MONTGOMERY
& ASSOCIATES
Water Resource Consultants

Well Investigation Work Plan

August 9, 2010

Prepared for:
Gallagher & Kennedy, P.A. and
Roosevelt Irrigation District

Roosevelt Irrigation District Early Response Action

West Van Buren Area
Water Quality Assurance Revolving Fund Site

www.elmontgomery.com 520-881-4912 1550 East Prince Road, Tucson AZ 85719

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August 9, 2010

WELL INVESTIGATION WORK PLAN

ROOSEVELT IRRIGATION DISTRICT
EARLY RESPONSE ACTION
WEST VAN BUREN AREA
WATER QUALITY ASSURANCE REVOLVING FUND SITE

REGISTERED GEOLOGIST
CERTIFICATE NO.
23687
DENNIS G
HALL
Date Signed 08-09-10
ARIZONA U.S.A.
Expires 03/31/12

MONTGOMERY & ASSOCIATES

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MONTGOMERY & ASSOCIATES

August 9, 2010

WELL INVESTIGATION WORK PLAN

ROOSEVELT IRRIGATION DISTRICT
EARLY RESPONSE ACTION
WEST VAN BUREN AREA
WATER QUALITY ASSURANCE REVOLVING FUND SITE

1.0 INTRODUCTION

This Work Plan outlines the scope of work and tasks associated with the proposed preliminary well investigations for the Early Response Action (ERA) for West Van Buren Area Water Quality Assurance Revolving Fund Site (the WVBA Site). The ERA was conditionally approved by the Arizona Department of Environmental Quality (ADEQ) on June 24, 2010 to reduce the adverse impact and threat of extensive groundwater contamination in the WVBA Site on Roosevelt Irrigation District's (RID's) wells, operations, and water supply, and on public health, welfare, and the environment. Locations for RID wells in the WVBA are shown on **Figure 1**. All work to be conducted under this Work Plan will be completed after securing project funding. This Work Plan was prepared in accordance with:

- the ERA Work Plan prepared by Montgomery & Associates (M&A, 2010);
- the ADEQ conditional approval of the ERA (included herein as **Appendix A**); and
- discussions held during the July 22, 2010 planning meeting with ADEQ.

The scope for this Well Investigation Work Plan is limited to a phased approach to assess wells within the existing plume and wells proposed for use in the ERA.

2.0 EARLY RESPONSE ACTION

The purposes and scope of the proposed ERA are described in the ERA Work Plan (M&A, 2010). The core engineering design elements of the proposed ERA include: 1) a centralized groundwater treatment facility (CGTF); 2) physical improvements to existing pipelines and canals; 3) modifications to existing production wells; and 4) new pipelines (M&A, 2010). This Well Investigation Work Plan describes the preliminary investigations required to evaluate the need and feasibility for potential modifications to existing extraction wells and to provide additional data to assess performance of the ERA.

Under the ERA, there will be no net change in annual groundwater pumping volumes by RID in the WVBA Site. Consequently, any impacts on overall RID water production capacity due to well modifications must be offset by pumping adjustments in other existing or new wells.

3.0 WEST VAN BUREN AREA

Figure 1 depicts the approximate boundaries of, relevant features within, and the extent of groundwater contamination in the WVBA Site. The extent of groundwater contamination associated with the WVBA Site is generally bounded on the north by Interstate 10, on the east by 7th Avenue, on the south by Lower Buckeye Road, and on the west beyond 75th Avenue **(Figure 1)**.

A summary of the physical setting, hydrogeologic conditions, groundwater conditions, sources of contamination and impact on RID wells and operations was provided in the Draft Remedial Investigation (RI) Report (Terranext, 2008) for the WVBA Site and in

the ERA Work Plan (M&A, 2010). The Draft RI Report was published by ADEQ in October 2008 and also included a discussion of the nature and extent of contamination in the WVBA area. Relevant parts of these topics are presented herein.

3.1 HYDROGEOLOGIC CONDITIONS

The WVBA Site is located within the West Salt River Valley (SRV) hydrologic sub-basin. In general, the basin-fill alluvial deposits in the SRV are subdivided into three hydrogeologic units from shallowest to deepest: 1) Upper Alluvial Unit (UAU), 2) Middle Alluvial Unit (MAU), and 3) Lower Alluvial Unit (LAU). The UAU within the WVBA Site was further divided into two subunits designated as the UAU1 and UAU2. The units of primary interest in the WVBA Site are the UAU and MAU. It is reported in the Draft RI Report that the LAU does not currently appear to be impacted in the WVBA Site, although limited data exist to characterize the LAU (Terranext, 2008).

3.2 GROUNDWATER CONDITIONS

Groundwater within the WVBA Site generally flows from east to west and occurs under unconfined conditions in the UAU and under semi-confined to confined conditions in the MAU and LAU. On an annual basis, groundwater levels in the WVBA Site vary seasonally with the highest water levels observed in the spring and lowest water levels observed in the fall. These fluctuations are due primarily to seasonal variations in groundwater pumping from the RID wells and are most prevalent in the central and western portions of the WVBA Site.

Groundwater within the WVBA Site is impacted by organic and inorganic compounds as a result of historical releases from numerous industrial facilities (M&A,

2010). The primary contaminants of concern (COCs) in groundwater in the WVBA Site are volatile organic compounds (VOCs). The primary VOCs of concern are tetrachloroethene (PCE), trichloroethene (TCE) and 1,1-dichloroethene (1,1-DCE) because these compounds are detected in groundwater at concentrations exceeding the Arizona Aquifer Water Quality Standards (AWQS)[1]. The most extensive groundwater contamination exists in the UAU1 and UAU2, with a substantially smaller area of impact existing in the MAU.

A downward vertical hydraulic gradient exists in areas within the WVBA Site, producing a downward component of groundwater flow in the aquifer units, which can cause contaminated groundwater to flow downward from upper aquifer zones to deeper aquifer zones in wells within the WVBA Site.

3.3 RID WELLS

RID owns and operates 32 large capacity water production wells within the WVBA Site.; 21 of these wells are currently impacted by the groundwater contamination[2]. Based on the reported hydrogeologic conditions in the WVBA Site in the Draft RI Report, the RID wells probably derive most of their water from the UAU. Groundwater pumping by RID represents the primary discharge from the WVBA Site (Terranext, 2008).

The ERA consists of integrated pumping and treatment of the 10 most highly contaminated RID wells in the WVBA Site and includes the specific RID extraction wells listed in **Table 1** and shown on **Figure 2**. The RID wells proposed for the ERA are variably screened within the UAU, MAU, and LAU. According to RID records, two of the 10 wells that will ultimately be operated for the ERA are completed in the UAU (including RID wells 100, and 108), four wells are completed in the UAU and MAU (RID wells 92, 107, 113, and

[1] Other hazardous substances detected in groundwater in the WVBA Site, 52nd Street Site, and WCP Site include benzene, toluene, ethylbenzene, xylenes, nitrate, vinyl chloride, 1,1,1-trichloroethane, 1,1-dichloroethane, cis-1,2-dichloroethene, and chloroform.
[2] These totals include RID-111, which is currently out of service due to collapsed well casing.

114), and four wells are deeper and completed across the UAU, MAU, and into the LAU (RID wells 89, 95, 106, and 112) **(Table 2)**.

