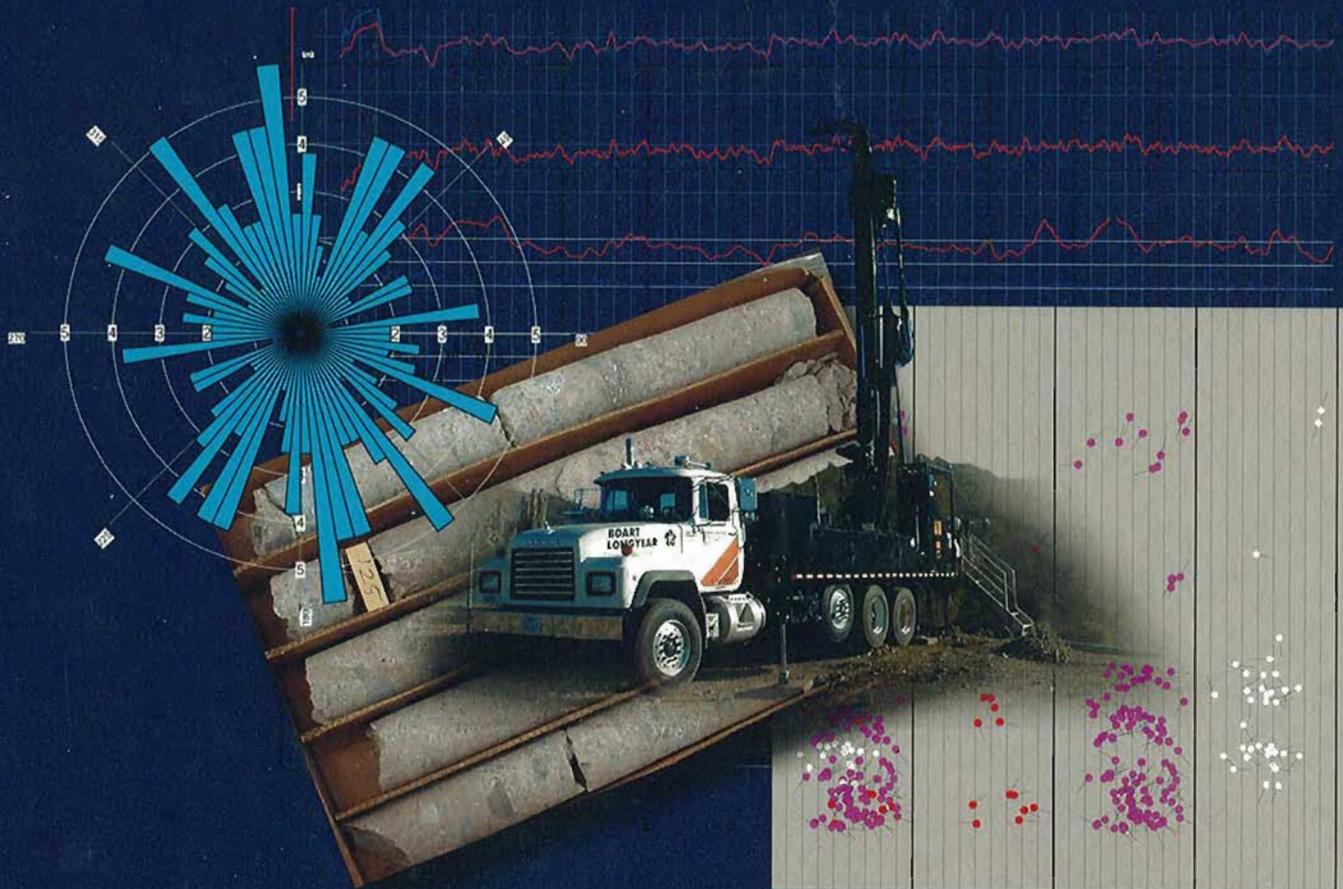


Universal Propulsion Co. Inc.

2009 ANNUAL MONITORING REPORT



DECEMBER 2010

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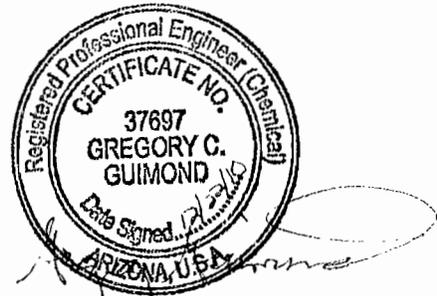
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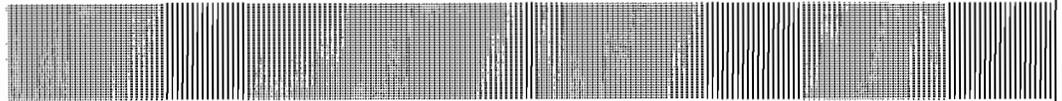
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2009 Annual Monitoring Report

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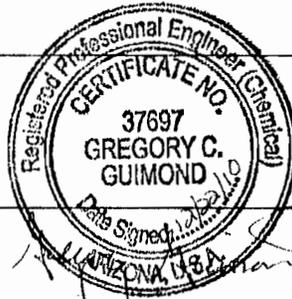
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1. Introduction

This Annual Monitoring Report (report) summarizes the monitoring activities and additional site investigations conducted at the Universal Propulsion Company, Inc. (UPCO) facility (site) in Phoenix, Arizona during 2009. The additional investigative activities included installation and monitoring of one site monitor well. This report continues to be part of an overall site characterization for soil and groundwater pursuant to Consent Order (Order) No. P-136-04 entered into between UPCO and the Arizona Department of Environmental Quality (ADEQ).

