Danielle R. Taber

From: Jerry Worsham <JWorsham@rhlfirm.com>
Sent: Wednesday, January 14, 2015 1:28 PM
To: Danielle R. Taber
Cc: Laura L. Malone; Ana I. Vargas; Wendy Flood; Anthony E. Young (anthony.young@azag.gov); Scott R. Green
Subject: Meritor, Inc. and Cooper Industries LLC's Supplemental Public Comments and Exhibits on RID's Feasibility Study Report/West Van Buren Water Quality Revolving Fund (WQARF) Site
Attachments: Cover Ltr w Supp Comments and Exhibits del. 1-13-15.pdf

Danielle et al:
Attached is the electronic version of the written comments I submitted to ADEQ yesterday on the Roosevelt Irrigation District's Feasibility Study Report. Please include these comments for consideration in the formal record. I have highlighted six major issues of concern in choosing the appropriate Feasibility Study. Enjoy the light reading and I appreciate the difficulty and issues in adopting a Feasibility Study in this matter. Please call me at (602) 744-5763 with any questions.

Jerry

_____

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January 13, 2015

Our File No.: 23787-0001

Arizona Department of Environmental Quality
ATTN: Danielle Taber
Waste Programs Division
1110 W Washington Street
Phoenix, Arizona 85054

Re: Supplemental Comments on West Van Buren Water Quality Assurance Revolving Fund (WQARF) Site – Feasibility Study (FS) Reports (Due January 14, 2015)

Dear Danielle:

Enclosed are the written comments supplied on the captioned Feasibility Study Reports on behalf of Meritor, Inc. and Cooper Industries LLC. These parties are not located in the West Van Buren WQARF Site, are not potentially liable parties in the West Van Buren WQARF Site, but supply these comments for the Arizona Department of Environmental Quality to assist in the selection of the Feasibility Study that:

1. Assures the protection of public health and welfare and the environment.
2. To the extent practicable, provides for the control, management or cleanup of the hazardous substances in order to allow the maximum beneficial use of the waters of the state.
3. Is reasonable, necessary, cost-effective and technically feasible.

Danielle Taber
January 13, 2015

Please include these supplemental comments with the ones filed for the record with ADEQ by Meritor, Inc. submitted on December 2, 2014.

Please call me at (602) 744-5763 with any questions.

Sincerely,

Jerry D. Worsham II
For the Firm

JDW/pjb

cc: Laura Malone - ADEQ
Tina LePage - ADEQ
Scott R. Green - ADEQ
Wendy Flood – ADEQ
Anthony Young, Esq. – Arizona Office of the Attorney General

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January 13, 2015

Our File No.: 23787-0001

Arizona Department of Environmental Quality
ATTN: Danielle Taber
Waste Programs Division
1110 W Washington Street
Phoenix, Arizona 85054

Re: Supplemental Comments on the Roosevelt Irrigation District's "Draft Feasibility Study Report West Van Buren Area WQARF Site" Prepared by Synergy Environmental, LLC and Montgomery & Associates (July 2014)

Dear Danielle:

On behalf of Meritor, Inc. and Cooper Industries LLC, I provide these additional comments on the Roosevelt Irrigation District's (RID) Draft Feasibility Study (FS) Report concerning the West Van Buren Area Water Quality Assurance Revolving Fund ("WQARF") Registry Site.

ISSUE No. 1. RISK

RID's Public Health Exposure Assessment

The RID's document titled "*Early Response Action – Public Health Exposure Assessment and Mitigation Work Plan*" (June 16, 2011) indicates that,

> "The Final Report will provide **Summary and Conclusions** that will quantify and compare the mass of [volatile organic compounds] VOCs that are released into the environment from current RID well operations in the WVBA and that which would

> occur upon implementation of the [Early Response Action] ERA to demonstrate how the planned ERA will reduce VOC releases to the environment to mitigate the associated public health exposure." (pg. 29)

The RID's document titled "*Early Response Action – Public Health Exposure Assessment and Mitigation Summary Report*" (September 16, 2011) states the following **Summary and Conclusions**,

> "Review of these data, and consideration of the reasonable likelihood for potential public exposure, result in the conclusion that **there is not an imminent (acute) risk to the public from** the contamination being released from the RID water systems. While air sampling results show that many points in the RID water systems exceed air inhalation screening-level guidelines for short-term exposure (acute MRLs and one-hour AAAQGs) these points are not likely to provide a reasonable public exposure pathway due to their physical nature and locations. Similarly, water sampling results show that many points in the RID water systems exceed screening-level guidelines for ingestion (EPA RSL – tap water and SWQs – drinking water), however, the contaminated water is not expected to lead to an unacceptable public exposure based on the limited and transient potential use of this water as a source of drinking water. Water from the RID system in the WVBA Site is not currently used for municipal drinking water supply." (pgs. 27-28)

Therefore, the RID's own documentation and report confirm that, ". . . there is not an imminent risk to the public from the contamination being released from the RID water systems." There is no imminent or substantial endangerment to the public health or environment.

1992 ADHS Health Risk Assessment

Despite RID's own risk report of summary and conclusions, the RID's Draft FS Report repeatedly references an outdated Arizona Department of Health Services (ADHS) Report titled, "*1992 Health Risk Assessment Task Assignment II-18*," Contract No 2217-000000-3-3-AB-2001(October 30, 1992). The RID Draft FS Report relies upon or cites this historical 1992 ADHS Report no less than seven (7) times (pgs. 14, 16, 56, 86, 92, 125 and 203) to allege or infer current risks to public health and the environment. However, RID's repeated reference to the 1992 ADHS Report, which is based on limited sampling data that is outdated, does not support RID's claim that there are current risks to public health and the environment.

Close review of the 1992 ADHS Report confirms that it relied upon a basic premise that, "Although public wells are not currently contaminated, pollutants similar to those in groundwater . . . are slowly migrating to the west. The City of Tolleson ("COT") public wells are likely to be impacted in the near future." (pg. 1)

In reality, RID has acknowledged that the COT public wells are not at risk and that groundwater pumping of the RID well field in the WVBA Site hydraulically contains the regional comingled groundwater contaminant plume and constrains the impact of this plume on peripheral wells of other water providers [including the COT public wells]. (*See* RID Draft FS Report pgs. 86 and 127) Therefore, the West Van Buren WQARF Area Plume has been and continues to be stable. Clearly, the basic premise in the 1992 ADHS Report concerning the impact to the COT public wells is not valid and has not occurred in 22 years. In addition, the 1992 ADHS Report is based upon limited groundwater sampling data. For example, the limited groundwater data in the 1992 ADHS Report relies upon RID-84 well and was analyzed on only two occasions (June 19, 1990 and May 5, 1991). As stated in the 1992 ADHS Report, "The quantity of data collected and reported is quite limited . . . Therefore the quantity of data is therefore of concern when interpreting the results of this Risk Assessment." (p. 4) Groundwater data collected by RID between 1992-2014 show a considerable declining trend in TCE/PCE concentration in RID-84 through 2014. (*See* RID Draft FS Report Table 2)

2015 ADHS Health Consultation

"In 2015, the Arizona Department of Health Services (ADHS) revisited the outdated 1992 ADHS Health Risk Assessment Report and have completed a new health consultation report titled, " ***Health Consultation: Evaluation of Water Sampling Results in the Roosevelt Irrigation District (RID),*** " ADHS Bureau of Public Health and Emergency Services, Environmental Toxicology Program (January 8 , 2015). (*See* **Exhibit "1"**) The 2015 ADHS Health Consultation Report finds that there is "No Apparent Public Health Hazard" based upon a review of historical and current groundwater data collected by the ADEQ and RID through 2014 and the identified exposure scenarios. ADHS reports that the current cancer risk has a calculated value which is well below the EPA's target risk range of 1×10^{-6} for total carcinogenic risk. The 2015 ADHS Health Consultation Report is based upon the available information provided by current groundwater sampling data and exposure to the chemicals of concern (i.e. TCE/PCE/1, 1-DCE). Therefore, based upon the 2015 ADHS Report, there is not an acute or long term risk to the public from the irrigation water pumped into the RID water systems for distribution.

West Van Buren WQARF Site Working Group's Risk Assessment

In addition to the RID's conclusion that "no risk to the public" exists from the RID water system and ADHS's determination of No Apparent Public Health Hazard, a recent report by the West Van Buren WQARF Site Working Group titled "*Human Health Risk Assessment [HHRA] West Van Buren WQARF Site, Phoenix, Arizona*," (July 2014) asserts,

"5.1.4 Summary of Quantitative Risk Characterization Results

The risk characterization results for the RID worker and resident are summarized below. For each receptor, cumulative [incremental lifetime cancer risks] ILCR[1] and total [Hazard Index] HI were estimated.

5.1.4.1 RID Worker
Based on the results of this HHRA for the RID worker, the cumulative ILCR is 4×10^{-7} and the total HI is 0.053. The cumulative ILCR is less than the cumulative ILCR point of departure of 1×10^{-6} and the total HI is less than the acceptable total HI of 1.0. Based on these results, mitigation is not warranted to protect the RID worker within the WVBA from potential exposure to groundwater from the RID wells.

5.1.4.2 Resident
Based on the results of this HHRA for the resident within the WVBA, the cumulative ILCR is 8×10^{-7} and total HI is 0.13. This cumulative ILCR is less that the cumulative ILCR point of departure 1×10^{-6} and the total HI is less than the acceptable total HI of 1.0. Based on these results, mitigation is not warranted to protect the residences within the WVBA from potential exposure to groundwater from the RID wells." (p. 37)

Issue No. 1 Conclusion

Of the three above identified risk assessment reports concerning the West Van Buren Area, the HHRA report by the West Van Buren WQARF Site Working Group more quantitatively meets the requirements of A.A.C. R-18-16-407 (H)(3)(b) to address the evaluation of risk. However, RID's, ADHS's and the West Van Buren Site Working Group's risk assessment reports confirm there is no current health risk associated with groundwater from the RID's wells to either residents or workers with the RID's current or future pumping of groundwater for irrigation.

[1] AACR 18, Chapter 7 similarly indicates that sites shall be remediated to site-specific residential and non-residential remediation levels within cumulative excess lifetime cancer risk of 1×10^{-6} and 1×10^{-4}. (See AACR 18-7-201 Definitions (28) and (37))

ISSUE No. 2 RISK HISTORY

In review of ADEQ's historical reports and documents, it is clear that ADEQ has understood the importance of the public health risk evaluation in the FS evaluation process. The earliest attempt to evaluate risk in the West Van Buren Area was in August of 1992 with a Statement of Risk report by the ADHS which [in retrospect] was based on limited groundwater data and faulty exposure assumptions. In fact, ADEQ has acknowledged the importance of identifying the current risk since the December 10, 2009 West Van Buren Community Advisory Board Meeting as documented in the Proposed Remedial Objective ("RO") Report (May 16, 2011) on the West Van Buren Area, following the December 2009 hearing and comment period. In the ADEQ's Draft RO Report – Appendix C "Responsiveness Summary to Comments," ADEQ responded to comments provided in 2009 by RID as follows:

> **Roosevelt Irrigation District [Comment]**
>
> #7 Protect human health and the environment by reducing and eventually eliminating potential exposure to hazardous substances that area contaminants of concern (COCs) in the groundwater;
>
> **[ADEQ] Response:**
>
> Data collected to date do not indicate a current risk to human health or environment by groundwater contamination within the WVBA WQARF site. Data collection has been requested of the RID to confirm historic determinations. **As soon as these data are available, ADEQ will reassess the potential for risk.** (p. Appendix C-3) (emphasis added)

When ADEQ issued the "conditional approval" of the RID's Early Response Action ("ERA") in June 24, 2010, the Task No. 1 of the ADEQ's conditional approval of the ERA is mandated as follows:

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	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.

	documentation about the risks will be mitigated during the ERA implementation has not yet been provided.	

In response, the RID submitted to ADEQ the "*Public Health Exposure Assessment and Mitigation Summary Report*" on September 16, 2011. That RID report states that, "The results of this assessment suggest that there is not an imminent (acute) risk to the public from the contamination being released from the RID water systems." (p. 2) Not surprising, RID's own report indicates that there is no risk to the public health.

The ADEQ's final RO Report (August 8, 2012) which is incorporated in the ADEQ's Final Remedial Investigation Report ("RI") (August 2012), ADEQ included the previous ADEQ response:

> "Data collected to date do not indicate a current risk to human health or environment by groundwater contamination within the WVBA WQARF site. Data collection has been requested of the RID to confirm historic determinations. **As soon as these data are available, ADEQ will reassess the potential for risk."** (p. Appendix C-3) (emphasis added)

The FS Report on the West Van Buren WQARF Site submitted by the West Van Buren WQARF Site Working Group (July 2014) includes a complete Human Health Risk Assessment (HHRA) under Appendix D. This HHRA Report finds that, "Based on the results of this HHRA for the residents within the WVBA, the cumulative ILCR is 8×10^{-7} and total HI is 0.13. This cumulative ILCR is less than the cumulative ILCR point of departure of 1×10^{-6} and the total HI is less than the acceptable total HI of 1.0. Based on these results, mitigation is not warranted to protect the residents within the WVBA from potential exposure to groundwater from the RID wells." (p. 37)

Finally, the ADHS has recently completed a Health Consultation Report titled, "*Evaluation of Water Sampling Results in the Roosevelt Irrigation District*" ("RID") (January 8, 2015). (*See* **Exhibit "1"**) That ADHS Report on page 3 concludes as follows:

> **Update of the 1992 Statement of Risk (ADHS 1992):** ADHS re-evaluated the potential health risks associated with the exposure to RID #84 as if it were used as potable water. **With the available information, ADHS concluded that exposure to trichloroethene (TCE), tetrachloroethene (PCE) and 1,1-dichloroethene (1,1-**

DCE), in RID #84 would not be expected to harm people's health under typical conditions of household water use.

RID irrigation wells and canal water: This health consultation evaluated the potential health risks associated with the exposure to groundwater collected from RID irrigation wells and canal water collected in the RID area. **With the available information, ADHS concluded that ingestion exposure to TCE and PCE in groundwater and canal water in RID sampling area is not expected to harm people's health.**

[EPA has established a target risk range of 1 in 1,000,000 to 10,000 (10^{-6} to 10^{-4}) for hazardous waste sites.] Calculated cancer risk was below EPA's target risk range.

Issue No. 2 Conclusion

In review of historical ADEQ records and documents, it is clear that ADEQ has consistently recognized the importance of the risk evaluation in the FS evaluation process. With respect to the West Van Buren WQARF Site, the data and risk reports available since September of 2011 (RID Report), July of 2014 (WVBFS Group Report) and January of 2015 (ADHS Report) all support the conclusion that since September of 2011 the groundwater data and risk evaluations do not indicate a current risk to human health or the environment for the groundwater used for irrigation purposes by the RID within the WVBA WQARF Site. Therefore, there was, and is, no legal or factual support regarding the WQARF Site [or the RID's ERA/MERA] that the groundwater contamination "present[s] an imminent and substantial endangerment to the public health or the environment."

ISSUE No. 3 DECLINING VOC TREND

RID has projected their Mass Removal Estimate for the 2004-2013 period based upon calculated historical volatilization that they allege occurs in the pumping strategy for RID's water supply delivery system for irrigation water.

RID WATER SUPPLY WELLS – MASS REMOVAL ESTIMATES, 2004-2013
WVBA SITE
(values presented are in approximate pounds of target COCs released)

2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
3,500	2,975	3,575	3,150	3,330	2,815	2,760	2,625	2,200	2,070

(See RID Draft FS Report pgs. 64-65).

According to RID, the approximate pounds of VOCs subject to volatilization have an estimated value starting in 2004 of 3,500 lbs. declining to 2,070 lbs. released in 2013. RID's removal estimates provide convincing evidence that the overall trend in contamination in the West Van Buren WQARF Site is on a steady path to decline. This is due to previous source control efforts by ADEQ and consistent with the overall trend of VOCs in the underlying aquifer. This trend will continue for the foreseeable future. Based upon RID's groundwater modeling in Appendix F, they apparently used the Central Phoenix Plume Model (CPPM) to only evaluate the future hydrologic effects of prioritized pumping in RID wells with wellhead treatment for various remedial alternatives. RID has not projected the future declines in the WVBA plume of impacted groundwater using the "Baseline Scenario" and "no wellhead treatment on any wells" taking into account the identified overall trend of VOCs in the underlying aquifer.

Issue No. 3 Conclusion

The overall declining trend in VOCs between 2004-2013 support the position that expensive pump and treat wellhead treatment systems are not "reasonable, necessary, cost effective and technically feasible," as required by A.R.S. §49-282.06 (A) (3). The RID's proposed Remedial Alternatives do not incorporate this identified downward trend of VOCs in the underlying aquifer and therefore the RID's Draft FS Report and associated groundwater modeling is not reliable to project future benefits for any of the identified Remedial Alternatives.

ISSUE No. 4 RID's OPERATIONAL HISTORY

In order to evaluate the RID's proposed Draft FS Study Report, ADEQ should review the RID's past performance and documentation submitted to ADEQ under the ADEQ's "conditional approval" of the Early Response Action (ERA) dated June 24, 2010 and the Modified Early Response Action (MERA) dated February 1, 2013. These documents provide a significant data base and negative operational history from RID's MERA wells including RID-89, RID-92, RID-95 and RID-114. For comparison purposes, the RID's figures are used.

MERA Phase 1 and Phase 2

The MERA Work Plan originally outlined the RID's previous intent to install wellhead treatment systems at eight of RID's groundwater irrigation production well locations in two phases (Phase 1 and Phase 2). Currently, the RID has installed wellhead treatment systems at only four locations (Phase 1), including irrigation wells identified RID-89, RID-92, RID-95 and RID-114. The Phase 2 of the MERA consists of installing wellhead treatment at the remaining four locations: RID-100, RID-106, RID-112 and RID-113. According to the RID's proposed Draft FS Report, the concept of implementing the Phase 2 wellhead treatment systems has been abandoned in the MERA and will instead be evaluated as part of the ADEQ's review of the merits of the RID's Draft FS Study Report. (*See* RID's Draft FS Report, pgs. 131 and 138)

RID's Less Aggressive Remedial Alternative

Close review of RID's "*Less Aggressive Remedial Alternative*" discussed in Section 7.4 of the RID's Draft FS Report (pgs. 136-143) and the associated ***Table 7*** – *"Costs of Remedial Alternatives"* and ***Table 10*** – *"Groundwater Remedial Actions – Comparative Analysis"* provide a way to compare RID's calculations and predictions in the Draft FS Report based upon RID's MERA operational history. (*See* **Exhibit "2"**) The RID's *Less Aggressive Groundwater Alternative* Remedy includes the four Phase 1 MERA wells RID-89, RID-92, RID-95 and RID-114 plus the addition of wells identified as RID-106 and RID-109. Subtraction of the cost elements in Table 7 and Table 10 of RID's Draft FS Report associated with RID-106 and RID-109 provides a valuable tool to evaluate RID's representative costs presented in the RID's Draft FS Report. It is problematic that RID's operational history for the Phase 1 MERA wells indicate that the RID has operated in by-pass/shutdown mode for a majority of the time since October 2012 (*See* **Exhibit "3"**). Meritor, Inc. has contracted with an environmental consultant, Arcadis U.S., Inc. to assist in the evaluation of the cost elements presented by RID for their accuracy.

Issue No. 4 Conclusion

Based upon a review of RID's past performance in implementing the MERA well head treatment systems, RID's predictions or calculations in the Draft FS Report are generally suspect, inaccurate and/or probably overstated. Meritor Inc. does not adopt or accept RID's figures or projections for any purpose other than comparison. The RID's Draft FS Report should

be rejected by ADEQ and other FS Reports adopted due to RID's inability to operate existing wellhead treatment systems. As stated by RID, they assert that they are not required to conduct any work unless adequate funds are available from other third parties or from cost recovery actions. These sources of funds have not been available to RID, nor will they be available, any time in the near future (if ever).

ISSUE No. 5 <u>ARCADIS TECHNICAL MEMORANDUM – RID's ERA/MERA PERFORMANCE</u>

Under **Exhibit 4** is a Technical Memorandum completed by Arcadis U.S., Inc. titled *"RID Phase 1 Wellhead Treatment System Annual VOC Mass Removal Evaluation"* (October 31, 2014) (Arcadis Report) which evaluates the RID's actual MERA well production data versus RID's estimated production treatment capacity, estimated VOC removal rates, annual VOC removals in 2012, 2013 and 2014 and finally the RID's "most likely" maximum annual VOC removal rate. It should be noted for the record that the RID has not been consistent in their technical submissions to ADEQ (and the public) about the ERA/MERA's ability to remove VOCs. The principal purpose of the Arcadis Report was to verify the RID's estimate to ADEQ of 1900 pounds (lbs.) per year for the total annual VOC mass removal by the MERA Phase 1 Wellhead Treatment Systems and to document RID's operational history under the MERA. The Arcadis Report confirms that the economic projections presented by the RID in their Draft FS Report in Table 10 should be rejected by ADEQ as inaccurate and should be closely scrutinized for accuracy and errors.

<u>Actual VOC Removal / Operational History</u>

In the MERA, RID's projected annual VOC reduction for Phase 1 MERA wells is **1900 lbs.** per year[2]. However, the most likely maximum VOC Mass Removal from the MERA Phase 1 wellhead treatment systems is **1446 lbs. per year**. (Arcadis Report pgs. 2/12 and 9/12) Based upon the RID's submission to ADEQ and the Monthly Progress Reports, in 2012 the MERA wells actually removed 895 lbs. of VOCs, in 2013 the MERA actually removed 767 lbs. of VOCs and in 2014 the MERA wells actually removed 89 lbs. (Arcadis pg. 2/12 and 6/12) The fact that RID has not been able to continuously operate the MERA wells and has operated in by-pass/shutdown for most of the operational history of the MERA wells certainly questions the ability of RID to accurately predict VOC removal in the future. (See **Exhibit "3"**)

Year	lbs. / VOC Removed
2012	895
2013	767

[2] Originally, the RID asserted to the Arizona Department of Environmental Quality (ADEQ) in the MERA Proposal (July 12, 2012) that the MERA would, ". . . remediate approximately **3,500 pounds** per year of VOC contamination in the regional groundwater . . ." (MERA Proposal Executive Summary p. iii and p. 7, Synergy Environmental, LLC, 2012a) In the MERA Workplan (October 2012), RID changed their position and asserted that the MERA wells would remediate up to **2,300 pounds per year** (MERA Work Plan Executive Summary p. ii). "Based on current VOC concentrations in the Phase 1 RID wells, the estimated total annual VOC mass removal during Phase 1 would be approximately **1,900 pounds** . . . Based on current VOC concentrations in the Phase 2 wells, the estimated total annual contaminant VOC mass removal following implementation of Phase 2 would be approximately **440 pounds.**" (MERA Work Plan p. 28, 29 and Table 2, Synergy Environmental, LLC 2012b) In the Draft FS Report-Table 10, RID predicts a removal rate of 2503 lbs. VOC/year which is a significant overstatement of projected removal rate for the "Less Aggressive Remedial Alternative."

2014	89
TOTAL	1751 lbs. Actual MERA Wells VOCs Removed to Date

Comparative Analysis – RID's Remedies vs. MERA Wells (Estimated Costs)

Under **Exhibit 5**, Meritor Inc. has provided ADEQ with a revision of RID's **Table 7** and **Table 10**, which is based upon the information derived from RID's current Table 7 and Table 10 and includes supporting technical information provided in the Arcadis Report. These revised Tables 7 and 10 by Arcadis provide documentation of RID's suspect, inaccurate and/or overstated information. These comparative Tables provide a way to compare the performance of the current, existing MERA wells to the RID's various proposed alternatives in the Draft FS Report.

Arcadis has accurately documented RID's flawed calculations as follows:

Design Treatment Capacity (MERA Wells)

RID	Arcadis
9250 gpm	8425 gpm

Projected Annual VOC Mass Removal Rate

RID	Arcadis
1900 lbs/year	1446 lbs/year

Actual Amount of VOCs removed (2012-2014)

RID	Arcadis
?	1751 lbs.

