1-13	Deer	10.1	29.8			52.2	10.2J	81
MMRDEERSS 1-14	Deer	10.3	38.9			55.7	12.1J	90.5
MMRDEERSS 1-15	Deer		17.7			30.8		42.5
MMRDEERSS 1-1F	Deer		114	1.31		210	90.6	80.8

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory - Metal Results								
		Compound						
		ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CHROMIUM	COBALT	COPPER
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		5.7	1.04	1.06	0.00222	0.4	0.14	5.4
Sample Label	**Location**							
MMRDEERSS 1-2	Deer		4.93J			11.8J		19.5J
MMRDEERSS 1-3	Deer	8.41	21.2			43.2		52.4
MMRDEERSS 1-4	Deer		11.2			18.5J		29.2
MMRDEERSS 1-4F	Deer		7.05J			13.7J		6.4J
MMRDEERSS 1-5	Deer		3.63J			12.1J		
MMRDEERSS 1-6	Deer		24			38.1	9.29J	23.1
MMRDEERSS 1-7	Deer		99.3	1.26		217	85.5	82.1
MMRDEERSS 1-8	Deer		113	1.35		228	88.8	83.7
MMRDEERSS 1-9	Deer		112	1.43		227	93.1	89.4
MMRDEERSS1-1	Deer							
MMRDEERSS1-10	Deer							
MMRDEERSS1-12	Deer							
MMRDEERSS1-1F	Deer							
MMRDEERSS1-7	Deer							
MMRDEERSS1-8	Deer							
MMRDEERSS1-9	Deer							
MMRDEMOPITSS 1-1F	Demo Pit		19.4			249	29.7	53.4
MMRDPASS 1-1	Demo Pit		24.9			282	31.6	61.3
MMRDPASS 1-2	Demo Pit		34.2			272	18.7	73.1
MMRDPASS BLANK	Demo Pit		24.8			282	23.9	57.9
MMRELKBLIND BLANK	Elk		209	1.37		225	112	104
MMRELKBLINDBLANK	Elk							
MMRELKSS 1-1	Elk		166	1.32		243	71.1	153

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory - Metal Results								
		Compound						
		ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CHROMIUM	COBALT	COPPER
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		5.7	1.04	1.06	0.00222	0.4	0.14	5.4
Sample Label	**Location**							
MMRELKSS 1-10	Elk	6.24	239	1.41		236	114	117
MMRELKSS 1-2	Elk	9.02	266	1.51		193	134	149
MMRELKSS 1-3	Elk	6.19	197	1.31		231	92.6	109
MMRELKSS 1-4	Elk		95	1.12		254	67	90.6
MMRELKSS 1-5	Elk		139	1.07		212	56.7	99.2
MMRELKSS 1-6	Elk	8.05	237	1.45		193	119	130
MMRELKSS 1-7	Elk		207	1.44		233	115	110
MMRELKSS 1-7F	Elk		203	1.28		223	117	111
MMRELKSS 1-8	Elk	19.1	171	1.22		182	117	417
MMRELKSS 1-9	Elk		117	1.2		237	92	82.2
MMRELKSS1-10	Elk							
MMRELKSS1-2	Elk							
MMRELKSS1-3	Elk							
MMRELKSS1-4	Elk							
MMRELKSS1-6	Elk							
MMRELKSS1-7	Elk							
MMRELKSS1-7F	Elk							
MMRELKSS1-8	Elk							
MMRELKSS1-9	Elk							
MMRFOXSS 1-1	Fox		139	1.26		166	35.2	65.3
MMRFOXSS 1-2	Fox		144	1.34		232	62.5	177
MMRFOXSS 1-3	Fox		92.3	1.39		187	65.7	79.7
MMRFOXSS 1-3F	Fox		103	1.27		218	86.7	81.5

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory - Metal Results								
		Compound						
		ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CHROMIUM	COBALT	COPPER
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		5.7	1.04	1.06	0.00222	0.4	0.14	5.4
Sample Label	**Location**							
MMRFOXSS BLANK	Fox		128	1.15		150	34.3	58.7
MMRFOXSS1-2	Fox							
MMRFOXSS1-3	Fox							
MMRFOXSS1-3F	Fox							
MMRMSFASS 1-1F	Makua Stream Firing Area		106			145	38.3	47.8
MMRMSFASS 1-2F	Makua Stream Firing Area							
MMRMSFASS1-2F	Makua Stream Firing Area		125	1.3J		197	53.5	66.7
MMRMSFASS1-3F	Makua Stream Firing Area		105	1.1J		164	43.7	58.4
MMRMTASS 1-1	Misc Training Area		156	1.38		292	96.8	144
MMRMTASS 1-2	Misc Training Area		192	1.42		287	96.9	149
MMRMTASS 1-3	Misc Training Area		72.6			263	37	89.1
MMRMTASS 1-3F	Misc Training Area		71.9			206	35.2	74
MMRMTASS 1-4	Misc Training Area		84	1.35		274	90.3	103
MMRMTASS 1-5	Misc Training Area		161	1.34		304	71.6	137
MMRMTASS1-1	Misc Training Area							
MMRMTASS1-2	Misc Training Area							
MMRMTASS1-3F	Misc Training Area							
MMRMTASS1-4	Misc Training Area							
MMRMTASS1-5	Misc Training Area							
MMRMTASSBLANK	Misc Training Area							

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory - Metal Results								
		Compound						
		ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CHROMIUM	COBALT	COPPER
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		5.7	1.04	1.06	0.00222	0.4	0.14	5.4
Sample Label	**Location**							
MMR-NFBR1-10	North Fire Break Road		204	1.61		105	41	38.6
MMR-NFBR1-11	North Fire Break Road		72.6			211	36.8	56.8
MMR-NFBR1-9	North Fire Break Road		11.9			4.4	1.86J	
MMRNFBRSS 1-20	North Fire Break Road		53			172	16.9	35.8
MMRNFBRSS 1-21	North Fire Break Road		118	1.17J		124	45	30.1
MMRNFBRSS1-20	North Fire Break Road							
MMRNFBRSS1-21	North Fire Break Road							
MMROB/ODBLIND BLANK	Open Burn Open Detontata		61.2			233	27.5	15100
MMROB/ODBLINDBLANK	Open Burn Open Detontata							
MMROB/ODSS 1-1F	Open Burn Open Detontata		92		1.17	242	61.3	300
MMROB/ODSS 1-1FDL	Open Burn Open Detontata							
MMROB/ODSS 1-2F	Open Burn Open Detontata		43.6			171	30.7	92.8
MMROB/ODSS 1-3F	Open Burn Open Detontata		80.8		0.817J	180	48.1	224
MMROB/ODSS 1-4F	Open Burn Open Detontata		76.8		0.689J	179	33.2	219
MMROB/ODSS 1-5F	Open Burn Open Detontata		58.9			218	24.4	226
MMROB/ODSS1-1F	Open Burn Open Detontata							
MMROB/ODSS1-2F	Open Burn Open							

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory - Metal Results								
		Compound						
		ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CHROMIUM	COBALT	COPPER
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		5.7	1.04	1.06	0.00222	0.4	0.14	5.4
Sample Label	**Location**							
	Detontata							
MMROB/ODSS1-3F	Open Burn Open Detontata							
MMROB/ODSS1-5F	Open Burn Open Detontata							
MMRPBPSS 1-1	Propose Burn Pit		84.7			106	17.9	28.2
MMRPBPSS 1-1F	Propose Burn Pit		75.3			92.2	16.7	22.4
MMRS-BACKGROUND 1-1	Background		73.2			229	49.7	66.2
MMR-SFBR1-12	South Fire Break Road		47.4			93.8	22	37.5
MMR-SFBR1-13	South Fire Break Road		12.9			294	8.35	65.4
MMR-SFBR1-14	South Fire Break Road		74			148	39.8	66.8
MMR-SFBR1-15	South Fire Break Road		56.1			122	27	56.2
MMR-SFBR1-16	South Fire Break Road		39.8			98.8	24.8	50.7
MMR-SFBR1-17	South Fire Break Road		87.2			158	38.6	74.2
MMR-SFBR1-18	South Fire Break Road		61.5			228	19.9	164
MMRSFBRSS 1-19	South Fire Break Road		86.7			201	36.4	64.8
MMRSFBRSS 1-22	South Fire Break Road		65.1			142	37.4	63.7
MMRSFBRSS1-19	South Fire Break Road							
MMRSFBRSS1-22	South Fire Break Road							
MMRSNFBR-1	North Fire Break Road		85.3			133	35.2	58
MMRS-NFBR1-7	North Fire Break Road		126	1.15J		149	40.3	54.5
MMRS-NFBR1-8	North Fire Break Road		123	1.21J		97.5	42.6	40.7
MMRSNFBR-2	North Fire Break Road		74.7			151	40.6	54.5
MMRSNFBR-3	North Fire Break Road		94.6			164	44.4	72.4

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory - Metal Results								
		Compound						
		ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CHROMIUM	COBALT	COPPER
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		5.7	1.04	1.06	0.00222	0.4	0.14	5.4
Sample Label	**Location**							
MMRSNFBR-4	North Fire Break Road		93.8	1.16J		124	37.9	75.5
MMRSNFBR-5	North Fire Break Road		130			131	40.3	48.2
MMRSNFBR-6	North Fire Break Road		121			223	60.7	86.1
MMRWOLFSS 1-1	Wolf		63.1			173	30.8	64.5
MMRWOLFSS 1-2	Wolf		246	1.43		276	58.6	107
MMRWOLFSS 1-3	Wolf		53			102	20.5	109
MMRWOLFSS 1-4	Wolf		57			178	37.6	70.2
MMRWOLFSS 1-5	Wolf		27.7			234	19.1	64
MMRWOLFSS 1-5F	Wolf		21.6			211	16.5	57.4
MMRWOLFSS 1-6	Wolf		151	1.22		271	52.4	87.8
MMRWSBPSS 1-1	Weather Station Burn Pan		185	1.4		245	69.1	80
MMRWSBPSS 1-1F	Weather Station Burn Pan		175	1.23		245	68.5	78.5
MMRWSBPSS1-1	Weather Station Burn Pan							
MMRWSBPSS1-1F	Weather Station Burn Pan							

J = Semiquantified Results

Ecol. Scr. Sed. = Ecological Screening Levels (ESLs) Developed by Region V EPA.

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory (Continued)											
		Compound									
		LEAD	MERCURY	NICKEL	SELENIUM	SULFIDE	THALLIUM	TIN	TITANIUM	VANADIUM	ZINC
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		0.0537	0.1	13.6	0.0276	0.00358	0.0569	7.62	7.62	1.59	6.62
Sample Label	**Location**										
MMR105FASS 1-1	105 Firing Area			29.9					1060	32.9	23.9
MMR105FASS 1-1F	105 Firing Area	7.78		116	2.48				4090	133	112
MMR105FASS 1-2	105 Firing Area	2.84		82.3	1.14				2900	81	84.7
MMR105FASS 1-2F	105 Firing Area			27.5					779	23.7	18.5
MMR105FASS BLANK	105 Firing Area	6.06		103	1.25				3910	108	146
MMR105FASS1-1F	105 Firing Area					23.3					
MMRAGSS 1-1	Area G	13.6		192	3.12				6440	221	117
MMRAGSS 1-2	Area G	10.1		208	3.33				5210	199	135
MMRAGSS 1-3	Area G	11.1		210	3.23				4840	198	134
MMRAGSS1-1	Area G		0.178								
MMRAGSS1-2	Area G		0.227								
MMRAGSS1-3	Area G		0.157								
MMRAREAGSS 1-2F	Area G	10		134	4.46				4750	196	100
MMRAREAGSS1-2F	Area G		0.233								
MMRBACKGROUND 1-10	North Fire Break Road	5.19		46.4	2.34				1400	135	38.3
MMR-BACKGROUND 1-2	Background	0.606J		87.4	1.45				1580	198	40.4
MMRBACKGROUND 1-3	Background			112					4300	161	80.5
MMRBACKGROUND 1-4	Background			97.6					3720	200	41.2
MMRBACKGROUND 1-5	Background			61.2					2190	151	113
MMRBACKGROUND 1-6	Background			119					2020	104	62.5
MMRBACKGROUND 1-7	North Fire Break Road	4.74	0.12J	134	1.86				4010	235	88.8
MMRBACKGROUND 1-8	North Fire Break Road	2.73		104	1.38J				3500	173	66.9
MMRBACKGROUND 1-9	North Fire Break Road	5.57	0.151	64.3	2.89				2620	176	63.9

