



EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency (EPA) Region 9 has conducted a Targeted Brownfields Assessment (TBA) Phase II Environmental Site Assessment (ESA) for the Office of the Mayor of Tinian and Aguiguan (the Applicant) at the Pina-Proposed Tinian Landfill Site (the Site). The Site is located within the former Masalog Ammunition Depot on Lot 271 T61 in Pina, Tinian, Commonwealth of Northern Mariana Islands (CNMI). The Site consists of approximately 30 acres of land comprised of a former ordnance storage area (primarily for aerial bombs) for the associated U.S. Army Air Corps airfields (Tinian North Field and Tinian West Field) from 1944 to 1946. Following World War II (WWII), much of this ordnance was left in several storage locations on the Islands of Tinian and Saipan in CNMI. Munitions and explosives of concern (MEC) are present at the Site, including unexploded ordnance (UXO) and discarded military munitions (DMM).

Previous Site investigations performed by All Hazard Management Professionals (AMPRO) Consultants, Allied Pacific Environmental Company, Inc. (APEC), EA Engineering, Science, and Technology, Inc. (EA), CNMI Department of Public Lands (DPL), CNMI Bureau of Environmental and Coastal Quality (BECQ), and the U.S. Department of Defense indicated the presence of UXO and DMM at the Site and throughout Tinian. Previous Site assessments include the following:

- The UXO survey performed for the Site for CNMI DPL (AMPRO Consultants 2008) identified a significant number of UXO and MEC components within the survey search area. Ordnance items that were found included 500-pound incendiary bombs, 10-pound incendiary bomblets, fragmentation bombs, incendiary cluster adapters and components, and other miscellaneous ordnance components.
- The previous Phase I and II ESAs performed for the Site (EA 2016, 2017) included UXO detector-aided surface surveys and analog geophysical surveys (using hand-held metal detectors) along transects. The 2017 Phase II ESA identified numerous MEC items at the surface, subsurface anomalies, and high anomaly density areas at the Site. In addition, the 2017 Phase II ESA for the Site included the collection of multi-increment (MI) soil samples at five decision units (DUs) across the Site.
- The 2017 Phase II ESA for the adjacent Pina Ridge Site (APEC 2017) located immediately to the north of the Site included UXO detector-aided surface surveys, analog geophysical surveys, and an intrusive investigation of 335 anomalies along limited transects. Of the 335 subsurface anomalies intrusively investigated, 51 were identified as AN M65 1,000-pound high explosive general-purpose



aircraft bombs. During the surveys, approximately 1,600 pounds of munitions debris or material documented as safe (MDAS) were recovered. A high density of subsurface anomalies was detected at several locations during the analog geophysical survey with a density maximum of 400 anomalies per acre. In addition, the 2017 Phase II ESA included collection of composite soil samples and MI soil samples.

The Site is proposed for the construction of a new landfill for Tinian (CMNI DPL 2019).

The Phase II ESA for the Site included a:

- UXO detector-aided surface survey;
- Magnetometer digital geophysical mapping (DGM) survey along transects over accessible portions of the Site; and
- Discrete soil sampling at locations with significant breached ordnance casings and high anomaly density areas detected by the DGM survey and indicated in the previous Phase II ESA (EA 2017) and at one background location, and laboratory analysis for munitions constituents (MC) and other chemicals of potential concern (COPC). Soil samples were analyzed for metals, including mercury, total petroleum hydrocarbons (TPH)-diesel-range organics (DRO) and TPH-residual-range organics (RRO), explosives, white phosphorus, and polycyclic aromatic hydrocarbons (PAHs) by a fixed-base laboratory. Soil analytical results were compared to EPA soil regional screening levels (RSLs) and Tropical Pacific Tier 1 soil environmental screening levels (ESLs) for residential and industrial receptors.