Routine O & M Costs ($ $lbs._{voc}$)

RID	Arcadis
$670 $lb._{voc}$	$961 $lb._{voc}$

Routine O & M Cost ($ /k gal.)

RID	Arcadis
~ $0.27 k gal	~ $0.36 k gal

Issue No. 5 Conclusion

Based upon facts and calculations in the Arcadis Technical Memorandum, RID has overstated 1) the treatment capacity of the MERA wells (9250 gpm vs. actual 8425 gpm), 2) the Annual Maximum VOC Mass Removal Rate (1900 lbs./year vs. 1446 lbs./year), and understated 3) the routine Operation and Maintenance (O & M) costs ($670 $lb._{voc}$ vs. $961 $lb._{voc}$). It is clear that the calculations and costs predicted by RID in the Draft FS Report are suspect. It is obvious that all the RID's proposed costs/estimates identified in the RID's Alternative Remedies are significantly flawed. The Arcadis Report confirms that the economic projections presented by the RID in Table 10 of their Draft Feasibility Study Report and the subsequent Net Present Value Calculations in Table 8 should be rejected by ADEQ as inaccurate and should be closely scrutinized for accuracy and errors. The Draft Feasibility Study Report by RID should be rejected by ADEQ due to clear errors in the projected calculations and costs.

ISSUE No. 6 REMEDY COSTS

ADEQ is evaluating the merits of two competing FS Reports[3]. Both competing FS Reports attempt to calculate the Net Present Value (30 year/NPV) of their proposals although there are some differences in how they reach those numbers (not surprising) but in reality the RID's preferred "Less Aggressive Alternative Remedy" is roughly **$51 million** and the WVBFS Group's "Reference Remedy is roughly **$8.7 million**. (*See* **Exhibit "6"**) No matter how you calculate NPV what do you get for that significant difference in cost?

RID stated that,

> "Treated water that is conveyed via the Salt Canal will be used for either agricultural purpose, by discharge into the Main Canal, or [municipal and industrial] M & I use. . . . RID anticipates a pipeline will be installed and available to deliver M & I water supplies within the next five (5) years. . . .
> For the near term, treated water to be conveyed through the Main Canal (and feeder laterals) to RID lands will continue for its current use as an agricultural water supply. However, RID anticipates that all RID water supply wells will be developed as future M & I drinking water supply sources in the reasonably foreseeable future." (*See* RID Draft FS Report p. 140)

The reality is that no municipality has contracted to receive RID's treated irrigation water which is currently blended with treated sewage effluent in the Main Canal before delivery to its irrigation customers. In addition, the Salt River Project has historically/currently asserted a legal right to the RID's irrigation water after 2026 based on historical contracts and water rights.

Issue No. 6 Conclusion

VOC mass removal just for the sake of mass removal makes no sense. The additional expenditure of $42.3 million is not reasonable, necessary or cost effective for the same use of the water. Arizona law under WQARF does not require mass removal under this scenario and EPA has generally endorsed the WVBFS Site Working Group's enhanced monitoring and natural attenuation approach to the FS in recent policy decisions. The Feasibility Study Report by the West Van Buren WQARF Site Working Group and the Reference Remedy proposed in that document is more cost effective than the one proposed by RID.

The water will continue to be used for irrigation purposes by RID, there is no calculated risk to the public or RID workers (in fact they shut down their system). RID has significantly overstated their VOC removal statistics to ADEQ and in reality they had 895 lbs. (2012), 767 lbs. (2013) and 89 lbs. (2014).

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[3] The West Van Buren WQARF Site Working Group's "Feasibility Study Report West Van Buren WQARF Site Phoenix, Arizona" by Haley & Aldrich, Inc. (July 2014) and the Roosevelt Irrigation District's "Draft Feasibility Study Report West Van Buren Area WQARF Site" Prepared by Synergy Environmental, LLC and Montgomery & Associates (July 2014)

COMMENT SUMMARY

Based on the conclusions found in the six identified issues, Meritor Inc. and Cooper Industries LLC request that ADEQ critically review and reject the RID's Draft Feasibility Study Report and the "Less Aggressive Alternative Remedy" that they propose. The RID's own documentation and report confirm that, ". . . there is not an imminent risk to the public from the contamination being released from the RID water systems." Based upon the West Van Buren WQARF Site Working Group's HHRA and the ADHS's Health Consultation Report, there is no imminent or substantial endangerment to the public health or environment based upon three evaluations of human health risk. Based upon a review of RID's past performance in implementing the MERA, RID's predictions or calculations in their Draft Feasibility Study Report are generally suspect, inaccurate and/or probably overstated. The fact that RID has not been able to continuously operate the MERA wells and has operated in by-pass/shutdown for most of the operational history of the MERA wells certainly questions the ability of RID to accurately predict or implement VOC removal in the future. It is obvious that all the RID's proposed costs/estimates identified in the RID's Alternative Remedies are significantly understated. The Feasibility Study Report by the West Van Buren WQARF Site Working Group and the Reference Remedy proposed by them is more cost effective than the one proposed by RID. As required by A.R.S. 49-282.06, the WVBFS Group's Reference Remedy generally satisfies the required criteria.

ADEQ should adopt the Reference Remedy in the West Van Buren WQARF Site that is the least expensive alternative to control, manage and cleanup the West Van Buren Area WQARF Site.

Please call me at (602) 744-5763 with any questions.

Sincerely,

Jerry D. Worsham II
For the Firm

JDW/pjb

EXHIBIT "1"

Health Consultation

Evaluation of Water Sampling Results in the Roosevelt Irrigation District (RID)

PHOENIX, MARICOPA COUNTY, ARIZONA

Prepared by the

Arizona Department of Health Services

January 8, 2015

HEALTH CONSULTATION

Evaluation of Water Sampling Results in the Roosevelt Irrigation District (RID)

PHOENIX, MARICOPA COUNTY, ARIZONA

Prepared By:

Arizona Department of Health Services

Office of Environmental Health

Environmental Health Consultation Services

Executive Summary

Introduction:	This report was written in response to a request from interested parties to evaluate whether there are potential human health risks from exposure to water for domestic use and residential irrigation in the Roosevelt Irrigation District (RID). This report serves two purposes – first, it analyzes updated 2013 data from monitoring well RID #84, which was the subject of a 1992 report prepared by the Arizona Department of Health Services (ADHS) due to concerns of the plume contaminated with volatile organic compounds (VOCs) reaching a production well. Second, it reviews 29 RID wells to determine whether concentrations of contaminants are at or above levels of public health concern. Since RID water is currently used for irrigation only, a risk assessment was conducted based on ingestion, inhalation, and dermal contact from recreational use and gardening.
Conclusions:	Update of the 1992 Statement of Risk (ADHS 1992): ADHS re-evaluated the potential health risks associated with the exposure to RID #84 as if it were used as potable water. **With the available information, ADHS concluded that exposure to trichloroethene (TCE), tetrachloroethene (PCE) and 1,1-dichloroethene (1,1-DCE) in RID #84 would not be expected to harm people's health under typical conditions of household water use.** RID irrigation wells and canal water: This health consultation evaluated the potential health risks associated with the exposure to groundwater collected from RID irrigation wells and canal water collected in the RID area. **With the available information, ADHS concluded that ingestion exposure to TCE and PCE in groundwater and canal water in RID sampling area is not expected to harm people's health.** **Calculated cancer risk was below EPA's target risk range.**
Basis for Decision:	For RID well #84: *1.* The detected TCE, PCE and 1,1-DCE concentrations were below their respective non-cancer health-based comparison values. Comparison values are estimated contaminant concentrations in a media where non-carcinogenic health effects are unlikely. *2.* The detected PCE concentration was below its Cancer Risk Evaluation Guideline (CREG), which was developed by ATSDR. CREGs are estimated contaminant concentrations that would be expected to cause no more than one additional excess cancer in one million (1,000,000) person exposed over a lifetime. *3.* The estimated cancer risk for TCE exposure was 1.43×10^{-6} and represents a possible 1-2 excess cancer cases in a population of 1,000,000 over a lifetime. Lifetime risk refers to the probability that an individual, over the course of a lifetime, will develop cancer. EPA has established a target risk range of 1 in 1,000,000 to 10,000 (10^{-6} to 10^{-4}) for hazardous waste sites. The estimated cancer risk did not exceed EPA target risk range (10^{-6} to 10^{-4}).

	For canal water samples collected in the RID area: 1. Potential non-cancer health effects: the detected TCE, PCE, 1,1-DCE, cis-1,2-dichloroethene (cis-1,2-DCE), 1,1-dichloroethane (1,1-DCA), and 1,1,1-trichloroethane (TCA) concentrations were below their respective non-cancer health-based comparison values. Comparison values are estimated contaminant concentrations in a media where non-carcinogenic health effects are unlikely. 2. Potential cancer health effects: • The detected PCE concentration was below its Cancer Risk Evaluation Guideline developed by ATSDR. CREGs are estimated contaminant concentrations that would be expected to cause no more than one additional excess cancer in one million (1,000,000) person exposed over a lifetime. • The estimated cancer risk for TCE exposure was 1.0×10^{-8} and represents a possible 1 excess cancer case in a population of 100,000,000 over a lifetime. The estimated cancer risk did not exceed EPA target risk range (10^{-6} to 10^{-4}). For groundwater collected from RID irrigation wells, and canal water samples collected in the RID area: 1. Potential non-cancer health effects: • The detected PCE, 1,1-DCE, cis-1,2-dichloroethene (cis-1,2-DCE), 1,1-dichloroethane (1,1-DCA), and 1,1,1-trichloroethane (TCA) concentrations were below their respective non-cancer health-based comparison values. Comparison values are estimated contaminant concentrations in a media where non-carcinogenic health effects are unlikely. • The calculated TCE daily exposure doses for adults and children were less than the reference dose. Reference dose is an estimate, with uncertainty or safety factors built in, of the daily lifetime does of a substance that is unlikely to cause non-cancerous health effects in humans. 2. Potential cancer health effects: The estimated cancer risk for TCE exposure was 1.6×10^{-7} and represents a possible 1-2 excess cancer cases in a population of 10,000,000 over a lifetime. The estimated cancer risk for PCE exposure was 1.9×10^{-9} and represents a possible of 2 excess cancer cases in a population of 1,000,000,000. The estimated cancer risks did not exceed EPA target risk range (10^{-6} to 10^{-4}).
Next Steps	ADHS recommends continuing to monitor levels of VOCs at RID #84, groundwater wells, and canal water to ensure that ingestion, inhalation, and dermal contact with the water does not occur at levels that exceed levels protective of public health.
For More Information:	*If you have concerns about your health, you should contact your health care provider. Please call ADHS at 602-364-3118 if you have questions about the information in this report.*

1. Purpose

This report was written in response to a request from interested parties to evaluate human health risks from exposure to water for domestic use and residential irrigation in the Roosevelt Irrigation District (RID). (See Appendix A for a map of the region RID serves.) This report serves two purposes – first, it analyzes updated 2013 data from monitoring well RID #84, which was the subject of a 1992 report prepared by the Arizona Department of Health Services (ADHS) due to concerns of the plume reaching a Tolleson production well. Second, it reviews 29 RID wells to determine whether concentrations of contaminants are at or above levels of public health concern. RID water is currently used for irrigating agricultural crops, parks, ball fields, and residential yards. Therefore, a risk assessment was conducted based on contact with the water from recreational use and gardening.

2. Background and Statement of Issues

A regional groundwater contaminant plume containing volatile organic compounds (VOCs) exists in the West Van Buren Water Quality Assurance Revolving Fund (WQARF) site. In 1992, a Statement of Risk report was written by the Arizona Department of Health Services (ADHS) and addressed to the Arizona Department of Environmental Quality (ADEQ). The report estimated potential health risk based on groundwater well sampling results from within the Roosevelt Irrigation District. Although no site-related contaminants were found in the City of Tolleson's production wells that served the community, there was concern in 1992 that the plume could move towards the Tolleson production wells. Therefore, the chemical concentrations detected in the closest monitoring well (RID #84) were used as surrogates to evaluate the potential health risks if water from RID #84 was used as a potable water source. Based on the chemical concentrations seen in RID #84 in 1992, the report found that "carcinogenic risk as a result of potential human exposure to concentrations of contaminants similar to those in the ADEQ monitor wells would be significant" (ADHS 1992).

However, as shown in Appendix B, contaminant concentrations detected in RID #84, particularly for tetrachloroethene (also known as perchloroethene (PCE)) and trichloroethene (TCE) have decreased significantly over the past twenty years. For the purpose of public health protection, ADHS was requested to reevaluate the potential health risks from RID #84 assuming that the water used is for potable purposes.

(Note: For this report, residential irrigation was not considered "domestic use." Domestic use of water includes such uses as drinking, food preparation, bathing, washing clothes and dishes, brushing teeth, using the hose, and gardening. Residential irrigation was considered separately.)

This report also analyzed data from 29 RID irrigation wells and the irrigation canal. Currently, RID's wells provide water for crop and lawn flood irrigation. RID has wellhead treatment systems on 4 of its irrigation wells that are located within the West Van Buren WQARF site. This report strives to evaluate the potential health risks from people coming into contact with irrigation water through incidental ingestion. The evaluation is based on samples taken from the RID wells and from the canal.

3. Discussion

3.1 General Assessment Methodology

ADHS generally follows a three-step methodology to assess public health issues related to environmental exposures. First, ADHS obtains representative environmental data for the site of concern and compiles a comprehensive list of site-related contaminants. Second, ADHS identifies exposure pathways, and then uses health-based comparison values to find those contaminants that do not have a realistic possibility of causing adverse health effects. For the remaining contaminants, ADHS reviews recent scientific studies to determine if exposures are sufficient to impact public health.

3.2 Environmental Data

ADHS used the most recent water quality data to perform its analysis. ADHS reviewed the laboratory results for RID #84 and 29 RID irrigation wells, and 4 canal locations from Terranext's Annual 2013-14 Water-Quality Report for the West Van Buren WQARF site (prepared for ADEQ). Canal and groundwater samples collected were analyzed by XENCO Laboratories in Phoenix, AZ for volatile organic compounds by gas chromatography/mass spectrometry (GC/MS) analysis in accordance with U.S. Environmental Protection Agency (EPA) Method 8260B. Field quality assurance/quality control (QA/QC) samples were employed for quality assurance.

First, ADHS reviewed updated 2014 data from monitoring well RID #84, which was the subject of a 1992 ADHS report due to concerns of the plume reaching a production well. As shown in Appendix B, contaminant concentrations have decreased significantly from 1990 to 2010. The concentrations of PCE,TCE and 1,1,-DCE detected in RID #84 groundwater samples collected in September 2013 and March 2014 are presented in Table 1 below. All other contaminants were below their detection limits.

Table 1. Chemical concentrations in micrograms per liter (µg/L) from RID #84

Contaminant of Concern (COC)	2013 Sample (µg/L)	2014 Sample (µg/L)	Averaged Concentration (µg/L)
Tetrachloroethene (PCE)	8.16	8.04	8.1
Trichloroethene (TCE)	1.38	1.26	1.32
1,1-dichloroethene (1,1-DCE)	1.14	1.08	1.11

Then, ADHS reviewed groundwater and canal water samples collected from RID's irrigation network. Groundwater samples were collected from 29 RID wells and canal water samples were collected from four locations within the RID irrigation distribution canal.

In September 2013, a total of 39 samples (including 2 trip blanks, 2 equipment blanks, and 2 duplicate samples) were collected from 29 RID wells and four RID canal water locations. In March 2014, a total of 38 samples (including 2 trip blanks, 1 equipment blank, and 3 duplicate samples) were collected from 28 RID wells and four RID canal water locations. If wellhead treatment systems were present in a well, the

samples were collected at a location between the wellhead and the treatment system. Table 2 shows the detected range of the contaminants of concerns (COCs) from the four canal water sampling locations. Table 3 shows the detected range of the COCs from RID groundwater wells.

Table 2: Detected concentration range in micrograms per liter (µg/L) for canal water samples collected from RID area

Contaminant of Concern (COC)	Range of Detected Concentrations for 2013 Samples (µg/L)	Range of Detected Concentrations for 2014 Samples (µg/L)
Tetrachloroethene (PCE)	< 0.5 – 1.10	1.16 – 4.32
Trichloroethene (TCE)	2.41 – 4.29	3.29 – 7.01
1,1-dichloroethene (1,1-DCE)	< 0.5 – 0.71	< 0.5 – 0.96
cis-1,2-dichloroethene (cis-1,2-DCE)	0.63 – 3.98	< 0.5 – 0.97
1,1-dichloroethane (1,1-DCA)	< 0.5 – 0.98	< 0.5
1,1,1-trichloroethane (TCA)	< 0.5	< 0.5

Table 3: Detected concentration ranges in micrograms per liter (µg/L) for groundwater samples collected from RID area

Contaminant of Concern (COC)	Range of Detected Concentrations for 2013 Samples (µg/L)	Range of Detected Concentrations for 2014 Samples (µg/L)
Tetrachloroethene (PCE)	< 0.5 – 22.1	< 0.5 – 21.5
Trichloroethene (TCE)	< 0.5 – 86.4	< 0.5 – 76.2
1,1-dichloroethene (1,1-DCE)	< 0.5 – 7.52	< 0.5 – 6.18
cis-1,2-dichloroethene (cis-1,2-DCE)	< 0.5 – 10.1	< 0.5 – 7.86
1,1-dichloroethane (1,1-DCA)	< 0.5 – 4.24	< 0.5 – 3.48
1,1,1-trichloroethane (TCA)	< 0.5	< 0.5

3.3 Exposure Pathway Analysis

Identifying exposure pathways is important in a health consultation because adverse health impacts can only happen if people are exposed to contaminants. The presence of a contaminant in the environment does not necessarily mean that people are actually coming into contact with that contaminant. Exposure pathways have been divided into three categories: completed, potential, and eliminated.

There are five elements considered in the evaluation of exposure pathways: (1) a source of contamination, (2) a media such as soil or groundwater through which the contaminant is transported, (3) a point of exposure where people can contact the contaminant, (4) a route of exposure by which the contaminant enters or contacts the body, and (5) a receptor population. Completed pathways exist when all five elements are present and indicate that exposure to a contaminant has occurred in the past and/or is occurring presently. In a potential exposure pathway, one or more elements of the pathway cannot be identified, but it is possible that the element might be present or might have been present. In eliminated pathways, at least one of the five elements is or was missing, and will never be present.

Completed and potential pathways, however, may be eliminated when they are unlikely to be significant.

RID #84: The well is not currently used for potable or domestic purposes. However, in 1992 there was concern that the chemical concentrations from RID #84 would move towards the Tolleson production wells that served the community. ADHS was requested to reevaluate the exposure risk based on current concentrations (from 2013-2014 data) to compare how the quantitative risk may have changed. Since RID #84 is not used as a production well, there is no current risk from using water from RID #84 for domestic purposes. RID #84 is part of the RID system that is used for irrigating crops, parks, ball fields, and residential yards within the Roosevelt Irrigation District service area (see Appendix A for a map). ADHS agreed to perform and report the risk calculations based on 2013-2014 data for comparison purposes only. Risk was calculated based on exposure from potable and domestic use as was done in the 1992 report. Based on this assumption, people could have contact with chemicals in the water via ingestion from drinking and cooking, and inhalation and skin contact while bathing or showering.

RID Groundwater Wells and Canal Water Locations: The water is currently being treated at four well heads and blended with other RID wells in a canal system for crop and lawn irrigation. The water from these wells and the canal is not currently being used for domestic purposes other than irrigation. Therefore, potential exposure pathways to this water for both children and adults include recreational use (i.e. playing in the water) and gardening. People may swallow small amounts of chemicals while conducting outdoor activities (i.e. playing in the water and gardening). People may have short term exposure with chemicals through inhalation and skin contact while using the water. The exposure through inhalation and skin contact are not likely to be significant due to the limited amount of time that people would be in direct contact with the water. Therefore, incidental ingestion was the primary exposure route considered in this evaluation.

Table 4. Exposure Pathway Evaluation

Location	Exposure Pathway Elements					Time Frame	Type of Exposure Pathway
	Source	Media	Point of Exposure	Route of Exposure	Estimated Exposed Population		
RID #84*	West Van Buren Area plume	Groundwater	Residence tap	Ingestion, Inhalation, Skin contact	Residents	Past	Eliminated
						Current	Eliminated
						Future	Potential
RID Groundwater Wells and Canal Water Locations	West Van Buren Area plume	Groundwater and Canal Water	Recreational use, gardening,	Incidental Ingestion	Residents	Past	Completed
						Current	Completed
						Future	Potential

* The water in RID #84 is not currently used for potable or domestic purposes (i.e. eliminated exposure pathway.) In this evaluation, the water is treated as being used for potable and domestic use.

3.4 Comparison to Health-based Comparison Values

Health-based comparison values (CVs) are screening tools used with environmental data that are relevant to an exposure pathway. The health-based CVs are concentrations of contaminants that the current public health literature suggests are "harmless". These comparison values are quite conservative because they include ample safety factors that account for the most sensitive populations. ADHS typically uses comparison values as follows: if a contaminant is never found at levels greater than its CV, ADHS concludes that the levels of corresponding contamination are "safe" or "harmless." If, however, a contaminant is found at levels that are greater than its comparison value, ADHS designates the pollutant as a contaminant of interest and examines potential human exposures in greater detail. Tables 5-7 compare site concentrations to CVs such as ATSDR's Environmental Media Evaluation Guide (EMEG).

Depending on site-specific environmental exposure factors (e.g. duration and amount of exposure) and individual human factors (e.g. personal habits, occupation, and/or overall health), exposure to levels greater than the comparison value may or may not lead to a health effect. Therefore, the comparison values should not be used to predict the occurrence of adverse health effects.

3.4.1 RID # 84

The averaged chemical concentrations of samples collected from September 2013 and March 2014 were used to represent current concentrations. Both PCE and 1,1-DCE were not selected for further evaluation because their current concentrations were below their respective health-based comparison values for non-cancer and cancer health effects. TCE concentration was selected for further evaluation of potential cancer health effects, since its averaged concentration was above its CREG

Table 5. Contaminants of concern for RID Well #84

Contaminant of Concern (COC)	Averaged Concentration (µg/L)	Non-cancer Comparison Value (µg/L) – Type	Cancer Comparison Value (µg/L) – Type	MCL (µg/L)	Selected for Further Evaluation?
Tetrachloroethene (PCE)	8.1	41 – RSL	17 – CREG	5	No
Trichloroethene (TCE)	1.32	5 – EMEG	0.75 – CREG	5	Yes
1,1-dichloroethene (1,1-DCE)	1.11	90 – EMEG	---	7	No

1. RSL: Regional Screening Level, developed by EPA, is a risk-based concentration derived from standardized equations combining exposure information assumptions with EPA toxicity data. EPA considers RSLs to be protective for humans (including sensitive groups) over a lifetime
2. EMEG: Environmental Media Evaluation Guide, developed by ATSDR, is an estimated contaminant concentration in a media where non-carcinogenic health effects are unlikely.
3. CREG: Cancer Risk Evaluation Guide, developed by ATSDR, is a media-specific comparison value that is used to identify concentrations of cancer causing substances that are unlikely to result in an increase of cancer rates in an exposed population after a lifetime of exposure.
4. MCL: Maximum Contaminant Level, developed by US EPA, is an enforceable standards set by EPA for the highest level of a contaminant allowed in drinking water. MCLs are set as close to MCL goals (MCLGs, the level of a contaminant in drinking water below which there is no known or expected risk to health) as feasible using the best available treatment technology and taking cost into consideration.

3.4.2 RID Groundwater Samples

ADHS averaged the chemical concentrations of samples collected from September 2013 and March 2014 to represent current concentrations. TCE was selected for further evaluation because 17 out of the 29 averaged concentrations exceeded the CREG of 0.75 µg/L. PCE was selected for further evaluation because the highest averaged concentration (from RID well 106) exceeded the CREG.