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory (Continued)											
		Compound									
		LEAD	MERCURY	NICKEL	SELENIUM	SULFIDE	THALLIUM	TIN	TITANIUM	VANADIUM	ZINC
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		0.0537	0.1	13.6	0.0276	0.00358	0.0569	7.62	7.62	1.59	6.62
Sample Label	**Location**										
MMRBACKGROUND1-3	Background	8.01			2.13						
MMRBACKGROUND1-4	Background	1.06J	0.116J		2.94						
MMRBACKGROUND1-5	Background	9.55	0.158		1.92						
MMRBACKGROUND1-6	Background	11.8			1.21J						
MMRBADGERBLIND BLANK	Badger	24.7		158	4.92				5370	228	175
MMRBADGERBLINDBLANK	Badger		0.243								
MMRBADGERSS 1-1	Badger	21.8		141	3.8					194	126
MMRBADGERSS 1-10	Badger	14.3		164	4.57					205	98.6
MMRBADGERSS 1-10F	Badger	15.1		131	4.21				5620	204	102
MMRBADGERSS 1-2	Badger	12.3		183	4.03					223	110
MMRBADGERSS 1-3	Badger	25.1		151	3.14					177	169
MMRBADGERSS 1-4	Badger	95.5		155	3.41					188	354
MMRBADGERSS 1-5	Badger	22		193	4.04					208	152
MMRBADGERSS 1-6	Badger	54.3		168	3.3					163	527
MMRBADGERSS 1-7	Badger	52.5		68.6	0.984J					81.2	67.8
MMRBADGERSS 1-8	Badger	14.1		243	4.31					244	132
MMRBADGERSS 1-9	Badger	25.2		136	1.44					102	153
MMRBADGERSS1-1	Badger		0.227								
MMRBADGERSS1-10	Badger		0.209								
MMRBADGERSS1-10F	Badger		0.209			13.5					
MMRBADGERSS1-2	Badger		0.216								
MMRBADGERSS1-3	Badger		0.252								
MMRBADGERSS1-4	Badger		0.179								

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory (Continued)											
		Compound									
		LEAD	MERCURY	NICKEL	SELENIUM	SULFIDE	THALLIUM	TIN	TITANIUM	VANADIUM	ZINC
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		0.0537	0.1	13.6	0.0276	0.00358	0.0569	7.62	7.62	1.59	6.62
Sample Label	**Location**										
MMRBADGERSS1-5	Badger		0.251								
MMRBADGERSS1-6	Badger		0.211								
MMRBADGERSS1-8	Badger		0.166								
MMRBHSS1-1	Borehole	3.2		160	1.04J				4240	170	49.8
MMRBHSS1-2	Borehole	2.96		122					7280	156	104
MMRBHSS1-3	Borehole	3.68		62.6					2680	50.8	70
MMRBHSS1-4	Borehole	1.53		212					4250	98.2	67.5
MMRBHSS1-5	Borehole	0.982J		147					3970	98	72.3
MMRBHSS1-6	Borehole	0.994J		156					4380	129	68.4
MMRBHSS1-7	Borehole	1.65		118	0.526J				3700	64.3	67.3
MMRBHSS1-8	Borehole	1.23J		256					5040	126	93.9
MMRBHSS2-1	Borehole	4.62		260	0.861J				4350	162	54.9
MMRBHSS2-2	Borehole	8.67		169	0.831J				4750	192	55.5
MMRBHSS2-3	Borehole	2.01		241	0.868J				4620	151	60.7
MMRBHSS2-4	Borehole	1.79		252	0.625J				4910	173	94.9
MMRBHSS2-5	Borehole	1.59		162	0.433J				4960	134	80.6
MMRBHSS2-6	Borehole	0.632J		132					6310	131	78.8
MMRBHSS2-7	Borehole	1.09J		175					4480	132	90.4
MMRBHSS2-8	Borehole	0.72J		90.6					3020	67.2	74.3
MMRBHSS3-1	Borehole	1.3		206					3220	92.4	49.5
MMRBHSS3-2	Borehole	0.464J		165	0.582J				4460	121	36.8
MMRBUFFALOBLIND BLANK	Buffalo	10		182	4.17				6700	234	149
MMRBUFFALOBLINDBLANK	Buffalo		0.324								

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory (Continued)											
		Compound									
		LEAD	MERCURY	NICKEL	SELENIUM	SULFIDE	THALLIUM	TIN	TITANIUM	VANADIUM	ZINC
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		0.0537	0.1	13.6	0.0276	0.00358	0.0569	7.62	7.62	1.59	6.62
Sample Label	**Location**										
MMRBUFFALOSS 1-1	Buffalo	3.76		134	5.1				5260	249	75.6
MMRBUFFALOSS 1-2	Buffalo	5.99		188	4.67				5890	239	203
MMRBUFFALOSS 1-3	Buffalo	4.15		205	3.69				6790	264	70.3
MMRBUFFALOSS 1-4	Buffalo	4.65		123	4.32				5670	229	122
MMRBUFFALOSS 1-5	Buffalo	8.03		102	4.53				6420	224	79.2
MMRBUFFALOSS 1-6	Buffalo	10.7		185	4.29				6140	220	152
MMRBUFFALOSS 1-6F	Buffalo	12		193	4.5				7160	261	169
MMRBUFFALOSS1-2	Buffalo		0.229								
MMRBUFFALOSS1-3	Buffalo		0.202								
MMRBUFFALOSS1-4	Buffalo		0.18								
MMRBUFFALOSS1-5	Buffalo		0.148								
MMRBUFFALOSS1-6	Buffalo		0.369								
MMRBUFFALOSS1-6F	Buffalo		0.363								
MMRCAABLIND BLANK	Counter Attack Area	14.6		211	4.21				3750	153	151
MMRCAABLINDBLANK	Counter Attack Area		0.269								
MMRCAASS 1-1	Counter Attack Area	53.3		187	3.51				4220	166	151
MMRCAASS 1-10	Counter Attack Area	523		233	4.56					190	186
MMRCAASS 1-11	Counter Attack Area	11.9		199	3.75					180	117
MMRCAASS 1-12	Counter Attack Area	26.3		200	3.59					162	105
MMRCAASS 1-13	Counter Attack Area	14		193	3.76					158	86.6
MMRCAASS 1-14	Counter Attack Area	14.9		145	4.46					175	72.4
MMRCAASS 1-1F	Counter Attack Area	46		156	4.05				3670	163	138
MMRCAASS 1-2	Counter Attack Area	41.1		226	4.73				5580	215	126

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory (Continued)											
		Compound									
		LEAD	MERCURY	NICKEL	SELENIUM	SULFIDE	THALLIUM	TIN	TITANIUM	VANADIUM	ZINC
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		0.0537	0.1	13.6	0.0276	0.00358	0.0569	7.62	7.62	1.59	6.62
Sample Label	**Location**										
MMRCAASS 1-3	Counter Attack Area	18.7		156	5.36				6090	202	90.6
MMRCAASS 1-4	Counter Attack Area	21.1		181	5.09				5660	199	98.9
MMRCAASS 1-5	Counter Attack Area	50.7		171	4.35				4880	206	113
MMRCAASS 1-6	Counter Attack Area	83.4		276	5.72					246	225
MMRCAASS 1-7	Counter Attack Area	30.8		151	4.28					170	108
MMRCAASS 1-7F	Counter Attack Area	25.1		132	5.71		0.737J		4140	172	101
MMRCAASS 1-8	Counter Attack Area	14.9		245	3.93					178	167
MMRCAASS 1-9	Counter Attack Area	29.7		289	5.78					238	375
MMRCAASS1-1	Counter Attack Area		0.125								
MMRCAASS1-10	Counter Attack Area		0.205								
MMRCAASS1-11	Counter Attack Area		0.244								
MMRCAASS1-12	Counter Attack Area		0.232								
MMRCAASS1-13	Counter Attack Area		0.318								
MMRCAASS1-14	Counter Attack Area		0.214								
MMRCAASS1-1F	Counter Attack Area		0.162								
MMRCAASS1-2	Counter Attack Area		0.228								
MMRCAASS1-3	Counter Attack Area		0.13								
MMRCAASS1-4	Counter Attack Area		0.288								
MMRCAASS1-5	Counter Attack Area		0.132								
MMRCAASS1-6	Counter Attack Area		0.207								
MMRCAASS1-7	Counter Attack Area		0.144								
MMRCAASS1-7F	Counter Attack Area		0.193								
MMRCAASS1-8	Counter Attack Area		0.24								

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory (Continued)											
		Compound									
		LEAD	MERCURY	NICKEL	SELENIUM	SULFIDE	THALLIUM	TIN	TITANIUM	VANADIUM	ZINC
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		0.0537	0.1	13.6	0.0276	0.00358	0.0569	7.62	7.62	1.59	6.62
Sample Label	**Location**										
MMRCAASS1-9	Counter Attack Area		0.149								
MMRCOYOTEBLIND BLANK	Coyote	80.7		175	4.23				3750	154	152
MMRCOYOTEBLINDBLANK	Coyote		0.164								
MMRCOYOTESS 1-1	Coyote	10.2		147	4.01					183	86.4
MMRCOYOTESS 1-2	Coyote	42.3		113	4.16				3450	168	70.9
MMRCOYOTESS 1-2F	Coyote	12.7		109	4.29				4520	197	81.2
MMRCOYOTESS 1-3	Coyote	6.14		71.8	3.54				4130	144	51.6
MMRCOYOTESS 1-4	Coyote	14.2		73.8	4.1				4220	150	47.9
MMRCOYOTESS 1-5	Coyote	6.21		134	3.86		0.319J		2210	187	149
MMRCOYOTESS 1-6	Coyote	43.2		108	4.57				3620	188	123
MMRCOYOTESS 1-7	Coyote	78.9		221	3.73		0.4J		4310	172	179
MMRCOYOTESS 1-8	Coyote	39.9		155	4.32				3250	192	111
MMRCOYOTESS1-1	Coyote		0.11								
MMRCOYOTESS1-2F	Coyote		0.119								
MMRDBSS 1-1	Deer Berms	25.8		265	3.02				4360	184	192
MMRDBSS 1-1F	Deer Berms	32		199	4.69				4490	190	179
MMRDBSS 1-2	Deer Berms	200		251	3.46				4180	182	187
MMRDBSS 1-3	Deer Berms	11.9		266	2.41		0.646J		4040	185	155
MMRDBSS 1-4	Deer Berms	29.4		223	3.21		0.591J		3480	200	151
MMRDBSS 1-5	Deer Berms	22.6		214	3.54		0.359J		3710	200	166
MMRDBSS BLANK	Deer Berms	27		226	3.55				3080	197	146
MMRDBSS1-1	Deer Berms		0.19								
MMRDBSS1-1F	Deer Berms		0.181								

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory (Continued)											
		Compound									
		LEAD	MERCURY	NICKEL	SELENIUM	SULFIDE	THALLIUM	TIN	TITANIUM	VANADIUM	ZINC
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		0.0537	0.1	13.6	0.0276	0.00358	0.0569	7.62	7.62	1.59	6.62
Sample Label	**Location**										
MMRDBSS1-2	Deer Berms		0.188								
MMRDBSS1-3	Deer Berms		0.263								
MMRDBSS1-4	Deer Berms		0.225								
MMRDBSS1-5	Deer Berms		0.13								
MMRDBSSBLANK	Deer Berms		0.241								
MMRDEEDSSS 1-1	Deeds	58		176	2.57				4780	171	120
MMRDEEDSSS 1-1F	Deeds	70.1		125	3.11				4960	186	108
MMRDEEDSSS 1-2	Deeds	151		139	1.13				3200	111	82.4
MMRDEEDSSS 1-3	Deeds	324		165	2.37				4390	162	112
MMRDEERBLIND BLANK	Deer	12.3		155	4.3				3130	170	92.4
MMRDEERBLINDBLANK	Deer		0.29								
MMRDEERSS 1-1	Deer	11.9		206	5.09				4390	190	112
MMRDEERSS 1-10	Deer	18.6		219	4.86				4480	197	115
MMRDEERSS 1-11	Deer	5.55		125	4.33				3340	202	87
MMRDEERSS 1-12	Deer	34.3		226	5.12				4180	209	129
MMRDEERSS 1-13	Deer	52		46.6					984	40.2	53.7
MMRDEERSS 1-14	Deer	78.3		60.4					1160	44.2	406
MMRDEERSS 1-15	Deer	57.4		34.3					597	24	22.8
MMRDEERSS 1-1F	Deer	12.5		156	4.73				3250	178	93.9
MMRDEERSS 1-2	Deer	9.7		16.9J					299	10.4J	13.8
MMRDEERSS 1-3	Deer	4.48		39.3					990	36.3	34.5
MMRDEERSS 1-4	Deer	14.7		27.8					435	16.2J	18.1
MMRDEERSS 1-4F	Deer	0.676J					0.467J		286	10.5J	12.2