This report is supported by the Remedial Investigation Work Plan (Hargis+Associates, Inc. (H+A), 2004a), Quality Assurance Project Plan (QAPP) (H+A, 2004b), Groundwater Monitoring Plan (Malcolm Pirnie, 2004), Updated Groundwater Monitoring Plan (Malcolm Pirnie, 2008a) and the Addendum to the Supplemental Groundwater Investigation Work Plan (Malcolm Pirnie, 2009c). This report consists of the following:

- facility description;
- summary of previous groundwater investigations;
- additional site investigative activities;
- data evaluation and verification;
- summary of monitoring activities for the year;
- lists of wells that were sampled, including sample dates and analyses performed;
- table of water level measurements including, well identification, date and time of measurement, depth to water below measuring point and groundwater elevation above mean sea level;
- table of analytical data;
- hydrographs for the UPCO facility groundwater monitor wells;
- maps of groundwater elevation data;
- trend graphs of perchlorate concentrations for the UPCO facility groundwater monitor wells;
- investigation derived waste (IDW) documentation;
- copies of laboratory reports and data verification summaries; and
- recommendations for revisions to the monitoring plan.

1.1. Site Description

The UPCO operations were transferred to a facility in Fairfield, California in the fourth quarter of 2009. Demolition of the UPCO facility occurred throughout 2009 and was completed in January 2010. The site is located approximately two miles north of the Deer Valley Airport, Phoenix, Arizona (Figure 1). Specifically, the facility was at the intersection of Central Avenue and Happy Valley Road at an address of 25401 North Central Avenue. The site is within the southeast quarter of Section 5, Township 4 North, Range 3 East of the Gila and Salt River Baseline and Meridian. The UPCO operations were located on approximately 160 acres of land leased from the State of Arizona and consisted of numerous manufacturing and administrative buildings (Figure 2). A chain link fence surrounds the previous manufacturing areas and restricts general access. Locks secure each well vault and gate to limit access and deter vandalism.

2. Monitoring Network

The following types of wells were utilized for the monitoring program in 2009:

- UPCO monitor wells and a production well;
- private domestic wells; and
- a nested soil vapor monitor well.

The primary objective of groundwater monitoring is to provide data to assess groundwater quality at and near the facility for target chemical constituents. Groundwater elevation data is collected to evaluate local groundwater conditions. The study area for monitoring during 2009 included the site, some private residences along the northern property boundary, and areas approximately ½ mile to the west, south, and east of the property boundary.

The primary objective of the soil vapor monitoring is to monitor the vertical distribution of contaminants of potential concern (COPCs) in soil gas beneath the suspected volatile organic compound (VOC) source area in the B-Complex (Figure 2).

2.1. UPCO Groundwater Monitor Wells

The locations of the UPCO monitor wells are shown on Figure 3. Table 1 includes a summary of the location and well construction details for UPCO monitor wells and production well PW-1. Table 2 summarizes private wells that are included in the monitoring program. Additional information regarding drilling and well construction details for the UPCO groundwater monitor wells is provided in the following reports:

- Phase I Monitoring Well Construction Summary Report (H+A, 2004c)
- Phase II Monitoring Well Installation Report (Malcolm Pirnie, 2005)
- Phase III Monitoring Well Installation Report (Malcolm Pirnie, 2006)
- Draft Interim Remedial Investigation Report (Malcolm Pirnie, 2009a)

2.2. Private Domestic Wells

Beginning in 2004, UPCO collected groundwater samples from private wells located along Yearling Road in accordance with the Order. The Order specified that UPCO collect semi-annual groundwater samples from private wells located along Yearling Road

north of the site for perchlorate analysis for a period of two years. UPCO collected groundwater samples from various private wells, according to owner requests and authorization, beginning in 2004 and ending during the second quarter of 2006. After that period, UPCO agreed to extend the private well sampling program with the current agreement running through the completion of the Remedial Investigation (RI) activities. The locations of these private wells are shown on Figure 4. The private wells were sampled for perchlorate analysis during the second and fourth quarter of 2009.

2.3. Soil Vapor Monitor Well

Beginning in 2008, UPCO began collecting soil gas samples from a nested soil vapor monitor well (SVMW-1) in the B-Complex. The nested soil vapor monitor well is used to monitor for potential vertical migration of VOCs in soil vapor. The location of SVMW-1 is shown on Figure 3. Table 1 includes a summary of screened intervals for SVMW-1 and Appendix A provides as-built specifications. Additional information regarding drilling and well construction details for the soil vapor monitor well is provided in the draft Interim Remedial Investigation Report (Malcolm Pirnie, 2009a).

3. Monitoring Activities

3.1. Previous Groundwater Investigation Activities

A summary of previous groundwater investigation activities is presented below:

3.1.1. 2004 Activities

The UPCO facility production well (PW-1) and point of entry (POE) have been sampled periodically as part of county requirements for water service providers. During 2004, perchlorate was detected at concentrations ranging from non-detect to 2.1 micrograms per liter ($\mu\text{g/L}$).

Monitor wells MW-1 and MW-2 were installed in December 2003 and sampled three times during the first quarter of 2004. During those sampling events, perchlorate was detected in samples collected from MW-1 and MW-2 at concentrations ranging from 39 to 130 $\mu\text{g/L}$.

Monitor wells MW-3 through MW-6 were installed in August 2004 and sampled three times during the fourth quarter of 2004. Monitor wells MW-7 and MW-8 were installed in October 2004 and sampled twice during the second quarter of 2004. During those sampling events, perchlorate was detected in samples collected from MW-5 and MW-6 at concentrations of 6.4 and 18 $\mu\text{g/L}$, respectively. Perchlorate was not detected above the laboratory reporting limit (2 $\mu\text{g/L}$) in samples collected from MW-3, MW-4, MW-7, and MW-8.