Table 7. Contaminants of Concern for Groundwater Samples

Contaminant of Concern (COC)	Maximum Averaged Concentration (µg/L)	Non-cancer Comparison Value (µg/L) – Type	Cancer Comparison Value (µg/L) – Type	MCL (µg/L)	Selected for Further Evaluation ?
Tetrachloroethene (PCE)	21.8	41 – RSL	17 – CREG	5	Yes
Trichloroethene (TCE)	81.3	5 – EMEG	0.75 – CREG	5	Yes
1,1-dichloroethene (1,1-DCE)	6.85	90 – EMEG	—	7	No
cis-1,2-dichloroethene (cis-1,2-DCE)	8.93	36 – RSL	—	70	No
1,1-dichloroethane (1,1-DCA)	3.86	3,800 – RSL	—	—	No
1,1,1-trichloroethane (TCA)	<0.5	8,000 – RSL	—	200	No

1. RSL: Regional Screening Level, developed by EPA, is a risk-based concentration derived from standardized equations combining exposure information assumptions with EPA toxicity data. EPA considers RSLs to be protective for humans (including sensitive groups) over a lifetime
2. EMEG: Environmental Media Evaluation Guide, developed by ATSDR, is an estimated contaminant concentration in a media where non-carcinogenic health effects are unlikely.
3. CREG: Cancer Risk Evaluation Guide, developed by ATSDR, is a media-specific comparison value that is used to identify concentrations of cancer causing substances that are unlikely to result in an increase of cancer rates in an exposed population after a lifetime of exposure.
4. MCL: Maximum Contaminant Level, developed by US EPA, is an enforceable standards set by EPA for the highest level of a contaminant allowed in drinking water. MCLs are set as close to MCL goals (MCLGs, the level of a contaminant in drinking water below which there is no known or expected risk to health) as feasible using the best available treatment technology and taking cost into consideration.

3.4.3 Canal Water Samples

ADHS averaged the chemical concentrations of samples collected from September 2013 and March 2014 to represent current concentrations. TCE was selected for further evaluation because the averaged concentration exceeded the CREG of 0.75 µg/L. The other chemicals were not selected for further evaluation because the averaged concentrations did not exceed their respective health-based comparison values for non-cancer and cancer health effects.

Table 6. Contaminants of Concern for Canal Water Samples					
Contaminant of Concern (COC)	**Maximum Averaged Concentration (µg/L)**	**Non-cancer Comparison Value (µg/L) – Type**	**Cancer Comparison Value (µg/L) – Type**	**MCL (µg/L)**	**Selected for Further Evaluation ?**
Tetrachloroethene (PCE)	2.29	41 – RSL	17 – CREG	5	No
Trichloroethene (TCE)	4.71	5 – EMEG	0.75 – CREG	5	Yes
1,1-dichloroethene (1,1-DCE)	0.84	90 – EMEG	—	7	No
cis-1,2-dichloroethene (cis-1,2-DCE)	2.48	36	—	70	No
1,1-dichloroethane (1,1-DCA)	0.62	3,800 – RSL	—	—	No
1,1,1-trichloroethane (TCA)	<0.5	8,000 – RSL	—	200	No

1. RSL: Regional Screening Level, developed by EPA, is a risk-based concentration derived from standardized equations combining exposure information assumptions with EPA toxicity data. EPA considers RSLs to be protective for humans (including sensitive groups) over a lifetime
2. EMEG: Environmental Media Evaluation Guide, developed by ATSDR, is an estimated contaminant concentration in a media where non-carcinogenic health effects are unlikely.
3. CREG: Cancer Risk Evaluation Guide, developed by ATSDR, is a media-specific comparison value that is used to identify concentrations of cancer causing substances that are unlikely to result in an increase of cancer rates in an exposed population after a lifetime of exposure.
4. MCL: Maximum Contaminant Level, developed by US EPA, is an enforceable standards set by EPA for the highest level of a contaminant allowed in drinking water. MCLs are set as close to MCL goals (MCLGs, the level of a contaminant in drinking water below which there is no known or expected risk to health) as feasible using the best available treatment technology and taking cost into consideration.

3.5 *Public Health Implications*

3.5.1 Trichloroethene (TCE)

Trichloroethene (TCE) is a man-made chemical that is widely used to remove grease from metal parts. It is also used to make other chemicals. It can be found in some household products such as paint removers, adhesives, spot removers, and rug cleaning fluids. TCE is a clear, colorless solvent, and has a somewhat sweet odor (ATSDR 1997). Studies showed that exposure to TCE can affect the central nervous system, the kidney, liver, immune system, male reproductive system, and the developing fetus. The Environmental Protection Agency (EPA) established a reference dose (RfD) of 0.0005 mg/kg/day for chronic oral exposure based on three rodent toxicological studies.

Human and animals studies have shown that TCE is associated with kidney and liver cancer, and with non-Hodgkin lymphoma (NHL). EPA has classified TCE as "carcinogenic in humans by all routes of exposure." The International Agency for Research on Cancer (IARC) has recently classified TCE as carcinogenic to human (Group 1). The National Toxicological Program (NTP) determined that TCE is reasonably anticipated to be a human carcinogen.

Site-specific Assessment

Non-cancer Health Effects:

- RID #84: the averaged TCE concentration was 1.32 µg/L, which is below the Environmental Media Evaluation Guide (EMEG, 5 µg/L) developed by ATSDR. EMEG is an estimated contaminant concentration in a media where non-carcinogenic health effects are unlikely.
- Groundwater samples: the highest averaged TCE concentration was 81.3 µg/L. ADHS estimated the daily exposure dose based on the exposure scenario (i.e. irrigation and recreational uses). Residents were assumed to incidentally swallow 50 mL of water per day. They were assumed to spend 50 days per year conducting outdoor activities with exposure to the water. The body weights were assumed to be 70 kg for adults, and 16 kg for children. Using the highest TCE concentration, the estimated exposure doses were 0.00001 mg/kg/day for adults, and 0.00003 mg/kg/day for children. Both of the estimated daily exposure doses were below the reference dose of 0.0005 mg/kg/day. RfD is an estimate, with uncertainty or safety factors built in, of the daily lifetime does of a substance that is unlikely to cause non-cancerous health effects in humans. ATDSR has recently adopted the RfD as its minimal risk level (MRL) for TCE (ATSDR 2013.) Therefore, ADHS does not expect to see adverse non-cancer health effects among the exposed population.
- Canal water samples: the highest averaged TCE concentration was 4.71 µg/L, which is below the EMEG.

Cancer Risk Estimation: ADH5 calculated the increased cancer risks using the EPA cancer slope factor and detected TCE concentration in water samples.

- RID well #84: as discussed in the previous section, water ingestion was used as the primary exposure pathway for comparison purposes to the 1992 risk assessment. However, there is no current exposure, and therefore no current risk. Showering or bathing with contaminated water could result in exposure to volatile organic compounds (VOCs). When showering in chlorinated hydrocarbon-contaminated water, a person might be exposed from breathing the portion of the contaminant that is released into the air, and from absorbing the contaminant through the skin. Studies in humans have shown that the internal dose of VOCs from showering can be comparable to the exposure dose resulting from the water ingestion (ATSDR 2005.)
    - The ingestion exposure was doubled to account for the additional exposure from inhalation and skin contact during showering/bathing. Default water consumption rates (2 L/day) were used in the calculation. The estimated cancer risk was 1.43×10^{-6} and represents a possible 1-2 excess cancer cases in a population of 1,000,000 over a lifetime.
    - Cancer is a common illness, with many different forms that result from a variety of causes; not all are fatal. According to the American Cancer Society, men have almost a 1 in 2 lifetime risk of developing cancer, and for women the risk is a little more than a 1 in 3 lifetime risk. This translates to about 500,000 men and a little more than 333,333 women in a population of one million people. Lifetime risk refers to the probability that

an individual, over the course of a lifetime, will develop cancer. EPA has established a target risk range of 1 in 1,000,000 to 10,000 (10^{-6} to 10^{-4}) for hazardous waste sites. The estimated cancer risk did not exceed EPA target risk range.

- Groundwater samples: as discussed in the previous section, water ingestion is the primary exposure pathway. ADHS used the highest averaged TCE concentration 81.3 µg/L to estimate the cancer risk. The result showed: 1.67×10^{-7} and represents a possible of 1-2 excess cancer cases in a population of ten million (10,000,000). The estimated cancer risk did not exceed EPA target risk range.
- Canal water samples: as discussed in the previous section, water ingestion is the primary exposure pathway. Exposure through inhalation and skin contact are not likely to be significant due to the limited amount of time that people would be in contact with the water. The highest averaged TCE concentration 4.71 µg/L was used to estimate the cancer risk. Residents were assumed to incidentally swallow 50 mL of water per day. They were assumed to spend 50 days per year to conduct site-related outdoor activities. The estimated cancer risk was 1.0×10^{-8} and represents a possible of 1 excess cancer case in a population of a hundred million (100,000,000). The estimated cancer risk did not exceed EPA target risk range.

3.5.2 Tetrachloroethene (PCE)

Tetrachloroethene (PCE) is a man-made chemical that is widely used for the drying of fabrics, including clothes. It is also used for degreasing metal parts, and making other chemicals. PCE is found in a variety of consumer products such as break and wood cleaners, glues, laundry aids, paint removers, and suede protectors. PCE is a nonflammable, colorless liquid at room temperature. It evaporates easily into the air and has a sharp, sweet-smelling odor. Most people can smell PCE in air at levels in excess of 7,000 µg/m^3 (ATSDR 1997).

PCE can affect the central nervous system (sensitive endpoint), the liver, kidney, immune system, and perhaps the reproductive system. Both animal and human studies showed that PCE exposure results in visual changes, increased reaction time, and reduction in mental abilities in learning and comprehension.

The US Department of Health and Human Services (DHHS) has determined that PCE may reasonably be anticipated to be a human carcinogen (NTP 2011). The International Agency for Research on Cancer (IARC) has classified PCE as a Group 2A carcinogen: probably carcinogenic to humans due to limited evidence in humans and sufficient evidence in animals (IARC 1995). EPA classified PCE as "*likely to be carcinogenic to humans*" by all routes of exposure based on increases tumor incidences in animal studies, and suggestive association between PCE exposure and cancer from epidemiologic studies (EPA 2012).

Site-specific Assessment

Non-cancer Health Effects:

None of the averaged concentration exceeded the EPA Regional Screen Level (RSL) for PCE (41 µg/L.) RSL is a risk-based concentrations derived from standardized equations combining exposure information assumptions with EPA toxicity data. EPA considers RSLs to be protective for humans (including sensitive groups) over a lifetime. Therefore, ADHS does not expect to see non-cancer adverse effects among the exposed population.

Cancer Risk Estimation:

The maximum concentration of RID #84 (8.16 µg/L) and canal water samples (2.29 µg/L) did not exceed the ATSDR Cancer Risk Evaluation Guideline (CREG) of 17 µg/L. CREGs are estimated contaminant concentrations that would be expected to cause no more than one additional excess cancer in one million (1,000,000) person exposed over a lifetime. They are calculated from EPA cancer slope factors.

The maximum concentration (22.1 µg/L) of groundwater samples was used to calculate the cancer risk. The estimated cancer risk was 1.9×10^{-9} and represents a possible of 2 excess cancer cases in a population of a billion (1,000,000,000). The estimated cancer risk did not exceed EPA's target risk range.

5. Child Health Considerations

ADHS considers children in its evaluations of all exposures, and we use health guidelines that are protective of children. No data describe the effects of exposure to COCs on children or immature animals. In general, ADHS assumes that children are more susceptible to chemical exposures than are adults. Children six years old or younger may be more sensitive to the effects of pollutants than adults. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. The comparison values (CVs) used in this health consultation were developed to be protective of susceptible populations such as children.

6. Conclusions

This health consultation provided an update of the 1992 Statement of Risk (ADHS 1992). ADHS re-evaluated the potential health risks associated with the exposure to RID #84 if used as potable water. With the available information, ADHS concluded that exposure to trichloroethene (TCE), tetrachloroethene (PCE) and 1,1-dichloroethene (1,1-DCE) in RID #84 is not expected to harm people's health under typical conditions of household water use because:

The detected TCE, PCE and 1,1-DCE concentrations were below their respective non-cancer health-based comparison values. Comparison values are estimated contaminant concentrations in a media where non-carcinogenic health effects are unlikely.

The detected PCE concentration was below its Cancer Risk Evaluation Guideline (CREG), which was developed by ATSDR. CREGs are estimated contaminant concentrations that would be expected to

cause no more than one additional excess cancer in one million (1,000,000) person exposed over a lifetime. They are calculated from EPA's cancer slope factors.

The estimated cancer risk for TCE exposure was 1.43×10^{-6} and represents a possible 1-2 excess cancer cases in a population of 1,000,000 over a lifetime. Lifetime risk refers to the probability that an individual, over the course of a lifetime, will develop cancer. EPA has established a target risk range of 1 in 1,000,000 to 10,000 (10^{-6} to 10^{-4}) for hazardous waste sites. The estimated cancer risk did not exceed EPA target risk range.

Exposure to multiple chemicals: Additively is the default assumption for evaluating health effects of simultaneous exposure to multiple chemicals. The estimated accumulated cancer risk due to exposure to TCE and PCE did not exceed EPA target risk range.

This health consultation evaluated the potential health risks associated with exposure to groundwater collected from RID irrigation wells, and canal water samples collected in the RID area. With the available information, ADHS concluded that exposure to chemicals in groundwater and canal water in RID sampling area is not expected to harm people's health.

Groundwater samples:

Potential non-cancer health effects: the detected PCE, 1,1-DCE, cis-1,2-dichloroethene (cis-1,2-DCE), 1,1-dichloroethane (1,1-DCA), and 1,1,1-trichloroethane (TCA) concentrations were below their respective non-cancer health-based comparison values. Comparison values are estimated contaminant concentrations in a media where non-carcinogenic health effects are unlikely.

Daily exposure dose was calculated for TCE exposures based on the assumed exposure scenario. The calculated daily exposure doses for adults (0.00001 mg/kg/day) and children (0.00003 mg/kg/day) were less than the reference dose (0.0005 mg/kg/day). Reference dose is an estimate, with uncertainty or safety factors built in, of the daily lifetime does of a substance that is unlikely to cause non-cancerous health effects in humans.

Potential cancer health effects: The estimated cancer risk for TCE exposure was 1.6×10^{-7} and represents a possible 1-2 excess cancer cases in a population of 10,000,000 over a lifetime. The estimated cancer risk for PCE exposure was 1.9×10^{-9} and represents a possible of 2 excess cancer cases in a population of 1,000,000,000. The estimated cancer risks did not exceed EPA target risk range (10^{-6} to 10^{-4}).

Exposure to multiple chemicals: dditively is the default assumption for evaluating health effects of simultaneous exposure to multiple chemicals. The estimated cancer risk due to exposure to PCE and TCE did not exceed EPA target risk range.

Canal water samples:

Potential non-cancer health effects: the detected TCE, PCE, 1,1-DCE, cis-1,2-dichloroethene (cis-1,2-DCE), 1,1-dichloroethane (1,1-DCA), and 1,1,1-trichloroethane (TCA) concentrations were below

their respective non-cancer health-based comparison values. Comparison values are estimated contaminant concentrations in a media where non-carcinogenic health effects are unlikely.

Potential cancer health effects: the detected PCE concentration was below its Cancer Risk Evaluation Guideline developed by ATSDR. CREGs are estimated contaminant concentrations that would be expected to cause no more than one additional excess cancer in one million (1,000,000) person exposed over a lifetime. They are calculated from EPA cancer slope factors.

The estimated cancer risk for TCE exposure was 0.9×10^{-8} and represents a possible 1 excess cancer case in a population of 100,000,000 over a lifetime. The estimated cancer risk did not exceed EPA target risk range (10^{-6} to 10^{-4}).

Exposure to multiple chemicals: Additively is the default assumption for evaluating health effects of simultaneous exposure to multiple chemicals. The estimated cancer risk due to exposure to PCE and TCE did not exceed EPA target risk range.

7. Recommendations

ADHS recommends the continuation of monitoring of VOCs at RID #84, groundwater wells, and canal water to ensure that ingestion, inhalation, and dermal contact with the water does not occur at levels that exceed levels protective of public health..

References

ATSDR (1997). Toxicological Profile for Tetrachloroethylene. Sept. 1997. 18 Nov. 2014. <http://www.atsdr.cdc.gov/toxprofiles/tp18.pdf>.

ATSDR (2005). Appendix F: Derivation of Comparison Values. Public Health Assessment Guidance Manual (January 2005 Update).

ATSDR (2005). Appendix G: Calculating Exposure Doses. Public Health Assessment Guidance Manual (January 2005 Update).

"Cis-1,2-Dichloroethylene (CASRN 156-59-2)." *EPA*. Environmental Protection Agency, 31 Oct. 2014. Web. 18 Nov. 2014. <http://www.epa.gov/iris/subst/0418.htm>.

"Ethylidene Dichloride (1,1-Dichloroethane)." EPA. Environmental Protection Agency, Jan. 2000. Web. 18 Nov. 2014. <http://www.epa.gov/ttnatw01/hlthef/dichloro.html>.

Petersen, Norman J. *Statement of Risk: Estimating the Potential Health Effects from Domestic Use of Water from the ADEQ Monitor Wells in the Estrella Business Park, RID #84, and the Rhoen Planc Well.* Arizona Department of Health Services: Division of Disease Prevention. Oct. 30, 1992.

Terranext (2012). *Remedial Investigation Report: West Van Buren Area WQARF Registry Site.* Terranext. August 10, 2012.

Terranext (2013). *First Quarter 2013 Water-Quality Report: West Van Buren Area (WVBA).* July 29, 2013.

Terranext (2014). *Annual 2013-14 Water-Quality Report: West Van Buren Area (WVBA).* Oct. 2014."Tetrachloroethylene (Perchloroethylene)[1]." *EPA*. Environmental Protection Agency, Dec. 2012. Web. 18 Nov. 2014. <http://www.epa.gov/ttnatw01/hlthef/tet-ethy.html>.

"Trichloroethylene[2]." *EPA*. Environmental Protection Agency, Jan. 2000. Web. 18 Nov. 2014. <http://www.epa.gov/ttnatw01/hlthef/tri-ethy.html>.

"Vinylidene Chloride (1,1-Dichloroethylene)." *EPA*. Environmental Protection Agency, Jan. 2000. Web. 18 Nov. 2014. <http://www.epa.gov/ttnatw01/hlthef/di-ethyl.html>.

[1] Tetrachloroethylene is equivalent to tetrachloroethene.
[2] Trichloroethylene is equivalent to trichloroethene.

Preparers of Report

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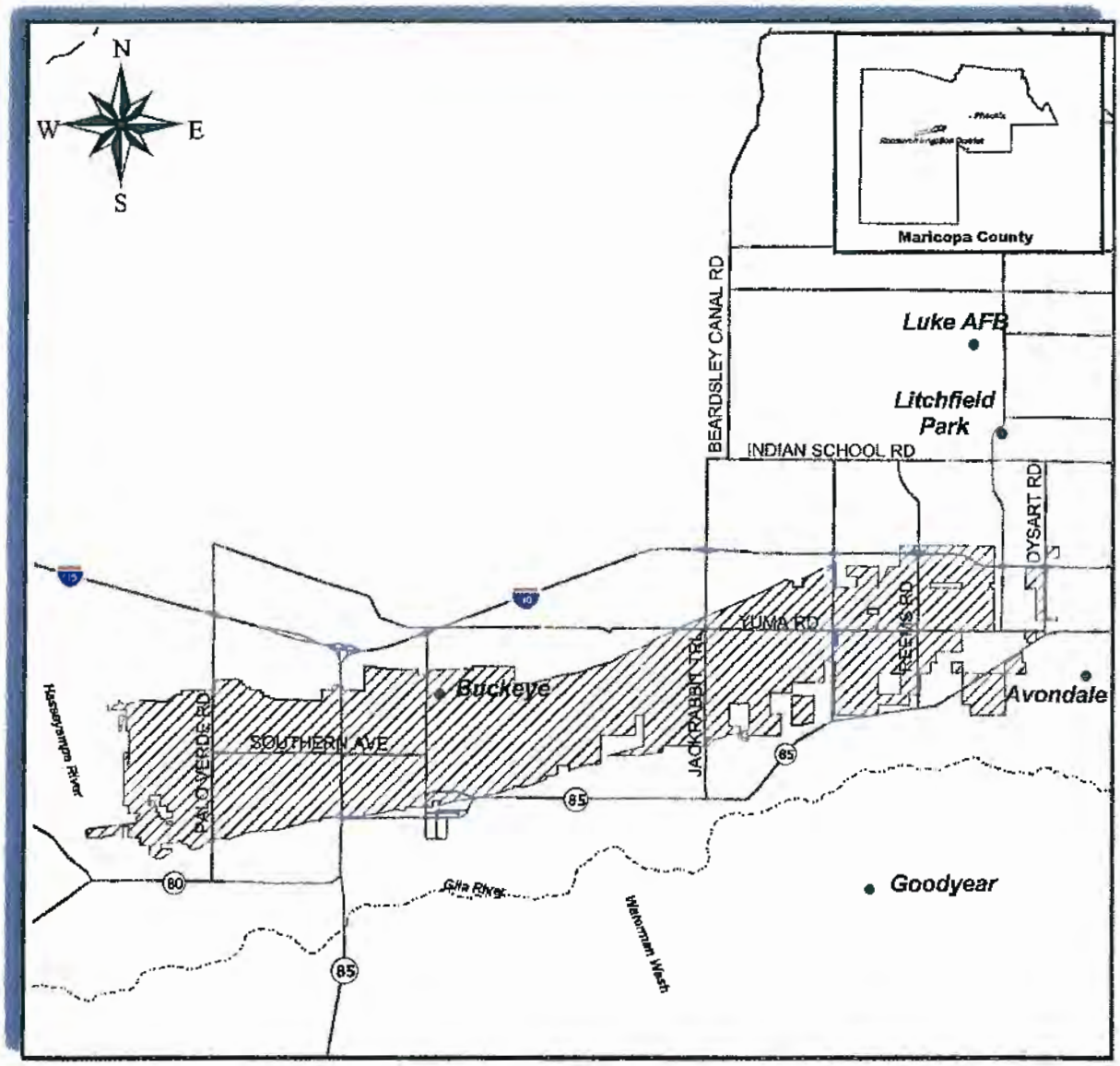
Brigitte Dufour, Office Chief, ADHS

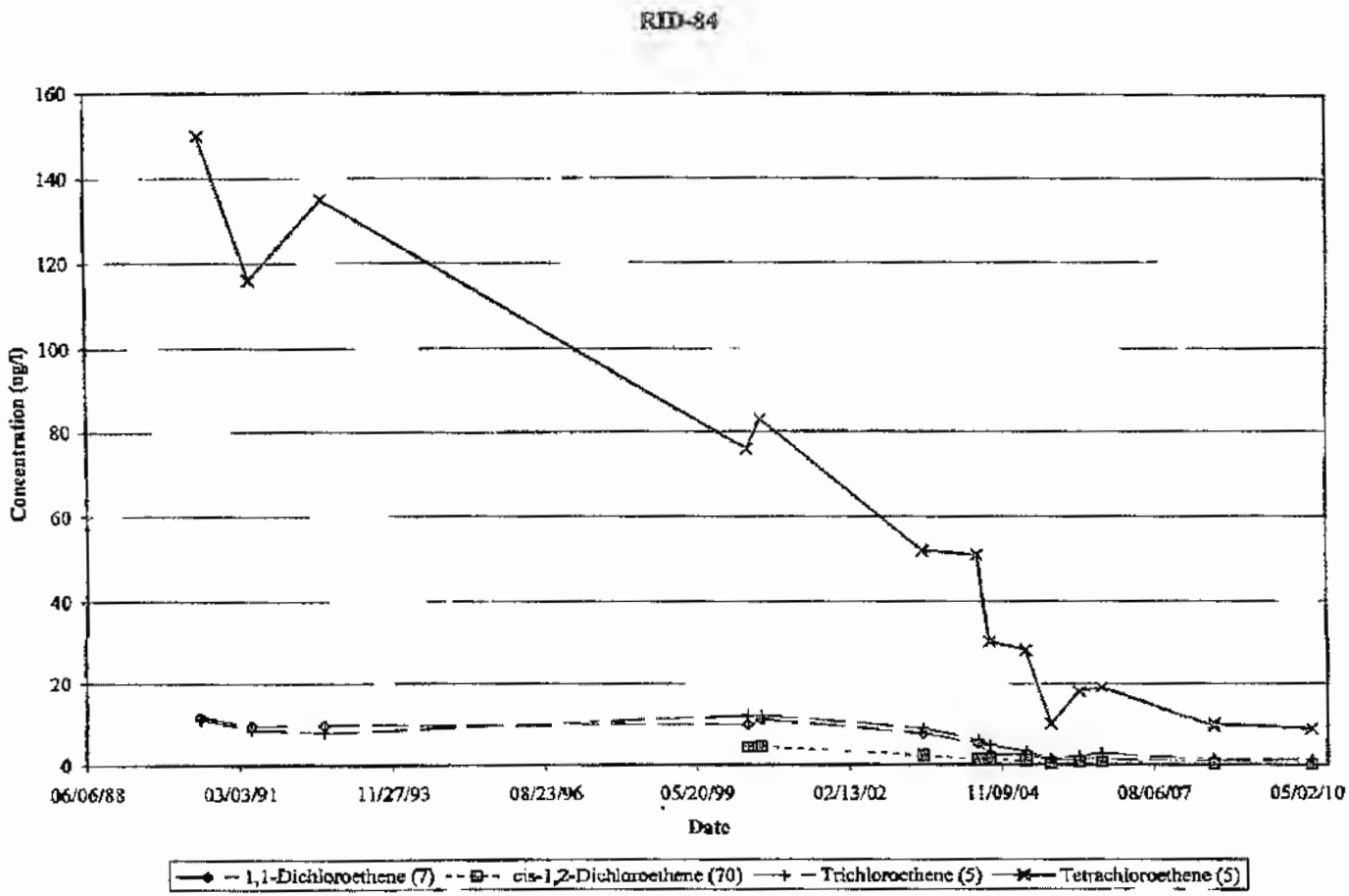
Appendix A: Roosevelt Irrigation District Map

Source: "Roosevelt Irrigation District (RID) Map." Roosevelt Irrigation District. 2009. Web. 18 Nov. 2014. <http://www.rooseveltirrigation.org/images/maplg.jpg>.



