Terranext
4050 E. Cotton Center Blvd., Ste. 73, Phoenix, AZ 85040

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ANNUAL 2013-14 WATER-QUALITY REPORT
WEST VAN BUREN AREA (WVB) WATER QUALITY ASSURANCE REVOLVING FUND (WQARF) REGISTRY SITE PHOENIX, ARIZONA

Terranext Project No. 03103154

October 2014

(480) 496-4100 phone (480) 496-4399 fax www.terranext.net

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PHOENIX, ARIZONA

Prepared For:

Arizona Department of Environmental Quality
Remedial Projects Unit
1110 West Washington
Phoenix, Arizona 85007

Prepared By:

Arthur J. Gordon, R.G
Project Manager

October 2014

Terranext, LLC

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THE FOLLOWING APPENDICES ARE PRESENTED IN THE ATTACHED CD:

LIST OF ABBREVIATIONS AND ACRONYMS

1,1-DCE	1,1-dichloroethene
1,1-DCA	1,1-dichloroethane
ADEQ	Arizona Department of Environmental Quality
AWQS	Aquifer Water Quality Standard
ASRAC	Arizona Superfund Response Action Contract
cis-1,2-DCE	*cis*-1,2-dichloroethene
COC	Contaminants of Concern
COP	City of Phoenix
DO	Dissolved Oxygen
EC	Electrical Conductivity
EPA	Environmental Protection Agency
GPM	Gallons per Minute
GC/MS	Gas Chromatography/Mass Spectrometry (Analysis)
LAU	Lower Alluvial Unit
LDC	Laboratory Data Corp.
MAU	Middle Alluvial Unit
MCL	Maximum Contaminant Level
mg/L	Milligram per Liter
mL	Milliliter
MTBE	Methyl-tertiary-butyl ether
ORP	Oxygen Reduction Potential
PCE	Tetrachloroethene
PDB	Passive Diffusion Bag
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RID	Roosevelt Irrigation District
RPD	Relative Percent Difference
Synergy	Synergy Environmental
TASOW	Task Assignment Scope of Work
TCA	1,1,1- trichloroethane
TCE	Trichloroethene
UAU	Upper Alluvial Unit
UAU1	Upper Portion of UAU
UAU2	Lower Portion of UAU
µg/L	Microgram per Liter
VOA	Volatile Organic Analysis

VOC	Volatile Organic Compound
WQARF	Water Quality Assurance Revolving Fund
WVB	West Van Buren

SECTION 1.0 INTRODUCTION

1.1 BACKGROUND

Terranext was retained by the Arizona Department of Environmental Quality (ADEQ) to perform an extended task assignment scope of work (TASOW) for the West Van Buren Area (WVB) Water Quality Assurance Revolving Fund (WQARF) Registry Site. The project is being performed in accordance with Arizona Superfund Response Action Contract (ASRAC) No. EV09-000AB and TASOW Procurement Reference No. 10-0047. The TASOW calls for the sampling and analysis of wells within and around the WVB to assist in evaluating the nature and extent of contamination.

The WVB is the areal projection of the western portion of a large commingled plume of contaminated groundwater in both the upper alluvial unit (UAU) and middle alluvial unit (MAU) in central Phoenix. These units are underlain by the lower alluvial unit (LAU), which does not appear to have been contaminated at this time. Multiple sources contribute to the plume. The primary contaminants of concern (COC) for the WVB include the following volatile organic compounds (VOCs): tetrachloroethene (PCE), trichloroethene (TCE), 1,1,1-trichloroethane (TCA), *cis*-1,2-dichloroethene (*cis*-1,2-DCE), 1,1-dichloroethane (1,1-DCA) and 1,1-dichloroethene (1,1-DCE). Chromium is also a COC to a limited extent. Contaminated groundwater also enters the WVB from the east; regional groundwater flow is in a general westerly direction.

1.2 OBJECTIVES

The objectives of the sampling were to evaluate the nature and extent of contamination within the WVB, monitor contaminant levels and trends in areas of known contamination, evaluate groundwater elevations and flow directions, and to identify potential contaminant sources.

1.3 SCOPE OF WORK

In Third Quarter 2013 and First Quarter 2014, Terranext performed WVB groundwater sampling. In Third Quarter 2013, 117 groundwater monitor wells comprised the WVB monitor well network; three new UAU1 monitor wells were added to the network in time for First Quarter 2014 sampling (Table 1.1 and Figure 1.1).

In Third Quarter 2013, 80 wells were sampled. Access could not be obtained to two wells (AVB86-01 and 128-01); 34 wells were dry, and a PDB was lost down one well (AVB129-02). Terranext also was provided samples from 29 Roosevelt Irrigation District (RID) wells and four RID surface water locations.

In First Quarter 2014, 100 wells were sampled. Access could not be obtained to one well (AVB86-01) and 19 wells were dry. Terranext had planned on implementing traffic control for AVB86-01 (located within 51st Avenue), but since nearby well AVB87-01 was dry (same depth as AVB86-01), there was a good likelihood that AVB86-01 was also dry. In addition to the monitor wells, Terranext was also provided samples from 28 Roosevelt Irrigation District (RID) wells and four RID surface water locations.

Additionally, due to increasing PCE concentrations observed in AVB119-01, monthly groundwater levels were collected from this and nine surrounding WVB monitor wells on a monthly basis from November 2013 through June 2014.

Field activities were conducted in accordance with the project Health and Safety Plan (BE&K/ Terranext, Sept. 2000), Quality Assurance Project Plan (BE&K/Terranext, April 2000), and Field Sampling and Analysis Plan (BE&K/Terranext, Dec. 2000). Water quality data collected as part of this task assignment will also be submitted to ADEQ in accordance with the Groundwater Data Submittal Guidance Document Version 3.4 (ADEQ, 2010) for inclusion in the ADEQ Groundwater Quality Database.

SECTION 2.0 FIELD ACTIVITIES

2.1 *THIRD QUARTER 2013 WATER LEVEL MEASUREMENTS*

The static depth to groundwater was measured to the nearest 0.01 foot with an electronic sounder. Water levels in most wells were measured from September 3 through 6, 2013. The water levels were measured from a known surveyed measuring point at each well; either the north side of the top of casing or another identifiable measuring point, such as a notch in the casing. Groundwater elevations were then calculated from the surveyed measuring point.

