YPG-141

RESPONSE TO COMMENTS ON DRAFT FINAL VERSION OF RFI REPORT DATED FEBRUARY 2012

Date: August 21, 2012
Comments from the State of Arizona Department of Environmental Quality

Comment #	Comment	Reference	Response to Comment
General Comments			
1	**Removal of Site from the RCRA Permit.** In a letter, dated February 2, 2012, accompanying the RFI report, Richard Martin (Garrison Manager, USAGYPG) requested that this site be removed from USAGYPG's permit. However, ADEQ notes that YPG-141 is a solid waste management unit (SWMU) identified in the hazardous waste permit (the Permit). As per the Corrective Action Schedule of Compliance, USAGYPG must show that YPG-141 may not release hazardous constituents so as to pose a threat to human health or the environment. Upon such a satisfactory demonstration that a release may not occur, or is sufficiently controlled, USAGYPG may submit a permit modification request to ADEQ to address the corrective actions done at YPG-141, and to end corrective action for the SWMU. At that time, ADEQ may also send USAGYPG a letter acknowledging that no further actions are required.		**Response –** Based on a meeting with ADEQ in June 2012, USAGYPG proposes that YPG-141 be moved forward to a Corrective Measures Study (CMS) rather than a permit modification request. The CMS will focus on corrective measures alternatives aimed at preventing exposure to the solid waste currently present at the site.

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2	**Hazardous Waste Deposition.** On page viii of the Executive Summary, and at other locations in the report, USAGYPG states that there was no evidence of hazardous waste in the landfill. However, the report does note the presence of both non-hazardous and hazardous constituents such as copper, lead, arsenic, and a number of organic compounds, above background levels and groundwater protection levels (GPLs). In light of the finding of heavy metals and organic compounds, the report should explain why it chooses to state that there is “no evidence” of hazardous waste disposal. Also, because YPG-141 is a SWMU identified in the Permit, it may not cause or contribute to a release of hazardous constituents so as to pose a threat to human health or the environment. Upon such a satisfactory demonstration that a release may not occur, or is sufficiently controlled, USAGYPG may submit a permit modification request to ADEQ to address the corrective actions at YPG-141, and to end corrective action at the SWMU. At that time, ADEQ may also send USAGYPG a letter acknowledging that no further actions are required.		**Response:** USAGYPG agrees that potentially hazardous constituents were detected during the investigation. However, with the exception of arsenic, these compounds were detected in concentrations less than the nrSRLs. A discussion was provided for the singular arsenic detection above an nrSRL stating that the arsenic was found in a clayey soil and not related to the sampling of waste. This arsenic was believed to be naturally occurring and associated with the soil type and not the waste constituents. Lead was detected above the GPL and was found within the waste; however, soil samples collected below the waste layer do not indicate that leaching is occurring. As mentioned in Response 1, USAGYPG will not be asking for a permit mod but will be recommending a CMS to mitigate exposure to the solid waste. Text in the Executive Summary and Section 4.4 has been revised to state, “No **visual** evidence of hazardous waste.”

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3	**Line numbers.** Delete the line numbers that appear on the side of each page.		**Response –**Line numbers have been removed from this and subsequent reports.
4	**Non-Residential SRLs.** In the report contaminant concentrations are compared to residential SRLs, and not to the non-residential SRLs. Based on discussions with YPG, there is no future residential use planned for the land comprising the landfill. Modify the report to reference non-residential SRLs wherever applicable.		**Response –** As stated in Section 4.3.1 of the RFI Work Plan (Parsons, 2010), "As a first tier, detected soil contaminant concentrations will be compared to residential SRLs; however, since there are no current or planned future residential developments at these sites, the non-residential SRLs will be used as a second tier in the screening process." At the request of ADEQ, nrSRLs have been added to Tables 4.3, 4.4, and 5.1. Text in the risk assessment (Section 5.0) has been revised so that sampling results are compared to nrSRLs and GPLs for risk purposes.
5	**Horizontal and Vertical Extent of Contamination.** The RFI should determine if YPG-141 was a solid or hazardous landfill and determine the horizontal and vertical extent of waste deposition. The sample number selected in the RFI does not support an accurate assessment of the concentration range of each contaminant. At best it can provide a measure of the "types" of contaminants. However, at various places in the report USAGYPG has stated that extent of contamination of a specific species (e.g., lead) has been determined. Provide the correct interpretation of the data with reference to individual contaminants.		**Response –** Text in Section 4.4 has been revised to state, "**Based on visual observations made during test pit operations and result from geophysical surveys and subsurface soil sampling, debris at YPG-141 is consistent with the site history and consists of industrial waste (bricks, wire, nails, metal strapping, wood) and municipal debris (glass baby bottles, paper, plastic wrapping, aluminum cans).**" The number and location of test pits excavated during the RFI was presented in the approved RFI Work Plan (Parsons, 2009). A grid-based sampling approach was utilized. Soil samples were collected within designated 200 by 200 ft grids. A biased sampling protocol was developed in the Work Plan where test pits were excavated in areas indicative of waste based on geophysical surveys. Samples were collected above, within, and below the waste. This data would be used to determine

Comment #	Comment	Reference	Response to Comment
			whether waste constituents could be migrating deeper into the soil column. Landfills by nature are non-homogenous but the sampling approach was used to determine the nature (types of waste) and types of contaminants associated with the waste. This biased sampling approach of the waste material in areas with the highest geophysical signature provides a high probability that the most significant contaminant concentration will be identified, or as identified in the RFI Work Plan, the "worst case." Identifying the footprint (horizontal extent) of waste within the landfill was part of the DQOs of the RFI; therefore, when waste was identified outside the predetermined geophysical anomaly zone, additional step out test pits were excavated until the boundaries of the landfill could confidently be identified. This approach provided accurate means of determining the locations of buried wastes. Sufficient data has been collected to complete the CMS and to address areas of buried waste at the landfill. The text states that the nature and extent of waste has been adequately delineated, and further sampling is not required. This is an accurate statement when considering the DQOs of the RFI.
Specific Comments:			
1	**Executive Summary. Non-Residential SRLs.** In the sixth line on page viii, it is stated that contaminant concentrations were compared to non-residential SRLs. The RFI report does not include comparison of COPC concentrations with non-residential	**Executive Summary Page viii**	**Response** – As stated in the response to Comment #4, nrSRLs have been added for comparison purposes. Text in the executive summary and throughout the document has been revised to add nrSRLs.

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	SRLs. Please correct the statement. Also, refer to general comment 4.		
2	**Executive Summary. Hazardous Waste Deposition.** In the fifth line of the third paragraph on page viii, USAGYPG has concluded that there was no evidence of hazardous waste in the excavation pits. Refer to general comment 2 and revise the discussion.	**Executive Summary Page viii**	**Response** – See Response to General Comment #2.
3	**Introduction**. YPG-141 is indicated on the various maps as being west of Laguna Army Airfield, not southeast as stated in the text. Please provide the correct location of YPG-141.	**Page 1-1 Section 1.0**	**Concur** – Text has been revised to state that YPG-141 is located west of Laguna Army Airfield.
4	**Section 1.1. Regulatory Framework.** (a) In the second paragraph, the statement "Based on the recommendation of the RFA, this RFI has been completed for each of the six inactive landfills" should be revised to clarify that the RFI has been completed for the inactive landfill, YPG-141. (b) In the third paragraph on page 1-2 it is stated that regulated wastes were not disposed at YPG-141. Clarify the term "regulated wastes." If USAGYPG is referring to hazardous waste or hazardous waste constituents that may be contained in solid waste, refer to the general comment 2.	**Page 1-2 Section 1.1**	**Concur –** (a) Text has been revised to clarify that the RFI has been completed for the inactive landfill YPG-141. (b) **Response –** The term 'regulated waste' will be removed in the referenced text and replaced with 'hazardous waste'. (c) **Response** - See response to General Comment #1.

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	(c) In section 1.1, page 1-2, the report states that the landfill is subject to ARS 49-701(3)(b), ARS 49-701 (29) and 40 CFR 258.1(c). This is not disputed, however, as stated in general comment 1, YPG-141 is also subject to Corrective Action, as contained in Part VI.A.1 of the Permit which requires USAGYPG to address corrective action as necessary to protect public health and the environment from releases of hazardous waste, including hazardous constituents from any SWMU at the facility, regardless of when the waste was placed in the unit.		
5	**Groundwater**. It should be specified that the "1-4 ft per mile" is the gradient.	**Page 2-7, Section 2.2.4.2**	**Concur –** Text has been revised to state, "at **a** 1-4 ft per mile **gradient**."
6	**Section Title.** The section title is listed as "Nature and Extent Investigation." Change it to "Nature and Extent of Contamination Investigation."	**Page 4-1, Section 4.0**	**Concur –** The title for Section 4.0 has been revised to "Nature and Extent **of Contamination** Investigation".
7	**Soil Sampling Activities**. The RFI work plan had specified that the field duplicate samples would be collected at a rate of 10%. During the investigation, USAGYPG collected only one field duplicate for 32 original/primary soil samples. USAGYPG stated that the rationale for this decision	**Page 4-4, Section 4.1.4**	**Concur –** Future investigations will include 10% duplicate samples for each site.

Comment #	Comment	Reference	Response to Comment
	was that the average duplicate collection frequency at the Muggins Mountain and inactive landfill sites was 10%. Considering that these SWMUs are distinct and the result of completely separate releases, such a rationale is baffling. For future investigations, duplicate samples must be collected at each site at a rate that is adequately supported by literature.		
8	**Evaluation of Soil Analytical Results. Step 2 - Residential SRL and GPL Comparison.** (a) Refer to general comment 4 on non-residential SRLs and revise the presentation. Also, compare concentrations of metals (e.g., copper, arsenic and lead) that exceed the residential SRLs with the non-residential SRLs. (b) The section should discuss the sampling results for chromium. One sample at test pit EP011 exceeded the hexavalent chromium residential SRL of 30 mg/kg.	**Page 4-8, Section 4.2.3**	**Response –** (a) See response to General Comment #4. (b) The ADEQ approved work plan (Parsons, 2010) presents the rSRL for Chromium (total) as 17,000 mg/kg. As noted in Table A.3.3, the SRLs for chromium (total) are assumed to consist of CrVI:CrIII at a ratio of 1:6. Because the USAGYPG facility has no history of Chromium VI use, and there is no evidence that Chromium VI materials were disposed of at YPG-141, this value is adequate. Because the detection does not exceed the rSRL presented in the work plan, no revision to text is necessary.
9	**Evaluation of Soil Analytical Results. Step 3 - Professional Judgment.** In paragraph 1 on page 4-10, it is stated that the horizontal and vertical extent of lead and copper contamination has been defined. Please refer to general comment 5 and revise the presentation.	**Page 4-10, Section 4.2.3, Step 3**	**Response –** Text stating that the horizontal and vertical extent of lead and copper contamination has been removed from the document. Please see response to referenced comment 5

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10	**Contamination Assessment.** In the second paragraph on page 4-11, the discussion is restricted to comparison with residential SRLs. Include non-residential SRLs and GPLs in the discussion and reference GPL exceedances of lead.	**Page 4-9, Section 4.3**	**Response –** See response to General Comment #4.
11	**Selection of Chemicals of Potential Concern (COPCs). Analysis of Lead Data.** In the discussion the concentrations of lead have been compared to the residential SRL of 400 mg/kg. It would be appropriate to also compare the lead concentration to the GPL of 290 mg/kg. YPG has used the available lead sampling data to calculate upper confidence level (UCL) for lead, and then compared the existing concentrations with the lead UCL. However, the available sampling data is insufficient to calculate a UCL for residential exposure. The sampling unit (decision unit) must be based upon an area similar to a residential size lot, typically a quarter acre in size. The sampling data from the entire two acre site cannot be used to characterize exposure to much smaller areas. More importantly, the RFI work plan clearly specifies that the lead concentration will be compared only to SRLs, GPL, and	**Page 5-3, Section 5.1.2**	**Response –** Text in Section 5.1.2 is referring to the selection of COPCs for the human health risk assessment, where it is appropriate to compare soil concentrations to the rSRLs and nrSRLs but not GPLs. Section 5.3, Soil-To-Groundwater Evaluation, is the appropriate section for the comparison contaminant concentrations to GPLs. Text referencing the UCL has been removed from the text.

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	background concentrations, and not a statistically derived UCL		
12	**Site Description and Land Use.** The location of YPG-141 relative to Laguna Army Airfield is either incorrectly specified in the text, or the maps are wrong. Provide the correct location. Also, refer to specific comment 3.	**Page 5-5 Section 5.2.1.2**	**Response –** See Response to specific comment #3
13	**Conclusions of the Risk Assessment**. USAPYPG has stated that a CMS is not required for YPG-141 since there are no COPCs that pose a threat to human health or the environment. Please note that lead exceedance of the GPL confirms a threat to groundwater. More importantly, the RFI proved that YPG-141 is an unlined solid waste landfill, and as a result is a candidate for a CMS which will yield a remedial alternative that ensures that it does not pose a threat to human health or the environment.	**Page 5-9 Section 5.4**	**Response –** A CMS will be conducted for YPG-141.
14	**Summary and Recommendations. Applicable Regulations**. The report states at section 6, page 6-2, that since YPG-141 is a solid waste landfill that ceased accepting waste before July 1, 1983, it meets the criteria of a closed solid waste facility in accordance with ARS §49-701(3)(b) and ARS §49-701(29). However,	**Page 6-2 Section 6.0**	**Response –** Hazardous waste in the form of ordnance, drums, liquids were not encountered during the intrusive investigation at YPG-141. Waste encountered was consistent with municipal waste. These findings are also consistent with the historical documentation of waste disposal at the site. There was no evidence that hazardous waste material was ever disposed of at YPG-141. However, a CMS will be conducted, which will identify corrective measures alternatives aimed at preventing

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	YPG-141 is also subject to Corrective Action, as contained in Part VI.A.1 of the Permit which requires USAGYPG to address Corrective Action as necessary to protect public health and the environment from releases of hazardous waste, including hazardous constituents, from any SWMU at the facility, regardless of when the waste was placed in the unit.		exposure to solid waste currently present.
15	**Summary and Recommendations. Post Closure Plans.** The report states that YPG-141 may benefit from certain management options, such as surface runoff controls, annual inspections, and incorporation of the landfill in the USAGYPG Master Plan. ADEQ believes that as part of its corrective measures study, USAGYPG must also consider measures such as capping, grading for run-on and run-off controls, and the construction of a vegetative cover.	**Page 6-2 Section 6.0**	**Concur –** Post-closure measures will be submitted as part of the CMS and may include a discussion considering the stated corrective measures alternatives.
16	**Summary and Recommendations. Landfill Operational Period.** In the second paragraph of page 6-1, it is mentioned that the landfill was operated between 1950 and 1964. Previous reports give the dates of operation for YPG-141 as 1955 to 1960 and 1964 to 1967. The period 1964 to 1967 was specified in the RFA and was cited throughout this report. Please	**Page 6-1 Section 6.0**	**Concur-**The text has been revised to state**….”**The landfill was reported to have received municipal and industrial waste between 1964 and 1976.”

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	confirm the time period during which YPG-141 operated as a landfill, and revise the text to be consistent when referencing this crucial information.		
17	**Comparison of Maximum Detected Concentrations to Background and SRLs.** Reference general comment 1 and include the non-residential SRLs in this table.	**Table 5.1**	**Concur –** The nrSRLs have been added to Table 5.1.

FINAL

RCRA FACILITY INVESTIGATION REPORT FOR INACTIVE LANDFILL YPG-141 U.S. ARMY GARRISON YUMA PROVING GROUND

Submitted To:

U.S. ARMY GARRISON YUMA PROVING GROUND

Prepared By:

March 2013

FINAL

RCRA FACILITY INVESTIGATION REPORT FOR INACTIVE LANDFILL YPG-141 U.S. ARMY GARRISON YUMA PROVING GROUND

Submitted To:

U.S. ARMY GARRISON YUMA PROVING GROUND

Prepared By:

PARSONS

March 2013

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ACRONYMS AND ABBREVIATIONS

ADEQ	Arizona Department of Environmental Quality
AGFD	Arizona Game and Fish Department
AMSL	Above Mean Sea Level
bgs	Below Ground Surface
BTV	Background Threshold Value
CFR	Code of Federal Regulations
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
COC	Chemical of Concern
COPC	Chemical of Potential Concern
COPEC	Chemical of Potential Ecological Concern
CSM	Conceptual Site Model
DoD	Department of Defense
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
°F	Degrees Fahrenheit
ft	Feet
GPL	Groundwater Protection Level
GPS	Global Positioning System
HQ	Hazard Quotient
HRA	Human Risk Assessment
HSWA	Hazardous and Solid Waste Amendment
IA	Impact Assessment
km	Kilometers
LOAEL	Lowest Observable Adverse Effects Level
Ma	Million Years
MD	Munitions Debris
MEC	Munitions and Explosives of Concern
mg/kg	Milligrams per Kilogram
mph	Miles Per Hour
MSWLF	Municipal Solid Waste Landfill
ND	Non-Detect
NFA	No Further Action
NOAEL	No Observable Adverse Effects Level
NRCS	National Resource Conservation Service
nrSRL	Non-Residential Soil Remediation Level
OB/OD	Open Burn/Open Detonation
PAH	Polycyclic Aromatic Hydrocarbon
QAPP	Quality Assurance Project Plan
QSM	Quality Systems Manual
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation

ACRONYMS AND ABBREVIATIONS (CONTINUED)

rSRL	Residential Soil Remediation Level
SVOC	Semivolatile Organic Compound
SWMU	Solid Waste Management Unit
TRV	Toxicity Reference Value
UCL	Upper Confidence Level
U.S.	United States
USAEHA	U.S. Army Environmental Hygiene Agency
USAGYPG	U.S. Army Garrison Yuma Proving Ground
USATHAMA	United States Army Toxic and Hazardous Materials Agency
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UXO	Unexploded Ordnance
VOC	Volatile Organic Compound
yd^3	Cubic Yard(s)

EXECUTIVE SUMMARY

This report presents the results of the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) activities conducted for the inactive landfill YPG-141 at U.S. Army Garrison Yuma Proving Ground (USAGYPG), Yuma, Arizona. This report also includes a human health and ecological risk assessment, which evaluates the potential for human health and ecological impacts from assumed exposures to chemicals of potential concern (COPCs) within the site.