3.4 IMPACT OF GROUNDWATER CONTAMINATION ON RID OPERATIONS

In September 2008, 20 RID wells had detectable concentrations of VOCs and 16 RID wells[3] were impacted by at least one VOC at a concentration exceeding AWQS (Terranext, 2008). The COCs detected above AWQS in September 2008 included tetrachloroethene (PCE), trichloroethene (TCE), and 1,1-dichloroethene (1,1-DCE). Of these COCs, PCE and TCE were the most prevalent, and TCE was detected at the highest concentration of 85 micrograms per liter (µg/L) in RID wells 92 and 114. The AWQS for both PCE and TCE is 5 µg/L. Sampling was conducted in 2010 for most of the impacted RID wells. Results for sampling conducted in 2010 by Montgomery & Associates are shown, together with results for 2008, on **Figure 3**. Final results for samples obtained by ADEQ in 2010 are available; however, ADEQ indicated that the data has not been reviewed for quality assurance / quality control (QA/QC). Results of the 2010 water quality sampling corroborate the results for the 2008 and previous monitoring events.

Groundwater pumped from the impacted RID wells, along with wastewater from the City of Phoenix 23rd Avenue waste water treatment plant and groundwater pumped from non-impacted RID wells, is currently conveyed to the RID Main Canal **(Figure 1)** and then to RID's service area west of the Agua Fria River. The contaminated groundwater in the WVBA Site impairs RID's wells, its operations, and restricts the use of this water supply. Based on the analytical results of groundwater sampling, historical operation of RID wells appears to have limited the downgradient migration of contaminated groundwater within the WVBA Site.

[3] These totals do ***not*** include RID-111 which is out of service and has not been sampled. Based on its location in the center of the contaminated plume, the well is likely contaminated at levels exceeding AWQS.

4.0 WELL INVESTIGATIONS

Well investigations will be conducted in a phased approach. The phased approach will allow critical tasks to be conducted in a timely manner and minimize impact on RID operations. The phased approach will also provide timely results that might be useful for groundwater modeling that will be conducted concurrently with the well investigations.

Technical work tasks proposed in this Work Plan include: review of existing well field data for all RID wells in the WVBA Site; preliminary testing (water levels and water quality) for all impacted wells; and detailed investigation of selected key wells. Information gathered from investigation of these key wells will be used: 1) to determine if additional well investigations are needed; 2) to determine if modification of any well(s) is warranted to enhance capture of groundwater contaminants during the ERA; and 3) to provide needed information for other phases of the ERA. The proposed scope of work includes the following tasks:

TASK 1: DATA COMPILATION AND EVALUATION
TASK 2: TECHNICAL SPECIFICATIONS AND BIDDING PROCESS
TASK 3: VIDEO SURVEYS
TASK 4: FLUID-MOVEMENT INVESTIGATIONS
TASK 5: ANALYSIS AND REPORTING

The scope of work for initial phase of well investigations will be applied to the RID wells integrated into the ERA as described below:

A. video surveys as specified in Task 3 will be conducted at all ERA extraction wells as shown in Table 1;
B. detailed well investigations as specified in Task 4 will be conducted at the four RID ERA wells completed into the LAU (RID wells 89, 95, 106, and 112); and
C. if results of detailed well investigations at the four RID wells completed into the LAU indicate that substantial flow is entering any wells from the MAU, then

detailed well investigations as specified in Task 4 will be conducted at the four RID ERA wells that are completed in the UAU and MAU (RID wells 92, 107, 113, and 114).

Based on results of the initial phase described above, recommendations for subsequent well investigations for other RID wells within the WVBA Site plume, if appropriate, will be submitted in the hydrogeologic report in accordance with Task 5.

The detailed well investigations will include the following tasks: review existing data; remove existing pumping equipment; obtain video surveys of the wells; install test equipment that will allow access to zones below the pumps; purge the wells as needed to ensure future samples will be representative of normal pumping conditions; conduct geophysical logging to obtain caliper, temperature, and fluid conductivity data; conduct dynamic spinner logging operations to identify zones where water enters the wells; obtain groundwater samples at selected depths, including depths where the flow regime changes noticeably, during pumping operations to identify zones where contaminants enter the wells; and obtain wellhead samples and flow rate information for evaluation of the depth-specific data obtained.

All groundwater monitoring activities conducted pursuant to the well investigation scope of work will be conducted in coordination with the goals of the proposed Groundwater Monitoring and Data Management Program (GMDMP) to be proposed by RID in a separate work plan. The GMDMP will integrate the goals of existing and proposed ADEQ and RID monitoring programs.

To the extent possible, the field activities, sampling methods, laboratory analyses and quality assurance procedures will adhere to protocols developed by ADEQ in the WVBA Field Sampling and Analysis Plan (FSAP), Quality Assurance Project Plan (QAPP) and Site-Specific Health and Safety Plan (HASP) (BE&K/Terranext, 2000a, b and c). RID will

coordinate with ADEQ to define any exceptions or other modifications to these Plans prior to the initiation of field work and formally adopt the approved plans to guide future data acquisition. RID will provide ADEQ with advance notice of any sampling or data collection activities and the results of these activities.

4.1 TASK 1 – DATA COMPILATION AND EVALUATION

Data for existing conditions for all of the RID wells within the WVBA Site will be compiled from various sources, including: the Draft RI Report for the WVBA Site (Terranext, 2008), 2) data obtained from the Arizona Department of Water Resources (ADWR); and 3) information provided by RID. The data compiled will include: well construction details, in particular diameter and type of well casing and perforated or sealed intervals; pumping rates; pumping water levels; non-pumping water levels; aquifer units projected to yield groundwater to wells (UAU, MAU, LAU); composite water quality for the wells (wellhead samples); and likelihood for vertical hydraulic gradients or for vertical differences in groundwater quality (using nearby nested groundwater monitoring wells). Based on these data, the proposed well investigations will be confirmed and the schedule of work will be prioritized to ensure proper conduct of all required tasks and to minimize the impact on RID operations.

4.2 TASK 2 – TECHNICAL SPECIFICATIONS AND BIDDING PROCESS

The scope of work for the proposed well investigations is given in this Work Plan. Based on this scope, technical specifications will be prepared that provide prospective contracting firms with detailed descriptions of protocols required for the work to be conducted at each RID well to be evaluated. These specifications will be submitted, together with appropriate bidding documents, to prospective drilling and pump contracting firms for

conduct of the well investigations. Expedited conduct of field operations will be implemented whenever possible.

4.3 TASK 3 – VIDEO SURVEYS

Video surveys will be conducted at all 13 RID wells proposed as extraction wells for Phases 1 and 2 of the ERA. These video surveys will be conducted to document the integrity and construction details of the well. The video survey will include color images in both horizontal and vertical downhole views. The video survey shall include a continuous downhole scan to total depth of the well and side view scans as appropriate. The video surveys will be scheduled to minimize impact to planned RID operations; when feasible, video surveys will be scheduled for periods when the pump is removed from the well for other reasons, and during periods when the well is not needed for RID operations.

The following information will be documented for each well: depth to water level; depth to top of fill material; description of water clarity and amount of suspended solids; depths to top and bottom of each major section of casing perforations; description of the type and number of perforations per foot; notes regarding integrity of well casing and degree of plugging of perforations; and notes regarding anomalous conditions in the casing and indications of vertical flow of water in the casing.

4.4 TASK 4 – FLUID-MOVEMENT INVESTIGATIONS

Preliminary data available for construction and depths to non-pumping water level for the RID wells within the WVBA Site are summarized in **Table 3**. These data will be conformed and augmented, where possible, with data obtained in Task 1 and Task 3. The protocol for selecting wells for fluid-movement investigations is described above. The

procedures summarized below for preparation and conduct of fluid-movement investigations will be completed for each RID well selected for fluid-movement investigations.