Following each water level measurement, dirt and rust were removed with a clean paper towel while the sounder was withdrawn from the well. The electric sounder was then decontaminated with a solution of Alconox® and water, followed by a rinse with tap water and a final rinse of deionized water.

Third Quarter 2013 depth to groundwater measurements and groundwater elevations are presented in Table 2.1. Locations of wells completed within UAU1, UAU2, and the MAU, along with groundwater elevations and SURFER-generated contours, are depicted on Figures 2.1, 2.2, and 2.3 respectively.

Groundwater contours for the upper portion of the UAU (UAU1) are shown on Figure 2.1. In the eastern portion of the WVB, groundwater flow is southwesterly at a gradient of about 16.8 feet per mile (between wells AVB123-01 and 120-01). In the central portion of the WVB, groundwater flow is southerly at a gradient of about 25.4 feet per mile (between wells AVB96-01 and 135-01). In the very western portion of the WVB, groundwater flow is northeasterly at a gradient of about 28 feet per mile (between wells AVB74-01 and 91-01).

Groundwater contours for the lower portion of the UAU (UAU2) are shown on Figure 2.2. In the eastern portion of the WVB, groundwater flow is southwesterly at a gradient of about 16.4 feet per mile (between wells AVB124-01 and 136-01), towards an apparent depression of the piezometric surface centered in the vicinity of the RID canal and 43rd Avenue. In the western portion of the WVB, groundwater flow is also southwesterly, but at a shallower gradient of about 5.7 feet per mile (between wells AVB141-01 and 98-01).

Groundwater contours for the MAU are shown on Figure 2.3. The MAU gradient in the eastern portion of the WVB is southwesterly at about 35.7 feet per mile (between wells AVB68-04 and 69-01); this steep gradient is likely due to the proximity of pumping RID well No. 104 to AVB69-01. A flattening of the piezometric surface is present between about 35th and 67th Avenues. West of about 67th Avenue, the gradient steepens westerly at about 17.3 feet per mile (between wells AVB82-01 and 60-01).

2.2 *FIRST QUARTER 2014 WATER LEVEL MEASUREMENTS*

Water levels in most wells were measured from March 4 through 7, 2014, following the procedure described in Section 2.1. First Quarter 2014 depth to groundwater measurements and groundwater elevations are presented in Table 2.2. Locations of wells completed within UAU1, UAU2, and the MAU, along with groundwater elevations and SURFER-generated contours, are depicted on Figures 2.4, 2.5, and 2.6 respectively. Historical hydrographs for WVB wells are included in Appendix A.

Groundwater contours for the upper portion of the UAU (UAU1) are shown on Figure 2.4. In the eastern half of the WVB, groundwater flow is westerly at a gradient of about 12.4 feet per mile (between wells AVB18-01 and 20-03). A flattening of the water table surface is present between about 43rd and 67th Avenues. West of 67th Avenue, groundwater flows towards an apparent depression of the water table surface centered in the vicinity of Interstate 10 and 75th Avenue.

Groundwater contours for the lower portion of the UAU (UAU2) are shown on Figure 2.5. In the eastern half of the WVB, groundwater flow is westerly at a gradient of about 11.9 feet per mile (between wells OU3-10M2 and AVB128-01). A shallower westward gradient of 7.3 feet per mile (between wells AVB120-02 and 98-01) is present in the western half of the WVB; a small apparent depression of the piezometric surface is centered around AVB98-01.

Groundwater contours for the MAU are shown on Figure 2.6. In the eastern half of the WVB, groundwater flow is westerly at a gradient of about 12 feet per mile (between wells AVB68-04 and 120-03). A shallower slightly southwesterly gradient of about six feet per mile (between wells AVB120-03 and 61-01) is present in the western half of the WVB.

Hydrograph data presented in Appendix A documents an overall decrease in UAU1 water levels since First Quarter 2011. UAU1 water levels decreased between about 7 to 17 feet in the WVB; the greatest measured water level decrease was about 17 feet in AVB10-01, 73-01, 75-01, and 94-01.

In UAU2 wells, a decrease in water levels since First Quarter 2011 has been occurring. UAU2 water levels decreased between about 9 to 23 feet in the WVB; the greatest measured water level decrease was about 23 feet in AVB136-01.

In MAU wells, a decrease in water levels since First Quarter 2011 has been occurring. MAU water levels decreased between about 13 to 23 feet in the WVB; the greatest measured water level decrease was about 23 feet in AVB61-01.

2.3 MONTHLY UAU1 WATER LEVEL MEASUREMENTS, VICINITY OF AVB119-01

From November 2013 through June 2014 (except for February 2014), Terranext performed monthly water level monitoring of the following ten UAU1 wells in the north-central portion of the WVB:

- AVB92-01
- AVB93-01
- AVB94-01
- AVB96-01
- AVB100-01

- AVB112-05
- AVB117-01
- AVB119-01
- AVB130-01
- AVB138-01

The reason this monitoring was performed was to evaluate monthly groundwater flow direction in the vicinity of AVB119-01, located on Roosevelt just east of 51st Avenue. PCE concentrations have been steadily increasing in groundwater samples collected from this well since First Quarter 2007, when PCE was first detected. On average, over the past 7.5 years, the PCE concentration associated with this well has been increasing by about 12 to 13 ug/l annually.

Tabulated monthly water levels and corresponding monthly water table contour maps are included as Appendix B. In November 2013, groundwater appears to flow both eastward and westward towards the center of the mapped area, where the lowest groundwater elevations were measured in AVB93-01, 100-01, and 119-01. This same general trend was observed in December 2013, and January and March 2014, except the lowest measured groundwater elevation was measured in AVB112-05, located north of AVB119-01. In April through June 2014, groundwater again appears to flow both eastward and westward towards the center of the mapped area, where the lowest groundwater elevations were measured in AVB93-01, 100-01, and 119-01. The observed groundwater flow directions suggest that, at least during certain times of the year, AVB119-01 may be hydraulically downgradient of the Prudential facility located west of 51st Avenue.