The RFI activities at YPG-141 consisted of removal of the surface debris followed by a geophysical survey, excavation of test pits, and drilling of soil borings to characterize the landfill and define its boundaries. Subsequent soil samples were also collected from the test pits and soil borings and analyzed for contaminants.

The surface debris removal action at YPG-141 consisted of the removal of metal banding, sheet metal, cast iron pipe, chicken wire, steel rods, a jeep window, and other smaller pieces of rusted metallic debris. The metallic debris was taken to the U.S. Marine Corps Yuma facility for inspection and recycling. Following the removal action, a geophysical survey was conducted at the site to confirm results of a previous geophysical investigation. Geophysical results indicate a shallow burial area extending north to south across the site (Parsons, 2010). Twenty-three magnetic anomalies were identified, of which nine are believed to coincide with surface metallic debris. Based on the results of the geophysical survey, fifteen biased test pits and three soil borings were excavated to define the vertical and horizontal extent of the buried waste. Associated soil samples were collected at the test pit and soil boring locations. One background test pit was also excavated and associated soil samples collected for use in calculating background threshold values (BTVs) for metals.

Of the fifteen test pits excavated, seven were found to contain solid waste (141EP002, 141EP003, 141EP004, 141EP007, 141EP008, 141EP011, and 141EP012), which included glass and plastic bottles, burned paper and wood, rusted metal objects, pipe, partially decomposed aluminum cans, Styrofoam™ cups, food packaging, fabric, and ceramics. At test pits where waste was encountered, subsurface soil samples were collected from within and below the waste. In addition to the samples collected from test pits, three subsurface soil samples were collected from the three soil borings drilled at the site (141SB001 through 141SB003). A total of 32 soil samples were collected from the test pits and soil borings and analyzed to define the extent of detectable contamination.

Soil samples collected at YPG-141 were analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), explosives and metals. The vertical and horizontal extent of impacts to soil was determined by comparing soil concentrations of COPCs to remediation goals (State of Arizona residential soil remediation levels [rSRLs] and non-residential [nrSRLs] and minimum groundwater protection levels [GPLs]). In addition, metals detections were evaluated using BTVs to determine if the detection is a result of site activities.

Analytical results from soil sampling at YPG-141 show that, although multiple organic compounds were detected in site soils, no compound had a concentration above its corresponding rSRL, nrSRL, or GPL. Three metals (arsenic, copper, and lead) were found to exceed their corresponding rSRL, nrSRLs, or GPL in five samples collected from three test pit locations (141EP004, 141EP008, and 141EP011). The copper and lead concentrations exceeded the rSRLs but not the nrSRLs. This contamination is believed to be associated with buried metallic debris from within the landfill, and to be stable and not significantly migrating. This conclusion is based on soil sampling results that show elevated concentrations of lead and copper found in samples collected from within the debris zone but not in samples collected from the overlying and underlying zones. The elevated level of arsenic, which exceeds both the rSRL and nrSRL is possibly related to a layer of mineral-rich soil in a limited area of the site not included in the cross-section. This conclusion is based on analytical results that show an elevated level of arsenic in only one sample collected from the site. This sample was collected at test pit 141EP004 from the interval located directly below the debris zone. The arsenic concentration in the sample collected from within the associated debris zone was below the BTV.

The soil-to-groundwater evaluation showed three lead concentrations exceeding the minimum GPL. This GPL has been shown to be conservative and represents the "worse-case" scenario. In addition, lead contamination at the site is believed to be confined to the buried waste layer and not migrating.

Surface and subsurface investigation activities conducted during the RFI indicate that debris at YPG-141 consists of municipal and industrial waste. The presence of charred wood and low levels of hydrocarbons and polycyclic aromatic hydrocarbons (PAHs) suggests a portion of the waste may have been burned. No visual evidence of hazardous waste or munitions debris was identified in the excavated pits. As state previously, soil sampling results show lead, copper, and arsenic concentrations exceeding the GPLs and rSRLs in five samples. The samples containing elevated levels of lead and copper were collected from within the debris zone, and are most likely related to metal debris. Deeper interval soil samples collected from within these two test pit locations show no evidence of vertical migration. The sample containing the elevated arsenic is possibly related to a layer of mineral-rich soil in a limited area of the site. Based on the results of the field investigation, the nature and extent of burial operations and associated contamination at YPG-141 has been delineated and no further sampling is required.

A human health and ecological risk assessment was performed for YPG-141 to assess potential risks and hazards from exposure to contaminants in soils and to recommend either no further action (NFA) (if the risks and hazards are acceptable) or of the development of cleanup goals and remedial alternatives under a corrective measures study (CMS) task (if unacceptable risks or hazards were identified). Results of the human risk assessment (HRA) indicate that there are no chemicals of concern (COCs) identified as potential hazards for human or ecological receptors. The soil-to-groundwater evaluation shows three concentrations of lead exceeding the minimum GPL. Although these lead concentrations are believed to be confined to the buried waste layer and there is no evidence of vertical migration, a CMS is recommended for the site to prevent exposure to the buried waste and leaching of material.

SECTION 1.0

INTRODUCTION

This report was prepared by Parsons, Inc. (Parsons) for the U.S. Army Garrison Yuma Proving Ground (USAGYPG) located near Yuma, Arizona. The purpose of this document is to present activities, procedures, and results of the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) for YPG-141, an inactive landfill located approximately 1 mile northeast of the Main Administrative Area, north of Barranca Road and west of Laguna Army Airfield. This RFI was performed pursuant to contract number W91ZLK-05-D-0016, Task Order 0002.

The objectives of the RFI were to: 1) collect data to adequately identify and characterize the nature and extent of buried waste and contamination; 2) conduct a risk assessment (human and ecological) to determine if constituents have been released to the environment which pose a risk to human health or the environment; and 3) evaluate if chemical constituents are present at levels that pose a threat to groundwater.

1.1 REGULATORY FRAMEWORK

Six inactive landfills were identified during the RCRA Facility Assessment (RFA) at USAGYPG as potentially containing hazardous waste; therefore, regulatory procedures regarding the landfills have followed the RCRA process as amended by the Hazardous and Solid Waste Amendments (HSWAs) of 1984. Under Subtitle C of RCRA, the State of Arizona has the authority to implement the RCRA program and many of the HSWA requirements. The Arizona Department of Environmental Quality (ADEQ) monitors RCRA compliance and enforces its provisions at USAGYPG. For example, USAGYPG is currently operating the open burn/open detonation (OB/OD) areas under a RCRA Part B permit issued in June of 2007. Primarily, RCRA regulations traditionally apply to active waste management facilities; however, HSWA added provisions to RCRA that enable inactive solid waste sites to be investigated and, if needed, remediated through a “corrective action” program. Based on these provisions, the inactive landfill sites at USAGYPG have been included within the USAGYPG Part B Permit and currently fall under the administration of RCRA and ADEQ.

The regulatory framework under which RFIs are completed is the RCRA corrective action process. The authority for RCRA corrective action is derived from RCRA Section 3004(u) and is comprised of four phases:

- RFA - Identifies releases and potential releases of hazardous wastes or constituents from the site.
- RFI - Verifies release(s) from the site and characterizes the nature and extent of contaminant migration.
- Corrective Measures Study (CMS) - Determines appropriate corrective measures for the site.
- Corrective Measures Implementation (CMI) – Provides the design, construction, operation and maintenance, and monitoring of the corrective measures.

An RFA was previously conducted at the six inactive landfill sites (Tetra Tech EM Inc., 1998). The RFA was completed to satisfy the requirements of the RCRA permit issued by the state of Arizona. Based on the recommendation of the RFA, this RFI has been completed for the inactive landfill YPG-141.

The six abandoned landfills were identified in the RFA as solid waste management units based on records and interviews indicating a potential history of solid waste disposal, which could include the presence of hazardous waste such as munitions and solvents. Facility engineering drawings, results of the RFA, and personnel interviews indicate that three of the landfills (YPG-27, YPG-29, and YPG-141) had previously been used by USAGYPG as municipal landfills. However, based on the results of this RFI, regulated wastes were not disposed of at YPG-141. Therefore, the landfill is subject to the rules and statues of the ADEQ Solid Waste Unit under ARS § 49-701 (3)(b) and (29) and the United States Environmental Protection Agency (USEPA) (40 CFR 258.1(c)).

1.2 DESCRIPTION AND HISTORY OF USAGYPG

The USAGYPG installation is located in a remote area of southwestern Arizona, bordered on the west by the Colorado River (Figure 1.1). It lies 37 kilometers (km) (23 miles) northeast of the city of Yuma along U.S. Highway 95, between Interstate Highways 8 and 10, and is approximately 200 km (125 miles) west of Phoenix, Arizona and 288 km (180 miles) east of San Diego, California. The nearest major population center to USAGYPG is the city of Yuma, which has a population of approximately 93,064 inhabitants (U.S. Census Bureau, 2010). The proving ground is one of the Department of Defense's (DoD's) largest installations, and encompasses an area of approximately 830,000 acres in size, or roughly 1,300 square miles. Comparatively, it is slightly larger than the state of Rhode Island.

The proving ground is a general purpose facility where the testing of weapon systems of all types and sizes has occurred for over fifty years. Equipment and munitions tested at the installation consist of medium and long-range artillery; aircraft target acquisition equipment and armament, armored and wheeled vehicles, a variety of munitions, and personnel and supply parachute systems. Testing programs are conducted for all U.S. military services, friendly foreign nations, and private industry. The USAGYPG installation is the Army's center for desert natural environment testing, and is one of 22 major test ranges that comprise the DoD Major Range Test Facility Base.

Military use of USAGYPG began in 1942 for training desert troops (USAEHA, 1988). The mission changed in January 1943 when the site began to be used as a testing ground for bridges, river crossing equipment, boats, vehicles, and well drilling equipment under the designation of Yuma Test Branch, Corps of Engineers. On October 1, 1947, it was designated the Engineering Research and Development Laboratories, Yuma Test Branch, Sixth Army. This installation was deactivated in January 1950 because of a military austerity program; however, on April 1, 1951 it was reactivated as the Yuma Test Station for desert environmental testing of equipment ranging from tanks to water purification units. On August 1, 1962, the station was assigned to the U.S. Army Materiel Command, and on July 1, 1963, it was renamed Yuma Proving Ground (USAEHA, 1988).

Today, USAGYPG has a working population of approximately 3000 people, including test and support soldiers, civil service employees, and supporting civilian contractors. It hosts about 23,000 visitors per year, including test customers, training units, U.S. government and foreign dignitaries, local organizations, and school groups (USAGYPG, 2009).

1.3 REPORT ORGANIZATION

This report contains the results of the RFI activities, including results of a nature and extent evaluation and human health and ecological risk assessment. The report is divided into seven sections and five appendices, and contains the necessary elements as required by the RFI program.

Section 1 **Introduction –** Presents the project overview including the regulatory framework and a description and history of USAGYPG.

Section 2 **Environmental Setting –** Provides a description of the environmental settings of the USAGYPG installation and the YPG-141 inactive landfill site. This section also includes an overview of the site location, description, and history of waste disposed of at the site.

Section 3 **Previous Investigations –** Describes previous investigations and activities conducted at YPG-141.

Section 4 **Nature and Extent Investigation –** Identifies the RFI approach and strategies along with investigation results and recommendations.

Section 5 **Human Health and Ecological Risk Assessment –** Provides an evaluation of the risks associated with potential waste buried at YPG-141.

Section 6 **Summary and Recommendations –** Summarizes human health and ecological risk screening results along with a corrective action evaluation and recommendations.

Section 7 **References –** Provides information resources cited in the report.

Appendix A Field Logs

Appendix B Site Photographs

Appendix C Analytical Data and Quality Control Tables

Appendix D Calculation of Background Threshold Values

Appendix E Ecological Risk Assessment

Appendix F Removal Action Photographs

SECTION 2.0
ENVIRONMENTAL SETTING

2.1 U.S. ARMY GARRISON YUMA PROVING GROUND FACILITY

2.1.1 Topography

The USAGYPG installation is located within the Sonoran Desert Southern Basin and Range Physiographic Province. The distinctive topography within this province consists of elongate low rugged uplifted mountains trending north-northwest with intervening sediment-filled valleys. The majority of the basins are structural depressions filled with alluvial sediments from the river systems that dissect the area and locally derived sediments from the surrounding mountains (Entech Engineers, Inc., 1988; Argonne, 2004).

Four major landforms are present: 1) alluvial fan (47% of the total area); 2) mountain highlands (27% of total area); 3) active washes (14% of the total area); and 4) alluvial plain (8% of the total area). The remaining 4% of the total USAGYPG land area consists of badlands, pediment, alluvial terrace, old terrace, and dunes (DRI, 2009).

The relief of the mountain ranges is relatively low but the topography is rugged, with slopes locally exceeding 40%. The maximum elevation of 2,822 feet (ft) above mean sea level (AMSL) occurs in the Chocolate Mountains and the lowest elevation, 195 ft AMSL, is just south of the Main Administrative Area. Surface drainage in the northern and western portion of USAGYPG flows west into the Colorado River while the remainder flows south into the Gila River. Most of the surface flow occurs on lowland washes that generally have slopes between 1% to 3% and are dry except during occasional periods of intense rainfall (Entech Engineers, Inc., 1987).

2.1.2 Climate

Because USAGYPG is in the Sonoran Desert, its climate is typical of a low elevation, hot, arid desert. It is characterized by high daytime temperatures with large daily temperature variations, low relative humidity, and very low average precipitation. The average monthly air temperature ranges from a low of 47.6 degrees Fahrenheit (°F) in January to a high of 106.8°F in July (NWS, 2011). The average annual precipitation in Yuma and other areas along the lower

Colorado River is very low, approximately 3.5 inches per year (NWS, 2011). Rainfall occurs predominantly in the form of summertime thunderstorms, which are sometimes very intense and produce local flash flooding. Evaporation in the arid climate is very high. The Yuma Citrus Station, located eight miles southwest of the city of Yuma, has an average annual pan evaporation rate of 99.2 inches per year, approximately 30 times the average annual precipitation (2.6 inches per year at the same location) (WRCC, 2012).

The wind speed in the Yuma area averages from 7.1 miles per hour (mph) during September through February to 8.6 mph from March through August with a yearly mean of 7.8 mph (NWS, 2012). The prevailing direction is from the north from late autumn until early spring (Oct. - Feb.), westerly to northwesterly in the spring (Mar. – May). Winds associated with the summer monsoons shift and come out of the south and south-southeast (WRCC, 2012).

2.1.3 Soils

Eight distinct soil types based on textural description, in accordance with the National Resource Conservation Service (NRCS), occur over the entire USAGYPG facility. These soil types, along with their corresponding percentages (DRI, 2009), are described in Table 2.1.

2.1.4 Hydrology

2.1.4.1 Surface Water

No perennial lakes or streams are present within USAGYPG, however, two major rivers flow through the adjacent desert. The Colorado River traverses a generally north-south direction, west of USAGYPG. The mostly dry Gila River drainage traverses an east-west direction, south of USAGYPG. Surface drainage on the northern and western parts of USAGYPG flows into the Colorado River, with the central and eastern parts of USAGYPG flowing into the Gila River.

Both rivers have breached their banks during wet years and caused property damage. However, upstream dams and reservoirs, including Mittry Lake, Martinez Lake, Squaw Lake, Imperial Dam, Ferguson Lake, and Senator Wash Reservoir (all located along the Colorado River west of USAGYPG) and Painted Rock Dam (on the Gila River) have decreased the severity of recent flood events.

Surface water within USAGYPG is limited to brief periods during and after intense rainfall events which produce flash flooding and ponding in low areas (Argonne, 2004). Infrequent rainfall produces localized flash-flooding and temporary surface water, especially during thunderstorms in August and September. Rainfall averages 3.5 inches per year, and the evaporation pan rate is 99.2 inches per year (WRCC, 2012). The combination of low precipitation and high evaporation prevents surface water from infiltrating deeply into the soil. Thus, most of the year, desert washes are dry. The dry washes vary in size, from less than 3 ft in width and depth, to more than a half mile in width and 30 ft in depth. Each wash contains numerous smaller channels that can change course during major flood events.

The USAGYPG installation has few natural, year-round sources of water. Some natural water sources have been modified to provide year-round water to wildlife. The four types of natural and artificial water sites are described below (Palmer, 1986):

- Tinajas are naturally occurring, bowl-shaped cavities scoured out of bedrock. Tinajas are usually found at the base of waterfalls where the bedrock formation that created the waterfall changes from harder to softer rock. Rocks trapped in the cavity increase scouring. Tinajas are usually located in the mountain canyons.
- Enhanced tinajas are tinajas that have been artificially improved to increase and prolong water storage capacity. Most enhanced tinajas retain water throughout the year.
- Water catchments are storage tanks, sized from 1,500 to 34,500 gallons, constructed by Arizona Game and Fish Department (AGFD). These tanks are located in the Cibola and Kofa Regions.
- Other artificial water sources have developed over the years as a result of leaking landscape irrigation pipes, excess water released by stand pipes, or by pumping water into impoundments (Morrill, 1990). These include Lake Alex, which is a well-pumped impoundment near Pole Line Road and north of Red Bluff Mountain in the eastern Kofa Region, and Ivan’s Well, which is a well-pumped impoundment near Growl Road and Kofa Mohawk Road in the Kofa Region.

2.1.4.2 Groundwater

The principal water-producing aquifer within USAGYPG is the unconsolidated alluvial aquifer. This aquifer varies in thickness from tens of feet at the margins of the basins to hundreds of feet in the center of the basins. Based on the results of a hydrogeologic study of this aquifer conducted in the early 1980s (Entech Engineers, Inc., 1988), the top of the groundwater aquifer ranges in elevation from approximately 155 to 200 ft AMSL. The depth to groundwater ranges from 30 ft below ground surface (bgs) in Well X (located in the main Cantonment area near the Colorado River) to greater than 600 ft bgs in Well M (located near the Castle Dome Heliport). Water levels in these wells did not substantially change over a one-year period in 1987 (Entech Engineers, Inc., 1988). The potentiometric surface data suggest that the direction of groundwater flow is southwest toward the Colorado and Gila Rivers. The groundwater gradient is about 4 to 5 ft/mile upgradient of the major pumping wells, and less than about 4 ft/mile near the rivers. Near the rivers, the groundwater elevation becomes shallower, and it may be within 10 ft of the surface in floodplain deposits (Click and Cooley, 1967). Local precipitation and runoff are very minor sources of groundwater recharge.