4.4.1 PREPARATIONS FOR TESTING

Prior to conduct of fluid-movement investigations, the existing well pumping equipment will be removed from the well and test pumping equipment will be installed in the well. Flow rate for testing operations will be designed to be as close to the normal operational pumping rate as feasible, within the constraints posed by the dimensions of the wells and testing equipment. All equipment installed in the well or used for testing operations will be properly decontaminated at an off-site location prior to mobilization to the site. The testing equipment will include: a submersible pump set to the minimum depth required for testing operations; a 3-inch diameter access pipe set below the bottom of the pump assembly to allow the wire line tools to pass the pump and access the bottom of the well; a separate 1½-inch diameter access pipe set to the top of the pump bowls for measurement of water levels during testing operations; and other piping appurtenances such as a flow meter, pressure gage, flow control valve, and sampling port. Water produced from the wells during testing operations will be discharged to existing RID canal and lateral system. Following completion of all tasks for each well, all testing equipment will be removed and existing or replacement permanent pumping equipment will be reinstalled.

Prior to conducting the fluid-movement investigations at each well, the test pumping equipment will be operated at the design flow rate for a minimum period of 3 days to minimize the potential impact of vertical flow in the wells during the preceding period when the wells were idle during preparation for testing.

4.4.2 TESTING OPERATIONS

Fluid-movement investigations and depth-specific sampling will be conducted under non-pumping conditions with no equipment installed and under pumping conditions. Fluid-movement investigations include geophysical logging to measure the flow rate of water at successive depth intervals within the cased borehole. When evaluated in conjunction with depth-specific samples obtained at appropriate depths, these data allow determination of differences in water quality and flow rate associated with specific zones where water and/or contaminants enter or exit the well. Locations for depth-specific samples will be selected based on results of geophysical logging and spinner flow meter logging.

The following geophysical logging and groundwater sampling will be conducted:

1) Temperature / Fluid Conductivity Probe – This combination probe provides continuous measurements for fluid temperature and conductivity. Results of the conductivity log shall be compensated for temperature in the field.

2) Spinner Flow Meter - The spinner flow meter shall be used to measure flow rates in the well. For non-pumping conditions, the spinner flow meter shall be used in the following three modes: 1) during downward travel at a constant speed (logs will be obtained at up to three separate constant speeds); 2) during upward travel at a constant speed (logs will be obtained at up to three separate constant speeds); and 3) and at stationary depths selected based on results of the geophysical logs obtained previously. For pumping conditions, the spinner flow meter shall be used in the following two modes: 1) during downward travel at a constant speed (logs will be obtained at three separate constant speeds); and 2) at stationary depths selected based on results of the geophysical logs obtained previously.

3) Depth-Specific Water Sampling – Depths for sampling will be selected in the field based on results of geophysical logs obtained previously. Depth-specific water samples will be obtained using vacuum-actuated sampling tools. Water samples will be analyzed for VOCs and selected general chemical constituents and parameters (such as total dissolved solids content, electrical conductivity, pH, and total organic carbon). Analyses of general chemical constituents will be conducted to evaluate changes in general groundwater chemistry between aquifer zones. In addition, field measurements for pH, electrical conductivity, and temperature will be recorded for the water samples obtained.

4) Caliper – The caliper tool will be used to document the diameter of the well casing and to calculate volume flow rates based on linear flow velocities measured with the spinner flow meter tool.

4.5 TASK 5 – ANALYSIS AND REPORTING

Data obtained in Tasks 1 through 4 will be analyzed to assess well construction details, well casing integrity, water levels, and water quality for wellhead samples for all wells. In addition, vertical profiles for both flow rate and water quality will be analyzed for wells where fluid-movement investigations are conducted. In accordance with the conditional approval by ADEQ, a hydrogeologic report summarizing results of work completed will be submitted to ADEQ within 60 days of completion of the work. Data obtained and interpretations made based on the data will also be used to improve the conceptual hydrogeologic model of the groundwater flow regime in the WVBA and refine assumptions incorporated into the groundwater flow model for the Site.

5.0 WELL MODIFICATIONS

Well modifications may be recommended based on results of the well investigations conducted pursuant to this Work Plan. Modifications to ERA wells would be implemented where deeper aquifer zones are identified that contribute substantial volumes of "clean" groundwater to the wells, and it is determined to be feasible to prevent the clean groundwater from being withdrawn during remedial pumping. This procedure has some potential to increase the effectiveness of contaminant removal and control because eight RID wells within the contaminant plume may be screened below the extent of impacted groundwater. However, any reduction in production capacity that would result from well modifications must be regained via increases in other new and/or existing RID wells.

The hydrogeologic report that summarizes the results of well investigations will include recommendations for any well modifications that may enhance the control, management, and cleanup of the groundwater contamination.

6.0 SCHEDULE

The proposed schedule for conducting the tasks described in the work plan is shown in the chart below. The timeframes anticipated for completing each task are approximate and based on the current Site conditions and understanding. Additionally, the well investigation activities need to be scheduled during the months of October through March to ensure access to RID wells during periods of lower water demand and well usage. An optimistic schedule would be to complete the data review, preliminary testing, and fluid-movement investigations (spinner logging and depth-specific sampling) at the four RID wells completed in the LAU, and submit a report to ADEQ within six months of authorization to proceed. All work to be conducted under this Work Plan will be contingent on securing necessary funding for the tasks required. If ADEQ approval, contractor availability, or RID operational constraints cause delays in the proposed work, the completion date and report would be occur later. A detailed project schedule will be submitted to ADEQ within 30 days following project initiation.

Schedule (months)						RID WELL INVESTIGATION TASK
1	2	3	4	5	6	
						Authorization to Proceed / Funding Secured (later of two)
						TASK 1: DATA COMPILATION AND EVALUATION
						TASK 2: TECHNICAL SPECIFICATIONS AND BIDDING PROCESS
						TASK 3: VIDEO SURVEYS
						TASK 4: FLUID-MOVEMENT INVESTIGATIONS
						TASK 5: ANALYSIS AND REPORTING

7.0 REFERENCES CITED

Arizona Department of Environmental Quality, 2010, **Conditional Approval of a Water Quality Assurance Revolving Fund (WQARF) Early Response Action (ERA) Work Plan for the West Van Buren Registry Site.** June 24, 2010.

BE&K/Terranext, 2000a, **Field Sampling and Analysis Plan, West Van Buren WQARF Registry Site, Phoenix, Arizona**: prepared for the Arizona Department of Environmental Quality, January 10, 2000.

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Montgomery & Associates, 2010, **Roosevelt Irrigation District Early Response Action Work Plan, West Van Buren Area, Water Quality Assurance Revolving Fund Site,** prepared for Gallagher & Kennedy, P.A. by Errol L. Montgomery & Associates, Inc., February 3, 2010.

Terranext, 2008, **Draft Remedial Investigation Report, West Van Buren Area WQARF Registry Site, Phoenix, Arizona:** prepared for the Arizona Department of Environmental Quality, October 2008.