2.4 SAMPLING LOCATIONS AND REQUESTED ANALYSES

Tables 2.1 and 2.2 list the wells sampled during Third Quarter 2013 and First Quarter 2014, and include the following information for each well:

- ADEQ well ID,
- Facility and owner names and facility well number,
- Date and time of well visit (if applicable),
- ADWR registration number,
- Well construction information,
- Depth to water measured prior to well sampling,
- Groundwater elevation calculated from available data, and
- Additional comments or observations.

Groundwater sampling was performed as follows (identification of wells sampled by these different methods is included in Tables 2.3 and 2.4):

- through the use of passive diffusion bags (PDBs) at wells selected by ADEQ personnel,
- purging prior to sampling, and
- collection of a grab sample with a bailer at wells where purging was not possible either due to insufficient water in the well for purging or no access for the three-inch diameter purge pump.

Groundwater samples collected from the WVB were analyzed by Transwest Geochem for purgeable volatile organic compounds by gas chromatography/mass spectrometry (GC/MS) analysis in accordance with U.S. Environmental Protection Agency (EPA) Method 8260B. Samples collected from PDBs were not analyzed for ethers, ketones, or alcohols because PDBs do not generally recover these compounds adequately due to their hydrophilic properties. In addition, monitor wells not sampled utilizing PDBs were analyzed for total and dissolved chromium by EPA Method 6010B.

During First Quarter 2014, the following additional analyses were performed as requested by ADEQ:

- AVB26-01 – total cyanide, total and dissolved selenium
- AVB69-02R – total cyanide
- AVB88-01 – total cyanide
- AVB116-01 – total hexavalent chromium, PCBs
- AVB116-02 - total hexavalent chromium, PCBs
- AVB125-01 – total cyanide
- AVB140-01 – total cyanide

2.5 GROUNDWATER SAMPLING PROCEDURES

Groundwater sampling activities were performed in accordance with the project health and safety, quality assurance, and field sampling and analysis plans. Third Quarter 2013 sampling, including the RID wells, took place from September 9 through 26, 2013; First Quarter 2014 sampling, including the RID wells, took place from March 10 through 28, 2014.

2.5.1 MONITOR WELL PURGING PROCEDURES

Purging procedures followed during sampling are described herein. A clean three-inch diameter submersible pump was utilized for purging the four-inch diameter shallow wells. The pump was lowered into the middle of the water column. Field parameters (pH, temperature, and specific electrical conductance) were measured during purging and recorded onto Terranext field sampling forms. A summary of purge and parameter information is included in Tables 2.3 and 2.4. Field sampling forms are included in Appendices C and D.

Purging continued until three casing volumes were removed from the wells and the field parameters stabilized to within ten percent of the previous reading. If the field parameters did not appear to have stabilized, additional well volumes were removed, to a maximum of five well volumes to avoid producing large quantities of investigative derived waste.

Terranext retained a subcontractor to purge the deeper monitor wells. A three-inch diameter submersible pump was used for the deeper wells. The pump was lowered into the well and set at the middle of the water column. Purging continued until three casing volumes were removed from the wells and the field parameters stabilized to within ten percent of the previous reading. If the field parameters did not appear to have stabilized, additional well volumes were removed, to a maximum of five well volumes to avoid producing large quantities of investigative derived waste.

2.5.2 *MONITOR WELL SAMPLE COLLECTION*

Upon completion of the purge procedures described in Section 2.5.1, the pump was removed and the sample was collected with a two-inch diameter stainless steel Timco® point source bailer. The sampling device was lowered to the desired collection interval via a steel cable. The Timco® bailer has two ball-check valves, which allow water to flow through the device while lowering, and then trap the water inside the bailer during retrieval. A Teflon® sampling port specifically designed for VOC sampling using a flow-regulating valve to reduce aeration during the filling of sample vials was utilized to transfer the groundwater sample from the bailer into the laboratory supplied sample containers. After the sample was collected, the pump was removed from the well. Grab samples were collected from wells that either did not have enough water in the well to sample through purging or there was insufficient access for the three-inch diameter purge pump. Analytical data from these wells are considered estimates as purging was not performed.

A sample label was affixed to each sample container at the time of collection. The label included the sample ID number, date and time sampled, analyses requested, preservatives used, and sampler's initials.

VOC samples were contained in four 40-milliliter (mL) volatile organic analysis (VOA) vials preserved with hydrochloric acid. Total chromium samples were contained in 500-mL plastic bottles preserved with nitric acid. Dissolved chromium samples were contained in separate unpreserved 500-mL plastic bottles; dissolved chromium samples then underwent laboratory filtering and subsequent preservation. Sample bottles were obtained daily from Transwest Geochem and were prepared by the laboratory with the appropriate preservative. Samples were placed in a cooler with ice immediately after collection, and were delivered to the laboratory on the day of sample collection. Samples remained within the control of Terranext personnel until delivery to the laboratory and were not left unattended at any time.

2.5.3 *DECONTAMINATION PROCEDURES*

Sampling equipment, pumps, bailers, discharge piping, etc. were decontaminated prior to each day's sampling and between sampling locations. Decontamination procedures consisted of scrubbing the equipment with coarse bristle brushes using a solution of Alconox® and tap water. A rinse with clean tap water followed with a final rinse with deionized water. A high-pressure steam cleaner was used to decontaminate subcontractor equipment between wells after saturating the equipment with an Alconox® solution.

The field procedures deviated from the quality assurance project plan (QAPP) with regards to the decontamination of some field equipment. The QAPP states in Section 2.2.6 that "Purging equipment such as submersible pumps will be steam cleaned in the field using deionized water and Alconox". A steam cleaner was not used for the decontamination of any equipment except as mentioned in the preceding paragraph. The effectiveness of Terranext's decontamination procedures was verified by the collection of a daily field equipment blank, as explained in Section 2.6.2.