UPCO and ADEQ sampled private domestic wells during the fourth quarter of 2004. ADEQ also sampled wells at the Arizona Department of Transportation (ADOT) facility located south west of the UPCO facility. Perchlorate was not detected above the laboratory reporting limit (2 $\mu\text{g/L}$) in samples collected from the private wells or at the ADOT facility.

Depth to groundwater measurements were collected monthly at each of the UPCO monitor wells during 2004.

3.1.2. 2005 Activities

Monitor wells MW-9 and MW-10 were installed in January 2005 and sampled quarterly during 2005. During those sampling events, perchlorate was not detected above the laboratory reporting limit (2 µg/L).

UPCO and ADEQ sampled private domestic wells semi-annually during 2005. Perchlorate was not detected above the laboratory reporting limit (2 µg/L) in samples collected from the private wells.

Depth to groundwater measurements were collected monthly at each of the UPCO monitor wells during 2005.

3.1.3. 2006 Activities

Monitor wells MW-11 and MW-12 were installed in December 2005 and initially sampled quarterly during 2006. During those sampling events, perchlorate was detected in samples collected from MW-11 at concentrations ranging from less than the laboratory reporting limit (2 µg/L) to 2.2 µg/L. Perchlorate was not detected above the laboratory reporting limit (2 µg/L) in samples collected from MW-12.

During the fourth quarter 2006 groundwater monitoring event conducted in November, the private wells were analyzed for perchlorate using two analytical methods. The two methods included EPA Method 314.0, which is specified in the Order, and EPA Method 332.0. This was performed for a comparative analysis between different perchlorate analytical testing methods. The results of the perchlorate comparative analysis showed concentration values ranging between 0.68 µg/L and 2.0 µg/L. The results of the perchlorate analysis for the UPCO monitor wells using both methods were analyzed for wells with perchlorate detection previously reported below 2 µg/L. Perchlorate analysis for UPCO monitor wells sampled during this quarter using Method 322.0 showed a range in concentration between 0.59 µg/L in monitor well MW-3 and 2.2 µg/L in monitor well MW-11. The HBGL specified in the Order for perchlorate is 14 µg/L.

3.1.4. 2007 Activities

In an effort to expand the evaluation of the hydrogeological conditions at the site, additional pressure transducers were installed on April 4, 2007 in four site wells (PW-1, MW-7, MW-8, and MW-10) and two private wells along Yearling Road (218 E. Yearling and 520 E. Yearling). Between the weeks of July 7 and August 6, 2007, UPCO conducted a geophysical survey and installed a pressure transducer at a third private well located along Yearling Road (18 E. Yearling). A review of groundwater level data collected to

date from the transducers indicate that the groundwater elevation in the private wells are currently lower than at the nearest site wells, MW-3 and MW-4. Wells MW-3 and MW-4 are completed in bedrock units, and both show an overall declining water level trend. More recently, some of the private well owners have also resorted to drilling deeper wells as water levels have continued to decline in the area.

During the 2007 monitoring period, perchlorate was detected in monitor wells MW-1, MW-2, MW-5, MW-6 and MW-11. Perchlorate was detected in groundwater samples collected from MW-1 at concentrations ranging from 70 µg/L to 76 µg/L; from MW-2 at concentrations ranging from 80 µg/L to 87 µg/L; from MW-5 at concentrations ranging from 19 µg/L to 22 µg/L; from MW-6 at concentrations ranging from 15 µg/L to 18 µg/L; and from MW-11 at concentrations ranging from less than 2 µg/L to 2.4 µg/L. Perchlorate was not detected at concentrations above the laboratory reporting limit (2 µg/L) in the remaining UPCO monitor wells, including the deep monitor well (MW-12) located near MW-1. Perchlorate was detected in samples collected from PW-1 and the POE at concentrations ranging from less than 2 µg/L to 3 µg/L.

Perchlorate was detected once in one of the private domestic wells at a concentration above the EPA Method 314.0 laboratory reporting limit of 2 µg/L. Perchlorate was detected in one sample collected from 520 East Yearling at a concentration of 2.4 µg/L. During the 2007 groundwater monitoring period, the site wells were analyzed for perchlorate using three analytical methods. The three methods included EPA Method 314.0, which is specified in the Order, and EPA Methods 332.0 and 6850. This was performed for a comparative analysis between different perchlorate analytical testing methods. The newer methods for perchlorate analysis were utilized in an attempt to obtain lower reporting limits and minimize potential false positives. Method 332.0 was promulgated by EPA and was approved by ADHS in January 2007.

3.1.5. 2008 Activities

Pressure transducers were removed from monitor wells MW-1, MW-6, MW-7, MW-8, MW-9 and MW-12 during the week of April 28, 2008. Additional pressure transducers were installed in monitor wells MW-14 and MW-15 during the week of September 22, 2008. Pressure transducers remained in private wells at 18 East Yearling, 218 East Yearling and 520 East Yearling, and site wells MW-3 and MW-4 based on ADEQ comments in a letter dated May 15, 2008 (Malcolm Pirnie, 2008c).

Groundwater monitor wells MW-13 through MW-15 were installed during May and June 2008 and sampled during the third and fourth quarters 2008 in accordance with the Updated Groundwater Monitoring Plan (Malcolm Pirnie, 2008a). At deep boring

location MW-13, a coring rig was used for retrieval of lithologic core samples. Zonal groundwater samples were collected at borehole locations MW-13 and MW-14 using a packer assembly or temporary well installation. Air rotary methods were used for completion of monitoring wells MW-13 through MW-15.