TABLES

TABLE 1
SUMMARY OF EARLY RESPONSE ACTION

ROOSEVELT IRRIGATION DISTRICT
EARLY RESPONSE ACTION WORK PLAN
WEST VAN BUREN AREA WATER QUALITY ASSURANCE REVOLVING FUND SITE

PHASE	WELL NAME	ESTIMATED PUMPING RATE (gallons per minute)[a]	TOTAL VOC CONCENTRATION (micrograms per liter)[b]		ESTIMATED MASS OF TOTAL VOCs REMOVED (pounds per year)[c]
1 Pump and treat impacted groundwater from RID wells located along Van Buren Street	RID-105	1,900		5	44
	RID-106	1,500		61	397
	RID-107	2,100		51	464
	RID-108	1,900		63	526
	RID-109	2,400		22	234
	RID-110	2,900		14	180
	RID-112	1,700		31	231
	RID-113	2,300		44	443
	RID-114	2,500		110	1,202
	SUBTOTAL	**19,200**	**AVG[d]**	**44**	**3,722**
2 Pump and treat impacted groundwater from RID wells with highest VOC concentrations	RID-89[e]	2,900		51	652
	RID-92	1,200		119	624
	RID-95[e]	1,700		80	593
	RID-100	2,100		65	599
	RID-106	1,500		61	397
	RID-107	2,100		51	464
	RID-108	1,900		63	526
	RID-112	1,700		31	231
	RID-113	2,300		44	443
	RID-114	2,500		110	1,202
	SUBTOTAL	**19,900**	**AVG[d]**	**66**	**5,732**

Notes:
[a]Pumping rates based on data provided by RID for 2008 and 2009.
[b]Sum of all detected VOCs; concentrations based on most recent analytical data available for each well.
[c]Total VOC removal in early years of remedy assuming all impacted wells from Phase 1 and 2 are pumped continously and all water is treated; actual mass removal may vary depending on demand for treated water.
[d]Pumping rate weighted average concentration in micrograms per liter assuming no loss due to volatilization or degradation.
[e]Pumping rates shown are 75% of reported rates; well testing and modification may be conducted to seal off lower portion of wells to optimize pumping of impacted groundwater.
Abbreviations:
RID - Roosevelt Irrigation District
VOC - Volatile organic compounds

TABLE 2.
SUMMARY OF CONSTRUCTION DETAILS FOR
ROOSEVELT IRRIGATION DISTRICT WELLS IN WVBA SITE

Well Name	Canal Site	RID Location	ADWR Number	UTM Y NORTHING[a] (meters)	UTM X EASTING[a] (meters)	Land Surface Altitude (feet, msl)	Hole Depth (feet, bls)	Screened Interval(s) (feet, bls)	Unit(s) Screened[b]	Year Constructed	Casing Total Depth (feet, bls)	Casing Material	Casing Diameter (inches)	Drilling Method	Reported Depth to Water[c] (feet, bls)	Reported Pump Capacity (gpm)	Estimated Pumping Rate (gpm)	Pump Setting Depth (feet, bls)
RID-83	CC1SS	4-1/2E 4-3/4N	55-607227	3,701,539	385,814	1,027.61	790	170-790	UAU, MAU, LAU	1/12/72	790	Steel - 0.375-inch wall	18 16	Rotary	107	1,940	2,300	260
RID-84	CC1SS	5-3/4E 4-1/2N	55-607226	3,701,110	387,420	1,036.27	600	130-518	UAU, MAU	2/4/52	532	Steel - 10 gauge	20	---	106[d]	2,419	2,400	220
RID-85	CC1SS	6E 4N	55-607225	3,700,499	388,212	1,029.57	700	135-682	UAU, MAU, LAU	4/11/52	700	Steel	20	---	98[d]	3,495	2,600	180
RID-86	CC1SS	6-1/2E 3-3/4N	55-607224	3,699,885	388,798	1,030.55	300	55-288	UAU	10/22/40; redrill	300	Steel - 8 gauge	24	---	97	5,286	3,600	200
RID-87	CC1SS	7-1/2E 3-1/2N	55-607223	3,699,441	390,397	1,034.69	500	75-480	UAU, MAU	8/7/47; redrill	496	Steel - 8 gauge	20	---	98	4,570	2,000	200
RID-88	CC1SS	8E 3-1/2N	55-607222	3,699,621	391,203	1,033.63	1,800	165-820 835-1,485 1,500-1,785	UAU, MAU, LAU	11/29/64	1785	Steel - 8 gauge	24 20 16	Cable Tool	92[d]	3,718	2,000	290
RID-89	CC1SS	8E 4-1/4N	55-607221	3,700,825	391,427	1,043.47	1,800	180-805 860-1,434 1,465-1,770	UAU, MAU, LAU	4/29/65; redrill	1785	Steel - 8 gauge	20 16 12	Cable Tool	102[d]	3,853	3,900	200
RID-90	CC1SS	8-1/2E 3-1/2N	55-607220	3,699,620	392,011	1,032.64	460	110-446	UAU, MAU	5/13/52	446	Steel	20	---	88[d]	3,494	2,500	290
RID-91	CC1SS	9E 3-1/2N	55-607219	3,699,621	393,019	1,039.56	449	80-448	UAU, MAU	3/12/99	449	Steel	20	---	92[d]	5,510	3,200	280
RID-92	CC1SS	9E 4-1/4N	55-607218	3,700,619	393,032	1,048.82	500	180-488	UAU, MAU	2/9/59; redrill	488	Steel - 8 gauge	20	Cable Tool	104[d]	1,971	1,200	270
RID-93	CC1SS	9-1/2E 3-1/2N	55-607217	3,699,612	393,827	1,038.83	540	110-431	UAU, MAU	3/9/57	445	Steel - 8 gauge	24	Cable Tool	86	6,944	4,000	180
RID-94	CC1SS	10E 3-3/4N	55-607216	3,700,003	394,638	1,044.76	425	85-412	UAU, MAU	6/29/52	425	Steel	24	Cable Tool	91	6,138	3,300	180
RID-95	CC1SS	10E 4-1/4N	55-607215	3,700,801	394,647	1,054.05	1,800	180-815 836-1,470 1,497-1,775	UAU, MAU, LAU	12/29/64; redrill	1775	Steel - 6 & 8 gauge	24 20 16	Cable Tool	98	3,875	2,300	180
RID-96	CC1SS	10-1/8E 3-1/4N	55-607214	3,699,002	394,631	1,041.87	800	123-788	UAU, MAU, LAU	5/7/68	788	Steel	24	---	82[d]	4,480	3,000	180
RID-97	CC1SS	10-1/2E 3-1/8N	55-607213	3,698,788	395,240	1,042.	1,800	200-824 836-1,490 1,500-1,788	UAU, MAU, LAU	10/26/65	1788	Steel	24 20 16	Cable Tool	78	5,958	3,200	200
RID-98	CC1SS	11E 3N	55-607212	3,698,560	396,258	1,048.42	1,675	200-785 800-1,480 1,500-1,665	UAU, MAU, LAU	8/28/65; redrill	1675	Steel	24 20 16	Cable Tool	78	5,286	3,800	200
RID-99	CC1SS	11E 3-3/4N	55-607211	3,699,977	396,058	1,050.55	420	70-400	UAU, MAU	6/24/52	420	Steel - 8 gauge	24	Cable Tool	89	2,778	2,400	180
RID-100	CC1SS	11E 4-1/4N	55-607210	3,700,572	396,257	1,061.17	302	55-290	UAU	10/10/40	302	Steel - 8 gauge	24	---	102	3,136	2,100	230
RID-101	CC1SS	11-1/2E 3N	55-607209	3,698,758	396,860	1,050.	400	110-390	UAU, MAU	2/28/69; redrill	400	Steel - 8 gauge	24	---	81	6,720	4,500	180
RID-102	CC1SS	11-3/4E 3-3/4N	55-607196	3,699,960	397,262	1,055.12	440	85-414	UAU, MAU	8/4/52	428	Steel - 8 gauge	24	Cable Tool	86	5,958	3,900	170
RID-103	CC1SS	12E 3-1/4N	55-607208	3,698,948	397,663	1,058.01	440	80-420	UAU, MAU	8/1/52	440	Steel - 8 gauge	24	Cable Tool	86	4,614	2,200	220

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TABLE 2.
SUMMARY OF CONSTRUCTION DETAILS FOR
ROOSEVELT IRRIGATION DISTRICT WELLS IN WVBA SITE