Groundwater has also been observed in the underlying bedrock (Entech Engineers, Inc., 1988). However, in the bedrock the water quality is more mineralized and groundwater flow is much slower than the overlying unconsolidated aquifer due to fracture flow and lack of permeability. According to the U.S. Geological Survey (USGS), the estimated recoverable groundwater in the aquifer of the basin is 50 million acre-ft. The estimated annual inflow and outflow to the aquifer is 65 thousand acre-ft (Freethey and Anderson, 1986).

2.1.5 Geology

The USAGYPG installation is located within the Sonoran Desert Southern Basin and Range Physiographic Province. The distinctive topography within this province is uplifted mountains with intervening sediment-filled valleys associated with the tectonic extension which started approximately 19 Million years (Ma) ago. The majority of the basins are structural depressions filled with alluvial sediments from the river systems that dissect the area and locally derived sediments from the surrounding mountains (Anderson et al., 1992).

The basement rocks in the vicinity of USAGYPG and surrounding areas are Pre-Tertiary metamorphic and igneous rocks consisting of schist, gneiss, granite, and weakly metamorphosed sedimentary rocks, all intruded by dikes of diorite porphyry and overlain by a thick series of lavas cut by dikes of rhyolite porphyry. Later Tertiary non-marine red-bed sedimentary rocks and volcanics overlie the basement sequence. The Laguna Mountains and Chocolate Mountains are made up of 33 Ma Tertiary volcanics. The late Tertiary, Miocene-Pliocene Bouse Formation overlies a 5.47 Ma tuff. The Bouse Formation is a massive siltstone unit with a basal limestone and is lacustrine/estuarine in origin.

The Palomas and Tank Mountains contain mostly extrusive igneous rocks with lesser amounts of metamorphic rocks. Intrusive igneous rocks are also found in the southern part of the Palomas Mountains. The Muggins Mountains are made up of metamorphic and extrusive igneous rocks with some sedimentary rocks. The Middle Mountains are composed of mostly extrusive igneous rocks with metamorphic and sedimentary rocks. The Trigo and Chocolate Mountains are largely extrusive igneous rocks with some metamorphic rocks. The basins or lowlands between mountain ranges are composed of alluvium which is typically comprised of sand, silt, and clay layers of Quaternary origin. The depth of the sediments is not known; however, wells 1,300 ft in depth have not reached the basin's bedrock floor (Entech Engineers, Inc., 1987). Sand dunes are visible features along the base of some mountains in the USAGYPG vicinity. Also, there is evidence in the Materiel Test Area that sand dunes existed in the geologic past. Cross-bedded sands, indicating the presence of buried sand dunes, were found by the U.S. Bureau of Reclamation in soil borings at the petroleum, oil, and lubricants bladder test spill site (USBR, 1993).

2.2 YPG-141 - INACTIVE LANDFILL

2.2.1 Location and Site Description

Site YPG-141 is located approximately 1 mile northeast of the Main Administrative Area, north of Barranca Road and west of Laguna Army Airfield.and the site consists of approximately 4.1 acres (Figures 2.1 and 2.2). Disposal activities reportedly occurred at the site from 1964 to 1967. Prior to a surface debris removal action of November 2009, abundant glass debris, burnt wood, and various metal scrap including cast-iron pipes, cans, cable, wire, metal banding/strapping, and other miscellaneous debris were present at the surface and within the drainage channel in the northwestern portion of the site (Section 4.1.1; Appendix F). In addition, metallic anomalies identified during a geophysical survey indicated the presence of buried waste in the south central region of the landfill (Section 3.3; Jason, 2007). A large pile of gravel-sized crushed concrete is present near the center of the site, and is believed to come from a housing/administration area demolition project. Following the November, 2009 removal of approximately 5 cubic yards (yd^3) of metal surface debris, an additional geophysical survey was conducted using a G-858 magnetometer (Section 5.1.4; Parsons, 2010). The results of this survey, along with the results of the RFI, indicate that metallic wastes were likely buried in cut and fill trenches trending north-south across the site.

2.2.2 Topography

The YPG-141 site is generally flat and is located along a drainage plain that trends from north to south. A main drainage channel is located along the west side of the landfill. Bedrock outcrops border the south-southeastern edges of the site. The elevation of the site is approximately 330 ft AMSL.

2.2.3 Geology

The shallow subsurface lithology at YPG-141 was obtained from 15 test pits excavated throughout the site and three soil borings drilled to 30 ft bgs (Section 4.1.3). The generalized lithology at YPG-141 consists of a sequence of unconsolidated silty sand and gravel, strongly cemented sandy clay, and white sand units. These unconsolidated deposits are light reddish-brown in color and poorly sorted. The sand is fine to medium-grained. The gravel ranges from pea- to cobble-size, and from angular to subround.

The uppermost unit in which the test pits were excavated consists of a weakly interbedded sand and gravel, with some silt. This unit is reddish-brown in color with pea-to cobble-sized gravel of subangular to subround clasts. Beneath this unit lies a fine to medium light beige to white, well-graded sand. While the dominant sediments are sands and gravels, isolated clay horizons have been observed in both test pits and drill core. Bedrock was exposed at 4.5 to 5.5 ft bgs at the base of two of the test pits (141EP012 and 141EP014), indicating that bedrock is near the surface at the southern and northeastern sides of the site. Bedrock consisted of volcanic deposits.

The alluvium at YPG-141 is likely the result of two distinct sources: the nearby paleo-Colorado River alluvial deposits and locally-derived alluvium from the mountains to the west and the small hill to the south.

2.2.4 Hydrology

2.2.4.1 Surface Water

The YPG-141 site borders a dry wash on the eastern side. The nearest surface water is the Imperial Dam, which is located approximately 5 miles down gradient. During periods of intense rainfall, the drainage area may experience surface water flow for short periods of time.

2.2.4.2 Groundwater

No groundwater was observed in the test pits or soil borings at YPG-141. However, based on the regional potentiometric surface, groundwater would be anticipated to occur at approximately 197 ft bgs and flow southwest at a 1 to 4 ft per mile gradient (Jason, 2007).

2.2.5 Vegetation and Wildlife

Vegetation at YPG-141 is sparse, and much of the site has been disturbed due to the landfill disposal activities (Figure 2.3). The undisturbed areas are scattered with small bushes and trees that include bursage, creosote, and paloverde. Wildlife at USAGYPG and YPG-141 includes numerous mammals including herbivores, omnivores, predators, and reptiles. There are also over 100 species of birds at the installation. Vegetation and wildlife at the site are presented in more detail in the ecological risk assessment (Section 5.2).

2.2.6 Land Use

YPG-141 is not currently operational as a landfill. The future use of the YPG-141 site is expected to continue as undeveloped/vacant land. The site is located on the active Kofa Military Training Range and access to the site is controlled by range control. No physical controls such as fences are present.

SECTION 3.0

PREVIOUS INVESTIGATIONS

This section describes previous investigations and activities conducted at the YPG-141 abandoned landfill. These activities were performed to determine the contents of the landfill and define the shape and size of the landfill area. Investigations conducted at the site included an RFA performed in 1998 (Tetra Tech EM Inc., 1998), a release assessment conducted in 2001 (Argonne, 2001), and a geophysical survey performed in 2006 (Jason, 2007).

3.1 1998 RCRA FACILITY ASSESSMENT

A records review was conducted for YPG-141 during the 1998 RFA (Tetra Tech EM Inc., 1998). The following list summarizes previous investigations at the site as described in that review:

- The 1978 Impact Assessment (IA) stated that the landfill was a 2-acre area that was active from 1964 to 1967 for the disposal of administrative and domestic solid wastes.
- The 1980 United States Army Toxic and Hazardous Materials Agency (USATHAMA) II-A report stated that the landfill was active from 1955 to 1960. Wastes that may have been disposed of in the landfill include sludge from the Building 2060 Holding Tank (Solid Waste Management Unit [SWMU]-17), and empty pesticide containers. Detected constituents from the Building 2060 holding tank included various metals, methylene chloride, C10-C22 and C22-C34 petroleum hydrocarbons, and polycyclic aromatic hydrocarbons (PAHs).
- The 1988 USAEHA (U.S. Army Environmental Hygiene Agency (USAEHA) report stated that the landfill was active from 1964 to 1967 for the disposal of administrative and domestic solid wastes, which probably included construction and maintenance wastes.

The 1998 RFA report concluded that the YPG-141 landfill began operations in 1964, was active for several years, and was closed in 1967. It was also concluded that the unit managed domestic and administrative solid waste, which probably included construction and maintenance wastes. It was not known if the landfill had any release controls; however, given the dates of operation, it is not likely that the unit was lined. At the time of the report, there was no documented evidence of release and no indication that sampling had ever been performed at this landfill (Tetra Tech EM Inc., 1998).

3.2 2001 RELEASE ASSESSMENT

During the 2001 Release Assessment a field team visited the YGP-141 site (Argonne, 2001). The team observed miscellaneous surface debris at the bottom of a wash located at the site. It was presumed that the landfill was unlined, and the report recommended that information be obtained on the landfill contents and that geophysics, soil sampling, and if warranted, groundwater monitoring be performed at the site.

3.3 2006 GEOPHYSICAL SURVEY

In 2006, a geophysical evaluation was performed at YPG-141 to assess the apparent lateral limits of buried landfill debris within accessible areas of the site (Jason, 2007). The study included the use of a Geonics EM31 terrain conductivity meter and a Geomtrics 858 cesium magnetometer in conjunction with a Trimble Pro XRS global positioning system (GPS) for spatial control. Results of the geophysical survey indicated the presence of several areas that may contain buried metal or relatively conductive materials.

SECTION 4.0

NATURE AND EXTENT OF CONTAMINATION INVESTIGATION

A nature and extent investigation was conducted at YPG-141 as part of the RFI. A description of the investigation activities and the results of these activities are presented in the following sections. This section also presents an evaluation of whether sufficient sampling was conducted to adequately characterize the nature and extent of chemicals detected in site media, and provides data to support a human health and ecological risk screening evaluation.

4.1 INVESTIGATION ACTIVITIES

The investigation activities at YPG-141 consisted of removing surface debris, performing a post-surface removal geophysical survey, excavating 15 exploratory test pits, and drilling three vertical soil borings. Magnetometer geophysical surveys were conducted to outline the areas of subsurface metallic debris. Exploratory test pits were excavated to determine the vertical and horizontal extent of buried debris, and soil borings were drilled to confirm the horizontal and vertical extent determinations. Soil samples were collected from the test pits and soil borings to determine if chemical constituents have been released from the waste and to assess the vertical extent of solid waste.. Table 4.1 presents the investigation activities conducted during the RFI and the characterization objectives of each activity.

4.1.1 Surface Debris Removal

Approximately five yd^3 of recyclable metal debris was removed from the site in November, 2009. At that time, 23 magnetic anomalies identified in the previous geophysical survey (Jason, 2007) were field verified. Nine of these anomalies were found to be related to surface metal debris. The surface metal debris collected from the site included metal banding, sheet metal, cast iron pipe, chicken wire, steel rods, a jeep window, and other smaller pieces of rusted metallic debris. The metal debris was taken to the U.S. Marine Corps Yuma facility for inspection and recycling. Evidence of buried burnt glass and metal debris was also found within portions of a small drainage located on the west side of the site. This debris was found to be 2 to

3 ft thick. No indication of munitions and explosives of concern (MEC) or munitions debris (MD) was found at the site.

4.1.2 Geophysical Survey

A magnetometer G-858 geophysical survey was conducted on the site following the surface debris removal. The G-858 was also used for the previous magnetic geophysical survey (Jason, 2007). Geophysical results indicate a shallow burial area extending north to south across the site (Parsons, 2010) (Figure 5.5).

4.1.3 Test Pit Excavations and Soil Borings

Fifteen test pit excavations and three soil borings were used to define the vertical and horizontal extent of potential buried waste. Associated surface and subsurface soil samples were collected and analyzed from the test pits and soil borings to determine if chemical constituents have been released from the waste, and if so, whether the constituents pose a threat to human health or the environment. Additionally, one background test pit was excavated and one associated surface sample and one subsurface soil sample were collected for use in background threshold value (BTV) calculations for metals at the inactive landfills (Appendix D).

Test pit locations were selected following the general strategy outlined in the RFI Work Plan (Parsons, 2010). Based on the results of geophysical survey (Section 5.1.4; Parsons, 2010), the area of YPG-141 was divided into eleven 200 ft by 200 ft grids, and one or two biased test pits were excavated within each grid cell (Figure 4.1). Six test pits (141EP002, 141EP004, 141EP006, 141EP008, 141EP009, and141EP012) were excavated at the locations of linear dipole magnetic anomalies found during the geophysical survey. One test pit (141EP004) was located in an area outside of the 2009 geophysical survey area, but where waste was expected to be present based on the results of the previous geophysical survey (Jason, 2007). Eight test pits (141EP001, 141EP003, 141EP005, 141EP007, 141EP010, and 141EP013) were excavated in areas outside the anomaly zone to determine the horizontal extent of the buried waste and define the footprint of the landfill.

Test pits were excavated using a wheeled backhoe with an extension arm allowing a 15-ft maximum depth of excavation. Debris and soil excavated during the test pit operations were visually inspected by unexploded ordnance (UXO)-qualified technicians for the presence of

MEC or MD. Test pits were oriented perpendicular to the linear geophysical trends to cross-cut the suspected burial trenches. Once the soil was inspected by the UXO technicians, the on-site geologist prepared a geologic log of the test pit, depicting depth of waste, soil type, and soil sample locations (Appendix A). Representative photographs of the test pit operations are presented in Appendix B. The depth, width, length, and number of soil samples collected from each test pit are presented on Table 4.2.

During excavation activities, seven test pits were found to contain solid waste (141EP002, 141EP003, 141EP004, 141EP007, 141EP008, and 141EP011, and 141EP012), which included glass and plastic bottles, burned paper and wood, rusted metal objects, pipe, partially decomposed aluminum cans, Styrofoam™ cups, food packaging, fabric, and ceramics (Table 4.2). Based on geophysical surveys, waste was expected to be encountered at 141EP006 and 141EP009; however, no waste was identified.

Test pit 141EP011 was originally to be located in an area outside the waste, but was moved in toward the anomaly zone to further characterize the suspected landfill. Waste was encountered at 141EP011; therefore, test pit 141EP015 was added and excavated in the original location planned for 141EP011. No waste was identified in 141EP015. Unexpected waste was identified in 141EP003; therefore, test pit 141EP014 was excavated outside 141EP003 and the anomaly zone to delineate the northeast boundary of the landfill. No waste was identified within 141EP014.

Although waste was found in 141EP007, it was limited to a small amount of asphalt stained soil a few inches below the surface and miscellaneous scattered debris at the surface and just below the surface. This limited amount of waste and debris did not warrant further delineation as it did not appear to be associated with buried debris within the landfill.

As shown in the test pit logs (Appendix A), two soil borings were drilled near the locations of two test pits where debris was identified (141SB001 near 141EP002 and 141SB002 near 141EP008) to define the vertical extent of contamination and determine if waste extended beyond the vertical boundary of the landfill. The soil borings were completed adjacent to test pit locations where the greatest depth of waste was identified. Each soil boring was completed to a depth of approximately 30 ft past the bottom of the adjacent test pit excavation. A third soil boring was drilled near 141EP005 to verify the absence of waste at that location. The boring 141SB003 was completed to a depth of 25 ft bgs since no geophysical data were available at this location. Waste was not identified in 141SB003 at any depth. No waste was identified in 141SB001 or 141SB002 past the depth of waste recorded for their associated test pits. The geologic cross-section A-A' depicting the relationship between the test pits and the soil boring also shows that waste does not extend below 15 ft bgs (Figures 4.1 and 4.2).

4.1.4 Soil Sampling Activities

A total of 32 soil samples and one field duplicate were collected from within the 15 test pits (141EP001-141EP015) and three soil borings (141SB001-141SB003). Surface (i.e., 0.2-0.7 ft bgs) soil samples were collected from each of the 15 test pit locations. At test pits where waste was encountered, subsurface soil samples were collected from within and below the waste. One subsurface soil sample was collected at each of the two test pits where waste was expected, but not found (141EP006 and 141EP009) to verify that chemical constituents have not been released. In addition to the samples collected from test pits, three subsurface soil samples were collected from the three soil borings drilled at the site (141SB001-141SB003). Split spoon samples were collected from the borings to retain as much of the in-place texture as possible. The soil boring core appeared to contain the original layered texture and was determined to be comprised of native soil.

Two soil samples were collected at the background test pit (141BG001), one from the ground surface (0.2-0.7 ft bgs), and one from the base of the excavation (9.5-10 ft bgs). These samples were analyzed for metals only. Data from the background test pit at YPG-141 were combined with background data from other inactive landfill RFI sites at USAGYPG to calculate background threshold values (BTVs) (Appendix D).

Surface and subsurface soil samples from the test pit locations and soil borings were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), explosives, and metals. Default analytes specific to these test panels are provided in the Quality Assurance Project Plan (QAPP, Appendix A of the RFI Work Plan [Parsons, 2010]) and were based on the list of chemicals contained within the DoD Quality Systems Manual (QSM) version 4.1. Complete analytical results for the soil samples are provided in Appendix C (Table C.1). Test pit and soil boring logs are provided in Appendix A, and photographs of the investigation activities are presented in Appendix B. Test pit locations, including the background excavation, are depicted on Figure 4.1.

4.1.5 Planned Versus Completed RFI Activities

Test pit excavations, soil borings, and sampling activities proposed in the RFI Work Plan (Parsons, 2010) were conducted at YPG-141 as planned with the following exceptions. Based on the geophysical survey, waste was not expected to be encountered at 141EP003. However, when the excavation was performed, waste was encountered from 4 to 15 ft bgs. Because of the thickness of waste and location of the 141EP003 test pit, an additional test pit was excavated to the northeast of 141EP003 (141EP014) to characterize the horizontal extent of waste at the site (Figure 4.1). No debris was identified during the additional excavation, and one surface soil sample was collected from test pit 141EP014.

Test pit 141EP011 was excavated in a location approximately 60 ft to the northeast of the planned location. Because waste was encountered during the excavation of this test pit, an additional pit (141EP015) was excavated in the originally-planned 141EP011 location to characterize the horizontal extent of waste at the site (Figure 4.1). No debris was identified during the excavation of test pit 141EP015, and one surface soil sample was collected from the location.