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory (Continued)											
		Compound									
		LEAD	MERCURY	NICKEL	SELENIUM	SULFIDE	THALLIUM	TIN	TITANIUM	VANADIUM	ZINC
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		0.0537	0.1	13.6	0.0276	0.00358	0.0569	7.62	7.62	1.59	6.62
Sample Label	**Location**										
MMRDEERSS 1-5	Deer	3.48						28.7J	234	9.39J	
MMRDEERSS 1-6	Deer	29.3		43.4					741	29.8	24.3
MMRDEERSS 1-7	Deer	30.3		174	4.62				3500	172	95.9
MMRDEERSS 1-8	Deer	31.4		187	4.73				3590	180	113
MMRDEERSS 1-9	Deer	36.7		198	4.5				4000	184	106
MMRDEERSS1-1	Deer		0.195								
MMRDEERSS1-10	Deer		0.231								
MMRDEERSS1-12	Deer		0.249								
MMRDEERSS1-1F	Deer		0.226								
MMRDEERSS1-7	Deer		0.178								
MMRDEERSS1-8	Deer		0.19								
MMRDEERSS1-9	Deer		0.252								
MMRDEMOPITSS 1-1F	Demo Pit	5.5		75.2	4.24				3940	211	61
MMRDPASS 1-1	Demo Pit	5.1		131	3.85				4070	208	73.9
MMRDPASS 1-2	Demo Pit	5.16		113	4.12				3550	216	64.2
MMRDPASS BLANK	Demo Pit	5.13		110	3.6		0.544J		3900	202	69.1
MMRELKBLIND BLANK	Elk	10.6		180	4.74				4580	200	140
MMRELKBLINDBLANK	Elk		0.358								
MMRELKSS 1-1	Elk	13		154	4.3				4680	184	120
MMRELKSS 1-10	Elk	18.8		239	4.21				4230	189	157
MMRELKSS 1-2	Elk	35.4		254	4.47		0.476J		4100	172	170
MMRELKSS 1-3	Elk	13.5		194	4.18				4280	189	183
MMRELKSS 1-4	Elk	22.7		144	4.39				4090	195	108

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory (Continued)											
		Compound									
		LEAD	MERCURY	NICKEL	SELENIUM	SULFIDE	THALLIUM	TIN	TITANIUM	VANADIUM	ZINC
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		0.0537	0.1	13.6	0.0276	0.00358	0.0569	7.62	7.62	1.59	6.62
Sample Label	**Location**										
MMRELKSS 1-5	Elk	28.7		124	3.13				4000	158	146
MMRELKSS 1-6	Elk	38.9		242	3.95				4040	170	161
MMRELKSS 1-7	Elk	10.4		205	4.09		0.36J		4580	202	148
MMRELKSS 1-7F	Elk	10.4		190	5.2		0.676J		4940	214	145
MMRELKSS 1-8	Elk	119000		181	3.68		0.654J		2550	153	123
MMRELKSS 1-9	Elk	33.4		164	3.85				4280	188	96.3
MMRELKSS1-10	Elk		0.15								
MMRELKSS1-2	Elk		0.223								
MMRELKSS1-3	Elk		0.141								
MMRELKSS1-4	Elk		0.192								
MMRELKSS1-6	Elk		0.244								
MMRELKSS1-7	Elk		0.267								
MMRELKSS1-7F	Elk		0.38								
MMRELKSS1-8	Elk		0.266								
MMRELKSS1-9	Elk		0.179								
MMRFOXSS 1-1	Fox	24.6		118	3.69				5470	164	92.4
MMRFOXSS 1-2	Fox	206		191	4.59				5240	192	109
MMRFOXSS 1-3	Fox	8.61		167	3.89				4310	178	101
MMRFOXSS 1-3F	Fox	20.1		149	4.75				3740	184	95.8
MMRFOXSS BLANK	Fox	24.6		95.9	2.7				4030	152	81.6
MMRFOXSS1-2	Fox		0.116								
MMRFOXSS1-3	Fox		0.139								
MMRFOXSS1-3F	Fox		0.239								

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory (Continued)											
		Compound									
		LEAD	MERCURY	NICKEL	SELENIUM	SULFIDE	THALLIUM	TIN	TITANIUM	VANADIUM	ZINC
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		0.0537	0.1	13.6	0.0276	0.00358	0.0569	7.62	7.62	1.59	6.62
Sample Label	**Location**										
MMRMSFASS 1-1F	Makua Stream Firing Area	3.74		80.1	2.64				3280	113	61.1
MMRMSFASS 1-2F	Makua Stream Firing Area										
MMRMSFASS1-2F	Makua Stream Firing Area	4.51		126	3.21				4880	157	89.7
MMRMSFASS1-3F	Makua Stream Firing Area	7.61	0.308	95.1	3.06				4110	152	74.1
MMRMTASS 1-1	Misc Training Area	5.97		228	3.64				6490	236	191
MMRMTASS 1-2	Misc Training Area	6.91		237	3.78				6490	244	214
MMRMTASS 1-3	Misc Training Area	10		125	3.54				2130	190	96.7
MMRMTASS 1-3F	Misc Training Area	10.7		71.5	4.07				1910	174	75.2
MMRMTASS 1-4	Misc Training Area	5.55		178	3.96				3520	218	125
MMRMTASS 1-5	Misc Training Area	7.89		194	3.9				6390	245	163
MMRMTASS1-1	Misc Training Area		0.197								
MMRMTASS1-2	Misc Training Area		0.301								
MMRMTASS1-3F	Misc Training Area		0.104J			32					
MMRMTASS1-4	Misc Training Area		0.172								
MMRMTASS1-5	Misc Training Area		0.217								
MMRMTASSBLANK	Misc Training Area		0.288								
MMR-NFBR1-10	North Fire Break Road	1.08J		81.2	0.919J				3080	97.9	78.8
MMR-NFBR1-11	North Fire Break Road	1.28J		106	1.34				3620	138	61.9
MMR-NFBR1-9	North Fire Break Road	1.12J			0.618J				192	5.34	6.9
MMRNFBRSS 1-20	North Fire Break Road			63.2					3080	205	35.5
MMRNFBRSS 1-21	North Fire Break Road			63.3					2200	224	75

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory (Continued)											
		Compound									
		LEAD	MERCURY	NICKEL	SELENIUM	SULFIDE	THALLIUM	TIN	TITANIUM	VANADIUM	ZINC
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		0.0537	0.1	13.6	0.0276	0.00358	0.0569	7.62	7.62	1.59	6.62
Sample Label	**Location**										
MMRNFBRSS1-20	North Fire Break Road	2.26	0.191		2.87						
MMRNFBRSS1-21	North Fire Break Road	4.95	0.164		2.4						
MMROB/ODBLIND BLANK	Open Burn Open Detontata	227		71.7	4.02				2620	197	4190
MMROB/ODBLINDBLANK	Open Burn Open Detontata		0.152								
MMROB/ODSS 1-1F	Open Burn Open Detontata	189		106	4.27				4800	210	956
MMROB/ODSS 1-1FDL	Open Burn Open Detontata										
MMROB/ODSS 1-2F	Open Burn Open Detontata	55.8		64.7	3.61				2660	170	70.4
MMROB/ODSS 1-3F	Open Burn Open Detontata	200		74.8	3.39				2890	156	200
MMROB/ODSS 1-4F	Open Burn Open Detontata	199		85.3	3.71				2810	147	531
MMROB/ODSS 1-5F	Open Burn Open Detontata	235		62.8	3.87				2260	178	236
MMROB/ODSS1-1F	Open Burn Open Detontata		0.111								
MMROB/ODSS1-2F	Open Burn Open Detontata		0.102J								
MMROB/ODSS1-3F	Open Burn Open Detontata		0.131								
MMROB/ODSS1-5F	Open Burn Open Detontata		0.157								
MMRPBPSS 1-1	Propose Burn Pit	2.03		62.8	2.05				1910	104	49.1
MMRPBPSS 1-1F	Propose Burn Pit	2.22		49	2.24				1140	89.1	41

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory (Continued)											
		Compound									
		LEAD	MERCURY	NICKEL	SELENIUM	SULFIDE	THALLIUM	TIN	TITANIUM	VANADIUM	ZINC
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		0.0537	0.1	13.6	0.0276	0.00358	0.0569	7.62	7.62	1.59	6.62
Sample Label	**Location**										
MMRS-BACKGROUND 1-1	Background	6		92.6	1.58				2560	160	76.5
MMR-SFBR1-12	South Fire Break Road	6.74		118					2100	79.1	36.8
MMR-SFBR1-13	South Fire Break Road	1.82		62.7	3.77				5790	218	26.6
MMR-SFBR1-14	South Fire Break Road	4.98	0.111J	71.6	1.23J				4020	133	74.6
MMR-SFBR1-15	South Fire Break Road	0.657J		67.7	1.2J				2340	118	109
MMR-SFBR1-16	South Fire Break Road	0.64J		166	0.558J				1550	56.7	57
MMR-SFBR1-17	South Fire Break Road	19.9		153	1.55				3920	114	91.5
MMR-SFBR1-18	South Fire Break Road	22.8		125	2.37				5020	144	135
MMRSFBRSS 1-19	South Fire Break Road			108					4480	170	86.9
MMRSFBRSS 1-22	South Fire Break Road			124					3060	114	72.8
MMRSFBRSS1-19	South Fire Break Road	6.9			2.01						
MMRSFBRSS1-22	South Fire Break Road	8.43			1.22J						
MMRSNFBR-1	North Fire Break Road	5.24		120			2.31		2170	106	72.7
MMRS-NFBR1-7	North Fire Break Road	9.37		142	1.32				3840	118	99.8
MMRS-NFBR1-8	North Fire Break Road	7.79		48.3	1.82				3200	146	78.5
MMRSNFBR-2	North Fire Break Road	7.92		110			2.72		2150	111	63.6
MMRSNFBR-3	North Fire Break Road	7.5		131			2.6		3520	137	79.6
MMRSNFBR-4	North Fire Break Road	6.26		108			1.15J		3090	78.2	74.7
MMRSNFBR-5	North Fire Break Road	2.75		319			2.91		2800	79.7	66.8
MMRSNFBR-6	North Fire Break Road	18	0.105J	134			4.31		3970	174	85.4
MMRWOLFSS 1-1	Wolf	38.5		104	2.72				3810	136	95.7
MMRWOLFSS 1-2	Wolf	157		236	3.78				6910	223	136
MMRWOLFSS 1-3	Wolf	191		88.6	0.577J				2580	81.3	56.9

Table K-4 Soil Levels Above Ecological Screening Levels - EMAX Laboratory (Continued)											
		Compound									
		LEAD	MERCURY	NICKEL	SELENIUM	SULFIDE	THALLIUM	TIN	TITANIUM	VANADIUM	ZINC
Unit		MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Criteria		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
Value		0.0537	0.1	13.6	0.0276	0.00358	0.0569	7.62	7.62	1.59	6.62
Sample Label	**Location**										
MMRWOLFSS 1-4	Wolf	235		114	3.44				5040	168	81.7
MMRWOLFSS 1-5	Wolf	14.7		119	4.9				5140	179	58.5
MMRWOLFSS 1-5F	Wolf	301		69.2	4.69				4620	177	47.3
MMRWOLFSS 1-6	Wolf	54.1		213	4.58				5090	193	136
MMRWSBPSS 1-1	Weather Station Burn Pan	7.05		223	3.37				5030	196	179
MMRWSBPSS 1-1F	Weather Station Burn Pan	8.51		139	4.51				4780	210	165
MMRWSBPSS1-1	Weather Station Burn Pan		0.139								
MMRWSBPSS1-1F	Weather Station Burn Pan		0.169								

J = Semiquantified Results

Ecol. Scr. Sed. = Ecological Screening Levels (ESLs) Developed by Region V EPA.