Appendix B: Contaminant Concentrations at RID-84 from 1990 to 2010

Source: Montgomery, Errol L., & Associates, Inc. "Groundwater Response Action: West Van Buren Area WQARF Site." 23 Mar. 2009. Lecture.



Appendix C: General Information on Contaminants of Concern (COCs)

The primary water contaminants of concern (COCs) in this report 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 (Terranext 2013). This health consultation focuses on PCE, TCE, 1,1-DCE, *cis*-1,2-DCE, and 1,1-DCA since those are chemicals that have been detected in RID irrigation wells. Their properties and potential health risks are summarized in Table 8 below. Uses and potential health risks were taken from EPA Hazard Summaries. Potential health effects listed are primarily from exposure via chronic inhalation, but effects from chronic ingestion are expected to be similar. Contaminant sources were taken from ADEQ's West Van Buren WQARF Registry Site Remedial Investigation Report.

Table 8: Sources and Potential Health Risks of COCs

Contaminant of Concern	Sources/Uses	Potential Health Effects
Tetrachloroethene (PCE)	PCE is widely used for dry-cleaning fabrics and metal degreasing operations.	- Impaired cognitive and motor neurobehavioral performance - Adverse effects in the kidney, liver, immune system, hematologic system - Association with several types of cancer
Trichloroethene (TCE)	Most of the TCE used in the United States is released into the atmosphere from industrial degreasing operations.	- Dizziness, headaches, confusion, euphoria, facial numbness, weakness - Adverse effects in the liver, kidney, immune system, endocrine system - Association with several types of cancer
1,1-Dichloroethene (1,1-DCE)	1,1-DCE is used as an intermediate in chemical synthesis and to produce polyvinylidene chloride copolymers.	- Adverse effects in the liver, kidney, central nervous system, lungs
***cis*-1,2-Dichloroethene (*cis*-1,2-DCE)**	*cis*-1,2-DCE is used as a solvent for waxes and resins; in the extraction of rubber; as a refrigerant; in the manufacture of pharmaceuticals and artificial pearls; and in the extraction of oils and fats from fish and meats.	- Adverse effects in the liver
1,1-Dichloroethane (1,1-DCA)	1,1-DCA is primarily used as an intermediate in chemical synthesis.	- Central nervous system depression, and a cardiostimulating effect resulting in cardiac arrhythmias - Adverse effects in the kidney

E-53500.5.0010

ARIZONA DEPARTMENT OF HEALTH SERVICES

Division of Disease Prevention

FIFE SYMINGTON, GOVERNOR
ALETHEA O. CALDWELL, DIRECTOR

October 30, 1992

Mr. Tom Curry
Remedial Projects Unit
Arizona Department of Environmental Quality
3033 N. Central Avenue
Phoenix, Arizona 85012

RE: Task Assignment II-18, Contract #2217-000000-3-3-AB-2001.

Dear Mr. Curry:

The following document is being provided in response to ADEQ Remedial Projects Coordination Unit request for performance of a Statement of Risk for the potentially affected Tolleson water wells and populace. The Statement of Risk estimates the potential health effects from domestic use of water from the ADEQ monitor wells in the Estrella Business Park, RID #84, and the Rhoen Plane well.

In accordance with TA II-18 (Contract #2217-000000-3-3-AB-2001), a Statement of Risk was prepared by the Arizona Department of Health Services, Division of Disease Prevention. Two copies of the work product are attached.

If you have questions, or need additional information, please call Will Humble at 230-5860.

Sincerely,

Norman J. Petersen, Chief
Office of Risk Assessment and
Investigation

NJP:wh
Enclosure
cc: Larry Sands, D.O., M.P.H.
Jim McDonald
Win Chromec, Ph.D.
Will Humble

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1.0 INTRODUCTION

The purpose of this statement of risk is to determine the potential adverse health effects to residents of the City of Tolleson as a result of exposure to organic contaminants in domestic water. Although public wells are not currently contaminated, pollutants similar to those in groundwater from Arizona Department of Environmental Quality monitor wells are slowly migrating to the west. The City of Tolleson public wells are likely to be impacted in the near future.

Authority

Pursuant to Chapter 7, Article 1 of the Arizona Revised Statutes, Water Quality Assurance Fund (WQARF), A.R.S. 49-282, this statement of risk has been prepared in accordance with the requirements of Contract Number 2217-000000-3-3-AB-2001 for the Arizona Department of Environmental Quality (ADEQ). This document was prepared using guidelines prescribed by the U.S. Environmental Protection Agency (USEPA) Risk Assessment Guidance for Superfund (RAGS), Volume I, Human Health Evaluation Manual: Part A (1989a) and RAGS Human Health Supplement (1991).

Overview

A regional groundwater contaminant plume containing volatile organic compounds (VOCs) exists in the West Van Buren study area (Kleinfelder, 1992). The upper alluvial groundwater movement in the area is toward the west (Kleinfelder, 1992). In the winter months, groundwater flow is to the west-northwest, toward a cone of depression near Luke Air Force Base (Kleinfelder, 1992). Since the general flow of groundwater is toward the west and northwest there is concern that the contaminant plume may reach the City of Tolleson production wells.

The four ADEQ monitor wells are located in the vicinity of 66th Avenue and Grant Street. Drilling and installation of the wells was accomplished between October 22, 1991 and December 26, 1991. The wells are located in close proximity to each other, and were drilled to varying depths in order to determine the extent of vertical migration of contaminants. The wells were then sampled at depths of 140, 190, 230 and 330 feet. A total of 11 samples were analyzed for 33 organic contaminants between January 26, 1991 and September 8, 1992. Laboratory analyses of the samples revealed the presence of 17 organic contaminants.

RID #84 is located less than 1/2 mile to the west of the ADEQ monitor wells. Groundwater samples from RID #84 were taken and analyzed on June 19, 1990 and May 5, 1991. Laboratory analyses of the samples revealed the presence of 8 organic contaminants.

The Rhoen Planc well is located approximately 2 miles to the west of the ADEQ monitor wells in the City of Tolleson. A total of four groundwater samples were taken from this well between August 24, 1990 and

September 8, 1992. Analyses of the samples revealed the presence of 4 organic contaminants. Contaminant concentrations in this well were substantially less than those in the ADEQ monitor wells and RID #84.

A total of 18 samples analyzed for 33 organic contaminants were available for this statement of risk. Estimates of potential excess cancer risk and noncancer hazard were calculated using this sample data. Excess lifetime cancer risk and chronic, systemic hazard calculations were made using USEPA guidelines and use standard residential exposure scenarios.

2.0 CHEMICALS OF POTENTIAL CONCERN

This section identifies the chemicals of potential concern in the ADEQ monitor wells, in RID #84, and in the Rhoen Planc well. Chemicals of concern were selected at each well independently. Chemicals were selected if they were detected in at least one sample in a well or set of wells. The ADEQ monitor wells were considered to be one set due to their very close proximity.

Groundwater samples were analyzed for 33 VOCs using EPA method 601 and 602. Seventeen chemicals were detected and selected in the ADEQ monitor wells, 8 were detected in RID #84, and 4 were detected in the Rhoen Planc well.

The average and 95% upper confidence limit (UCL) chemical concentrations were then calculated for ADEQ monitor well #1 (140'), ADEQ monitor well #2 (330'), and all samples from ADEQ monitor wells 1 through 4. In addition, average and UCL values were calculated for RID #84 and the Rhoen Planc well. These values are displayed in Appendix Tables 2 and 3. Table 2.1 displays the organic chemicals that were tested in each sample and indicates which chemicals were present in each well or set of wells.

Table 2.1 Chemicals Detected in ADEQ Monitor Wells, RID #84, and Rhoen Planc Well.

Chemical	Abbreviation	ADEQ Monitor Wells	RID #84	Rhoen Planc
Benzene	BZ	●		
Bromodichloromethane	BDCM	●		
Bromoform	BF			
Bromomethane	BM			
Carbon Tetrachloride	CT	●		
Chlorobenzene	CB			
Chloroethane	CE			
Chloroform	CF	●	●	
Dibromochloromethane	DBCM			
2-Chloroethyl Vinyl Ether	CVE			
1,3 Dichlorobenzene	1,3 DCB			
1,2 & 1,4 Dichlorobenzene	——			
Dichlorodifluoromethane	DCFM			
1,1 Dichloroethane	1,1 DCA	●	●	
1,2 Dichloroethane	1,2 DCA	●	●	
1,1 Dichloroethene	1,1 DCE	●	●	●
1,2 Dichloroethene	1,2 DCE	●	●	
1,2 Dichloropropane	DCPA			
cis- 1,3 Dichloropropene	c-1,3 DCP			
trans- 1,3 Dichloropropene	t- 1,3 DCP			
Ethylbenzene	EB	●		
Methylene Chloride	MC			
1,1,2,2 Tetrachloroethane	1,1,2,2 PCA	●		
Tetrachloroethene	PCE	●	●	●
Toluene	TOL	●		●
1,1,1 Trichloroethane	1,1,1 TCA	●	●	
1,1,2 Trichloroethane	1,1,2 TCA			
Trichloroethene	TCE	●	●	●
Trichlorofluoromethane	TCFM	●		
Vinyl Chloride	VC			
Xylene	XY	●		
Trichlorotrifluoroethane	TCTFA	●		

Data Uncertainties

The quantity of data collected and reported is quite limited. When available data are limited, accurate and reliable estimates of contaminant concentrations are difficult to obtain. Therefore, the quantity of data is therefore of concern when interpreting the results of this risk assessment. In order to compensate for this uncertainty, both mean concentrations and 95% UCL estimates were used for risk characterizations. The means were used to estimate typical potential risk and the UCL was used for RME. This was done to better characterize the true range of probable risk. True risk may be much less than calculated risk. This is done intentionally to be protective of public health.

3.0 EXPOSURE ASSESSMENT

This exposure assessment focuses on potential human exposure to chemicals present in the ADEQ monitor wells, RID #84 and the Rhoen Planc well. It estimates possible exposure pathways associated with contamination detected at the site. An exposure pathway is considered complete when a chemical of concern contacts a receptor. An exposure assessment requires an estimate of exposure concentrations of chemicals in water and an estimate of intake for each pathway.

A potentially complete human exposure pathway describes the route a chemical may take from the source to a population or receptor. A complete exposure pathway includes the following components (EPA, 1989a):

1) A source and mechanism of release to the environment,
2) A medium for the transport of the released chemical to the environment.
3) A point of potential human contact with the contaminated medium (exposure point).
4) An exposure route at the exposure point, (ingestion, inhalation, dermal contact).

Quantification of Exposures

Estimates of exposure concentrations and pathway specific intake doses must be made to quantify exposures. Reasonable assumptions are made to estimate exposure and intake of chemicals in drinking water. Exposures are estimated to derive the potential hazard and risk that humans would face as a result of exposure to groundwater from the selected wells. Potential exposures as a result of domestic use of groundwater are then quantitatively evaluated.

Exposure Estimation Methods

Contaminant water concentrations are calculated and summarized in the appendix. They are estimates of concentrations in water that could potentially be contacted at an exposure point. Chemical intake or dose is expressed as mass per unit body weight and time (mg/kg-day). Most toxicity values are expressed on the

basis of administered dose not absorbed dose. Therefore, chemical intakes from water ingestion are also expressed as administered dose.

Intake equations for ingestion, inhalation and dermal contact are summarized in Table 3.1. Variable values for average and reasonable maximum exposures (RME) for resident adults are also shown. The intake formula follows EPA guidelines (EPA, 1989a,b). Variable values incorporate standard assumptions from EPA standard default exposure factors (EPA, 1991).

The ingestion rate of 2 liters per day is the USEPA guideline and represents approximately the 90th percentile for drinking water consumption. In this statement of risk USEPA Region IX guidance for calculation of risks from ingestion exposures to residential water supplies was followed. The sum of the risk or hazard due to inhalation and dermal exposures were assumed to be equal to that of ingestion for VOCs (EPA, 1991).

Table 3.1 Formula Used to Calculate Chronic Daily Intake (CDI) from Ingestion of Groundwater

$$CDI = \frac{(CS)(IR)(EF)(ED)(CF)}{(BW)(AT)}$$

Where:

CDI	=	Chronic Daily Intake (mg/kg-day)
CS	=	Chemical Concentration in Water (ug/L)
IR	=	Ingestion Rate (L/day)
EF	=	Exposure Frequency (days/year)
ED	=	Exposure Duration (years)
CF	=	Conversion Factor (1E-3 mg/ug)
BW	=	Body Weight (kg)
AT	=	Averaging Time (period over which exposure is averaged-days)

Variable Values:

CS	:	Chemical concentration in the water
IR	:	2 L/day for residents
EF	:	350 days/year for residents
ED	:	9 years for the average resident 30 years for the RME resident
BW	:	70 kg for adults
AT	:	Carcinogenic Effects = (70 years)(365 days/year) Non Carcinogenic Effects = (ED)(365 days/year)

CDIs are calculated for both an average and reasonable maximum exposure (RME). The average CDI uses the mean contaminant concentration as the chemical concentration in the water. The RME is calculated using the 95% UCL contaminant concentration as the chemical concentration in the water; however, when

the UCL exceeds the maximum detected concentration, the maximum detected concentration is used. This is consistent with guidelines from USEPA (EPA,1989a). The CDI for each chemical in each well is displayed in Appendix Tables 2 and 3. The CDIs were calculated using the assumption that intake from inhalation and dermal contact with VOCs in the water are equal to that of ingestion. CDIs displayed in the Appendix are therefore equal to twice the CDI from ingestion of water.

4.0 TOXICITY ASSESSMENT

Adverse effects associated with chemicals of potential concern in the selected wells are summarized in this section. The fundamental differences between the mechanisms of carcinogenic and noncarcinogenic effects and the derivation of the dose-response variables used to estimate risks to human health are incorporated into risk assessment methodology by the EPA. Each compound of concern must be examined for potential carcinogenic and noncarcinogenic effects. Toxicological profiles for the chemicals detected in the wells are available from ADHS but are not included in this statement of risk.

Information About Noncarcinogenic Effects

Reference dose (RfD) values are used as dose response variables for noncarcinogenic effects of contaminants in quantitative risk assessments. RfD values are determined by the EPA using experimental data verifying a compound's noncarcinogenic toxicity. It is assumed in the development of an RfD that there is a threshold of exposure for which there are no adverse health effects. The RfD is an estimated daily intake rates for a specific chemical which will pose no appreciable risk of adverse health effects to humans, including sensitive populations. Subchronic RfD values are used for short term exposures, while chronic RfD values are used for exposures over longer durations. Table 4.1 displays chronic RfDs for chemicals of potential concern in the selected wells. Information in Table 4.1 was obtained from EPA's Integrated Risk Information System (IRIS) (September, 1992), and the EPA Health Effects Assessment Summary Tables Final (HEAST)(1992).

Table 4.1. -- Reference dose (RfD for ingestion) and reference concentration (RfC for inhalation) for chemicals of concern.

Chemical	Inhalation RfC (mg/kg-d)	Ingestion RfD (mg/kg-d)	Confidence In Data (Oral)	Sensitive Organs and Systems Affected	RfC/RfD Source	UF/MF
Benzene	———	———	———	Blood; CNS; Developmental; GI, Immune, Reproductive Systems; Skin	———	———
Bromodichloromethane	———	2E-2	Medium	Adrenal, Blood, Brain, CNS, Developmental & Genotoxicity, Immune System, Kidney, Liver, Lungs	———/IRIS	1,000/1
Carbon Tetrachloride	———	7E-4	Medium	Blood, CNS, Kidney, Liver	———/IRIS	1,000/1
Chloroform	———	1E-2	Medium	CNS, Kidney, Liver	———/IRIS	1,000/1
1,1-Dichloroethane	1E-1	1E-1	———	CNS, Heart	HEAST/HEAST	1,000/- Inh. 1,000/- Ing.
1,2-Dichloroethane	———	———	———	GI System, Kidney, Liver, Respiratory System, Skin	———	———
1,1-Dichloroethylene	———	9E-3	Medium	Developmental, GI, Respiratory Systems; Liver	———/IRIS	1,000/1
1,2-Dichlorothylene	———	2E-2	Low	Blood; CNS; GI, Immune, Respiratory Systems; Kidney; Liver	———/IRIS	1,000/1
Ethylbenzene	———	1 E-1	Low	Kidney, Liver	———/IRIS	1,000/1
Fluoride	———	6E-2	High	Bones and Teeth, CNS, GI System, Heart, Kidney, Lung,	———/IRIS	1/1
Tetrachloroethylene	———	1E-2	Medium	CNS, Kidney, Liver	——— / IRIS	1,000/1
Toluene	———	1 E-1	Medium	Kidney, Liver	———/IRIS	1,000/1
1,1,1-Trichloroethane	3E-1	9E-2	———	CNS, GI and Reproductive Systems, Heart, Liver, Lung, Skin	HEAST/HEAST	1,000/-Inh 1,000/-Inh
Trichloroethylene	———	6 E-3	Low	CNS, Eye, GI System, Heart, Kidney, Liver, Lung	———/ECAO[1]	———/3,000
Trichlorofluoromethane	———	3 E-1	Medium	———	———/IRIS	1,000/1
Trichlorotriflouroethane	———	3 E+0	———	———	———/HEAST	100/———
Xylene	———	2 E+0	Medium	———	———/IRIS	100/1

1 RfD developed by Environmental Criteria and Assessment Office (ECAO).

Information About Carcinogenic Risk

Potential health effects are evaluated differently for chemicals classified by the EPA as possible carcinogens than noncarcinogens. The upper-bound excess cancer risk is calculated by multiplying an estimated dose from an exposure route by a slope factor (SF). The SF $(mg/kg\text{-}day)^{-1}$ is usually determined using the upper 95% confidence limit of the slope of the linearized multi-stage model. Excess cancer risk is expressed as a function of exposure. The model assumes that there is no threshold for the initiation of cancer. For most applications, extrapolations must be made from high experimental doses to low doses resulting from environmental exposures. The application of the no threshold assumption and the 95% confidence limit for estimation of slope factors provides a conservative upper bound estimate of potential carcinogenic risks. Human response to a dose is probably less than the predicted response.

The likelihood that a chemical agent is a carcinogen in humans is given by the weight of evidence (WoE) classifications developed by the EPA's Carcinogen Advisory Group. "A" means the chemical is considered a proven human carcinogen. Probable human carcinogens are designated either "B1", indicating that studies in humans are highly suggestive, but not conclusive, or "B2", if the chemical has been found to be conclusively carcinogenic in repeated animal studies, but no conclusive human studies exist. A chemical may be considered a possible human carcinogen ("C") if a single high-quality animal study or several low quality animal studies indicate carcinogenicity. If there is insufficient human and animal evidence to determine the carcinogenicity of the chemical, it is rated "D". A chemical conclusively demonstrated to be noncarcinogenic in humans is rated "E". This designation is rare due to the difficulty in producing the necessary negative data.

Slope Factors (SF) were obtained from the EPA's Integrated Risk Information System (IRIS) (September, 1992) database, and the EPA Health Effects Assessment Summary Tables Final, (1992). Slope factors and weight of evidence ratings for the potential carcinogens are listed in Table 4.2.

Table 4.2 -- Slope Factor (SF) for Carcinogenic Chemicals of Concern.

Chemical	WoE	Slope Factor		Type of Cancer	Study Source of SF	Reference for SF
		Inhalation $(ug/m^3)^{-1}$	Ingestion $(ug/L)^{-1}$ $[(mg/kg\text{-}day)^{-1}]$	Inhalation/Ingestion		
Benzene	A	———	[1.8E+0]	Leukemia/Lymphomas	Human/Human	IRIS
Bromodichloromethane	B	———	[1.3E-2]	———/Tumors of Large Intestines, Kidney, Liver	———/Mouse	IRIS
Carbon Tetrachloride	B2	1.5 E-5	3.7E-6 [1.3E-1]	———/Hepatocellular Carcinoma	Mouse, Rat/ Mouse, Rat, Hamster	IRIS
Chloroform	B2	———	[6.1E-3]	———/Kidney and Liver Cancers	Mouse/Rat	IRIS
1,1-Dichloroethane	C	———	———	———/Hemangiosarcoma, Mammary and Liver Cancers, Uterine Polyps	———	———
1,2-Dichloroethane	B2	2.6 E-5	2.6 E-6 [9.1 E-2]	———/Hemangiosarcoma, Hepatocellular Carcinoma	Mouse, Rat/ Mouse Rat	IRIS
1,1-Dichloroethylene	C	———	[6.0 E-1]	Kidney and Mammary Cancer, Leukemia, Lung Tumor /Liver Tumor	Mouse/Rat	IRIS
Tetrachloroethane	C	———	[2.0 E-1]	———/Kidney, Liver	———/Mouse	IRIS
Tetrachloroethylene	B2	5.2 E-7	[5.1 E-2]	Bladder, Cervix, Kidney, Lung and Skin Cancers/Liver Cancer	Rat Mouse/ Mouse	HEAST
Trichloroethylene	B2	8.4 E-5	3.2 E-7 [1.1 E-2]	Testicular Tumor, Lymphomas, Cancers of Kidney, Liver, Lungs/ Leukemia, Cancer of Liver and Kidney	Mouse/Mouse	HEAST

5.0 RISK CHARACTERIZATION

Risks, both current and potential, are characterized in this chapter utilizing exposure and toxicology information previously developed and discussed. Risk characterization is presented in a quantitative format. Risk estimation methods were based on USEPA guidelines (USEPA, 1989a). Risk calculations proceed from estimation for a single compound for a single exposure route, to a summation of risk for all chemicals of concern for a given route, to a summation of risk across exposure routes.

Both carcinogenic risk and non-carcinogenic hazard quotients (HQ) are assumed to be additive when more than one chemical of concern is present. In both cases, values for individual chemical specific values are summed to obtain an estimate of total carcinogenic risk or systemic HQ.