Geophysical testing was conducted in the MW-13 and MW-14 boreholes prior to each well installation. Geophysical logging was not conducted in borehole MW-15 due to its close proximity to the MW-14 borehole. Hydrophysical testing was conducted in the MW-14 borehole. A short duration aquifer test was also conducted at monitor well MW-14 after well installation. During the test, drawdown and recovery were monitored. Test results and summaries are presented in the draft Interim RI Report (Malcolm Pirnie, 2009a).

At soil vapor boring SVMW-1, a temporary well was constructed on October 23, 2008 from 218 to 238 feet below ground surface (bgs) for collection of a groundwater grab sample. Perchlorate was detected at 7.8 $\mu\text{g/L}$ in the grab sample. Based on results from the groundwater grab sample, the borehole was backfilled below the water table and then completed as a vadose zone nested soil vapor monitor well (SVMW-1) on November 4, 2008.

During the 2008 monitoring period, perchlorate was detected in monitor wells MW-1, MW-2, MW-5, MW-6, MW-11, MW-13 and MW-14. Perchlorate was detected in groundwater samples collected from MW-1 at concentrations ranging from 73 $\mu\text{g/L}$ to 76 $\mu\text{g/L}$; from MW-2 at concentrations ranging from 78 $\mu\text{g/L}$ to 88 $\mu\text{g/L}$; from MW-5 at concentrations ranging from 22 $\mu\text{g/L}$ to 25 $\mu\text{g/L}$; from MW-6 at concentrations ranging from 15 $\mu\text{g/L}$ to 18 $\mu\text{g/L}$; and from MW-11 at concentrations ranging from <2.0 $\mu\text{g/L}$ to 2.6 $\mu\text{g/L}$. Perchlorate was detected in samples collected from the production well, PW-1, and POE at concentrations ranging from less than 2.0 $\mu\text{g/L}$ to 2.5 $\mu\text{g/L}$. Perchlorate was detected in samples collected from MW-13 at concentrations of 220 $\mu\text{g/L}$ to 330 $\mu\text{g/L}$ and from MW-14 at concentrations of less than 2.0 $\mu\text{g/L}$ to 2.5 $\mu\text{g/L}$. The zonal sample collected from 247 to 269 feet bgs at MW-13 contained perchlorate at a concentration of 120,000 $\mu\text{g/L}$. Perchlorate was not detected at MW-3, MW-4, MW-7, MW-8, MW-9, MW-10, MW-12 or MW-15 above the laboratory reporting limit of 2.0 $\mu\text{g/L}$. Perchlorate concentrations in samples collected at MW-13 showed a declining trend in 2008.

During the 2008 monitoring period perchlorate was detected once in one of the private domestic wells at a concentration above the EPA Method 314.0 laboratory reporting limit of 2.0 $\mu\text{g/L}$. Perchlorate was detected in one sample collected from 25903 North 1st Street at a concentration of 2.2 $\mu\text{g/L}$. During the 2008 groundwater monitoring period, the

private wells were analyzed for perchlorate using two analytical test methods, EPA Method 314.0, which is specified in the Order, and EPA Method 332.0, which was performed for a comparative analysis between different perchlorate analytical testing methods. Perchlorate was detected in private wells located at 16 East Yearling Road, 412 East Yearling Road, 424 East Yearling Road, 520 East Yearling Road and 25903 North 1st Street using EPA Method 332.0 at a concentration greater than 2.0 µg/L.

Samples were collected from soil vapor monitor well, SVMW-1, on November 13, 2008. At SVMW-1 1,1-dichloroethene (1,1-DCE) was detected at concentrations ranging from 180 parts per billion by volume (ppbv) to 11,000 ppbv and acetone was detected at concentrations ranging from 530 ppbv to 1300 ppbv. Lower concentrations of 1,1-dichloroethane, 2-butanone (MEK), carbon disulfide, chloromethane, heptane, hexane, propene, tetrachloroethene, toluene and trichloroethene were also detected. Results are provided in the Final 2008 Annual Monitoring Report (Malcolm Pirnie, 2009d). The 2008 sampling activities were conducted in accordance with the schedule outlined in the 2007 Annual Groundwater Report (Malcolm Pirnie, 2008d).

3.2. 2009 Groundwater Monitoring

3.2.1. Water Level Measurements

An Updated Groundwater Monitoring Plan for UPCO was submitted to ADEQ in March 2008 (Malcolm Pirnie, 2008a). Following ADEQ's approval, groundwater measurements were collected on a monthly basis. Depth to water was measured to the nearest 0.01 foot with respect to a surveyed measurement point at the top of each well using a decontaminated electronic sounding device.

Pressure transducers were removed from private wells at 18 East Yearling Road, 218 East Yearling Road and 520 East Yearling Road on July 31, 2009 and August 24, 2009. Pressure transducers were removed from site monitor wells MW-3 and MW-4 on July 24, 2009 and July 31, 2009, and MW-14 and MW-15 on October 7, 2009 after at least one year of data was collected. Transducers have been removed from the site monitor wells and private wells. Monthly water level monitoring continues via manual measurements.

3.2.2. UPCO Facility Wells Sampling

2009 sampling activities were conducted in accordance with the schedule outlined in the Final 2008 Annual Groundwater Report (Malcolm Pirnie, 2009b). Project specific sampling procedures outlined in the Groundwater Monitoring Plan (Malcolm Pirnie, 2004), the Updated Groundwater Monitoring Plan (Malcolm Pirnie, 2008a), and industry standard methods were used. Groundwater samples were collected from UPCO

groundwater monitor wells MW-1 through MW-15 and facility production well PW-1, as outlined in the Final 2008 Annual Monitoring Report (Malcolm Pirnie, 2009b) in 2009. Installation of Phase V monitor well MW-18 was completed during the fourth quarter, 2009. Monitor well MW-18 was initially sampled on October 30, 2009. A sample was also collected at the POE on January 12, 2009. The location of the POE prior to site demolition, at the sink in the building A-1 lunchroom, no longer provided value-added data for monitoring groundwater quality at the UPCO site. Sampling at the POE for groundwater monitoring purposes was not performed beyond the first quarter 2009. UPCO continued to collect samples at the POE to remain in compliance with drinking water regulations. A list of UPCO monitor wells sampled, including dates and analysis performed, is provided in Table 3.