Table K-5 - Soil Levels Above Ecological Screening Levels - EMAX Laboratory - Non-Metal Results									
		Compound							
Unit		2,6-DINITRO TOLUENE	2,6-DNT	BETA-BHC	DI-N-BUTYLPHTHALATE	ENDRIN ALDEHYDE	N-NITROSO DIPHENYLAMINE	PCB-1254	PCB-1260
Screening Level		UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG
Value		Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil	Ecol. Scr. Soil
		32.80	32.80	3.98	150.00	1.50	545.00	0.33	0.33
Sample Label	**Location of Sample**								
MMR105FASS 1-1F	105 Firing Area				580				
MMRMSFASS 1-2F	Makua Stream Firing Area				300J				
MMROB/ODBLIND BLANK	Open Burn Open Detontata				210J	35			
MMROB/ODSS 1-1F	Open Burn Open Detontata	1400	3400		23000E	5.1	600	50	28J
MMROB/ODSS 1-1FDL	Open Burn Open Detontata	1100J	3200J		29000				
MMROB/ODSS 1-2F	Open Burn Open Detontata				190J				
MMROB/ODSS 1-3F	Open Burn Open Detontata			7.6	900	1.6J			
MMROB/ODSS 1-4F	Open Burn Open Detontata				490	8.8			
MMROB/ODSS 1-5F	Open Burn Open Detontata				660	38		24J	
J = Semiquantified Results E= Rerun of Sample									
Ecol. Scr. Sed. = Ecological Screening Levels (ESLs) Developed by Region V EPA for Sediment									

Table K-6 - Soil Levels Above Ecological Screening Levels - Sequoia Laboratory																	
	Compound																
	Arsenic	Barium	Berylliu m	Cadmiu m	Chromiu m	Cobalt	Copper	Di-n-bu tyl phtha late	Lead	Mercury	Nickel	PCB-1260	Seleniu m	Thallium	Tin	Vanadiu m	Zinc
Unit	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	UG/KG	MG/K G	MG/KG	MG/KG	UG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Level	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil
Value	5.7	1.04	1.06	0.00222	0.4	0.14	5.4	150.00	0.0537	0.1	13.6	0.33	0.0276	0.0569	7.62	1.59	6.62
Sample Label																	
MMR Badger SS-1-1	0.00	140.00	0.00	0.40	300.00	120.00	110.00	0.00	4.00	0.00	130.00	0.00	2.00	0.08	0.00	250.00	100.00
MMR BADGERSS1-1	0.00	130.00	0.00	0.00	320.00	95.00	100.00	0.00	24.00	0.14	130.00	0.00	1.80	0.00	11.00	260.00	150.00
MMR Buffalo SS 1-6	0.00	210.00	0.00	0.65	320.00	78.00	120.00	0.00	3.10	0.17	160.00	0.00	1.50	0.00	18.00	280.00	150.00
MMR BUFFALOSS1-6	0.00	210.00	0.00	0.85	320.00	79.00	120.00	0.00	7.80	0.13	170.00	0.00	2.60	0.00	0.00	280.00	150.00
MMR CAA SS 1-10	6.70	240.00	0.00	1.40	250.00	110.00	100.00	0.00	41.00	0.00	170.00	0.00	3.60	0.00	0.00	210.00	160.00
MMR CAASS1-2	5.90	250.00	0.00	1.10	220.00	150.00	110.00	0.00	14.00	0.11	220.00	0.00	3.90	0.26	0.00	200.00	160.00
MMR Coyote SS 1-7	0.00	220.00	0.00	0.99	250.00	100.00	100.00	0.00	34.00	0.00	170.00	0.00	3.20	0.12	0.00	210.00	160.00
MMR COYOTESS1-7	0.00	240.00	0.00	0.86	240.00	110.00	110.00	0.00	30.00	0.00	180.00	0.00	3.60	0.00	0.00	200.00	170.00
MMR Deer SS 1-1	0.00	120.00	1.20	0.27	240.00	110.00	79.00	0.00	14.00	0.11	140.00	0.00	2.60	0.00	8.40	200.00	95.00
MMR DEERSS1-1	0.00	110.00	0.00	0.00	190.00	110.00	61.00	0.00	8.40	0.00	120.00	0.00	1.90	0.14	0.00	140.00	62.00
MMR Elk SS 1-7	0.00	220.00	0.00	0.63	240.00	130.00	100.00	0.00	3.10	0.17	160.00	0.00	3.80	0.24	0.00	230.00	140.00
MMR ELKSS1-7	0.00	210.00	0.00	0.64	250.00	130.00	100.00	0.00	9.50	0.19	160.00	0.00	4.60	0.13	0.00	230.00	130.00
MMRBACKGROUND1-4	0.00	35.00	0.00	0.00	61.00	9.70	24.00	0.00	1.90	0.00	46.00	0.00	0.71	0.00	0.00	150.00	22.00
MMRBHSS1-4	0.00	150.00	1.90	0.14	210.00	56.00	35.00	0.00	1.80	0.00	150.00	0.00	0.45	0.00	0.00	170.00	53.00
MMRBHSS2-2	0.00	16.00	0.00	0.54	150.00	9.70	100.00	0.00	20.00	0.00	54.00	0.00	0.41	0.00	0.00	140.00	67.00
MMRCAASS1-7F	0.00	140.00	1.50	0.76	360.00	140.00	96.00	0.00	43.00	0.13	170.00	0.00	2.40	0.35	19.00	310.00	130.00
MMRCOYOTESS1-2	0.00	93.00	0.00	0.37	280.00	61.00	68.00	0.00	13.00	0.00	100.00	0.00	1.60	0.14	12.00	230.00	82.00
MMRDEEDSSS1-3	0.00	160.00	0.00	0.85	240.00	59.00	82.00	0.00	360.00	0.00	110.00	0.00	1.00	0.14	10.00	210.00	130.00
MMRDEERBERM1-1F	0.00	140.00	1.20	0.79	250.00	120.00	100.00	0.00	20.00	0.00	150.00	0.00	3.40	0.24	380.00	220.00	130.00
MMRNFBRSS1-20	0.00	35.00	0.00	0.00	120.00	12.00	27.00	0.00	2.50	0.00	36.00	0.00	0.55	0.00	0.00	160.00	23.00
MMROB/ODSSI-5	0.00	57.00	0.00	2.10	250.00	29.00	240.00	1,400.00	170.00	0.00	64.00	42.00	0.95	0.00	35.00	290.00	280.00

Table K-6 - Soil Levels Above Ecological Screening Levels - Sequoia Laboratory

	Compound																
	Arsenic	Barium	Berylliu m	Cadmiu m	Chromiu m	Cobalt	Copper	Di-n-bu tyl phtha late	Lead	Mercury	Nickel	PCB-1260	Seleniu m	Thallium	Tin	Vanadiu m	Zinc
Unit	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	UG/KG	MG/K G	MG/KG	MG/KG	UG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Screening Level	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil	Ecol Scr. Soil
Value	5.7	1.04	1.06	0.00222	0.4	0.14	5.4	150.00	0.0537	0.1	13.6	0.33	0.0276	0.0569	7.62	1.59	6.62
Sample Label																	
MMRSFDRSS1-22	0.00	50.00	0.00	0.00	48.00	28.00	43.00	0.00	5.40	0.00	75.00	0.00	0.61	0.00	0.00	97.00	50.00
MMRWOLFSS1-3	0.00	36.00	0.00	0.00	60.00	14.00	100.00	0.00	220.00	0.00	29.00	0.00	1.40	0.00	0.00	57.00	40.00
MMRWSBPSS1-1	0.00	130.00	1.10	0.49	250.00	110.00	80.00	0.00	5.30	0.00	130.00	0.00	1.90	0.17	0.00	220.00	130.00

J = Semiquantified Results E= Rerun of Sample

Ecol. Scr. Sed. = Ecological Screening Levels (ESLs) Developed by Region V EPA for Sediment

Table K-7: Soils Levels Above Ecological Screening Levels - Sequoia Laboratory - Non Metal Results

SAMP_NAME	LAB_SAM_ID	ANALYTE	RESULT	UNITS	Low Standard	Low Action Limit	Units
MMROB/ODSSI-5	P210242-01	Di-n-butyl phthalate	1400.0000	UG/KG	Ecol Scr. Soil	150.0000	UG/KG
MMROB/ODSSI-5	P210242-01	PCB-1260	42.0000	UG/KG	Ecol Scr. Soil	0.3320	UG/KG

J = Semiquantified Results E= Rerun of Sample

Ecol. Scr. = Ecological Screening Levels (ESLs) Developed by Region V EPA for Surface Water

Nat. Rec. WQC = National Recommended Water Quality Criteria (AWQC)

Har 11-54 = State of Hawaii 11-54

*Lowest Screening Level = Type of Screening level with the lowest value (if more stringent than PRG)

Table K-8 - Water Levels Above Ecological Screening, National Recommended Water Quality, and Hawaii 11-54 Levels EMAX Laboratory

		Compound																	
		ALUMINUM	BARIUM	BERYLLIUM	CADMIUM	CARBON DISULFIDE	CHLORIDE	CHROMIUM	COBALT	COPPER	CYANIDE	ENDOSULFAN I	ENDRIN	GAMMA-BHC (LINDANE)	HEPTACHLOR	HEPTACHLOR EPOXIDE	MERCURY	NICKEL	SELENIUM
Unit		MG/L	MG/L	MG/L	MG/L	UG/L	MG/L	MG/L	MG/L	MG/L	MG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	MG/L	MG/L
Lowest Screening Level*		Nat Rec WQC	Ecol Scr.	Ecol Scr.	Ecol Scr.	Ecol Scr.	Nat Rec WQC	Nat Rec WQC	Ecol Scr.	Ecol Scr.	Nat Rec WQC	Nat Rec WQC	HAR 11-54	Ecol Scr.	Nat Rec WQC	Nat Rec WQC	Ecol Scr.	HAR 11-54	Ecol Scr.
Screening Level		87.00	220.00	3.60	0.15	15.00	230,000.00	11.00	24.00	1.58	5.20	0.06	0.00	0.03	0.00	0.00	0.00	5.00	5.00
Unit		UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
Sample Label	**Location**																		
MMRKASR2-1	Kaluakauila Stream	1.54																	
MMRKASR2-2	Kaluakauila Stream	0.971																	
MMR-KAS-R3-1	Kaluakauila Stream	4.95						0.0202		0.00885J									
MMR-KAS-R3-2	Kaluakauila Stream	7.65						0.0331		0.0152									
MMRKASSW-R2	Kaluakauila Stream	1.32			0.00201J					0.00733J									
MMRKASSW-R3	Kaluakauila Stream	2.33								0.00539J									
MMRKASSW-R4	Kaluakauila Stream	1.98								0.00624J									0.00514J
MMRKASSW-R5	Kaluakauila Stream	1.5								0.00524J									
MMRKASSW-R6	Kaluakauila Stream	0.759																	
MMRKGSR2-1	Koiahi Gulch Stream	5.98						0.0166J		0.00619J	0.015							0.0175J	
MMRKGSR2-2	Koiahi Gulch Stream	4.26						0.0143J										0.0104J	
MMRKGSR2-3	Koiahi Gulch Stream	3.7						0.0115J										0.0124J	
MMRKGSR2-4	Koiahi Gulch Stream	4.13								0.00577J								0.0103J	
MMRKGSR2-5	Koiahi Gulch Stream	3.95						0.0113J											
MMR-KGS-R3-1	Koiahi Gulch Stream	16.5						0.1		0.0231				0.052J	0.015J			0.0299	
MMR-KGS-R3-2	Koiahi Gulch Stream	27.5						0.147		0.049								0.0539	
MMR-KGS-R3-3	Koiahi Gulch Stream	2.7						0.0172J		0.0108									
MMR-KGS-R3-4	Koiahi Gulch Stream	0.569																	
MMRKSSW-R1	Koiahi Gulch Stream	2.42						0.0157J		0.00611J			0.031J	0.047J	0.045J	0.02J		0.0114J	
MMRKSSW-R2	Koiahi Gulch Stream	24.3						0.102	0.0322	0.0354								0.0448	
MMRKSSW-R3	Koiahi Gulch Stream	2.72						0.0163J		0.00731J								0.0124J	0.00521J
MMRKSSW-R4	Koiahi Gulch Stream	2.35						0.0132J		0.00722J								0.0161J	
MMRSB1B	Lysimeter					41E													
MMRSB1BDL	Lysimeter					35													
MMR-SB2B-R2	Lysimeter					41													
MMRISCOR1-1	Makua Stream	3.68								0.00571J									
MMRISCOR1-11	Makua Stream	4.24								0.00791J									
MMRISCOR1-12	Makua Stream	5.48								0.0106							0.161J		
MMRISCOR1-13	Makua Stream	7.45						0.0204		0.00831J									
MMRISCOR1-15	Makua Stream	6.63						0.0178J		0.0103									
MMRISCOR1-18	Makua Stream	4.43								0.00933J							0.157J		
MMRISCOR1-19	Makua Stream	5.34						0.0118J		0.00609J									

Table K-8 - Water Levels Above Ecological Screening, National Recommended Water Quality, and Hawaii 11-54 Levels EMAX Laboratory