Calculation of Carcinogenic Risk

Carcinogenic risk is calculated as the incremental probability of an individual developing cancer over a lifetime (70 years), due to exposure to a carcinogenic compound. This is also referred to as incremental excess cancer risk and represents the increased risk of developing cancer above the background rate, estimated at 30%. Total excess cancer risk is expressed as a probability.

Carcinogenic risks are based on calculations developed in the following order. Information on exposure pathways, exposure concentrations, and toxicology were assembled or calculated. Chronic daily intakes (CDI) were then calculated using assumptions from the exposure and toxicity values presented in Chapters 3 and 4. Non detects of chemicals present in at least one water sample in a well or set of wells were quantified by using 1/2 of the detection limit as the contaminant concentration. Mean and UCL concentration values were then used to calculate the estimated risk or hazard. Chemical specific carcinogenic slope factors (SF) were used to convert estimated CDI, averaged over a lifetime, to incremental risk (refer to Chapter 4).

The dose-response relationship is considered to be linear under the low dose conditions usually encountered in environmental exposures. In consideration of this assumption, the SF is a constant and risk is directly related to intake. Therefore the linear low-dose cancer risk equation is:

$$\text{Risk} = \text{CDI} \times \text{SF}$$

Where:

Risk = a unitless probability of an individual developing cancer;
CDI = Chronic Daily Intake averaged over 70 years (mg/kg-day);
SF = slope factor, expressed in $(\text{mg/kg-day})^{-1}$.

The SF usually represents an upper 95th percentile confidence limit of the probability of response, based on experimental animal data. Therefore, the risk estimate will also be an upper bound estimate and "true risk" is likely to be less than predicted by the model.

The result of risk calculations indicate that excess carcinogenic risk as a result of potential human exposure to concentrations of contaminants similar to those in the ADEQ monitor wells would be significant. The estimated excess cancer risk using all data from the monitor wells was 1E-4 for typical residential exposure and 8E-4 for RME residential exposure. The estimated excess cancer risk from RID #84 was approximately 9E-5 and 4E-4 for typical and RME exposures respectively. Excess cancer risk from exposure to chemicals in the Rhoen Planc wells was calculated to be 3E-6 and 2E-5 for typical and RME exposures.

Estimates for excess cancer risk calculated using slope factors and expressed as probabilities are summarized in Table 5.1. Worksheets showing the contaminant concentrations and CDI values are displayed in Appendix Tables 2 and 3.

Noncarcinogenic Effects

Noncarcinogenic health effects include neurotoxic, hepatotoxic, nephrotoxic, teratogenic, reproductive reactions, and any other noncancer related systemic toxic responses. The potential for an individual suffering a noncarcinogenic effect is not expressed as a probability, but as a ratio or quotient by comparison of the CDI to the chemical specific RfD which is not expected to produce toxic effects. The HQ is the ratio of an exposure level over a specified period (CDI) to the experimentally determined toxicity of the chemical. The HQ is calculated as follows:

$$\text{Noncancer Hazard Quotient (HQ)} = \text{CDI/RfD}$$

Where:

CDI = Daily Intake (dose) in mg/kg-day;
RfD = Reference Dose in mg/kg-day.

The HQ is not a probability. If the HQ exceeds 1, the exposed population may experience adverse health effects. The higher the HQ, the greater the concern. Effects can be evaluated over three time periods; short term, usually less than 2 weeks (acute), 2 weeks to 7 years (subchronic), and more than 7 years (chronic). In this statement of risk, chronic exposures are evaluated for potential exposure to groundwater.

The HQ using all data from the ADEQ monitor wells was estimated to be 1 for typical exposure and 2 for RME exposure. The RID #84 well HQ was estimated to be 1 for both typical and RME residential exposure. This indicates that domestic use of water having concentrations of contaminants similar to those in the ADEQ monitor wells and RID #84 would be adequate to produce adverse noncancer health effects. The HQ in the Rhoen Planc well is substantially below 1, and domestic use of this water would not be expected to produce adverse non cancer health effects. Table 5.2 summarizes the results of the HQ calculations. Worksheets showing the contaminant concentrations and CDI values are included in Appendix Tables 2 and 3.

Summary

The VOCs found in the ADEQ monitor wells and RID #84 are part of a regional alluvial groundwater contaminant plume which appears to be continuous in an east-west direction in the West Van Buren study area (Kleinfelder, 1992). The upper alluvial groundwater movement in the area is toward the west (Kleinfelder, 1992). In the winter months groundwater flow is to the west-northwest, toward a cone of depression near Luke Air Force Base (Kleinfelder, 1992). Since the general flow of groundwater is toward the west and northwest, there is concern that the contaminant plume may reach the City of Tolleson production wells. This statement of risk determines the potential adverse health effects to residents of the City of Tolleson as a result of possible future exposure to concentrations of organic contaminants similar to those in groundwater from the ADEQ monitor wells, RID #84, and the Rhoen Planc well in the City of Tolleson.

The result of risk calculations indicate that carcinogenic risk as a result of potential human exposure to concentrations of contaminants similar to those in the ADEQ monitor wells would be significant. The estimated excess cancer risk using all data from the monitor wells was 1E-4 (one in ten thousand) for typical residential exposure and 8E-4 (eight in ten thousand) for RME residential exposure. The estimated excess cancer risk from RID #84 was approximately 9E-5 and 4E-4 for typical and RME exposures respectively. Excess cancer risk from exposure to chemicals in the Rhoen Planc wells was calculated to be 3E-6 and 2E-5 for typical and RME exposures.

The range of excess cancer risk as a site remediation goal is in the range of 1E-4 to 1E-7. The 1E-6 risk level is generally used as the point of departure for determining remediation goals (EPA 1991c).

The HQ using all data from the ADEQ monitor wells was estimated to be 1 for average exposure and 2 for RME exposure. The RID #84 well HQ was estimated to be 1 for both average and RME residential exposure. This indicates that domestic use of water having concentrations of contaminants similar to those in the ADEQ monitor wells and RID #84 would be adequate to produce adverse non cancer health effects. The HQ in the Rhoen Planc well is substantially below 1, and domestic use of this water would not be expected to produce adverse noncancer health effects. Table 5.2 displays the results of the HQ calculations.

These results indicate that potential excess carcinogenic risk and noncancer hazard from domestic use of groundwater are substantially higher in the region near the ADEQ monitor wells and RID #84 than in the Rhoen Planc well in the City of Tolleson. Although Tolleson public wells are not currently contaminated, pollutants similar to those in groundwater from Arizona Department of Environmental Quality monitor wells are migrating to the west. The City of Tolleson public wells are likely to be impacted in the near future. The result of the risk and hazard calculations indicate that the possible health effects from domestic use of groundwater with concentrations of contaminants similar to those in the ADEQ monitor wells and RID #84 would be significant. Remedial action to prevent further migration of the contaminant plume would be prudent.

Table 5.1 Summary of Estimated Excess Carcinogenic Risk

Well (Well Depth in Feet)	Excess Cancer Risk	
	AVG	RME
Monitor Well 1 (140')	4E-4	1E-3
Monitor Well 2 (330')	2E-6	7E-6
Monitor Wells 1-4 (140'-330')	1E-4	8E-4
RID # 84 (532'-600')	9E-5	4E-4
Rhoen Planc Well (146')	3E-6	2E-5

Table 5.2 Summary of Hazard Quotients

Well (Well Depth in Feet)	Hazard Quotient	
	AVG	RME
Monitor Well 1 (140')	4	4
Monitor Well 2 (330')	.05	.08
Monitor Wells 1-4 (140'-330')	1	2
RID #84 (532'-600')	1	1
Rhoen Planc Well (146')	.01	.02

References

Brown and Pool. Hydrogeology of the Western Part of the Salt River Valley Area, Maricopa Co. Arizona. U.S. Geological Survey, Water Resources Investigation Report 88-4202.
Kleinfelder Inc. Phase I Report, West Van Buren Area, Phoenix, Arizona. July 1989.

Kleinfelder Inc. Draft Phase II Technical Memorandum, West Van Buren Study Area, Phoenix, Arizona. May 1992.

Reeter, RW and WH Remick. Maps Showing Groundwater Conditions in the West Salt River, East Salt River, Lake Pleasant, Carefree, Fountain Hills, Sub-basins of the Phoenix Active Management Area, Maricopa, Pinal and Yavapi Counties, Arizona. Arizona Department of Water Resources Hydrologic Map Series Report No. 12, July 1986.

U.S. Environmental Protection Agency, 1991a, Health Effects Assessment Summary Tables January 1991.Office of Emergency and Remedial Response.

U.S. Environmental Protection Agency, 1989a, Risk Assessment Guidance for Superfund (RAGS), Volume 1, Human Health Evaluation Manual (Part A), Interim Final. Office of Emergency and Remedial Response. EPA/540/1-89-002.

U.S. Environmental Protection Agency, 1991c, Risk Assessment Guidance for Superfund (RAGS), Volume 1, Human Health Evaluation Manual (Part B), Office of Emergency and Remedial Response. EPA.

U.S. Environmental Protection Agency, 1989b, Region IX. Risk Assessment Guidance for Superfund: Human Health Assessment- Region IX Recommendations, Interim Final.

U.S. Environmental Protection Agency, 1991b, Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual Supplemental Guidance, "Standard Default Exposure Factors" Interim Office of Emergency and Remedial Response Toxics Integration Branch. OSWER Directive 9285.6-03.

U.S. Environmental Protection Agency, September, 1992, Integrated Risk Information System (IRIS) Online. Office of Health and Environment, Cincinnati, Ohio, April, 1992.

Appendix Table 3. Chronic Daily Intake, Hazard Index, and Excess Cancer Risk for RID #84 and Perimeter Wells.

	CF	1,1DCA	1,2DCA	1,1DCE	1,2DCE	PCE	TOL	1,1,1TCA	TCE	
RID-AVG	0.43	4.83	0.30	10.73	3.70	150.00	0.25	0.37	9.90	
RID-STD	0.12	0.21	0.17	2.12	0.70	17.78	0.00	0.46	1.25	
RID-UCL	0.72	1.35	0.73	13.53	7.44	174.18	0.25	1.51	13.01	
RID-MAX	0.5	1	0.4	11.7	6.5	150	0.25	0.9	11.1	
RME CONC	0.5	1	0.4	11.7	6.5	150	0.25	0.9	11.1	
CDI C AVG	3.1E-06	5.9E-06	2.1E-06	7.6E-05	4.6E-05	9.2E-04	1.8E-06	2.6E-06	7.0E-05	
CDI C RME	1.2E-05	2.4E-05	9.4E-06	2.7E-04	1.5E-04	3.5E-03	5.9E-06	2.1E-05	2.6E-04	
CDI N AVG	2.4E-05	4.6E-05	1.7E-05	5.9E-04	3.1E-04	7.2E-03	2.4E-05	2.0E-05	5.4E-04	
CDI N RME	2.8E-05	5.5E-05	2.2E-05	6.4E-04	3.6E-04	8.3E-03	1.4E-05	5.0E-05	6.1E-04	Totals
C RISK AVG	1.9E-08		1.9E-07	4.5E-05		4.7E-05			7.7E-07	9.3E-05
C RISK RME	7.2E-08		8.6E-07	1.6E-04		1.8E-04			2.9E-06	3.5E-04
HAZARD AVG	2.4E-03	4.6E-04		6.6E-02	1.6E-02	7.2E-01	6.9E-05	2.2E-04	9.1E-02	8.9E-01
HAZARD RME	2.8E-03	5.5E-04		7.2E-02	1.8E-02	8.3E-01	6.9E-05	5.5E-04	1.0E-01	1.0E+00
PER-AVG				0.53		0.88	0.44		0.58	
PER-STD				0.51		0.68	0.38		0.29	
PER-UCL				1.33		1.96	1.03		0.88	
PER-MAX				1.1		1.6	1		0.7	
RME CONC				1.1		1.6	1		0.7	
CDI C AVG				3.7E-06		6.1E-06	3.1E-06		4.1E-06	
CDI C RME				2.6E-05		3.8E-05	2.4E-05		1.6E-05	
CDI N AVG				2.9E-05		4.8E-05	2.4E-05		3.2E-05	
CDI N RME				6.1E-05		8.8E-05	5.5E-05		3.9E-05	
C RISK AVG				2.2E-06		3.1E-07			4.5E-08	2.6E-06
C RISK RME				1.6E-05		1.9E-06			1.8E-07	1.8E-05
HAZARD AVG				3.2E-03		4.8E-03	1.7E-04		5.3E-03	1.3E-02
HAZARD RME				6.7E-03		8.8E-03	2.8E-04		6.4E-03	2.2E-02

Appendix Table 1. Laboratory Results for Selected Wells. (Results in ug/L)

	BZ	BDCM	CT	CF	1,1DCA	1,2DCA	1,1DCE	1,2DCE	EB	PCA	PCE	TOL	1,1,1TCA	TCE	TCFM	XY	TCTFA
MW-1 140'																	
12/26/91	0.25 D	0.2	0.3	1.9	2.5	2.1	45	22	0.25 D	0.1	550	0.25 D	1.6	37	3.8	0.25 D	2.2
4/17/92	0.25 D	0.1 D	0.1 D	3.9	0.1 D	0.1 D	44	19	0.25 D	0.1 D	520	0.25 D	0.1 D	43	6	0.25 D	1
9/8/92	2.5 D	1 D	1 D	4	1 D	2	41	25	2.5 D	1 D	640	2.5 D	1 D	37	2.5 D	2.5 D	10 D
MW-2 330'																	
12/26/91	0.25 D	0.1 D	0.1 D	3.5	0.1 D	0.1 D	0.1 D	0.1 D	2.6	0.1 D	2.9	120	0.1 D	0.1 D	0.25 D	9.6	1 D
1/15/92	0.6	0.1 D	0.1 D	2.6	0.1 D	0.1 D	0.1 D	0.1 D	2.5	0.1 D	2.2	81	0.1 D	0.1 D	0.25 D	9.5	1 D
4/17/92	0.6	0.1 D	0.1 D	0.6	0.5	0.1 D	0.1 D	0.1 D	2	0.1 D	2.7	23	0.1 D	0.1 D	0.25 D	4.4	1 D
9/9/92	0.25	0.1 D	0.1 D	0.4	0.1 D	0.1 D	0.1 D	0.1 D	0.6	0.1 D	1.4	9.1	0.1 D	0.1 D	0.25 D	2.4	1 D
MW-3 190'																	
12/26/91	0.25 D	0.1 D	0.1 D	5.8	1.1	0.6	15	7.8	0.25 D	0.1 D	120	140	0.3	11	0.25 D	0.25 D	1 D
9/8/92	5	2	0.2 D	14	0.2 D	0.2 D	7	4	4	0.2 D	59	52	0.2 D	5	0.5 D	16	2 D
MW-4 230'																	
12/26/91	0.25 D	0.1 D	0.1 D	0.8	0.8	0.2	2.8	2.7	0.25 D	0.1 D	41	240	0.1 D	2	0.25 D	0.25 D	1 D
9/8/92	1.25 D	0.5 D	0.5 D	0.5 D	0.5 D	0.5 D	0.5 D	0.5 D	1.25 D	0.5 D	0.5 D	120	0.5 D	0.5 D	1.25 D	1.25 D	5 D
RID #84																	
6/19/90	0.25 D	0.1 D	0.1 D	0.5	0.6	0.4	11.7	6.5	0.25 D	0.1 D	150	0.25 D	0.9	11.1	0.25 D	0.25 D	1 D
5/15/91 D	0.25 D	0.1 D	0.1 D	0.5	1	0.4	9.5	5.2	0.25 D	0.1 D	116	0.25 D	0.1 D	8.6	0.25 D	0.25 D	1 D
5/15/91 C	0.25 D	0.1 D	0.1 D	0.3	0.9	0.1 D	11	5.4	0.25 D	0.1 D	124	0.25 D	0.1 D	10	0.25 D	0.25 D	1 D
R. PLANC																	
5/5/92	0.25 D	0.1 D	0.1 D	0.1 D	0.1 D	0.1 D	0.8	0.1 D	0.25 D	0.1 D	1.3	0.25 D	0.1 D	0.7	0.25 D	0.25 D	1 D
9/8/92	0.25 D	0.1 D	0.1 D	0.1 D	0.1 D	0.1 D	1.1	0.1 D	0.25 D	0.1 D	1.6	0.25 D	0.1 D	0.6	0.25 D	0.25 D	1 D
RSCD #5																	
8/24/90	0.25 D	0.1 D	0.1 D	0.1 D	0.1 D	0.1 D	0.1 D	0.1 D	0.25 D	0.1 D	0.4	0.25 D	0.1 D	0.7	0.25 D	0.25 D	1 D
5/20/91	0.25 D	0.1 D	0.1 D	0.1 D	0.1 D	0.1 D	0.1 D	0.1 D	0.25 D	0.1 D	0.2	1	0.1 D	0.3	0.25 D	0.25 D	1 D

Note: "D" indicates that the Value Presented is 1/2 of the Detection Limit

Appendix Table 2. Chronic Daily Intake, Hazard Index, and Excess Cancer Risk in ADEQ Monitor Wells

	BZ	BDCM	CT	CF	1,1DCA	1,2DCA	1,1DCE	1,2DCE	EB	PCA	PCE	TOL	1,1,1TCA	TCE	TCFM	XY	TCTFA	
MW-1 AVG	1.00	0.43	0.47	3.27	1.20	1.40	43.33	22.00	1.00	0.40	570.00	1.00	0.90	39.00	4.10	1.00	4.40	
MW-1 STD	1.30	0.49	0.47	1.18	1.21	1.13	2.08	3.00	1.30	0.52	62.45	1.30	0.75	3.46	1.77	1.30	4.89	
MW-1 UCL	5.54	2.16	2.12	7.41	5.44	5.34	50.61	32.49	5.54	2.22	788.32	5.54	3.54	51.71	10.28	5.34	21.48	
MW-1 MAX	2.5	1	1	4	2.5	2.1	45	25	2.5	1	640	2.5	1.6	43	6	2.5	10	
RME CONC	2.5	1	1	4	2.5	2.1	45	25	2.5	1	640	2.5	1.6	43	6	2.5	10	
CDI C AVG	7.1E-06	3.1E-06	3.3E-06	2.3E-05	8.5E-06	9.9E-06	3.1E-04	1.6E-04	7.1E-06	2.8E-06	4.0E-03	7.1E-06	6.3E-06	2.7E-04	2.9E-05	7.1E-06	3.1E-05	
CDI C RME	3.9E-05	2.4E-05	2.4E-05	9.4E-05	5.9E-05	4.9E-05	1.1E-03	5.9E-04	5.9E-05	2.4E-05	1.5E-02	5.9E-05	3.8E-05	1.0E-03	1.4E-04	5.9E-05	2.4E-04	
CDI N AVG	5.5E-05	2.4E-05	2.6E-05	1.8E-04	6.6E-05	7.7E-05	2.4E-03	1.2E-03	5.5E-05	2.2E-05	3.1E-02	5.5E-05	5.0E-05	2.1E-03	2.3E-04	5.5E-05	2.4E-04	
CDI N RME	1.4E-04	5.5E-05	5.5E-05	2.2E-04	1.4E-04	1.2E-04	2.5E-03	1.4E-03	1.4E-04	5.5E-05	3.5E-02	1.4E-04	8.8E-05	2.4E-03	3.3E-04	1.4E-04	5.5E-04	Totals
C RISK AVG	2.0E-07	4.0E-07	4.3E-07	1.4E-07		9.0E-07	1.8E-04			5.6E-07	2.0E-04			3.0E-06				3.9E-04
C RISK RME	1.7E-06	3.1E-06	3.1E-06	5.7E-07		4.5E-06	6.5E-04			4.7E-06	7.7E-04			1.1E-05				1.4E-03
HAZARD AVG		1.2E-03	3.7E-02	1.8E-02	6.6E-04		2.6E-01	6.1E-02	5.5E-04		3.1E+00	2.8E-04	5.5E-04	3.6E-01	7.5E-04	2.8E-05	8.1E-05	3.9E+00
HAZARD RME		2.8E-03	7.9E-02	2.2E-02	1.4E-03		2.8E-01	6.9E-02	1.4E-03		3.5E+00	6.9E-04	9.8E-04	3.9E-01	1.1E-03	6.9E-05	1.8E-04	4.4E+00
MW-2 AVG	0.43	0.10	0.10	1.78	0.20	0.10	0.10	0.10	1.93	0.10	2.30	58.28	0.10	0.10	0.25	6.48	1.00	
MW-2 STD	0.20	0.00	0.00	1.52	0.20	0.00	0.00	0.00	0.92	0.00	0.67	51.60	0.00	0.00	0.00	3.64	0.00	
MW-2 UCL	0.75	0.10	0.10	4.19	0.53	0.10	0.10	0.10	3.39	0.10	3.36	140.33	0.10	0.10	0.25	12.27	1.00	
MW-2 MAX	0.6	0.1	0.1	3.5	0.5	0.1	0.1	0.1	2.6	0.1	2.9	120	0.1	0.1	0.25	9.6	1	
RME CONC	0.6	0.1	0.1	3.5	0.5	0.1	0.1	0.1	2.6	0.1	2.9	120	0.1	0.1	0.25	9.6	1	
CDI C AVG	3.0E-06	7.1E-07	7.1E-07	1.5E-05	1.4E-06	7.1E-07	7.1E-07	7.1E-07	1.4E-05	7.1E-07	1.6E-05	4.1E-04	7.1E-07	7.1E-07	1.8E-06	4.6E-05	7.1E-06	
CDI C RME	1.4E-05	2.4E-06	2.4E-06	8.2E-05	1.2E-05	2.4E-06	2.4E-06	2.4E-06	6.1E-05	2.4E-06	6.8E-05	2.8E-03	2.4E-06	2.4E-06	5.9E-06	2.3E-04	2.4E-05	
CDI N AVG	2.3E-05	5.5E-06	5.5E-06	9.8E-05	1.1E-05	5.5E-06	5.5E-06	5.5E-06	1.1E-04	5.5E-06	1.3E-04	3.2E-03	5.5E-06	5.5E-06	1.4E-05	3.6E-04	5.5E-05	
CDI N RME	3.3E-05	5.5E-06	5.5E-06	1.9E-04	2.8E-05	5.5E-06	5.5E-06	5.5E-06	1.4E-04	5.5E-06	1.6E-04	6.6E-03	5.5E-06	5.5E-06	1.4E-05	5.3E-04	5.5E-05	
C RISK AVG	8.7E-08	9.2E-08	9.2E-08	7.6E-08		6.4E-08	4.2E-07			1.4E-07	8.3E-07			7.5E-09				1.8E-06
C RISK RME	4.1E-07	3.1E-07	3.1E-07	5.0E-07		2.1E-07	1.4E-06			4.7E-07	3.5E-06			2.6E-08				7.1E-06
HAZARD AVG		2.8E-04	7.9E-03	9.8E-03	1.1E-04		6.1E-04	2.8E-04	1.1E-03		1.3E-02	1.6E-02	6.1E-05	9.2E-04	4.6E-05	1.8E-04	1.8E-05	5.0E-02
HAZARD RME		2.8E-04	7.9E-03	1.9E-02	2.8E-04		6.1E-04	2.8E-04	1.4E-03		1.6E-02	3.3E-02	6.1E-05	9.2E-04	4.6E-05	2.6E-04	1.8E-05	8.0E-02
MWS-AVG	1.04	0.40	0.25	3.45	0.65	0.55	14.15	7.40	1.50	0.23	176.34	71.65	0.38	12.35	1.41	4.24	2.38	
MWS-STD	1.48	0.60	0.29	3.92	0.73	0.76	19.29	9.76	1.30	0.28	256.91	77.06	0.49	17.49	1.92	5.23	2.80	
MWS-UCL	2.02	0.80	0.43	6.05	1.13	1.06	26.95	13.87	2.36	0.42	346.79	122.79	0.71	23.96	2.69	7.71	4.24	
MWS-MAX	5	2	1	5.8	2.5	2.1	45	25	4	0.5	640	240	1.6	43	3.8	16	10	
RME CONC	2.02	0.8	0.43	5.8	1.19	1.06	26.95	13.87	2.36	0.42	346.7	122.8	0.71	23.9	2.7	7.7	4.24	
CDI C AVG	7.3E-06	2.8E-06	1.7E-06	2.4E-05	4.6E-06	3.9E-06	1.0E-04	5.2E-05	1.1E-05	1.6E-06	1.2E-03	5.1E-04	2.7E-06	8.7E-06	1.0E-05	3.0E-05	1.7E-05	
CDI C RME	4.7E-05	1.9E-05	1.0E-05	1.4E-04	2.7E-05	2.5E-05	6.3E-04	3.3E-04	5.5E-05	9.9E-06	8.1E-03	2.9E-03	1.7E-05	5.6E-04	6.3E-05	1.8E-04	1.0E-04	
CDI N AVG	5.7E-05	2.2E-05	1.4E-05	1.9E-04	3.6E-05	3.1E-05	7.8E-04	4.1E-04	8.2E-05	1.3E-05	9.7E-03	3.9E-03	2.1E-05	6.8E-04	7.8E-05	2.3E-04	1.3E-04	
CDI N RME	1.1E-04	4.4E-05	2.4E-05	3.2E-04	6.7E-05	5.8E-05	1.5E-03	7.6E-04	1.3E-04	2.3E-05	1.9E-02	6.8E-03	3.9E-05	1.3E-03	1.5E-04	4.2E-04	2.3E-04	
C RISK AVG	2.1E-07	3.7E-07	2.2E-07	1.5E-07		3.6E-07	6.0E-05			3.2E-07	6.3E-05			9.6E-07				1.3E-04
C RISK RME	1.4E-06	2.4E-06	1.3E-06	8.3E-07		2.3E-06	3.8E-04			2.0E-06	4.2E-04			6.2E-06				8.1E-04
HAZARD AVG		1.1E-03	1.9E-02	1.9E-02	3.6E-04		8.7E-02	2.0E-02	8.2E-04		9.7E-01	2.0E-02	2.3E-04	1.1E-01	2.6E-04	1.2E-04	4.4E-05	1.3E+00
HAZARD RME		2.2E-03	3.4E-02	3.2E-02	6.2E-04		1.6E-01	3.8E-02	1.3E-03		1.9E+00	3.4E-02	4.3E-04	2.2E-01	5.0E-04	2.1E-04	7.8E-05	2.4E+00