2.5.4 PASSIVE DIFFUSION BAG SAMPLING

Wells that were sampled by retrieving PDBs previously placed in the wells are identified in Tables 2.3 and 2.4. PDBs allow for the equilibration of VOCs within and outside the PDB; however, PDB samples are not recommended for the analysis of acetone, 2-butanone, 4-methyl-2-pentanone, 2-hexanone, and methyl tert butyl ether (MTBE). Upon retrieval of the PDB from each well, the PDB was immediately cut open and VOA vials were filled and handled as described in Section 2.5.2.

2.5.5 RID WELL SAMPLE COLLECTION

Roosevelt Irrigation District (RID) well samples were collected by Synergy Environmental, RID's consultant, by replacing a plug on the discharge pipe with a valved hose bib. Water was allowed to discharge from the hose bib for several minutes prior to sample collection. During this time, the field parameters of pH, conductivity, and temperature were measured and recorded (Tables 2.5 and 2.6). Samples were collected by the filling of sample containers directly from the hose bib discharge. Sample containers were labeled and handled as described in Section 2.5.2. After collection by Synergy, the samples were then transferred to Terranext personnel following chain-of-custody procedures; Synergy collected select split samples.

2.5.6 RID SURFACE WATER SAMPLING PROCEDURES

Sampling of RID surface water was also performed. Surface water sampling procedures consisted of a measurement of each location's physical structure followed by a measurement of surface water field parameters. Physical measurements collected by Terranext included the following:

- Canal/lateral bottom width (feet)
- Water depth (feet)
- Canal/lateral width at water surface (feet)
- Water velocity (counts per second converted to centimeters per second)

Surface water field parameters were measured by Terranext using a YSI multiple meter sensor. The following parameters were measured at each sample location:

- Temperature
- pH
- electrical conductivity
- dissolved oxygen
- oxidation reduction potential

Field measurements for each of the surface water sampling locations are summarized in Tables 2.7 and 2.8. Additionally, using the channel and velocity measurements, surface water flow in cubic feet per second was estimated by Terranext for each location.

Sample containers provided by Transwest Geochem were filled by Synergy using a peristaltic pump. The samples were then transferred to Terranext personnel following chain-of-custody procedures. Synergy collected select split samples.

A sample label was affixed to each sample container at the time of collection. The label included the sample ID number, date and time sampled, analysis requested, and preservative used. Sample containers were obtained from Transwest Geochem and were prepared by the laboratory with the appropriate preservative. Samples were placed in a cooler with ice immediately after collection, and were delivered to the laboratory on the day of sample collection. Samples remained within the control of Terranext personnel until delivery to the laboratory and were not left unattended at any time.

2.6 FIELD QUALITY ASSURANCE/QUALITY CONTROL

Field quality assurance/quality control (QA/QC) samples were employed for quality assurance. The QA/QC samples are used to verify that field sample collection, handling, transportation, and laboratory processes have not adversely affected sample integrity. These samples consisted of trip blanks, equipment blanks, and field duplicate samples. Field QA/QC samples are described herein.

2.6.1 TRIP BLANKS

Trip blanks provide a check on possible VOC contamination occurring during sample transport and storage. A laboratory prepared trip blank was supplied by Transwest Geochem to accompany each sample cooler on a daily basis. The samples and trip blank remained together on ice until delivery to the laboratory.

2.6.2 EQUIPMENT BLANKS

Equipment blanks provide information on the effectiveness of decontamination procedures on non-dedicated sampling equipment. One equipment blank was collected on each day of purged sampling. Equipment blanks were collected after the sampling of at least one well.

Equipment blanks were collected after the final deionized water rinse of the decontamination process. Water deionized by reverse osmosis was poured into the sampling device and then collected into 40 mL VOA vials using the same process to collect groundwater samples. Equipment blanks were also collected in 500-mL bottles for total and dissolved chromium analysis; additionally, equipment blank AVB26-0104-1000 was analyzed for total selenium. Equipment blanks were labeled and placed in the cooler immediately after collection.

2.6.3 *Duplicate Samples*

Field duplicate samples allow for an evaluation of analytical precision. Precision is the ability to reproduce a sample result. Field duplicate samples were collected at an approximate 1 in 10 frequency and submitted to Transwest for analysis of VOCs, and additionally for purged duplicates. Total and dissolved chromium. Results from these samples are presented and explained in Section 3.3.

2.7 *Investigative-Derived Waste Management*

Monitor well purge water was collected in a mobile 550-gallon tank transported between wells as they were sampled. Manhole entry permits were obtained from the City of Phoenix (COP) through the Water Services Department to dispose of the purge water into COP sewer system manholes identified by Terranext at various locations in the project area. Copies of the manhole entry permits (no permit numbers) are included in Appendices E and F. COP prohibited the discharge of purge water from one well due to high VOC concentrations: AVB20-03. Purge water from this well was drummed and then profiled/disposed as non-hazardous liquid waste; disposal documentation is also included in Appendices E and F.

SECTION 3.0 ANALYTICAL RESULTS

3.1 MONITOR WELL ANALYTICAL RESULTS

3.1.1 THIRD QUARTER 2013

During the Third Quarter 2013, 80 existing monitor wells were sampled, and a total of 111 samples were submitted to the laboratory for analysis. Of these, 13 were trip blanks, 80 were groundwater samples, nine were equipment blanks, and nine were duplicate samples.

A table of analytical results for groundwater is presented as Table 3.1; QA/QC data is included as Table 3.2. Existing Aquifer Water Quality Standards (AWQSs) are also included in Table 3.1. Level II data reports for the analyses, with the laboratory QA/QC data, are included in Appendix G. At the request of ADEQ, approximately ten percent of the data packages were also obtained as Level III data packages; these Level III data packages are included as Appendix H. PCE, TCE, and 1,1-DCE exceed their respective AWQSs. Figures 3.1 through 3.7 depict concentrations of 1,1-DCE, PCE, and TCE from the Third Quarter 2013 sampling event.

Contaminants of interest associated with petroleum products are benzene, toluene, ethylbenzene, xylenes and MTBE. Toluene was detected in one sample, the sample collected from AVB136-01. It should be noted that this well was sampled using Yellowjacket Drilling's pump rig. Historically, prior to the use of Yellowjacket's pump rig, toluene had not been detected in WVB wells, and toluene was not detected in associated trip and equipment blanks. However, recent previous use of Yellowjacket's pump rig appears to have resulted in the detection of toluene in some wells sampled using their rig, and it appears that this is a result of pump rig contamination. The subcontractor was previously notified of this situation, and the toluene data has been flagged in Table 3.1.