The intent of the Phase II ESA was to:

- (1) Detect and map subsurface anomalies that may be associated with MEC at a greater depth and resolution than the 2017 Phase II ESA analog geophysical surveys, evaluate DGM anomaly density, fill in subsurface MEC data gaps, and evaluate geophysical technology suitable for the Site terrain and remedial alternatives;
- (2) Resolve MC and COPC data gaps regarding residual soil contamination that may be localized to breached casings or high ordnance and anomaly density areas that may require special handling and management during Site redevelopment, and determine if a soil management plan will be required during future landfill construction; and



- (3) Where applicable, satisfy the innocent purchaser defense under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), ASTM International E1903-19. Phase II ESA results will be used to reduce uncertainty in the Site remediation cost estimate provided in the Data Evaluation Report ([Appendix E](#)).

Review of survey and analytical data from this Phase II ESA led to the following noteworthy findings:

- The UXO detector-aided surface survey found a total of three suspect surface material potentially presenting an explosives hazard (MPPEH) items over 0.51 acre of survey coverage (six suspect MPPEH items per acre). Two suspect MPPEH items were found in DU1 and one in DU3, including one large suspect surface MPPEH item in DU3.
- The DGM survey detected a total of 490 target anomalies over 0.51 acre of survey coverage (961 anomalies per acre). This DGM anomaly density is 58 percent greater than the 400 anomalies per acre anomaly density of the analog geophysical surveys for the Phase II ESA performed for the adjacent Pina Ridge Site (APEC 2017) located immediately to the north of the Site.
- Aluminum, arsenic, cadmium, cobalt, iron, and manganese detected in soil exceeded their respective residential soil EPA RSLs and background soil sample concentrations but were below the industrial soil EPA RSLs (except for arsenic). No Tropical Pacific Tier 1 ESLs exist for aluminum, iron, and manganese. Metals, TPH-DRO, and TPH-RRO were not detected above the industrial Tropical Pacific Tier 1 ESLs in any of the surface soil samples collected. Explosives, white phosphorus, and PAHs were not detected in any surface soil samples. These results are summarized in [Table ES-1](#).

Recommendations

Surface and subsurface MEC and MPPEH at the Site will require detection and removal to mitigate potential exposure for human receptors. Based on the Phase II ESA results, a soil management plan is recommended for future landfill construction.

A Data Evaluation Report was prepared to evaluate cleanup alternatives required to address surface and subsurface MEC, MPPEH, MC, and COPC, and the abandoned former munitions storage revetments at the Site and is included as [Appendix E](#) in the Final Phase II ESA Report.

The Data Evaluation Report ([Appendix E](#)) identified five cleanup alternatives for the Site:

- Alternative 1: No Action (Baseline);



- Alternative 2a: Surface and Subsurface MEC Removal, Earthen Revetments and Soil Hotspots Excavation, and Off-Site Disposal (Industrial Soil Screening Levels);
- Alternative 2b: Surface and Subsurface MEC Removal, Earthen Revetments and Soil Hotspots Excavation, and Off-Site Disposal (Residential Soil Screening Levels);
- Alternative 3a: Surface and Subsurface MEC Removal, Earthen Revetments and Soil Hotspots Excavation, On-Site Consolidation, and Capping with Institutional Controls (ICs) (Industrial Soil Screening Levels); and
- Alternative 3b: Surface and Subsurface MEC Removal, Earthen Revetments and Soil Hotspots Excavation, On-Site Consolidation, and Capping with ICs (Residential Soil Screening Levels).

Alternative 1 for the Site is included as a baseline for comparison purposes. This alternative would involve no containment, treatment, removal, or monitoring of contaminants, and it would not address potential exposure to MEC and contamination present on the Site.

Alternatives 2a and 2b for the Site would involve vegetation removal, UXO detector-aided surface surveys, DGM surveys, management and disposition of MEC and MDAS, and soil excavation with off-site disposal.

Alternatives 3a and 3b for the Site would involve vegetation removal, UXO detector-aided surface surveys, DGM surveys, management and disposition of MEC and MDAS, and soil excavation with on-site consolidation and capping.