EXHIBIT "2"

TABLE 7. ESTIMATED COSTS OF REMEDIAL ALTERNATIVES

West Van Buren Area WQARF Site

Costs Summary:	Capital Cost	Annual O&M
Reference Remedy	$13,645,000	$2,956,900
Less Aggressive	$9,445,000	$2,049,500
More Aggressive	$14,623,000	$2,192,600
Most Aggressive	$19,460,000	$4,169,900

Less Aggressive

Well	Description	Capital Cost	Annual O&M	Comments/Explanation
89	3 skids GAC treatment	$1,500,000	$300,000	Modified ERA
92	1 skid GAC treatment	$1,000,000	$100,000	Modified ERA
95	2 skids GAC treatment	$1,000,000	$250,000	Modified ERA (increased O&M with higher concentration of 1,1-dichloroethene, resulting in quicker breakthrough)
114	3 skids GAC treatment	$1,500,000	$300,000	Modified ERA
106	3 skids GAC treatment	$1,500,000	$300,000	Modified ERA + supplemental action
109	2 skids GAC treatment	$1,000,000	$200,000	Modified ERA
84	off-season injection	TBD	TBD	operation of pumps and filtration (contingengy; If > MCLs after 2 years of remedy)
	volatilization control	$180,000		sealing wellhead discharge boxes @ sites with COCs greater than MCLs & enclose open lateral south of RID-92
	groundwater monitoring		$134,000	based on Fiscal Year 2015 budget estimate by Terranext
	Salt Canal improvements	$750,000		2 open section + manholes (1,500 feet @ $500/foot)
	restore lost production capacity	$615,000		1) re-drill, new pump, new motor at RID-106 2) new pump, same motor at RID-114
	power penalty		$140,000	estimated offset for increased pumping cost through wellhead treatment from increase in operating pressure ($10,000/skid/year)
	equipment repair/replacement		$225,000	3% of capital equipment costs
	real estate acquisition	$400,000		106, 109 ($200,000/site)
	project administration/reporting		$100,500	6.0% of annual O&M (excludes power penalty and groundwater monitoring)
	TOTALS:	$9,445,000	$2,049,500	

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TABLE 10. GROUNDWATER REMEDIAL ACTIONS - COMPARATIVE ANALYSIS

West Van Buren Area WQARF Site

Site	Treatment Technology	Required Treatment Levels[1]	End Use of Remediated Water	Remedy Capital Cost (in years completed)	Remedy Capital Cost (2014 dollars)[2]	Design Treatment Capacity	Normalized[3] Capital Costs/ Treatment Capacity ($/gpm)	Amount of Groundwater Extracted Through 2013	Amount of VOC Mass Removed Through 2013	Average Annual Groundwater Pump & Treat Rate	Annual VOC Mass Removal Rate	Annual Remedy O&M Costs	Routine O&M Cost ($/lb$_{VOC}$)	Routine O&M Cost ($/Kgal)
WVBA Site Proposed Less Aggressive Alternative Remedy	LGAC (lead/lag)	Primary Drinking Water Standards	Irrigation Drinking Water[a]	~ $9.4 MM[f]	~ $9.4 MM	~13,300 gpm[f,l]	~ $707	—	—	~ 11,758 gpm[n]	~ 2,503 pounds/year[o]	~ $1.7 MM/year[f,r]	~ $670	~ $0.27
WVBA Site Proposed Reference Remedy	LGAC (lead/lag)	Primary Drinking Water Standards	Irrigation Drinking Water[a]	~ $13.6 MM[f]	~ $13.6 MM	~19,500 gpm[f,l]	~ $697	—	—	~ 16,071 gpm[n]	~ 2,820 pounds/year[o]	~ $2.5 MM/year[f,r]	~ $883	~ $0.29
WVBA Site Proposed More Aggressive Alternative Remedy	LGAC (lead/lag)	Primary Drinking Water Standards	Irrigation Drinking Water[a]	~ $14.6 MM[f]	~ $14.6 MM	~13,300 gpm[f,l]	~ $1,098	—	—	~ 12,142 gpm[n]	~ 2,569 pounds/year[o]	~ $1.8 MM/year[f,r]	~ $708	~ $0.28
WVBA Site Proposed Most Aggressive Alternative Remedy	LGAC (lead/lag)	Primary Drinking Water Standards	Irrigation Drinking Water[a]	~ $19.5 MM[f]	~ $19.5 MM	~29,100 gpm[f,l]	~ $670	—	—	~ 23,047 gpm[n]	~ 3,164 pounds/year[o]	~ $3.5 MM/year[f,r]	~ $1,120	~ $0.29

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TABLE 10. GROUNDWATER REMEDIAL ACTIONS - COMPARATIVE ANALYSIS
West Van Buren Area WQARF Site

Notes:

1) Treatment Levels applicable to site Contaminants of Concern
2) Based on percentage increase in Consumer Price Index (CPI) from dates of construction completion through May 2014.
3) Capital Cost in 2014 dollars relative to design treatment capacity in gpm.

* Values in red denote 2013 reported values/metrics

Abbreviations:

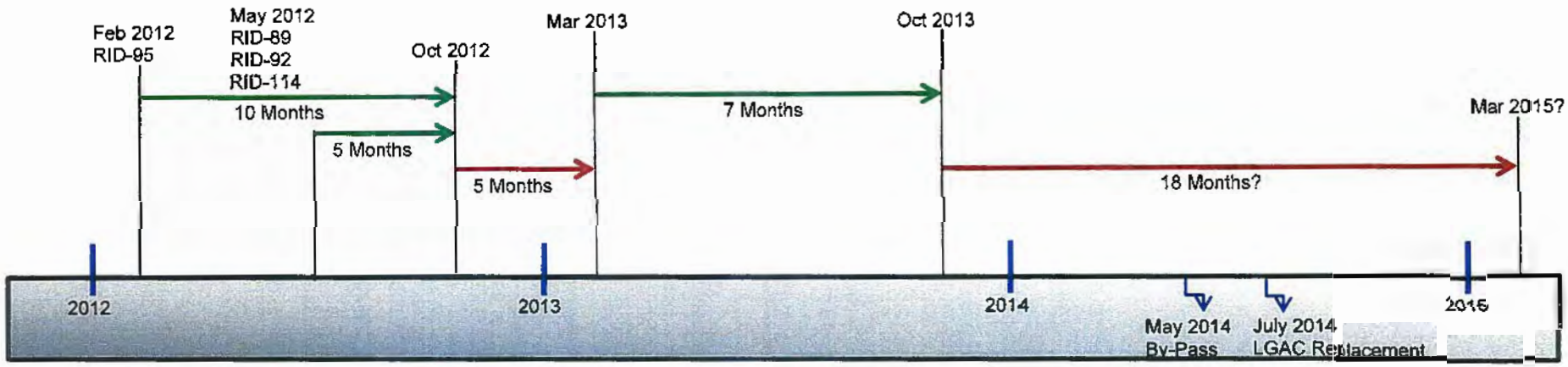
M52 = Motorola 52nd Street Superfund Site
NIBW = North Indian Bend Wash
TIAA = Tucson International Airport Area
WVBA = West Van Buren Area
VGAC = vapor-phase GAC
LGAC = liquid-phase GAC
lb = pound
Kgal = thousand gallons
MM = million
gpm = gallons per minute
O&M = operation and maintenance
VOC = volatile organic compound
TCE = trichloroethene
~ = values are estimates
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)

Explanation:

a) A major portion of remediated water is planned for municipal use pending RID construction of a separate conveyance pipeline from the WVBA Site to District land.
b) *Letter of Determination for Motorola 52nd Street Facility* , Phoenix, dated September 30, 1988.
c) *Final Remedial Action Report for Motorola 52nd Street Superfund Site, Operable Unit 2 Area* , Phoenix, Arizona, prepared by Black & Veatch Corporation, dated September 12, 2003.
d) *Final Feasibility Study Addendum* , North Indian Bend Wash Superfund Site, Scottsdale, Arizona, prepared by the NIBW Participating Companies, dated November 15, 2000 (*See* Table M5 in Appendix M, Volume 5).
e) Verbal communication: Mr. Jeff Biggs, Project Coordinator, Tucson Airport Remediation Project, Tucson Water.
f) *Draft Feasibility Study Report* , West Van Buren Area WQARF Site, Phoenix, Arizona, prepared by Synergy Environmental (*See* Table 5 for design treatment capacity and Table 7 for capital and O&M costs).
g) *2011 Sitewide Five-Year Review Report, Motorola 52nd Street Superfund Site* , Phoenix, Arizona, prepared by URS Corporation, September 2011 (See Sections 4.1 and 4.2; Tables 4-1 and 4-2).
h) *First Five-Year Report for Tucson International Airport Area Superfund Site* , Pima County, Arizona, prepared by U.S. Environmental Protection Agency, September 2013 (*See* Section 4.2.1 for pounds of VOCs removed and volume of groundwater extraction over 216 month period, and Section 4.3.1 for O&M costs [2001]).
i) The proposed remedy provides remediation of up to 26,800 gpm water supply when including blending of other contaminated supply wells that would operate according to an approved remedial action plan.
j) Information pertaining to amount of groundwater treated and mass removed is from annual Operable Unit No. 1 Effectiveness Reports prepared by Clear Creek Associates.
k) Information pertaining to amount of groundwater treated and mass removed is from annual Effectiveness Reports for 20th Street Groundwater Treatment Facility, Operable Unit 2 Area prepared by Connestoga-Rovers & Associates.
l) Information pertaining toamount of groundwater treated and mass removed is from annual Site Monitoring Reports, NIBW Superfund Site prepared by the NIBW Participating Companies.
m) Information pertaining to amount of groundwater treated and mass removed is from annual Water Quality Reports prepared by Tucson Water.
n) Estimated pumping rate is based on assigned pumping of remedy wells developed for the FS Model (see Appendix F).
o) Based on reported 2013 concentrations of PCE, TCE, and 1,1-DCE and projected pumping in groundwater modeling scenarios (see Appendix F).
p) *Motorola 52nd St. Superfund Site, Five-Year Review Completed Fact Sheet* , prepared by Environmental Protection Agency and Arizona Department of Environmental Quality (*See* page 2 for average VOC mass removed and average volume of groundwater extracted for 2006-2010).
q) *First Five-Year Review, Indian Bend Wash Superfund Site* , Scottsdale and Tempe, Maricopa County, Arizona, prepared by U.S. Environmental Protection Agency, September 2011 (*See* Table 4-8; periodic rehabilitation costs not included in O&M Costs Summary).
r) Excluding line item costs for area-wide groundwater monitoring and capital equipment costs from Table 7 *Draft Feasibility Study Report* , West Van Buren Area WQARF Site, Phoenix, Arizona, prepared by Synergy Environmental.

EXHIBIT "3"

ROOSEVELT IRRIGATION DISTRICT
MODIFIED EARLY RESPONSE ACTION
OPERATIONAL TIMELINE



According to the RID's revised O&M Plan (October 2014 -Revision 4) at page 21:

"Based on carbon change out frequencies for each of the well head treatment systems to date, the estimated LGAC change-out schedule per vessel at each MERA site is included below:

4 MERA Wells have 9 Skids/18 Vessels LGAC:
RID-89: 4-5 months of operation
RID-92: 2-3 months of operation
RID-95: 2-3 months of operation
RID-114: 5-6 months of operation"

Carbon change out costs for one vessel is at least $16,000.00 per vessel. (Source: RID's Request for Reimbursement under ARS 49-282 (E) (11) to ADEQ including the chart titled "Reimbursement for Remedial Action Costs/Roosevelt Irrigation District")

Treatment System Operations Key:

Operational

By-Pass/Shutdown

WEST VALLEY Groundwater CLEANUP COALITION

ROOSEVELT IRRIGATION DISTRICT

RID Early Response Action Technical Briefing

To The

West Van Buren Community Advisory Board

Arizona Department of Environmental Quality

December 6, 2012

✦ WELLHEAD PILOT TREATMENT SYSTEMS INITIATIVE

- ✧ RID-95 TREATMENT SYSTEM STARTED UP 2/6/2012
  - -- TECHNOLOGY/DESIGN DEMONSTRATION PERIOD --
- ✧ RID-89 TREATMENT SYSTEM STARTED UP 5/24/2012
- ✧ RID-92 TREATMENT SYSTEM STARTED UP 5/23/2012
- ✧ RID-114 TREATMENT SYSTEM STARTED UP 5/22/2012

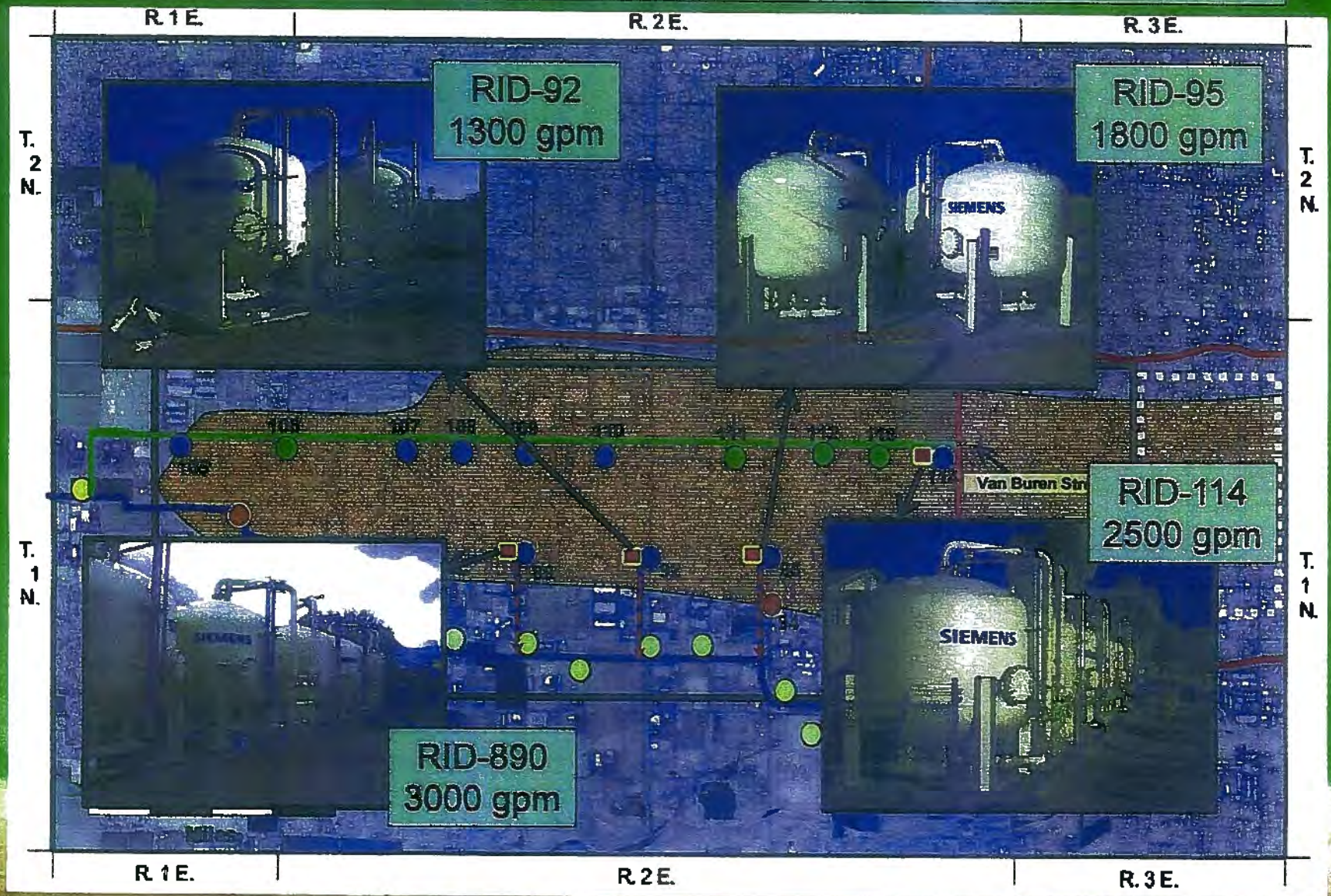
ALL TREATMENT SYSTEMS TURNED OFF 10/31/2012 AND WILL BE RESTARTED IN THE SPRING WHEN RID WATER DEMAND INCREASES

~ 2 BILLION GALLONS OF CONTAMINATED GROUNDWATER TREATED

APPROXIMATELY 1000 POUNDS OF VOCS CAPTURED / DESTROYED

RID ERA TECHNICAL BRIEFING

12/6/12



Groundwater

SYNERGY ENVIRONMENTAL, LLC

October 7, 2013

Ms. Tina LePage
Manager, Remedial Projects Unit
Arizona Department of Environmental Quality
1011 West Washington Street
Phoenix, AZ 85007

Re: September 2013 Monthly Progress Report – RID Wellhead Treatment Systems

Dear Ms. LePage:

This September 2013 Monthly Progress Report for the RID Wellhead Treatment Systems is provided for your review. This Monthly Progress Report, consistent with Section 8 of the *RID-95 Wellhead Pilot Treatment System Proposal*, dated August 18, 2011, provides information regarding wellhead treatment systems currently operating at RID-89, RID-92, RID-95, and RID-114. This will be the final monthly progress report for 2013. The next report will be completed after wells are restarted by RID in early 2014.

This Monthly Progress Report includes:

- Narrative summary of operational status including malfunctions, if any, and the actions taken to correct the malfunction.
- Operational data including: hours/percentage of operating time during the reporting period, volume of groundwater treated, approximate mass of target contaminants of concern (COCs) removed, and cumulative mass of target COCs removed since system start-up.
- Tabular summary of water quality samples collected and analytical results.
- Copies of final laboratory reports.

Please contact me by phone at 602-430-2785 or by email at andrew.machugh@syn-env.com, should you have any questions or comments regarding this report.

Best Regards,
Synergy Environmental, LLC

Andrew MacHugh, PE

Registered Professional Engineer (Chemical)
CERTIFICATE NO. 44674
ANDREW J. MacHUGH
Date Signed 10-7-13
ARIZONA, U.S.A.
Expires 06/30/2015

cc: Donovan Neese, Roosevelt Irrigation District
David Kimball, Gallagher & Kennedy

SYNERGY ENVIRONMENTAL, LLC

Summary of Operational Status

RID-89 Wellhead Treatment System

The RID-89 Wellhead Treatment System (WTS) did not operate during the reporting period because the well was shut off for the first four days due to a decrease in RID's customer water demand, and after the well was restarted on September 5th, the WTS operated in bypass mode to allow for granular activated carbon (GAC) fill line maintenance. RID shut down the well for the remainder of the pumping season on September 25th. Operational data and estimated mass of target COCs removed since WTS start-up are provided in **Table 1.** No water quality samples were collected during the reporting period.

RID-92 Wellhead Treatment System

The RID-92 WTS only operated in bypass mode during the reporting period to allow for GAC fill line maintenance. RID shut down the well for the remainder of the pumping season on September 25th. Operational data and estimated mass of target COCs removed since WTS start-up are provided in **Table 1.** No water quality samples were collected during the reporting period.

RID-95 Wellhead Treatment System

The RID-95 WTS did not operate during the reporting period because the well was shut off for the first four days due to a decrease in RID's customer water demand, and after the well was restarted on September 5th, the WTS operated in bypass mode to allow for GAC fill line maintenance. RID shut down the well for the remainder of the pumping season on September 24th. Operational data and estimated mass of target COCs removed since WTS start-up are provided in **Table 1.** No water quality samples were collected during the reporting period.

RID-114 Wellhead Treatment System

RID-114 WTS operated approximately 25% of the time during the reporting period. The well was shut off for the first four days due to a decrease in RID's customer water demand, and after the well was restarted on September 5th, the WTS processed flow from the well at an average flow rate of 2,380 gpm. WTS operation changed from treatment to bypass mode on September 14th due to GAC exhaustion. It was decided to delay replacement of the GAC until the beginning of the 2014 pumping season to prevent in-vessel fouling of new GAC during the 4 to 5 month system lay-up. RID shut down the well for the remainder of the pumping season on September 24th. Operational data and estimated mass of target COCs removed for the reporting period and since WTS start-up are provided in **Table 1**. A summary of water quality data is provided in **Table 2**.

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Attachments:

1) Table 1. RID Wellhead Treatment Systems Metrics
2) Table 2. RID-114 Wellhead Treatment System Data Summary
3) Copy of Final Analytical Report

TABLE 1. RID WELLHEAD TREATMENT SYSTEMS METRICS

West Van Buren Area WQARF Registry Site

Reporting Period: **September 2013**

WELLHEAD TREATMENT SYSTEMS DATA						
RID-89	Volume of GW Treated, This Period:	0	acre-feet	Estimated Mass of Target COCs Removed, This Period:	0	pounds
	Volume of GW Treated, Since Start-up[1]:	3,809	acre-feet	Mass of Target COCs Removed, Since Start-up:	406	pounds
	Operational Hours:	0	0%			
RID-92	Volume of GW Treated, This Period:	0	acre-feet	Estimated Mass of Target COCs Removed, This Period:	0	pounds
	Volume of GW Treated, Since Start-up[2]:	1,521	acre-feet	Mass of Target COCs Removed, Since Start-up:	361	pounds
	Operational Hours:	0	0%			
RID-95	Volume of GW Treated, This Period:	0	acre-feet	Estimated Mass of Target COCs Removed, This Period:	0	pounds
	Volume of GW Treated, Since Start-up[3]:	2,825	acre-feet	Mass of Target COCs Removed, Since Start-up:	477	pounds
	Operational Hours:	0	0%			
RID-114	Volume of GW Treated, This Period:	83	acre-feet	Estimated Mass of Target COCs Removed, This Period:	7	pounds
	Volume of GW Treated, Since Start-up[4]:	3,437	acre-feet	Mass of Target COCs Removed, Since Start-up:	419	pounds
	Operational Hours:	189	25%			
TOTALS (all sites):	Volume of GW Treated, This Period:	**83**	acre-feet	Estimated Mass of Target COCs Removed, This Period:	**7**	pounds
	Volume of GW Treated, This Period:	**27**	million gallons	Mass of Target COCs Removed, Since Start-up:	**1,662**	pounds
	Volume of GW Treated, Since Start-Up:	**11,592**	acre-feet			
	Volume of GW Treated, Since Start-Up:	**3,777**	million gallons			

Explanation: [1] May 24, 2012 start-up date.