		Compound																	
		ALUMINUM	BARIUM	BERYLLIUM	CADMIUM	CARBON DISULFIDE	CHLORIDE	CHROMIUM	COBALT	COPPER	CYANIDE	ENDOSULFAN I	ENDRIN	GAMMA-BHC (LINDANE)	HEPTACHLOR	HEPTACHLOR EPOXIDE	MERCURY	NICKEL	SELENIUM
Unit		MG/L	MG/L	MG/L	MG/L	UG/L	MG/L	MG/L	MG/L	MG/L	MG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	MG/L	MG/L
Lowest Screening Level*		Nat Rec WQC	Ecol Scr.	Ecol Scr.	Ecol Scr.	Ecol Scr.	Nat Rec WQC	Nat Rec WQC	Ecol Scr.	Ecol Scr.	Nat Rec WQC	Nat Rec WQC	HAR 11-54	Ecol Scr.	Nat Rec WQC	Nat Rec WQC	Ecol Scr.	HAR 11-54	Ecol Scr.
Screening Level		87.00	220.00	3.60	0.15	15.00	230,000.00	11.00	24.00	1.58	5.20	0.06	0.00	0.03	0.00	0.00	0.00	5.00	5.00
Unit		UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
Sample Label	**Location**																		
MMRISCOR1-21	Makua Stream	4.75								0.00557J									
MMRISCOR1-25	Makua Stream	3.88								0.00587J									
MMRISCOR1-26	Makua Stream	5.43								0.00619J									
MMRISCOR1-3	Makua Stream	2.72																	
MMRISCOR1-31	Makua Stream	4.04							0.198										
MMRISCOR1-32	Makua Stream	3.58							0.109	0.00673J									
MMRISCOR1-36	Makua Stream	2.49							0.176	0.00582J									
MMRISCOR1-38	Makua Stream	2.01								0.0051J									
MMRISCOR1-4	Makua Stream	5.35						0.0169J		0.0268									
MMRISCOR1-40	Makua Stream	1.53								0.00674J									
MMRISCOR1-6	Makua Stream	4.79								0.00537J									
MMRISCOR1-8	Makua Stream	3.96								0.00835J									
MMRISCOR1-9	Makua Stream	9.37						0.0244		0.0143								0.0112J	
MMRKASSW-R1	Makua Stream							0.00669J											
MMR-MSISCO-B11-1	Makua Stream	111	0.273					0.516	0.0876	0.167								0.237	
MMRMSR2-1	Makua Stream	17.7						0.049		0.01								0.03	
MMR-MS-R3-1	Makua Stream	169	1.02	0.00874J	0.00267J			0.927	0.346	0.324					0.047J			0.338	
MMR-MS-R3-2	Makua Stream	114	0.384	0.00418J	0.00251J			0.627	0.12	0.184								0.22	
MMR-MS-R3-3	Makua Stream	2.92																	
MMRMSSW-R1	Makua Stream	4.67						0.0139J		0.00657J								0.0181J	
MMRMSSW-R2	Makua Stream	4.73						0.0147J		0.00542J								0.0147J	
MMRMSSW-R3	Makua Stream	4						0.0157J		0.00949J									
MMRMSSW-R4	Makua Stream	4.06						0.0112J		0.00557J									
MMRMSSW-R5	Makua Stream	2.75						0.0124J		0.00513J									
MMR-SW-E2-B01	Makua Stream	41.1						0.146	0.0252	0.0416								0.0826	
MMR-SW-E2-B03	Makua Stream	31.1						0.0982		0.0316								0.0578	
MMR-SW-E2-B04	Makua Stream	21.4						0.0658		0.0176								0.0391	
MMR-SW-E2-B05	Makua Stream	193	0.457	0.00534J				0.866	0.172	0.267							0.157J	0.391	
MMR-SW-E2-B10	Makua Stream	45.3						0.195	0.0294	0.0528								0.0803	0.00642J
MMR-SW-E2-B14	Makua Stream	25.6						0.0888		0.0249								0.0464	
MMR-SW-E2-B18	Makua Stream	16.9						0.0523		0.0147								0.0312	
MMR-SW-E2-B24	Makua Stream	10.8						0.0311		0.00884J								0.0131J	

Table K-8 - Water Levels Above Ecological Screening, National Recommended Water Quality, and Hawaii 11-54 Levels EMAX Laboratory

		Compound																	
		ALUMINUM	BARIUM	BERYLLIUM	CADMIUM	CARBON DISULFIDE	CHLORIDE	CHROMIUM	COBALT	COPPER	CYANIDE	ENDOSULFAN I	ENDRIN	GAMMA-BHC (LINDANE)	HEPTACHLOR	HEPTACHLOR EPOXIDE	MERCURY	NICKEL	SELENIUM
Unit		MG/L	MG/L	MG/L	MG/L	UG/L	MG/L	MG/L	MG/L	MG/L	MG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	MG/L	MG/L
Lowest Screening Level*		Nat Rec WQC	Ecol Scr.	Ecol Scr.	Ecol Scr.	Ecol Scr.	Nat Rec WQC	Nat Rec WQC	Ecol Scr.	Ecol Scr.	Nat Rec WQC	Nat Rec WQC	HAR 11-54	Ecol Scr.	Nat Rec WQC	Nat Rec WQC	Ecol Scr.	HAR 11-54	Ecol Scr.
Screening Level		87.00	220.00	3.60	0.15	15.00	230,000.00	11.00	24.00	1.58	5.20	0.06	0.00	0.03	0.00	0.00	0.00	5.00	5.00
Unit		UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
Sample Label	**Location**																		
MMR-SW-E3-B01	Makua Stream	82.2	0.265					0.479	0.105	0.116								0.131	0.0121
MMR-SW-E3-B03	Makua Stream	89.3	0.221					0.475	0.0804	0.132								0.162	0.00961J
MMR-SW-E3-B05	Makua Stream	55.5						0.296	0.0463	0.0766								0.0982	0.0102
MMR-SW-E3-B07	Makua Stream	51.2						0.254	0.0354	0.0684								0.088	0.00787J
MMR-SW-E3-B09	Makua Stream	17.3						0.0655		0.0178								0.035	
MMR-SW-E3-B11	Makua Stream	28.3						0.125		0.0332								0.0497	0.00809J
MMR-SW-E3-B13	Makua Stream	16.3						0.0832		0.0221								0.027	
MMR-SW-E3-B15	Makua Stream	18						0.0683		0.0195								0.0347	
MMR-SW-E3-B17	Makua Stream	12						0.0498		0.0146								0.027	
MMR-SW-E3-B19	Makua Stream	9						0.04		0.0121								0.0204	
MMR-SW-E3-B21	Makua Stream	11.2						0.0367		0.0114								0.0164J	
MMR-SW-E3-B23	Makua Stream	8.8						0.0324		0.01								0.0163J	
MMR-SW-E4-B02	Makua Stream	75	0.256					0.463	0.0797	0.105								0.136	
MMR-SW-E4-B04	Makua Stream	30.9						0.227	0.0346	0.0469								0.0404	
MMR-SW-E4-B06	Makua Stream	22.8						0.119		0.0282								0.047	
MMR-SW-E4-B11	Makua Stream	12.8						0.0532		0.02								0.0382	
MMR-SW-E4-B24	Makua Stream	6.33						0.013J										0.0152J	
MMRPSR2-1	Punapohaku Stream	0.41																	
MMR-PS-R3-1	Punapohaku Stream	1.63								0.00775J					0.016J				
MMR-PS-R3-2	Punapohaku Stream	1.83								0.00658J									
MMRPSSW-R1	Punapohaku Stream	0.962								0.00658J					0.011J				
MMRPSSW-R2	Punapohaku Stream	1.02																0.0115J	
MMRPSSW-R3	Punapohaku Stream	0.774																	
MMRPSSW-R4	Punapohaku Stream	1.03								0.00576J								0.0111J	
MMRPSSW-R5	Punapohaku Stream	0.448																	
MMRDUP-R3	Wells	0.139J																	
MMR-DUP-R5	Wells									0.14								0.0119J	
MMRMW1-R2	Wells	0.503																	
MMR-MW1-R5	Wells																	0.0112J	
MMRMW2-R1	Wells	0.123J																	
MMRMW2-R2	Wells																	0.0122J	
MMRMW2-R3	Wells						231												

Table K-8 - Water Levels Above Ecological Screening, National Recommended Water Quality, and Hawaii 11-54 Levels EMAX Laboratory

		Compound																	
		ALUMINUM	BARIUM	BERYLLIUM	CADMIUM	CARBON DISULFIDE	CHLORIDE	CHROMIUM	COBALT	COPPER	CYANIDE	ENDOSULFAN I	ENDRIN	GAMMA-BHC (LINDANE)	HEPTACHLOR	HEPTACHLOR EPOXIDE	MERCURY	NICKEL	SELENIUM
Unit		MG/L	MG/L	MG/L	MG/L	UG/L	MG/L	MG/L	MG/L	MG/L	MG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	MG/L	MG/L
Lowest Screening Level*		Nat Rec WQC	Ecol Scr.	Ecol Scr.	Ecol Scr.	Ecol Scr.	Nat Rec WQC	Nat Rec WQC	Ecol Scr.	Ecol Scr.	Nat Rec WQC	Nat Rec WQC	HAR 11-54	Ecol Scr.	Nat Rec WQC	Nat Rec WQC	Ecol Scr.	HAR 11-54	Ecol Scr.
Screening Level		87.00	220.00	3.60	0.15	15.00	230,000.00	11.00	24.00	1.58	5.20	0.06	0.00	0.03	0.00	0.00	0.00	5.00	5.00
Unit		UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
Sample Label	**Location**																		
MMR-MW2-R5	Wells																	0.0135J	
MMRMW3A-R3	Wells	0.16J																	
MMR-MW3A-R5	Wells																	0.0101J	
MMRMW-3B	Wells	0.787																	
MMRMW3B-R2	Wells	0.308																	
MMRMW3B-R3	Wells	0.733																	
MMRMW3B-R4	Wells	0.164J																	
MMR-MW3B-R5	Wells	0.107J																	
MMRMW-3C	Wells	0.127J																	
MMRMW3C-R2	Wells	1.59								0.00516J		0.45				0.039J		0.0126J	
MMRMW3C-R3	Wells	1.22										0.26							
MMRMW3C-R4	Wells	0.485																	
MMR-MW3C-R5	Wells	0.269																	
MMRMW3C-R6	Wells	0.112J																	
MMRMW4A-R3	Wells	0.227																	
MMRMW4B-R2	Wells	0.155J																	0.00724J
MMRMW4B-R3	Wells	0.973								0.00679J									
MMRMW4B-R4	Wells																		0.00582J
MMR-MW4B-R5	Wells																	0.0116J	
MMRMW-4C	Wells				0.00237J														
MMRMW4C-R2	Wells	0.12J																	
MMRMW4C-R3	Wells	10.7						0.0434		0.0226								0.0397	
MMRMW4C-R4	Wells	0.129J																	
MMR-MW4C-R5	Wells	0.203																0.0127J	
MMRMW4C-R6	Wells	0.1J																	
MMRMW5-R2	Wells	0.113J						0.0167J										0.0118J	0.00555J
MMRMW5-R3	Wells	0.168J						0.0183J											0.00696J
MMRMW5-R4	Wells							0.0162J											0.00597J
MMR-MW5-R5	Wells	0.479						0.0167J										0.0162J	0.00644J
MMRMW5-R6	Wells	0.122J						0.0178J											0.00619J
MMRMWS4A	Wells		0.351																
MMRMWS4L	Wells		0.43																

Table K-8 - Water Levels Above Ecological Screening, National Recommended Water Quality, and Hawaii 11-54 Levels EMAX Laboratory

		Compound																	
		ALUMINUM	BARIUM	BERYLLIUM	CADMIUM	CARBON DISULFIDE	CHLORIDE	CHROMIUM	COBALT	COPPER	CYANIDE	ENDOSULFAN I	ENDRIN	GAMMA-BHC (LINDANE)	HEPTACHLOR	HEPTACHLOR EPOXIDE	MERCURY	NICKEL	SELENIUM
Unit		MG/L	MG/L	MG/L	MG/L	UG/L	MG/L	MG/L	MG/L	MG/L	MG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	MG/L	MG/L
Lowest Screening Level*		Nat Rec WQC	Ecol Scr.	Ecol Scr.	Ecol Scr.	Ecol Scr.	Nat Rec WQC	Nat Rec WQC	Ecol Scr.	Ecol Scr.	Nat Rec WQC	Nat Rec WQC	HAR 11-54	Ecol Scr.	Nat Rec WQC	Nat Rec WQC	Ecol Scr.	HAR 11-54	Ecol Scr.
Screening Level		87.00	220.00	3.60	0.15	15.00	230,000.00	11.00	24.00	1.58	5.20	0.06	0.00	0.03	0.00	0.00	0.00	5.00	5.00
Unit		UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
Sample Label	**Location**																		
MMRMWSP7-R2	Wells							0.0124J											
MMRSP7-R3	Wells	1.67						0.0115J											
MMR-SP7-R5	Wells																	0.0141J	
MW-5-R1	Wells	0.88			0.00306J			0.0159J		0.00512J								0.0172J	0.0159

J = Semiquantified Results E= Rerun of Sample

Ecol. Scr. = Ecological Screening Levels (ESLs) Developed by Region V EPA for Surface Water

Nat. Rec. WQC = National Recommended Water Quality Criteria (AWQC)

Har 11-54 = State of Hawaii 11-54

*Lowest Screening Level = Type of Screening level with the lowest value (if more stringent than PRG)

Table K-9 - Water Levels Above Ecological Screening, National Recommended Water Quality, and Hawaii 11-54 Levels
EMAX Laboratory - Non-Metal Values

		Compound							
		CARBON DISULFIDE	CHLORIDE	CYANIDE	ENDOSULFAN I	ENDRIN	GAMMA-BHC (LINDANE)	HEPTACHLOR	HEPTACHLOR EPOXIDE
Unit		UG/L	MG/L	MG/L	UG/L	UG/L	UG/L	UG/L	UG/L
Lowest Screening Level*		Ecol Scr.	Nat Rec WQC	Nat Rec WQC	Nat Rec WQC	HAR 11-54	Ecol Scr.	Nat Rec WQC	Nat Rec WQC
Screening Level		15.00	230,000.00	5.20	0.06	0.00	0.03	0.00	0.00
Screening Level Unit		UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
Sample Label	**Location**								
MMRKGSR2-1	Koiahi Gulch Stream			0.015					
MMR-KGS-R3-1	Koiahi Gulch Stream						0.052J	0.015J	
MMRKSSW-R1	Koiahi Gulch Stream					0.031J	0.047J	0.045J	0.02J
MMR-MS-R3-1	Makua Stream							0.047J	
MMRMW2-R3	Wells		231						
MMRMW3C-R2	Wells				0.45				0.039J
MMRMW3C-R3	Wells				0.26				
MMR-PS-R3-1	Punapohaku Stream							0.016J	
MMRPSSW-R1	Punapohaku Stream							0.011J	
MMRSB1B	Lysimeter	41E							
MMRSB1BDL	Lysimeter	35							
MMR-SB2B-R2	Lysimeter	41							