4.2 INVESTIGATION RESULTS

4.2.1 Data Quality

The analytical data from soil samples collected from the test pits and soil borings have been reviewed, verified, and validated with regard to quality and usability. No major quality control issues were discovered during the quality control assessment; therefore, the data are considered complete and usable for decision making purposes. A more detailed analytical quality control summary report is included in Appendix C. Appendix C also contains a table of all analytical results (Table C.1).

One data quality issue discussed in Appendix C involves the detections of acetone and methyl ethyl ketone in the majority of samples. This issue was identified and investigated, and these detections were determined to be false positives due to an unknown abiotic soil reaction that occurs with the addition of sodium bisulfate, gamma radiation, or heat. Although these detections were determined to be likely false positives, the data were conservatively used in the risk assessment.

4.2.2 Soil Screening Values

4.2.2.1 Background Threshold Values

The objectives of collecting soil samples at YPG-141 were to determine if soils were impacted by waste disposal activities, evaluate the vertical and horizontal extent of impacted areas, and provide data to support human health and ecological risk screening assessments (Section 5.0).

To evaluate metals results and determine if site activities have impacted soils, background test pits were excavated at each landfill and a surface and subsurface soil sample were collected and analyzed for 27 metals. These data were combined into a background soil database. Organic compounds were not analyzed in the background soils and detections of organic constituents are considered site related. The background metals data were processed using the statistical approach presented in Appendix A of the RFI Work Plan (Parsons 2010, Appendix A). Statistical calculations of the data were used to derive a BTV for each detected metal. The BTVs represent the ninety-five percent upper confidence level for the background value. The BTV calculation methods, background dataset, and the BTVs for metals at the six abandoned landfills are presented in Appendix D.

The BTVs were used to establish background metals concentrations for the purposes of identifying soils that may have been impacted by waste disposal activities. If a YPG-141 soil sample concentration exceeded the BTV, it was assumed that the concentration may be a result of waste disposal activities. A final step in the evaluation of metals concentrations in soils was the application of professional judgment (e.g., changes in soil type and an evaluation of concentration gradients) to evaluate whether soil sample results with metals concentrations that exceed the BTV are a result of waste disposal activities.

4.2.2.2 Remediation Goals

The vertical and horizontal extent of impacts to soil was determined by comparing soil concentrations to remediation goals. Remediation goals include the state of Arizona residential and non-residential soil screening levels (rSRLs and nrSRLs) and the minimum groundwater protection levels (GPLs). The rSRLs and nrSRLs are published in Appendix A of the Arizona Administrative Code R18-7-205. The GPLs are based on state of Arizona guidance document *A Screening Method to Determine Soil Concentrations Protective of Groundwater Quality* (ADEQ, 1996). Vertical and horizontal extent of soil impacted by site activities is defined by soil samples that have concentrations that exceed remediation goals.

4.2.3 Evaluation of Soil Analytical Results

The purpose of this section is to present and evaluate metals and organic constituents detected during the RFI. The evaluation includes comparing soil metal concentrations to BTVs and remediation goals, and comparing organic constituents to remediation goals. The specific evaluation includes the following:

1. Identifying chemicals of potential concern (COPCs) detected in site soils with concentrations above BTVs for metals.
2. Determining which (if any) chemicals identified during Step 1 and any detected organic chemicals exceeded corresponding ADEQ rSRLs, nrSRLs, or GPLs.
3. Using professional judgment (consisting of an evaluation of the magnitude, frequency, and spatial distributions of chemical concentrations) to determine if adequate soil sampling was conducted for the chemicals identified in Step 2.

A total of 32 surface and subsurface soil samples and one field duplicate were collected from test pits and soil borings at YPG-141 and analyzed for VOCs, SVOCs, metals, and explosives (Section 4.1).

Detections in surface and subsurface soil samples consisted of select VOCs, SVOCs, explosives, and metals (Tables 4.3 and 4.4). Surface and subsurface soil samples were collected from soil borings and test pit excavations from biased locations with the greatest potential for contamination based on geophysical and visual survey results (Appendix B of Jason, 2007; Parsons, 2010). The BTV and remediation goal comparison steps are presented below. Locations and analyte concentrations detected above remediation goals are presented on Figure 4.3.

Step 1 – Background Threshold Value Comparison

The first step in evaluating impacts to soil at YPG-141 was to compare the analytical inorganic soil sample results to the BTVs. The BTV calculation method was presented in the RFI Work Plan (Parsons, 2010) and included background samples from YPG-27, -28, -29, -141 and -178 (Appendix D). Table 4.3 presents the inorganic soil sample results for samples collected during the field investigation. Soil concentrations were compared to the BTVs and results shown in bold font indicate values that exceed the BTV. Twenty-seven of the 32 soil samples have inorganic concentrations greater than their respective BTV. These 27 samples were collected from the following 16 test pit locations:

- 141EP002 (cadmium, copper, lead, molybdenum, silver, thallium, zinc)
- 141EP003 (thallium)
- 141EP004 (aluminum, arsenic, cadmium, chromium, copper, iron, lead, mercury, molybdenum, nickel, silver, thallium, zinc)
- 141EP005 (silver, thallium)
- 141EP006 (silver, thallium, vanadium)
- 141EP007 (mercury, silver, zinc)
- 141EP008 (cadmium, chromium, copper, iron, lead, mercury, molybdenum, nickel, silver, thallium, zinc)
- 141EP009 (silver)
- 141EP010 (silver)
- 141EP011 (arsenic, barium, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, silver, vanadium, zinc)
- 141EP012 (lead, mercury, silver, thallium, zinc)
- 141EP013 (silver)
- 141EP014 (thallium, vanadium)
- 141SB001 (copper)
- 141SB002 (copper, mercury)
- 141SB003 (copper)

Of the 27 samples with inorganic concentrations greater than BTVs, seven were collected from within debris zones, and an additional three samples were collected from an interval underlying the same debris zones. Table 4.5 details the samples within the waste with metals exceeding BTVs (shown in bold), and the corresponding samples collected below the waste with BTV exceedances.

Based on the results of the BTV comparison beryllium, calcium, cobalt, magnesium, manganese, potassium, selenium, and sodium were eliminated from further evaluation because they all had soil concentrations less than BTVs. All other metals detected in YPG-141 soils were carried forward to the subsequent steps in this analysis.

Step 2 – rSRL, nrSRL and GPL Comparison

The extent of contamination was evaluated by comparing organic (Table 4.4) and inorganic (Table 4.3) analytical results to the remediation goals (i.e., ADEQ rSRLs, nrSRLs, and minimum GPLs). Detected organic compounds and inorganic results with concentrations above BTVs were included in this evaluation (i.e., potentially site-related inorganics). The evaluation showed that although several organic compounds were detected in site soils, no organic compound had concentrations above its corresponding rSRL, nrSRL or GPL.

Three metals (arsenic, copper, and lead) were found to exceed their corresponding rSRL, nrSRL, or GPL at three test pit locations (141EP004, 141EP008, and 141EP011). One sample containing arsenic at a concentration of 21.2 mg/kg exceeded the rSRL and nrSRL of 10 mg/kg, but not the GPL of 290 mg/kg. This sample was collected from below the debris zone (6-6.5 ft bgs) of test pit 141EP011. It should be noted that the concentration of arsenic collected from within the shallower debris zone at 141EP011 (3.77 mg/kg; 3-3.5 ft bgs) did not exceed the rSRL and nrSRL of 10 mg/kg or the BTV of 6.6 mg/kg. No other samples collected from the site had concentrations of arsenic exceeding the rSRL, nrSRL, or GPL.

Copper was detected from within the debris zone of test pit 141EP008 (12.5-13 ft bgs) at 12,000 mg/kg, in excess of the rSRL of 3,100 mg/kg but not the nrSRL of 41,000 mg/kg (there is no minimum GPL available for copper). A sample was not collected from directly below the debris zone because of sloughing; however, a sample collected from the co-located soil boring associated with 141EP008 (141SB002 at a depth of 33-34 ft bgs) contained a concentration of copper (28.1 mg/kg) less than the rSRL of 3,100 mg/kg and nrSRL of 41,000 mg/kg. It should be noted that all three soil borings (141SB001-141SB002) collected from similar depths at YPG-141 contain concentrations of copper above the BTV but below the rSRL and nrSRL.

Concentrations of lead were found in samples taken from debris zones of test pits 141EP004 (546 mg/kg; 5-6 ft bgs), 141EP008 (543 mg/kg; 12.5-13 ft bgs), and 141EP011 (638 mg/kg; 3-3.5 ft bgs) at concentrations exceeding the rSRL of 400 mg/kg and the GPL of 290 mg/kg, but not the nrSRL of 800 mg/kg. Samples collected from intervals below the debris zones at the same test pits had concentrations of lead that did not exceed the BTV.

Step 3 - Professional Judgment

Arsenic, copper, and lead were detected above their corresponding remediation goals at YPG-141. The copper and lead contamination is believed to be associated with buried metallic debris from within the landfill because the samples with elevated concentrations were collected from within the debris zone. These metals are believed to be stable and have not migrated to any significant degree, based on concentrations less than remediation goals in overlying and underlying samples. Therefore, additional sampling for copper and lead is not needed.

Arsenic exceeded the rSRL and nrSRL in one of 32 samples collected at the site. This single sample containing an elevated arsenic concentration (21.2 mg/kg) was collected from below the debris zone (6-6.5 ft bgs) of test pit 141EP011. Two other samples collected at this location at depths of 0.2-0.7 ft bgs (above the debris zone) and 3-3.5 ft bgs (within the debris zone) had arsenic concentrations below the BTV, rSRL, and nrSRL values. The low concentration of arsenic (3.77 mg/kg) collected from within the debris zone indicates that the deeper arsenic concentration is not likely to be due to contaminant migration from a buried waste source (i.e., the arsenic concentration gradient increases with depth instead of decreasing with depth, which would be expected if leaching from the debris zone was occurring). Therefore, the elevated arsenic is assumed to be naturally occurring in the native soil. Furthermore, the soil sample may have been collected from a localized mineral rich deposit, given the presence of a number of remnant mines in the nearby Kofa Area. Given the spurious nature of the single elevated arsenic concentration at 141EP011, the reverse concentration gradient with depth, and the low arsenic concentration from within the debris zone at 141EP011, the nature and exent of arsenic has been characterized and additional sampling for this metal is not needed.

4.3 CONTAMINATION ASSESSMENT

During the geophysical survey conducted in 2006 (Jason, 2007), a cesium gradiometer magnetometer was used to determine the extent of the metallic buried waste at the abandoned landfill YPG-141. The magnetometer was found to be effective in identifying suspect burial areas. Depressions and disturbed vegetation were also noted that coincided with metallic anomalies identified during the geophysical survey.

In November 2009, a surface removal of five yd^3 of metal debris was completed. Once the surface was cleared, the post-removal geophysical survey was conducted to obtain additional information regarding the potential locations of subsurface debris. The geophysics indicated the presence of a burial area extending north to south across the site. Investigation of the area consisted of excavating 15 test pits and one additional background test pit and three soil borings. Debris was encountered within seven of the pits and correlated with the location of magnetometer anomalous zones with the exception of test pits 141EP003, 141EP004, and 141EP007, which are located in the northeastern portion of the site that was not surveyed. Debris included glass and plastic bottles, burned paper and wood, rusted metal objects, pipe, partially decomposed aluminum cans, Styrofoam™ cups, food packaging, fabric, and ceramics. Each test pit excavation was supervised by UXO technicians who visually inspected the material for evidence of munition debris. No evidence of munition debris was identified during the excavations.

A total of 32 soil samples were collected from the test pit excavations and soil borings from above the waste, within the waste itself, and soils underlying the waste. Numerous inorganic compounds were detected in surface and subsurface soils that exceeded BTVs. Three metals (arsenic, copper, and lead) were found to exceed their corresponding rSRL and/or nrSRL. Copper and lead contamination is believed to be associated with buried metallic debris from within the landfill because the samples with elevated concentrations were collected from within the debris zone. These metals are believed to be stable and have not migrated to any significant degree, based on concentrations less than remediation goals in underlying samples. Although arsenic was detected in one sample (141EP011) in excess of the rSRL and nrSRL, it is believed to be an anomaly because no source for the arsenic was identified within the debris zone (i.e., arsenic was detected well below the BTV, rSRL,and nrSRL within the overlying debris zone).

Two soil borings were completed adjacent to two test pits excavated where waste was encountered. These boring were drilled to define the vertical extent of contamination and determine if waste extended beyond the vertical boundary of the test pits, which were generally excavated to 15 ft bgs. Each soil boring was completed to a depth of 25-30 feet bgs. Debris was not found in either boring past the bottom of the adjacent test pit. One soil boring was drilled adjacent to a test pit where no waste was encountered to verify this finding, since there were no geophysical data associated with that area. Split spoon samples were collected from the borings to retain as much of the in-place texture as possible. Soil samples appeared to contain the original layered texture and are believed to represent native soils. The lack of any additional waste and the presence of the original soil layering indicate that the landfill burial was probably a cut and fill operation in which a dozer is used to cut long linear trenches and debris was buried in the trench and either burned or soil was pushed over the trench. This type of disposal operation was common for small landfill sites operating during the 1950s and 1960s, corresponding to the likely operation of the YPG-141 landfill between 1964 and 1967.

4.4 NATURE AND EXTENT RECOMMENDATIONS

Based on visual observations made during test pit operations and results from geophysical surveys and subsurface soil sampling, debris at YPG-141 is consistent with the site history and consists of industrial waste (bricks, wire, nails, metal strapping, wood) and municipal debris (glass baby bottles, paper, plastic wrapping, aluminum cans). The presence of charred wood and low levels of hydrocarbons and polycyclic aromatic hydrocarbons (PAHs) (Table 4.4) suggests some of the waste may have been burned. No visual evidence of hazardous waste or munitions debris was identified in the excavation pits at the site.

Soil sampling results show lead, copper, and arsenic concentrations exceeding the minimum GPLs, rSRLs, and/or nrSRLs in five samples. The lead and copper samples were collected from within the debris zone, and the elevated concentrations are most likely related to metal debris. Deeper interval soil samples collected from within two of these test pit locations show no evidence of vertical migration. The soil sample containing the elevated arsenic concentration was collected from the interval below the debris zone; however the arsenic level in the sample collected from within the associated debris zone did not have arsenic above the BTV. The elevated level of arsenic may be related to a layer of mineral-rich soil in a limited area of the site that was not included in the cross-section.

The horizontal extent of buried waste at YPG-141 was determined based on test pits located on the perimeter of the magnetic anomalies, as defined in Figure 4.1, containing no buried waste. The vertical extent of buried waste at the site was determined based on the depth of waste found during test pit excavation and the drilling of soil borings. Based on these results, the nature and extent of burial operations and associated contamination at YPG-141 has been delineated and no further sampling is required.

SECTION 5.0

HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

This Section presents the methods and results of the Human Risk Assessment (HRA) and Ecological Risk Assessment (ERA) performed as one of the steps of the RFI for YPG-141. The objectives of the HRA and ERA were to:

- Assess potential risks and hazards from exposure to site soils.
- Support development of either a no further action (NFA) decision (if no unacceptable risks or hazards are identified) or cleanup goals and remedial alternatives under the CMS task (if unacceptable risks and/or hazards are identified).

5.1 SCREENING LEVEL HUMAN HEALTH RISK ASSESSMENT

This screening level HRA evaluates the potential for human health impacts from assumed exposures to COPCs within YPG-141, an inactive landfill at USAGYPG near Yuma, Arizona. The results of this HRA provide a basis for decisions regarding further action, if necessary, with respect to the COPCs at the site. Following USEPA (1989) guidance, the HRA process consists of six major components:

- Development of the Conceptual Site Model (CSM)
- Selection of COPCs
- Estimation of chemical exposure
- Toxicity assessment
- Risk characterization
- Uncertainty analysis

Each step of the HRA process is discussed in detail below. This HRA was conducted using methods consistent with USEPA (1989, 1990, 2002, 2010) guidance.

5.1.1 Development of the Conceptual Site Model

Developing a CSM is a critical step in properly evaluating potential exposures at a site. The CSM is a comprehensive representation of the site that documents the potential for exposure (under current and future land use) to chemicals at a site based on the source of contamination, the release mechanism, migration routes, exposure pathways, and receptors either at the site or that may reasonably be anticipated to be at the site (USEPA, 2002).

YPG-141 is located one mile northeast of Main Administration Area, north of Barranca Road and west of Laguna Army Airfield (Figure 2.1). This site was used as a landfill from approximately 1964 to 1967 (Tetra Tech EM Inc., 1998), with the waste material occupying a surface area of approximately 4.1 acres (Figure 4.3). Currently, the site is no longer operational and is a vacant land with no structures. There is a large drainage channel located along the west side of the landfill. The future use of the YPG-141 site is expected to continue as undeveloped/vacant land.

Although residents and industrial workers are not present at the site, and will not be present at the site in the future, they were selected for evaluation to determine whether the site qualifies for an NFA determination or closure under an industrial use scenario. Therefore, two hypothetical human receptors were evaluated: 1) residents, and 2) industrial workers.

5.1.2 Selection of Chemicals of Potential Concern

The COPCs are those chemicals detected in environmental media for which human contact may result in adverse health effects. The selection of COPCs consisted of a three step process, as follows:

- Data review;
- Exclusion of essential nutrients;
- Identification of metals elevated above background; and
- Screening against risk-based screening levels.

The data collected at the site is presented in detail in Section 4. As discussed in Section 4, 32 soil samples (plus 1 field duplicate) were collected and analyzed for metals, VOCs, SVOCs, and explosives using the methods specified in the QAPP (Appendix A of the RFI Work Plan [Parsons, 2010]). Soil samples were collected from surface soils (0.2-0.7 ft bgs) at all sampling locations, with subsurface samples collected at depths up to 34 ft bgs (Table 4.2).

Data quality was evaluated in Appendix C. As part of the data quality assessment, the data were assigned qualifiers. Definitions of the data qualifiers described in the following text are found in Table C.2 of Appendix C. Data without qualifiers and data with J qualifiers were considered appropriate for risk assessment purposes (USEPA, 1989, 1992). U and UJ qualified data were considered to be non-detect (ND) but usable for risk assessment purposes. NJ qualified data were treated as detections, although they were determined to be potentially false positives (Appendix C). R qualified data were excluded from this risk assessment (USEPA, 1989, 1992). The validated data collected from 0-10 ft bgs were evaluated in the selection of COPCs.

