Mojave River Pyrotechnics Assessment Report

Barstow, San Bernardino County, California

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List of Abbreviations and Acronyms

APN	assessor parcel number
bgs	below ground surface
CAM	California Assessment Manual
CDPH	California Department of Public Health
E & E	Ecology and Environment, Inc.
ER-QASP	Emergency Response Quality Assurance Sampling Plan
ERS	Emergency Response Section
ERT	Environmental Response Team
FOSC	Federal On-Scene Coordinator
GPS	Global Positioning System
mg/kg	milligrams per kilogram
QA/QC	Quality Assurance/Quality Control
RSL	U.S. EPA Regional Screening Level
RWQCB	California Regional Water Quality Control Board
SAP	Sampling and Analysis Plan
START	Superfund Technical Assessment and Response Team
ug/l	micrograms per liter
U.S. EPA	United States Environmental Protection Agency

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1 Introduction

In December 2010, United States Environmental Protection Agency Region 9 Emergency Response Section (U.S. EPA) Federal On-Scene Coordinator (FOSC) Harry Allen tasked the Ecology and Environment, Inc. Superfund Technical Assessment and Response Team (START) to provide technical assistance for a Removal Assessment regarding perchlorate contamination in groundwater in the city of Barstow, San Bernardino County, California. The California Regional Water Quality Control Board, Lahontan Region (RWQCB), had requested U.S. EPA assistance in evaluating two properties within the city limits of Barstow that could be contributing to the groundwater contamination problem.

The specific properties involved are a former pyrotechnics manufacturing facility that operated in the 1980s, and the former home of the owner of the facility. According to information provided by the RWQCB, the Mojave River Pyrotechnics Company, which closed in the mid-1980s, allegedly handled perchlorate for the manufacturing of various pyrotechnics devices. The owner/ operator of the facility was James Bray, who resided at a property that is one of the subjects of the assessment. Because perchlorate contamination has been recently detected at a nearby public water supply well and in private domestic wells in the vicinity of the properties, the RWQCB suspects that chemicals containing perchlorate may have been disposed at the Bray residential property and/or at the former pyrotechnics manufacturing facility.

This report presents the assessment activities conducted by the U.S. EPA and START at the former pyrotechnics manufacturing facility and at the facility owner's former residence.

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2 Site Description

The Mojave River Pyrotechnics Assessment site is composed of two properties: the former pyrotechnics manufacturing facility, and the former residence of the owner of the pyrotechnics manufacturing facility.

The former pyrotechnics manufacturing facility is situated on two parcels located at 36131 N. Yucca Street in Barstow, San Bernardino County, California (Appendix A, Figure 1). The San Bernardino County Assessor Parcel Numbers (APNs) are 0425-091-36-0000 and 0425-091-37-0000. The former facility is located across the Mojave River drainage channel and approximately 1500 feet southwest of the residence property. The former pyrotechnics manufacturing facility is approximately 5.5 acres in area. It is completely surrounded by chain-link fencing and is currently being used as a storage yard.

The residence property consists of four conjoined 5-acre parcels located at 30433 Poplar Street in Barstow, San Bernardino County, California (Appendix A, Figure 1). In this report, the residence property is referred to as the Poplar Street property. The San Bernardino County APNs for the Poplar Street property are 0425-091-21-0-000, 0425-091-22-0-000, 0425-091-23-0-000, and 0425-091-24-0-000. The property is situated approximately 0.25 miles south of Old Highway 58 and one mile northwest of Interstate 15.

The northwestern parcel of the Poplar Street property contains two residential structures and associated outbuildings in the northern portion of the parcel, with the remainder of the parcel consisting of undeveloped land. The other three of the four parcels are also undeveloped land. The Mojave River drainage channel is immediately adjacent to the parcels, to the south. Adjacent to the north of the property is Poplar Street, on the other side of which is undeveloped property. Residential properties are present immediately west and northeast of the Poplar Street property, but the majority of the immediate surrounding area is undeveloped.

The site is situated at an elevation of approximately 2,000 feet above mean sea level. The topographic relief is flat with a gentle slope toward the Mojave River, which transects the two properties. North of the site the land slopes steeply upward due to the presence of the Mitchel Range. The site is located within the Mojave Desert Geomorphic Province. Surface and shallow subsurface soils in the site vicinity are Holocene and Pleistocene-aged alluvium derived from weathering

of the surrounding mountain ranges (CDMG, 1986). The RWQCB-Lahontan Region estimates groundwater at the site to occur between 25 and 50 feet below ground surface (bgs). Groundwater would be anticipated to flow toward the Mojave River.

3 U.S. EPA and START Assessment Activities

The RWQCB had initially requested assistance solely for the investigation of the Poplar Street property. The U.S. EPA and START conducted three sampling events at the property, in December 2010, March 2011, and August 2011. Based on perchlorate concentrations found in soil at the residence, assessment activities were expanded during the third sampling event to include the nearby former pyrotechnics manufacturing facility.

For all three sampling events, all sample locations were logged using a global positioning system (GPS) instrument. All samples were analyzed by the U.S. EPA Region 9 Laboratory in Richmond, California. Blind (to the laboratory) duplicates of soil and water samples were collected at a frequency of at least 10% for quality assurance/quality control (QA/QC) purposes. To determine whether field decontamination procedures were effective, equipment blank samples were collected on a daily basis when non-dedicated sampling equipment was used. A START chemist performed Tier 2 validations of all sample data in accordance with *Quality Assurance/Quality Control Guidance for Removal Activities, Sampling QA/QC Plan and Data Validation Procedures* (1990), *U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (2004), and *U.S. EPA Region IX Superfund Data Evaluation/ Validation Guidance R9QA/006* (2001). Duplicate results and equipment blank results were reviewed as part of the START data validation. All generated data were found to be acceptable as definitive category data, and the data were determined to be usable to meet project use objectives. Validated laboratory data sheets are provided in Appendix B.

Photo documentation of assessment activities is provided in Appendix C.

3.1 December 2010 Sampling Event

Prior to the first visit to the Poplar Street property, the START prepared an *Emergency Response and Time Critical Quality Assurance Sampling Plan for Soil, Water and Miscellaneous Matrix Sampling* (December 17, 2010) (ER-QASP) (Appendix D).

On December 20, 2010, during an initial site visit to the Poplar Street property, the START and U.S. EPA inspected a "garden area" to the west of the main house, where it was suspected that drummed material had been dumped during the 1980s. The START and U.S. EPA observed that the garden area was being heavily watered via numerous hoses attached to at least four spigots. As there was no actual gardening occurring at the time, the water could only benefit some well-established trees that surround the garden area. Within a slight depression in the garden area, a white precipitate material was observed protruding through the surface soil. The material was one to two inches in thickness, and spread horizontally out to an unknown extent. The START collected a sample of the precipitate, which was identified as MRPA-1. Approximately six feet to the west of this first sample, the START collected three samples from a hand-augered soil boring at 0 to 6 inches bgs, 12 to 15 inches bgs, and 32 to 36 inches bgs (MRPA-2, -3, and -4). At approximately 14 inches bgs within this soil boring, the same white precipitate was found.

At U.S. EPA direction, the START also collected a composite surface soil sample (MRPA-5) of five individual aliquots from a grid pattern distributed within the garden area; a surface soil sample (MRPA-6) composited from four individual aliquots from a fire pit located to the rear of the primary residence; and a surface soil sample (MRPA-7) composited from four surface soil sample aliquots collected near an on-site groundwater well located near the southwest corner of the northwestern parcel. The sample locations are shown on Appendix A, Figure 2. There were no deviations from the ER-QASP. The samples were shipped to the U.S. EPA Region 9 Laboratory in Richmond, California and analyzed for perchlorate, nitrate, sulfate, and 17 California Assessment Manual (CAM-17) metals. The analytical results are presented in Appendix A, Table 1.

3.1.1 Discussion of Results

Concentrations of perchlorate in the soil samples ranged from 2.3 milligrams per kilogram (mg/kg) in MRPA-7 to a maximum detected concentration of 130,000 mg/kg (13 percent) in MRPA-1. While MRPA-2 contained a perchlorate concentration of 120 mg/kg, the perchlorate concentration increased to 120,000 mg/kg in MRPA-3 (the 12 – 15 inches bgs sample). MRPA-4 (32 – 36 inches bgs), at 4,800 mg/kg perchlorate, was also still elevated above the surface soil sample at that location. Concentrations of perchlorate in MRPA-5 and MRPA-6 were 36 mg/kg and 2.9 mg/kg, respectively. Nitrate concentrations ranged from not detected to 83 mg/kg. Sulfate concentrations ranged from not detected to 410 mg/kg. Metals results were compared to U.S. EPA Regional Screening Levels (RSLs) for residential soil (EPA, 2011). Arsenic concentrations, which ranged from less than the reporting limit of 2.1 (<2.1) to 12 mg/kg, exceeded the arsenic RSL of 0.39 mg/kg where detected, and some vanadium concentrations, which ranged from 4.0 to 26 mg/kg, exceeded the vanadium RSL of 5.5 mg/kg. Other metals concentrations did not exceed their respective RSLs. However, background metals concentrations for the area were not established as part of the sampling.

The START also performed hazard categorization field tests on the white precipitate, with the following results:

pH:	7
Solubility:	Soluble in water
Oxidizer:	Negative
Sulfide:	Negative
Nitrate:	Negative
Cyanide:	Negative
Flammability:	Negative

It is apparent from the field test results that the field test for oxidizer is not sensitive for a 13% concentration of perchlorate.

3.2 March 2011 Sampling Event

As a result of the significant perchlorate concentrations found in the Poplar Street property garden area in December 2010, FOSC Will Duncan, who had taken over the U.S. EPA management of the project, requested that the START plan for additional sampling to determine the extent of the perchlorate contamination in the garden area and to determine what other areas of the residential site might be impacted by perchlorate. The START prepared a *Sampling and Analysis Plan, Mojave River Pyrotechnics Assessment* (SAP) (March 18, 2011) that described the sampling activities to occur. The SAP is presented in Appendix E. The sole contaminant of concern addressed in the SAP was perchlorate in soil and groundwater.

The site-specific action levels for perchlorate in soil and groundwater were established by FOSC Duncan to be 55 mg/kg for soil and 6 micrograms per liter (ug/l) for groundwater. The 55 mg/kg action level for soil is the U.S. EPA's non-cancer hazard, ingestion pathway Regional Screening Level (RSL) for residential soil (EPA, 2011). The action level for groundwater is the California Department of Public Health (CDPH) Maximum Contaminant Level for perchlorate (CDPH, 2011).

From March 21 to 24, 2011, the START collected surface and subsurface soil samples and two groundwater samples at the Poplar Street property using hand augers and a direct-push (Geoprobe) drill rig. The U.S. Coast Guard's Pacific Strike Team provided two personnel to operate the Geoprobe. A START geologist supervised all Geoprobe work and prepared lithologic logs for all soil borings. The lithologic logs are archived in the project file.

The U.S. EPA's Environmental Response Team (ERT) conducted a geophysical study on the two northern Poplar Street parcels to look for subsurface anomalies that might be indicative of buried material or drums. The instruments the ERT employed included ground-penetrating radar, an electromagnetic inductive Geonics® EM-31 instrument, and a Geonics® EM-61 metal detector. The ERT also checked Geoprobe locations for potential shallow-subsurface anomalies prior

to the initiation of any drilling activities. In two instances (at sample locations MR-022 and MR-028), the ERT recommended an offset of a Geoprobe location a few feet away from initial placement, due to potential anomalies. The geophysical study did not discover any significant buried anomalies.

Upon initial access to the Poplar Street property on March 21, 2011, the garden area was again found to be undergoing heavy watering, and the START shut off all of the spigots. FOSC R. Martyn, who supported FOSC Duncan during the March 2011 sampling event, subsequently made a request to the property owner that the continuous watering be stopped.

3.2.1 Soil Sampling

Following procedures described in the SAP, the START collected soil samples from 28 soil borings, MR-001 through MR-028, at depths of 1, 3, 6, and 10 feet bgs. The 1-foot and 3-foot depth samples were collected by hand auger, and all deeper samples were collected from acetate sleeves of soil produced from Geoprobe operations. Two soil borings were extended to 20 feet bgs and sampled at 15 and 20 feet bgs, and one soil boring was extended to 20 feet bgs with a sample collected only at 20 feet bgs due to a Geoprobe sample recovery problem (no 15-foot sample). The first 20 soil borings were drilled on a grid in the garden area, as was specified in the SAP. Three soil borings were drilled outside the garden area in areas also specified in the SAP, and the remaining five soil boring locations were placed at locations FOSCs Duncan and Martyn determined during a site walk. The five locations chosen by the FOSCs were chosen based on site features such as depressions visible on the ground; remains of metal containers or debris; and, in the case of sample MR-028, evidence of a rusted piece of a possible drum with adjacent white material on the ground surface that resembled the white precipitate material that was found in the garden area in December 2010. The white material was collected as a sample identified as MR-028-Solid.

All soil samples were submitted to the U.S. EPA Region 9 Laboratory for perchlorate analysis. At U.S. EPA request, six soil samples were also submitted to the laboratory for CAM-17 metals analysis. Appendix A, Figure 3 and Tables 2 and 3 present the locations and analytical results for the soil samples collected.

3.2.2 Groundwater Sampling

The START had planned to collect three groundwater samples at points about the perimeter of the garden area. However, when drilling to depth at the MR-001 sample location on the northwest corner of the garden area, the Geoprobe was unable to push through the dense, rocky material with the Geoprobe Macro Core® system. Two groundwater samples were subsequently collected at new locations specified by the U.S. EPA using the Geoprobe equipped with a smaller-diameter, retractable-screen system, at locations shown on Appendix A, Figure 3. This type of system cannot accurately identify the depth to water. For sample MR-MW-1, the Geoprobe rod was extended to a depth of 42 feet and the screen was exposed from 38 to 42 feet bgs. For sample MR-MW-2, the Geoprobe rod was extended to a depth of 39 feet and the screen was exposed from 35 to 39 feet

bgs. In each case, water was collected using polyethylene tubing equipped with a check valve.

The START also collected a sample from a private, operational groundwater well located near the southwest corner of the northwestern parcel. The sample was given the identifier MR-WS-1. The sample was collected directly from a spigot located on the well head. Because the well was in continuous service supplying water to the Poplar Street residence, no effort was made to purge the well prior to sampling.

All groundwater samples were submitted to the U.S. EPA Region 9 Laboratory for perchlorate analysis. The analytical results are presented in Appendix A, Table 4. The groundwater sampling locations are presented in Appendix A, Figure 3.

3.2.3 Deviations from the SAP

The following deviations from the SAP occurred:

- In addition to perchlorate analysis, at U.S. EPA request, six soil samples were analyzed for CAM-17 metals. The samples analyzed for CAM-17 metals were in some cases chosen for their location near metal debris found on ground surface.
- As described above, five additional soil borings were sampled at locations determined once in the field.
- The prefix "MR" was added to the groundwater sample identifiers.
- Headspace tests for volatile organic compounds (VOCs) using a photoionization detector were only conducted on the deeper soil samples (six feet bgs and greater). No significant VOC concentrations were detected in any of the samples.
- As described above, the location of the groundwater samples as well as the sampling methodology deviated from that which was planned in the SAP. Two groundwater samples were collected using the Geoprobe, and one groundwater sample was collected from the on-site well.

3.2.4 Discussion of March 2011 Sample Results

3.2.4.1 Soil Samples

Soil sample results are presented in Appendix A, Tables 2 and 3. No significant metals concentrations were found in any of the six soil samples analyzed for CAM-17 metals. As was found in most of the December 2010 samples, vanadium concentrations exceeded the RSL for residential soil.

Soil samples from garden area grid locations MR-011, MR-014, MR-015, and MR-019 contained perchlorate at concentrations that exceeded the site-specific action level of 55 mg/kg. These four sampling locations are located in the area of the depression where the white precipitate was found in December 2010. Of the 20 samples collected at these four locations, 11 exceeded the site-specific action

level of 55 mg/kg, and at all four locations, the action level was exceeded in the sample at the maximum depth of the soil boring. As a result, it is unknown to what depth perchlorate contamination exceeds the action level at these locations. The area of these four locations is bounded to the north, east, and west by other sample locations that show that perchlorate has decreased to below the site-specific action level. A dwelling with a slab foundation bounds this area to the south.

Perchlorate was also found to exceed the action level and was unbounded at depth at locations MR-022 and MR-023. These two locations were chosen for sampling because they are within an area showing evidence of potential disposal activities both visible currently (it is the location of a trash pile) and through historical aerial photograph reviews. The area of these two locations was subsequently bounded by additional sampling locations in August 2011, as discussed below.

Sample MR-028 Solid was found to have a concentration of 66,000 mg/kg perchlorate. However, soil samples collected at depth at the MR-028 location did not exceed the site-specific action level for perchlorate, and perchlorate was not detected in the 10-foot-depth sample at that location. To further characterize the MR-028 area, additional sampling at was conducted at U.S. EPA request in August 2011, as discussed below.

3.2.4.2 Groundwater Samples

Groundwater sample results are presented in Appendix A, Table 4, and the groundwater sampling locations are shown in Appendix A, Figure 3. Perchlorate was found in the on-site water well at 2.5 ug/l. Sample MR-MW-1, collected from a location approximately 400 feet southeast of the garden area, was found to contain perchlorate at a concentration of 19 ug/l. Sample MR-MW-2, which was collected from a location immediately west of the garden area, was found to contain perchlorate at a concentration of 110,000 ug/l. The results are indicative that perchlorate contamination in soil in the garden area, combined with the observed heavy watering in the garden area, may be influencing perchlorate concentrations in groundwater. However, insufficient information has been obtained to determine the groundwater gradient and actual depth to water. The depth to water at MR-MW-1 can only be determined to be above or within the range of 38 to 42 feet bgs, and at MR-MW-2 to be above or within the range of 35 to 39 feet bgs. As of the date of this report, the RWQCB does not have information on the screen interval(s) and depth of the on-site well from which sample MR-WS-1 was collected, but it has stated that other wells in the area are generally 150 feet deep and screened from 50 to 150 feet bgs[1]. The U.S. EPA has determined that no further groundwater assessment work will be the conducted by the U.S. EPA ERS because the RWQCB is currently conducting its own groundwater investigation.

[1] Email from Tim Post, Lahontan RWQCB, August 19, 2011.

3.3 August 2011 Sampling Event

Additional sampling was conducted in August 2011 in an attempt to further delineate the extent of perchlorate contamination in soil at the residential site. No samples were collected in the garden area during this sampling event. Heavy watering was again observed in this area, and the START closed all the spigots prior to sampling.

This sampling event was also extended to include the former pyrotechnics manufacturing facility location. A brief SAP Addendum (Appendix F) was prepared to cover the additional sampling activities. The only analyte investigated was perchlorate. The U.S. EPA Region 9 Laboratory conducted the analyses. The sample locations are shown in Appendix A, Figures 3 and 4. The analytical results are presented in Appendix A, Tables 2 and 5.

3.3.1 Poplar Street Location Soil Sampling

During the August 2011 sampling event, the START collected soil samples from sample locations MR-029 through MR-045. Following procedures conducted for the March 2011 sampling event, the samples were collected at depths of 1, 3, 6, and 10 feet bgs. The 1-foot and 3-foot depth samples were collected by hand auger, and all deeper samples were collected from acetate sleeves of soil produced from Geoprobe operations. Three soil borings were extended to 20 feet bgs and sampled at 15 and 20 feet bgs. The START provided personnel to operate the Geoprobe, and a START geologist prepared lithologic logs for all soil borings. The lithologic logs are archived in the project file. All samples were collected into plastic bags, homogenized, and then split in order to provide sample material for testing of a field screening method for perchlorate (see Section 3.3.1.1).

The analytical results are presented in Appendix A, Table 2, and the sample locations are shown in Appendix A, Figure 3. The sample locations were chosen to either:

- Attempt to delineate the horizontal and vertical boundaries of the known perchlorate-contaminated areas at MR-022/MR-023 and at MR-028; or
- Attempt to locate additional areas of perchlorate contamination via judgmental sampling at general areas of the property that were not previously investigated.

Sample locations MR-029, -030, and -031 were placed to surround the MR-028 location at which a perchlorate-contaminated white solid had been found in March 2011. Sample locations MR-032, -033, and -034 were placed to surround March 2011 hot spots MR-022 and -023.

As discussed in Section 3.3.1.1 below, a perchlorate-specific electrode was used in the field by the START to obtain quick-turnaround “screening quality” analytical results. Based on a screening result showing perchlorate in soil at location MR-032-6 (6-foot depth sample) at 290 mg/kg, a concentration that

exceeds the site-specific action level for perchlorate in soil of 55 mg/kg, FOSC Duncan requested that two additional sample locations be added to the northeast and northwest of location MR-032. These two locations, MR-043 and MR-044, were also found to have perchlorate-contaminated soil at levels exceeding the action level.

All other sample locations investigated during the August 2011 sampling event were distributed about the two northern Poplar Street parcels at locations chosen or approved by the U.S. EPA, with the objective of obtaining the best possible areal coverage of the properties, given the resources available.

3.3.1.1 Field Screening of Soil Samples

Prior to the August 2011 sampling activities, the START acquired an ion-specific electrode (ISE) for perchlorate and developed a "field-friendly" analytical screening method for the determination of perchlorate concentrations in soil. The investigation and testing of a screening method was approved by FOSC Duncan so that, should a removal action take place at the site in the future, the screening method might be used to obtain quick-turnaround results that could expedite the removal process. The START was able to analyze 24 soil samples while in the field before the ISE became unstable and unusable due to unknown causes. A comparison of START screening results to the U.S. EPA Region 9 Laboratory results is provided in Appendix G. The comparison shows the screening method to be highly comparable to the laboratory data when all available data are plotted, with a correlation coefficient of 0.9788. However, when a single, higher-concentration sample (MR-032-6) is removed from the comparison in order to evaluate the accuracy of the ISE in the 0 – 100 mg/kg range, the correlation falls to 0.867.