J = Semiquantified Results E= Rerun of Sample

Ecol. Scr. = Ecological Screening Levels (ESLs) Developed by Region V EPA for Surface Water

Nat. Rec. WQC = National Recommended Water Quality Criteria (AWQC)

Har 11-54 = State of Hawaii 11-54

*Lowest Screening Level = Type of Screening level with the lowest value (if more stringent than PRG)

Table K-10 - Water Levels Above Ecological Screening, National Recommended Water Quality, and Hawaii 11-54 Levels
Sequoia Laboratory

		Compound							
		Aluminum	Cadmium	Chromium	Copper	Mercury	Nickel	Selenium	Silver
Unit		UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
Lowest Screening Level*		Nat Rec. WQS	Ecol. Scr.	Nat Rec. WQS	Ecol. Scr.	Ecol. Scr.	HAR 11-54	Ecol. Scr.	Ecol. Scr.
Screening Level		87.00	0.15	11.00	1.58	0.00	5.00	5.00	0.12
Screening Level Unit		UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
Sample Label	**Location**								
MMRK6SR2-3	Koiahi Gulch Stream	3,300.00	0.00	0.00	7.20	0.08	5.90	0.00	0.00
MMRKASSW-R6-S	Kaluakauila Stream	770.00	0.00	0.00	2.70	0.00	0.00	0.00	0.00
MMR-KGS-R3-3	Koiahi Gulch Stream	5,600.00	0.00	17.00	14.00	0.00	9.20	0.00	0.00
MMRMW3B-R3	Well MW 3B	100.00	2.60	0.00	0.00	0.00	0.00	0.00	0.00
MMRMW3B-R4-DUP	Well MW 3B	0.00	2.10	0.00	0.00	0.00	0.00	0.00	0.00
MMRMW-4C	Well MW 4C	31.00	0.00	0.00	0.00	0.01	0.00	0.00	1.50
MMRMW5-R2	Well MW-5	790.00	2.90	14.00	2.70	0.04	5.80	6.40	0.00
MMRPSSW-R6-S	Punapohaku Stream	0.00	0.00	0.00	3.10	0.00	0.00	0.00	0.00

J = Semiquantified Results E= Rerun of Sample

Ecol. Scr. = Ecological Screening Levels (ESLs) Developed by Region V EPA for Surface Water

Nat. Rec. WQC = National Recommended Water Quality Criteria (AWQC)

Har 11-54 = State of Hawaii 11-54

*Lowest Screening Level = Type of Screening level with the lowest value (if more stringent than PRG)

Table K-11 - Soil Levels Above Region IX Site Screening Levels Migration to Groundwater (DAF-20) Metal Values - EMAX laboratory					
		Compound			
		ANTIMONY	CHROMIUM	NICKEL	SELENIUM
Unit		MG/KG	MG/KG	MG/KG	MG/KG
Screening Level		5.00	38.00	130.00	5.00
Sample Label	**Location**	MG/KG	MG/KG	MG/KG	MG/KG
MMR105FASS 1-1	105 Firing Area		43		
MMR105FASS 1-1F	105 Firing Area		121		
MMR105FASS 1-2	105 Firing Area		92.3		
MMR105FASS BLANK	105 Firing Area	6.7J	114		
MMRAGSS 1-1	Area G	8.02J	281	192	
MMRAGSS 1-2	Area G	6.78J	245	208	
MMRAGSS 1-3	Area G	6.13J	265	210	
MMRAREAGSS 1-2F	Area G	7.19J	230	134	
MMR-BACKGROUND 1-2	Background	7.04J	170		
MMRBACKGROUND 1-3	Background		186		
MMRBACKGROUND 1-4	Background	6.2J	183		
MMRBACKGROUND 1-5	Background	7.46J	118		
MMRBACKGROUND 1-6	Background		154		
MMRS-BACKGROUND 1-1	Background	5.63J	229		
MMRBADGERBLIND BLANK	Badger	6.13J	293	158	
MMRBADGERSS 1-1	Badger		264	141	
MMRBADGERSS 1-10	Badger		267	164	
MMRBADGERSS 1-10F	Badger		248	131	
MMRBADGERSS 1-2	Badger		320	183	
MMRBADGERSS 1-3	Badger		223	151	
MMRBADGERSS 1-4	Badger	5.61J	250	155	
MMRBADGERSS 1-5	Badger	5.39J	263	193	
MMRBADGERSS 1-6	Badger	5.35J	218	168	
MMRBADGERSS 1-7	Badger		89.3		
MMRBADGERSS 1-8	Badger	9.88J	317	243	
MMRBADGERSS 1-9	Badger	5.75J	124	136	
MMRBHSS1-1	Borehole		250	160	
MMRBHSS1-2	Borehole	5.16J	91.1		
MMRBHSS1-3	Borehole		44.7		
MMRBHSS1-4	Borehole	9.27J	134	212	
MMRBHSS1-5	Borehole	5.16J	153	147	
MMRBHSS1-6	Borehole		114	156	
MMRBHSS1-7	Borehole		170		
MMRBHSS1-8	Borehole		209	256	
MMRBHSS2-1	Borehole	6.25J	228	260	
MMRBHSS2-2	Borehole	6.23J	306	169	

Table K-11 - Soil Levels Above Region IX Site Screening Levels Migration to Groundwater (DAF-20) Metal Values - EMAX laboratory					
		Compound			
		ANTIMONY	CHROMIUM	NICKEL	SELENIUM
Unit		MG/KG	MG/KG	MG/KG	MG/KG
Screening Level		5.00	38.00	130.00	5.00
Sample Label	**Location**	MG/KG	MG/KG	MG/KG	MG/KG
MMRBHSS2-3	Borehole		490	241	
MMRBHSS2-4	Borehole	11.4J	227	252	
MMRBHSS2-5	Borehole		130	162	
MMRBHSS2-6	Borehole	6.02J	144	132	
MMRBHSS2-7	Borehole		139	175	
MMRBHSS2-8	Borehole		74.5		
MMRBHSS3-1	Borehole	7.68J	153	206	
MMRBHSS3-2	Borehole		206	165	
MMRBUFFALOBLIND BLANK	Buffalo	7.74J	288	182	
MMRBUFFALOSS 1-1	Buffalo	5.36J	313	134	5.1
MMRBUFFALOSS 1-2	Buffalo	6.93J	293	188	
MMRBUFFALOSS 1-3	Buffalo	7.8J	357	205	
MMRBUFFALOSS 1-4	Buffalo	7.29J	282		
MMRBUFFALOSS 1-5	Buffalo	9.94J	285		
MMRBUFFALOSS 1-6	Buffalo	7.67J	281	185	
MMRBUFFALOSS 1-6F	Buffalo	6.87J	292	193	
MMRCAABLIND BLANK	Counter Attack Area		183	211	
MMRCAASS 1-1	Counter Attack Area	6.07J	182	187	
MMRCAASS 1-10	Counter Attack Area	6.13J	236	233	
MMRCAASS 1-11	Counter Attack Area	11.6	236	199	
MMRCAASS 1-12	Counter Attack Area	5.78J	203	200	
MMRCAASS 1-13	Counter Attack Area	6.13J	193	193	
MMRCAASS 1-14	Counter Attack Area	6.84J	247	145	
MMRCAASS 1-1F	Counter Attack Area		173	156	
MMRCAASS 1-2	Counter Attack Area	7.92J	266	226	
MMRCAASS 1-3	Counter Attack Area	5.32J	266	156	5.36
MMRCAASS 1-4	Counter Attack Area		263	181	5.09
MMRCAASS 1-5	Counter Attack Area	12.5	271	171	
MMRCAASS 1-6	Counter Attack Area		324	276	5.72
MMRCAASS 1-7	Counter Attack Area	6.37J	228	151	
MMRCAASS 1-7F	Counter Attack Area	7.69J	214	132	5.71
MMRCAASS 1-8	Counter Attack Area	6.16J	210	245	
MMRCAASS 1-9	Counter Attack Area		289	289	5.78
MMRCOYOTEBLIND BLANK	Coyote	6.77J	200	175	
MMRCOYOTESS 1-1	Coyote		260	147	
MMRCOYOTESS 1-2	Coyote		217		

Table K-11 - Soil Levels Above Region IX Site Screening Levels Migration to Groundwater (DAF-20) Metal Values - EMAX laboratory					
		Compound			
		ANTIMONY	CHROMIUM	NICKEL	SELENIUM
Unit		MG/KG	MG/KG	MG/KG	MG/KG
Screening Level		5.00	38.00	130.00	5.00
Sample Label	**Location**	MG/KG	MG/KG	MG/KG	MG/KG
MMRCOYOTESS 1-2F	Coyote	6.43J	234		
MMRCOYOTESS 1-3	Coyote	6.06J	190		
MMRCOYOTESS 1-4	Coyote	5.39J	206		
MMRCOYOTESS 1-5	Coyote	5.77J	231	134	
MMRCOYOTESS 1-6	Coyote	5.71J	199		
MMRCOYOTESS 1-7	Coyote		220	221	
MMRCOYOTESS 1-8	Coyote	6.64J	250	155	
MMRDEEDSSS 1-1	Deeds	5.47J	217	176	
MMRDEEDSSS 1-1F	Deeds	5.21J	208		
MMRDEEDSSS 1-2	Deeds	7.66J	138	139	
MMRDEEDSSS 1-3	Deeds	8J	217	165	
MMRDEERBLIND BLANK	Deer		208	155	
MMRDEERSS 1-1	Deer	6.83J	219	206	5.09
MMRDEERSS 1-10	Deer		228	219	
MMRDEERSS 1-11	Deer		246		
MMRDEERSS 1-12	Deer	8.56J	264	226	5.12
MMRDEERSS 1-13	Deer		52.2		
MMRDEERSS 1-14	Deer		55.7		
MMRDEERSS 1-1F	Deer		210	156	
MMRDEERSS 1-3	Deer		43.2		
MMRDEERSS 1-6	Deer		38.1		
MMRDEERSS 1-7	Deer	6.7J	217	174	
MMRDEERSS 1-8	Deer		228	187	
MMRDEERSS 1-9	Deer		227	198	
MMRDBSS 1-1	Deer Berms	6.49J	228	265	
MMRDBSS 1-1F	Deer Berms	6.33J	216	199	
MMRDBSS 1-2	Deer Berms	10.8J	222	251	
MMRDBSS 1-3	Deer Berms		231	266	
MMRDBSS 1-4	Deer Berms	9.75J	247	223	
MMRDBSS 1-5	Deer Berms	8.3J	254	214	
MMRDBSS BLANK	Deer Berms		253	226	
MMRDEMOPITSS 1-1F	Demo Pit	5.94J	249		
MMRDPASS 1-1	Demo Pit	7.67J	282	131	
MMRDPASS 1-2	Demo Pit		272		
MMRDPASS BLANK	Demo Pit		282		
MMRELKBLIND BLANK	Elk	7.72J	225	180	
MMRELKSS 1-1	Elk		243	154	