Essential human nutrients are toxic only at very high doses (i.e., much higher than those associated with exposure at a site) and were excluded as COPCs. These include calcium, iron, magnesium, potassium, and sodium (USEPA, 1989).

Next, metals were compared to the BTVs (see Appendix D). Metals detected at concentrations below the BTVs were assumed to be present at background concentrations and were not evaluated further, while metals detected at concentrations greater than the BTVs were evaluated in the next step. The following metals were detected at concentrations greater than the BTVs at 0-10 ft bgs (Table 5.1):

- Aluminum
- Arsenic
- Barium
- Cadmium
- Chromium, total
- Copper
- Lead
- Mercury
- Molybdenum
- Nickel
- Silver
- Thallium
- Vanadium
- Zinc

Last, the maximum detected concentrations of inorganics exceeding the BTVs and all detected inorganic and organic compounds were compared to the ADEQ (2007) rSRLs, and nrSRLs. Lead and arsenic were detected at concentrations exceeding their corresponding rSRL or nrSRL (Table 5.1).

Lead was detected at concentrations exceeding the rSRL of 400 mg/kg but not the nrSRL of 800 mg/kg in two samples collected from the waste material (i.e., 546 mg/kg in 141EP004 at a depth of 5-6 ft bgs and 638 mg/kg in 141EP011 at a depth of 3-3.5 ft bgs). In both test pits (141EP004and 141EP011), soil samples were also collected above and below the waste layer, and the lead concentrations were significantly below the rSRL and nrSRL in these corresponding samples (Table 4.3). This indicates that lead concentrations are confined to the waste layer and that lead is not identified as COPC.

Arsenic was detected at a concentration of 21.2 mg/kg in test pit 141EP011 at a depth of 6-6.5 ft bgs, which was collected below the waste layer. This value exceeds the rSRL and nrSRL of 10 mg/kg. The sample collected from the waste layer at 141EP011 had an arsenic concentration of 3.77 mg/kg and the sample collected from above the waste layer had an arsenic concentration of 2.78 mg/kg (Table 4.3). This indicates that the arsenic concentration detected at 141EP011 at 6-6.5 ft bgs is not due to the waste material. Historically, there have been a number of mines in the area, which were operated as the King of Arizona mine. Thus, there are a number of mineral-rich orebodies in the area. One explanation for the isolated elevated arsenic detection at 141EP011 is that it was taken in a mineral rich deposit and is not representative of the waste material at the site. Given the spurious nature of the single elevated arsenic detection at 141EP011 and the low arsenic concentration from within the debris zone at 141EP011, arsenic was not identified as a COPC.

5.2 ECOLOGICAL RISK ASSESSMENT

This ERA evaluates the potential for ecological impacts from potential exposure to chemicals of potential ecological concern (COPECs) in soils at YPG-141. The results of this ERA provide a basis for consideration in making decisions regarding further action with respect to the COPECs in soils at the site.

Following USEPA (1997, 1998) guidance, the ERA process consists of four major components:

- Problem formulation
- Analysis
- Risk characterization
- Uncertainty analysis

This section presents a summary of the ERA for YPG-141. The ERA is presented in detail in Appendix E. Each step of the ERA process is summarized below.

5.2.1 Problem Formulation

5.2.1.1 Habitat Characterization

USAGYPG is located in the Sonoran Desert, a low elevation, hot, arid desert. It is characterized by high daytime temperatures with large daily temperature variations, low relative humidity, and very low average precipitation. No perennial lakes or streams occur within USAGYPG; however, two major rivers flow through the adjacent desert (i.e., the Colorado and

Gila Rivers). See Section 2.1 for additional information regarding the climate and surface water hydrology of USAGYPG.

Approximately 62 species of mammals, 141 species of birds, 33 species of reptiles, and three species of amphibians have been observed at USAGYPG. No fish have been recorded at USAGYPG. Numerous plant species have been recorded at USAGYPG, including eight Arizona special status species (Appendix E [Table E.1]).

5.2.1.2 Site Description and Land Use

As discussed in Sections 2.2.1 and 5.1.1,YPG-141 is located approximately 1 mile northeast of the Main Administrative Area, north of Barranca Road and west of Laguna Army Airfield, and is approximately 4.1 acres in size (Figures 2.1 and 2.2). Disposal activities reportedly occurred at the site from 1964 to 1967. Currently, the site is vacant with no structures. The future use of the YPG-141 site is expected to continue as undeveloped/vacant land.

Much of the site has been disturbed by past landfill disposal activities and has little to no vegetation (Figure 2.3). In the undisturbed parts of the site, there are scattered small bushes and trees, including bursage, creosote, and paloverde. The site is generally flat and is located along a drainage plain which drains from north to south. A main drainage channel is located along the west side of the landfill. Bedrock outcrops border the south-southeastern edges of the site. Surface debris (including abundant glass debris, burnt wood, and various metal scrap including pipes, cans, cables, wires, metal banding/strapping, etc.) were present at the surface and within the drainage channel in the northwestern portion of the site, and were removed in November, 2009 (Parsons, 2010).

5.2.1.3 Selection of Representative Ecological Receptors

Ecological receptors (i.e., representative species) include non-domesticated plants and wildlife that may reasonably be expected to inhabit or regularly forage at the site, given current and anticipated future site conditions. As generally recognized by ERA guidance documents, it is impractical to evaluate all possible ecological receptors for a given site. Instead, a few species representative of the habitat functions and trophic structure are selected for evaluation in the ERA. The representative species selected for evaluation are listed in Table 5.2.

5.2.1.4 Selection of Chemicals of Potential Ecological Concern

Using the process presented in Appendix E, bis(2-ethyhexyl)phthalate, cadmium, copper, lead, mercury, silver, vanadium, and zinc were the COPECs selected for evaluation in this ERA.

5.2.1.5 Exposure Pathways

Exposures to COPECs were quantitatively evaluated for the following pathways at YPG-141:

- Incidental ingestion of soils
- Ingestion of site-associated biota

These pathways are described in detail in Appendix E. Note that there is no surface water at YPG-141 and groundwater occurs at approximately 197 ft bgs (Section 2.2.4.2). Therefore, the surface water, sediment, and groundwater exposure pathways were determined to be incomplete and were not evaluated.

5.2.2 Analysis

Toxicity reference values (TRVs) are used to evaluate the potential hazards from the exposure estimated for each COPEC. TRVs protective of reproductive and developmental effects were used in this ERA. The sources from which the TRVs were obtained are provided in Appendix E.

To estimate exposures, exposure point concentrations (EPCs) were calculated for the COPECs in soils as the lesser of the upper confidence level (UCL) and the maximum detected concentration. For plants and invertebrates, the soil EPC was used to evaluate exposures. For birds, mammals, and reptiles, dietary exposures were estimated using bioaccumulation models, estimated ingestion rates, and dietary composition. The models and parameters used to estimate dietary exposures are described in detail in Appendix E.

5.2.3 Risk Characterization

Risk characterization involves two components, hazard estimates and risk description. For vertebrates, hazard estimates are based on the comparison of average daily dose to the chemical- and receptor-specific TRVs and are expressed as a hazard quotient (HQ). For invertebrates and plants, the HQ is calculated by dividing the soil EPC by the benchmark concentration. The HQs greater than one indicate that adverse effects may occur. A no observable adverse effects level (NOAEL)-based HQ of one is the threshold at or below which the contaminant is unlikely to cause adverse ecological effects; NOAEL-based HQs greater than 1 indicate that exposures exceed a no-effect dose and do not necessarily indicate that adverse effects will occur. Lowest observable adverse effects level (LOAEL)-based HQs better indicate the potential for adverse effects to receptors because they are based on effect-based toxicological data. Thus, LOAEL-based HQs greater than one indicate that adverse effects will probably occur, but whether or not significant effects would actually occur cannot be judged with certainty.

5.2.3.1 Plant and Invertebrate Receptor Hazard Estimates

For plants, only the incremental HQ (i.e., site minus background concentrations) for lead of 2 slightly exceeds the threshold value of one (Appendix E [Table E.12]). For invertebrates, the HQs for mercury and zinc (16 and 2, respectively) exceed the threshold value of one, regardless of the contribution of background (Table E.12).

Vegetation and invertebrates at YPG-141, although identified as a representative receptors, are not expected to be targets of environmental management objectives, and are unlikely to be drivers for a CMS. This site does support vegetation and invertebrates that can play an ecological role in primary productivity and serve as food or cover habitat for animals. However, the plants and invertebrates at this site are not unique, nor does the setting provide an important vegetation and invertebrate resource relative to the expanse of the surrounding landscape. Therefore, plants and invertebrates were not considered further in the ERA, but were retained as critical food-web components for the biotransfer component of the vertebrate receptor evaluations.

5.2.3.2 Vertebrate Receptor Hazard Estimates

For the vertebrate receptors, the incremental NOAEL-based HQs exceed one for assumed exposures to bis(2-ethyhexyl)phthalate, cadmium, mercury, and lead (see tables in Section E.3.2 of Appendix E). All other NOAEL-based HQs were less than one. As discussed in Section 5.2.3 above, NOAEL-based HQs greater than one indicate a need for further evaluation and do not necessarily indicate that adverse effects will occur.

The LOAEL-based HQs for all COPEC and receptor combinations were less than the threshold value of one, including LOAEL-based HQs for bis(2-ethyhexyl)phthalate, cadmium, mercury, and lead. In addition, all of the LOAEL-based hazard indexes (i.e., the sum of all HQs for an individual receptor) were below the threshold value of one, which indicate that adverse effects to vertebrate receptors from exposures to YPG-141 soils are unlikely.

Based on the results of this ERA, the concentrations of COPECs in site soils do not pose a threat to ecological receptors and further action is not needed at the site on the basis of ecological risk.

5.2.4 Uncertainty Analysis

All risk assessments involve the use of assumptions, professional judgment, and imperfect data to varying degrees, which results in uncertainty in the final hazard estimates. A complete discussion of the uncertainties associated with this ERA is presented in detail in Appendix E.

5.3 SOIL-TO-GROUNDWATER EVALUATION

Copper was detected at a concentration of 12,000 mg/kg at a depth of 12.5-13 ft bgs in test pit 141EP008. This value exceeds the rSRL of 3,100 mg/kg but not the nrSRL of 41,000 mg/kg. There is no minimum GPL for copper. Because there is no residential use planned for the land comprising YPG-141, and no minimum GPL, copper is not expected to impact groundwater in the future.

Arsenic was detected at a concentration of 21 mg/kg at test pit 141EP008, above the rSRL and nrSRL of 10 mg/kg. Because the concentration of arsenic did not exceed the GPL of 290 mg/kg, arsenic is not expected to impact groundwater in the future.

Lead was detected at concentrations that exceeded the GPL in the debris zone samples at three test pit locations: 141EP004 (546 mg/kg; 5-6 ft bgs), 141EP008 (543 mg/kg; 12.5-13 ft bgs), and 141EP011 (638 mg/kg; 3-3.5 ft bgs). In two of these test pits (141EP004and 141EP011), soil samples were also collected above and below the waste layer. Lead concentrations were significantly below the GPL of 290 mg/kg in these corresponding samples (Table 4.3). In test pit 141EP008, a soil sample could not be collected below the waste; however, soil boring 141SB002 was drilled adjacent to the test pit. This soil boring verified that waste at 141EP008 does not extend below the bottom of the test pit and lead concentrations were below the BTV. Because lead concentrations detected below the waste at test pits 141EP003 and 141EP011 were several magnitudes less than the lead concentrations detected in the waste, it can be assumed that soil below test pit EP141008 contains concentrations of lead similar to those at test pits 141EP004 and 141EP011, and that the lead concentration below the waste at 141EP008 is below the corresponding BTV. Based on this evaluation, lead is believed to be stable and has not migrated to any significant degree, and is therefore not expected to impact groundwater.

Furthermore, the method used to determine the default ADEQ GPL of 290 mg/kg has been evaluated below to show its conservative nature. This evaluation will show that the actual GPL for YPG-141 would, in reality, be much greater than the default GPL. The input parameters used to determine the "worst-case" situation used in the default GPL calculation have been shown to be conservative two ways:

1) The input parameters assume the theoretical correlation between the total metals test and leaching test can be no less than 20:1. This is the ratio at which 100% of the metal in the soil is leached by the leaching procedure test (ADEQ, 1996).
2) The input parameters assume that soil at the site is located within the water table. Groundwater at YPG-141 is located well below the sampled soils, at 197 ft bgs.

These assumptions represent a 'worse-case' scenario, and the minimum GPLs should be used as a first-level screening of contaminants (ADEQ, 1996). Although a site-specific leachability study could be conducted to adjust the GPL, a CMS will be developed which will address future threats to groundwater. 5.4 Conclusions of the risk assessment

One of the final steps of an RFI includes an evaluation of the human health and ecological risks associated with potential exposure to hazardous constituents which may be present at a site. The objectives of this risk assessment were to assess potential risks and hazards from exposure to contaminants in soils and to recommend either NFA (if the risks and hazards are acceptable) or of the development of cleanup goals and remedial alternatives under a CMS task if unacceptable risks or hazards were identified. The results of this risk assessment indicate that there are no chemicals of concern (COCs) identified as potential hazards for human or ecological receptors.

The soil-to-groundwater evaluation shows three concentrations of lead exceeding the minimum GPL at YPG-141. These lead concentrations are believed to be confined to the buried waste layer and there is no evidence of vertical migration. A CMS is recommended to prevent future exposure to the buried waste and leaching of material..

SECTION 6.0

SUMMARY AND RECOMMENDATIONS

An RFI has been completed at YPG-141 to 1) collect data to adequately identify and characterize the nature and extent of buried waste and contamination, including to determine whether regulated waste is present in the abandoned landfill; 2) conduct a risk assessment (human and ecological) to determine if constituents have been released to the environment which pose a risk to human health or the environment; and 3) evaluate if chemical constituents are present at levels that pose a threat to groundwater.

The landfill was reported to have received municipal and industrial waste between 1964 and 1976. Surface debris removed from the site consisted of glass debris, burnt wood, and metal scrap including pipes, cans, cable, wire, metal banding/strapping, and a variety of construction items.

Geophysical surveys were completed to outline areas where subsurface metal debris burial is present. Test pit excavations and soil borings were conducted to determine the nature of the waste and to collect soil samples. Debris encountered during test pit excavations was visually inspected by UXO technicians for the presence of military munitions. No munitions or munition debris were identified in the subsurface excavations, and debris was consistent with municipal and industrial waste. Waste identified in the excavated test pits included glass and plastic bottles, burned paper and wood, rusted metal objects, pipe, partially decomposed aluminum cans, Styrofoam™ cups, food packaging, fabric, and ceramics.

A total of 32 soil samples and one field duplicate were collected from the surface and subsurface soils. With the exception of one arsenic concentration, one copper concentration, and three lead concentrations collected in three test pits (141EP004, 141EP008 and 141EP011), results of soil and debris sampling performed at the site did not detect inorganic or organic compounds above the rRSLs, nrSRLs or GPLs. The high concentration of arsenic detected in a single sample is possibly the result of a limited area of clay soil type at the site. The lead and copper samples were collected from within debris zones, and the elevated concentrations are most likely related to metal debris. Based on the nature and extent evaluation presented in Section 4.0, the waste and associated soil contamination associated with the landfills has been adequately characterized and further characterization activities are not warranted.

Analytical results obtained from the site were used to complete an HRA and ERA. The risk assessment concluded that the site does not pose unacceptable risks to potential human or ecological receptors (Section 5.0).

The soil-to-groundwater evaluation shows three concentrations of lead exceeding the minimum GPL at YPG-141. Although these lead concentrations are believed to be confined to the buried waste layer and there is no evidence of vertical migration, a CMS is recommended for the site. Although no risk to human or ecological receptors has been identified, it is recommended that a CMS be conducted for YPG-141.