3.2.3. Private Wells Sampling

Private wells incorporated into the groundwater monitoring program were sampled using existing dedicated submersible pumps. Groundwater samples were collected semi-annually in the second and fourth quarters of 2009. A list of private wells that were sampled in 2009, including dates and analysis performed, is included in Table 5. The resident at 106 West Yearling was reportedly purchasing water due to insufficient well production prior to and during the scheduled fourth quarter 2009 sampling event, therefore a sample was not collected. The private well at 8 West Yearling Road was not sampled during the second quarter due to resident relocation with no forwarding contact information. The new resident at 8 West Yearling was contacted prior to the fourth quarter sampling event and the well was subsequently sampled.

3.2.4. Soil Vapor Monitor Well Sampling

Soil vapor monitor well, SVMW-1, was sampled quarterly in 2009 at intervals of 30 to 40 feet bgs; 90 to 100 feet bgs; 140 to 150 feet bgs and 190 to 200 feet bgs. A vacuum pump was used to purge approximately three well volumes at a flow rate of less than one cubic feet per minute. A one liter Summa canister fitted with a dedicated one liter per minute flow restrictor was used at each sample interval for time-integrated sample collection.

3.3. Additional Monitor Well Installation

This section summarizes the Phase V monitor well drilling and installation activities at UPCO in 2009, which included installation of monitor well MW-18. Monitor well MW-18 was installed to address potential perchlorate migration to the southwest of MW-1 between existing monitor wells MW-7 and MW-8.

Monitor well MW-18 was installed between August and September 2009. Well installation activities were completed in general accordance with the Monitor Well Construction Work Plan (H+A, 2004c), the Supplemental Groundwater Investigation Work Plan (Malcolm Pirnie, 2008e) and the Addendum to the Supplemental Groundwater Investigation Work Plan (Malcolm Pirnie, 2009c). The specifications and location of monitor well MW-18 were verified with ADEQ prior to well construction. The location of monitor well MW-18 is shown in Figure 3. Installation of Phase V monitor wells MW-16 and MW-17 was postponed in 2009, awaiting approval from the Arizona State Land Department.

3.3.1. Drilling Method

Drilling at borehole location MW-18 was accomplished using air rotary methods. A 20-foot section of low carbon steel conductor casing was grouted in place to provide a surface seal and prevent collapse of the borehole. Grab samples of the cuttings were collected at regular intervals and logged using the Unified Soil Classification System (USCS) method with United States Geological Survey (USGS) bedrock descriptions. The lithologic log for borehole MW-18 is provided in Appendix A.

The MW-18 boring was drilled to a depth of 400 feet for collection of deep zonal samples and backfilled with cement grout. Monitor well MW-18 was installed at 230 feet bgs.

3.3.2. Borehole Geophysics

Geophysical surveys were performed in the borehole for monitor well MW-18 on September 17, 2009 prior to well construction. The suite of geophysical techniques performed included:

- natural gamma ray;
- neutron;
- caliper;
- optical borehole televiewer; and
- induction resistivity.

The methods employed depended upon the stability of the borehole and potential of the borehole to produce and retain fluid. The geophysical data was collected by a variety of source and receivers. The geophysical data is presented in Appendix K.

3.3.3. Geophysical Fracture Analysis

Fracture analyses were performed in the boring for MW-18 to provide a quantitative assessment of the orientation and intensity of fractures. An optical televiewer geophysical tool collected fracture data from the boreholes. The data was digitized and reduced to conduct the fracture analyses. The orientation and depth interval were recorded for each fracture observed. Borehole geophysics collected in this boring, as well as others at the site, indicates there is not a strong preferential orientation of the fractures, as fractures are observed in a variety of orientations. A summary of the fracture analyses from the geophysical logs for MW-18 is provided in Appendix K.

3.3.4. Zonal Sampling

Depth specific (zonal) groundwater samples were collected during drilling of monitor well MW-18 at 195 feet bgs, 295 feet bgs and 390 feet bgs, on September 3, 2009, September 14, 2009, and September 16, 2009, respectively.

The MW-18 borehole was drilled to a depth of 200 feet for installation of a temporary well set with a screened interval of 175 feet to 195 feet bgs; the borehole was advanced to 303 feet bgs for installation of a temporary well set with a screened interval of 275 feet to 295 feet bgs and advanced to 396 feet bgs for installation of a temporary well set with a screened interval of 369.5 feet to 389.5 feet bgs. Temporary well sets for zonal sample collection were installed consistent with the draft Interim RI Report (Malcolm Pirnie, 2009a).

3.3.5. Monitor Well Installation

Monitor well MW-18 was installed following completion of drilling, zonal sampling and geophysical survey activities. The well was constructed in the manner outlined in the Addendum to the Supplemental Groundwater Investigation Work Plan (Malcolm Pirnie, 2009c). A summary of the well information for the UPCO facility monitor wells is included in Table 1. The as-built well construction diagram for MW-18 is provided in Appendix A.

3.3.6. Monitor Well Development

Monitor well MW-18 was developed within one week of installation. The monitor well was developed by surging and bailing. The well screen was surged in 10-foot sections from the top of the interval to the bottom for approximately 30 minutes. A bailer was used to remove settled solids that had entered the casing during surging. Approximately 40 gallons were bailed before monitoring well MW-18 was dewatered. Pumping was not used during development at monitor well MW-18 due to insufficient well recharge.