The ISE was returned to the manufacturer for testing to determine the cause of its failure. The manufacturer determined that the reference electrode portion of the probe had failed due to an unknown cause, and the ISE is currently undergoing repair under warranty. The U.S. EPA Region 9 Laboratory also had difficulties with analyzing some of the samples, due to an unknown contaminant in the soil that caused matrix interference. Because of the interference, the method detection limit for perchlorate in some of the samples analyzed by the laboratory had to be raised. It is currently unknown whether the cause of the interference may also have been the cause of the ISE failure.

3.3.2 Former Pyrotechnics Manufacturing Facility Location

At FOSC Duncan's request, on August 3, 2011, the START collected soil samples from eight locations within the former pyrotechnics manufacturing facility. The locations were chosen by FOSC Duncan based upon information provided by a former worker at the former facility, who met the U.S. EPA and the START at the site.

Following the same procedures conducted at the residential property, the samples were collected at depths of 1, 3, 6, and 10 feet bgs. The 1-foot and 3-foot depth

samples were collected by hand auger, and all deeper samples were collected from acetate sleeves of soil produced from Geoprobe operations. START personnel operated the Geoprobe, and a START geologist prepared lithologic logs for all soil borings. The lithologic logs are archived in the project file. All samples were collected into plastic bags, homogenized, and then split in order to provide sample material for testing of the field screening method for perchlorate.

The sample locations are presented in Appendix A, Figure 4, and the analytical results are presented in Appendix A, Table 5.

3.3.3 Discussion of August 2011 Soil Sampling Results

3.3.3.1 Poplar Street Location

No samples exceeded the site-specific action level for perchlorate in soil, with the exception of some of the samples from locations MR-032, MR-043, and MR-044. The results show that perchlorate contamination in the area of MR-022/MR-023 extends toward the north and decreases in concentration with distance. The MR-043-6 (6-foot depth sample) result is indicative that perchlorate contamination originated in the area of MR-022/MR-023 and has diffused downward to the north. The boundary of perchlorate contamination in soil that is above the site-specific action level of 55 mg/kg was not completely defined vertically or laterally by the August 2011 sampling activities.

3.3.3.2 Former Pyrotechnics Manufacturing Facility Location

None of the samples collected from the former pyrotechnics manufacturing facility exceeded the 55 mg/kg site-specific action level for perchlorate in soil. The only detections of perchlorate found were from location MFAC-006, where the maximum perchlorate concentration found was 7.8 mg/kg. The MFAC-006 location is just north of a concrete loading dock area that dates back to the time of the facility's operations.

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4 Estimate of Removal Volumes

A rough estimate of the removal volume required to remove perchlorate-contaminated soil in the garden area and in the MR-022/MR-023 area to below the 55 mg/kg action level threshold is in the range of 4,400 to 10,100 cubic yards. The assumptions used to determine these volumes are presented in Appendix H.

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5 Conclusions and Recommendations

Over the period December 2010 through August 2011, the START conducted assessment activities at a former pyrotechnics manufacturing facility and at the former residence of the owner of the facility. Significant (up to 130,000 mg/kg, or 13 percent) perchlorate contamination was found in soil at the former residence location, in an area termed the "garden area." Perchlorate was also found at the former residence location in an area showing evidence of dumping activities, at up to a concentration of 590 mg/kg. A groundwater sample collected adjacent to the garden area was found to contain perchlorate at a concentration of 110,000 ug/l. Soil and groundwater sample results indicate that part of the garden area is highly contaminated with perchlorate, and that excessive watering in the area is likely accelerating the leaching of perchlorate from the soil into groundwater.

No significant perchlorate contamination was found in soil at the former pyrotechnics manufacturing facility.

A removal of the contaminated soil in the garden area and in the area showing evidence of dumping activities is recommended, in order to reduce the threat these areas pose to groundwater.

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6 References

1. California Department of Public Health (CDPH), 2011. *Perchlorate in Drinking Water*. Available online at: http://www.cdph.ca.gov/certlic/drinkingwater/pages/Perchlorate.aspx

2. California Division of Mines and Geology (CDMG), 1986. Bortugno, E. J. and Spittler, T. E., *Geologic Map of the San Bernardino Quadrangle, Regional Geologic Map Series*, Map No. 3A, 1:25,000 scale.

3. U.S. Environmental Protection Agency (EPA), 1990. *Quality Assurance/Quality Control Guidance for Removal Activities, Sampling QA/QC Plan and Data Validation Procedures.*

4. EPA, 2001. *U.S. EPA Region IX Superfund Data Evaluation/Validation Guidance R9QA/006*

5. EPA, 2004. *USEPA Contract Laboratory Program, National Functional Guidelines for Inorganic Data Review*, USEPA-540-R-04-004. October.

6. EPA, 2011. *Regional Screening Level (RSL) Resident Soil Table June 2011*. Available online at: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/pdf/ressoil_sl_table_run_JUN2011.pdf.

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A Figures and Tables

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Project # 002693.2124.01RA
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Source: ESRI Streetmaps

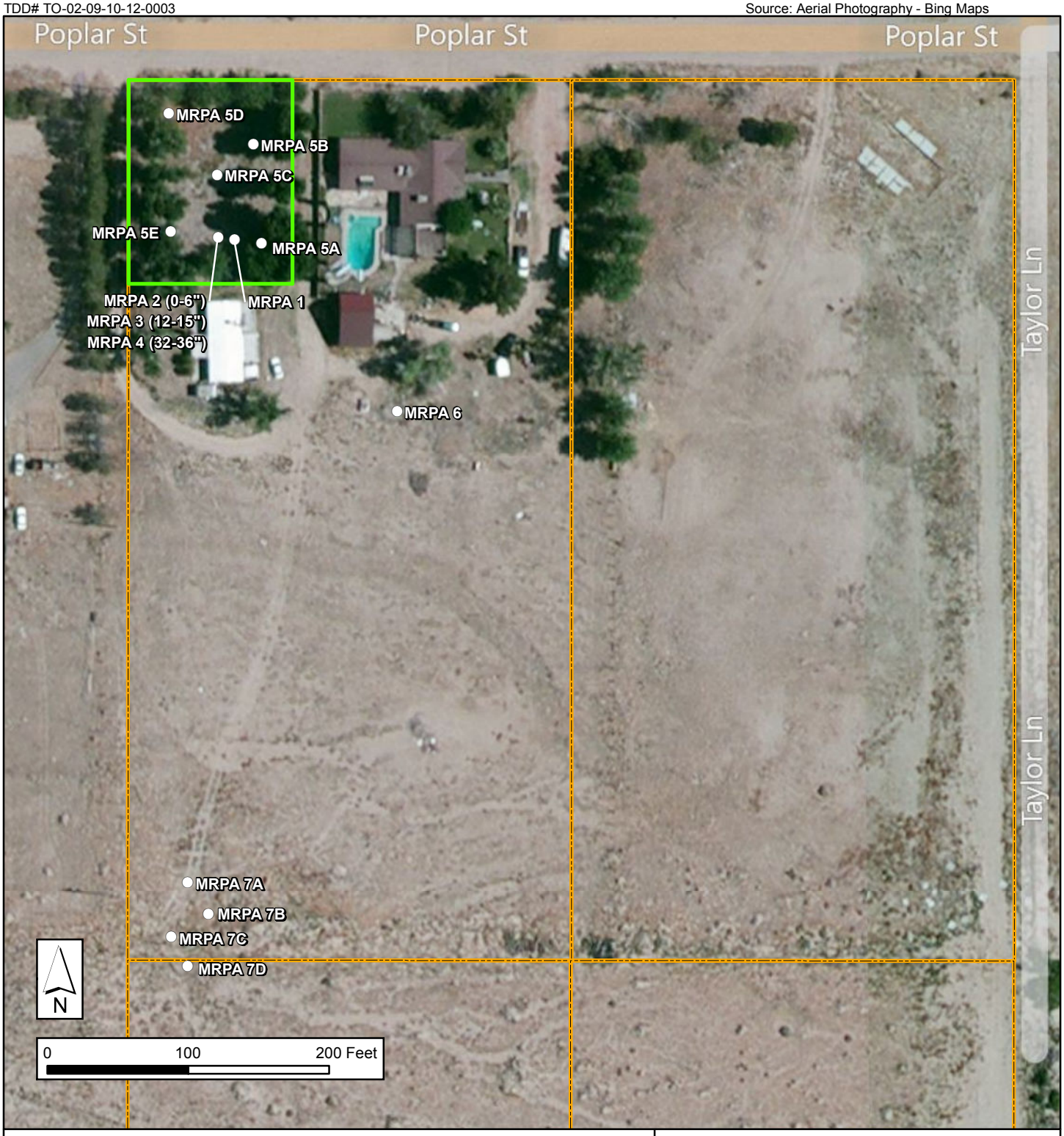
ecology and environment, inc.
International Specialists in the Environment

Figure 1

Site Location Map
Mojave River Pyrotechnics Assessment
Barstow, San Bernardino County, California

Project # 002693.2124.01RA
TDD# TO-02-09-10-12-0003

Source: Aerial Photography - Bing Maps



LEGEND

- Soil sampling location
- Garden area
- Parcel boundary

Figure 2
December 20, 2010 Poplar Street Sampling Locations
Mojave River Pyrotechnics Assessment
30433 Poplar Street
Barstow, San Bernardino County, California

ecology and environment, inc.
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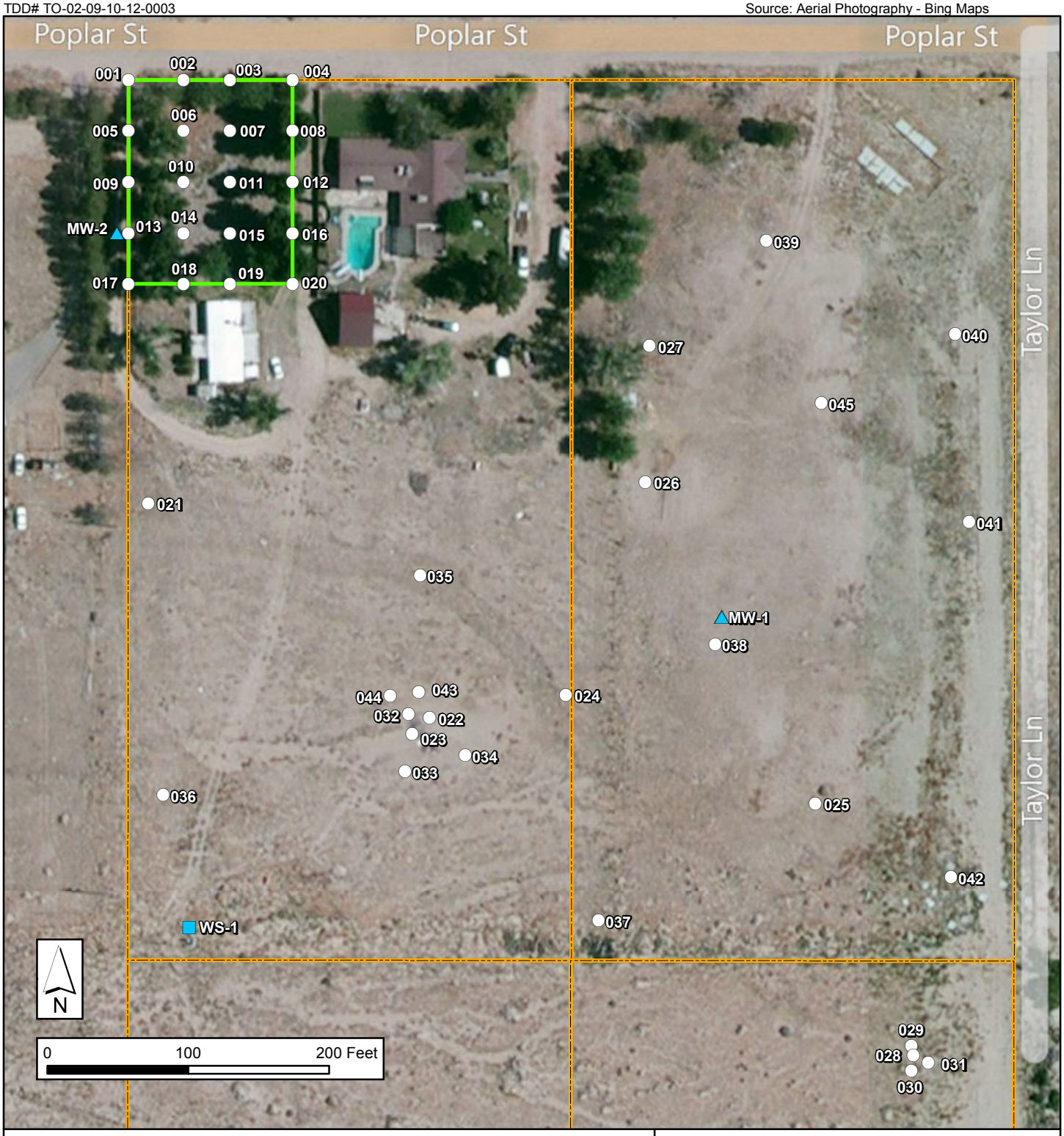
Project # 002693.2124.01RA
TDD# TO-02-09-10-12-0003

Source: Aerial Photography - Bing Maps



LEGEND

- Geoprobe water sampling location
- Geoprobe soil boring sampling location
- Residential water well
- Garden area
- Parcel boundary

NOTE

Sample location IDs have been truncated.
For example 001 = MR-001

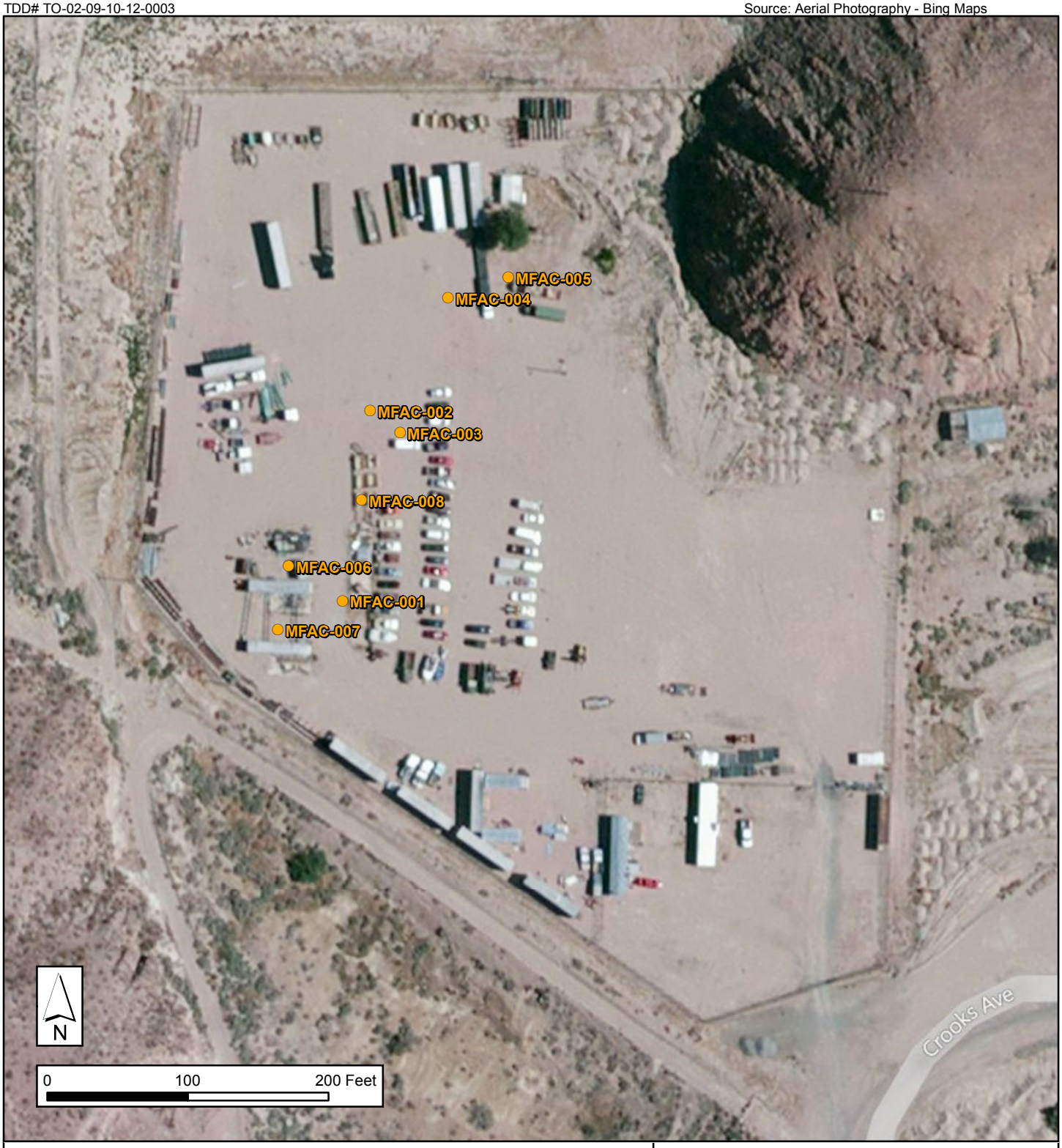
Water samples and soil sample locations 001 through 028 collected in March 2011.
Soil sample locations 029 through 045 collected in August 2011.

Figure 3
March and August 2011 Poplar Street Sampling Locations
Mojave River Pyrotechnics Assessment
30433 Poplar Street
Barstow, San Bernardino County, California

ecology and environment, inc.
International Specialists in the Environment

Project # 002693.2124.01RA
TDD# TO-02-09-10-12-0003

Source: Aerial Photography - Bing Maps



LEGEND

- Geoprobe soil boring sampling location

Figure 4

Sample Locations
Former Fireworks Manufacturing Facility
Mojave River Pyrotechnics Assessment
36131 N. Yucca Street
Barstow, San Bernardino County, California

ecology and environment, inc.
International Specialists in the Environment

Table 1
December 2010 Analytical Results, Poplar Street Location
30433 Poplar Street, Barstow Location

Samples Collected December 20, 2010
mg/kg

TDD No. 02-09-10-12-0003 E&E Project No. 002693.2124.01RA

Analyte	RSL	MRPA-1	MRPA-2	MRPA-3	MRPA-4	MRPA-5	MRPA-6	MRPA-7
Perchlorate	55	**130,000**	**120**	**120,000**	**4,800**	36	2.9	2.3
Nitrate (as N)	130,000	<1.1 UJ	<1.2 UJ	15 J	<1.0 UJ	83 J	25 J	3.3 J
Sulfate	none	8.8	6.8	71	<5.2	410	260	120
Mercury	10	0.026	0.016	0.017	<0.026	0.031	<0.031	<0.029
Antimony	31	<2.3	<2.2	<2.1	<2.1	<2.3	<2.5	<2.3
Arsenic	0.39	12	1.9	10	<2.1	2.4	<2.5	2.5
Barium	15,000	16	91	16	15	120	92	87
Beryllium	160	<0.11	0.29	0.07	0.10	0.31	0.19	0.24
Cadmium	70[1]	<0.57	<0.54	<0.53	<0.52	<0.58	<0.62	<0.58
Chromium	120,000[2]	17	7.5	13	2.6	8.4	5.8	9.6
Cobalt	23	1.1	4.1	1.1	1.1	4.2	2.7	4.4
Copper	3,100	6.4	6.3	4.5	<4.1	8.0	17	12
Lead	400	2.3	2.6	1.7	<3.1	4.2	4.8	17
Molybdenum	390	<5.7	<5.4	<5.3	<5.2	<5.8	<6.2	<5.8
Nickel	3,700[3]	62	4.6	43	<5.2	5.0	3.7	5.7
Selenium	390	<2.3	<2.2	<2.1	<2.1	<2.3	<2.5	<2.3
Silver	390	<1.1	<1.1	<1.1	<1.0	<1.2	<1.2	<1.2
Thallium	none	<5.7	<5.4	<5.3	<5.2	<5.8	<6.2	<5.8
Vanadium	5.5	4.0	24	5.7	6.9	26	17	20
Zinc	23,000	8.4	34	9.1	8.3	45	61	36

J: Estimated concentration
mg/kg: Milligrams per kilogram
RSL: U.S. EPA Regional Screening Level for Residential Soil
UJ: Not detected above approximated reporting limit
[1] - Dietary
[2] - No RSL for total chromium in soil. Reported concentration is for Chromium (III) insoluble salts
[3] - As refinery dust
Results in **bold** exceed the RSL

Table 2
March and August 2011 Perchlorate Analytical Results in Soil, Poplar Street Location
30433 Poplar Street, Barstow Location
Mojave River Pyrotechnics Assessment
Samples Collected March 21 - 24, 2011 (MR-001 through MR-028)
and August 1 - 3, 2011 (MR-029 through MR-045)
mg/kg

TDD No. 02-09-10-12-0003 E&E Project No. 002693.2124.01RA

Sample ID	Perchlorate
MR-001-1	0.050
MR-001-3	0.17
MR-001-6	0.029
MR-001-10	<0.026
MR-001-20	<0.021
MR-002-1	0.089
MR-002-3	0.034
MR-002-6	0.040
MR-002-10	0.070
MR-003-1	0.20
MR-003-3	0.095
MR-003-6	0.17
MR-003-10	0.013 J
MR-004-1	0.066
MR-004-3	1.8 J
MR-004-6	3.8 J
MR-004-10	0.057 J
MR-005-1	0.045
MR-005-3	0.59
MR-005-6	<0.023
MR-005-10	<0.024
MR-006-1	0.059
MR-006-3	0.11
MR-006-6	0.83 J
MR-006-10	0.21 J
MR-007-1	0.26
MR-007-3	0.038
MR-007-6	0.88 J
MR-007-10	0.11 J
MR-008-1	0.050
MR-008-3	<0.021
MR-008-6	<0.023
MR-008-10	0.029 J
MR-009-1	<0.021
MR-009-3	0.019 J
MR-009-6	0.13
MR-009-10	<0.024
MR-010-1	1.4
MR-010-3	11
MR-010-6	0.18 J
MR-010-10	1.7 J
MR-011-1	1.9
MR-011-3	1.3
MR-011-6	0.20 J
MR-011-10	**110 J**
MR-012-1	4.5
MR-012-3	0.44
MR-012-6	0.028 J
MR-012-10	<0.027 UJ