[Table ES-2](#) summarizes the effectiveness, implementability, and cost for each cleanup alternative evaluated to address risk to human health from MEC and contamination that prevents or impedes the preferred type of Site redevelopment. The cost estimates presented in the table are order-of-magnitude estimates intended only for the relative comparison of the alternatives and should not be used as budget- or design-level estimates.

Future steps for the Site will include evaluation, selection, and implementation of a cleanup alternative to prepare the site for construction of a new landfill.



Table ES-1: Summary of Soil Analytical Results
Phase II ESA TBA Report
Pina-Proposed Tinian Landfill Site

Analyte	Project Screening Level (mg/kg)					Samples Exceeding Residential Screening Level	Samples Exceeding Industrial Screening Level	Samples Exceeding Background Sample
	EPA RSL		Tropical Pacific Tier 1 ESLs		Background Soil Sample			
	Residential Soil	Industrial Soil	Residential Soil	Industrial Soil	Result (mg/kg)			
Aluminum	77,000	1,100,000	NC	NC	52,000	DU2	--	DU2
Arsenic	0.68	3.0	24	95	7.97	DU1-1, DU1-2, DU2, DU3-1, DU3-1 Duplicate, DU3-2, DU4, and DU5	--	--
Cadmium	7.1	100	14	74	2.82	DU1-2	--	--
Cobalt	23	350	80	80	31.9	DU1-1, DU1-2, DU2, and DU5	--	DU1-1
Iron	55,000	820,000	NC	NC	83,100	DU1-1, DU1-2, DU2, DU3-2, DU4, and DU5	--	DU1-1, DU1-2, DU2, DU3-2, and DU5
Manganese	1,800	26,000	NC	NC	3,000	DU1-1, DU2, and DU5	--	DU1-1

Notes:

- No samples exceeded the indicated soil screening level.
- DU Decision unit
- EPA U.S. Environmental Protection Agency
- ESL Environmental screening level
- mg/kg Milligram per kilogram
- NC No criterion
- RSL Regional screening level



**Table ES-2: Summary of Alternatives
Phase II ESA TBA Report
Pina-Proposed Tinian Landfill Site**

Criteria	Alternative 2a		Alternative 2b		Alternative 3a		Alternative 3b	
	Surface and Subsurface MEC Removal, Earthen Revetments and Soil Hotspots Excavation, and Off-Site Disposal (Industrial Soil SLs)		Surface and Subsurface MEC Removal, Earthen Revetments and Soil Hotspots Excavation, and Off-Site Disposal (Residential Soil SLs)		Surface and Subsurface MEC Removal, Earthen Revetments and Soil Hotspots Excavation, On-Site Consolidation, and Capping with ICs (Industrial Soil SLs)		Surface and Subsurface MEC Removal, Earthen Revetments and Soil Hotspots Excavation, On-Site Consolidation, and Capping with ICs (Residential Soil SLs)	
	Rating	Score	Rating	Score	Rating	Score	Rating	Score
Effectiveness	High	5	High	5	Moderate	3	Moderate	3
Implementation	Difficult to Moderate	2	Difficult to Moderate	2	Moderate	3	Moderate	3
Cost	\$194,500,000	1	\$216,700,000	1	\$65,500,000	4	\$70,500,000	4
Overall Score	8		8		10		10	

Notes:

Effectiveness Ratings:

Low	1
Low to Moderate	2
Moderate	3
Moderate to High	4
High	5

Implementation Ratings:

Difficult	1
Difficult to Moderate	2
Moderate	3
Easy to Moderate	4
Easy	5

Cost Ratings:

1	>\$160 million
2	\$120 to \$160 million
3	\$80 to 120 million
4	\$40 to 80 million
5	\$0 to \$40 million

MEC Munitions and explosives of concern
IC Institutional control
SL Screening level