Monitor wells purged for sampling during this round were also analyzed for total and dissolved chromium by EPA Method 6010B. The analytical results for the chromium sampling are summarized in Table 3.1 and laboratory data sheets are included in Appendix G.

During this round of sampling, 13 wells exhibited chromium concentrations at or greater than the AWQS of 0.1 mg/L (see table Page 13). It should be noted that most of the dissolved chromium concentrations of these wells were less than the AWQS, suggesting the total chromium concentrations are likely the result of unfiltered sediment contained within the groundwater samples.

3.1.2 FIRST QUARTER 2014

During the First Quarter 2014, 100 existing monitor wells were sampled, and a total of 130 samples were submitted to the laboratory for analysis. Of these, 12 were trip blanks, 100 were groundwater samples, eight were equipment blanks, and ten were duplicate samples.

A table of analytical results for groundwater is presented as Table 3.3; QA/QC data is included as Table 3.4. Existing AWQSs are also included in Table 3.3. Historic WVB concentration trends for 1,1-DCE, PCE, and TCE are included as Appendix I. Level II data reports for the analyses, with the laboratory QA/QC data, are included in Appendix J. At the request of ADEQ, approximately ten percent of the data packages were also obtained as Level III data packages; these Level III data packages are included as Appendix K. PCE, TCE, and 1,1-DCE exceed their respective AWQSs. Figures 3.8 through 3.14 depict concentrations of 1,1-DCE, PCE, and TCE from the First Quarter 2014 sampling event. Additional ADEQ-supplied data was used for the preparation of Figures 3.8 through 3.14, and this data is included in Appendix L.

The contaminants of concern are PCE, TCE, 1,1-DCE, *cis*-1,2-DCE, 1,1-DCA, and TCA. These constituents are displayed below with their highest detected concentration in micrograms per liter (ug/L) and corresponding well for the last three rounds of sampling.

	March 2014			September 2013			March 2013		
Contaminant	Well	Unit	Conc	Well	Unit	Conc	Well	Unit	Conc
PCE	AVB119-01	UAU1	94.1	AVB82-01	MAU	56.5	AVB119-01	UAU1	87.5
TCE	AVB132-01	UAU2	183	AVB132-01	UAU2	252	AVB132-01	UAU2	177
1,1-DCE	AVB82-01	MAU	27.7	AVB82-01	MAU	25.1	AVB82-01	MAU	29.4
cis-1,2-DCE	AVB132-01	UAU2	28.6	AVB132-01	UAU2	33	AVB132-01	UAU2	31.7
1,1-DCA	AVB134-02	UAU2	8.27	AVB132-01	UAU2	9.61	AVB132-01	UAU2	10.4
TCA	AVB85-01	UAU1	1.34			ND	AVB85-01	UAU1	0.600

Contaminants of interest associated with petroleum products are benzene, toluene, ethylbenzene, xylenes and MTBE. Benzene was detected (at 0.8 ug/l) in one sample, the sample collected from AVB10-01. Toluene was detected in groundwater samples collected from 16 wells (AVB10-01 and -02, 61-01, 82-02, 91-03, 116-02, 121-02, 124-02, 126-02 and -03, 131-01, 132-02, 133-01, 136-01, 137-01, and 141-01); all of these wells were sampled using Yellowjacket Drilling's pump rig. Use of Yellowjacket's pump rig appears to have resulted in the detection of toluene in some wells sampled using their rig, and it appears that this is a result of pump rig contamination. The subcontractor had previously been notified of this situation, and as a result of this ongoing issue, Terranext recently recommended to ADEQ that Yellowjacket's pump rig not be used for WVB sampling. The toluene data has been flagged in Table 3.3.

Monitor wells purged for sampling during this round were also analyzed for total and dissolved chromium by EPA Method 6010B. The analytical results for the chromium sampling are summarized in Table 3.3 and laboratory data sheets are included in Appendix J.

During this round of sampling, ten wells exhibited chromium concentrations at or greater than the AWQS of 0.1 mg/L. A list of these wells is displayed below with their corresponding total and dissolved chromium concentrations in mg/L, along with concentrations observed during the previous two rounds of sampling. It should be noted that most of the dissolved chromium concentrations of these wells were less than the AWQS, suggesting the total chromium concentrations are likely the result of unfiltered sediment contained within the groundwater samples.

Well ID	Contaminant	Concentration (mg/L)		
		March 2014	September 2013	March 2013
AVB12-01	Total Cr	0.032	0.193	<0.0100
	Dissolved Cr	<0.0100	0.0221	<0.0100
AVB14-01	Total Cr	0.033	0.205	0.0211
	Dissolved Cr	<0.0100	0.0102	<0.0100
AVB15-01	Total Cr	0.164	NS	0.0146
	Dissolved Cr	<0.0100		<0.0100
AVB57-01	Total Cr	0.325	NS	0.465
	Dissolved Cr	<0.0100		<0.0100
AVB69-02R	Total Cr	0.0122	0.157	0.0254
	Dissolved Cr	<0.0100	<0.0100	<0.0100
AVB70-01	Total Cr	3.61	NS	3.19
	Dissolved Cr	<0.0100		<0.0100
AVB71-01	Total Cr	0.0646	1.40	1.21
	Dissolved Cr	<0.0100	0.0239	<0.0100
AVB72-01	Total Cr	3.68	NS	1.19
	Dissolved Cr	<0.0100		<0.0100
AVB73-01	Total Cr	1.98	NS	2.32
	Dissolved Cr	<0.0100		<0.0100
AVB74-01	Total Cr	10.9	3.15	5.74
	Dissolved Cr	0.0295	0.0153	0.0322
AVB75-01	Total Cr	10.2	15.9	3.84
	Dissolved Cr	<0.0100	0.0257	<0.0100
AVB88-01	Total Cr	0.0688	0.247	0.0607
	Dissolved Cr	0.0672	<0.0100	0.0569
AVB91-01	Total Cr	0.0346	0.160	0.141
	Dissolved Cr	0.0202	0.0174	0.0208
AVB92-01	Total Cr	0.0220	0.1370	0.0575
	Dissolved Cr	0.0120	0.0108	0.0115
AVB97-01	Total Cr	<0.0100	0.104	0.0136
	Dissolved Cr	<0.0100	0.0312	<0.0100
AVB125-01	Total Cr	0.303	0.187	0.155
	Dissolved Cr	0.296	0.179	0.135
AVB126-03	Total Cr	0.286	0.0299	0.0342
	Dissolved Cr	0.0171	0.0187	0.0104
AVB140-01	Total Cr	<0.0100	0.137	0.0175
	Dissolved Cr	<0.0100	<0.0100	<0.0100
PS-9	Total Cr	0.114	0.188	0.0437
	Dissolved Cr	<0.0100	<0.0100	<0.0100