Sample ID	Perchlorate
MR-013-1	0.41
MR-013-3	0.28
MR-013-6	0.022
MR-013-10	0.33
MR-014-1	0.48
MR-014-3	1.2
MR-014-6	**380 J**
MR-014-10	**220 J**
MR-014-15	**230 J**
MR-014-20	**230 J**
MR-015-1	**64**
MR-015-3	18
MR-015-6	**540 J**
MR-015-10	**560 J**
MR-015-15	**250 J**
MR-015-20	**300 J**
MR-016-1	5.6
MR-016-3	0.083
MR-016-6	0.027 J
MR-016-10	<0.026 UJ
MR-017-1	<0.022
MR-017-3	0.034
MR-017-6	0.051
MR-017-10	<0.020
MR-018-1	0.063
MR-018-3	0.032
MR-018-6	0.061 J
MR-018-10	1.3 J
MR-019-1	1.3
MR-019-3	0.44
MR-019-6	30 J
MR-019-10	**120 J**
MR-020-1	0.60
MR-020-3	0.65
MR-020-6	3.0 J
MR-020-10	0.53 J
MR-021-1	<0.020 UJ
MR-021-3	0.013 J
MR-021-6	0.031 J
MR-021-10	<0.020 UJ
MR-022-1	19 J
MR-022-3	**100 J**
MR-022-6	**270 J**
MR-022-10	**180 J**
MR-023-1	**300 J**
MR-023-3	**180 J**
MR-023-6	**590 J**
MR-023-10	**340 J**

Sample ID	Perchlorate
MR-024-1	0.4 J
MR-024-3	8.7 J
MR-024-6	14 J
MR-024-10	<0.020 UJ
MR-025-1	0.055 J
MR-025-3	0.28 J
MR-025-6	0.12 J
MR-025-10	0.033 J
MR-026-1	<0.021 UJ
MR-026-3	0.69 J
MR-026-6	0.059 J
MR-026-10	0.018 UJ
MR-027-1	0.15 J
MR-027-3	1.2 J
MR-027-6	0.35 J
MR-027-10	<0.021 UJ
MR-028-Solid*	**66000 J**
MR-028-1	0.23 J
MR-028-3	29 J
MR-028-6	11 J
MR-028-10	<0.021 UJ
MR-029-1	<1.0
MR-029-3	<1.0
MR-029-6	2.0
MR-029-10	<1.0
MR-030-1	1.2
MR-030-3	<1.0
MR-030-6	<1.0
MR-030-10	<1.0
MR-031-1	<1.0
MR-031-3	<1.1
MR-031-6	19
MR-031-10	<1.0
MR-032-1	17 J
MR-032-3	20 J
MR-032-6	**280**
MR-032-10	**89**
MR-032-15	29
MR-032-20	16
MR-033-1	0.39
MR-033-3	46
MR-033-6	7.0
MR-033-10	<0.021
MR-033-15	<0.020
MR-033-20	<0.021

Sample ID	Perchlorate
MR-034-1	0.30
MR-034-3	1.7
MR-034-6	15
MR-034-10	21
MR-034-15	<0.021
MR-034-20	<0.021
MR-035-1	2.8
MR-035-3	1.7
MR-035-6	<0.41
MR-035-10	0.78
MR-036-1	<1.0
MR-036-3	<1.1
MR-036-6	<0.43
MR-036-10	<0.41
MR-037-1	<0.42
MR-037-3	0.21
MR-037-6	3.1
MR-037-10	<1.0
MR-038-1	0.46
MR-038-3	1.0
MR-038-6	<1.0
MR-038-10	<1.0
MR-039-1	2.5
MR-039-3	1.1
MR-039-6	<1.0
MR-039-10	<1.0
MR-040-1	<1.0
MR-040-3	0.99
MR-040-6	<1.0
MR-040-10	<1.0
MR-041-1	<1.0
MR-041-3	<1.0
MR-041-6	0.67
MR-041-10	<1.0
MR-042-1	2.4
MR-042-3	1.1 J
MR-042-6	1.0
MR-042-10	<1.0
MR-043-1	0.80
MR-043-3	6.0
MR-043-6	**170**
MR-043-10	1.4
MR-044-1	1.4
MR-044-3	**100**
MR-044-6	19
MR-044-10	<1.0
MR-045-1	<1.0
MR-045-3	<1.0
MR-045-6	<1.0
MR-045-10	<1.0

Notes:
mg/kg = Milligrams per kilogram
J = Estimated concentration
UJ = Not detected above approximated reporting limit
* - White solid crystalline substance found near possible disintegrating drum
USEPA Regional Screening Level for perchlorate in soil is 55 mg/Kg

Results in **bold** exceed site-specific action level of 55 mg/kg

Table 3
March 2011 CAM-17 Metals Results, Poplar Street Location
30433 Poplar Street, Barstow Location
Mojave River Pyrotechnics Assessment
Samples Collected March 21 - 24, 2011
mg/kg

TDD No. 02-09-10-12-0003 E&E Project No. 002693.2124.01RA

Analyte	RSL	MR-022-3	MR-025-1	MR-025-3	MR-026-1	MR-026-3	MR-027-3
Antimony	31	<2.1	<2	<2	<2.1	<2	<2.1
Arsenic	0.39	<2.1	<2	<2	<2.1	<2	<2.1
Barium	15,000	36	61	13	75	17	32
Beryllium	160	0.17	0.23	0.08	0.26	0.09	0.15
Cadmium	70[1]	<0.53	<0.51	<0.51	<0.51	<0.51	<0.53
Chromium	none	5.5	6.1	1.7	6.6	2.1	4.2
Cobalt	23	2.5	3.3	<2	3.6	<2	1.8
Copper	3,100	4.1	5.0	<4.1	5.2	<4.1	3.0
Lead	400	<3.2	2.3	<3.1	2.0	<3.1	1.6
Mercury	10	<0.027	0.015	<0.025	0.016	0.15	<0.026
Molybdenum	390	<5.3	<5.1	<5.1	<5.1	<5.1	<5.3
Nickel	3,700[2]	3.0	3.7	<5.1	4.1	<5.1	<5.3
Selenium	390	<2.1	<2	<2	<2.1	<2	<2.1
Silver	390	<1.1	<1	<1	<1	<1	<1.1
Thallium	none	<5.3	<5.1	<5.1	<5.1	<5.1	<5.3
Vanadium	5.5	18	21	6.2	25	7.1	13
Zinc	23,000	18	25	6.8	26	7.2	14

Notes:
CAM-17: 17 California Assessment Manual metals
mg/kg: Milligrams per kilogram
RSL: U.S. EPA Regional Screening Level for Residential Soil
[1] - Dietary
[2] - As refinery dust

Table 4
Analytical Results
Perchlorate in Groundwater
30433 Poplar Street, Barstow Location
Mojave River Pyrotechnics Assessment
Samples Collected March 2011
ug/l

TDD No. 02-09-10-12-0003 E&E Project No. 002693.2124.01RA

Sample ID	Perchlorate	Description
MR-WS-1	2.5	Collected from extant well located near the southwest corner of the northwestern residential parcel.
MR-MW-1	19	Discrete sample collected by Geoprobe from location 390 feet southeast of garden area.
MR-MW-2	110,000	Discrete sample collected by Geoprobe from location in driveway immediately west of garden area.

Notes:
ug/l = micrograms per liter
MR-MW-1 was screened from 38 to 42 feet bgs, but water could have infiltrated from above the screen. Depth to water is not known.
MR-MW-2 was screened from 35 to 39 feet bgs, but water could have infiltrated from above the screen. Depth to water is not known.
The site-specific action level is 6 ug/l.

Table 5
August 2011 Perchlorate Results, Former Fireworks Manufacturing Facility
36131 N. Yucca Street, Barstow
Mojave River Pyrotechnics Assessment
Samples Collected August 3, 2011
mg/kg

TDD No. 02-09-10-12-0003 E&E Project No. 002693.2124.01RA

Sample ID	Perchlorate	Sample ID	Perchlorate
MFAC-001-1	<1.0	MFAC-005-1	<1.1
MFAC-001-3	<1.2	MFAC-005-3	<1.0
MFAC-001-6	<1.1	MFAC-005-6	<1.0
MFAC-001-10	<1.1	MFAC-005-10	<1.1
MFAC-002-1	<1.0	MFAC-006-1	<1.1
MFAC-002-3	<1.1	MFAC-006-3	7.8
MFAC-002-6	<1.0	MFAC-006-6	5.5
MFAC-002-10	<1.0	MFAC-006-10	0.86
MFAC-003-1	<1.0	MFAC-007-1	<1.1
MFAC-003-3	<1.0	MFAC-007-3	<1.1
MFAC-003-6	<1.0	MFAC-007-6	<1.1
MFAC-003-10	<1.0	MFAC-007-10	<1.0
MFAC-004-1	<1.1	MFAC-008-1	<1.1
MFAC-004-3	<1.0	MFAC-008-3	3.2
MFAC-004-6	<1.0	MFAC-008-6	<1.0
MFAC-004-10	<1.1	MFAC-008-10	<1.0

Notes:
mg/kg = Milligrams per kilogram
USEPA Regional Screening Level for perchlorate in soil is 55 mg/Kg

B Laboratory Data Sheets

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C Photo Documentation

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ECOLOGY AND ENVIRONMENT, INC.
Superfund Technical Assessment and Response Team
Mojave River Pyrotechnics Assessment
Barstow, California

E&E Project. No.: 002693. 2124.01RA

TDD No: TO2-09-10-12-0003
Contract No. EP-S5-08-01

PHOTO 1

Date: 12/20/10

Direction: N/A

Photographer: M. Schwennesen, START

Description: White crystalline material found just below the surface in the garden area of the Poplar Street property. The material was found to contain 13 percent perchlorate.

PHOTO 2

Date: 3/23/11

Direction: West

Photographer: M. Schwennesen, START

Description: Groundwater sample MR-MW-1 being collected.

E&E Project. No.: 002693. 2124.01RA

TDD No: TO2-09-10-12-0003
Contract No. EP-S5-08-01

PHOTO 3

Date: 3/24/11

Direction: North

Photographer: M. Schwennesen, START

Description: Geoprobe set at MR-MW-2 groundwater sampling location.

PHOTO 4

Date: 8/3/11

Direction: West

Photographer: M. Schwennesen, START

Description: Geoprobe drilling in progress at MFAC-007 location. The concrete loading ramp and (flagged) MFAC-001 sampling location are in the foreground.

E&E Project. No.: 002693. 2124.01RA

TDD No: TO2-09-10-12-0003
Contract No. EP-S5-08-01

PHOTO 5

Date: 3/23/11

Direction: Southwest

Photographer: M. Schwennesen, START

Description: Geoprobe drilling in progress at MR-023 location.

PHOTO 6

Date: 8/2/11

Direction: N/A

Photographer: R. Clemens, START

Description: START member M. Diener performing "field" soil analysis for perchlorate in local hotel room.

D ER-QASP

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EPA Emergency Response Section (ERS)
And Superfund Technical Assessment and Response Team (START)

Emergency Response and Time Critical
Quality Assurance Sampling Plan
For
Soil, Water and Miscellaneous Matrix Sampling

Response Location: Poplar Street and Taylor Lane, Barstow, California

Site Name: Mojave River Pyrotechnics Assessment

E&E Project No. TBD

Date: December 17, 2010

Prepared by: M.Tymkow

Reviewed by: M. Schwennesen

Approved by:
This sampling plan was prepared and delivered to the EPA OSC prior to sampling

This emergency sampling plan is intended to be used in conjunction with the EPA Region 9 Emergency Response Section's Generic Data Quality Objectives (DQOs) for Emergency Responses and Time Critical Evaluations. This sampling plan has been designed to assist field responders in their preparation for collecting, analyzing, shipping, storing and handling samples collected during an emergency response. The use of this generic sampling plan will involve forethought and planning that should help direct the sampling and analytical work. It is meant to be used in the case of emergency responses or time-critical responses when sampling teams may not have the opportunity to write a more thorough sampling plan. Sampling teams should always reference standard quality procedures, standard operations procedures, standard methods for sampling and analytical guidance.

The development of this generic plan will improve the documentation, communication, planning, and overall quality associated with the sampling and analysis by:

1) encouraging field teams to consider their goals and objectives before the generation of environmental data,
2) documenting predetermined information in a standardize format,
3) increasing the communication between sampling personnel and decision makers, and
4) detailing expectations and objective before samples are collected.

1.0 Introduction and Background. ***Describe the site and specify the geographic boundaries for the site and any specific areas of concern***. *What is the problem, what precipitated the response, which agencies and other entities (e.g., contractors) are on site, who has taken the lead for the response and for environmental clean-up actions?*

Site geographic boundaries will not be known until a site visit is conducted. The site is the former home of an owner of a fireworks manufacturing company. There has been speculation that the owner may have disposed of chemicals on his property, and the California Regional Water Quality Control Board, Lahontan Region (RWQCB), has requested EPA assistance. The RWQCB is concerned about elevated perchlorate concentrations found in groundwater wells near the site. The EPA will conduct a site visit, and may collect composite surface soil samples if the EPA representative determines that sampling is warranted.

2.0 Objectives. *Brief statement on the general project objective. What is the overall goal or objective? Specific objectives are summarized in Table D.*

IF SOIL SAMPLING IS DIRECTED BY THE EPA:

The objective of the sampling will be to determine the presence or absence of perchlorate and/or California Assessment Manual (CAM) metals in significant concentrations in site soil. If significant concentrations are found, additional soil sampling will be conducted at a later date under a revised ER-QASP in order to determine the boundaries of the contamination. The EPA will be responsible for the determination of whether a concentration of a particular analyte is "significant."

2.1 Data Use Objectives. (How will the data be used?)

Data that are generated will be used: (Select Appropriate Boxes)

1		To be compared with a background or reference sample(s).
2		To be compared with an available detection or quantification level.
3	X	To assist in determining the presence or absence of a hazardous material or substance at levels above an available detection or quantification level.
4		To assist with determining the area of impact due to a hazardous material release. (i.e., horizontal and lateral extent).
5	X	To be compared with site-specific action levels or risk-based action levels (e.g., EPA PRGs) to assist in determination if health threats exist.
6		As definitive confirmatory data for confirmation of non-definitive (screening) data.
7		Other objectives:

2.2 Sampling Objectives. (What are you proposing to do?)

1	X	Sampling to determine only the presence or absence of a hazardous substance within the area of concern.
2	X	Sampling to estimate: X contamination levels within the area of concern. contamination area(s) within a site.
3	X	Sampling to determine the location of hot spots within the area of concern..
4		Surface soil sampling to estimate the lateral extent of contamination of specific source area(s) or areas of concern over entire site
5		Sub-surface sampling to estimate the vertical extent of contamination of specific source area(s) or areas of concern over entire site.
6		Sampling off site to determine:

2.3 Sample Matrices

1	X	Surface soils
2		Subsurface soil Depth(s):
3		Surface water
4		Groundwater Depth(s):
5		Other aqueous matrices Please specify:
6		Wipe samples
7		Biota Please specify:
8		Other matrices:

Please note: Please use other QASPs for air and containerized samples.

2.4 Data Type

In general, data type and data needs should be decided prior to data generation. The data can be generally divided into three categories: definitive methodology data (generally data generated using standardize methods), non-definitive methodology data (also referred to as screening data) and screening data with at least 10% definitive conformation. The generation of definitive data is preferable, however in emergency and time critical situations where definitive data is not available, non-definitive data should be generated. Note that the data type is not an indicator of precision, accuracy or documentation completeness, or quality! Reported data should be verified (by a party other than the laboratory) as meeting specific quality control and data category requirements by following a verification or validation procedure. Refer to the START or ERS Quality Assurance Plans for specific quality parameters and requirements.

Check appropriate box(es):

1	Screening data will be generated. The data by itself may not be verifiable. **Due to the time critical situation, the data must be reported and may be used to make decisions.**
2a	Screening data with at least 10 percent definitive data will be generated. Data using non-definitive analytical methodologies will be generated. **Due to the time critical situation, the data must be reported and may be used to make decisions prior to generation of definitive data.** The screening data by itself may not be verifiable. Screening data will be evaluated and reported with definitive data at a later time.

2b Screening data with 10 percent definitive data will be generated. Data using non-definitive analytical methodologies will be generated. **Data will not be reported until it is evaluated against definitive data.**

3a Definitive data will be generated. The sampling and analysis must be done on an emergency basis. **Due to the time critical situation, the preliminarily data must be reported and used for comparison without validation. Analytical data packages will be required**. **However, since the data was not used or intended for decision making, validation of the data package will not be performed.** (Document generic DQO deviation in Section 4.4)

3b X Definitive data will be generated. The sampling must be done on an emergency basis. **Due to the time critical situation, preliminary data must be reported and may be used to make decisions without validation. The generated analytical documentation packages will be reviewed and validated. Qualified data will be reported after validation.**

3c Definitive data will be generated. **Full documentation will be required. Analytical data packages will be reviewed and validated prior to reporting.**

2.5 Contaminants of Concern

Potential contaminants of potential concern (COPC), proposed analytical method, proposed action levels and available reporting limit are summarized in Table A.

Table A
Contaminants of Concern

Potential COC	Proposed Analytical Method	Proposed Action Level	Available Reporting Limit
Perchlorates	EPA Method 314.0	None*	TBD
CAM Metals (17 metals)	EPA Methods 6010/7473	None*	TBD
Nitrate/Sulfate	EPA 300 Series	None*	TBD
*None = action level will be determined after initial sample results are reviewed			
Other Data Collection Activity (non-chemical) *(circle all that apply)*	**GPS** Visual Interviews Magnetometer Other Geophysical Modeling **Photography** File Search		

Add additional pages if necessary.

3.0 Approach and Sampling Methodologies

3.1 Sampling Approach

Indicate sampling approaches to be used (select approach)

1		Due to the lack of site information the approach will be determined in the field based on professional judgment of START.
2	X	Due to the lack of site information the approach will be determined in the field based on professional judgment of US EPA.
3		Due to the lack of site information the approach will be determined in the field based on professional judgment of local regulator.
4	X	Judgmental (Biased)
5		Random
6		Systematic
7		Transects
8		Search-Grid

If a search-grid, specify grid type (circle one): Square Triangle Rectangle

Size of contamination hot-spot to be detected:

Shape of hot-spot (circle one): Circle Elliptical Elongated-Elliptical

Required Grid Spacing:

Acceptable probability of missing hot-spot (circle one): 5 % 10 % 20% 40%

3.2 Field Analysis Equipment

Field analysis equipment requirements are summarized in Table B1.

Table B1
Field Analytical Equipment

Analysis Equipment Specify the field analytical procedures to be used. Select the appropriate boxes.	**Model**	**Analyses**	**Matrix**	**Resource/Contractor**
X-Ray Fluorescence (XRF) Device [for metals]				
Lumex (XRF) Mercury Instrument				
Oil Analysis Kit [for oils]				
Immunoassay Test Kits [pesticides, oils, chlorinated substances]				
Chlor-N-Soil/Chlor-N-Oil test kits[PCBs, chlorinated substances]				
pH Meter				
Other field test kits [for pesticides]				
Radiation Meter (such as Victoreen)	Eberline R020			EPA
Multi-gas Monitor	MultiRAE PLUS PGM-50			EPA

3.3 Field Sampling Equipment

Field equipment requirements are summarized in Table B2.

Table B2
Field Sampling and Decontamination Equipment

Analyses and Matrix	Sampling Equipment	Dedicated or Reusable	Decontamination Solution	Resource/ Contractor
Soil	Plastic scoops or spoons	Dedicated	N/A	START

Add additional pages if necessary.

3.4 Field Methods and Procedures

3.4.1 Sample Locations. Indicate the sampling location name, describe location, and indicate rationale for each sample location chosen.

If collected, samples MRPA-1 through (up to) MRPA-10 will be grab or composite samples, as directed by the EPA.

Sample locations will be determined in the field.

Add additional pages if necessary.

Sketch a map of the site and any areas of concern. Indicate sampling locations or sampling areas in Figure A and included names. Use a scale that is meaningful for the sampling work covered under this plan. Sketch out where the samples will be collected and include sampling location names. Attach a local map to this plan if it is available.

Figure A **Sample Location Map**
A site map will not be available until a site visit is conducted.

Add additional maps if necessary.

3.4.2 Sample Labeling and Documentation

Sample Jar Labels

Sample labels will clearly identify the particular sample and should include the following:

1. Site name
2. Time and date samples were taken
3. Sample preservation
4. Analysis requested
5. Sample location and/or identification number

Sample labels will be securely affixed to the sample container.

Chain of Custody Record

A chain of custody record will be maintained from the time the sample is taken to its final deposition. Every transfer of custody must be noted and signed for, and a copy of this record kept by each individual who has signed. When samples (or groups of samples) are not under direct control of the individual responsible for them, they must be stored in a secured container sealed with a custody seal.

The chain of custody record should include (at minimum) the following:

1. Sample identification number
2. Sample information
3. Sample location
4. Sample date and time
5. Names(s) and signature(s) of sampler(s)
6. Signature(s) of any individual(s) with control over samples

Custody Seals

Custody seals demonstrate that a sample container has not been tampered with or opened. The individual in possession of the sample(s) will sign and date the seal, affixing it in such a manner that the container cannot be opened without breaking the seal. The name of this individual, along with a description of the samples= packaging, should be noted in the field book.