SECTION 7.0

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SECTION 8.0

CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Richard T. Martin
Garrison Manager

TABLES

TABLE 2.1

SOIL TYPES AT USAGYPG

US ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Soil Type	Composition	Percent of USAGYPG	Landforms	pH
Rositas	sand	0.0019	dunes and sand sheets	8.0
Superstition-Rositas	sand	0.0843	sandy eolian deposits	7.8 to 8.4
Carrizo	extremely gravelly loamy coarse sand	0.1434	flood plains, alluvial fans, fan piedmonts and bolson floors	7.8 to 8.0
Riverbend	extremely cobbly sandy loam	0.0054	stratified fan alluvium	7.8 to 8.2
Cristobal-Gunsight	silty, clayey gravel with sand to extremely gravelly loamy fine sand to very gravelly silt	0.2897	fan alluvium	8.2
Gunsight-Chuckawalla	extremely gravelly sandy loam to extremely gravelly loamy fine sand to very gravelly silt	0.1764	fan terraces or stream terraces	8.3
Carsitas-Chuckawalla	extremely gravelly sand to extremely gravelly loamy fine sand to very gravelly silt loam	0.0262	alluvial fans, moderately steep valley fills and dissected remnants of alluvial fans	Unspecified, generally characterized as mildly to moderately alkaline
Lithic Torriorthents	extremely gravelly sandy loam	0.2728	steeper hillsides and mountain slopes	8.2 to 8.4

Source: DRI (2009)

TABLE 4.1
CHARACTERIZATION OBJECTIVES
RCRA FACILITY INVESTIGATION REPORT - YPG-141

U.S. ARMY GARRISON YUMA PROVING GROUND, YUMA, ARIZONA

Field Activity	Characterization Objective of Field Activity				
	Determine Disposal Site Boundaries	Evaluate Potential Surface Soil Contamination Source Areas	Evaluate Potential Subsurface Soil Contamination Source Areas	Determine if Contamination is Migrating from Source Areas	Determine Concentrations of Background Metals
Surface Debris Removal	Surface debris removed to prevent possible geophysical survey interference	Surface debris removal assisted in determining possible areas of surface soil contamination			
Geophysical Survey	4.12 Acres		4.12 Acres		
Test Pits	<u>EP001 – EP015</u> 29 Samples 1 field duplicate	<u>EP001 – EP015</u> 15 Surface Soil Samples	<u>EP001 – EP015</u> 14 Subsurface Soil Samples	Surface and subsurface soil samples collected from outside landfill boundary and below suspected waste	
Vertical Soil Borings	<u>SB001, SB002, and SB003</u> 3 Subsurface Samples Vertical soil borings used to determine depth of waste			<u>SB001, SB002, and SB003</u> 3 Subsurface Samples Vertical soil borings used to determine possible leaching of contaminants	
Background Test Pit					<u>BG001</u> 1 Surface and 1 Subsurface Soil Sample

TABLE 4.2
SOIL SAMPLING SUMMARY
YPG-141

U.S. ARMY GARRISON YUMA PROVING GROUND, YUMA ARIZONA

Sample Location	Total Depth (ft)	Total Width (ft)	Total Length (ft)	Sample Depth (ft bgs)			Notes
				First	Second	Third	
141EP001	9	3	13	0.2-0.7	NA	NA	No stain, debris, or other evidence of contamination observed.
141EP002	15	10	35	0.2-0.7	**14.5-15**	NA	Waste present from 4 ft bgs to below bottom of excavation (15 ft bgs). During excavation, banks continuously failed, sloughed off. At west end of landfill, waste was still in its full thickness (~11 ft). Waste neared surface at east end.
141EP003	15	5	60	0.2-0.7	**10-10.5**	NA	Waste present from 4 to 15 ft bgs; waste consisted of glass bottles and jars, metal wire, wood, and plastic bread wrappers. Side walls of test pit sloughed and bottom of waste was not encountered.
141EP004	13	6	25	0.2-0.7	**5-6**	**12.5-13**	Waste present from 4 to 11 ft bgs; waste consisted of mainly household waste - glass (bottles and broken), rusted metal, wire, bread wrappers, household batteries. Burn zone consisted of burned paper and plastic.
141EP005	9	3	12	0.2-0.7	NA	NA	No stain, debris, or other evidence of contamination observed.
141EP006	10	4	13	0.2-0.7	9.5-10	NA	No stain, debris, or other evidence of contamination observed. Subsurface soil sample was collected since waste was expected, but not encountered.
141EP007	8	3	13	0.2-0.7	1.5-2	7.5-8	No debris present. Layer of asphalt stained soil from 0.8 to 2 ft bgs.
141EP008	13	10	54	0.2-0.7	4-4.5	12.5-13	Waste mixed with sand present from 5 to 13 ft bgs. Waste consists of glass (bottles and broken), rusted metal wire, ash, ceramics, wood, pipes, radio tubes, decomposing aluminum and fabric.
141EP009	9	3	15	0.2-0.7	8.5-9	NA	No stain, debris, or other evidence of contamination observed. Subsurface soil sample was collected since waste was expected, but not encountered.
141EP010	8	4	13	0.2-0.7	NA	NA	No stain, debris, or other evidence of contamination observed.

TABLE 4.2
SOIL SAMPLING SUMMARY
YPG-141

U.S. ARMY GARRISON YUMA PROVING GROUND, YUMA ARIZONA

Sample Location	Total Depth (ft)	Total Width (ft)	Total Length (ft)	Sample Depth (ft bgs)			Notes
				First	Second	Third	
141EP011	6.5	5	50	0.2-0.7	**3-3.5**	**6-6.5**	Waste present from 3 ft bgs to below bottom of excavation (6.5 ft bgs). Failure of sides made excavation deeper than 6.5 ft impossible. Waste included ash, burned wood, glass (broken and bottles), rusted metal, wire, insulation, tin cans, and rubber.
141EP012	5	3	40	0.2-0.7	**3-3.5**	4.5-5	Waste present from 3 to 4 ft bgs in west end of excavation, and consisted of rusted matal, 35 mm film, wood, styrofoam, wrappers, wire, a plastic bucket, automotive metal, rubber matting, foam insulation,and glass insulators.
141EP013	8	2.67-45	12	0.2-0.7	NA	NA	No stain, debris, or other evidence of contamination observed.
141EP014	5	4	12	0.2-0.7	NA	NA	No stain, debris, or other evidence of contamination observed.
141EP015	9	3	12	0.2-0.7	NA	NA	No stain, debris, or other evidence of contamination observed.
SB001	31	NA	NA	30.5-31.5	NA	NA	See test pit EP002 for details from 0-11 ft bgs. No stain debris, or other evidence of contamination observed from 11-31 ft bgs
SB002	34	NA	NA	33-34	NA	NA	See test pit EP008 for details from 0-13 ft bgs. No stain debris, or other evidence of contamination observed from 13-34 ft bgs
SB003	25	NA	NA	24.5-25	NA	NA	No stain, debris, or other evidence of contamination observed.
Background (BG001)	10	3	13	0.2-0.7	9.0-9.5	NA	No stain, debris, or other evidence of contamination observed.

Notes: Bolded values indicate locations containing waste.

Definitions: NA = Not Applicable, ft = feet, bgs = below ground surface.

TABLE 4.3
INORGANIC ANALYTICAL RESULTS - DETECTIONS - YPG-141
US ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Location ID	Sample Depth	Sample Type	Sample Date	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium (Total)	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
			rSRL	76,000	31	10	15,000	150	39	NA	120,000	1,400	3,100	NA	400	NA	3300	23	390	1,600	NA	390	390	NA	5.2	78	23,000
			nrSRL	920,000	410	10	170,000	1,900	510	NA	1,000,000	1,300	41,000	NA	800	NA	32,000	310	5,100	20,000	NA	5,100	5,100	NA	67	1,000	310,000
			GPL	NA	35	290	12,000	23	29	NA	590	NA	NA	NA	290	NA	NA	12	NA	590	NA	290	NA	NA	12	NA	NA
			Background Threshold Values	12,000	--	6.6	290	0.92	0.65	37,000	14	7.9	15	15,000	14	6,100	920	0.016	0.49	14	2,500	--	0.062	8400	0.57	26	44
141EP001	0.2-0.7	N	7/26/10	1,950	--	2.18	65.1	--	--	8,910 J	5.76	1.61	1.57	5,500 J	3.3	1,170 J	110	0.0054 J	0.14 J	2.74	578	--	--	29.2 J	0.096 J	19.4	11.9
141EP002	0.2-0.7	N	7/27/10	3,620	--	2.92	79.4	--	0.039 J	23,300 J	7.29	2.17	6.22	7,310 J	4.19	2,130 J	155	0.005 J	0.16 J	4.07	1,510	--	0.053 J	--	0.34 J	16.7	19.9
141EP002	14.5-15	N	7/27/10	4,530	--	3.02	95.3	--	**1.11**	12,600 J	13.3	2.4	**40.1**	9,490 J	**73.6**	1,930 J	247	--	**0.71 J**	9.18	1,070	--	**3.99**	--	**0.68 J**	19.4	**168**
141EP003	0.2-0.7	N	7/22/10	2,310	--	2.04	84.3	--	0.014 J	12,800	4.88	1.85	2.85	5,500	3.77	1,580	256	0.0091 J	0.19 J	3.1	784	0.27 J	--	--	**0.61 J**	15.7	15.3
141EP003	10-10.5	N	7/22/10	2,010	--	1.76	66.6	--	0.015 J	10,200	5.08	1.98	3.13	5,250	3.74	1,390	211	--	0.26 J	3.67	700	0.32 J	--	21.5 J	**0.8 J**	15.2	15.5
141EP004	0.2-0.7	N	7/26/10	5,210	--	5.24	124	--	0.1 J	28,300 J	9.4	2.96	7.45	9,490 J	7.01	3,470 J	217	--	0.37 J	5.57	1,890	--	**0.1 J**	--	0.51 J	24.5	32.5
141EP004	5-6	N	7/26/10	**13,700**	27.7	**7.12**	112	--	**6.99**	15,200 J	**27**	6.9	**154**	**40,200 J**	**546**	2,960 J	776	**0.14**	**3.34**	**29.2**	1,550	2.06 J	**2.4**	506	**3.03**	16.8	**505**
141EP004	12.5-13	N	7/26/10	2,630	--	3.93	135	--	0.059 J	14,300 J	5.39	1.96	4.38	6,170 J	8.91	1,400 J	219	0.0077 J	0.21 J	3.48	708	--	**0.1 J**	--	0.47 J	19.9	21.9
141EP005	0.2-0.7	N	7/22/10	2,420	--	2.22	81	--	0.026 J	12,500	4.87	1.88	2.95	5,210	3.62	1,590	222	--	0.16 J	3.18	839	--	**0.077 J**	30.5 J	**0.66 J**	15.2	16.3
141EP006	0.2-0.7	N	7/27/10	5,460	--	5.59	149	--	0.067 J	23,200 J	8.87	3.02	9.73	9,620 J	9.61	3,150 J	192	0.01 J	0.35 J	6.3	1,650	--	**0.23 J**	--	0.47 J	**29.2**	33.5
141EP006	9.5-10	N	7/27/10	1,960	--	1.35 J	117	--		6,650 J	3.31	1.54	1.46	4,090 J	3.54	892 J	287	--	0.089 J	2.43	403	--	0.06 J	--	**0.72 J**	11.1	9.93
141EP007	0.2-0.7	N	7/22/10	3,850	--	4.55	107	--	0.095 J	23,200	8.73	2.64	7.17	8,010	9.21	2,640	268	**0.036**	0.36 J	5.48	1,370	--	**0.14 J**	--	0.55 J	20.5	**45.4**
141EP007	1.5-2	N	7/22/10	3,110	--	5.49	63.2	--	0.014 J	11,500	4.57	2.06	4.45	6,000	5.23	1,970	137	**0.13**	0.38 J	6.69	1,000	--	--	480 J	0.53 J	17	25.2
141EP007	7.5-8	N	7/22/10	2,230	--	3.33	70.9	--	0.035 J	11,800	4.56	1.66	1.83	5,290	3.18	1,140	179	0.0061 J	0.15 J	2.85	582	--	0.044 J	312 J	0.46 J	17.5	14.2
141EP008	0.2-0.7	N	7/27/10	3,530	--	2.79	96.1	--	0.24	14,000 J	7.07	2.42	7.32	6,830 J	12.2	2,310 J	188	--	0.29 J	5.17	1,180	--	**2**	--	0.31 J	20.5	**103**
141EP008	4-4.5	N	7/27/10	2,100	--	1.76	38.2	--		6,150 J	4.48	1.51	2.95	4,510 J	2.83	1,060 J	98.9	--	0.11 J	2.74	466	--	0.032 J	--	0.15 J	14.3	9.8
141EP008	12.5-13	N	7/27/10	6,640	15.5	6.28	230	--	**1.61**	14,100 J	**17.1**	3.21	**12,000**	**22,000 J**	**543**	1,860 J	511	**0.14**	**3.59**	**38.6**	1,430	1.04 J	**36.8**	1,860	**1.98**	14.2	**859**
141EP009	0.2-0.7	N	7/26/10	3,940	--	2.61	95.8	--	0.087 J	14,300 J	6.4	2.55	6.09	7,330 J	8.13	2,300 J	207	--	0.23 J	4.38	1,140	--	**1.5**	--	0.52 J	19.4	34
141EP009	8.5-9	N	7/26/10	2,070	--	1.7	89	--		8,390 J	5.15	1.97	1.72	5,630 J	3.63	1,090 J	153	--	0.11 J	2.99	494	--	0.051 J	--	0.21 J	19.1	12.8
141EP010	0.2-0.7	N	7/22/10	2,410	--	2.17	79.3	--	0.079 J	10,600	5.58	2.09	3.07	6,200	4.89	1,520	219	0.014	0.23 J	3.34	750	--	**0.12 J**	25.5 J	0.31 J	18.8	18.3
141EP011	0.2-0.7	N	7/28/10	2,920	--	2.78	107	--	0.26	12,900 J	6.56	2.39	4.48	6,780 J	6.16	1,990 J	220	--	0.18 J	4.12	768	--	**0.54**	--	0.41 J	22.4	29.4
141EP011	3-3.5	N	7/28/10	4,370	3.54	3.77	210	--	**9.04**	14,300 J	11.7	2.66	**253**	9,520 J	**638**	2,030 J	217	**2.39**	**1.3**	9.45	1,430	0.39 J	**17.2**	1,100	0.5 J	20.1	**748**
141EP011	6-6.5	N	7/28/10	4,550	--	**21.2**	**314**	--	0.021 J	3,630 J	**76.9**	6.51	5.76	13,700 J	4.88	1,630 J	62.9	--	0.36 J	**18.1**	613	0.62 J	**0.082 J**			**60.1**	24
141EP012	0.2-0.7	N	7/28/10	2,710	--	2.09	104	--	0.15 J	9,280	7.99	2.63	3.46	9,800	6.02 J	1,580	191 J	--	0.23 J	3.86	775	--	**0.33 J**	31.4 J	0.36 J	**32**	31
141EP012	3-3.5	N	7/28/10	3,020	--	2.85	116	--	0.37	13,500 J	7.3	2.38	6.39	6,910 J	7.87	1,700 J	192	--	0.34 J	4.49	723	--	**0.94**	--	0.31 J	21	**46.2**
141EP012	4.5-5	N	7/28/10	3,600	--	2.78	163 J	--	0.51	19,100 J	7.61	2.88	5.21	6,570 J	**16.1 J**	2,040 J	265	**0.06**	0.23 J	5.78	898 J	--	**1.68**	--	**0.76 J**	20.1	**48.6**
141EP012	4.5-5	FD	7/28/10	3,910	--	2.69	167	--	0.27	17,800	7.42	3.18	5.15	7,890	5.77 J	2,030	320 J	--	0.28 J	5.21	898	--	**1.02**	--	**0.81 J**	23.4	**52.9**
141EP013	0.2-0.7	N	7/26/10	2,060	--	1.96	81.3	--		8,810	4.74	1.67	2.41	5,770	3.95 J	1,200	161 J	--	0.16 J	2.76	597	--	**0.08 J**	36.8 J	0.16 J	18.9	14.5
141EP014	0.2-0.7	N	7/26/10	2,920	--	2.37	114	--	0.009 J	14,600	6.49	2.48	2.91	8,050	4.79 J	1,600	253 J	--	0.18 J	3.92	808	--	0.041 J	--	**0.65 J**	**27.8**	17.2
141EP015	0.2-0.7	N	7/28/10	1,900	--	2.18	60	--		7,370	6.48	1.71	2.02	7,160	3.36 J	1,150	108 J	--	0.16 J	2.75	500	--	--	30.6 J	0.21 J	24.6	13.4
141SB001	30.5-31.5	N	2/15/11	2,190	--	1.38 J	160	0.085 J	0.09 J	10,000	5.35	2.39	**22.1**	6,960	3.92	995	332	0.0045 J	0.11 J	3.73	459 J	--	--	196	--	21.2	23.5
141SB002	33-34	N	2/15/11	2,190	--	1.31 J	55.9	0.1 J	0.07 J	8,160	8.17	3.43	**28.1**	7,670	3.45	1,320	131	**0.022**	0.17 J	4.48	513 J	--	--	77.20	--	19.4	28.8
141SB003	24.5-25.5	N	2/16/11	1,840	--	3.25	53.6	0.11 J	0.025 J	4,620	4.63	2.00	**15.8**	5,390	3.56	796	129	0.0047 J	0.074 J	2.72	440 J	--	--	751	--	17.8	18.1

Notes: Results are reported in units of milligrams per kilogram (mg/kg). Sample depths are in feet below ground surface (ft bgs). Bolded values are results above the background threshold value. Green highlighted rows are samples collected within the debris zone. Yellow highlighted cells are results exceeding the ADEQ nrSRL, rSRL, or GPL.

Definitions: N = normal sample. FD = field duplicate. nrSRL = ADEQ nonresidential soil remediation level. rSRL = ADEQ residential soil remediation level. GPL = ADEQ minimum groundwater protection level. 'NA' = not available. '--' = non-detect. 'J' = estimated value.