NS – Not Sampled

As indicated in Section 2.4, during First Quarter 2014, the following additional analyses were performed as requested by ADEQ:

- AVB26-01 – total cyanide, total and dissolved selenium
- AVB69-02R – total cyanide
- AVB88-01 – total cyanide
- AVB116-01 – total hexavalent chromium, PCBs
- AVB116-02 - total hexavalent chromium, PCBs
- AVB125-01 – total cyanide
- AVB140-01 – total cyanide

None of these constituents were detected; detection limits are provided in Appendix J.

3.2 RID ANALYTICAL RESULTS

3.2.1 THIRD QUARTER 2013

On September 11 and 23, 2013, 29 RID wells and four RID surface water locations were sampled with 39 samples submitted to the laboratory for analysis; sample locations are shown on Figure 3.15. Of the samples submitted, two were trip blanks, two were equipment blanks, and two were duplicate samples.

A table of analytical results is presented as Table 3.5; QA/QC data is included as Table 3.6. For comparison purposes only, existing AWQSs are also included in Table 3.5. The Level II data reports for the analyses, with the laboratory QA/QC data, are included in Appendix M.

The contaminants of concern in the WVB are PCE, TCE, 1,1-DCE, *cis*-1,2-DCE, 1,1-DCA, and TCA. These constituents are displayed below with their highest detected concentration in ug/L and corresponding surface water location:

PCE	RID Canal west of 67th Ave	1.1
TCE	RID Canal west of 67th Ave	4.29
1,1-DCE	Salt Canal west of RID-105	0.71
cis-1,2-DCE	Salt Canal west of RID-105	3.98
1,1-DCA	Salt Canal west of RID-105	0.98
TCA	Not Detected	-

AWQSs (for comparison only) were not exceeded in the four surface water samples. Contaminants associated with petroleum products were not detected.

The contaminants of concern are displayed below with their highest detected concentration in ug/L and corresponding well:

PCE	RID-106	22.1
TCE	RID-92	86.4
1,1-DCE	RID-95	7.52
cis-1,2-DCE	RID-95	10.1
1,1-DCA	RID-95	4.24
TCA	Not Detected	-

Of the previous contaminants, PCE and TCE were the most prevalent, one or both exceeding the AWQS of 5 ug/l in 13 of the 29 sampled wells. The AWQS of 7 ug/l for 1,1-DCE was exceeded in one well, RID-95. AWQSs were not exceeded in RID-82, -85, -86, -87, -88, -90, -91, -93, -94, -101, -102, -103, -104, -105, -108, and –111R. Contaminants associated with petroleum products were not detected in any of the sampled RID wells.

3.2.2 First Quarter 2014

On March 27-28, 2014, 28 RID wells and four RID surface water locations were sampled with 38 samples submitted to the laboratory for analysis; sample locations are shown on Figure 3.16. Of the samples submitted, two were trip blanks, one was an equipment blank, and three were duplicate samples.

A table of analytical results is presented as Table 3.7; QA/QC data is included as Table 3.8. For comparison purposes only, existing AWQSs are also included in Table 3.7. The Level II data reports for the analyses, with the laboratory QA/QC data, are included in Appendix N.

The contaminants of concern in the WVB are displayed below with their highest detected concentration in ug/L and corresponding surface water location:

PCE	Salt Canal west of RID-105	4.32
TCE	Salt Canal west of RID-105	7.01
1,1-DCE	Salt Canal west of RID-105	0.96
cis-1,2-DCE	Salt Canal west of RID-105	0.97
1,1-DCA	Not Detected	-
TCA	Not Detected	-

The AWQS for TCE (for comparison only) was exceeded in the surface water sample collected from the Salt Canal west of RID-105. Contaminants associated with petroleum products were not detected.

The contaminants of concern are displayed below with their highest detected concentration in ug/L and corresponding well:

PCE	RID-106	21.5
TCE	RID-92	76.2
1,1-DCE	RID-95	6.18
cis-1,2-DCE	RID-95	7.86
1,1-DCA	RID-95	3.48
TCA	Not Detected	-

Of the previous contaminants, PCE and TCE were the most prevalent, one or both exceeding the AWQS of 5 ug/l in 12 of the 28 sampled wells. The AWQS of 7 ug/l for 1,1-DCE was not exceeded in any well. AWQSs were not exceeded in RID-82, -85, -86, -87, -88, -90, -91, -93, -94, -101, -102, -103, -104, -105, -108, and –111R. Contaminants associated with petroleum products were not detected in any of the sampled RID wells.

3.3 QA/QC Samples

3.3.1 Third Quarter 2013

Fifteen trip blanks (including RID sampling) were submitted for Third Quarter 2013 sampling; the trip blanks were analyzed by EPA Method 8260B. One VOC, methylene chloride, was detected in the trip blank that accompanied the September 12, 2013 samples (Table 3.2). Methylene chloride was not detected in any of the samples analyzed that day; thus, the presence of methylene chloride in the trip blank is likely a result of laboratory contamination.