Well Name	Canal Site	RID Location	ADWR Number	UTM Y NORTHING[a] (meters)	UTM X EASTING[a] (meters)	Land Surface Altitude (feet, msl)	Hole Depth (feet, bls)	Screened Interval(s) (feet, bls)	Unit(s) Screened[b]	Year Constructed	Casing Total Depth (feet, bls)	Casing Material	Casing Diameter (inches)	Drilling Method	Reported Depth to Water[c] (feet, bls)	Reported Pump Capacity (gpm)	Estimated Pumping Rate (gpm)	Pump Setting Depth (feet, bls)
RID-104	CC1SS	12-1/8E 3-3/4N	55-607207	3,699,953	397,864	1,058.	410	100-370	UAU, MAU	6/14/57; redrill (new location)	390	Steel - 8 gauge	24	Cable Tool	88	5,510	3,600	200
RID-105	Salt Canal	5E 5N	55-607206	3,701,924	386,623	1,033.61	622	80-508	UAU, MAU	7/16/42; redrill	622	Steel - 8 gauge	20	---	117	2,374	1,900	260
RID-106	Salt Canal	6E 5N	55-607205	3,701,890	388,246	1,041.62	790	80-776	UAU, MAU, LAU	5/30/42; redrill	790	Steel - 8 gauge	20	---	118	3,000	1,500	200
RID-107	Salt Canal	7E 5N	55-607204	3,701,867	389,824	1,049.69	414	200-404	UAU, MAU	5/27/43; redrill	414	Steel - 10 gauge	24 16	---	121	2,195	2,100	220
RID-108	Salt Canal	7-1/2E 5N	55-607203	3,701,846	390,432	1,054.6	284	62-270	UAU	11/22/40; redrill	276	Steel - 8 gauge	24	---	123	1,711	1,900	210
RID-109	Salt Canal	8E 5N	55-607202	3,701,830	391,446	1,058.01	500	140-394	UAU, MAU	5/18/57; redrill	406	Steel - 8 gauge	20	Cable Tool	125	2,845	2,400	200
RID-110	Salt Canal	9E 5N	55-607201	3,701,820	392,849	1,060.3	500	140-465	UAU, MAU	4/18/57; redrill	480	Steel - 8 gauge	20	---	112[d]	3,069	2,900	240
RID-111	Salt Canal	9-3/4E 5N	55-607200	3,701,802	394,459	1,062.45	454	55-192 206-442	UAU, MAU	3/30/43; redrill	454	Steel - 8 & 10 gauge	24 16	---	---	2,016	2,000	---
RID-112	Salt Canal	10-1/2E 5N	55-607199	3,701,571	395,856	1,064.44	650	300-635	UAU, MAU, LAU	9/15/43	650	Steel - 10 gauge	16	---	107[d]	3,136	1,700	210
RID-113	Salt Canal	11E 5N	55-607198	3,701,765	396,055	1,070.71	415	228-398	UAU, MAU	1/24/53	398	Steel - 10 gauge	20	---	n/a	3,136	2,300	220
RID-114	Salt Canal	11-1/2E 5N	55-607197	3,701,759	396,862	1,070.38	395	205-380	UAU, MAU	2/11/53	395	Steel - 10 gauge	20	---	108	2,240	2,500	220

Notes:
[a]Universal Transverse Mercator Zone 12, North American Datum 1927.
[b]Average depth to aquifer units: UAU from land surface to 310 feet bls, MAU from 310 to 500 feet bls, and LAU 500 feet bls and below (February 2010 ERA Work Plan).
Unit depths also determined based on Draft RI geologic cross sections prepared by Terranext.
[c]RID reported 2008 non-pumping water levels.
[d]RID reported potential obstruction in well, or oil on water surface caused problem with sounder measurement.
Yellow highlighted wells produce groundwater impacted by volatile organic compounds.

RID-XX Indicates well has been impacted by contaminants

Abbreviations:
msl = above mean sea level
bls = below land surface
WVBA = West Van Buren Area

TABLE 3.
SUMMARY OF PROPOSED WELL INVESTIGATION TASKS
ROOSEVELT IRRIGATION DISTRICT WELLS IN WVBA SITE

Well Name	Impacted by Contaminants	Water Level Monitoring[a]	Water Quality Monitoring (Volatile Organic Compounds)[a]	Video Survey	Fluid-Movement Investigations
RID-83		Yes	Yes	No	No
RID-84	Yes	Yes	Yes	contingent - 2	contingent - 2
RID-85		Yes	Yes	No	No
RID-86		Yes	Yes	No	No
RID-87		Yes	Yes	No	No
RID-88		Yes	Yes	No	No
RID-89	Yes	Yes	Yes	Yes - ERA Extraction Well	Yes (LAU well)
RID-90		Yes	Yes	No	No
RID-91		Yes	Yes	No	No
RID-92	Yes	Yes	Yes	Yes - ERA Extraction Well	contingent - 1
RID-93		Yes	Yes	No	No
RID-94	Yes	Yes	Yes	contingent - 2	contingent - 2
RID-95	Yes	Yes	Yes	Yes - ERA Extraction Well	Yes (LAU well)
RID-96		Yes	Yes	No	No
RID-97		Yes	Yes	No	No
RID-98		Yes	Yes	No	No
RID-99	Yes	Yes	Yes	contingent - 2	contingent - 2
RID-100	Yes	Yes	Yes	Yes - ERA Extraction Well	contingent - 1
RID-101	Yes	Yes	Yes	contingent - 2	contingent - 2
RID-102	Yes	Yes	Yes	contingent - 2	contingent - 2
RID-103	Yes	Yes	Yes	contingent - 2	contingent - 2
RID-104	Yes	Yes	Yes	contingent - 2	contingent - 2
RID-105	Yes	Yes	Yes	Yes - ERA Extraction Well	contingent - 2
RID-106	Yes	Yes	Yes	Yes - ERA Extraction Well	Yes (LAU well)
RID-107	Yes	Yes	Yes	Yes - ERA Extraction Well	contingent - 1
RID-108	Yes	Yes	Yes	Yes - ERA Extraction Well	contingent - 1
RID-109	Yes	Yes	Yes	Yes - ERA Extraction Well	contingent - 2
RID-110	Yes	Yes	Yes	Yes - ERA Extraction Well	contingent - 2
RID-111[b]	Yes	No	No	No	No
RID-112	Yes	Yes	Yes	Yes - ERA Extraction Well	Yes (LAU well)
RID-113	Yes	Yes	Yes	Yes - ERA Extraction Well	contingent - 1
RID-114	Yes	Yes	Yes	Yes - ERA Extraction Well	contingent - 1

[a] Monitoring to be conducted in conjunction with well evaluation program; however monitoring noted will be part of the Groundwater Monitoring and Data Management Plan

[b] RID well 111 is not in service

contingent - X = indicates that task at this well is contingent on results for other tasks; number (X) indicates the priority of the contingent action