Table K-11 - Soil Levels Above Region IX Site Screening Levels Migration to Groundwater (DAF-20) Metal Values - EMAX laboratory					
		Compound			
		ANTIMONY	CHROMIUM	NICKEL	SELENIUM
Unit		MG/KG	MG/KG	MG/KG	MG/KG
Screening Level		5.00	38.00	130.00	5.00
Sample Label	**Location**	MG/KG	MG/KG	MG/KG	MG/KG
MMRELKSS 1-10	Elk		236	239	
MMRELKSS 1-2	Elk	8.05J	193	254	
MMRELKSS 1-3	Elk	7.74J	231	194	
MMRELKSS 1-4	Elk	8.51J	254	144	
MMRELKSS 1-5	Elk	8.03J	212		
MMRELKSS 1-6	Elk		193	242	
MMRELKSS 1-7	Elk	6.18J	233	205	
MMRELKSS 1-7F	Elk	5.81J	223	190	5.2
MMRELKSS 1-8	Elk	139	182	181	
MMRELKSS 1-9	Elk	5.13J	237	164	
MMRFOXSS 1-1	Fox	6.45J	166		
MMRFOXSS 1-2	Fox	8.21J	232	191	
MMRFOXSS 1-3	Fox	5.23J	187	167	
MMRFOXSS 1-3F	Fox	6.77J	218	149	
MMRFOXSS BLANK	Fox		150		
MMRKASBS-0.5	Kaluakauila Stream	6.95J	138		
MMRKASBS-1.0	Kaluakauila Stream	11.6J	149	159	
MMRKSBS-0.5	Koiahi Gulch	8.91J	191	139	
MMRKSBS-1.0	Koiahi Gulch		145		
MMRKSBS-1.5	Koiahi Gulch	9.14J	172	143	
MMRMSBS-0.5	Makua Stream	6.99J	154	312	
MMRMSBS-1.0	Makua Stream	5.96J	142	336	
MMRMSBS-1.5	Makua Stream		159	382	
MMRMSFASS 1-1F	Makua Stream Firing Area		145		
MMRMSFASS1-2F	Makua Stream Firing Area	6.07J	197		
MMRMSFASS1-3F	Makua Stream Firing Area		164		
MMRMTASS 1-1	Misc Training Area	6.46J	292	228	
MMRMTASS 1-2	Misc Training Area	5.51J	287	237	
MMRMTASS 1-3	Misc Training Area	11.5J	263		
MMRMTASS 1-3F	Misc Training Area	6.02J	206		
MMRMTASS 1-4	Misc Training Area	8.05J	274	178	
MMRMTASS 1-5	Misc Training Area	5.46J	304	194	
MMRBACKGROUND 1-10	North Fire Break Road		105		
MMRBACKGROUND 1-7	North Fire Break Road	8.45J	339	134	
MMRBACKGROUND 1-8	North Fire Break Road	5.43J	221		

Table K-11 - Soil Levels Above Region IX Site Screening Levels Migration to Groundwater (DAF-20) Metal Values - EMAX laboratory					
		Compound			
		ANTIMONY	CHROMIUM	NICKEL	SELENIUM
Unit		MG/KG	MG/KG	MG/KG	MG/KG
Screening Level		5.00	38.00	130.00	5.00
Sample Label	**Location**	MG/KG	MG/KG	MG/KG	MG/KG
MMRBACKGROUND 1-9	North Fire Break Road	6.38J	117		
MMR-NFBR1-10	North Fire Break Road	5.34J	105		
MMR-NFBR1-11	North Fire Break Road	6.75J	211		
MMRNFBRSS 1-20	North Fire Break Road	12J	172		
MMRNFBRSS 1-21	North Fire Break Road	10.4J	124		
MMRSNFBR-1	North Fire Break Road	6.14J	133		
MMRS-NFBR1-7	North Fire Break Road	8.16J	149	142	
MMRS-NFBR1-8	North Fire Break Road	7.14J	97.5		
MMRSNFBR-2	North Fire Break Road		151		
MMRSNFBR-3	North Fire Break Road		164	131	
MMRSNFBR-4	North Fire Break Road		124		
MMRSNFBR-5	North Fire Break Road		131	319	
MMRSNFBR-6	North Fire Break Road		223	134	
MMROB/ODBLIND BLANK	Open Burn Open Detontata	14.1	233		
MMROB/ODSS 1-1F	Open Burn Open Detontata	8.78J	242		
MMROB/ODSS 1-2F	Open Burn Open Detontata		171		
MMROB/ODSS 1-3F	Open Burn Open Detontata	6.89J	180		
MMROB/ODSS 1-4F	Open Burn Open Detontata	5.03J	179		
MMROB/ODSS 1-5F	Open Burn Open Detontata	5.84J	218		
MMRPBPSS 1-1	Propose Burn Pit		106		
MMRPBPSS 1-1F	Propose Burn Pit		92.2		
MMRPSBS-0.5	Punapohaku Stream	6.3J	147		
MMRPSBS-1.0	Punapohaku Stream	6.65J	157		
MMRPSBS-1.5	Punapohaku Stream	9.66J	162		
MMR-SFBR1-12	South Fire Break Road		93.8		
MMR-SFBR1-13	South Fire Break Road	7.27J	294		
MMR-SFBR1-14	South Fire Break Road		148		
MMR-SFBR1-15	South Fire Break Road		122		
MMR-SFBR1-16	South Fire Break Road	5.47J	98.8	166	
MMR-SFBR1-17	South Fire Break Road	6.15J	158	153	
MMR-SFBR1-18	South Fire Break Road	6.02J	228		
MMRSFBRSS 1-19	South Fire Break Road	5.75J	201		
MMRSFBRSS 1-22	South Fire Break Road	5.28J	142		

Table K-11 - Soil Levels Above Region IX Site Screening Levels Migration to Groundwater (DAF-20) Metal Values - EMAX laboratory					
		Compound			
		ANTIMONY	CHROMIUM	NICKEL	SELENIUM
Unit		MG/KG	MG/KG	MG/KG	MG/KG
Screening Level		5.00	38.00	130.00	5.00
Sample Label	**Location**	MG/KG	MG/KG	MG/KG	MG/KG
MMRWSBPSS 1-1	Weather Station Burn Pan	6.8J	245	223	
MMRWSBPSS 1-1F	Weather Station Burn Pan	5.89J	245	139	
MMRMWS4L	Wells		83.8		
MMRWOLFSS 1-1	Wolf	6.43J	173		
MMRWOLFSS 1-2	Wolf	8.52J	276	236	
MMRWOLFSS 1-3	Wolf		102		
MMRWOLFSS 1-4	Wolf	5.53J	178		
MMRWOLFSS 1-5	Wolf		234		
MMRWOLFSS 1-5F	Wolf	8.81J	211		
MMRWOLFSS 1-6	Wolf	6.33J	271	213	
Key: J = Semiquantified Result					

Table K-12 - Soil Levels Above Region IX Site Screening Levels Migration to Groundwater (DAF-20)
Non-Metal Values - EMAX Laboratory

		Compound							
		2,4-DINITROTOLUENE	2,4-DNT	2,6-DINITROTOLUENE	2,6-DNT	ALPHA-BHC	BETA-BHC	BIS(2-CHLOROETHYL)ETHER	DIELDRIN
Unit		UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG
Screening Level Unit		0.80	0.80	0.70	0.70	0.50	3.00	0.40	4.00
Sample Label	**Location**								
MMRBHSS2-1	Borehole					0.91J			
MMRKSBS-1.0	Koiahi Gulch					1.8J			
MMRKSBS-1.5	Koiahi Gulch					2.2J			
MMRMSFASS 1-3F	Makua Stream Firing Area					1.6J			
MMROB/ODBLIND BLANK	Open Burn Open Detontata					6.8			
MMROB/ODSS 1-1F	Open Burn Open Detontata	24000E	58000E	1400	3400			19J	
MMROB/ODSS 1-1FDL	Open Burn Open Detontata	23000	76000	1100J	3200J				
MMROB/ODSS 1-2F	Open Burn Open Detontata					1.7J			33
MMROB/ODSS 1-3F	Open Burn Open Detontata	1500				5.9	7.6		43
MMROB/ODSS 1-4F	Open Burn Open Detontata	280J				3.1			22
MMROB/ODSS 1-5F	Open Burn Open Detontata	320J				12			

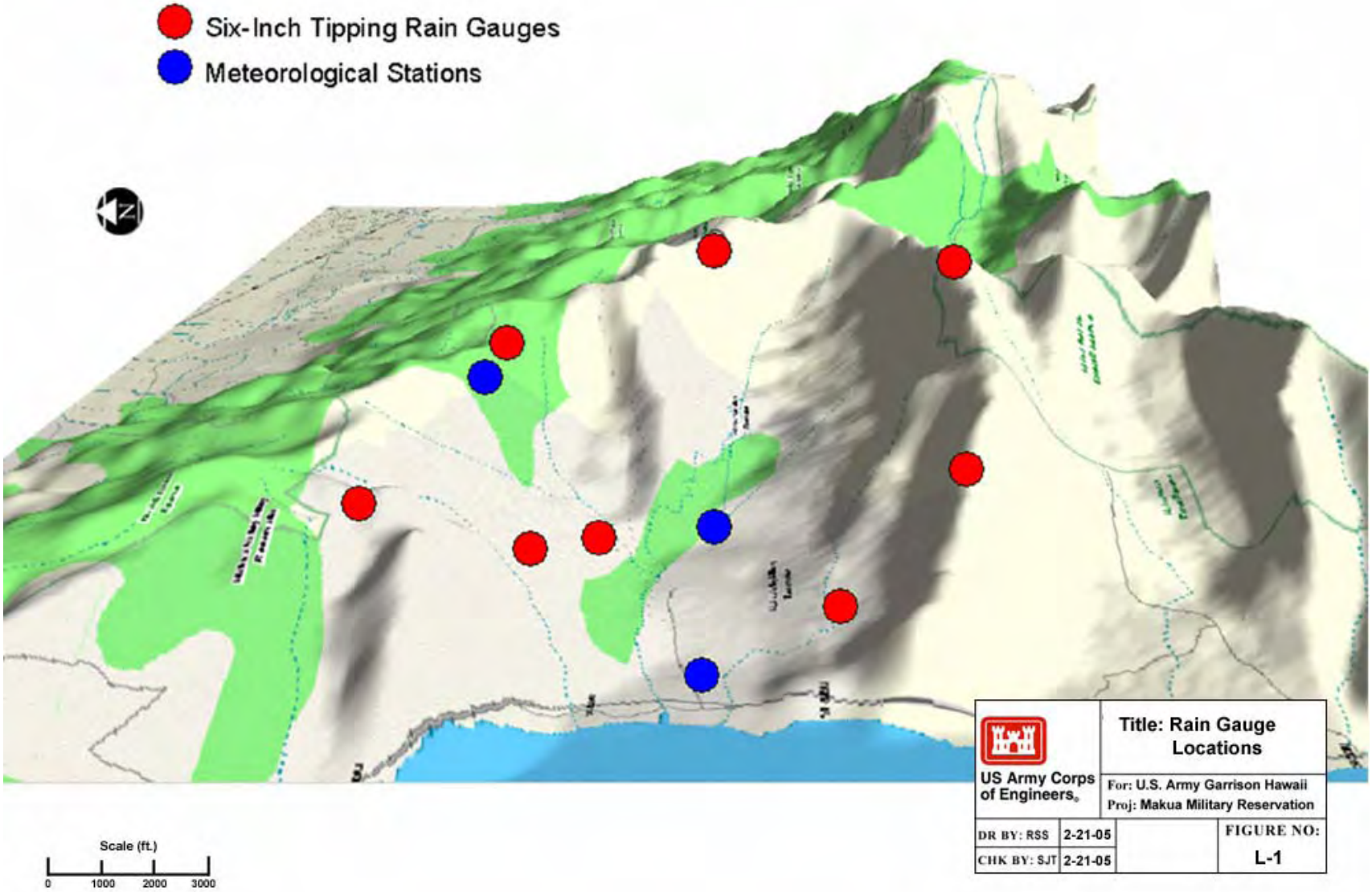
Key: E = Rerun of sample, J = Semiquantified Result

Table K-13 - Soil Levels Above Region IX Site Screening Levels Migration to Groundwater (DAF-20)			
Metal Values - EMAX Laboratory			
	Compound		
	Antimony	Chromium	Nickel
Unit	MG/KG	MG/KG	MG/KG
Screening Level	5.00	38.00	130.00
Sample Name			
MMR Badger SS-1-1	5.9	300	
MMR BADGERSS1-1	5.1J	320	
MMR Buffalo SS 1-6	7.1	320	160
MMR BUFFALOSS1-6	11	320	170
MMR CAA SS 1-10		250	170
MMR CAASS1-2		220	220
MMR Coyote SS 1-7	8	250	170
MMR COYOTESS1-7		240	180
MMR Deer SS 1-1		240	140
MMR DEERSS1-1		190	
MMR Elk SS 1-7		240	160
MMR ELKSS1-7		250	160
MMRBACKGROUND1-4		61	
MMRBHSS1-4	5.8	210	150
MMRBHSS2-2		150	
MMRCAASS1-7F	12	360	170
MMRCOYOTESS1-2	5.9J	280	
MMRDEEDSSS1-3	10	240	
MMRDEERBERM1-1F		250	150
MMRMSBS-1.5		120	190
MMRNFBRSS1-20		120	
MMROB/ODSSI-5	12	250	
MMRSFDRSS1-22		48	
MMRWOLFSS1-3		60	
MMRWSBPSS1-1		250	
J = Semiquantified Result			

Table K-14: Soil Levels Above Region IX Site Screening Levels Migration to Groundwater (DAF-20)						
Non-Metal Values - Sequoia Laboratory						
Sample Name	**Location**	**ANALYTE**	**RESULT**	**UNITS**	**DAF**	**Unit**
MMROB/ODSSI-5	OB/OD area	2,4-Dinitrotoluene	570.000	UG/KG	0.800	UG/KG
*Only compounds with a DAF-20 lower than the Industrial PRG for Soil are Listed						