Duplicate samples were collected on a frequency of approximately one for every ten groundwater samples. Purged monitor well duplicate sample containers were generally filled with water from the same bailer as the groundwater samples, minimizing the chance of obtaining water from a different depth interval. Eleven duplicate samples (including RID sampling) were submitted to the laboratory for Third Quarter 2013 sampling. The results of the duplicate samples are displayed and compared in Table 3.9. The duplicate samples generally compared favorably with the groundwater samples. Relative percent differences (RPD) exceeding 25 percent are as follows (it should be noted that concentrations were low, resulting in relatively larger RPDs even though absolute differences were small):

- AVB61-01 (total chromium 0.0293 vs. 0.0479 mg/l resulting in RPD of 48.19 percent)
- AVB82-02 (dissolved chromium 0.0112 vs. 0.0175 mg/l resulting in RPD of 43.9 percent)
- AVB140-01 (total chromium 0.0142 vs. 0.1370 mg/l resulting in RPD of 162.43 percent)

As described in Section 3.4, this data was qualified by a third-party subcontractor.

Equipment blanks were collected after the decontamination of sampling equipment. Eleven equipment blanks (including RID sampling), one for each day of purging/sampling, were collected and submitted for analysis for Third Quarter 2013 sampling. No analyzed constituents were detected in any of the equipment blank samples.

3.3.2 FIRST QUARTER 2014

Fourteen trip blanks (including RID sampling) were submitted for First Quarter 2014 sampling; the trip blanks were analyzed by EPA Method 8260B. No VOCs were detected in any of the equipment blank samples.

Duplicate samples were collected on a frequency of approximately one for every ten groundwater samples. Purged monitor well duplicate sample containers were generally filled with water from the same bailer as the groundwater samples, minimizing the chance of obtaining water from a different depth interval. Thirteen duplicate samples (including RID sampling) were submitted to the laboratory for First Quarter 2014 sampling. The results of the duplicate samples are displayed and compared in Table 3.10. The duplicate samples generally compared favorably with the groundwater samples. Relative percent differences (RPD) exceeding 25 percent are as follows (it should be noted that concentrations were low, resulting in relatively larger RPDs even though absolute differences were small):

- AVB26-01 (PCE 0.99 vs. 1.49 ug/l resulting in RPD of 40.32 percent)
- AVB116-01 (1,1-DCA 0.68 vs. 1.01 ug/l resulting in RPD of 39.05 percent)
- PS-9 (total chromium 0.114 vs. 0.181 mg/l resulting in RPD of 45.42 percent)

As described in Section 3.4, this data was qualified by a third-party subcontractor.

Equipment blanks were collected after the decontamination of sampling equipment. Nine equipment blanks (including RID sampling), one for each day of purging/sampling, were collected and submitted for analysis for First Quarter 2014 sampling. No analyzed constituents were detected in any of the equipment blank samples.

3.4 DATA VERIFICATION

Data verification and validation was performed by Laboratory Data Consultants (LDC), a subcontractor (Appendices O and P). LDC's review resulted in the addition of several qualifiers to the original laboratory data sheets. A summary of the qualified data is presented in Tables 3.11 and 3.12. For Third Quarter 2013 data (Table 3.11) the concentrations of the constituents identified in the table should be considered estimated. According to Ms. Erlinda Rauto, LDC operations manager, the estimated concentrations were determined by LDC to be usable.

For First Quarter 2014 data (Table 3.12) the concentrations of the constituents identified in the table should also be considered estimated. Toluene was detected in groundwater samples collected from 16 wells (AVB10-01 and -02, 61-01, 82-02, 91-03, 116-02, 121-02, 124-02, 126-02 and -03, 131-01, 132-02, 133-01, 136-01, 137-01, and 141-01); all of these wells were sampled using Yellowjacket Drilling's pump rig. Use of Yellowjacket's pump rig appears to have resulted in the detection of toluene in some wells sampled using their rig, and it appears that this is a result of pump rig contamination. The toluene data has been flagged in Table 3.3.

SECTION 4 SUMMARY

4.1 THIRD QUARTER 2013

- For the upper portion of the UAU (UAU1), in the eastern portion of the WVB, groundwater flow is southwesterly at a gradient of about 16.8 feet per mile. In the central portion of the WVB, groundwater flow is southerly at a gradient of about 25.4 feet per mile. In the very western portion of the WVB, groundwater flow is northeasterly at a gradient of about 28 feet per mile.

- For the lower portion of the UAU (UAU2), in the eastern portion of the WVB, groundwater flow is southwesterly at a gradient of about 16.4 feet per mile, towards an apparent depression of the piezometric surface centered in the vicinity of the RID canal and 43rd Avenue. In the western portion of the WVB, groundwater flow is also southwesterly, but at a shallower gradient of about 5.7 feet per mile.

- The MAU gradient in the eastern portion of the WVB is southwesterly at about 35.7 feet per mile; this steep gradient is likely due to the proximity of pumping RID well No. 104 to AVB69-01. A flattening of the piezometric surface is present between about 35th and 67th Avenues. West of about 67th Avenue, the gradient steepens westerly at about 17.3 feet per mile.

- Based upon approximate measurements of lateral/canal structure and surface water velocity, flow in the RID Main Canal was calculated to range from 128 to 153 cfs, and flow in the Salt Canal at the sample location was 11 cfs.

- Regarding UAU1, 1,1-DCE, PCE, and/or TCE exceed their AWQS at multiple locations. VOC-contaminated groundwater appears to be entering or originating in the WVB from the east, southeast, and north-central portions of this WQARF registry site, and extends as far west as just west of 67th Avenue. These results are similar to those observed during previous rounds of groundwater sampling.

- Regarding UAU2, PCE and TCE exceed their AWQS from near the northeastern corner of the site to just west of 67th Avenue; 1,1-DCE exceeds the AWQS from the eastern boundary to just west of 35th Avenue, similar to the last few rounds of groundwater sampling.

- Regarding the MAU, PCE and TCE exceed their AWQS at AVB82-01 and 120-03; PCE barely exceeds its AWQS at AVB82-02.

- AWQSs (for comparison only) were not exceeded in the four surface water samples, and contaminants of interest associated with petroleum products were not detected.

- PCE and TCE were the most prevalent detected VOCs in the RID wells; one or both exceeding the AWQS of 5 ug/l in 13 of the 29 sampled wells. The AWQS of 7 ug/l for 1,1-

DCE was exceeded in one well, RID-95. AWQSs were not exceeded in RID-82, -85, -86, -87, -88, -90, -91, -93, -94, -101, -102, -103, -104, -105, -108, and –111R. Contaminants associated with petroleum products were not detected in any of the sampled RID wells.