All sample documents will be completed legibly in ink. Any corrections or revisions will be made by lining through the incorrect entry and by initialing the error. These include the logbooks, the chain of custody forms, this field QASP and any other tracking forms.

Field Logbook

The field logbook is essentially a descriptive notebook detailing site activities and observations so that an accurate account of field procedures can be reconstructed in the writer's absence. All entries will be dated and signed by the individuals making the entries and will include the following:

1. Site name and project number
2. Names of sampling personnel
3. Dates and times of all entries (military time preferred)
4. Descriptions of all site activities, especially sampling start and ending times. Include site entry and exit times
5. Noteworthy events and discussions
6. Weather conditions
7. Site observations
8. Identification and description of samples and locations
9. Subcontractor information and names of on-site personnel
10. Date and time of sample collections, along with chain of custody information
11. Record of photographs
12. Site sketches
13. Exact times of various activities and occurrences related to sampling
14. Deviations from standard procedures or methods and the rational for the deviations.

3.4.3 Sample Containers and Preservatives

Containers and preservatives are summarized in Table C.

Table C
Containers and Preservatives

Analyses and Matrix	Container Type (per sample)	Preservation Method	Holding Time
Perchlorates in soil	1 x 4-oz jar	ice	28 days
CAM metals in soil			6 months 28 days (Hg)
Nitrate/Sulfate in soil			ASAP/28 days
ASAP = as soon as possible			

Add additional pages if necessary.

3.5 Analytical Methods and Procedures

The analytical methods per sample and sample location are presented in Table D. General field QC considerations and requirements are presented in Table E.

Table D
Sample Locations and Data Objective
Summary

Sampling Locations and Identifiers should correspond to location indicated on Figure A

Sample Location(s) (should match with 3.3.1 and Figure A)	**Sample Identifiers**	**Analytical Method** Refer to Table A	**Data Use Objective(s)** Refer to Section 2.1	**Data Category** Refer to Section 2.3	**Samples Matrix**
See Section 3.4.1	See Section 3.4.1	All	See Section 2.1	See Section 2.3	Soil

Add additional pages if necessary.

3.6 Quality Assurance and Quality Control

General field QA/QC considerations and requirements are presented in Table E.

Table E
Quality Control Samples and Data Quality Indicator Goals

QC Sample	Number/Frequency	Data Quality Indicator Goals & Evaluation Criteria	Comments/Exceptions *Site specific remarks:*
FIELD SPECIFIED QA/QC			
Background or reference sample	At least one sample should be collected from an area believed to be unaffected by source contamination.	Source samples should be at least 3 times background.	Surface soil: up-slope. Surface water: upstream. Ground water: up-gradient.
			No background samples will be collected
Field Blanks	1 per SDG[1], per matrix, per method	Source samples should be at least 3 times the blank.	Water only.
			:
Travel Blanks	1 per SDG, per matrix, per method	Source samples should be at least 3 times the blank.	Volatile analytes, water only.
			:
Equipment Blanks	1 per SDG, per matrix, per method	Source samples should be at least 3 times the blank.	Only when the use of decontaminated non-dedicated equipment is involved.
			No equipment blanks will be collected
Field Duplicates or Replicates	1 per SDG, per matrix, per method	Water - 25% RPD[2] Soil - 35% RPD[2] Other - 35%	As needed by sampling objectives. The procedure for collecting duplicate samples can greatly effect the reproducibility.
			No duplicates will be collected for this initial investigation phase
Performance Standards	1 per project, per matrix, per method	75 -125 %R[3]	If available.
			Not applicable
SELECTED LABORATORY QA/AC			
Method Blank	1 per SDG, per matrix, per method	Stds and samples should be at least 3 times the blank.	Mandatory.
Matrix Spike	1 per SDG, per matrix, per method on field designated sample.	75 -125 %R	Designate sample on COC.
Matrix Spike Duplicate or Replicate	1 per SDG, per matrix, per method on field designated sample.	≤50 RPD for organics; ≤20 RPD for metals	Designate sample on COC. A double-volume sample will be designated for "laboratory QC"
Reference Standards	1 per SDG, per matrix, per method	75 -125 %R	If available.
Internal Standards	All samples	50 -200 %R	All GC/MS and some GC analyses only.
Laboratory Control Standards	1 per SDG, per matrix, per method	75 - 125 %R	Per method for organic analyses.

[1] SDG = Sample Delivery Group (Maximum 20 samples)
[2] RPD = Relative Percent Difference
[3] %R = Percent Recovery

4.0 Project Organization and Responsibilities

4.1 Schedule of Sampling Activities

Sampling activities are summarized in Table F.

Table F **Proposed Schedule of Work For Sampling Activities**		
Activity	**Start Date**	**End Date**
All	12/20/10	12/20/10

Add additional pages if necessary.

4.2 Project Laboratories

Laboratories used for this project are summarized in Table G.

Table G **Laboratories**	
Lab Name/ Location	**Methods**
Richard Bauer U.S. EPA Region 9 Laboratory 1337 South 46th Street, Bldg 201 Richmond, CA 94804 (510) 412-2312	All

Add additional pages if necessary.

4.3 Project Personnel and Responsibilities

Personnel and responsibilities are summarized in Table H.

Table H **Sample Team(s) Personnel**	
Personnel (Agency)	**Responsibility**
M. Schwennesen, START	Project Manager, sampler
M. Tymkow, START	Sampler

Add additional pages if necessary.

4.4 Modification or Additions to the Generic Data Quality Objective for Emergency and Time Critical Sampling

Project specific modification to the generic DQO statements for this are summarized in Table I. Also indicate which DQO step corresponds to the addition or modification.

Table I **DQO Modifications and Additions**	
Additions or Modifications to the Generic DQO Output Statements	**DQO Step**

Add additional pages if necessary.

E Sampling and Analysis Plan

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Sampling and Analysis Plan

Mojave River Pyrotechnics Assessment

Contract No.: EP-S5-08-01
TDD No.: TO2-09-10-12-0003
Job No.: 002693.2124.01RA

March 18, 2011

Prepared for:

U.S. ENVIRONMENTAL PROTECTION AGENCY
Region IX

Prepared by:

ECOLOGY AND ENVIRONMENT, INC.
3700 Industry Avenue, Suite 102
Lakewood, California 90712

Superfund Technical Assessment and Response Team

Sampling and Analysis Plan
Mojave River Pyrotechnics Assessment

Contract No.: EP-S5-08-01
TDD No.: TO2-09-10-12-0003
Job No.: 002963.2124.01RA

March 2011

Approved by: _____
Howard Edwards, START Quality Assurance Manager
Ecology & Environment, Inc.

Approved by: _____
Michael Schwennesen, START Project Manager
Ecology & Environment, Inc.

Approved by: _____
Will Duncan, U.S. EPA On-Scene Coordinator
U.S. Environmental Protection Agency, Region IX

Approved by: _____
Eugenia McNaughton, PhD, Quality Assurance Officer
U.S. Environmental Protection Agency, Region IX

_____

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List of Abbreviations and Acronyms

APN	Assessor Parcel Number
bgs	below ground surface
DQI	Data Quality Indicator
DQO	Data Quality Objective
E & E	Ecology and Environment, Inc.
EPA	Environmental Protection Agency
ERS	Emergency Response Section
ERT	U.S. EPA Environmental Response Team
FOSC	Federal On-Scene Coordinator
GC/MS	gas chromatograph/mass spectrometer
GPS	Global Positioning System
IDW	investigation-derived waste
LCS	laboratory control sample
MS/MSD	matrix spike/matrix spike duplicate
mg/kg	milligrams per kilogram
µg/L	micrograms per liter
PETG	polyethylene terephthalate glycol
PID	photoionization detector
PM	Project Manager
PPE	personal protective equipment
PVC	polyvinyl chloride

List of Abbreviations and Acronyms (cont.)

QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RPD	relative percent difference
RSL	Regional Screening Level
RWQCB	California Regional Water Quality Control Board
SAP	Sampling and Analysis Plan
SOP	standard operating procedure
START	Superfund Technical Assessment and Response Team
USA	Underground Services Alert
U.S. EPA	United States Environmental Protection Agency
VSP	Visual Sample Plan

1 Introduction

The United States Environmental Protection Agency (U.S. EPA) directed Ecology and Environment, Inc.'s (E & E) Superfund Technical Assessment and Response Team (START) to support a U.S. EPA-funded removal assessment at the Mojave River Pyrotechnics property (site) in Barstow, San Bernardino County, California (Figure 1-1). To support the U.S. EPA's environmental data collection activities, the START has identified project data quality objectives and developed this Sampling and Analysis Plan (SAP). This SAP is written to conduct soil sampling and analysis and combines the basic elements of a Quality Assurance Project Plan and a Field Sampling Plan.

This SAP describes the project and data use objectives, data collection rationale, quality assurance goals, and requirements for sampling and analysis activities. It also defines the sampling and data collection methods that will be used for this project. This SAP is intended to accurately reflect the planned data-gathering activities for this support activity; however, site conditions, budget, and additional U.S. EPA direction may warrant modifications. All significant changes will be documented in site records.

The format of the SAP has been derived primarily from *Sampling and Analysis Plan Guidance and Template, Version 4, General Projects* (EPA R9QA/00X, September 2009). The specific field sampling and chemical analysis information in this SAP was prepared in accordance with the following U.S. EPA documents: *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R 5, March 2001, EPA/240/B-01/003); *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA QA/G-4, February 2006, EPA/240/B-06/001); *Guidance on Choosing a Sampling Design for Environmental Data Collection* (EPA QA/G-5S, December 2002, EPA/240/R 02/005); and *Uniform Federal Policy for Implementing Environmental Quality Systems* (EPA/505/F-03/001, March 2005).

The site is a 20-acre residential property located at 30433 Poplar Street in the city of Barstow, San Bernardino County, California. The property was the former residence of a fireworks manufacturing company owner. The California Regional Water Quality Control Board (RWQCB) – Lahontan Region, concerned about elevated perchlorate concentrations found in groundwater wells in the vicinity of the site, is investigating the possibility that the owner disposed of chemicals from his fireworks manufacturing business on the site property. The RWQCB has requested assistance from the U.S. EPA Emergency Response Section (ERS) for the assessment of the property.

In December 2010, the U.S. EPA ERS and START conducted surface and shallow subsurface soil sampling at portions of the site. Elevated perchlorate concentrations were detected in surface and subsurface soil samples, indicating the need for further assessment. The purpose of the proposed assessment presented in this SAP is to assist in determining future actions at the site by 1) delineating the lateral and vertical extent of perchlorate concentrations in soil above the site screening level in the specific area of the site with known perchlorate contamination; 2) evaluating perchlorate concentrations in soils in additional suspected areas of concern at the site; and 3) evaluating perchlorate concentrations in groundwater beneath the site.

1.1 Project Organization

The following is a list of project personnel and their responsibilities:

U.S. EPA Federal On-Scene Coordinator (FOSC) – The U.S. EPA FOSC is Will Duncan. Mr. Duncan is the primary decision-maker and will direct the project, specify tasks, and ensure that the project is proceeding on schedule and within budget. Additional duties include coordination of communication with the START Project Manager, U.S. EPA Quality Assurance (QA) Office, and U.S. EPA Region 9 Laboratory, if applicable.

START Project Manager (PM) – The START PM is Michael Schwennesen. The START PM is responsible for the performance of tasks assigned to the START by the U.S. EPA. The START PM manages the project's data collection efforts and is responsible for documentation of project objectives; developing and implementing the SAP; coordinating project tasks and field sampling; managing field data; and completing all preliminary and final reporting.

Principal Data Users – Data generated during the implementation of this SAP will be utilized by the FOSC to make decisions regarding potential future actions at the site.

START Quality Assurance (QA) Coordinator – Mr. Howard Edwards is the START QA Coordinator. Mr. Edwards will coordinate with the U.S. EPA's Quality Assurance Office as needed.

Analytical Laboratory – The U.S. EPA's Region 9 Laboratory in Richmond, California will be responsible for sample analysis by definitive analytical methodologies.

1.2 Distribution List

Copies of the final SAP will be distributed to the following persons and organizations:

- Will Duncan, U.S. EPA, Region 9
- E & E START Field Team
- E & E START project files.

1.3 Statement of the Specific Problem

The principal contaminant of potential concern for this assessment is perchlorate. Previous sampling indicates that elevated concentrations of perchlorate are present in shallow soils at the site. Elevated concentrations of perchlorate in groundwater have also been documented at groundwater wells in proximity to the site. Perchlorates are environmentally persistent, perchlorate salts are readily soluble in water, and perchlorates can be toxic to human health and the environment. Perchlorates are also a widespread contaminant in the drinking water of the state of California. Additional sampling is required to 1) adequately delineate the horizontal and vertical extent of perchlorate that exceeds the site screening level in the soils at a specific area of the site and that may require removal, 2) evaluate the concentrations of perchlorate in soil in additional areas of concern at the site, and 3) evaluate the concentrations of perchlorate in groundwater at the site.

2 Background

2.1 Site Location

The Mojave River Pyrotechnics Assessment site consists of four conjoined 5-acre parcels located at 30433 Poplar Street in Barstow, San Bernardino County, California (Figure 2-1). The San Bernardino County Assessor Parcel Numbers (APNs) for the property are 0425-091-21-0-000, 0425-091-22-0-000, 0425-091-23-0-000, and 0425-091-24-0-000. The location of the site is 34° 54' 44.09" North Latitude, 116° 59' 56.37" West Longitude. The site is situated approximately 0.25 miles south of Old Highway 58 and one mile northwest of Interstate 15.

2.2 Site Description

The northwestern of the four parcels of the site (APN 0425-091-21-0-000) contains two residential structures and associated outbuildings in the northern portion of the parcel, with the remainder of the parcel consisting of undeveloped land. The other three of the four parcels are also undeveloped land. The Mojave River drainage channel is immediately adjacent to the site to the south. Adjacent to the north of the site is Poplar Street, on the other side of which is undeveloped property. Residential properties are present immediately west and northeast of the site, but the majority of the immediate surrounding area is undeveloped.

2.3 Site History

According to information provided by the RWQCB – Lahontan Region, the Mojave River Pyrotechnics Company, which closed in the mid-1980s, allegedly handled perchlorate in the manufacturing of various fireworks devices. The owner/operator was James Bray, who resided at the 30433 Poplar Street property that is the subject of this Removal Assessment. Based on recent perchlorate contamination that has been detected at a nearby public water supply well and a few private domestic wells in the vicinity of the site, the RWQCB suspects that chemicals containing perchlorate were illegally disposed of at the Bray residential property.

2.4 Physiographic Conditions, Geology, and Hydrology

The site is situated at an elevation of approximately 2,080 feet above mean sea level. Topographic relief at the site is flat with a gentle slope toward the Mojave River, which is immediately adjacent to the site to the south. North of the site the land slopes steeply upward due to the presence of the Mitchel Range. The site is located within the Mojave

Desert Geomorphic Province. Surface and shallow subsurface soils in the site vicinity are Holocene and Pleistocene-aged alluvium derived from weathering of the surrounding mountain ranges. The RWQCB-Lahontan Region estimates groundwater at the site to occur between 25 and 50 feet below ground surface (bgs). Groundwater would be anticipated to flow toward the Mojave River.

2.5 Previous Investigations

On December 20, 2010, surface and shallow soil sampling was conducted by the U.S. EPA and the START at the northwestern parcel. The deepest of the samples was collected from 32 to 36 inches bgs. A total of seven soil samples were collected and analyzed for perchlorate, nitrate, sulfate, and metals. Two surface (0 – 6 inches bgs) soil samples, MRPA-1 and MRPA-2, were collected in a "garden area" approximately 115 feet by 145 feet in size, located in the northwest corner of the northwestern parcel. The garden area was reportedly identified by neighbors as a location where unauthorized dumping may have occurred, and during the December 2010 sampling event, a white precipitate was observed in soils within the garden area. Soil samples MRPA-3 and MRPA-4 were collected at 12 – 15 inches bgs and 32 – 36 inches bgs, respectively, from the same location as MRPA-2. Surface soil sample MRPA-5 was collected by compositing five individual aliquots from a grid pattern distributed within the garden area. Surface soil sample MRPA-6 was collected by compositing four individual aliquots from a fire pit located to the rear of the primary residence in the northwestern parcel. In the southwest corner of the northwestern parcel, four surface soil aliquots collected from the end of a footpath were composited as sample MRPA-7. The December 2010 sampling locations are presented in Appendix A.

Perchlorate concentrations in the soil samples ranged from 2.3 milligrams per kilogram (mg/kg) in MRPA-7 to a maximum detected concentration of 130,000 mg/kg in MRPA-1. While MRPA-2 contained a perchlorate concentration of 120 mg/kg, the perchlorate concentration increased to 120,000 mg/kg in MRPA-3 (the 12 – 15 inches bgs sample). MRPA-4 (32 – 36 inches bgs), at 4,800 mg/kg perchlorate, was also still elevated above the surface soil sample at that location. Concentrations of perchlorate in MRPA-5 and MRPA-6 were 36 mg/kg and 2.9 mg/kg, respectively. Nitrate concentrations ranged from not detected to 83 mg/kg. Sulfate concentrations ranged from not detected to 410 mg/kg. Metals results were compared to U.S. EPA Regional Screening Levels (RSLs) for residential soil. Arsenic concentrations, which ranged from less than 2.1 (<2.1) to 12 mg/kg, exceeded the arsenic RSL of 0.39 mg/kg, and vanadium concentrations, which ranged from 4.0 to 26 mg/kg, exceeded the vanadium RSL of 5.5 mg/kg. Other metals concentrations did not exceed their respective RSLs. However, background metals concentrations for the area were not established as part of the sampling. The perchlorate, nitrate, sulfate, and metals results for the December 2010 soil sampling event are presented in Appendix A.

3 Project Objectives

3.1 Data Use Objectives

The data generated by implementing this SAP will be used to evaluate potential future actions at the site. The sampling results will be reviewed to 1) delineate soil with perchlorate concentrations above the site screening level in a specific area of concern (garden area) at the site, 2) identify whether perchlorate is present at concentrations above the site screening level in additional areas of concern at the site, and 3) determine whether groundwater beneath the site contains perchlorate at concentrations above the site screening level.

3.2 Project Task/Sampling Objectives

The U.S. EPA directed the START to determine objectives and prepare this SAP to support the environmental data collection activities necessary to conduct potential future actions at the site.

Soil and groundwater sampling followed by laboratory analysis will be implemented to accomplish the project objectives. Sampling objectives include the following:

- Delineate the lateral and vertical extent of soils containing concentrations of perchlorate that exceed the site screening level in the garden area at the site.
- Document the concentrations of perchlorate in subsurface soils in additional specific areas of concern at the site and determine where these concentrations exceed the site screening level.
- Document the concentrations of perchlorate in groundwater beneath the site and determine whether these concentrations exceed the site screening level.

3.3 Site Screening Level

The site screening level for perchlorate in soils is its residential U.S. EPA Region 9 RSL, which is specified in Table 3-1. U.S. EPA Region 9 RSLs are risk-based concentrations that combine current human health toxicity values with standard exposure factors to estimate contaminant concentrations in environmental media (soil, air, and water) that are considered by the U.S. EPA to be health protective of human exposures (including sensitive groups), over a lifetime. The site screening level for perchlorate in groundwater

is derived from the California EPA Office of Environmental Health Hazard Assessment Maximum Contaminant Level/Public Health Goal for perchlorate.

Table 3-1
Site Screening Level and Data Quality Indicators for Soil and Groundwater
Mojave River Pyrotechnics Assessment
Barstow, San Bernardino County, California

E & E Project No. 002693.2124.01RA TDD No. TO2-09-10-12-0003

Contaminant of Potential Concern	Site Screening Level		Laboratory PQLs	Accuracy (% Recovery for MS/ MSD)	Precision (RPD [%] from MS/MSD and Duplicates)	Percent Complete
	Soil (mg/kg) [1]	Groundwater (µg/L) [2]				
Perchlorate/ perchlorate salts	55	6.0	Soil: 1 mg/kg Water: 2.0 µg/L	50 – 150	< 35	> 90

Notes:
[1] United States Environmental Protection Agency (U.S. EPA) Region 9 Regional Screening Levels for Residential Soil (November, 2010)
[2] Perchlorate: California EPA/Office of Environmental Health Hazard Assessment Maximum Contaminant Level/ Public Health Goal
PQLs = Practical Quantitation Limits for U.S. EPA Region 9 Laboratory
RPD = Relative Percent Difference N/A = Not available
MS/MSD = Matrix Spike/Matrix Spike Duplicate
mg/kg = milligrams per kilogram µg/L = micrograms per liter

3.4 Data Quality Objectives

The Data Quality Objectives (DQO) Process for the Mojave River Pyrotechnics Assessment is presented in Appendix B.

3.5 Schedule of Sampling Activities

The field sampling activities are scheduled to commence on March 21, 2011, and are expected to continue through March 25, 2011.

3.6 Special Training Requirements/Certifications

The operation of field data collection instrumentation requires specialized training that will be administered, prior to mobilization, to all START personnel scheduled to be on site. Additionally, all START personnel assisting with the operation of the U.S. EPA Geoprobe® during soil sample collection will have specialized training and will follow all appropriate Standard Operating Procedures (SOPs) (see Section 6.1).

Data validation requires specialized training and experience. A START chemist will likely complete the data validation.

Field sampling personnel should be trained and have experience with soil sampling at hazardous waste sites while wearing respiratory protective equipment. One field sampler should be trained and familiar with Global Positioning System (GPS) data collection. All sampling personnel must have appropriate training that complies with 29 Code of Federal Regulations 1910.120. The site specific health and safety plan for this project is presented in Appendix C.