LAU = lower alluvial unit

ERA = Early Response Action

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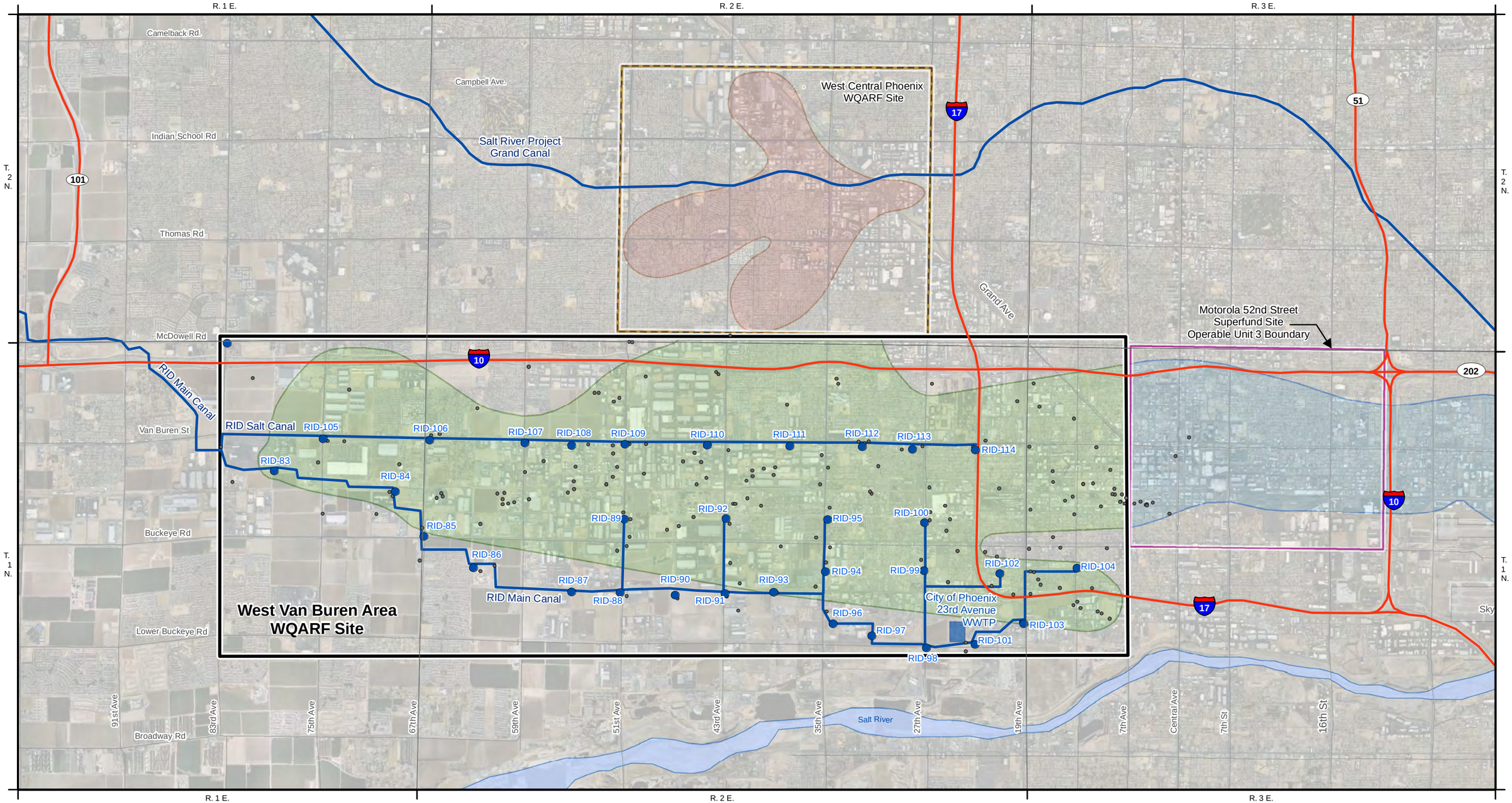
ILLUSTRATIONS



EXPLANATION

- Roosevelt Irrigation District Well
- Monitor Well
- Existing Canal or Pipeline
- Interstates
- Local Streets
- Estimated Extent of Impacted Groundwater in WVBA WQARF Site Based on 1st Quarter 2008 Data (Terranext, 2008a)
- Estimated Extent of Impacted Groundwater in West Central Phoenix WQARF Site
- Estimated Extent of Impacted Groundwater in Motorola 52nd Street Superfund Site

Abbreviations

WVBA - West Van Buren Area
WQARF - Water Quality Assurance Revolving Fund
WWTP - Waste Water Treatment Plant
RID - Roosevelt Irrigation District