APPENDIX I

Rainfall Data

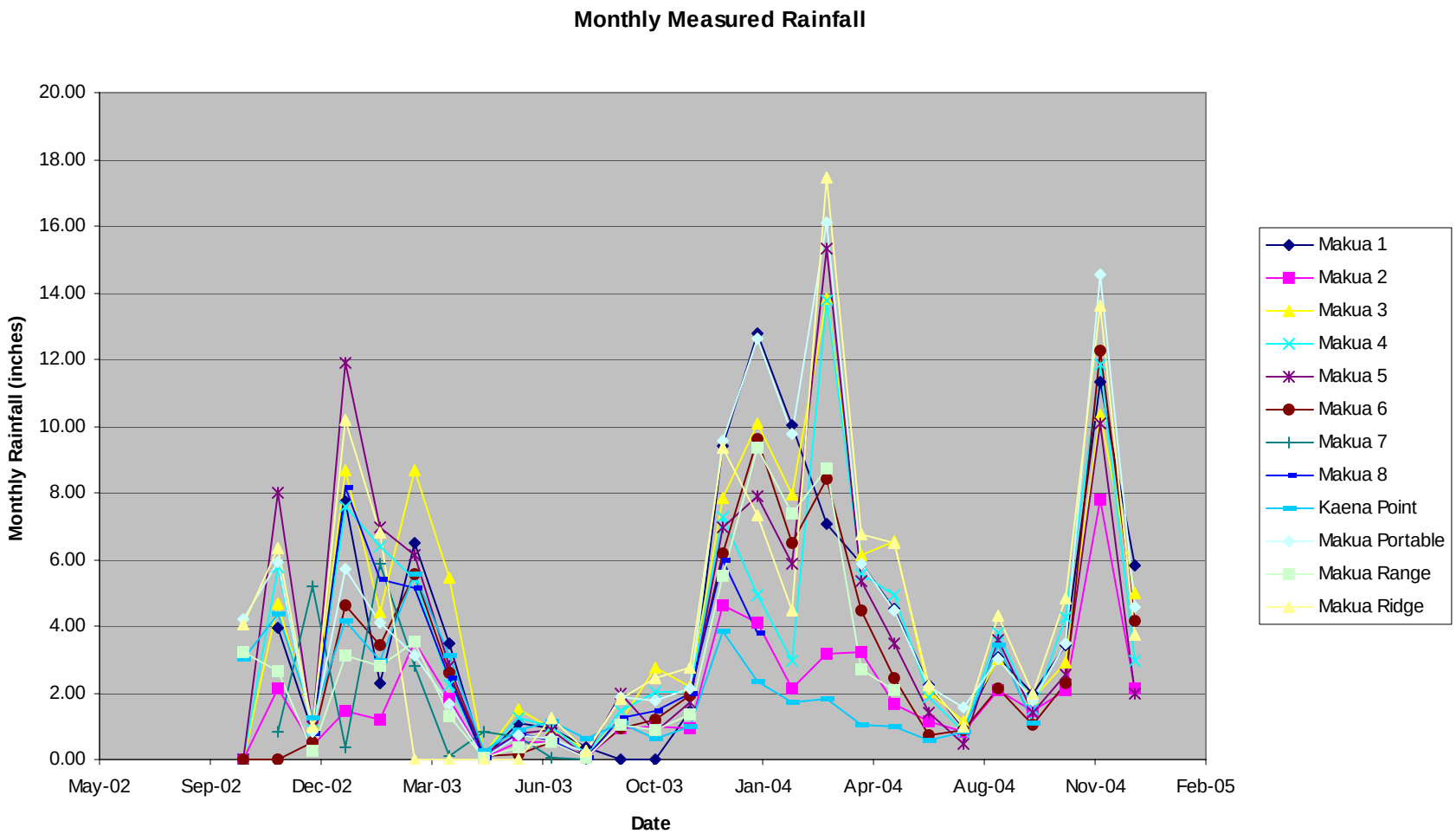


US Army Corps of Engineers

Title: Rain Gauge Locations

For: U.S. Army Garrison Hawaii
Proj: Makua Military Reservation

DR BY: RSS	2-21-05		FIGURE NO:
CHK BY: SJT	2-21-05		L-1


Monthly Measured Rainfall
Monthly Rainfall (inches)
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
May-02
Sep-02
Dec-02
Mar-03
Jun-03
Oct-03
Jan-04
Apr-04
Aug-04
Nov-04
Feb-05
Date
Makua 1
Makua 2
Makua 3
Makua 4
Makua 5
Makua 6
Makua 7
Makua 8
Kaena Point
Makua Portable
Makua Range
Makua Ridge

	Makua 1	Makua 2	Makua 3	Makua 4	Makua 5	Makua 6	Makua 7	Makua 8	Kaena Point 841.3	Makua Portable	Makua Range	Makua Ridge
Start Date of Monitoring	10/16/2002	10/16/2002	10/28/2002	10/28/2002	10/28/2002	11/25/2002	11/25/2002	11/25/2002	1972	2001	2001	2001
Oct-02									3.00	4.2	3.22	4.07
Nov-02	3.96	2.11	4.7	5.76	8.01				4.37	5.93	2.66	6.34
Dec-02	0.81	0.39	1.05	0.87	0.97	0.54	0.84	0.76	1.26	0.84	0.28	0.98
Jan-03	7.75	1.47	8.65	7.57	11.88	4.62	5.21	8.17	4.17	5.7	3.13	10.17
Feb-03	2.31	1.2	4.41	6.37	6.97	3.43	0.38	5.4	2.94	4.09	2.78	6.82
Mar-03	6.48	3.51	8.65	5.4	6.13	5.54	5.85	5.14	5.58	3.13	3.53	NA
Apr-03	3.49	1.84	5.47	2.22	2.79	2.62	2.83	2.42	3.12	1.64	1.3	NA
May-03	0.03	0.05	0.18	0.15	0.13	0.08	0.09	0.05	0.24	0.04	0.04	NA
Jun-03	1.08	0.52	1.5	1.25	0.78	0.14	0.82	0.79	0.86	0.73	0.34	NA
Jul-03	0.95	0.53	0.91	0.99	0.86	0.53	0.69	0.58	1.16	0.63	0.53	1.23
Aug-03	0.34	0.07	0.24	0.16	0.08	0.08	0.03	0.05	0.61	0.19	0.05	0.26
Sep-03	0.01	0.93	1.12	1.43	1.99	0.96	0.02	1.26	1.11	1.88	1.04	1.8
Oct-03	0.00	0.99	2.76	2.01	0.85	1.22	NA	1.45	0.6	1.76	0.87	2.46
Nov-03	1.45	0.96	2.18	2.02	1.7	1.9	NA	2	0.99	2.14	1.34	2.73
Dec-03	9.41	4.63	7.86	7.27	6.96	6.16	NA	5.97	3.83	9.55	5.49	9.35
Jan-04	12.79	4.12	10.09	4.92	7.91	9.61	NA	3.79	2.35	12.62	9.33	7.34
Feb-04	10.02	2.12	7.94	2.94	5.89	6.51	NA	NA	1.71	9.78	7.38	4.48
Mar-04	7.08	3.18	13.82	13.75	15.3	8.39	NA	NA	1.84	16.1	8.73	17.48
Apr-04	5.85	3.23	6.13	5.57	5.37	4.48	NA	NA	1.04	5.89	2.71	6.77
May-04	4.50	1.67	6.55	4.94	3.49	2.42	NA	NA	1.00	4.46	2.08	6.51
Jun-04	2.23	1.16	2.05	1.86	1.39	0.71	NA	NA	0.59	2.19	NA	2.25
Jul-04	0.91	0.85	1.14	0.82	0.46	0.88	NA	NA	0.84	1.55	NA	0.97
Aug-04	3.05	2.08	3.02	3.78	3.61	2.15	NA	NA	3.43	3.03	NA	4.31
Sep-04	1.95	1.48	1.84	1.5	1.39	1.02	NA	NA	1.08	1.77	NA	1.96

	Makua 1	Makua 2	Makua 3	Makua 4	Makua 5	Makua 6	Makua 7	Makua 8	Kaena Point 841.3	Makua Portable	Makua Range	Makua Ridge
Start Date of Monitoring	10/16/2002	10/16/2002	10/28/2002	10/28/2002	10/28/2002	11/25/2002	11/25/2002	11/25/2002	1972	2001	2001	2001
Oct-04	3.43	2.07	2.9	4.24	2.56	2.31	NA	NA	NA	3.5	NA	4.85
Nov-04	11.31	7.77	10.33	11.83	10.06	12.25	NA	NA	NA	14.52	NA	13.6
Dec-04	5.84	2.14	5.01	2.94	2.00	4.13	NA	NA	NA	4.56	NA	3.72
Dec02-Dec04	103.07	48.96	115.80	96.80	101.52	82.68	16.76	119.33 (to 1/7/05)				

Makua 5 plugged when downloaded on 1/4/05

Makua 6 plugged when downloaded on 1/7/05

Makua 7 battery dead when downloaded on 1/7/05

Makua 8 gave incorrect dates when downlodaded on 1/7/05. Rainfall total correct (81.5" between 1/7/04 and 1/7/05). Kaena Point 841.3, Hawaii, Station 512410/99999. Elev. 1,240 Feet. Lat 21°34'N, Lon 158°14'W

Final Environmental Impact Statement

MILITARY TRAINING ACTIVITIES AT MĀKUA MILITARY RESERVATION, HAWAIʻI

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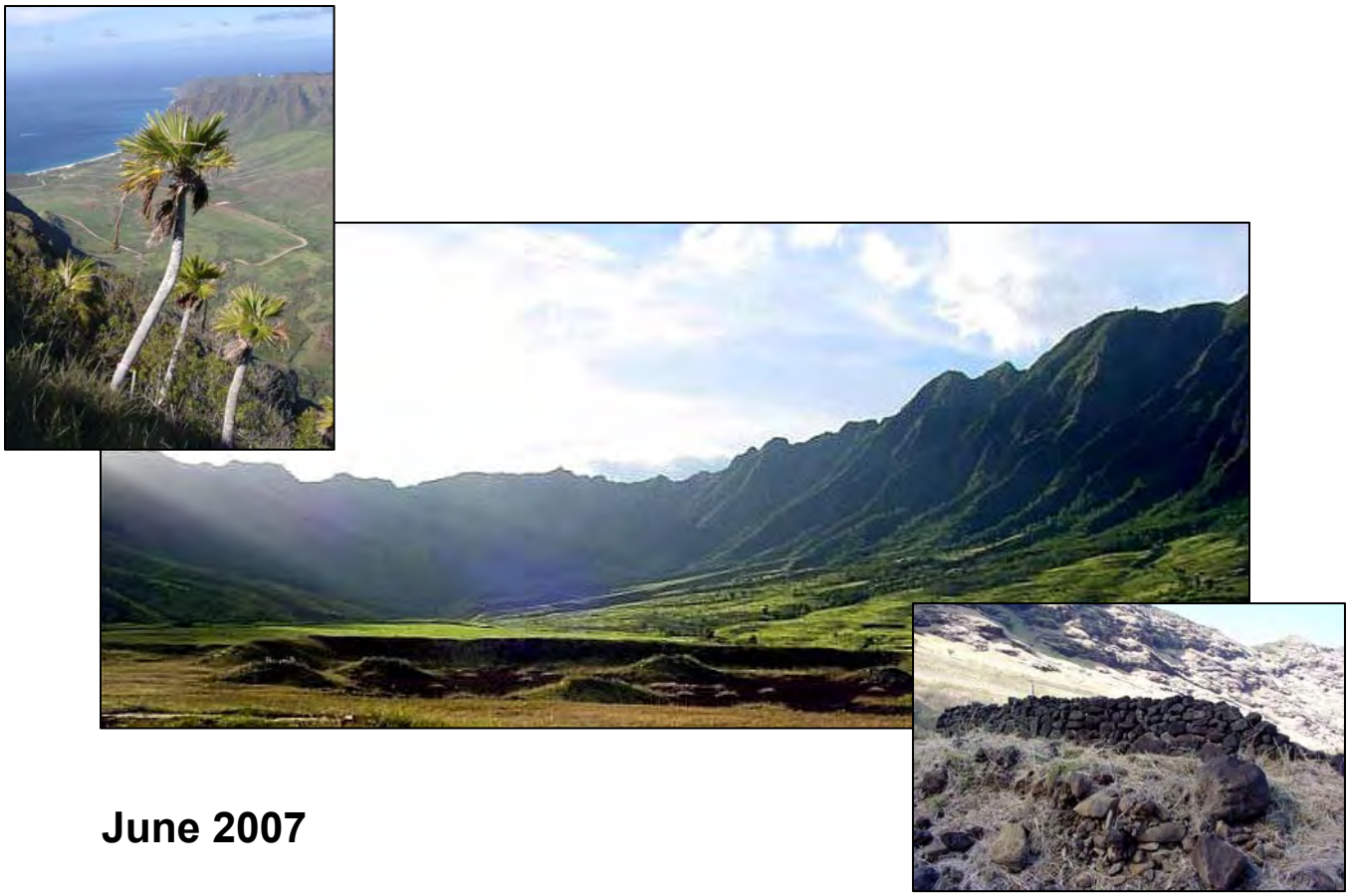

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