4 Sampling Rationale and Design

The objectives of the sampling are: 1) to evaluate perchlorate concentrations in subsurface soils within the garden area at the site; 2) to evaluate the lateral and vertical extent of perchlorate concentrations that exceed the screening level in soil within the garden area; 3) to evaluate perchlorate concentrations in soils at areas of concern in other portions of the site selected based on visual observations of historical aerial photographs; and 4) to evaluate perchlorate concentrations in groundwater beneath the garden area at the site. The START reviewed available site information, including recent sampling data, and consulted with the U.S. EPA FOSC to determine the specific sampling design.

The primary sampling area for this Removal Assessment is the garden area located in the northwest corner of the northwest residential parcel of the site (APN 0425-091-21-0-000). During the December 2010 sampling, the garden area was the location of the surface and shallow subsurface soil samples in which elevated perchlorate concentrations were detected. Based on review of historical aerial photographs, additional sample areas were identified to the rear of this parcel as potential historical storage or unauthorized disposal areas. A geophysical survey will be conducted by the U.S. EPA Environmental Response Team (ERT) in the garden area and the potential historical storage areas prior to sampling to determine whether any anomalous subsurface features are present. Additionally, during the proposed March 2011 sampling event, the other three parcels that make up the site will be evaluated visually to identify any potential areas of concern. Potential areas of concern identified in the other three parcels may be selected for targeted geophysical surveys and potential subsequent soil sampling; however, a sampling plan has not been established as part of this SAP for the three remaining parcels.

In consultation with the U.S. EPA, a grid sampling design combined with judgmental sampling was selected to meet the specified DQOs. A rectangular grid of 20 soil boring locations was situated to cover the entire garden area, including the perimeters. Visual Sample Plan, Version 6.0 (Battelle Memorial Institute 2010) (VSP) was used to determine that the specified grid will detect a circular hotspot with a radius of at least 27 feet. At three boring locations in the garden area grid, situated at the northwestern and southwestern corners and in the center of the eastern perimeter, groundwater samples will be collected. A fourth boring location may be added on the north side of Poplar Street, for collection of an additional groundwater sample.

Three additional judgmental boring locations were selected, in consultation with the U.S. EPA, for locations in the southern half of the northwestern residential parcel. Based on review of historical aerial photographs, the northwestern and southeastern of the three biased sample locations are situated at either end of a visible pathway or trail that may have been used to traverse historical storage or disposal areas. The third biased sample location is located in an area that historical aerial photographs show to have been fenced at one time, possibly indicating a storage or disposal area. Proposed sampling locations are presented in Figure 4-1 of the SAP.

4.1 Sampling Locations and Depths

A total of 23 soil boring locations, three of which are also groundwater sampling locations, are proposed within the northwestern parcel of the site. Twenty of the boring locations, including all three groundwater sample locations, are distributed in a rectangular grid within the garden area. The garden area is located in the northwest corner of the northwestern parcel and is approximately 115 feet by 145 feet. The grid spacing is approximately 38 feet by 36 feet. The groundwater sample locations are at the northwestern and southwestern corners of the grid and in the center of the eastern perimeter of the grid. The three remaining soil boring locations, which are in the southern portion of the northwestern parcel, are situated in areas where historical unauthorized disposal or storage of chemicals is suspected based on review of aerial photographs.

Four vertical soil samples per each of the 23 sampling locations will be collected at 1 foot bgs (6 – 12 inches bgs), 3 feet bgs, 6 feet bgs, and 10 feet bgs. Based on field observations, up to five sample locations in the garden area may be selected for additional sampling at 15 and 20 feet bgs. At the three boring locations selected for groundwater sampling, soil samples will be collected to 20 feet bgs at the intervals described above; below 20 feet bgs, soil samples will be collected at 10-foot intervals to first encountered groundwater and will also be collected in the vadose zone immediately above first encountered groundwater. Groundwater is estimated to occur between 25 and 50 feet bgs.

An estimated 117 systematic and judgmental soil samples are proposed within the gridded garden area and at the three biased sample locations. Three groundwater samples are proposed within the garden area. Sample locations at the other three parcels that make up the site or across Poplar Street will not be collected without prior direction from the FOSC. Table 5-1 summarizes the samples to be collected.

4.2 Analytes of Concern

The soil and groundwater samples will be analyzed for perchlorate by U.S. EPA Method 314.0 (Table 3-1).

5 Analytical Testing

It is anticipated that 129 soil samples, including 12 field duplicate samples, and four groundwater samples, including one field duplicate sample, will be collected and sent to an analytical laboratory for testing. The specific laboratory analytical analyses are described below.

5.1 Laboratory Analysis

Soil and groundwater samples will be submitted to the U.S. EPA Region 9 Laboratory in Richmond, California for the following analyses:

- Perchlorate by U.S. EPA Method 314.0

Sample containers, preservatives, holding times, estimated number of field soil and groundwater samples, and quality control (QC) samples are summarized in Table 5-1.

5.2 Quality Control

To provide analytical quality control for the analytical program, the following measures will be utilized:

- Additional sample volume will be collected for at least five percent of samples per each analytical method, to be utilized for matrix spike/matrix spike duplicate analysis.
- Duplicate samples will be collected from ten percent of the sampling locations. Duplicate soil samples will be collected as a 50/50 split of the sample after collection and homogenization. Duplicate groundwater samples are collected at the same time as the primary groundwater samples by doubling the volume of groundwater collected.
- A rinsate blank will be collected at a rate of one per day to evaluate decontamination procedures at the site. The rinsate blank will be collected by pouring deionized water over the decontaminated sample collection device (e.g., hand auger, GeoProbe® tooling) and capturing the water in the specified sample container.

Table 5-1
Assessment Sampling and Analysis Summary – Soil, Groundwater, and Quality Control Samples
Mojave River Pyrotechnics Assessment
Barstow, San Bernardino County, California

E & E Project No. 002693.2124.01RA TDD No. TO2-09-10-12-0003

Method	Perchlorate by U.S. EPA Method 314.0	Perchlorate by U.S. EPA Method 314.0
Matrix	Soil	Water
Sample Container	4 or 8 ounce glass jars	250 milliliter plastic bottle
Preservation	4°C	4°C
Analysis Holding Time	28 days	28 days
Estimated Number of Primary Samples	117	3
Estimated Number of Field Duplicate Samples (10 percent)	12	1
Minimum Total Site Sample Analyses	129	4
Matrix Spike/Matrix Spike Duplicates (5 percent, double volume)	7	1
Equipment Rinse Blanks (if non-dedicated equipment is used)		
Sample Container	250 milliliter plastic bottle	N/A
Preservation	4°C	N/A
Analysis Holding Time	14 days	N/A
Number of Samples	1 per day (5)	N/A

Note:

N/A = Not applicable

6 Field Methods and Procedures

The following sections describe in detail the sample collection methods. Specific analysis requests for the samples were discussed in previous sections of this SAP.

A GeoProbe® will be used to advance to the target depths identified for the collection of subsurface soil samples. Subsurface soil samples will be collected at depths of 1 foot (6 – 12 inches), 3 feet, 6 feet, and 10 feet bgs. Additional samples may be collected at 15 and 20 feet bgs at a select number of locations. Specific soil sampling procedures are presented in Section 6.2. At three of the soil boring locations, the GeoProbe® will be used to advance to groundwater. At these three borings, in addition to collecting soil samples to 20 feet bgs at the intervals described above, soil samples will be collected at 10-foot intervals between 20 feet bgs and first encountered groundwater. Vadose zone soil samples will also be collected in the soil borings selected for groundwater sampling prior to collecting groundwater samples. Specific groundwater sampling procedures are presented in Section 6.3.

Sampling will be conducted in accordance with the U.S. EPA Environmental Response Team (ERT) SOPs listed in Section 6.1. These SOPs are included in Appendix D.

6.1 Field Procedures

The following sampling SOPs or their equivalent will be used to guide the field procedures:

- U.S. EPA ERT SOP #2050, *GeoProbe® Operation*
- U.S. EPA ERT SOP #2012 *Soil Sampling*
- U.S. EPA ERT SOP #2006 *Sampling Equipment Decontamination*.
- U.S. EPA ERT SOP #2007 *Groundwater Well Sampling*
- Ecology and Environment, Inc. SOP #ENV 3.7 *Groundwater Well Sampling*

Deviations from the SOPs will be documented in the field notes.

6.1.1 Equipment

The equipment listed in the next subsection may be utilized to obtain environmental samples. The START and U.S. EPA will determine which equipment to use in the field depending on site conditions and other factors such as accessibility, soil characteristics, and geotechnical limitations.

6.1.1.1 Equipment Used

The following equipment has been identified for potential sample collection use during the Mojave River Pyrotechnics Assessment:

Table 6-1 Sampling Equipment
Mojave River Pyrotechnics Assessment
Barstow, San Bernardino County, California

E & E Project No. 002693.2124.01RA TDD No. TO2-09-10-12-0003

Matrix	Equipment	Fabrication	Dedicated
Soil	Geoprobe® Macrocore® sample assembly	Steel	No
	Sample liner	Polyethylene terephthalate glycol	Yes
	Hacksaw	Stainless steel	No
	Hand auger	Hardened/stainless steel	No
	Photoionization detector or other volatile organic compound gas monitor (headspace)	Electronics	No
	Global Positioning System Unit	Electronics	No
Groundwater	Casing riser and screen	PVC	Yes
	Tubing	Plastic	Yes
	Bailer	Plastic	Yes
	5-gallon buckets	Plastic	No
Decontamination	5-gallon buckets	Plastic	No
	Scrub brushes	Plastic	No
	Towels	Paper	Yes
	Tarp	Plastic	No
	Sample bags	Plastic	Yes

Note: PVC = polyvinyl chloride

6.1.1.2 Equipment Maintenance

Field instrumentation for the collection of soil and groundwater samples will be operated, calibrated (if applicable), and maintained by the sampling team in accordance with the SOPs listed in Section 6.1 or their equivalent. Field instrumentation utilized for health and safety purposes will be operated, calibrated, and maintained by the sampling team according to manufacturers' instruction. Calibration and field use data will be recorded in the instrument log books.

6.1.1.3 Inspection/Acceptance Requirements for Supplies and Consumables

There are no project-specific inspection/acceptance criteria for supplies and consumables. It is standard operating procedure that personnel will not use broken or defective materials; items will not be used past their expiration date; supplies and consumables will be checked against order and packing slips to verify the correct items were received; and the supplier will be notified of any missing or damaged items.

6.1.2 Field Notes

Field notes are a daily requirement and will be kept by the START sample team in a site logbook. Details are described in the next subsection.

6.1.2.1 Logbooks

Field logbooks will document where, when, how, and from whom any vital project information was obtained. Logbook entries will be complete and accurate enough to permit reconstruction of field activities. A separate logbook will be maintained for each project. Logbooks are bound with consecutively numbered pages. Each page will be dated and the time of entry noted in military time. All entries will be legible, written in ink, and signed by the individual making the entries. Language will be factual, objective, and free of personal opinions. The following information will be recorded, as applicable, during the collection of each sample:

- Sample location and description
- Site sketch showing sample location and measured distances
- Sampler's name(s)
- Date and time of sample collection
- Type of sample (matrix)
- Type of sampling equipment used
- Field instrument readings (e.g., organic vapors, air monitoring data)
- Field observations and details related to analysis or integrity of samples (e.g., weather conditions, noticeable odors, colors, etc.)
- Preliminary sample descriptions (e.g., for soils: clay loam, very wet; for water: clear water with strong ammonia-like odor)
- Type(s) of preservation used
- Shipping arrangements (air bill numbers)
- Receiving laboratory(ies).

In addition to sampling information, the following specifics may also be recorded in the field logbook for each day of sampling:

- Team members and their responsibilities
- Time of arrival on-site and time of departure
- Other personnel on-site
- A summary of any meetings or discussions with any potentially responsible parties, or representatives of any federal, state, or other regulatory agency
- Deviations from sampling plans, site safety plans, and SAP procedures
- Changes in personnel and responsibilities as well as reasons for the change
- Levels of safety protection
- Calibration information for equipment used on-site
- Record of photographs.

6.1.2.2 Photographs

Photographs will be taken at representative sampling locations and at other areas of interest on-site. They will serve to verify information entered in the field logbook. When a photograph is taken, the following information will be written in the logbook or will be recorded in a separate field photography log:

- Time, date, location, and, if appropriate, weather conditions
- Description of the subject photographed
- Name of person taking the photograph.

6.1.2.3 Electronic Sample Logging

The sampling team may utilize field management software to prepare sample labels and chain-of-custody forms.

The following information should be entered for each sample after collection:

- Sample name
- Sample date and time
- Number of sample bottles
- Type of preservation
- Analyses
- Sampler's name(s).

In addition to these items, the software may also be used to keep track of other information such as sample depth, field measurements, and split samples.

The field team will generate chain-of-custody forms for each set of samples packaged and sent to a laboratory. Each chain-of-custody form will refer to the shipping method and tracking number, as applicable. Printed chain-of-custody forms will be submitted to the laboratory with the samples.

The use of field management software may require that the field team have access to a computer, a printer, computer paper, and labels while in the field. Field team members will have received specific training in use of the software.

6.1.3 Field Mapping

The following field mapping and marking identification activities will be conducted prior to or during the sample collection effort.

6.1.3.1 Mapping Equipment

Proposed sample points and anomalous underground features determined by the geophysical survey (Section 6.1.3.2) will be located and marked with survey paint in the field. A GPS unit will be used to confirm precise geographic coordinates for sample locations or features on the site, or to document final coordinates of sample locations that are moved during field activities. GPS mapping will be done by personnel trained in the use of the equipment and will be completed in accordance with the manufacturer's instructions. Expected output from the use of GPS mapping will be site maps with sample locations and major site features of potential concern.

6.1.3.2 Geophysical Survey

Prior to sampling activities, the U.S. EPA ERT will conduct a geophysical survey in the garden area, the areas of concern identified for biased sampling, and any other locations on the property (including the three parcels not currently identified for sampling) where site features may indicate past waste storage or disposal. The results of the geophysical survey will be used to determine if anomalous subsurface features are present that may indicate unauthorized subsurface waste disposal. The geophysical survey will be conducted using ground penetrating radar, electromagnetic tools, and metal detection equipment.

The geophysical survey will also be used to identify underground utilities in the vicinity of proposed sample locations prior to sampling to prevent unnecessary damage to utilities, property, and sampling equipment. In addition, U.S. law requires the clearance of underground utilities. The following methods will be employed:

- Underground Services Alert (USA) will be contacted by START a minimum of 48 hours prior to the sampling event and provided with detailed sampling location information and sampling dates. USA will then contact all regional utility companies so that they may send field crews to mark with paint the locations of underground utilities. USA can provide this service only for public lands and right-of-ways adjacent to private property.

- The U.S. EPA ERT will use electromagnetic and ground penetrating radar equipment to located buried utilities within the boundaries of the site and within a 5-foot radius of each proposed boring location. All confirmed utilities will be marked with survey paint color-coded to represent identified electric, water, gas, and telecommunications utilities.

In the event that boring locations are moved or added in an area not previously investigated during the geophysical survey, a hand auger will be used to collect the 1-foot and 3-feet bgs samples. The hand auger will then be used to advance to 5 feet bgs before using the Geoprobe® to collect the 6-feet bgs and deeper samples.

6.2 Soil Sampling Procedures

Discrete soil samples will be collected for laboratory analysis at all 23 soil borings at 1, 3, 6, and 10 feet bgs using a Geoprobe® direct-push drill rig equipped with either a 4-foot long Macrocore® sampler or a 2-foot long Largebore discrete soil sampler. Up to five of the 23 soil borings will be selected for discrete soil sampling for laboratory analysis at 15 and 20 feet bgs. At the three borings selected for groundwater sampling (see Section 6.3), soil samples will be collected to 20 feet bgs at the intervals specified above; below 20 feet bgs, soil samples will be collected for laboratory analysis at 10-foot intervals until first encountered groundwater and also collected in the vadose zone. The samplers will collect discrete intervals of undisturbed soil encompassing the target sample depth in polyethylene terephthalate glycol (PETG) liners. Continuous core sampling may also be employed for lithologic description purposes or when advancing to groundwater in order to identify vadose zone samples and first encountered groundwater.

The soils at the target depth will be transferred from the PETG liner to a plastic bag for homogenization. The homogenized soil will then be placed into 4- or 8-ounce glass sample jars as determined by laboratory analytical requirements. The samples will be sealed, labeled, and placed on ice in a cooler for shipment to the laboratory.

The soils remaining after collection of the samples for laboratory analysis will be used for lithologic description, including field organic vapor analysis using a photoionization detector (PID). The PID will be calibrated in accordance with the manufacturer's instruction at the beginning of each field day. A small amount of soil will be placed into a plastic zip-lock bag, sealed with some headspace, and placed out of the sun. After allowing time for potential volatiles to off-gas from the soil into the headspace of the bag, the PID will be inserted into the bag via a small opening at the seal. The PID instrument readings will be recorded in the boring logs.

After subsurface sample collection, all boreholes will be backfilled with a bentonite and/or Portland cement grout. If applicable, the borehole will be resurfaced with concrete or asphalt, but boring locations are anticipated to be in open soil.

All sample locations will be recorded in the field logbook as sampling is completed. A sketch, if needed, of the sample location will be entered into the logbook and any physical reference points will be labeled. If possible, distances to reference points will be given.

6.3 Groundwater Sampling Procedures

At the three boring locations selected for groundwater sampling, the Geoprobe® will be advanced to first encountered groundwater, which is anticipated between 25 and 50 feet bgs. Soils will be collected for laboratory analysis as described in Section 6.2, and continuous coring will also be utilized during boring advancement to characterize lithology and to identify when groundwater is reached based on soil saturation. The boring will be terminated approximately 5 to 10 feet into groundwater. After withdrawing the Geoprobe® rods, a temporary groundwater well will be constructed using 3/4-inch diameter polyvinyl chloride (PVC) casing riser connected to 5 to 10 feet of 0.010-inch slot PVC screen.

After the water level in the well has equilibrated, the well will be sampled by lowering a clean bailer and attached line into the water column. Plastic sheeting will be placed around the well to prevent contact of the bailer or line with the ground. The bailer will be lowered to different points adjacent to the well screen to ensure collection of a representative water sample. The bailer will be retrieved slowly and gently to avoid contact with the well casing. The groundwater contained in the bailer will be poured into the appropriate sample container for analysis of perchlorate. Plastic tubing attached to a valve may also be used to create a passive pumping system as an alternative to using a bailer. The sample container will be sealed, labeled, and placed on ice in a cooler for shipment to the laboratory.

After groundwater sample collection, the PVC casing and screen will be removed from the borehole. The borehole will then be backfilled with a Portland cement grout using a tremie pipe. If applicable, the borehole will be resurfaced with concrete or asphalt, but groundwater well locations are anticipated to be in open soil.

6.4 Field Decontamination Procedures

All non-dedicated equipment that comes into contact with potentially contaminated soil will be decontaminated in accordance with ERT SOP #2006 (Appendix D) and the procedures outlined below. Equipment will be decontaminated in a pre-designated area on pallets, racks, or plastic sheeting, and clean equipment will be stored in an uncontaminated area. Disposable equipment intended for one-time use will not be decontaminated, but will be packaged for appropriate disposal. Decontamination will occur after each use of a piece of equipment.

Decontamination for the non-dedicated soil sampling equipment and accessories are as follows:

- Non-phosphate detergent and tap-water wash using a brush to scrub solids from the surface
- Tap-water rinse
- Triple rinse with deionized or distilled water
- Air dry.

The decontamination procedures do not include a hexane rinse (organics) or a nitric acid rinse (inorganics), which have been demonstrated to be unnecessary for decontamination of stainless-steel equipment to remove organic/inorganic contaminants. The hexane and nitric acid rinses were also eliminated to avoid additional site contamination and the generation of hazardous investigation-derived waste (IDW). Rinsate blanks will be used to confirm the adequacy of the decontamination procedures.

7 Disposal of Investigation-Derived Waste

In the process of collecting environmental samples at this site, several different types of potentially contaminated IDW will be generated, including the following:

- Used personal protective equipment (PPE)
- Disposable sampling equipment
- Decontamination fluids and solids (e.g. towels, etc.)
- Residual soil cuttings

The U.S. EPA's National Contingency Plan requires that management of IDW generated during site investigations comply with all relevant or appropriate requirements to the extent practicable. This sampling plan will follow the Office of Emergency and Remedial Response Directive 9345.3-02 (May 1991), which provides the guidance for management of IDW during site investigations. Listed below are the procedures that will be followed for handling IDW. The procedures are flexible enough to allow the site investigation team to use its professional judgment on the proper method for the disposal of each type of IDW generated at each sampling location.

- Used PPE and disposable sampling equipment will be double bagged in plastic trash bags and disposed of in a municipal refuse dumpster. These wastes are not considered hazardous and can be sent to a municipal landfill. Any PPE or dedicated equipment that is to be disposed of that can still be reused will be rendered inoperable before disposal.
- Decontamination fluids and residual soil cuttings generated during the sampling event will be disposed of in the garden area at the location of known high concentrations of perchlorate (i.e, in the location of former sampling locations MRPA-1 or MRPA-2).

8 Sample Identification, Documentation, and Shipment

8.1 Sample Nomenclature

Each sample requires a unique identifier that ideally indicates the type of sample, the location on the site where the sample was collected, and the depth of the sample. Each sample will be assigned a unique Sample Identification Number using the following methodology for each type of sample.

8.1.1 Soil Samples

Soil samples will have a prefix "MR" indicating the site from which they were collected (Mojave River). The prefix will be followed by a number representing the sampling location, based on the numerical system assigned to the proposed sample locations. All samples will have a final number indicating the target depth at which the sample was collected (1, 3, 6, etc.). For example, the sample collected at six feet bgs at boring MR-002 will be identified as MR-002-06. Field duplicate samples will have the same designations as their originals except the sequential number will be 900; thus, the field duplicate of MR-002-6 would be MR-902-6.