3.3.7. Well Head Completion

Following monitor well MW-18 construction and development activities a 4-inch removable well plug was installed on the open well pipe. A 12-inch diameter steel monument extending approximately 4-feet above grade surrounded by a 3-foot by 3-foot, at grade concrete pad was installed at MW-18 for surface completion on September 22, 2009. A stamped steel plate with the monitor well identification and Arizona Department of Water Resources registration number was attached to the top of the monument. Monitor well information is provided in Table 1.

3.3.8. Initial Monitor Well Sampling

Groundwater samples were collected from monitor well MW-18 on October 30, 2009 after further development with a disposable plastic bailer and a drop pump on October 7, 2009 and October 29, 2009, respectively. Results are provided in Appendix E and discussed in Section 4.

3.4. Well Head Modification Activities

Existing flush grade monitor well head vaults were converted to 4-foot above grade monument vaults to improve monitor well security. Flush grade monitor well completions at MW-1, MW-2, MW-5, MW-6, MW-12, MW-13 and SVMW-1 were converted to monument vaults during August and September, 2009. The well drop pipe, sounding tube and well pipe were extended on each well to maintain pre-modification pump intake and screened sounding tube depth bgs. Revised as-built well construction diagrams are provided in Appendix A.

Monitor well MW-13 was damaged during site demolition activities in December 2009. The surface completion, sounding tube and pump drop pipe were impacted near ground surface by demolition equipment. The surface damage was visually inspected on December 30, 2009. The sounding tube, drop pipe and pump were removed from MW-13 for inspection. A video log performed on January 4, 2010 indicated no apparent damage occurred to the below surface well casing of MW-13. The well casing, pump, drop pipe, sounding tube and surface completion were reinstalled at MW-13 on January 7, 2010.

3.5. Survey

A state registered land surveyor established horizontal and vertical control at Phase V monitor well MW-18 and the modified well heads discussed in Section 3.4. The vertical coordinates of the sounding port, top of casing, and ground surface were surveyed in the Arizona State Plane Coordinate System (NGVD 29) with units of international feet above mean sea level. The measuring point elevation of the PVC sounding tube port contained in the well seal was measured to the nearest 0.01 foot. The measuring point was marked on the north side of the port. The horizontal coordinates of the well were surveyed in the Arizona State Plane Coordinate System, Central Zone, North American Datum 1983 (NAD 83) with units of international feet. Survey information is provided in Table 1.

3.6. Investigative Derived Waste

Soil cuttings and water generated during the drilling, installation, development, and sampling of monitor well MW-18 were stored in roll-off bins or poly tanks. The soil and water were sampled and characterized prior to off-site disposal. Investigative Derived Waste (IDW) documentation related to groundwater sampling during 2009 is provided in Appendix B.

4. Data Evaluation

4.1. Groundwater Level Measurements

Groundwater elevations have been monitored at and near the UPCO facility to evaluate potential gradients. These measurements have been collected on a regular basis at UPCO site wide monitor wells and private wells located near the north property boundary at 18 East Yearling Road, 218 East Yearling Road and 520 East Yearling Road using electronic water level equipment and pressure transducers. Private well locations are shown in Figure 4.

Historic depth to groundwater measurements and groundwater elevations for site and private wells are summarized in Appendix C. Historic hydrographs are presented in Appendix D. Graphs of the transducer data collected to date are presented in Appendix D. Groundwater elevation maps for 2009 are provided on Figures 5 through 16.

The highest water elevations were observed in late 2004 to early 2005, and the lowest elevations for a majority of the wells were observed in 2009. A potential geologic structure (Malcolm Pirnie, 2009a) is located east of the area monitored by MW-6, MW-7, MW-10 and MW-18 and generally on the west side of the UPCO facility. Groundwater elevations on the west side of the structure are approximately 30 feet higher than on the east side of the structure. The wells located east of the potential geologic structure, with the exception of MW-3, MW-4, MW-14 and MW-15 showed a nearly static/slightly declining water level trend. The difference between the minimum and maximum groundwater elevations measured in each of these wells in 2009 (i.e., the groundwater elevation decline) varied between 0.33 feet in monitor well MW-9 and 1.09 feet in monitor well MW-12. Monitor wells MW-4, MW-3, MW-15 and MW-14 continue to show a generally larger decline in groundwater elevations with differences of groundwater elevations of 1.08, 1.53, 1.77, and 3.15 feet, respectively in 2009.

West of the potential geologic structure, groundwater elevations were also declining. However, monitor well MW-18 exhibited a rising trend during the last quarter 2009. The rise of 2.07 feet in MW-18 may be the result of low permeability leading to very slow recharge, and a small data set. The difference between the minimum and maximum groundwater elevations varied by 0.90 and 1.05 feet in monitor wells MW-7 and MW-10, and 1.39 feet in monitor well MW-6.

A review of groundwater elevation data collected with transducers at site and private wells indicate a general declining water level trend. The observed declining groundwater elevation trend in the transducers is in agreement with the manual measurements. Hydrographs for the private wells show pumping level drawdowns ranging from 10 to 50 feet below static levels, particularly during the on-cycles which may correlate with cumulative peak periods of use (Appendix D). This drawdown has not been observed in the nearest site wells showing, at a minimum, that the short term pumping-related drawdown does not extend very far. Although, as noted above, wells MW-3, MW-4, MW-14 and MW-15, on the north side of the site show steeper water level declines when compared to other onsite wells suggesting that the overall lowered water table to the north is propagating south toward the site. Steeper declines are also seen west of the potential geologic structure in monitor wells MW-6, MW-7 and MW-10.