[2] May 23, 2012 start-up date.

[3] February 6, 2012 start-up date.

[4] May 22, 2012 start-up date.

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TABLE 2. RID-114 WELLHEAD TREATMENT SYSTEM DATA SUMMARY
WEST VAN BUREN AREA WQARF REGISTRY SITE
(results presented in micrograms per liter, µg/L)

SAMPLE LOCATION	SAMPLE ID*	DATE	LEAD VESSEL	SAMPLE TYPE	TARGET COCs					
					TCE	PCE	1,1-DCE	TCM	1,1-DCA	cis-1,2-DCE
EPA MAXIMUM CONTAMINANT LEVELS (MCL), as µg/L					5	5	7	none	none	70
INFLUENT	114-Influent	9/9/13	--	Primary	35.4	2.5	2.1	2.1	1.5	6.0
POINT OF COMPLIANCE	114-POC	9/2/13	--	--	No sample collected; production well was offline.					
	114-POC	9/9/13	--	Primary	5.7	<0.5	2.8	2.1	1.7	7.5
	114-POC	9/16-30/13	--	Primary	Not sampled because system was in bypass mode or offline.					
TREATMENT SKID #1 (NORTH, REACTIVATED CARBON)										
MID-SKID (EFFLUENT OF LEAD VESSEL)	114-MID-1	9/2/13	B	--	No sample collected; production well was offline.					
	114-MID-1	9/9/13	B	Primary	23.3	<0.5	3.2	2.3	1.9	8.2
	114-MID-1	9/16-30/13	B	--	Not sampled because system was in bypass mode or offline.					
TREATMENT SKID #2 (MIDDLE, REACTIVATED CARBON)										
MID-SKID (EFFLUENT OF LEAD VESSEL)	114-MID-2	9/2/13	B	--	No sample collected; treatment system offline.					
	114-MID-2	9/9/13	B	Primary	30.7	<0.5	2.8	2.1	1.6	7.2
	DUP090913	9/9/13	B	Duplicate	31.1	<0.5	2.9	2.2	1.6	7.4
	114-MID-2	9/16-30/13	B	--	Not sampled because system was in bypass mode or offline.					
TREATMENT SKID #3 (SOUTH, REACTIVATED CARBON)										
MID-SKID (EFFLUENT OF LEAD VESSEL)	114-MID-3	9/2/13	B	--	No sample collected; treatment system offline.					
	114-MID-3	9/9/13	B	Primary	27.8	<0.5	3.0	2.2	1.7	7.6
	114-MID-3	9/16-30/13	B	--	Not sampled because system was in bypass mode or offline.					

EXPLANATION:

COC = Contaminant of Concern
TCE = Trichloroethene
PCE = Tetrachloroethene
1,1-DCE = 1,1-Dichloroethene
TCM = Chloroform
1,1-DCA = 1,1-Dichloroethane
cis-1,2-DCE = cis-1,2-Dichloroethene
* All samples analyzed by Airtech Environmental Laboratories following EPA Test Method 8260B.
<0.5 = Result is less than laboratory method reporting limit (MRL).

SYNERGY ENVIRONMENTAL, LLC

SYNERGY ENVIRONMENTAL, LLC

Copies of Final Analytical Reports

Airtech Environmental Laboratories (AEL)

4620 E.Elwood St., Suite 13, Phoenix, AZ 85040 480-968-5888 Fax 480-966-1888

Date: September 13, 2013

Client:	Andrew MacHugh	Work Order #:	13I007
Company:	Synergy Environmental, LLC	Project Name:	RID Pilot Treatment Systems
Address:	10645 N. Tatum Blvd, #200-437	Project Number:	802.40
	Phoenix, AZ 85028	Received Date:	9/9/2013

Dear Client:

Airtech Environmental Laboratories received seven (7) samples for analysis.

All analyses met laboratory QA/QC with any exceptions addressed in the Case Narrative.

If you have any questions or concerns regarding your samples analysis, please contact the laboratory at 480-968-5888

Sincerely,

Yu Min Shi
Technical Director
Airtech Environmental Labs

Arizona ADHS License No. AZ0740

Airtech Environmental Laboratories (AEL)

4620 E.Elwood St., Suite 13, Phoenix, AZ 85040 480-968-5888 Fax 480-966-1888

Date: September 13, 2013

Client:	Andrew MacHugh	Work Order #:	13I007
Company:	Synergy Environmental, LLC	Project Name:	RID Pilot Treatment Systems
Address:	10645 N. Tatum Blvd, #200-437	Project Number:	802.40
	Phoenix, AZ 85028	Received Date:	9/9/2013

SAMPLE SUMMARY

LAB ID	CLIENT ID	METHOD	SAMPLE DATE	SAMPLE TIME
13I007-01	Trip Blank	8260B	8/5/2013	–
13I007-02	114-Influent	8260B	9/9/2013	1158
13I007-03	114-POC	8260B	9/9/2013	1200
13I007-04	114-MID-1	8260B	9/9/2013	1202
13I007-05	114-MID-2	8260B	9/9/2013	1204
13I007-06	114-MID-3	8260B	9/9/2013	1206
13I007-07	DUP090913	8260B	9/9/2013	

ROOSEVELT IRRIGATION DISTRICT

DIRECTORS
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103 WEST BASELINE ROAD
BUCKEYE, ARIZONA 85326
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SUPERINTENDENT
DONOVAN L. NEESE

October 20, 2014

Ms. Tina LePage, Manager
Remedial Projects Unit, Waste Programs Division
Arizona Department of Environmental Quality
1110 West Washington Street
Phoenix, AZ 85007

Re: RESPONSE TO COMMENTS: REVIEW OF OPERATION AND MAINTENANCE PLAN – ROOSEVELT IRRIGATION DISTRICT WELLHEAD TREATMENT SYSTEMS
West Van Buren WQARF Registry Site
Phoenix, Arizona

Dear Ms. LePage:

The Roosevelt Irrigation District (RID) has reviewed comments by the Arizona Department of Environmental Quality (ADEQ) and three (3) individuals/entities (David Iwanski, a WVBA Site CAB member; Ridenour Hienton, PLLC, counsel for Meritor, Inc., and Fennemore Craig, PC, counsel for Nucor Corporation and BNSF Railway Company) on the *Operation & Maintenance Plan, RID Wellhead Treatment Systems* (O&M Plan), dated October 2013 (Revision 3), received on September 5th, 2014. As requested, the following responses to ADEQ comments and the stakeholder comment letters are being submitted within 45 calendar days of the date of ADEQ's letter. Also, with this letter, RID is submitting a revised O&M Plan for ADEQ's review, and if appropriate, approval pursuant to Arizona Administrative Code (A.A.C.) R18-16-411(E)(1) and "certification by the Department that the elements of the operations and maintenance plan adequately protect public health against treatment system failure" in accordance with A.A.C. R18-16-411(E)(1).

RESPONSES TO ADEQ REQUIRED INFORMATION

Comment #1: "In accordance with A.A.C. R18-16-411(E)(4), the O&M Plan shall include 'a process for the treatment system operator to promptly notify potentially affected water providers of a failure of a key treatment system component that could affect the quality of a discharge of treated water.'

While RID has provided a brief notification procedure description in Section 4.1, which includes notification to ADEQ, RID has not included potentially affected water providers such as the City

RID's Response: As requested, Section 4.5.5 of the revised O&M Plan has been updated to include a referral to the notification procedure outlined in Section 4.1.

RID has considered ADEQ's comment regarding automatic operation of the sump pumps. Now that the wellhead treatment systems have been operating for several pumping seasons, RID is comfortable changing the controls system so that the sump pumps operate automatically in response to a high liquid level alarm, and then automatically shut-off the well pump in response to a high-high liquid level critical alarm (in lieu of switching the systems to bypass mode).

The requested pipe route from the secondary containment sump to the discharge point are included in the new piping and instrumentation diagrams (Figures 3 through 6), and detailed in the engineering drawings included in Appendices A through D.

Comment #21: "Section 4.5.6 – SCADA System and Control Strategy, page 19: ADEQ requests that O&M Plan include screen shots from the SCADA system. The information provided in this section does not adequately document the remote system operation. ADEQ recommends that a table outlining the SCADA system alarm parameters be included in this section."

RID's Response: A new appendix (Appendix G) will include screen shots from the SCADA system, however, since the wellhead treatment systems are not operating, the screen shots will need to be included after the treatment systems are restarted to show relevant operational data. Due to RID's historical pumping operations / customer water demand, the treatment systems may not be restarted until March 2015. RID will provide ADEQ with the requested SCADA system screen shots as soon as they are available to include in its copy of the revised O&M Plan.

As requested, a table that outlines the SCADA system alarm parameters has been included in Section 4.5.6 of the revised O&M Plan.

Comment #22: "Section 4.5.9 – Unplanned Shutdowns/System Operation Upset Events: ADEQ advises that a referral to the notification procedure in Section 4.1 be included in this section for when a power outage, heavy rain or critical alarm occurs. ADEQ recommends that a list of the critical alarm conditions be provided in this section."

RID's Response: The requested information has been included in Section 4.5.9 of the revised O&M Plan. However, there is only one critical alarm that will automatically shut off the well pump, which is the high wellhead pressure shut-off condition. These details are included in the revised O&M Plan.

Comment #23: "Section 4.6 – Sampling and Analysis: The Field Sampling Plan and Quality Assurance Plan for the WVBA WQARF site was not developed with the sampling and QA/quality control (QC) procedures for the operations of a groundwater treatment/remedy system. As

changes were already included in the revised O&M Plan. For new comments that were favorably considered, the revised O&M Plan was modified to address those comments.

In response to General Comment #3, there are no permits required to operate the wellhead treatment systems.

In response to Specific Comment #3, spare parts are identified in the engineering drawings now included as Appendices A through D, and the Siemens O&M Manual included as Appendix E of the revised O&M Plan.

Other comments that were considered but not addressed in the revised O&M Plan were not regarded as "technical problems", and therefore, not necessary elements to adequately protect public health against treatment system failure.

Letter #3 - Fennemore Craig, P.C., counsel for Nucor Corporation and BNSF Railway Company, *Comments on the Roosevelt Irrigation District's ("RID") "Operation and Maintenance Plan"*, dated July 21, 2014.

Comment: "It is more logical to consider these four wellhead treatments as four separate treatment facilities requiring four separate O&M Plans."

RID's Response: All wellhead treatment systems pump and treat groundwater from a commingled plume, are operated from one central field office, and are comprised of identical equipment sets, control valves, RTUs, instrumentation, etc. The primary differences include the capacity of the wells feeding the treatment systems and the routing of the treatment system piping, which is not a significant aspect for O&M considerations. RID does not believe these differences merit generating four (4) separate plans, and therefore, only one (1) O&M Plan will be used for the wellhead treatment systems. Similarly, these wellhead treatment systems are part of a single effort to address regional contamination pursuant to the ADEQ-approved Modified ERA, dated February 1, 2013.

We appreciate your prompt review of the attached revised *O&M Plan, RID Wellhead Treatment Systems* (Revision 4), and are available to meet at your convenience regarding any questions you may have.

Best Regards,
Roosevelt Irrigation District

Donovan L. Neese

EXHIBIT "4"

ARCADIS U.S., Inc.
410 North 44th Street
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Phoenix
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Tel 602 438 0883
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MEMO

To:
Jerry D. Worsham II, Esq.
Ridenour Hienton, P.L.L.C.
Chase Tower
201 North Central Ave, Suite 3300,
Phoenix, Arizona 85004

Copies:
Robert A. Mongrain, RG (ARCADIS)
ARCADIS Project File

From:
Quentin R. Moore, P.E. (ARCADIS)

Date:
October 31, 2014

ARCADIS Project No.:
AZ001042.0005

Subject:
RID Phase 1 Wellhead Treatment System Annual VOC Mass Removal Evaluation

---

ARCADIS has prepared this technical memorandum in response to your request to evaluate the validity of the Roosevelt Irrigation District (RID) anticipated total annual volatile organic compound (VOC) mass removal of up to **1,900 pounds** through the operation of the **Modified Early Response Action (MERA) Phase 1 wellhead treatment systems**. The locations and general construction of the MERA Phase 1 wellhead treatment systems are detailed in the Modified Early Response Action Work Plan (MERA Work Plan) for the West Van Buren Area (WVBA) Water Quality Assurance Revolving Fund (WQARF) Site, prepared by Synergy Environmental, LLC on behalf of the RID (Synergy Environmental, LLC, 2012). The locations of the wells are shown on Figure 1. The Phase 1 wellhead treatment systems consist of groundwater extraction and wellhead treatment using liquid-phase granulated activated carbon (LGAC) at four RID production wells, including RID-89, RID-92, RID-95 and RID-114. (Figures 2-1 through 2-4 identifies RID's Process Flow Diagram and treatment system for each Phase 1 well.) Groundwater extraction and treatment operations were initiated at RID production well RID-95 in February 2012, and at all other production wells in May 2012. The plan to utilize four additional groundwater extraction wells in Phase 2 of the MERA apparently has been abandoned.

Originally, the RID asserted to the Arizona Department of Environmental Quality (ADEQ) in the MERA Proposal (July 12, 2012) that the MERA would, "...remediate approximately **3,500 pounds** per year of VOC contamination in the regional groundwater..." (MERA Proposal Executive Summary p. iii and p.7, Synergy Environmental, LLC, 2012a) In the MERA Workplan (October 2012), RID changed their position and asserted that the MERA wells would remediate up to **2,300 pounds per year** (MERA Work Plan

Executive Summary p. ii). "Based on current VOC concentrations in the Phase 1 RID wells, the estimated total annual VOC mass removal during Phase 1 would be up to **approximately 1,900 pounds** ....Based on current VOC concentrations in the Phase 2 wells, the estimated total annual contaminant VOC mass removal following implementation of Phase 2 would be **approximately 440 pounds**." (MERA Work Plan p. 28, 29 and Table 2, Synergy Environmental, LLC 2012b) (Attachment 1).

The purpose of this technical memorandum is to verify the RID's estimate to ADEQ of 1,900 pounds per year for the total annual VOC mass removal by the MERA Phase 1 wellhead treatment systems. In support of this estimate, ARCADIS reviewed ADEQ's website[1] and available operational data documented in Monthly Progress Reports obtained from the West Valley Groundwater Cleanup Coalition[2] website, and estimated individual production well pumping rates and total VOC concentrations (Montgomery & Associates, 2009; HDR Engineering, Inc. 2010).

Report Summary

According to the Phase 1 wellhead treatment system Monthly Progress Reports, in 2012, 2013 and 2014, the Phase 1 wellhead treatment systems actually removed only 895 pounds, 767 pounds and 89 pounds of VOCs, respectively. This is well below the RID's annual projections of 1,900 pounds. If all Phase 1 wellhead treatment systems operated continuously, without downtime, at sustained maximum observed VOC concentrations and at a removal efficiency of 100 percent, the Phase 1 wellhead treatment systems could remove up to 2,182 pounds per year of target VOCs annually. However, given that the RID historically decreases production during the late fall and winter months [November – March] when the irrigation demand is low and the mass removal efficiency is not likely to exceed 95 percent, the most-likely maximum annual VOC removal rate is **1,446** pounds per year. Therefore, it is apparent that the RID's projected total annual target VOC mass removal of 1,900 pounds per year is a significant over estimate. The most-likely maximum annual VOC removal rate is approximately 25 percent less than the RID's anticipated removal rate (1,446/1,900 lbs/year x100%). Additionally, it should be noted that during late 2013 and for nearly all of 2014 (where RID reports are available to describe operations), the RID Phase 1 MERA wells have been operated in bypass mode, such that groundwater bypassed the treatment systems and was delivered to their canal/conveyance system untreated.

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[1] http://www.azdeq.gov/environ/waste/sps/wub.html

[2] http://www.wvgroundwater.org/project-documents

Background Facts

The WVBA WQARF Site is located in West Phoenix. The Site extends from 7th Avenue to 75th Avenue and from Buckeye Road to Interstate-10. The groundwater in the WVBA Site is impacted primarily by VOCs as a result of several historical releases as well as impacted groundwater migrating from the upgradient Motorola 52nd Street Superfund Site. The primary VOC constituents of concern (COCs) detected at concentrations exceeding the respective Arizona Aquifer Water Quality Standard (AWQS) and United States Environmental Protection Agency (USEPA) Maximum Contaminant Level (MCL) within the WVBA Site include:

Table 1: WVBA Site VOCs and Associated MCLs

VOC	MCL (µg/L)
1,1-dichloroethane (1,1-DCA)	N/A
1,1-dichloroethene (1,1-DCE)*	7
cis 1,2-dichloroethene (cis, 1,2 DCE)	70
tetrachloroethene (PCE)*	5
1,1,1-trichlorethane (TCA)*	200
trichloroethene (TCE)	5
vinyl chloride (VC)	2
chloroform	80**
Benzene, toluene, ethylbenzene, xylenes (collectively, BTEX)	5; 1,000; 700; 10,000

µg/L: micrograms per liter

N/A: None Assigned

*Target VOC

**Based on the USEPA Maximum Contaminant Level Goal.

The RID operates 32 water supply wells within the WVBA Site currently for irrigation purposes. Twenty-three of these wells are located within the extent of WVBA groundwater impacts. The RID wells located within the WVBA Site are variably screened across the Upper Alluvial Unit (UAU), Middle Alluvial Unit (MAU) and Lower Alluvial Unit (LAU) of the West Salt River Valley (SRV) alluvial basin. The RID extracts approximately 75,000 acre-feet per year (ac-ft/yr) of groundwater on average from wells located within the WVBA Site; however the capacity of the RID well network within the WVBA Site exceeds 110,000 ac-ft/yr. The majority of this groundwater extraction is derived from the UAU and occurs during the peak irrigation demand season that begins in early March and extends through the end of September. The RID has

elected to pursue a voluntary early response action (ERA) (Montgomery & Associates, 2010) which has been significantly modified and is commonly referred to as the MERA. Details of the MERA are found in the MERA Proposal (July 2012) and the MERA Work Plan (October 2012).

RID Wellhead Treatment Systems

The MERA Work Plan outlines the RID's intent to install wellhead treatment systems at eight of RID's production well locations. Currently, the RID has installed wellhead treatment systems at only four locations (Phase 1), including production wells RID-89, RID-92, RID-95 and RID-114. Phase 2 of the MERA consists of installing wellhead treatment at the remaining four locations: RID-100, RID-106, RID-112 and RID-113. According to the RID's proposed Draft Feasibility Study (July 2014), the concept of implementing the Phase 2 wellhead treatment systems has been abandoned in the MERA and will instead be evaluated as part of the Arizona Department of Environmental Quality's (ADEQ's) review of the merits of the Draft Feasibility Study (see pgs 131, 138 [Synergy Environmental, LLC and Montgomery & Associates, 2014])[3].

The Phase 1 wellhead treatment systems consist of Siemens HP1220 treatment skids, which include two 20,000 pound LGAC vessels per skid connected in series. Each treatment skid is capable of treating up to 1,100 gallons per minute (gpm). Several treatment skids are operated in parallel for those wellhead treatment systems requiring greater than 1,100 gpm treatment capacity. Table 2 below provides basic information for each Phase 1 wellhead treatment system. Several sources of information provide estimated treatment system flow rates (Table 2). The flow rates reported in the MERA Work Plan are obtained from actual 2012, 2013 and 2014 data. The flow rates reported by Montgomery & Associates (Groundwater Response Action Implementation Plan [Montgomery & Associates, 2009]) and HDR Engineering LLC (Early Response Action Conceptual Design Summary [HDR Engineering Inc., 2010]) were estimated before head loss associated with the treatment system components and piping was well understood. Figure 1 provides the location of each Phase 1 RID well and associated treatment system.

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[3] "RID-100, RID-106, RID-109 and RID-112: Wellhead treatment at these four (4) impacted water supply wells was authorized by ADEQ in the Modified ERA Work Plan. The wellhead treatment systems were to be installed in Phase 2 of the Modified ERA Work Plan, but now have been incorporated into the FS." (Synergy Environmental, LLC, 2014 p. 131)

Table 2: Phase 1 Wellhead Treatment System – Basic Information

Wellhead Treatment System	Location	Flow Rate (gpm)			Number of Skids (Vessels)
		MERA[1]	GWRA IP[2]	ERA CDS[3]	
RID-89	51st Ave. and Hadley St.	3,100	2,900	3,900	3 (6)
RID-92	43rd Ave. and Hadley St.	1,300	1,200	1,200	1 (2)
RID-95	35th Ave. and Sherman St.	1,700	1,700	2,300	2 (4)
RID-114	23rd Ave. and Van Buren St.	2,500	2,500	2,500	3 (6)

gpm: gallons per minute

[1] Modified Early Response Action (Synergy Environmental LLC, 2012)

[2] Roosevelt Irrigation District Groundwater Response Action Implementation Plan (Montgomery & Associates, 2009)

[3] Roosevelt Irrigation District Early Response Action Conceptual Design Summary (HDR Engineering, Inc., 2010)

Implementation of the MERA Work Plan is based on the treatment of select target VOCs. The target VOCs include: TCE, PCE and 1,1-DCE. Based on the target VOC concentrations observed at each Phase 1 production well in September 2012, the RID estimated a total annual target VOC mass removal of approximately 1,900 pounds. (See Attachment 1 RID's "MERA Work Plan", Pgs. 28-30, Table 2 [October 2012]).

Phase 1 Wellhead Treatment System Mass Removal Verification

ARCADIS reviewed available Phase 1 operational data documented in Monthly Progress Reports obtained from the West Valley Groundwater Cleanup Coalition website (Synergy Environmental, LLC, 2012c-j, 2013a-g and 2014a-e). The Phase 1 operational data obtained from the Monthly Progress Reports is summarized in Attachment 2, Table 2-1. According to the Monthly Progress Reports, the actual annual mass removal of target VOCs (TCE, PCE and 1,1-DCE) was 895 pounds, 767 pounds and 89 pounds in 2012, 2013 and 2014 respectively (Table 3).

Table 3: Phase 1 Wellhead Treatment System 2012, 2013 and 2014 VOC Mass Removal (Actuals)

Year	Pounds of Target VOCs
2012	895
2013	768
2014	89
Total	**1,751**

ARCADIS evaluated the Monthly Progress Report data to confirm the accuracy of the reported monthly and cumulative mass of target VOCs removed. Monthly Progress Reports are available for the months of February thru August and October of 2012, March thru September of 2013, and May thru September of 2014. ARCADIS confirmed the accuracy of the monthly VOC mass removed reported in each Monthly Progress Report, with the exception of the mass removed at the RID-92 wellhead treatment system for the August 2012 reporting period. According to the August 2012 Monthly Progress Report, no water samples were collected from the RID-92 wellhead treatment system influent or effluent (point of compliance) during the reporting period, because the treatment system was offline for the majority of the period (to accommodate well investigation activities) and when online, the treatment system was operated in bypass mode. However, the target VOC mass removed by the RID-92 wellhead treatment system for the month of August 2012 is reported as 7 pounds. The basis for this VOC mass is unclear considering no influent and effluent samples were collected and the system, when online, operated only in bypass mode. It appears that the previous month's (July 2012) target VOC concentration data was assumed as a reasonable estimate for the purposes of estimating the August 2012 VOC mass removed.

ARCADIS also confirmed the accuracy of the cumulative mass removed in 2012, 2013 and 2014, assuming:

- 134 pounds of target VOCs were removed during the month of September 2012 (this Monthly Progress Report is not available). This is based on the difference between the cumulative mass removed between the August 2012 and October 2012 reporting periods.
- Operations were suspended at all wellhead treatment systems for the months of November 2012 thru February 2013 and October 2013 thru April 2014 (Monthly Progress Reports for these months are also unavailable). This is a reasonable assumption considering 1) the reported cumulative target VOC mass removed through March 2013 is consistent with no treatment operations between November 2012 and February 2013; 2) the cumulative mass removed through May 2014 is consistent with no treatment operations between October 2013 and May

2014; and 3) that the irrigation demand season typically begins in early March and extends through the end of September.