8.1.2 Groundwater Samples

Groundwater samples will be designated by the monitoring well number (MW-01, MW-02, etc.) followed by a hyphen and the sample collection date. For example, a sample collected from monitoring well MW-01 on March 22, 2011 would be identified as MW-01-032211. A duplicate sample will be identified by adding the number 900 to the well number. Therefore, a duplicate sample collected from monitoring well MW-01 on July March 22, 2011 would be identified as MW-901-032211.

8.1.3 Blanks

Equipment rinse blanks for the soil drilling and sampling equipment will be designated with the collection date following the "MR" prefix, and the letters "RB" will be used as the suffix. For example, a rinse blank collected on March 22, 2011would be designated MJ-032211-RB. As all groundwater sampling equipment will be dedicated for each well, no rinse blanks will be collected during groundwater sampling.

8.2 Container, Preservation, and Holding Time Requirements

All sample containers will have been delivered to the START in a certified, pre-cleaned condition. Container, preservation, and holding time requirements are summarized in Table 5-1.

8.3 Sample Labeling, Packaging, and Shipping

All samples collected will be labeled in a clear and precise way for proper identification in the field and for tracking in the laboratory. Sample labels will be affixed to the sample containers and will contain the following information:

- Sample name
- Date and time of collection
- Site name
- Analytical parameter and method of preservation.

Samples collected for laboratory analysis will be stored on ice in a secure location pending delivery or shipment to the laboratory. Sample coolers will be retained in the custody of site personnel at all times or secured so as to deny access to anyone else. When samples are not under the direct control of the individual responsible for them, they will be stored in a locked container sealed with a custody seal.

The procedures for shipping soil samples are:

- Ice will be packed in double zip-lock plastic bags.
- The drain plug of the cooler will be sealed with tape to prevent melting ice from leaking.
- The bottom of the cooler will be lined with bubble wrap to prevent breakage during shipment.
- Screw caps will be checked for tightness.
- Containers will have custody seals affixed so as to prevent opening of the container without breaking the seal.
- All glass sample containers will be wrapped in bubble wrap.
- All containers will be sealed in zip-lock plastic bags.

All samples will be placed in coolers with the appropriate chain-of-custody forms. All forms will be enclosed in plastic bags and affixed to the underside of the cooler lid. Bags of ice will be placed on top of and around samples. Empty space in the cooler will be filled with bubble wrap to prevent movement and breakage during shipment. Each ice chest will be securely taped shut with strapping tape, and custody seals will be affixed to the front, right, and back of each cooler.

Samples will be hand-delivered or shipped for immediate delivery to the selected laboratory. Upon shipping, the laboratory will be notified of:

- Sampling contractor's name
- Name of the site
- Shipment date and expected delivery date
- Total number of samples, by matrix, and for each sample the relative level of contamination (i.e., low, medium, or high), if known
- Carrier; air bill number(s), method of shipment (e.g., priority)
- Irregularities or anticipated problems associated with the samples
- Whether additional samples will be sent; whether this is the last shipment.

8.4 Chain-of-Custody Forms and QA/QC Summary Forms

A chain-of-custody form will be maintained for all samples to be submitted for analysis, from the time the sample is collected until its final deposition. Every transfer of custody must be noted and a signature affixed. Corrections on sample paperwork will be made by drawing a single line through the mistake and initialing and dating the change. The correct information will be entered above, below, or after the mistake. When samples are not under the direct control of the individual responsible for them, they must be stored in a locked container sealed with a custody seal. The chain-of-custody form must include the following:

- Sample identification numbers
- Identification of sample to be used for Matrix Spike/Matrix Spike Duplicate (MS/MSD) purposes
- Site name
- Sample date
- Number and volume of sample containers
- Required analyses
- Signature and name of samplers
- Signature(s) of any individual(s) with control over samples
- Airbill number (if applicable)
- Note(s) indicating special holding times and/or detection limits.

The chain-of-custody form will be completed and sent with the samples for each laboratory and each shipment. Each sample cooler will contain a chain-of-custody form for all samples within the sample cooler.

A QA/QC sample summary form will be completed for each method and each matrix of the sampling event. The sample number for all blanks, reference samples, laboratory QC samples (MS/MSDs), and duplicates will be documented on this form. This form is not sent to the laboratory. The original form will be sent to the reviewer who is validating and evaluating the data; a photocopy of the original will be made for the project manager's master file.

9 Quality Assurance and Quality Control

9.1 Field Quality Control Samples

The QA/QC samples described in the following subsections, which are also summarized in Table 5-1, will be collected during this investigation.

9.1.1 Blank Samples

An equipment rinsate blank will be collected to evaluate field sampling and decontamination procedures on the soil sampling equipment during the course of fieldwork. The rinsate blank will be collected by pouring deionized or distilled water over the decontaminated sample collection device (e.g., Geoprobe® Macrocore sampler) and capturing the water in the specified sample container. Equipment rinsate blank samples will be collected at a rate of one per day of fieldwork and submitted for analysis of perchlorate.

9.1.2 Assessment of Sample Variability (Field Duplicate)

Duplicate split soil samples will be collected at selected sample locations that will be chosen randomly in the field. If field changes to the sampling plan are made that require the collection of additional samples from additional borings or additional sample depths, then additional duplicates will be randomly selected. Field duplicates will be collected at a rate of 1 for every 10 field samples. A duplicate split sample is a 50/50 split of a sample after collection and homogenization.

9.1.3 Laboratory Quality Control Samples

A laboratory QC sample, also referred to as an MS/MSD, is not an extra sample; rather, it is a sample that requires additional QC analyses and therefore may require a larger sample volume. The chain-of-custody records for these samples will identify them as laboratory QC samples. The location of laboratory QC samples will be selected at random. At a minimum, one laboratory QC sample per 20 samples (or one per delivery group), per matrix, for each analytical parameter will be submitted. If the data quality indicators (DQIs) for analytical parameters are not achieved, further data review will be conducted to assess the impact on data quality. Laboratory QC samples will be selected randomly.

Additional sample volume will be submitted for all samples designated as laboratory QC samples and will be marked on the chain-of-custody to the laboratory.

9.2 Analytical and Data Package Requirements

It is required that all samples be analyzed in accordance with the U.S. EPA Method listed in Table 5-1. The laboratory is required to supply documentation to demonstrate that their data meet the requirements specified in the method. Analytical laboratory turnaround time for sample results is approximately 21 days. The laboratory will also provide all data electronically in a spreadsheet-compatible format or delimited text file.

Deliverables for this project must meet the guidelines in *Laboratory Documentation Requirements for Data Evaluation* (U.S. EPA Region IX R9/QA/00.4.1, March 2001). The following deliverables are required. Note that the following data requirements are included to specify and emphasize general documentation requirements and are not intended to supersede or change requirements of each method.

- A copy of the chain-of-custody, sample log-in records, and a case narrative describing the analyses and methods used
- Analytical data (results) for up to three significant figures for all samples, method blanks, MS/MSDs, Laboratory Control Samples (LCS), duplicates, and field QC samples
- QC summary sheets/forms that summarize the following:
  - MS/MSD/LCS recovery summary
  - Method/preparation blank summary
  - Initial and continuing calibration summary (including retention time windows)
  - Sample holding time and analytical sequence (i.e., extraction and analysis)
  - Calibration curves and correlation coefficients
  - Duplicate summary
  - Detection limit information
- Analyst bench records describing dilution, sample weight, percent moisture (solids), sample size, sample extraction and cleanup, final extract volumes, and amount injected
- Standard preparation logs, including certificates of analysis for stock standards
- Detailed explanation of the quantitation and identification procedure used for specific analyses, giving examples of calculations from the raw data
- A final deliverable report consisting of sequentially numbered pages
- Internal/surrogate recoveries
- Gas chromatograph/mass spectrometer tuning conditions
- Reconstructed ion current chromatogram and quantitation reports for all sample standards, blanks, and MS/MSD samples

- For every compound identified and each field sample, raw versus enhanced spectrum and enhanced versus reference spectrum
- For target analytes, the reference spectrum shall be the check standard for that sample. For tentatively identified compounds, the reference mass spectrum shall be the best fit spectrum from a search of the spectral library.

9.3 Data Management

Samples will be collected and described in a logbook, as discussed in Section 6.1.2.1. Samples will be kept secure in the custody of the sampler at all times; the sampler will assure that all preservation parameters are being followed. All samples that are to be sent to the analytical laboratory will be collected and logged on chain-of-custody forms as discussed in Section 8.4. A START member will only submit samples to the analytical laboratory with chain-of-custody documentation. All submitted samples will be in properly custody-sealed containers. Specifics are discussed in Section 8.3. The laboratories will note any evidence of tampering upon receipt.

All data summary reports and complete data packages will be archived by the project manager and stored in the START project file. The data validation reports and laboratory data summary reports will be included in the final report to be submitted to the U.S. EPA and the START project file.

All field data, including field measurements, will be managed in SCRIBE.

9.4 Data Validation

Data validation of all data will be performed by the START in accordance with U.S. EPA Region 9 Superfund Data Evaluation/Validation Guidance R9QA/006.1, December 2001.

Standard data quality review requirements, including Tier 2 data validation of 100 percent of the laboratory data (as defined in *Documentation of Data Validation Requirements in Quality Assurance Project Plans, Field Sampling Plans, and SAPs*, EPA Region 9 Quality Assurance Office, January 2000), will satisfy the data quality requirements for this project. Upon completion of validation, data will be classified as one of the following: acceptable for use without qualifications, acceptable for use with qualifications, or unacceptable for use.

If during or after the evaluation of the project's analytical data it is found that the data contain excess QA/QC problems or if the data do not meet the DQI goals, then the independent reviewer may determine that additional data evaluation is necessary. Additional evaluation may include U.S. EPA Region 9 Superfund Data Evaluation/ Validation Guidance R9QA/006.1 for evaluation Tier 3.

To meet evaluation and project requirements, the following criteria will be evaluated during a Tier 2 evaluation:

Evaluation of Completeness

The data validator will verify that the laboratory sample information matches the field sampling information and that all the required items are included in the data package. If the data package is incomplete, the data validator will contact the laboratory, which must provide all missing information.

Evaluation of Compliance

The actual data validation effort will be conducted in accordance with the following briefly outlined procedures:

- Review the data to check field and laboratory QC data, to verify that holding times and acceptance and performance criteria were met, and to note any anomalous values;
- Review chromatograms, mass spectra, and other raw data if provided as backup information for any apparent QC anomalies;
- Ensure all analytical problems and corrections are reported in the case narrative and that appropriate laboratory qualifiers are added;
- For any problems identified, review concerns with the laboratory, obtain additional information if necessary, and check all related data to determine the extent of the error; and
- Apply data qualifiers to the analytical results to indicate potential limitations on data usability.

The data validator will follow qualification guidelines stated in the START-3 procedures for Tier 2 Data Validation of ERS data. This procedure follows guidelines derived from:

- *EPA CLP National Functional Guidelines for Inorganic Data Review*, (EPA/540/R-94/013, February 1994).
- *Quality Assurance/Quality Control Guidance for Removal Activities, Sampling QA/QC Plan and Data Validation Procedures* (EPA/540/G-90/004, OSWER Directive 9360.4-01, April 1990).

9.5 Field Variances

As conditions in the field may vary, it may become necessary to implement minor modifications to this plan. When appropriate, the U.S. EPA FOSC and the START QA Coordinator will be notified of the modifications and a verbal approval obtained before implementing the modifications. Modifications to the original plan will be recorded in site records and documented in the final report.

9.6 Assessment of Project Activities

The following assessment activities will be performed by the START:

- All project deliverables (SAP, Data Summaries, Data Validation Reports, Investigation Report) will be peer reviewed prior to submission to the U.S. EPA. In time critical situations, the peer review may be concurrent with the release of a draft document to the U.S. EPA. Errors discovered in the peer review process will be reported by the reviewer to the originator of the document, who will be responsible for corrective action.
- The QA Coordinator will review project documentation (logbooks, chain-of-custody forms, etc.) to ensure the SAP was followed and that sampling activities were adequately documented. The QA Coordinator will document deficiencies, and the PM will be responsible for corrective actions.

9.6.1 Project Status Reports to Management

It is standard procedure for the START PM to report to the U.S. EPA FOSC any issues, as they occur, that arise during the course of the project and which could affect data quality, data use objectives, the project objectives, or project schedules.

9.6.2 Reconciliation of Data with DQOs

Assessment of data quality is an ongoing activity throughout all phases of a project. The following paragraphs outline the methods to be used by the START for evaluating the results obtained from the project.

Review of the DQO outputs and the sampling design will be conducted by the START QA Coordinator prior to sampling activities. The reviewer will submit comments to the START PM for action, comment, or clarification. This process will be iterative.

A preliminary data review will be conducted by the START. The purpose of this review is to look for problems or anomalies in the implementation of the sample collection and analysis procedures and to examine QC data for information to verify assumptions underlying the DQOs and the SAP. When appropriate to the sample design, basic statistical quantities will be calculated and the data will be graphically represented.

When appropriate to the sample design and if specifically tasked to do so by the U.S. EPA FOSC, the START may select a statistical hypothesis test and identify assumptions underlying the test.

10 References

Battelle Memorial Institute. 2010. Visual Sample Plan, Version 6.0

U.S. EPA Region 9, 2000. *Documentation of Data Validation Requirements in Quality Assurance Project Plans, Field Sampling Plans, and SAPs*. Quality Assurance Office Memorandum. January.

U.S. EPA Region 9, 2001. *Superfund Data Evaluation/Validation Guidance*, R9QA/006.1, December.

U.S. EPA, Region 9, 2009. *Sampling and Analysis Plan (SAP) Guidance and Template, Version 4, General Projects,* R9QA/00X, September.

U.S. EPA, 1990. *Quality Assurance/Quality Control Guidance for Removal Activities, Sampling QA/QC Plan, and Data Validation Procedures*. EPA/540/G-90/004, OSWER Directive 9360.4-01. April.

U.S. EPA, 1991. *Management of Investigation-Derived Wastes During Site Inspections.* Office of Emergency and Remedial Response. Directive 9345.3-02. May.

U.S. EPA, 1994. *EPA CLP National Functional Guidelines for Inorganic Data Review*. EPA/540/R-94/013. February.

U.S. EPA, 2001. *EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5*. Office of Environmental Information. EPA/240/B-01/003. March.

U.S. EPA, 2002. *Guidance for Choosing a Sampling Design for Environmental Data Collection, EPA QA/G-5S*. Office of Environmental Information. EPA/240/R-02/005. December.

U.S. EPA, 2005. *Uniform Federal Policy for Implementing Environmental Quality Systems*. EPA/505/F-03/001. March.

U.S. EPA, 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4*. Office of Environmental Information. EPA/240/B-06/001. February.

U.S. EPA, 2010. *Regional Screening Levels for Chemical Contaminants at Superfund Sites*, November.

Figures

Source: ESRI Streetmaps

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Figure 1-1

Site Vicinity Map
Mojave River Pyrotechnics Assessment
Barstow, San Bernardino County, California

Project # 002693.2125.01RA
TDD# TO-02-09-10-12-0004

Source: Aerial Photography - Bing Maps

LEGEND

Garden area

Parcel boundary

N

0 200 400 Feet

Figure 2-1

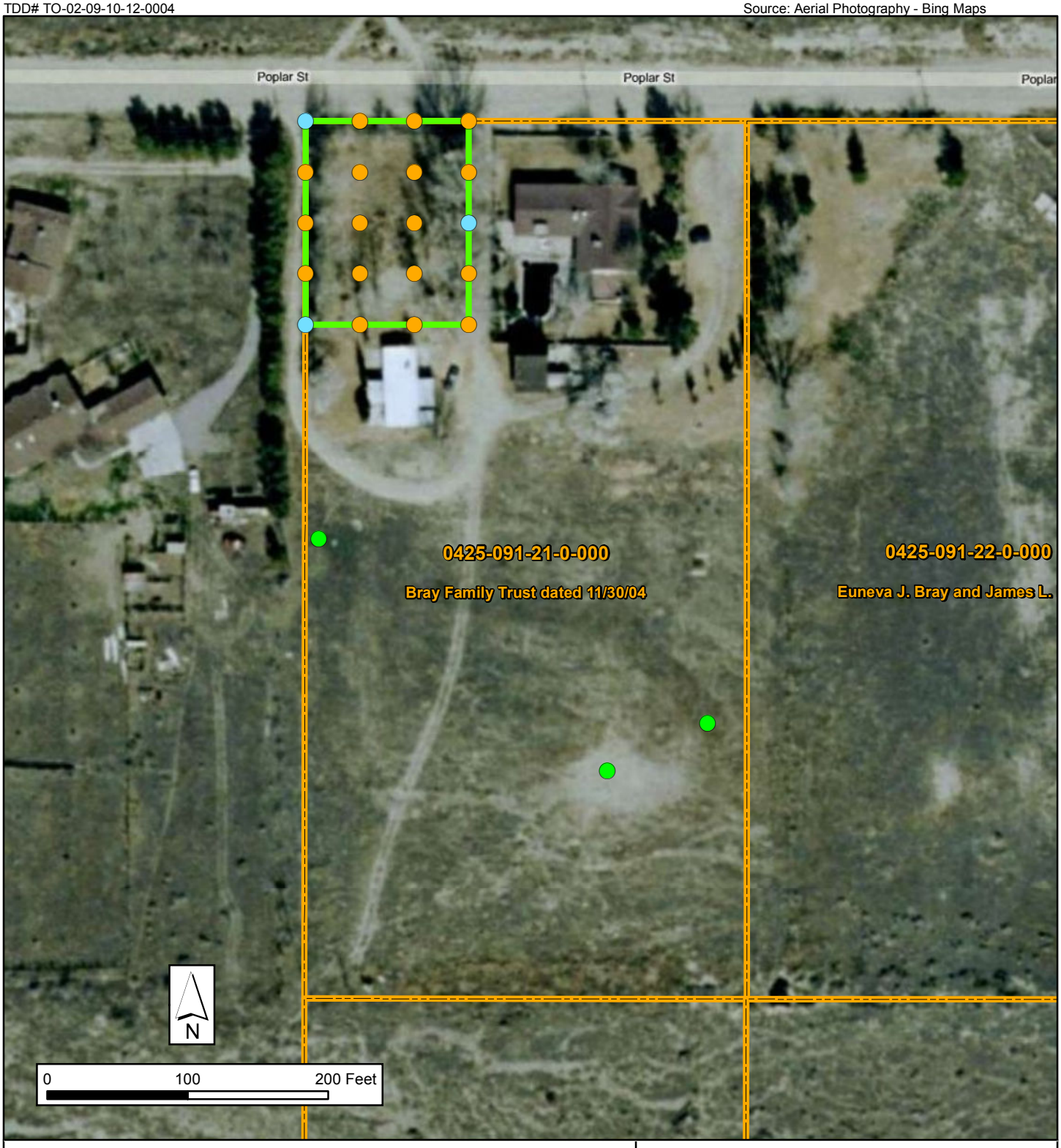
Site Location Map
Mojave River Pyrotechnics Assessment

Barstow, San Bernardino County, California

ecology and environment, inc.
International Specialists in the Environment

Project # 002693.2125.01RA
TDD# TO-02-09-10-12-0004

Source: Aerial Photography - Bing Maps



LEGEND

- Biased Sample Location
- Grid Soil Sample Location
- Grid Soil and Water Sample Location
- Garden area
- Parcel boundary

Figure 4-1

Proposed Sample Locations Mojave River Pyrotechnics Assessment

Barstow, San Bernardino County, California

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A December 2010 Sampling Event Results

Mojave River Pyrotechnics Assessment
Analytical Results
Samples Collected December 20, 2010
mg/kg

TDD No. 02-09-10-12-0003 E&E Project No. 002693.2124.01RA

Analyte	MRPA-1	MRPA-2	MRPA-3	MRPA-4	MRPA-5	MRPA-6	MRPA-7
Perchlorate	130,000	120	120,000	4,800	36	2.9	2.3
Nitrate (as N)	<1.1	<1.2	15	<1.0	83	25	3.3
Sulfate	8.8	6.8	71	<5.2	410	260	120
Mercury	0.026	0.016	0.017	<0.026	0.031	<0.031	<0.029
Antimony	<2.3	<2.2	<2.1	<2.1	<2.3	<2.5	<2.3
Arsenic	12	1.9	10	<2.1	2.4	<2.5	2.5
Barium	16	91	16	15	120	92	87
Beryllium	<0.11	0.29	0.07	0.10	0.31	0.19	0.24
Cadmium	<0.57	<0.54	<0.53	<0.52	<0.58	<0.62	<0.58
Chromium	17	7.5	13	2.6	8.4	5.8	9.6
Cobalt	1.1	4.1	1.1	1.1	4.2	2.7	4.4
Copper	6.4	6.3	4.5	<4.1	8.0	17	12
Lead	2.3	2.6	1.7	<3.1	4.2	4.8	17
Molybdenum	<5.7	<5.4	<5.3	<5.2	<5.8	<6.2	<5.8
Nickel	62	4.6	43	<5.2	5.0	3.7	5.7
Selenium	<2.3	<2.2	<2.1	<2.1	<2.3	<2.5	<2.3
Silver	<1.1	<1.1	<1.1	<1.0	<1.2	<1.2	<1.2
Thallium	<5.7	<5.4	<5.3	<5.2	<5.8	<6.2	<5.8
Vanadium	4.0	24	5.7	6.9	26	17	20
Zinc	8.4	34	9.1	8.3	45	61	36

Path: M:\SanFrancisco\START_Project\AerialPhotoMap2.mxd

Base Map Source: Cal-Atlas 2009; ESRI 2009; USGS 1993;
California Interagency Watershed Mapping Committee 1999

● Sample Location

Mojave River Pyrotechnics Assessment
Samples Collected December 20, 2010
30433 Poplar Street
Barstow, California

B Data Quality Objectives

Mojave River Pyrotechnics Assessment

Data Quality Objectives (DQO) Process Document
Objective Outputs

Contract: EP-S5-08-01
TDD No.: TO2-09-10-12-0003
Job No.: 002693.2124.01RA

In December 2010, the United States Environmental Protection Agency (U.S. EPA) Region IX Emergency Response Section's Superfund Technical Assessment and Response Team (START) Project Officer directed the Ecology and Environment, Inc. START to support a U.S. EPA-funded assessment of soils and groundwater at a residential property located at 30433 Poplar Street (site) in the city of Barstow, San Bernardino County, California. To support the U.S. EPA's environmental data collection activities, the START has developed these project data quality objectives (DQOs), which will be used to develop the Mojave River Pyrotechnics Assessment Sampling and Analysis Plan (SAP). These DQOs are included as Appendix B of the SAP.