4.2. Groundwater Quality Data

Tables presenting water quality analytical data for the UPCO monitor wells, UPCO production well PW-1 and the POE are summarized in Appendix E. The perchlorate results for the UPCO monitor wells are provided in Table 6. The perchlorate results for the private wells are provided in Table 7. A table presenting historic water quality analytical data for the private wells is provided in Appendix F. Perchlorate concentration trend plots for each UPCO monitor well are presented in Appendix G. Field parameter data collected during 2009 sampling events is provided in Appendix H. Figures 17 through 20 present perchlorate concentration maps for First Quarter 2009 through Fourth Quarter 2009.

4.2.1. Perchlorate

The Arizona Department of Health Services (ADHS) Health Based Guidance Level (HBGL) identified by ADEQ in the Order is 14 µg/L for perchlorate. The laboratory reporting limit using the Order-specified EPA Method 314.0 is 2.0 µg/L. During the 2009 monitoring period, perchlorate was detected in monitor wells MW-1, MW-2, MW-5, MW-6, MW-11, MW-13. Perchlorate was detected in groundwater samples collected from MW-1 at concentrations ranging from 70 µg/L to 83 µg/L; from MW-2 at concentrations ranging from 83 µg/L to 96 µg/L; from MW-5 at concentrations ranging from 23 µg/L to 27 µg/L; from MW-6 at concentrations ranging from 15 µg/L to 19 µg/L; from MW-13 at concentrations ranging from 30 µg/L to 190 µg/L and from MW-11 at concentrations ranging from less than 2.0 µg/L to 2.3 µg/L.

Perchlorate was not detected at concentrations above the laboratory reporting limit (2.0 µg/L) in the remaining UPCO monitor wells. Perchlorate was detected in samples collected from PW-1 at concentrations ranging from less than 2 µg/L to 4.8 µg/L.

During the 2009 monitoring period perchlorate was not detected in the private domestic wells at a concentration above the EPA Method 314.0 laboratory reporting limit of 2.0 µg/L.

Some of the site wells that typically did not detect perchlorate at concentrations above 2.0 µg/L, and each of the private domestic wells, were analyzed for perchlorate using two analytical test methods. The two methods included EPA Method 314.0, which is specified in the Order, and EPA Method 332.0. Two methods were performed for a comparative analysis between different perchlorate analytical testing methods. The results of the perchlorate comparative analyses for the site wells are included in Table 6, and show Method 332.0 concentration values ranging between 0.62 µg/L in monitor well MW-7 and 2.1 µg/L in monitor well MW-11. The results of the perchlorate comparative analysis for the private wells are included in Table 7, and show Method 332.0 concentration values ranging between 0.63 µg/L and 1.9 µg/L.

4.2.2. VOCs

Five VOCs were detected during 2009 groundwater sampling activities including 1,1-DCE, 1,1-DCA, 1,4-dioxane, bromoform and chloroform. These detections were at concentrations below the applicable Arizona Aquifer Water Quality Standard (AWQS). 1,1-DCE was detected in groundwater samples collected from PW-1 at concentrations ranging from less than the laboratory reporting limit of 0.5 µg/L to 6.0 µg/L. The AWQS for 1,1-DCE is 7 µg/L. 1,1-DCA was detected in groundwater samples collected from PW-1 at concentrations ranging from less than the laboratory reporting limit of 0.50 µg/L to 0.62 µg/L. A numeric standard has not been established for 1,1-DCA. 1,4-Dioxane was detected in samples collected from MW-2 and PW-1 at concentrations ranging from less than 2.0 µg/L to 2.9 µg/L. 1,4-Dioxane does not have an applicable AWQS; however, EPA Region 3, Region 6 and Region 9 have combined to form regional screening levels (RSLs), formerly known as preliminary remediation goals (PRGs). The RSL for 1,4-dioxane remains at 6.1 µg/L. Bromoform and chloroform were detected in samples collected from PW-1. These chemicals are classified as trihalomethanes and were detected below the AWQS for total trihalomethanes, which is 100 µg/L. Results for monitor well groundwater quality are provided in Appendix E.

4.2.3. Metals

Barium was detected in each of the UPCO monitor wells and ranged in concentration from 0.0044 mg/L to 0.27 mg/L. The AWQS for barium is 2 mg/L. Arsenic was detected in each of the UPCO monitor wells and ranged in concentration from 0.0020 mg/L to 0.062 mg/L in monitor well MW-18. The AWQS for arsenic is 0.05 mg/L. Arsenic concentrations at the remaining site wells were less than 0.050 mg/L. Chromium was detected in monitor wells MW-1, MW-2, MW-5, MW-7, MW-8, MW-10, MW-11, MW-12, MW-13, MW-18 and PW-1 and ranged in concentration from 0.0012 mg/L to 0.029 mg/L. The AWQS for chromium is 0.1 mg/L. Lead was detected in monitor wells MW-1, MW-2, MW-3, MW-4, MW-6, MW-7, MW-8, MW-9, MW-10, MW-14, MW-15 and PW-1 and ranged in concentration from 0.001 mg/L to 0.0042 mg/L. The AWQS for lead is 0.050 mg/L. Selenium was detected in monitor wells MW-6 and MW-11 and ranged in concentration from 0.0024 mg/L to 0.0042 mg/L. The AWQS for selenium is 0.05 mg/L. Mercury was detected in production well PW-1 at 0.00083 mg/L. The AWQS for mercury is 0.002 mg/L. Calcium, potassium, sodium, and magnesium were detected in PW-1 and MW-18. However, no AWQS have been established for these metals. No other metals analyzed during the monitoring period were detected above the laboratory detection limits.

4.3. Zonal Groundwater Data

Zonal samples were collected from the MW-18 borehole prior to well completion. The zonal samples collected at MW-18 were analyzed for perchlorate by EPA Method 314. Table 8 summarizes the zonal sampling analytical data for perchlorate.