N

0 5,000
Feet

Roosevelt Irrigation District
Early Response Action
Well Evaluation Work Plan

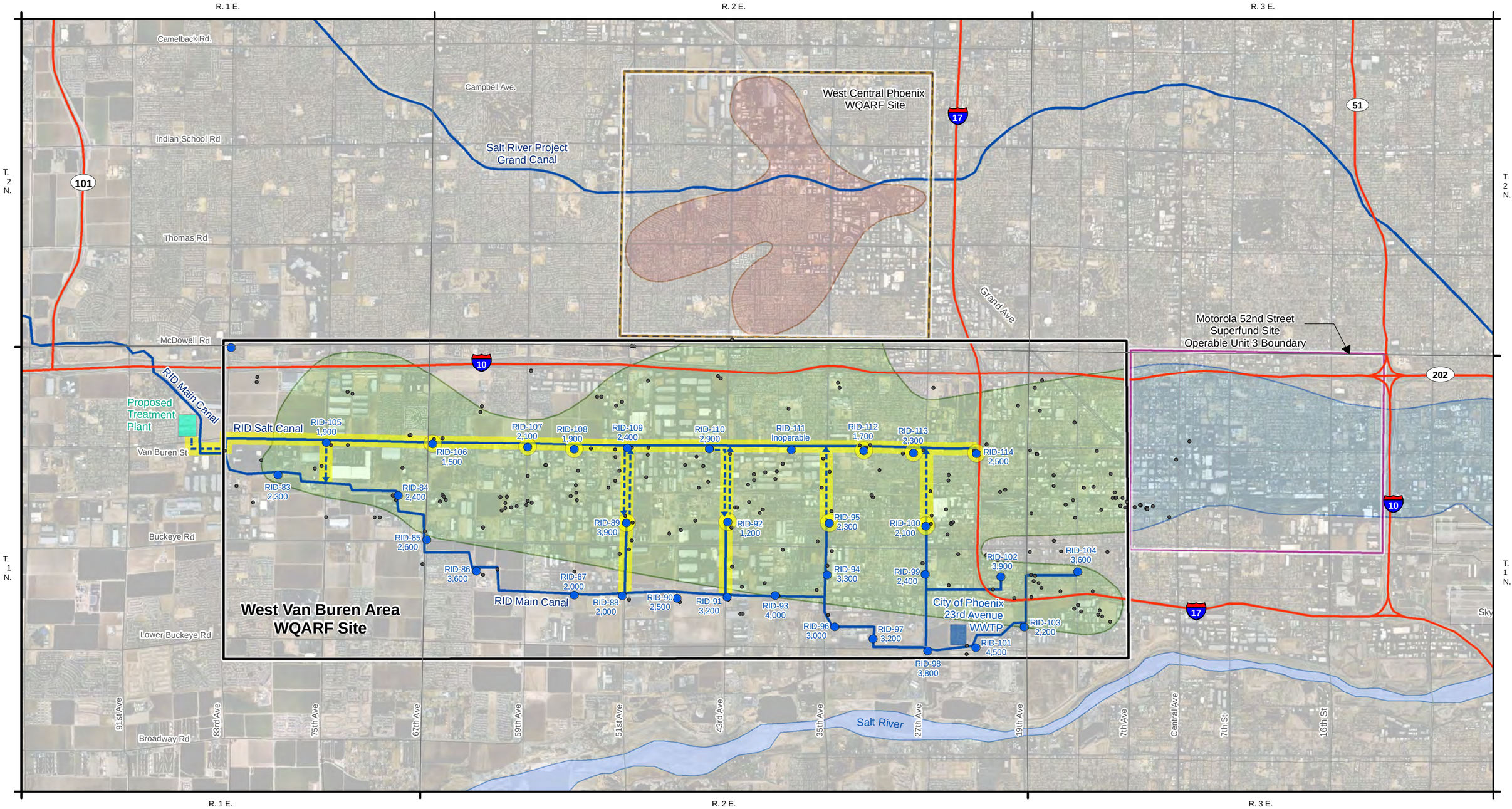
STUDY AREA

MONTGOMERY & ASSOCIATES
Water Resource Consultants

2010

FIGURE 1

G:\GIS-Tuc\Projects\802\03\Site_Map_StudyArea.mxd\05Aug2010



EXPLANATION

- Roosevelt Irrigation District Well
- RID-89 — Well ID; 3,900 — Estimated Pumping Rate (gpm)
- Monitor Well
- Existing Canal or Pipeline
- Proposed New Below-Grade Pipeline
- Interstates
- Local Streets
- Estimated Extent of Impacted Groundwater in WVBA WQARF Site Based on 1st Quarter 2008 Data (Terranext, 2008a)
- Estimated Extent of Impacted Groundwater in West Central Phoenix WQARF Site
- Estimated Extent of Impacted Groundwater in Motorola 52nd Street Superfund Site
- Early Response Action (see Table 2 for a summary of phased implementation)

Abbreviations

WVBA - West Van Buren Area
WQARF - Water Quality Assurance Revolving Fund
WWTP - Waste Water Treatment Plant
RID - Roosevelt Irrigation District
gpm - Gallons Per Minute

N

0 5,000
Feet

Roosevelt Irrigation District
Early Response Action
Well Evaluation Work Plan

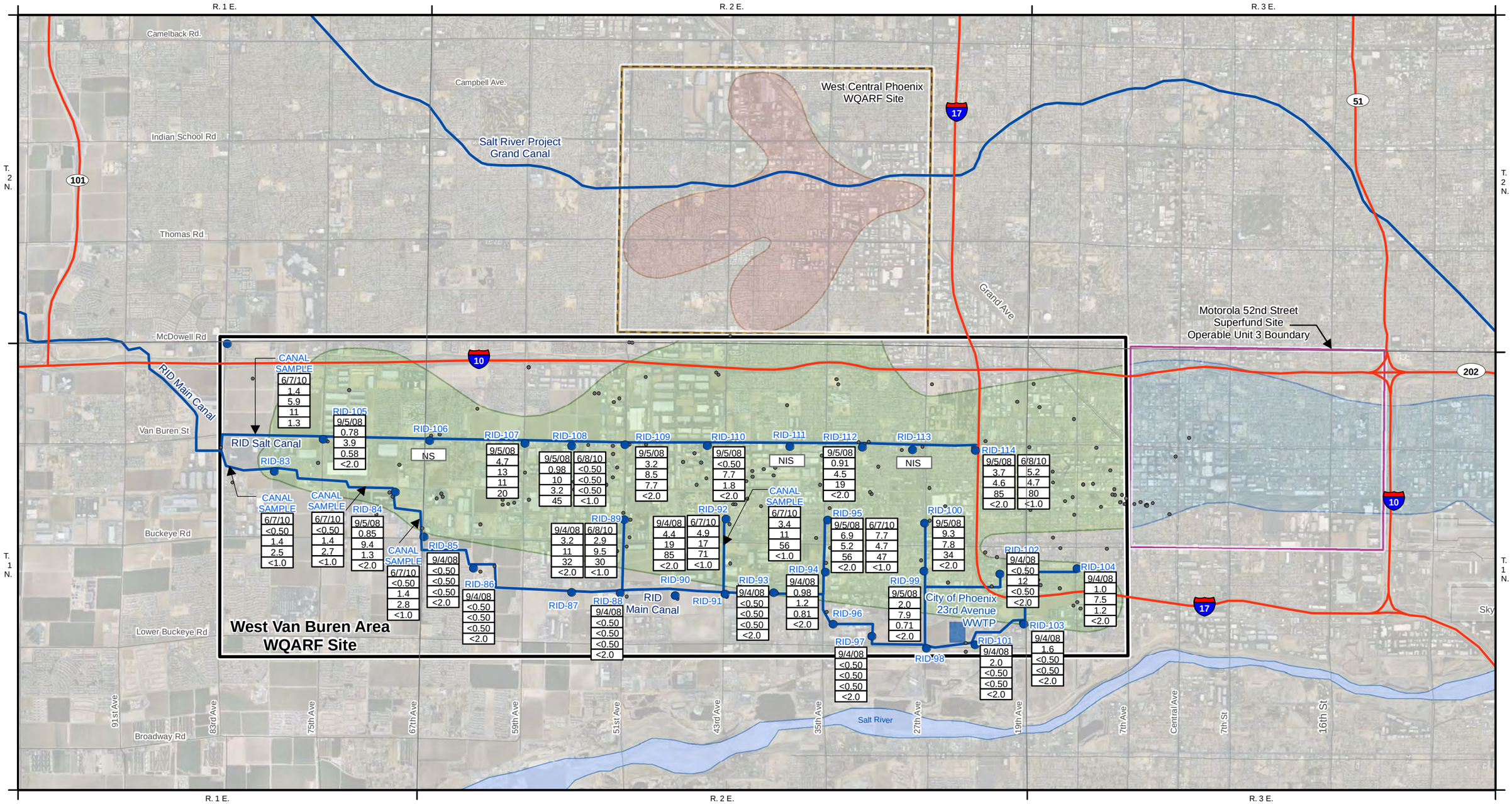
EARLY RESPONSE ACTION

MONTGOMERY & ASSOCIATES
Water Resource Consultants

2010

FIGURE 2

G:\GIS-Tuc\Projects\802\03\Site_Map_Qrtr1_2008.mxd\05Aug2010



EXPLANATION

- Roosevelt Irrigation District Well
- Monitor Well
- Existing Canal or Pipeline
- Interstates
- Local Streets
- Estimated Extent of Impacted Groundwater in WVBA WQARF Site Based on 1st Quarter 2008 Data (Terranext, 2008a)
- Estimated Extent of Impacted Groundwater in West Central Phoenix WQARF Site
- Estimated Extent of Impacted Groundwater in Motorola 52nd Street Superfund Site

Contaminant Concentrations (micrograms per liter)

DATE	
DCE	= 1,1-dichloroethene
PCE	= tetrachloroethene
TCE	= trichloroethene
MTBE	= methyl tertiary butyl ether

2010 data shown are from Montgomery & Associates; Final 2010 data from ADEQ not available

WVBA - West Van Buren Area
WQARF - Water Quality Assurance Revolving Fund
WWTP - Waste Water Treatment Plant
RID - Roosevelt Irrigation District
NS - Well Not Sampled
NIS - Well Not in Service

*No flow at RID-100 sample port on June 8, 2010; could not collect sample.

Canal sample locations are approximate.

N

0 5,000 Feet

Roosevelt Irrigation District
Early Response Action
Well Evaluation Work Plan

RID WELL CONTAMINANT CONCENTRATIONS: 2008 and 2010

MONTGOMERY & ASSOCIATES
Water Resource Consultants

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FIGURE 3

G:\GIS-Tuc\Projects\802\03\Well_ContaminantConcentrationsa.mxd\06Aug2010

APPENDIX A

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

1110 West Washington Street • Phoenix, Arizona 85007
(602) 771-2300 • www.azdeq.gov

Janice K. Brewer
Governor

Benjamin H. Grumbles
Director

June 24, 2010

Mr. Stanley H. Ashby
Superintendent
Roosevelt Irrigation District
103 W. Baseline Road
Buckeye, AZ 85326

Re: Conditional Approval of a Water Quality Assurance Revolving Fund (WQARF) Early Response Action (ERA) Work Plan for the West Van Buren Registry Site

Dear Mr. Ashby:

The Arizona Department of Environmental Quality (ADEQ) has reviewed the Roosevelt Irrigation District (RID) ERA Work Plan for the West Van Buren WQARF Registry Site (the Site) dated February 3, 2010. The Work Plan summarizes technical information regarding the Site, provides justification for an ERA, and describes an ERA remedy designed to remediate contaminated groundwater within the Site. In addition to the ERA Work Plan, ADEQ has also carefully analyzed technical and legal documents and correspondence contained in the Site file, including submittals by RID and other interested parties since September 2009, and comments received through the public participation process.