TABLE 4.4

ORGANIC ANALYTICAL RESULTS - DETECTIONS - YPG-141

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Location ID	Sample Depth	Sample Type	Sample Date	1,2-Dichloropropane	1,3-Dinitrobenzene	2-Hexanone	Benzene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzyl Butyl Phthalate	bis(2-Ethylhexyl) Phthalate	Bromomethane	Carbon Disulfide	Chlorobenzene	Chloroethane	Chloromethane	Chrysene	Di-n-Butyl Phthalate	Di-n-Octyl Phthalate	Ethylbenzene	Fluoranthene	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	Indeno(1,2,3-c,d)pyrene	m,p-Xylene (Sum Of Isomers)	Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	Methylene Chloride	n-Propylbenzene	Pentaerythritol Tetranitrate	Phenanthrene	Pyrene	Tetrachloroethylene (PCE)	Tetryl	Toluene	Xylenes, Total
			nrSRL	7.4	62	-	1.4	21	2.1	21	29,000	210	120,000	1,200	13	720	530	65	160	2,000	62,000	25,000	400	22,000	160	21	420	17,000	210	240	-	240,000	29,000	13	6,200	650	420
			rSRL	3.4	6.1	-	0.65	6.9	0.69	6.9	2,300	69	12,000	390	3.9	360	150	30	48	680	6,100	2,400	400	2,300	50	6.9	270	5,300	93	240	-	22,000	2,300	5.1	610	650	270
			GPL	-	-	-	0.71	-	-	-	-	-	-	-	-	-	22	-	-	-	-	-	120	-	-	-	2,200	-	-	-	-	-	-	1.3	-	400	2,200
141EP001	0.2-0.7	N	7/26/10	-	-	-	0.00066 J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0017 J	-	-	-	-	-	0.0086 J	0.0025 J	-	-	-	-	-	0.0019 J	-
141EP002	0.2-0.7	N	7/27/10	-	-	-	0.00087 J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0087 J	-	-	-	-	-	-	-	0.0024 J	-
141EP002	14.5-15	N	7/27/10	-	-	-	0.0064 J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0013 J	-	0.013 J	-	-	-	`	0.0022 J	-	-	0.0013 J
141EP003	0.2-0.7	N	7/22/10	0.0044 J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.026 J	-	-	-	0.0073 J	-	-	-	-	0.0028 J	-	-	-
141EP003	10-10.5	N	7/22/10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.026 J	-	-	-	0.0017 J	-	-	-	-	-	-	-	-
141EP004	0.2-0.7	N	7/26/10	-	-	-	0.001 J	-	-	-	-	-	-	-	-	-	-	0.0017 J	-	-	-	-	0.0011 J	-	-	-	-	-	0.0032 J	-	0.046 J	-	-	-	-	0.0017 J	-
141EP004	4-4.5	N	7/26/10	-	-	-	0.033	-	-	-	-	-	-	-	0.012	-	-	-	0.055	-	-	-	0.0018 J	-	-	-	-	-	-	-	-	-	-	-	-	0.0069 J	-
141EP004	12.5-13	N	7/26/10	-	-	-	0.0016 J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0012	-	-	-	-	-	-	-	-	-	-	-	-	0.0021 J	-
141EP005	0.2-0.7	N	7/22/10	0.0049 J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0071 J	-	-	-	-	0.0024 J	-	-	-
141EP006	0.2-0.7	N	7/27/10	-	-	-	0.0010 J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0018 J	-
141EP006	9.5-10	N	7/27/10	-	-	-	0.00062 J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0018 J	-
141EP007	0.2-0.7	N	7/22/10	-	-	0.0042 J	-	-	-	-	-	-	0.031 J	0.35 J	-	-	0.0017 J	-	-	0.024 J	-	0.57 J	-	0.008 J	-	-	-	-	0.0016 J	-	-	-	-	-	-	-	-
141EP007	4.5-5	N	7/22/10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0021 J	-	-	-	-	-	0.010 J	-	-
141EP007	9.5-10	N	7/22/10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0018 J	-	-	-	-	0.0020 J	-	-	-
141EP008	0.2-0.7	N	7/27/10	-	-	-	0.0019 J	-	-	-	-	-	-	-	-	-	-	-	0.0028 J	-	-	-	0.0013 J	-	-	-	-	-	0.034	-	-	-	-	-	-	0.0034 J	-
141EP008	4-4.5	N	7/27/10	-	-	-	0.00046 J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0014 J	-
141EP008	12.5-13	N	7/27/10	-	0.0071 J	-	0.025	-	-	-	-	-	-	-	0.037	-	-	-	0.062	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0097	-
141EP009	0.2-0.7	N	7/26/10	-	-	-	0.0012 J	0.024 J	-	0.02 J	-	-	-	-	-	-	-	-	-	0.031 J	-	-	0.0016 J	0.044 J	-	-	-	-	0.0080 J	-	-	0.021 J	-	-	-	0.0019 J	-
141EP009	8.5-9	N	7/26/10	-	-	-	0.00078 J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0023 J	-
141EP010	0.2-0.7	N	7/22/10	-	-	-	-	0.055 J	0.027 J	0.062 J	0.028 J	0.039 J	-	-	-	-	-	-	-	0.068 J	-	-	-	0.067 J	-	0.14 J	-	-	0.0030 J	-	-	0.016 J	0.086 J	-	-	-	-
141EP011	0.2-0.7	N	7/28/10	-	-	-	0.00096 J	-	-	-	-	-	-	-	-	-	-	-	-	0.011 J	-	-	-	0.016 J	-	-	-	-	0.0031 J	-	-	-	-	-	-	0.0018 J	-
141EP011	3-3.5	N	7/28/10	-	-	-	0.029 J	-	-	-	-	-	-	-	0.0051 J	0.0040 J	-	-	0.011 J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0090 J	-
141EP011	6-6.5	N	7/28/10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0031 J	-
141EP012	0.2-0.7	N	7/28/10	-	-	-	0.0018 J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0015 J	0.011 J	-	-	-	-	0.0084 J	-	-	-	-	-	-	0.0012 J	-
141EP012	3-3.5	N	7/28/10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0090 J	-	-	-	-	-	-	0.0013 J	-
141EP012	4.5-5	N	7/28/10	-	-	-	0.0011 J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.013 J	-	-	-	-	-	-	-	-	-	-	-	-	-
141EP013	0.2-0.7	N	7/26/10	-	-	-	0.0011 J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0013 J	-	-	-	-	-	0.0033 J	-	-	-	-	-	-	0.0012 J	-
141EP014	0.2-0.7	N	7/26/10	-	-	-	0.0016 J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0019 J	-	-	-	-	-	-	-	-	-	-	-	-	-	-
141EP014	0.2-0.7	N	7/28/10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0014 J	-	-	-	-	-	0.0052 J	-	-	-	-	-	-	-	-
141SB002	33-34	N	2/15/11	-	-	-	-	-	-	-	-	-	-	0.052 J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
141SB003	24.5-25.5	N	2/16/11	-	-	-	-	-	-	-	-	-	-	0.014 J	-	-	-	-	-	-	0.012 J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes: Results are reported in units of milligrams per kilogram (mg/kg). Sample depths ar in feet below ground surface (ft bgs).

Definitions: N = normal sample. nrSRL = ADEQ nonresidential soil remediation level. rSRL = ADEQ residential soil remediation level. GPL = ADEQ minimum groundwater protection level. "--" = nondetect. "J" = estimated value.

TABLE 4.5

COMPARISON OF SOIL SAMPLES COLLECTED WITHIN WASTE AND SOIL SAMPLES COLLECTED BELOW WASTE AT YPG-141

YUMA PROVING GROUND, YUMA, ARIZONA

Location	Depth	Metals Greater than BTV
141EP002	**14.5-15**	**7**
141EP003	**10-10.5**	**1**
141EP004	**5-6**	**13**
141EP004	12.5-13	1
141EP007	**1.5-2**	**1**
141EP008	**12.5-13**	**11**
141EP011	**3-3.5**	**7**
141EP011	6-6.5	6
141EP012	**3-3.5**	**2**
141EP012	4.5-5	5

TABLE 5.1
COMPARISON OF MAXIMUM DETECTED CONCENTRATIONS TO BACKGROUND AND SRLs
YPG-141
U.S. ARMY GARRISON YUMA PROVING GROUND, YUMA ARIZONA

Group	Chemical	Max Detect[1] (mg/kg)	BTV (mg/kg)	rSRL[2] (mg/kg)	nrSRL (mg/kg)	GPL (mg/kg)	Exceeds				COPC
							BTV	rSRL	nrSRL	GPL	
Metals	Aluminum	13,700	12,000	76,000	920,000	-	Yes	No	No	-	No
	Antimony	27.7	-	31	410	35	-	No	No	Yes	No
	Arsenic	21.2	6.6	10	10	290	Yes	Yes	Yes	No	No[3]
	Barium	314	290	15,000	170,000	12,000	Yes	No	No	No	No
	Cadmium	9.04	0.65	39	510	29	Yes	No	No	No	No
	Chromium, total[4]	76.9	14	120,000	1,000,000	590	Yes	No	No	No	No
	Cobalt	6.9	7.9	1,400	13,000	-	No	No	No	-	No
	Copper	12,000	15	3,100	41,000	-	Yes	Yes	No	-	No
	Lead	638	14	400	800	290	Yes	Yes	No	Yes	No
	Manganese	776	920	3,300	32,000	-	No	No	No	-	No
	Mercury	2.39	0.016	23	310	12	Yes	No	No	No	No
	Molybdenum	3.34	0.49	390	5100	-	Yes	No	No	-	No
	Nickel	38.6	14	1,600	20,000	590	Yes	No	No	No	No
	Selenium	2.06	-	390	5,100	290	-	No	No	No	No
	Silver	36.8	0.062	390	5,100	-	Yes	No	No	-	No
	Thallium	3.03	0.57	5.2	67	12	Yes	No	No	No	No
	Vanadium	60.1	26	78	1000	-	Yes	No	No	-	No
	Zinc	859	44	23,000	310,000	-	Yes	No	No	-	No
VOC	1,2-Dichloropropane	0.00487	NA	3.4	7.4	-	NA	No	No	-	No
	2-Hexanone	0.00418	NA	-	NA	-	NA	No	No	-	No
	Acetone	0.121	NA	14,000	54,000	-	NA	No	No	-	No
	Benzene	0.033	NA	0.65	1.4	0.71	NA	No	No	No	No
	Bromomethane	0.0117	NA	3.9	13	-	NA	No	No	-	No
	Carbon disulfide	0.00396	NA	360	720	-	NA	No	No	-	No
	Chlorobenzene	0.0017	NA	150	530	22	NA	No	No	No	No
	Chloroethane	0.00172	NA	30	65	-	NA	No	No	-	No
	Chloromethane	0.0549	NA	48	160	-	NA	No	No	-	No
	Ethylbenzene	0.00188	NA	400	400	120	NA	No	No	No	No
	Methyl ethyl ketone (2-Butanone	0.0192	NA	23,000	34,000	-	NA	No	No	-	No
	Methyl isobutyl ketone (4-Methyl-2-Pentanone)	0.00865	NA	5,300	17,000	-	NA	No	No	-	No

TABLE 5.1
COMPARISON OF MAXIMUM DETECTED CONCENTRATIONS TO BACKGROUND AND SRLs
YPG-141
U.S. ARMY GARRISON YUMA PROVING GROUND, YUMA ARIZONA

Group	Chemical	Max Detect[1] (mg/kg)	BTV (mg/kg)	rSRL[2] (mg/kg)	nrSRL (mg/kg)	GPL (mg/kg)	Exceeds				COPC
							BTV	rSRL	nrSRL	GPL	
VOC (Cont'd)	Methylene chloride	0.034	NA	93	210	-	NA	No	No	-	No
	N-Propylbenzene	0.00254	NA	240	240	-	NA	No	No	-	No
	Tetrachloroethylene (PCE)	0.00279	NA	5.1	13	1.3	NA	No	No	No	No
	Toluene	0.00898	NA	650	650	400	NA	No	No	No	No
SVOC	Benzo(a)anthracene	0.0548	NA	6.9	21	-	NA	No	No	-	No
	Benzo(a)pyrene	0.0268	NA	0.69	2.1	-	NA	No	No	-	No
	Benzo(b)fluoranthene	0.0616	NA	6.9	21	-	NA	No	No	-	No
	Benzo(g,h,i)perylene[5]	0.0284	NA	2,300	29,000	-	NA	No	No	-	No
	Benzo(k)fluoranthene	0.0389	NA	69	210	-	NA	No	No	-	No
	Benzyl Butyl Phthalate	0.0308	NA	12,000	120,000	-	NA	No	No	-	No
	Bis(2-ethylhexyl) phthalate	0.349	NA	390	1,200	-	NA	No	No	-	No
	Chrysene	0.0682	NA	680	2,000	-	NA	No	No	-	No
	Di-n-octyl phthalate	0.565	NA	2,400	25,000	-	NA	No	No	-	No
	Fluoranthene	0.0674	NA	2,300	22,000	-	NA	No	No	-	No
	Indeno(1,2,3-c,d)pyrene	0.14	NA	6.9	21	-	NA	No	No	-	No
	Phenanthrene[6]	0.0213	NA	22,000	240,000	-	NA	No	No	-	No
	Pyrene	0.0858	NA	2,300	29,000	-	NA	No	No	-	No
Explosives	Hexahydro-1,3,5-trinitro-1,3,5-triazine	0.026	NA	50	160	-	NA	No	No	-	No
	Pentaerythritol tetranitrate[7]	0.046	NA	120	120	-	NA	No	No	-	No
	Tetryl	0.01	NA	610	6,200	-	NA	No	No	-	No

Notes:
1 - For 0-10 ft bgs.
2 - Lesser of the 10^{-5} risk and noncarcinogen based residential SRLs
3 - See text Section 5.1.2 Selection of Chemicals of Potential Concern
4 - as Chromium III
5 - No SRL. Pyrene used as a surrogate.
6 - No SRL. Anthracene used as a surrogate.
7 - No SRL. USEPA (2011) residential Regional Screening Level provided.

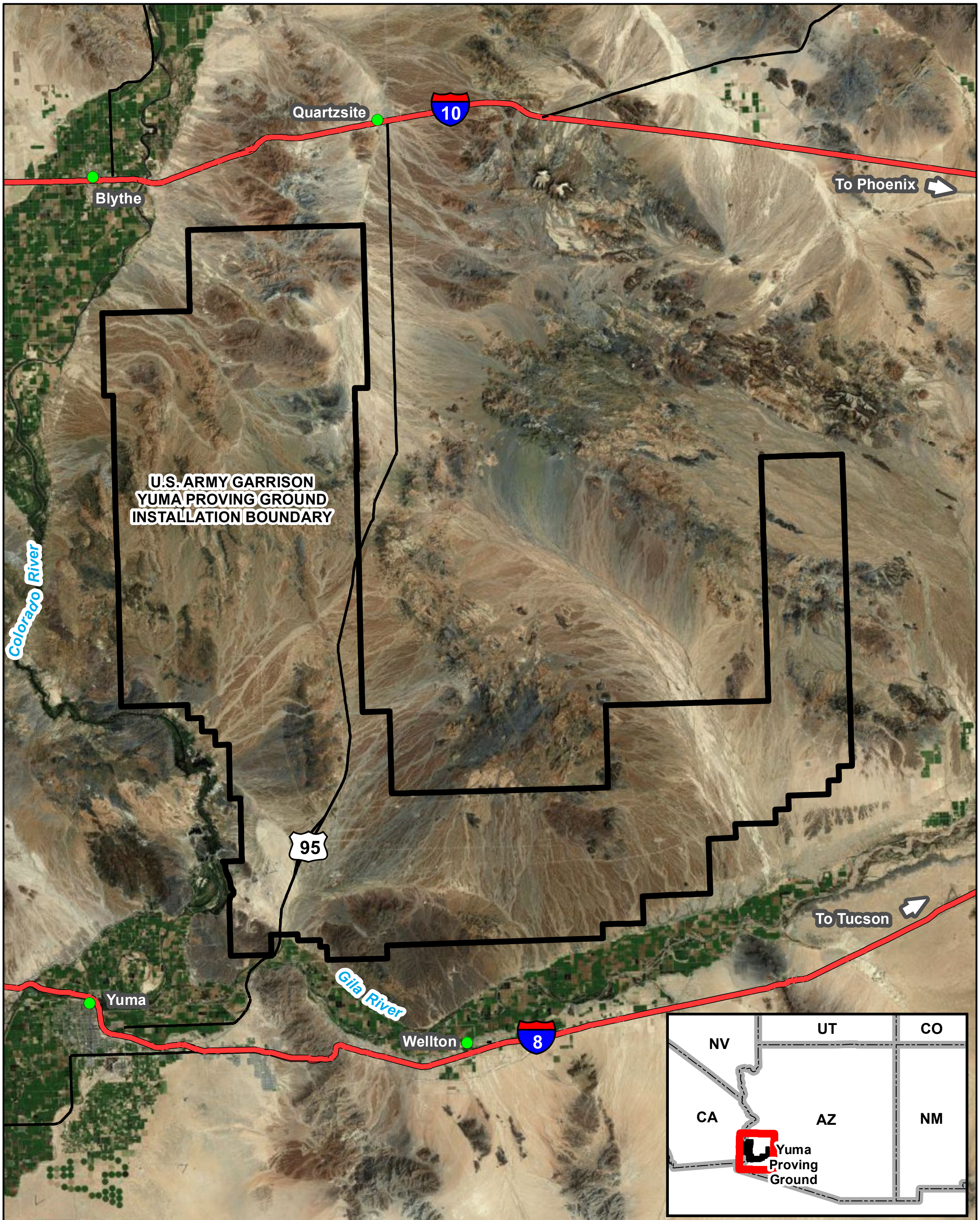
Definitions:
BTV - Background threshold value (see Appendix D)
Max - maximum
NA - Not applicable
rSRL - 2007 Arizona residential soil remediation level
COPC- Chemical of potential concern
VOC - Volatile Organic Compound
SVOC - Semi Volatile Organic Compound

TABLE 5.2
REPRESENTATIVE SPECIES

YUMA PROVING GROUND, YUMA, ARIZONA

Class	Species - Common Name (Scientific Name)
Plants	Terrestrial Plants
Invertebrates	Terrestrial (soil dwelling) invertebrates
Mammals	Desert shrew (*Notiosorex crawfordi*) Little pocket mouse (*Perognathus longimembris*) Kit fox (*Vulpes macrotis*)
Birds	Gambel's quail (*Callipepla gambelii*) Verdin (*Auriparus flaviceps*) American kestrel (*Falco sparverius*)
Reptiles	Sonoran desert tortoise (*Gopherus morafkai*)