- During this round of sampling, 13 wells exhibited chromium concentrations at or greater than the AWQS of 0.1 mg/L. It should be noted that most of the dissolved chromium concentrations of these wells were less than the AWQS, suggesting the total chromium concentrations are likely the result of unfiltered sediment contained within the groundwater samples.

4.2 FIRST QUARTER 2014

- For the upper portion of the UAU (UAU1), in the eastern half of the WVB, groundwater flow is westerly at a gradient of about 12.4 feet per mile. A flattening of the water table surface is present between about 43rd and 67th Avenues. West of 67th Avenue, groundwater flows towards an apparent depression of the water table surface centered in the vicinity of Interstate 10 and 75th Avenue.

- For the lower portion of the UAU (UAU2), in the eastern half of the WVB, groundwater flow is westerly at a gradient of about 11.9 feet per mile. A shallower westward gradient of 7.3 feet per mile is present in the western half of the WVB; a small apparent depression of the piezometric surface is centered around AVB98-01.

- For the MAU, in the eastern half of the WVB, groundwater flow is westerly at a gradient of about 12 feet per mile. A shallower slightly southwesterly gradient of about six feet per mile is present in the western half of the WVB.

- Hydrograph data documents an overall decrease in UAU1 water levels since the first UAU1 wells were monitored in 1993 (AVB10, 12, 14, 18, 26, and 57-01) has been occurring. UAU1water levels in the east and central portions of the WVB have decreased approximately 35 feet since 1993; UAU1water levels in the western portion of the WVB (AVB10-01) have decreased approximately 45 feet since 1993.

- In UAU2 wells, a decrease in water levels since the first UAU2 well was monitored in 1993 (AVB10-02) has been occurring. The UAU2 water level in AVB10-02 has decreased about 45 feet since 1993.

- In MAU wells, a decrease in water levels since the first MAU wells were monitored in 1994 (AVB60 and 61-01) has been occurring. MAU water levels in AVB60 and 61-01 have decreased approximately 30 feet since 1994.

- Based upon approximate measurements of lateral/canal structure and surface water velocity, flow in the RID Main Canal was calculated to range from 124 to 297 cfs, and flow in the Salt Canal at the sample location was 110 cfs.

- Regarding UAU1, 1,1-DCE, PCE, and/or TCE exceed their AWQS at multiple locations. VOC-contaminated groundwater appears to be entering or originating in the WVB from the east, southeast, and north-central portions of this WQARF registry site, and extends as far west as just west of 67th Avenue. These results are similar to those observed during previous rounds of groundwater sampling.

- Regarding UAU2, PCE and TCE exceed their AWQS from near the northeastern corner of the site to west of 67th Avenue; 1,1-DCE exceeds the AWQS from the eastern boundary to just west of 35th Avenue, similar to the last few rounds of groundwater sampling.

- Regarding the MAU, PCE and TCE exceed their AWQS at AVB82-01.

- The AWQS (for comparison only) for TCE was exceeded in the surface water sample collected from the Salt Canal; contaminants of interest associated with petroleum products were not detected.

- PCE and TCE were the most prevalent detected VOCs in the RID wells; one or both exceeding the AWQS of 5 ug/l in 12 of the 28 sampled wells. The AWQS of 7 ug/l for 1,1-DCE was not exceeded in any wells. AWQSs were not exceeded in RID-82, -85, -86, -87, -88, -90, -91, -93, -94, -101, -102, -103, -104, -105, -108, and –111R. Contaminants associated with petroleum products were not detected in any of the sampled RID wells.

- During this round of sampling, ten wells exhibited chromium concentrations at or greater than the AWQS of 0.1 mg/L. It should be noted that most of the dissolved chromium concentrations of these wells were less than the AWQS, suggesting the total chromium concentrations are likely the result of unfiltered sediment contained within the groundwater samples.

- During First Quarter 2014, the following additional analyses were performed as requested by ADEQ; none of these constituents were detected:

  - AVB26-01 – total cyanide, total and dissolved selenium
  - AVB69-02R – total cyanide
  - AVB88-01 – total cyanide
  - AVB116-01 – total hexavalent chromium, PCBs
  - AVB116-02 - total hexavalent chromium, PCBs
  - AVB125-01 – total cyanide
  - AVB140-01 – total cyanide

- Based on the known three-dimensional distribution of VOCs in the WVB, Terranext recommends that new monitor wells be installed at the below-identified locations to address data gaps as follows:

UAU1 Wells

- 27th Lane just south of I-10. The purpose of this well is to evaluate the northern extent of UAU1 VOC contamination in this portion of the WVBA.
- 4800 Block West Roosevelt. The purpose of this well is to evaluate the extent of UAU1 VOC contamination observed in AVB119-01, and evaluate whether a source may be located east of AVB119-01.
- 61st Avenue just south of Van Buren. The purpose of this well is to evaluate whether a source of VOC groundwater contamination may be located hydraulically upgradient of this proposed location.

MAU Wells

- Vicinity of AVB134-02. The purpose of this well is to evaluate the vertical extent of VOC contamination within the MAU at this location.
- Vicinity of AVB120-03. The purpose of this well is to evaluate the vertical extent of VOC contamination within the MAU at this location.
- Vicinity of 51st Avenue and the railroad tracks. The purpose of this well is to evaluate the vertical extent of VOC contamination at this location.

SECTION 5 REFERENCES

ADEQ, 2010, Groundwater Data Submittal Guidance Document (Version 3.4)

BE&K/Terranext, April 2000, Quality Assurance Project Plan (QAPP), West Van Buren WQARF Registry Site, prepared for ADEQ

BE&K/Terranext, Sept. 2000, Site Specific Health and Safety Plan (HASP), West Van Buren WQARF Registry Site, prepared for ADEQ

BE&K/Terranext, Dec. 2000, Field Sampling and Analysis Plan (FSAP), West Van Buren WQARF Registry Site, prepared for ADEQ