Perchlorate was detected at a concentration of 2.8 µg/L in the shallow zonal sample. The detection may have been influenced by water added during vadose zone drilling for cuttings management and dust control. The source of the water added during drilling was the production well (PW-1) which has historically contained low concentrations of perchlorate. A sample collected from the water stored in the driller's support truck contained perchlorate at a concentration of 3.2 µg/L, similar to the shallow zonal sample. Water from PW-1 was not added during the installation of the temporary wells at 295 feet and 390 feet bgs. Perchlorate was not detected above the laboratory reporting limit of 2.0 µg/L in groundwater zonal samples collected at 295 feet and 390 feet bgs. Perchlorate was not detected in monitoring well MW-18 during fourth quarter 2009 monitoring.

4.4. Soil Vapor Quality Data

Soil gas samples were collected from soil vapor monitor well SVMW-1 during 2009 monitoring and analytical results are provided in Table 9. The primary contaminant of concern, 1,1-DCE, ranged from 210 parts per billion by volume (ppbv) at 200 feet bgs to 23,000 ppbv at 100 feet bgs. Acetone ranged from less than 99 ppbv at 40 feet bgs to 3,500 ppbv at 200 feet bgs. Other VOCs detected in the soil gas samples, at a lower concentration, included 1,1-DCA, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, 1,3-butadiene, 2,2,4-trimethylpentane, 2-butanone (MEK), 2-hexanone, 4-ethyltoluene, benzene, bromomethane, carbon disulfide, chloroform, chloromethane, cyclohexane, dichlorodifluoromethane, ethylbenzene, Freon 113, hexane, m,p-xylenes, o-xylenes, methylene chloride and tetrachloroethene were detected. Soil vapor monitoring well results are provide in Table 9.

5. Quality Assurance and Data Verification

Analytical data provided by the laboratories were subjected to data review for quality control/quality assurance. A summary of the data verification is presented in Appendix I. Copies of the analytical data reports are provided in Appendix J.

Groundwater monitoring activities followed the quality assurance procedures outlined in the QAPP (H+A, 2004b). The project specific QAPP establishes procedures and guidance for the following:

- data quality objectives;
- sample documentation and custody;
- sample container requirements;
- quality control procedures; and
- quality assurance management including, data management and data verification/validation procedures.

Samples were collected and submitted to the laboratory in a manner that provides data that are representative of site conditions. Laboratory analyses were conducted according to analytical methods described in EPA guidance manuals. Field quality control (QC) samples included field duplicates and trip blanks. Laboratory QC samples included method blanks, laboratory control samples (LCS), and matrix spike/matrix spike duplicate (MS/MSD) samples.

Laboratory deliverables consist of Level II data packages (including a QC summary). Data reported by the laboratory has been verified that the data meets the data quality objectives. The results were considered usable for the intended purposes, and the project data quality objectives (DQOs) specified in the QAPP (H+A, 2004b) were met.

6. Future Monitoring Activities

The 2009 monitoring program was conducted in accordance with the procedures and methods outlined in the Updated Groundwater Monitoring Plan (Malcolm Pirnie, 2008a). UPCO revised the monitoring program to include the quarterly monitoring requirements for the new groundwater monitoring well MW-18, and planned monitoring wells MW-16 and MW-17. Former production well PW-1 will continue to be utilized as a site monitor well. Since PW-1 no longer functions as a drinking water supply well, As, Ag, Ba, Cd, Cr, Hg, Pb, Se, Ca, Mg, K, and Na will be not be analyzed in 2010. PW-1 will be sampled for perchlorate using EPA Method 314.0 in 2010. Private domestic wells will continue to be monitored on a semi-annual basis, in the second and fourth quarters of 2010. The 2010 sampling and analysis schedule is summarized in Table 10.

7. References

- Hargis + Associates, Inc. (H+A), 2004a. Draft Remedial Investigation Work Plan, Volume I of II, Goodrich Universal Propulsion Company, Inc., June 11, 2004.
- _____, 2004b. Quality Assurance Project Plan, Goodrich Universal Propulsion Company, Inc., July 16, 2004.
- _____, 2004c. Monitoring Well Construction Summary Report, Goodrich Universal Propulsion Company, Inc., July 16, 2004.
- Malcolm Pirnie, Inc., 2004. Groundwater Monitoring Plan, Universal Propulsion Company, Inc., December 16, 2004.
- _____, 2005. Phase II Monitoring Well Installation Report, Universal Propulsion Company, Inc., January 7, 2005.
- _____, 2006. Phase III Monitoring Well Installation Report, Universal Propulsion Company, Inc., April 2006.
- _____, 2008a. Updated Groundwater Monitoring Plan, Universal Propulsion Company, Inc., March 14, 2008.
- _____, 2008b. Supplemental Soil and Soil Gas Investigation Work Plan, Universal Propulsion Company, Inc., March 2008.
- _____, 2008c. Groundwater Monitoring Pressure Transducer Assessment, Universal Propulsion Company, Inc., March, 2008.
- _____, 2008d. 2007 Annual Groundwater Report, Universal Propulsion Company, Inc., May 15, 2008.
- _____, 2008e. Supplemental Groundwater Investigation Work Plan, Universal Propulsion Company, Inc., March 14, 2008.
- _____, 2009a. draft Interim RI Report, Universal Propulsion Company, Inc., February 13, 2009.
- _____, 2009b. Final 2008 Annual Monitoring Report, Universal Propulsion Company, Inc., December 18, 2009.

_____, 2009c. Addendum to the Supplemental Groundwater Investigation Work Plan, Universal Propulsion Company, Inc., April 10, 2009.