FIGURES



Miles
0 5 10
0 8 16
Kilometers

FIGURE 1.1

REGIONAL LOCATION

U.S. Army Garrison Yuma Proving Ground

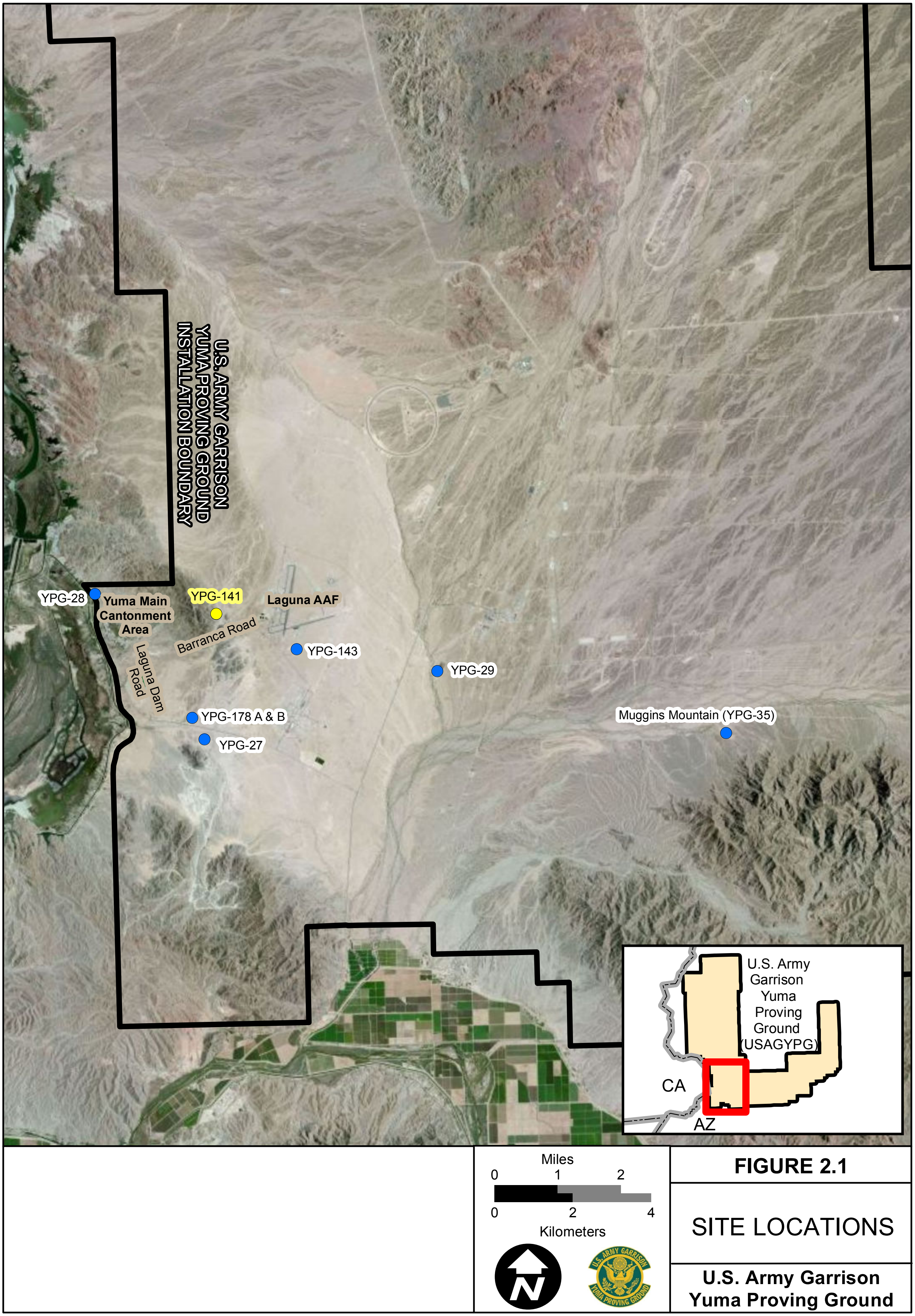
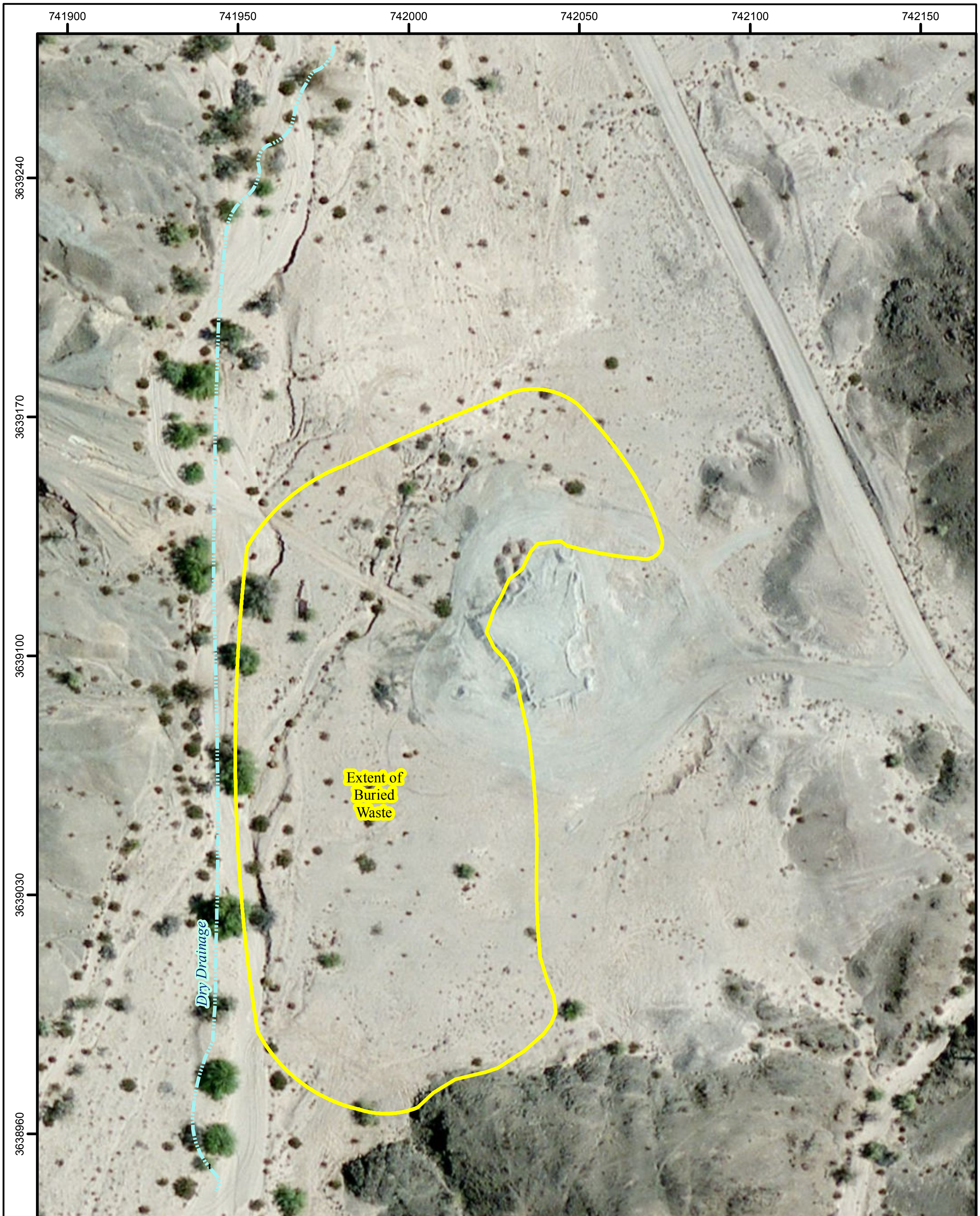


FIGURE 2.1

SITE LOCATIONS

U.S. Army Garrison Yuma Proving Ground

X:\GISCADD\projects\yuma\mapfiles\YPG_141\RFI_Draft\RFI_141_site_locations.mxd 12/21/2011



LEGEND

Extent of Buried Waste

Feet
0 65 130
0 20 40
Meters

FIGURE 2.2

YPG-141
SITE MAP

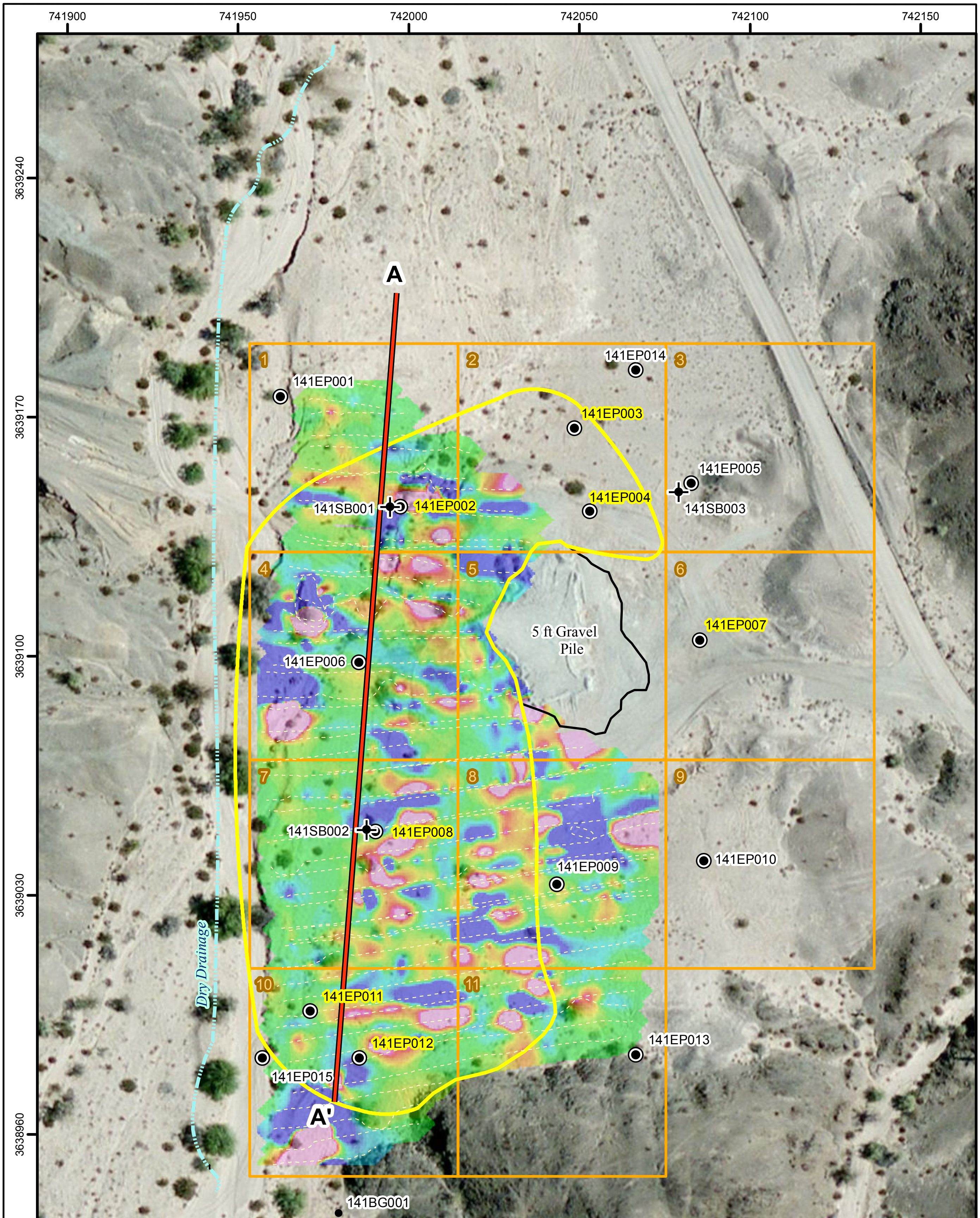
U.S. Army Garrison
Yuma Proving Ground

X:\GISCADD\projects\yuma\mapfiles\YPG_141\RFI_Draft\RFI_141_2009_extent_buried_waste.mxd 12/21/2011

PARSONS

FIGURE 2.3

Surface Debris at Inactive Landfill YPG-141



LEGEND

Top Sensor Magnetic Reading (nT/M)

- Background Test Pit
- Test Pit
- Soil Boring
- Cross Section
- Path Lines of Geophysical Survey
- Washed Gravel Pile
- Extent of Buried Waste
- 2 Sampling Grid with Grid ID
- 141EP003 Test Pits with Waste

Feet
0 65 130

0 20 40
Meters

FIGURE 4.1

YPG-141
GEOPHYSICAL
SURVEY RESULTS

U.S. Army Garrison
Yuma Proving Ground

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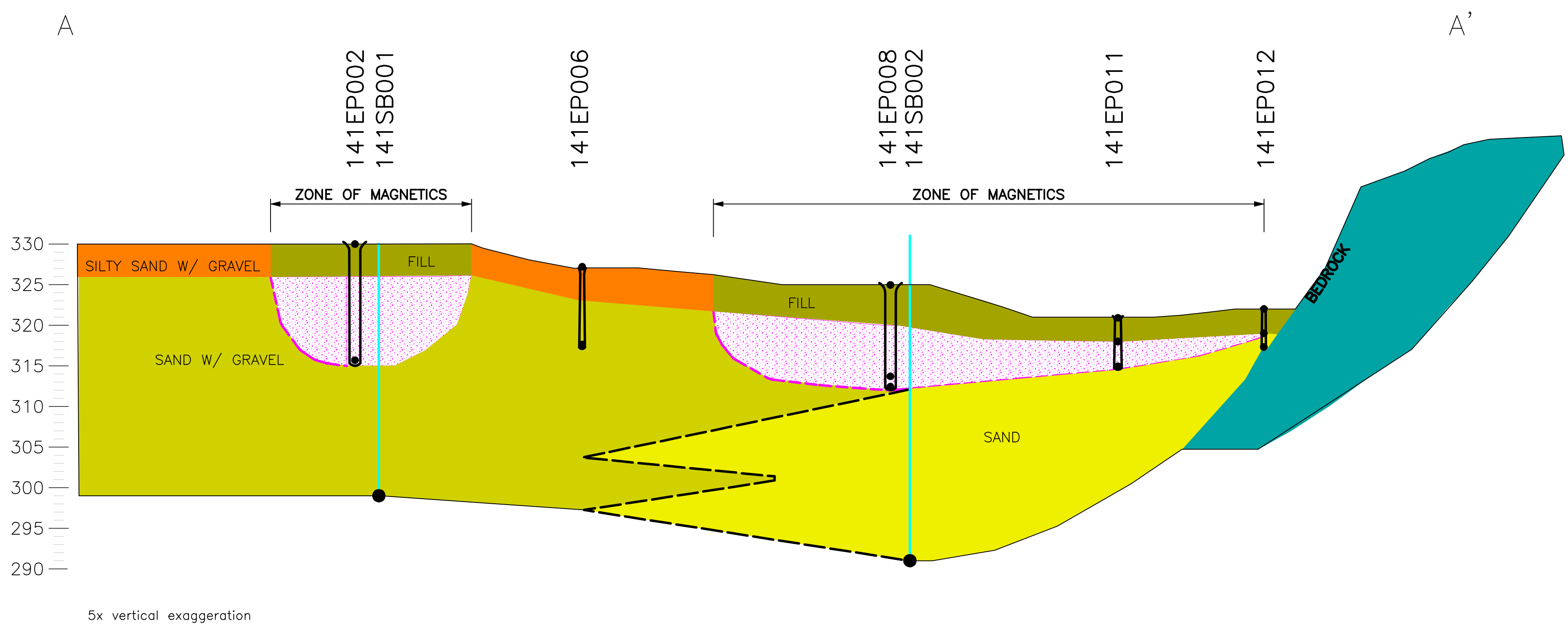


LEGEND

FILL, local material

SAND, silty with gravel

SAND, with gravel

SAND

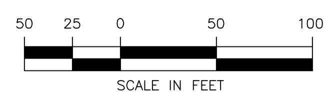
BEDROCK

Waste disposal area consisting of parallel waste trenches mixed with soil.

TEST PIT EXCAVATION

SAMPLE LOCATION

BORING LOCATION



PARSONS

FIGURE 4.2

YPG-141
CROSS SECTION VIEW
OF TEST PITS
FROM A TO A'

YUMA PROVING GROUND

$FILE$
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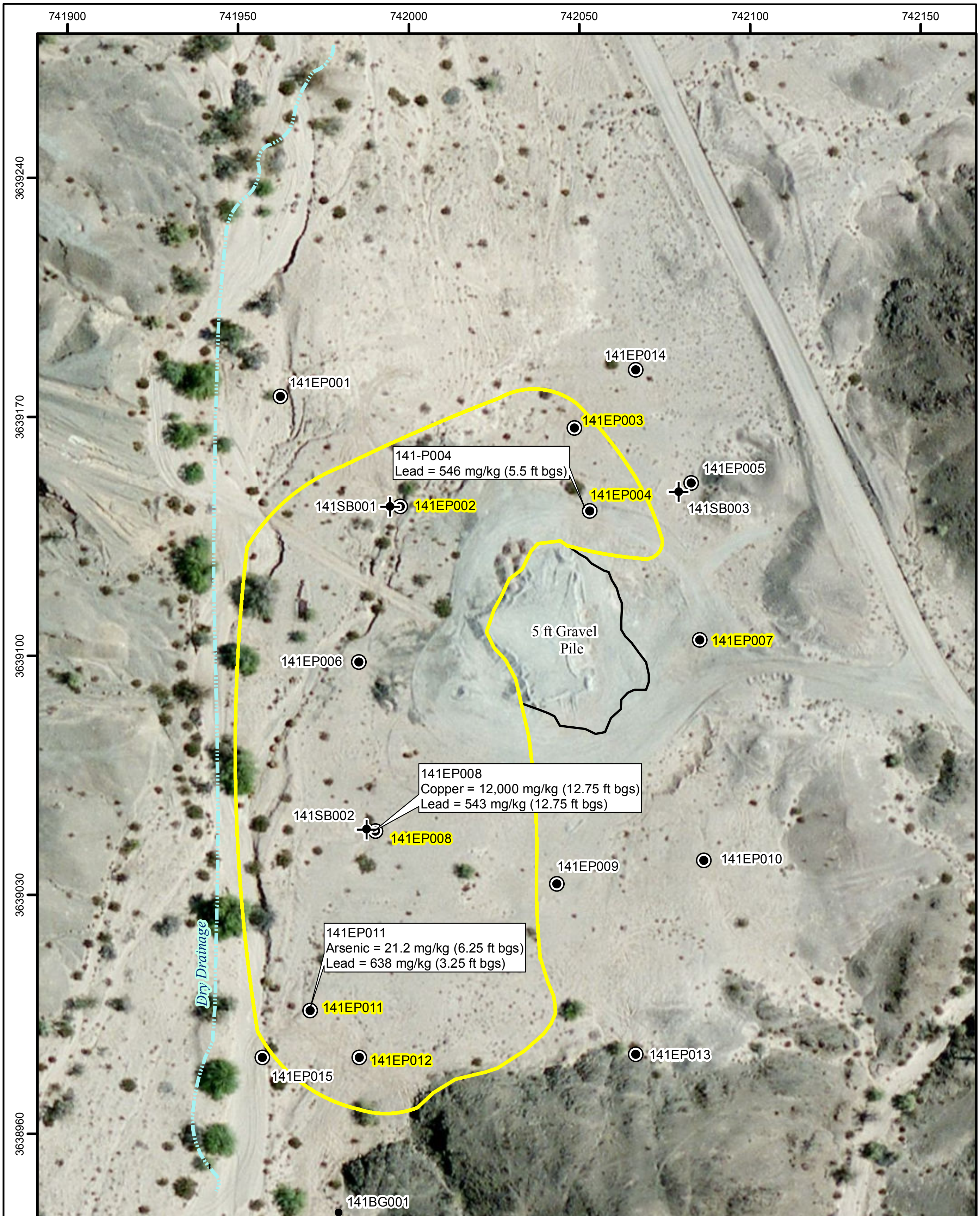

LEGEND

- Background Test Pit
- Test Pit
- Soil Boring
- Washed Gravel Pile
- Extent of Buried Waste
- 141EP003 Test Pits with Waste

Note: Only detected concentrations above remediation goals are shown.

Feet
0 65 130
0 20 40
Meters

FIGURE 4.3

YPG-141
SOIL SAMPLING
RESULTS

U.S. Army Garrison
Yuma Proving Ground

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