1. THE PROBLEM

Background:
The Mojave River Pyrotechnics Assessment site consists of four conjoined 5-acre parcels located at 30433 Poplar Street in the City of Barstow, San Bernardino County, California. The San Bernardino County Assessor Parcel Numbers (APNs) for the property are 0425-091-21-0-000, 0425-091-22-0-000, 0425-091-23-0-000, and 0425-091-24-0-000. The location of the site is 34° 54' 44.09" North Latitude, 116° 59' 56.37" West Longitude. The Mojave River drainage channel is immediately adjacent to the site to the south. The site is situated approximately 0.25 mile south of Old Highway 58 and one mile northwest of Interstate 15.

The site is the former residence of a fireworks manufacturing company owner. The California Regional Water Quality Control Board (RWQCB) – Lahontan Region, concerned about elevated perchlorate concentrations found in groundwater wells in the vicinity of the site, is investigating the possibility that the owner disposed of chemicals on the site property. The RWQCB has requested assistance from the U.S. EPA Emergency Response Section (ERS) in assessing the property.

The northwestern of the four parcels (APN 0425-091-21-0-000) contains two residential structures and associated outbuildings in the northern portion of the parcel, with the remainder of the parcel consisting of undeveloped land. The other three of the four parcels are also undeveloped land. Adjacent to the north of the site is Poplar Street, on the other side of which is undeveloped property. Residential properties are present immediately west and northeast of the site, but the majority of the immediate surrounding area is undeveloped until in closer proximity to Old Highway 58 to the north and east.

On December 20, 2010, surface and shallow soil sampling was conducted by the U.S. EPA and the START at the northwestern parcel. The deepest of the samples was collected from 32 to 36 inches below ground surface (bgs). A total of seven soil samples were collected and analyzed for perchlorate, nitrate, sulfate, and metals. Two surface (0 – 6 inches bgs) soil samples, MRPA-1 and MRPA-2, were collected in

a “garden area” approximately 115 feet by 145 feet in size, located in the northwest corner of the northwestern parcel. The garden area was reportedly identified by neighbors as a location where unauthorized dumping may have occurred, and during the December 2010 sampling event, a white precipitate was observed in soils within the garden area. Soil samples MRPA-3 and MRPA-4 were collected at 12 – 15 inches bgs and 32 – 36 inches bgs, respectively, from the same location as MRPA-2. Surface soil sample MRPA-5 was collected by compositing five individual aliquots from a grid pattern distributed within the garden area. Surface soil sample MRPA-6 was collected by compositing four individual aliquots from a fire pit located to the rear of the primary residence in the northwestern parcel. In the southwest corner of the northwestern parcel, four surface soil aliquots collected from the end of a footpath were composited as sample MRPA-7. The December 2010 sampling locations are presented in Appendix A of the SAP.

Perchlorate concentrations in the soil samples ranged from 2.3 milligrams per kilogram (mg/kg) in MRPA-7 to a maximum detected concentration of 130,000 mg/kg in MRPA-1. While MRPA-2 contained a perchlorate concentration of 120 mg/kg, the perchlorate concentration increased to 120,000 mg/kg in MRPA-3 (the 12 – 15 inches bgs sample). MRPA-4 (32 – 36 inches bgs), at 4,800 mg/kg perchlorate, was also still elevated above the surface soil sample at that location. Concentrations of perchlorate in MRPA-5 and MRPA-6 were 36 mg/kg and 2.9 mg/kg, respectively. Nitrate concentrations ranged from not detected to 83 mg/kg. Sulfate concentrations ranged from not detected to 410 mg/kg. Metals results were compared to U.S. EPA Regional Screening Levels (RSLs) for residential soil. Arsenic concentrations, which ranged from less than 2.1 (<2.1) to 12 mg/kg, exceeded the arsenic RSL of 0.39 mg/kg, and vanadium concentrations, which ranged from 4.0 to 26 mg/kg, exceeded the vanadium RSL of 5.5 mg/kg. Other metals concentrations did not exceed their respective RSLs. However, background metals concentrations for the area were not established as part of the sampling. The perchlorate, nitrate, sulfate, and metals results for the December 2010 soil sampling event are presented in Appendix A of the SAP.

Based on the perchlorate concentrations detected in soil in the garden area, additional subsurface soil sampling as well as groundwater sampling has been proposed to further delineate the lateral and vertical extent of perchlorate contamination in the garden area and to identify other potential locations of perchlorate contamination in areas of concern.

Conceptual Site Model:

- The media of concern are soil and groundwater at the site.
- The contaminant of potential concern is perchlorate.
- The soil at the site was potentially contaminated with perchlorate due to suspected unauthorized disposal of chemicals associated with fireworks manufacturing.
- The suspected historical release of chemicals at the site has resulted in shallow soils impacted by perchlorate.
- The suspected historical release of perchlorate at the site has potentially impacted groundwater.

Exposure Scenario:

Current Conditions

- Concerns based on current conditions include: 1) direct exposure of human and/or environmental receptors to perchlorate in soils; 2) direct exposure of human and/or environmental receptors to perchlorate in groundwater; and 3) vertical migration of perchlorate through subsurface soil to underlying groundwater aquifers.

Removal Action Conditions

- The conditions at the site during any future removal action may pose an additional threat to human health and the environment. Direct exposure of human and/or environmental receptors to perchlorate-contaminated soils is of concern during a removal.
- Soils removed from the site may also pose a threat to human health during transportation and disposal.

Post Removal

- While removal of perchlorate-containing soils at the site may significantly reduce the potential for human and/or environmental exposure to perchlorate concentrations in soil, as well as reduce the potential for perchlorate migration to groundwater, residual perchlorate concentrations in groundwater may still pose a threat to human health and the environment.

Planning Team:

Mr. Will Duncan, U.S. EPA Federal On-Scene Coordinator (FOSC)
Mr. Howard Edwards, START Quality Assurance Officer
Mr. Michael Schwennesen, START Project Manager
Analytical Laboratory – U.S. EPA Region 9 Laboratory or START Basic Ordering Agreement (BOA) lab.

The Roles and Responsibilities for this investigation are as follows:

- **Will Duncan, U.S. EPA FOSC**, will be the primary decision-maker and will direct the project, specify tasks, and ensure that the project is proceeding on schedule and within budget. Additional duties include coordination of all preliminary and final reporting and communication with the START Project Manager.
- **Howard Edwards, START Quality Assurance Officer**, will provide quality assurance oversight to ensure that planning and plan implementation are in accordance with U.S. EPA regional quality assurance/quality control (QA/QC) protocol. He will provide technical direction concerning QA/QC as needed to the U.S. EPA FOSC and the START project manager.
- **Michael Schwennesen, START Project Manager**, will coordinate with the planning team to develop objectives and complete an approved SAP. The START Project Manager will have the responsibility for implementation of the SAP, coordination of project tasks, coordination of field sampling, project management, and completion of all preliminary and final reporting.

Available Resources:

The current START budget for environmental data collection and reporting is $49,800, which includes activities related to the planning, sampling, laboratory analysis, data evaluation, and reporting for the Mojave River Pyrotechnics Assessment.

Other Considerations and Constraints Related to Problem and Resources:

- The scheduling of data collection activities is determined by the U.S. EPA-funded assessment schedule. Mobilization to the site for assessment activities is scheduled to begin on March 21, 2011. START field work is not expected to exceed five field days.
- Soil analyses available for assessment are not always useful for determining disposal and remediation costs. Additional waste testing of excavated soil is usually necessary to determine disposal requirements.
- Contamination not found during the soil investigation might be encountered during a removal if the sample areas are not adequately defined during the assessment.

2. THE DECISION

Primary and Secondary Study Questions:

Primary Study Question #1: What is the lateral and vertical extent of perchlorate-contaminated soils in the area of concern (garden area) that exceed the site screening levels?

Secondary Study Question #1: Do soils in additional areas of concern at the site (as identified by site observations or aerial photographs) contain perchlorate at concentrations that exceed the site screening levels?

Primary Study Question #2: Does groundwater at the site contain perchlorate at concentrations that exceed the site screening levels?

Actions that could Result from Resolution of the Study Questions:

For Primary and Secondary Study Questions #1:

If it is resolved that the lateral and/or vertical extent of perchlorate contamination in the garden area has not been defined, then further assessment to delineate extent may be initiated.

If it is resolved that the lateral and/or vertical extent of perchlorate contamination in the garden area has been defined, then no further delineation will be required.

If the lateral and vertical extent of perchlorate contamination in the garden area is defined, the delineation will be used as a guide for planning future assessment or removal activities.

If it is resolved that the perchlorate concentrations in soil in a sampling location in a specific area of concern at the site do not exceed any screening level, then the information may be used to support a determination that no further action is needed for that area of the site.

If it is resolved that the soil in a sampling location in a specific area of concern at the site contains perchlorate at concentrations that exceed screening levels, then further assessment and/or actions may be warranted in that area of the site.

For Primary Study Question #2:

If it is resolved that perchlorate in groundwater does not exceed any screening level, then the information may be used to support a determination that no further action is needed.

If it is resolved that perchlorate in groundwater is present at concentrations that exceed screening levels, then further assessment may be warranted.

Decision Statement(s):

Soil analytical data will be used to evaluate the lateral and vertical extent of perchlorate at concentrations above screening levels in the garden area soils at the site. Soil analytical data will also be used to evaluate if perchlorate is present in soil at concentrations above screening levels in specific areas of concern at the site. Groundwater analytical data will be used to evaluate if perchlorate is present in groundwater at concentrations above screening levels at the site.

- The location and extent of soils at the site containing perchlorate at concentrations that exceed site screening levels will be determined in order to assist the U.S. EPA in establishing the need to conduct further assessment or actions.
- The presence of groundwater at the site containing perchlorate at concentrations that exceed site screening levels will be determined in order to assist the U.S. EPA in establishing the need to conduct further assessment.

3. DECISION INPUTS

Sources of Information Currently Available:

- Surface and shallow soil data collected during U.S. EPA/START December 2010 sampling event (see Appendix A of the SAP).

New Environmental Data Required to Resolve the Decision Statements:

- Definitive analytical data for perchlorate at the site (between 0 and 20 feet below ground surface [bgs], to a maximum of approximately 50 feet bgs).
- Physical site data such as observations of soil types beneath the site.
- Definitive analytical data for perchlorate in groundwater beneath the site.
- Geospatial (location) data for the area and sampling locations.

Sources of Information to Resolve the Decision Statements:

- Analytical data from proposed sampling.
- Global Positioning System (GPS) location data from proposed sampling.

Information Needed to Establish Site Screening Level:

Potential screening levels for COPCs may come from the following sources:

- U.S. EPA Region 9 RSLs for Residential Soil (November, 2010).
- California EPA Office of Environmental Health Hazard Assessment (OEHHA) maximum contaminant levels (MCLs)/Public Health Goals (PHGs).

Measurement Methods:

Collected soil and groundwater samples can be definitively analyzed to determine perchlorate concentrations by the U.S. EPA methods as follows:

- Perchlorate by U.S. EPA Method 314.0.

Confirm that Appropriate (Analytical) Methods Exist to Provide the Necessary Data:

All indicated definitive methods have sufficient sensitivity, accuracy, precision, and other quality parameters to generate necessary data. See Table 3-1 of the SAP for additional information.

4. DEFINE THE STUDY BOUNDARIES

Specific Characteristics that Define Population Being Studied:

- The spatial distribution of perchlorate in soils within the specified spatial and temporal boundaries.
- The perchlorate concentrations in soils within the specified spatial and temporal boundaries.
- The perchlorate concentrations in groundwater within the specific spatial and temporal boundaries.

Spatial Boundaries:
The investigation boundaries will be the property boundaries of the northwestern-most of the four 5-acre parcels (APN 0425-091-21-0-000), with potential extension of the spatial boundaries to include the other three 5-acre parcels depending on site observations. The boundary will encompass the specified area to a depth of approximately 50 feet bgs, the deepest depth at which first encountered groundwater is anticipated.

Temporal Boundaries:
The decisions will apply to determinations of risk associated with long-term direct exposure to contaminated soils as well as potential future migration to groundwater. However, the decision may also apply to short-term (acute) exposure during potential future removal activities.

Perchlorates are environmentally persistent, and perchlorate salts are readily soluble in water. Perchlorate is also a widespread contaminant in drinking water in the State of California.

The timeframe of the planned assessment is as follows:

- The SAP will be submitted to the U.S. EPA by March 14, 2011.
- Sample collection will take place beginning March 21, 2011.
- Preliminary analytical data will be reported to START approximately three weeks after sample delivery to the laboratory.
- Data packages and final data should be reported to project management approximately 5 weeks after sample delivery to the laboratory.

Practical Constraints on Data Collection:

<u>Physical Constraints:</u>

- The two structures on the property may prevent delineation to the east and south of the area of concern.
- Geoprobe refusal in the subsurface will limit the vertical extent of sampling. Repeated sampling attempts at locations near refusal locations will proceed within practical time and effort constraints.
- Groundwater and vadose zone soil sampling may be inhibited if groundwater is first encountered at a depth difficult to attain or through a soil type difficult to penetrate using a Geoprobe®. Groundwater has been estimated by the RWQCB to occur at depths between 25 and 50 feet bgs. Soil type is unknown.

<u>Other Constraints on Data Collection</u>

- The turnaround times on data are always estimated and cannot be assured. Sample and system problems may indiscriminately increase data turnaround times.
- Definitive data will undergo a U.S. EPA Region 9 Tier 2 validation prior to final reporting.

5. DECISION RULE

Statistical Parameter:
One goal of the assessment sampling is to generate a geographically distributed set of data points (which is not a statistical parameter). Each data point will be used to determine the contaminant concentration at that location. The data points will be used to locate contamination hot spots and may be used to represent the geographic distribution of contamination.

To meet additional sampling objectives, statistical analysis may be used to determine parameters such as the range of contaminant concentrations, average concentration, and contamination variability within the decision area. It will be necessary to consider an individual sampling data point as representing the contaminant concentration within a specific area.

Site Screening Level:

- For perchlorate in soil, the U.S. EPA Region 9 RSL for residential soil (November, 2010) will be used.
- For perchlorate in groundwater, the California EPA/OEHHA MCL/PHG will be used.

Refer to Table 5.1 for site soil and groundwater screening levels.

Decision Rule:
If the new data indicate that contaminant concentrations in soils and/or groundwater at the site are above the site screening levels, then decision-makers will decide whether further assessment and potential action are required in order to protect human health and/or the environment.

Table 5.1
Potential Site Screening Levels for Soil and Groundwater
Mojave River Pyrotechnics Assessment

E & E Project No.: 002693.2124.01RA TDD No.: TO2-09-10-12-0003

Contaminants of Potential Concern	Site Screening Level	
	Soil (mg/kg) [1]	Groundwater (µg/L) [2]
Perchlorate/perchlorate salts	55	6.0

[1] United States Environmental Protection Agency (U.S. EPA) Region 9 Regional Screening Levels for Residential Soil (November, 2010)
[2] Perchlorate: California EPA/Office of Environmental Health Hazard Assessment Maximum Contaminant Level (MCL)/Public Health Goal
mg/kg – milligrams per kilogram µg/L – micrograms per liter
N/A – Not Available

6. LIMITS ON DECISION ERRORS

Range of the Parameter(s) of Interest:
For all investigation areas and parameters, the range of interest for a COPC is from ½ the site screening level to anything above the site screening levels. Quantitatively precise and accurate determinations of contaminant concentrations that are significantly above (i.e., >100 times) the site screening level are not necessary.

Based upon previous investigations, soils containing perchlorate are expected to be present at the site at concentrations above site screening levels.

Baseline Condition *(The Null Hypothesis)*:
The contaminant concentrations in soil and/or groundwater are equal to or greater than the site screening levels.

Alternative Condition *(The Alternative Hypothesis)*:
The contaminant concentrations in soil and/or groundwater are less than site screening levels.

Decision Error
A discussion of decision error and decision error goals is presented in Tables 6-1 and 6-2.

TABLE 6-1 DECISION ERRORS
Soil and Groundwater
Mojave River Pyrotechnics Assessment

E & E Project No.: 002693.2124.01RA TDD No.: TO2-09-10-12-0003

Decision Error	Deciding that an area is contaminated and requires restrictions, additional investigation, and mitigation when the site is not contaminated.	Deciding that an area is not contaminated and requires no restrictions, additional investigations or mitigation when the site is contaminated.
True Nature of Decision Error	The sample concentrations are either not representative or are biased high.	The sample concentrations are either not representative or are biased low.
The Consequence of Error	1) Development of the site will have restrictions and will undergo additional investigation or additional mitigating activities. These situations would cost additional resources of time, money, and manpower and could negatively impact the environment. This could limit use of the site.	1) Site occupants could be directly exposed to contaminants. 2) The COPCs in contaminated soil could potentially migrate throughout the area or migrate vertically to impact groundwater. 3) The COPCs in contaminated groundwater could continue to migrate and could potentially impact drinking water. 3) The contaminants could become more exposed and more accessible if the site is in use.
Which Decision Error Has More Severe Consequences Near the Screening Level?	**LESS SEVERE** To human health, but with appreciable economic consequences.	**MORE SEVERE** Since the contaminated soil may pose risks to human health and/or the environment.
Error Type Based on Consequences	**False Acceptance Decisions** A decision that the area is contaminated when it is not.	**False Rejection Decisions** A decision that the area is not contaminated when it is.

Definitions
False Acceptance Decisions = A false acceptance decision error occurs when the null hypothesis is not rejected when it is false.
False Rejection Decisions = A false rejection decision error occurs when the null hypothesis is rejected when it is true.

Because a judgmental sampling approach will be utilized for groundwater sampling and for a portion of the soil sampling, decision error limit goals were determined only for the systematic soil sampling in the garden area.

TABLE 6-2 DECISION ERROR LIMIT GOALS
Soil – Garden Area
Mojave River Pyrotechnics Assessment

E & E Project No.: 002693.2124.01RA TDD No.: TO2-09-10-12-0003

True Average Concentration of Area (% of Screening Level [SL])	Decision Error	Typical Decision Error Probability Goals (Based on Professional Judgment)	Type of Decision Error
<75 %	A decision that a portion of the site is contaminated when it is not.	Less than 5 %	False Acceptance
75 to <100 % SL	A decision that a portion of the site is contaminated when it is not.	Gray Area [1]	False Acceptance
100 to 150 % SL	A decision that a portion of the site is not contaminated when it is.	10 % [2]	False Rejection
> 150 %	A decision that a portion of the site is not contaminated when it is.	less than 1%	False Rejection

The goals in this table are based on professional judgment as relevant to the Soil Assessment.

[1] Gray Area is where relatively large decision errors are acceptable.

[2] Note that relatively large decision errors are expected when the true contaminant concentrations are between 100 and 150 % of the screening level. Decreasing the probability is not possible since sampling and analytical uncertainties and biases cannot be eliminated.

7. OPTIMIZED DESIGN FOR OBTAINING DATA

General:
All activities and documentation related to the project should proceed under a Quality Management Plan. All sampling, analytical, and quality assurance activities will proceed under a U.S. EPA-approved SAP. A record of sampling activities and deviation from the SAP must be documented in a bound field log book. Prior to sample collection, all project sampling personnel will review relevant sampling procedures and relevant QA/QC requirements for selected analytical methods.

Decision Error Minimization:

Average Concentrations
In order to minimize a decision error related to data uncertainty, the decision-maker should consider statistical evaluations of the data prior to making decisions.

Data from Individual Sample Locations
The decision-maker should consider data uncertainty when making decisions based upon sampling data and associated estimated values based upon a single location. An individual data value reported below the site screening level may potentially be biased low, while a data value reported above the site screening level may potentially be biased high. The probability of decision errors increases at COPC concentrations around the site screening level due to both data uncertainty and data bias.

For any reported values near the method detection limit, the uncertainty of any given value is even greater. Thus the probability of decision error is greatly increased at COPC concentrations near detection limits. The uncertainty for estimated data (i.e., data based on extrapolations and interpolations) is typically greater than for actual data. Therefore, the probability of decision errors is greatly increased for extrapolated data.

Due to the nature of the deposition of contamination, it is reasonable to assume that data from any individual sample locations on this site can represent a larger area. However, there are insufficient data to determine the confidence of any single sampling location. Thus the decision-maker should acknowledge that discrete data points could potentially not be representative of any greater area.

Contamination Distribution Map
Data from sampling locations can be used to create a contamination distribution map. The mapped contaminant concentrations indicated within an area should generally be based upon the sample data from that area and the sample data from adjacent locations (particularly if discrete sample data are being used). The generated map model could be used to estimate the concentrations of contamination throughout the property. The decision-maker should consider the data source and statistical sophistication of the distribution map prior to making decisions based upon the map.

Search Grid Size
Decision-makers should consider the sizes and probability of missing a contamination hot spot when evaluating sampling grid data.