Based on our analysis of all available information, ADEQ conditionally approves, the February 3, 2010 ERA Work Plan. The attached matrix identifies specific conditions, tasks and outcomes that must be achieved to maintain the conditional approval. RID has a unique opportunity to increase the removal of contamination from the aquifer via its wells by analyzing and potentially modifying existing well screen intervals and pumping rates. Without treatment, these contaminants will continue to degrade the quality of the aquifer within the Site. The conditions ADEQ is placing on this approval will ensure that the ERA maximizes the benefit of pumping and treating contaminated groundwater within the Site, which is intended to result in aquifer restoration and reduce the cost of the final remedy.

ADEQ reserves the right to identify additional conditions as new information becomes available throughout ERA implementation. In addition, RID shall submit all information and take all action required by A.A.C. R18-16-405(H), 404, 411, 412, 413 and A.R.S. § 49-282.06(A). The information and actions required by these provisions include, but are not limited to, community involvement, the submittal of design and engineering plans for the ERA, and addressing unknown or changed conditions during implementation of the ERA.

ADEQ analyzed the ERA Work Plan to determine compliance with applicable State statutes and rules. ADEQ has not reviewed whether the ERA Work Plan is consistent with any federal laws or regulations. In addition, ADEQ's review and conditional approval of the ERA is limited only to those activities expressly described within the ERA related to the extraction and treatment of contaminated groundwater within the Site. ADEQ's conditional approval does not include an analysis or approval of the transport or final disposition and use of the treated water.

Until information about a final remedy is developed, ADEQ cannot estimate the cost of the final remedy and each responsible party's proportionate share of liability. As a result, ADEQ will not provide any covenants not to sue or contribution protection for WQARF liability in a settlement, until we have enough information about the final remedy to determine the impact of the settlement on funding of the final remedy.

We look forward to working with you and other interested parties as you begin to implement the ERA. Please contact Amanda Stone, Director of the Waste Programs Division at (602) 771-4567 if you wish to discuss the technical aspects of this conditional approval.

Sincerely,

Benjamin H. Grumbles
Director

Attachment (1)

cc: Herb Guenther, Arizona Department of Water Resources

Approval of the proposed RID ERA is made with the following conditions that must be met within the time periods identified below, or within another time period approved by ADEQ. All work plans required by this conditional approval must be submitted to ADEQ for approval prior to implementation, and must include a schedule for performing all tasks identified in the work plan. Once a work plan is approved by ADEQ, all tasks within the work plan must be completed in accordance with the schedule in the approved work plan, unless a deviation is agreed upon by ADEQ in writing. RID shall begin implementation of task 1 and 2 concurrently, and 2, 3 and 4 sequentially. Conditional approval is based on the assumption that each of these areas of concern will be investigated appropriately and the results of the investigations will demonstrate that the ERA continues to meet minimum applicable statutory and rule requirements. Days are calendar days, unless specifically noted otherwise.

Task No.	Description	Completion/Submittal Date
1. Public Health Threat	The RID work plan states there is a current risk to the public health from exposure to VOCs (from both air and water) within the West Van Buren Area (WVBA), however, specific documentation about the risks and how the risks will be mitigated during the ERA implementation has not yet been provided.	Within 30 days of ERA approval, RID shall submit a risk analysis work plan to ADEQ documenting the risks and demonstrating to ADEQ how and when the ERA will mitigate the risks.
2. RID Wells Investigation	Due to the proposed increased pumping rate at RID wells to be used for remediation, RID must conduct well testing and modeling to insure that changes in pumping will not adversely affect groundwater quality and levels within the WVBA beyond what would be expected with the current pumping conditions. Water levels must be maintained at or near current levels taking into account natural variations. The investigation must determine how ERA workplan implementation will affect both the aquifer and wells in the area of the plume.	Within 45 days of ERA approval, RID shall submit a well investigation work plan for the investigation of RID wells within the plume boundary. This investigation shall include at a minimum, water levels, screen intervals, spinner log testing, depth specific analytical testing, and video logging. Within 60 days of completion of the work required by the well investigation work plan, RID shall submit a well investigation report to ADEQ.

Task No.	Description	Completion/Submittal Date
3. Groundwater Modeling	A groundwater model must be constructed to estimate the effects of the changed RID well pumping rates. RID has indicated that the overall pumping rate will stay the same; however, the wells that will be pumped will change. This change must be modeled. The groundwater model must also evaluate how the diverted pumpage of RID wells will affect other contaminant groundwater plumes, such as those created at Leaking Underground Storage Tank (LUST) sites and neighboring WQARF and Superfund sites. The model must also consider differing pumping rates and locations. One of the goals of the ERA is to remediate groundwater. RID must maximize, to the extent practical, the removal of contaminants from the subsurface when the ERA is implemented. Currently the RID treatment system plan is based on treating the entire volume of groundwater that the RID wells are capable of pumping. However, this may be excessive if the wells can be pumped at a lower rate from the contaminant zone and still maintain the desired effects of groundwater recovery. Therefore, the model shall also consider impacts of other pumping rates on drawdown and capture zones.	Within 60 days of ADEQ's written approval of the well investigation report, RID shall submit a groundwater model work plan. At a minimum, the groundwater model shall estimate the effects of changed pumping rates and locations on the aquifer, including but not limited to water levels and all contaminant plumes within the WVBA and neighboring WQARF and CERCLA sites. Within 60 days of completion of the work required by the groundwater model work plan, RID shall submit a groundwater model report to ADEQ for approval.

Task No.	Description	Completion/Submittal Date
4. Pump and Treat System	RID must complete an engineering design study which describes all technical requirements for a pump and treat remediation system, including a description of the influent and effluent contaminant levels. All applicable permits must be in place, prior to construction and/or operation of the pump and treat system, as required under the relevant statutes and rules. RID must also submit a construction, operation and maintenance work plan for the pump and treat system. The work plan must contain a plan for monitoring groundwater quality and groundwater elevations, including what wells will be sampled and monitored, the frequency that they will be sampled and monitored, and the parameters that will be analyzed. As part of the work plan, RID must also submit proposed sampling frequency, locations, and analytical methods, at the pump and treat system.	Within 60 days of ADEQ's written approval of the groundwater model report, RID shall submit an engineering design study for the pump and treat remediation system sealed by an Arizona Registered Professional Engineer. At a minimum the engineering design study shall include all of the technical design requirements of the pump and treat remediation system, including a description of the influent and effluent contamination levels. In addition, the engineering design study must include a list of all permits that must be obtained prior to construction and operation. Within 60 days of ADEQ's written approval of the engineering design study, RID shall submit a remediation system construction, operation, and maintenance work plan. At a minimum the work plan shall include, an Operation and Maintenance (O&M) plan for the remediation system, a description of the sampling of RID canals and wells (both for groundwater elevation and quality) during operation of the remediation system, and a description of sampling of remediation system influent and effluent water.