Decision Error Limits
There are limited contaminant data available for the soils and groundwater at this site. Therefore, a sampling design constructed specifically to meet the decision error limits discussed in Step 6 is not possible. Data generated from this investigation may be used to determine whether decision error goals have been achieved.

Specific Design Optimization:
Based upon the project's goals and objectives, the Planning Team considered the following design elements as necessary to achieve the DQOs:

- The collection of soil samples for perchlorate analysis.
- The collection of groundwater samples for perchlorate analysis.
- Systematic soil sampling within the garden area.
- Biased judgmental soil sampling at individual locations of concern in other portions of the site selected based on visual observations.
- Judgmental groundwater sampling at locations distributed within the garden area.
- Generation of data that will indicate the geographical distribution of contamination (GPS data).

The objectives of the sampling are: 1) to evaluate perchlorate concentrations in soils within the garden area at the site; 2) to evaluate the lateral and vertical extent of perchlorate concentrations that exceed the screening level in soil within the garden area; 3) to evaluate perchlorate concentrations in soils at areas of concern in other portions of the site selected based on visual observations of historical aerial photographs; and 4) to evaluate perchlorate concentrations in groundwater beneath the garden area at the site.

The primary sampling area is the garden area located in the northwest corner of the northwest residential parcel of the site (APN 0425-091-21-0-000). During the December 2010 sampling, the garden area was the location of the surface and shallow subsurface soil samples in which elevated perchlorate concentrations were detected. Based on review of historical aerial photographs, additional sample areas were identified to the rear of this parcel as potential historical storage or unauthorized disposal areas. A subsurface geophysical survey will be conducted in the garden area and the potential historical storage areas prior to sampling to determine whether any anomalous subsurface features are present. Additionally, during the proposed March 2011 sampling event, the other three parcels that make up the site will be evaluated visually to identify any potential areas of concern. Potential areas of concern identified in the other three parcels may be selected for targeted geophysical surveys and potential subsequent soil sampling; however, a sampling plan has not been established as part of this SAP for the three remaining parcels.

In consultation with the U.S. EPA, a grid sampling design combined with judgmental sampling was selected to meet the specified DQOs. A rectangular grid of 20 soil boring locations was situated to cover the entire garden area, including the perimeters. Visual Sample Plan, Version 6.0 (Battelle Memorial Institute 2010) (VSP) was used to determine that the specified grid will detect a circular hotspot with a radius of at least 27 feet.

Three additional judgmental boring locations were selected, in consultation with the U.S. EPA, for locations in the southern half of the northwestern parcel. Based on review of historical aerial photographs, the northwestern and southeastern of the three biased sample locations are situated at either end of a visible pathway or trail that may have been used to traverse historical storage or disposal areas. The third biased sample location is located in an area that historical aerial photographs show to have been fenced at one time, possibly indicating a storage or disposal area. Proposed sampling locations are presented in Figure 4-1 of the SAP.

Four vertical soil samples per each of the 23 boring locations will be collected at 1 foot bgs (6 – 12 inches bgs), 3 feet bgs, 6 feet bgs, and 10 feet bgs. Based on field observations, up to five sample locations in the garden area may be selected for additional sampling at 15 and 20 feet bgs. At three boring locations in the garden area grid, situated at the northwestern and southwestern corners and in the center of the eastern

perimeter, groundwater samples will be collected. A fourth boring location may be added on the north side of Poplar Street, for collection of an additional groundwater sample. At these borings, soil samples will be collected to 20 feet bgs at the intervals described above; below 20 feet bgs, soil samples will be collected at 10-foot intervals to first encountered groundwater and will also be collected in the vadose zone immediately above first encountered groundwater. Groundwater is estimated to occur between 25 and 50 feet bgs.

An estimated 117 systematic and judgmental soil samples are proposed within the gridded garden area and at the three biased sample locations. Three groundwater samples are proposed within the garden area. Sample locations at the other three parcels that make up the site or across Poplar Street will not be collected without prior direction from the FOSC.

The following methods of soil and groundwater sampling may be used at the site:

- A Geoprobe® with Macrocore or Largebore sampling device will use direct push technology to advance the soil boring to the boring termination depth. During boring advancement, the Geoprobe® will collect soil cores in a polyethylene terephthalate glycol (PETG) sample liner in discrete intervals encompassing the target sampling depth. Soils will be transferred from the sample sleeve at the appropriate target depth to the appropriate container for transportation to the laboratory.
- A hand auger may be used to advance the boring to the desired depth in areas suspected of potential underground obstructions. After the hand auger is used to advance to the target sampling depth, the soils will be transferred from the auger to the appropriate sample containers.
- At the three boring locations selected for groundwater sampling, the Geoprobe® will be advanced to first encountered groundwater. Soils will be collected and observed during boring advancement to characterize lithology and to identify when groundwater is reached based on soil saturation. The boring will be terminated approximately 5 to 10 feet into groundwater. After withdrawing the Geoprobe® rods, a temporary groundwater well will be constructed using 3/4-inch diameter PVC casing riser connected to 5 to 10 feet of 0.010-inch slot PVC screen. A grab groundwater sample will be collected by lowering a bailer within the temporary well to the water level or by using tubing and valve to create a passive pumping system. The water sample will be transferred from the bailer or tubing to the appropriate sample container.

All samples will be placed in coolers and chilled with ice for storage and shipping. Duplicates, equipment blanks, and other appropriate QA/QC samples will be collected and are specified in the SAP. Data review, independent of the laboratory, will be performed on all analytical data that may be used in decision-making. The GPS coordinates (latitude and longitude) of each sampling location will be determined and documented during sampling.

If the initial sampling location is inaccessible or refusal is encountered, the boring will be moved several feet and a second attempt will be made. If a boring location was moved to an area that was not subject to a geophysical survey to identify subsurface features, the borehole will be hand augered to a depth of approximately 3 to 5 feet bgs prior to sampling using the Geoprobe®. The field sampling team will proceed to collect samples at a specific location within practical time and effort constraints.

Analysis:
All soil and groundwater samples collected will be analyzed for perchlorate by the following definitive method:

- Perchlorate by U.S. EPA Method 314.0.

C Site Specific Health and Safety Plan

D Standard Operating Procedures

F

Sampling and Analysis Plan Addendum

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Sampling and Analysis Plan
Addendum
Mojave River Pyrotechnics
Assessment

Contract No.: EP-S5-08-01
TDD No.: TO2-09-10-12-0003
Job No.: 002693.2124.01RA

July 27, 2011

Prepared for:

U.S. ENVIRONMENTAL PROTECTION AGENCY
Region IX

Prepared by:

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Mojave River Pyrotechnics Assessment
SAP Addendum 1
July 27, 2011

This SAP Addendum modifies Ecology and Environment, Inc.'s *Draft Sampling and Analysis Plan, Mojave River Pyrotechnics Assessment*, March 18, 2011. The reason for the amendment is to provide information and methodology for additional sampling activities which have become warranted due to analytical results obtained from sampling activities which were conducted under the SAP in March 2011.

The specific items described in this addendum were prescribed by FOSC Will Duncan. The items include:

- Conduct additional biased sampling using hand auger and Geoprobe at the approximate locations shown as "proposed additional sampling locations" in the attached SAP Addendum Figure 1. The sampling depths will not deviate from those described in the SAP; i.e., sample depths will be at 1, 3, 6, and 10 feet bgs, with some holes extended to collect samples at 15 and 20 feet bgs. Sample locations shown on SAP Addendum Figure 1 will be refined once in the field. The soil borings to be extended to 20 feet bgs will also be determined in the field. Additional or fewer sample locations than presented in Figure 1 may actually be sampled based on the FOSC's discretion.

- Collect samples at biased locations at surface and depth at the former fireworks manufacturing facility located at 36131 North Yucca Street, Barstow, California. The sampling locations and depths will be determined by FOSC Duncan when in the field.

- In addition to sending all samples to the U.S. EPA Region 9 Laboratory for analysis, attempt to analyze all soil samples in the field using a perchlorate-specific electrode and a method currently under development by the START. The information gained may provide laboratory relief during an upcoming removal action to occur at one or both locations (Poplar Street and Yucca Street).

Field methods and procedures; disposal of investigation-derived waste; sample identification, documentation, and shipment; and quality assurance/quality control parameters will not deviate from that which is described in the SAP.

G

Comparison of Field Electrode Results to Laboratory Results

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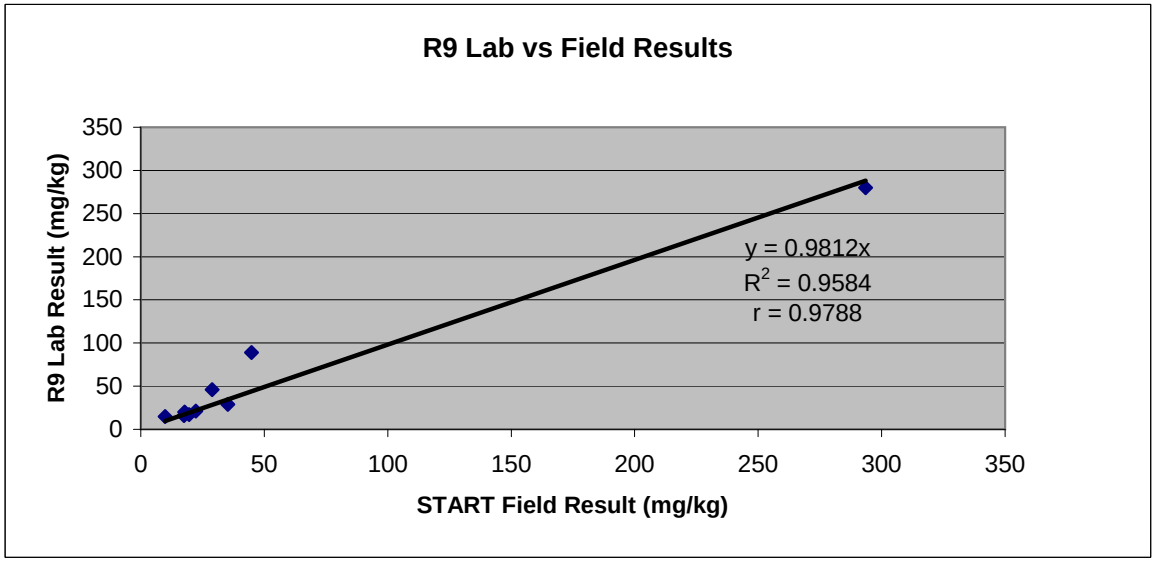
Comparison of U.S. EPA Region 9 Laboratory Results versus Field Electrode Results for Perchlorate in Soil (24 Samples Investigated)

Sample ID	START Field Result	R9 Lab Result
32-1	19.6	17
32-3	17.8	20
32-6	293.5	280
32-10	44.9	89
32-15	35.2	29
32-20	17.5	16
33-1	<1.3	0.39
33-3	28.9	46
33-6	<4.6	7.0
33-10	<1.2	<0.021
33-15	<1.2	<0.020
33-20	<0.8	<0.021
34-1	<1.4	0.30
34-3	<2.3	1.7
34-6	9.8	15
34-10	22.3	21
34-15	<1.3	<0.21
34-20	<1.1	<0.21
35-1	<6.0	2.8
35-3	<3.9	1.7
35-6	<1.4	<0.41
35-10	<2.4	0.78
36-1	<6.4	<1.0
36-3	<4.5	<1.1



Sample ID	START Field Result	R9 Lab Result
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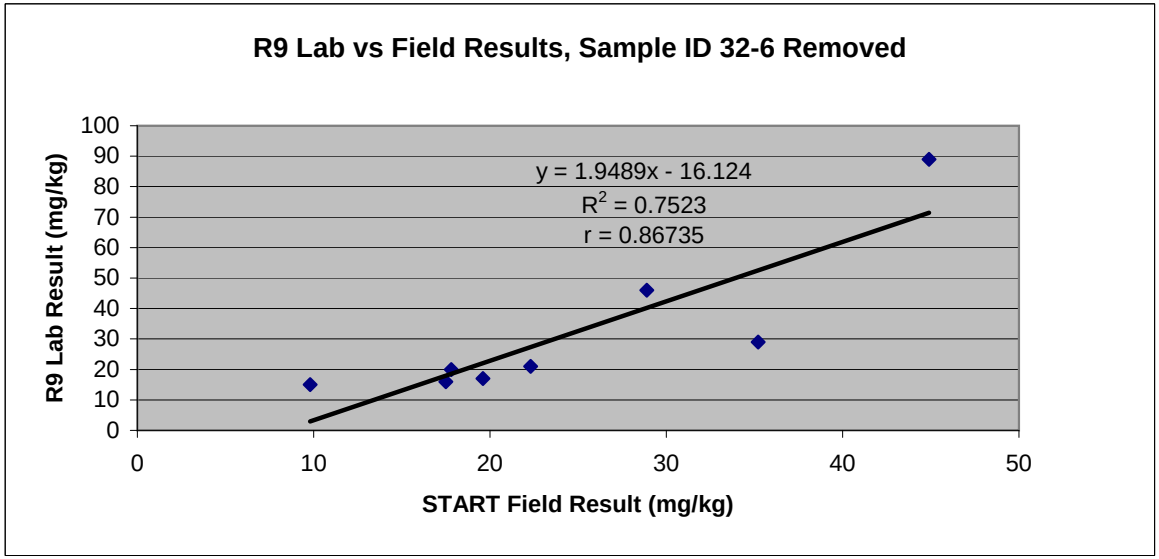
32-20	17.5	16
33-3	28.9	46
34-6	9.8	15
34-10	22.3	21



Note: Samples with a "<" value (less than reporting limit) are not plotted

H Estimate of Removal Volumes

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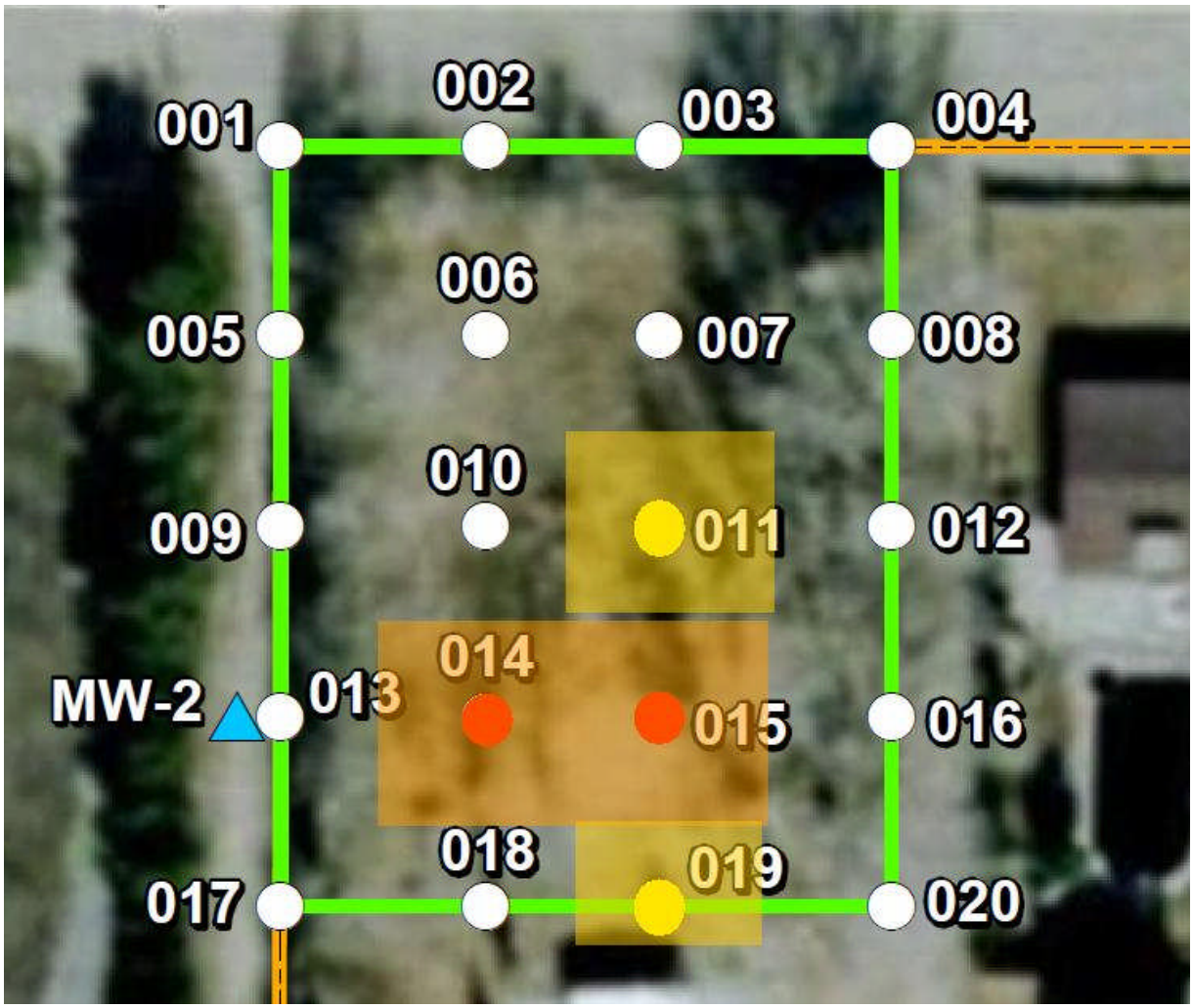
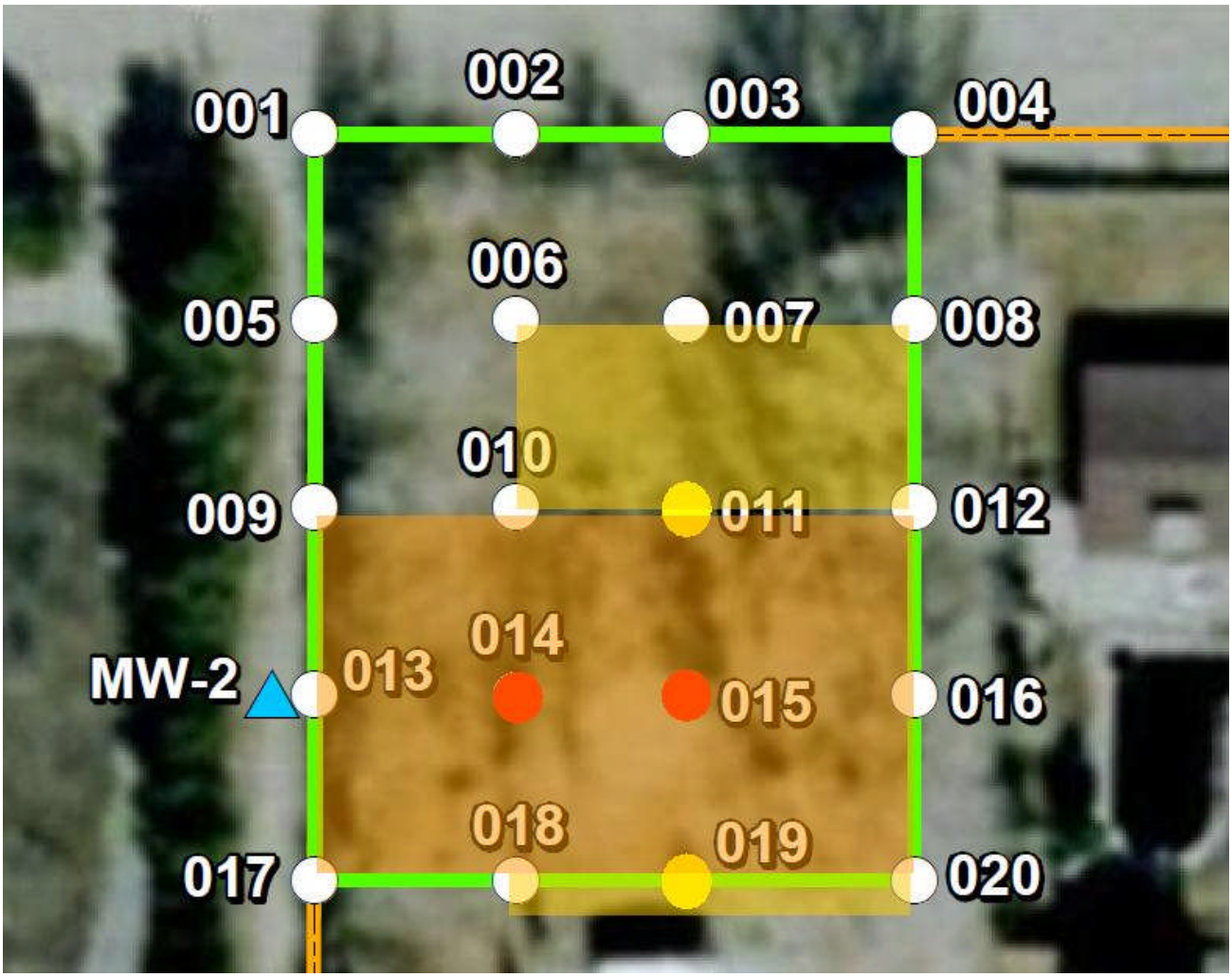


Garden Area
Proposed Excavation Option 1
3,764 Cubic Yards

Proposed excavation option 1 is based on only going halfway to adjacent "clean" sample locations. It assumes a 75x35 foot excavation to 25 feet bgs, and 40x35-foot and 40x25-foot excavations to 15 feet.



Garden Area
Proposed Excavation Option 2
9,454 Cubic Yards

Proposed excavation option 2 is determined strictly based on sample results. It assumes a 115x70-foot excavation to 25 feet, with 80x35- and 80x10-foot excavations to 15 feet.

MR-022/MR-023 Area
600 Cubic Yards

This volume assumes that the yellow area extends to a 20-foot depth and has an area of 30x25 feet; and that the orange area is a 3-foot thick lift (after "clean" cover has been removed) with an area of 45x20 feet.