- Use of the treatment systems was suspended in May 2014 and the wells were operated in bypass mode through the majority of the 2014 pumping season. The Phase 1 treatment systems will not likely be restarted until March 2015 (Roosevelt Irrigation District, 2014).

ARCADIS' verified the mass of each target VOC removed (TCE, PCE and 1,1-DCE), total target VOC mass removed (sum of the TCE, PCE and 1,1-DCE mass removed), and cumulative target VOC mass removed. The results of these calculates are provided in Attachment 2, Table 2-1 under the columns titled "MASS REMOVED – VERIFICATION". The difference, expressed as a percentage, between the reported VOC mass removed and ARCADIS' calculations is provided in the final column of Table 2-1. The net percent difference for 2012 and 2013 is less than 0.50 percent, which could be entirely attributed to rounding; therefore ARCADIS has determined that the actual quantity of target VOC mass removed reported by the RID is accurate.

Phase 1 Wellhead Treatment System Potential Maximum VOC Mass Removal

Table 4 below summarizes the potential maximum annual target VOC mass removal for the Phase 1 wellhead treatment systems. The maximum potential mass removal is based on each wellhead treatment system operating at:

- maximum flow rate, continuously 365 days per year;
- sustained target VOC concentrations, represented by the maximum of each target VOC exceeding the respective USEPA MCL observed at each respective location between 2012 and 2014; and
- 100 percent mass removal efficiency (VOCs are reduced to concentrations below the detection limit).

This annual target VOC mass removal represents the "best-case" scenario. The maximum flow rate for each wellhead treatment system is taken as the lesser of the actual maximum flow rate observed between 2012 and 2013, or the wellhead treatment system capacity (based on 1,100 gpm per treatment skid). The reported maximum flow rate is not a representative flow rate because these flow rates were estimated before head loss associated with the treatment system components and piping was well understood. The USEPA MCL is 5 µg/L for TCE and PCE and 7 µg/L for 1,1-DCE.

Table 4: Potential Maximum Annual Target VOC Mass Removal.

Wellhead Treatment System	Flow Rate (gpm)			VOC Concentration (µg/L)			VOC Mass Removal (pounds)
	Actual Maximum	Treatment System Capacity	Reported Maximum	TCE	PCE	1,1-DCE	
RID-89	3,129	3,300	3,900 [3]	32	9.7	2.6	572
RID-92	1,327	1,100	1,300 [1]	77	14	5.1	442
RID-95	1,874	2,400	2,300 [3]	65	4.4	8.2	601
RID-114	2,634	3,300	2,500 [1,2,3]	49	3.9	3.5	566
						Total	**2,182**

gpm: gallons per minute

µg/L: micrograms per liter

[1] Modified Early Response Action (Synergy Environmental LLC, 2012)

[2] Roosevelt Irrigation District Groundwater Response Action Implementation Plan (Montgomery & Associates, 2009)

[3] Roosevelt Irrigation District Early Response Action Conceptual Design Summary (HDR Engineering, Inc., 2010)

Table 5 below presents a more realistic, yet still conservative scenario, which accounts for the decrease in irrigation water demand during the late fall to early winter. Similar to the "best-case" scenario (Table 4), the most-likely annual mass removal is based on each wellhead treatment system operating at:

- maximum flow rate; and
- sustained target VOC concentrations, represented by the maximum of each target VOC exceeding the respective USEPA MCL observed at each respective location between 2012 and 2014.

However, the flow rate is not assumed to be continuous. Rather, the wellhead treatment systems are assumed to be inactive for the months of January, February, November and December. In addition, the actual average mass removal efficiency of the Phase 1 wellhead treatment systems from 2012 to 2014 was 93 percent. The mass removal efficiency is better represented by 95 percent, which is more realistic than a mass removal efficiency of 100 percent.

Table 5: Most-Likely Maximum Annual VOC Mass Removal.

Wellhead Treatment System	Flow Rate (gpm)			VOC Concentration (µg/L)			VOC Mass Removal (pounds)
	Actual Maximum	Treatment System Capacity	Reported Maximum	TCE	PCE	1,1-DCE	
RID-89	3,129	3,300	3,900 [3]	32	9.7	2.6	384
RID-92	1,327	1,100	1,300 [1]	77	14	5.1	358
RID-95	1,874	2,400	2,300 [3]	65	4.4	8.2	404
RID-114	2,634	3,300	2,500 [1,2,3]	49	3.9	3.5	380
						Total	**1,446**

gpm: gallons per minute

µg/L: micrograms per liter

[1] Modified Early Response Action (Synergy Environmental LLC, 2012)

[2] Roosevelt Irrigation District Groundwater Response Action Implementation Plan (Montgomery & Associates, 2009)

[3] Roosevelt Irrigation District Early Response Action Conceptual Design Summary (HDR Engineering, Inc., 2010)

Conclusions

The RID reported in the MERA Work Plan an anticipated total annual target VOC mass removal of up to 1,900 pounds per year through the operation of the Phase 1 wellhead treatment systems. It is now apparent that the four Phase 2 wells will not receive wellhead treatment systems. In 2012 and 2013, the Phase 1 wellhead treatment systems removed **895 pounds** and **767 pounds**, respectively (Table 3). In 2014, because the wells were generally operated in temporary shutdown or bypass mode, the Phase 1 wellhead treatment systems removed a total of **89 pounds** (Table 3). If all Phase 1 wellhead treatment systems operated continuously, without downtime, at sustained maximum observed VOC concentrations and at a removal efficiency of 100 percent, the Phase 1 wellhead treatment systems could remove up to 2,182 pounds per year of target VOCs annually (Table 4). However, given that the RID must decrease production during the late fall and winter months when the irrigation demand is low and the mass removal efficiency is not likely to exceed 95 percent, the most-likely maximum annual VOC removal rate is **1,446 pounds** per year. Therefore, it is apparent that the anticipated total annual target VOC mass removal of 1,900 pounds is a significant over estimate. RID's Phase 1 wellhead treatment systems will remove only 76 percent of the projected VOC removal rate on an annual basis. Additionally, as the wells have been operated in temporary shutdown or bypass mode during late 2013 and nearly all of 2014 (where reports were available) minimal treatment for VOCs have occurred under the MERA Phase 1. In all, the treatment systems have been operational for approximately 16 months since 2012, and either offline or operated in bypass mode the remaining 17 months to date.

References

HDR Engineering, Inc., 2010. RID Groundwater Remediation Early Response Action Conceptual Design Summary Technical Memo. Prepared for Montgomery and Associates, Inc. February 2.

Montgomery and Associates, 2009. Draft Roosevelt Irrigation District Groundwater Response Action Implementation Plan, West Van Buren Water Quality Assurance Revolving Fund Site. September 25.

Montgomery and Associates, 2010. Roosevelt Irrigation District Groundwater Response Action Implementation Plan, West Van Buren Water Quality Assurance Revolving Fund Site. February 3.

Roosevelt Irrigation District, 2014. Response to Comments: Review of Operation and Maintenance Plan – Roosevelt Irrigation District Wellhead Treatment Systems, West Van Buren WQARF Registry Site, Phoenix, Arizona. October 20.

Synergy Environmental, LLC, 2012a. Modified Early Response Action Proposal, for the West Van Buren Water Quality Assurance Revolving Fund Site, Phoenix, Arizona. Submitted to the Arizona Department of Environmental Quality on behalf of Roosevelt Irrigation District. July 17.

Synergy Environmental, LLC, 2012b. Modified Early Response Action Work Plan, West Van Buren WQARF Registry Site, Phoenix, Arizona. Prepared for Arizona Department of Environmental Quality on behalf of Roosevelt Irrigation District. October.

Synergy Environmental, LLC, 2012c. February 2012 Monthly Progress Report – RID-95 Wellhead Pilot Treatment Systems. March 19.

Synergy Environmental, LLC, 2012d. March 2012 Monthly Progress Report – RID-95 Wellhead Pilot Treatment Systems. April 10.

Synergy Environmental, LLC, 2012e. April 2012 Monthly Progress Report – RID-95 Wellhead Pilot Treatment Systems. May 14.

Synergy Environmental, LLC, 2012f. May 2012 Monthly Progress Report – RID-95 Wellhead Pilot Treatment Systems. June 14.

Synergy Environmental, LLC, 2012g. June 2012 Monthly Progress Report – RID-95 Wellhead Pilot Treatment Systems. July 14.

Synergy Environmental, LLC, 2012h. July 2012 Monthly Progress Report – RID-95 Wellhead Pilot Treatment Systems. August 14.

Synergy Environmental, LLC, 2012i. August 2012 Monthly Progress Report – RID-95 Wellhead Pilot Treatment Systems. May 14.

Synergy Environmental, LLC, 2012j. October 2012 Monthly Progress Report – RID-95 Wellhead Pilot Treatment Systems. November 13.

Synergy Environmental, LLC, 2013a. March 2013 Monthly Progress Report – RID Wellhead Treatment Systems. April 15.

Synergy Environmental, LLC, 2013b. April 2013 Monthly Progress Report – RID Wellhead Treatment Systems. May 8.

Synergy Environmental, LLC, 2013c. May 2013 Monthly Progress Report – RID Wellhead Treatment Systems. June 12.

Synergy Environmental, LLC, 2013d. June 2013 Monthly Progress Report – RID Wellhead Treatment Systems. July 11.

Synergy Environmental, LLC, 2013e. July 2013 Monthly Progress Report – RID Wellhead Treatment Systems. August 12.

Synergy Environmental, LLC, 2013f. August 2013 Monthly Progress Report – RID Wellhead Treatment Systems. September 12.

Synergy Environmental, LLC, 2013g. September 2013 Monthly Progress Report – RID Wellhead Treatment Systems. October 7.

Synergy Environmental, LLC, 2014a. May 2014 Monthly Progress Report – RID Wellhead Treatment Systems. June 17.

Synergy Environmental, LLC, 2014b. June 2014 Monthly Progress Report – RID Wellhead Treatment Systems. July 18

Synergy Environmental, LLC, 2014c. July 2014 Monthly Progress Report – RID Wellhead Treatment Systems. August 11.

Synergy Environmental, LLC, 2014d. August 2014 Monthly Progress Report – RID Wellhead Treatment Systems. September 15.

Synergy Environmental, LLC, 2014e. September 2014 Monthly Progress Report – RID Wellhead Treatment Systems. October 15.

Synergy Environmental, LLC, and Montgomery & Associates 2014. Draft Feasibility Study Report, West Van Buren WQARF Site, Phoenix, Arizona. Prepared for Arizona Department of Environmental Quality on behalf of Roosevelt Irrigation District. July 11.

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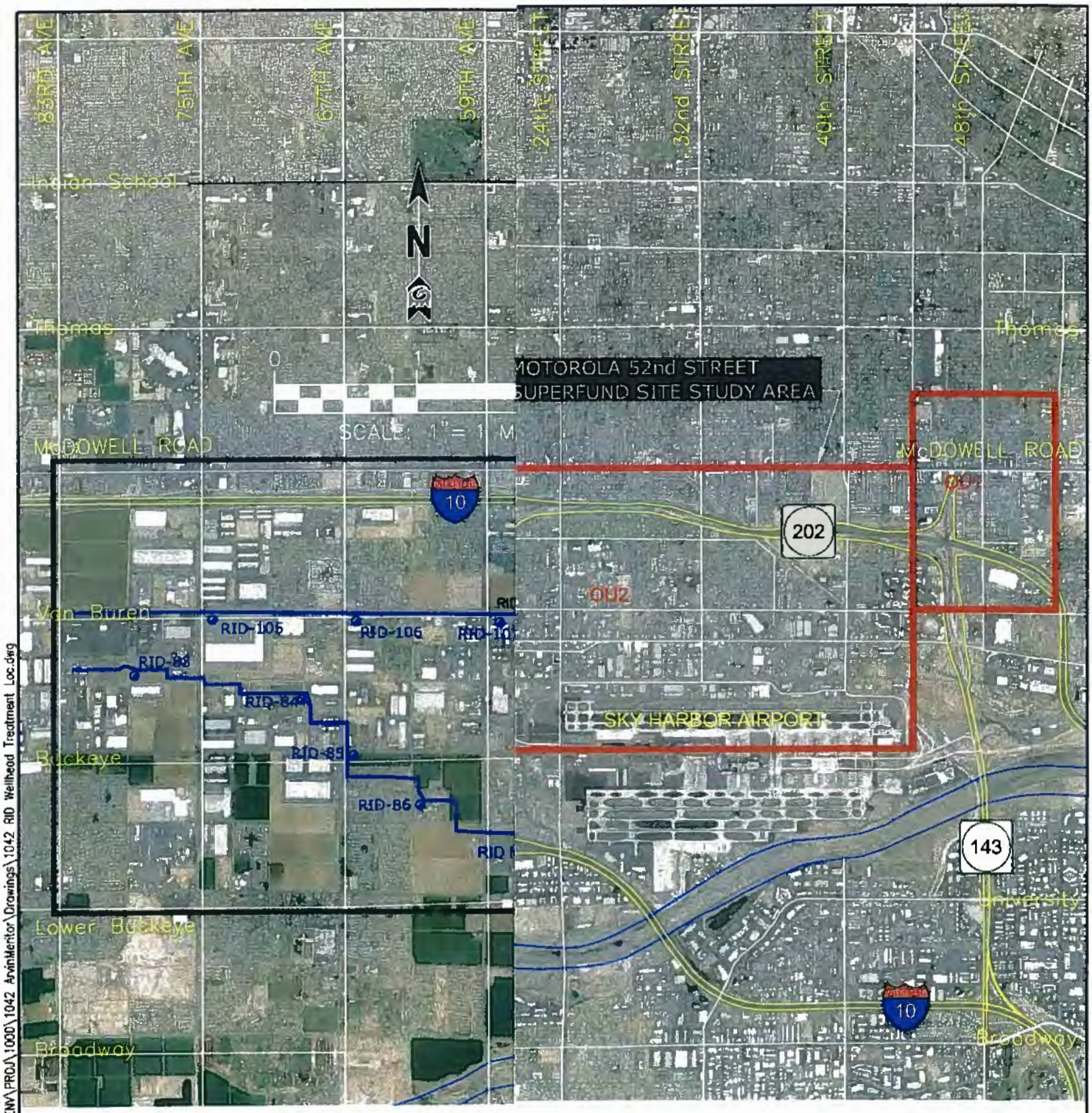
Figures



S:
RABLE UNIT
SEVELT IRRIGATION DISTRICT
ER QUALITY ASSURANCE REVOLVING FUND
T VAN BUREN AREA
IFIED EARLY RESPONSE ACTION

Date\Time : Wed, 03 Sep 2014 - 6:19am
Path\Name : G:\ENV\ENV\PROJ\1000\1042 ArvinMeritor\Drawings\1042 RID Wellhead Treatment Loc.dwg

Acad Version : R18.1s (LMS Tech)
User Name : RKosciolek

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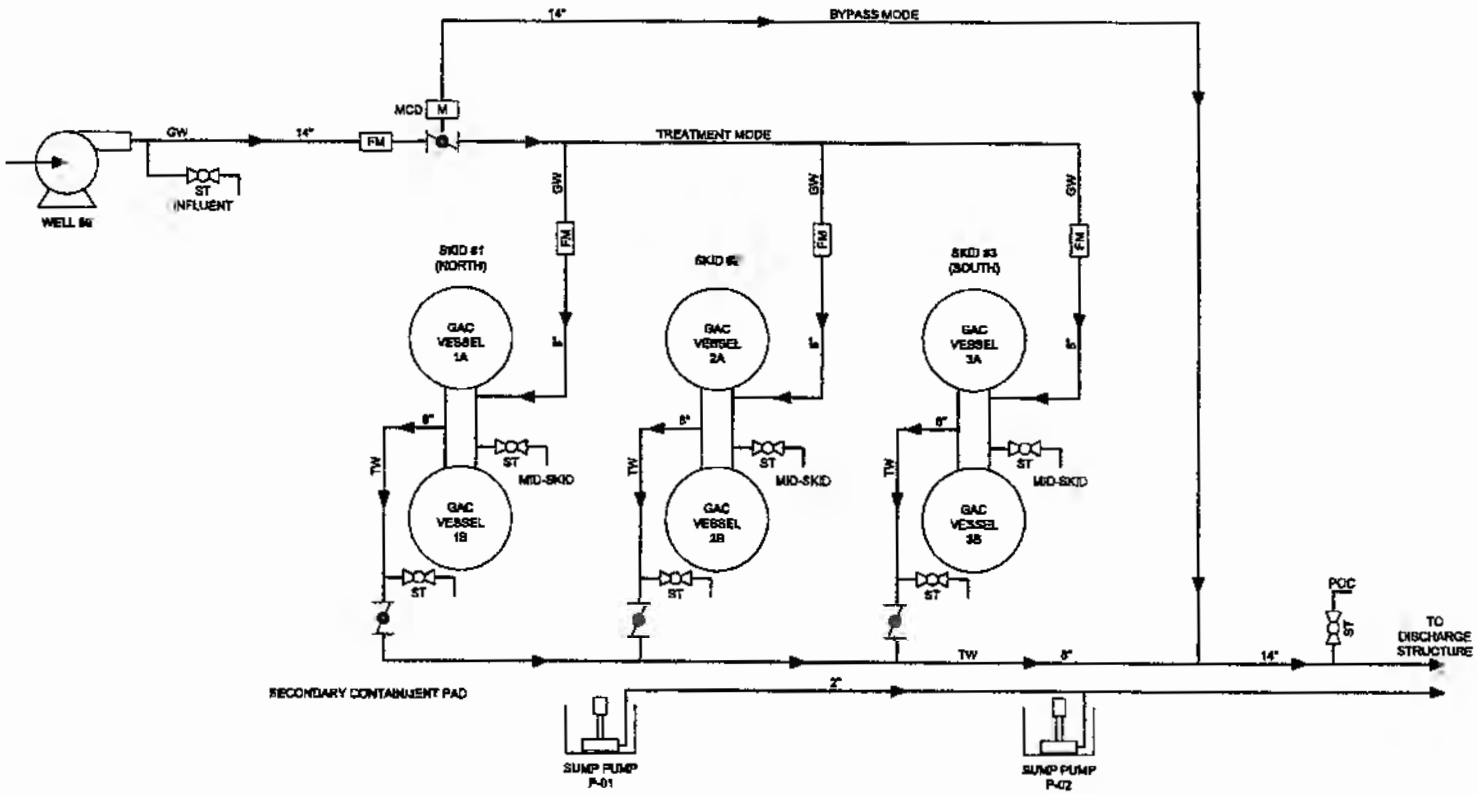
PROJECT MANAGER	DEPARTMENT MANAGER	DESIGNER	CHECKED
Q. MOORE	R. MONGRAIN	R. KOSCIOLEK	Q. MOORE
SHEET TITLE		PHASE/TASK NUMBER .0005.000PM	DRAWN BY R. KOSCIOLEK
		PROJECT NUMBER AZ001042	DRAWING NUMBER 1



LEGEND:

	CENTRIFUGAL PUMP		MANUAL VALVE
FM	FLOW METER	ST	SAMPLE TAP
M	MOTOR-OPERATED VALVE, MODULATING	GW	GROUNDWATER
		TW	TREATED WATER
		POC	POINT OF COMPLIANCE

ADAPTED FROM SYNERGY ENVIRONMENTAL, LLC FIGURE 2, DATED 10/03/13

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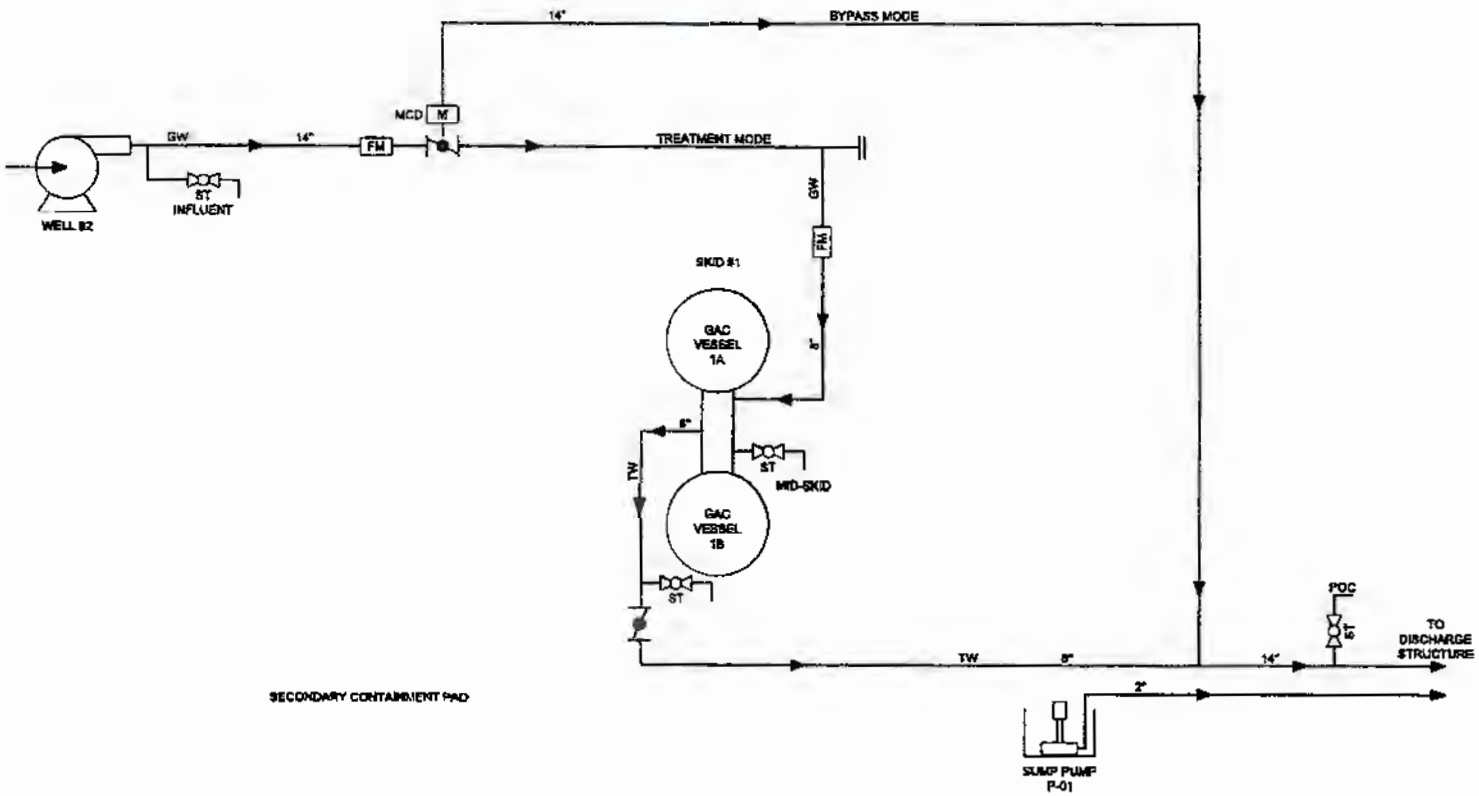
PROCESS FLOW DIAGRAM
RID-89 WELL HEAD TREATMENT SYSTEM
500 South 15th Street Facility
Phoenix, Arizona

FIGURE
2-1



LEGEND:

	CENTRIFUGAL PUMP		MANUAL VALVE
FM	FLOW METER	ST	SAMPLE TAP
M	MOTOR-OPERATED VALVE, MODULATING	GW	GROUNDWATER
		TW	TREATED WATER
	BLIND FLANGE FOR FUTURE CONNECTION	POC	POINT OF COMPLIANCE

ADAPTED FROM SYNERGY ENVIRONMENTAL, LLC FIGURE 3, DATED 10/03/13

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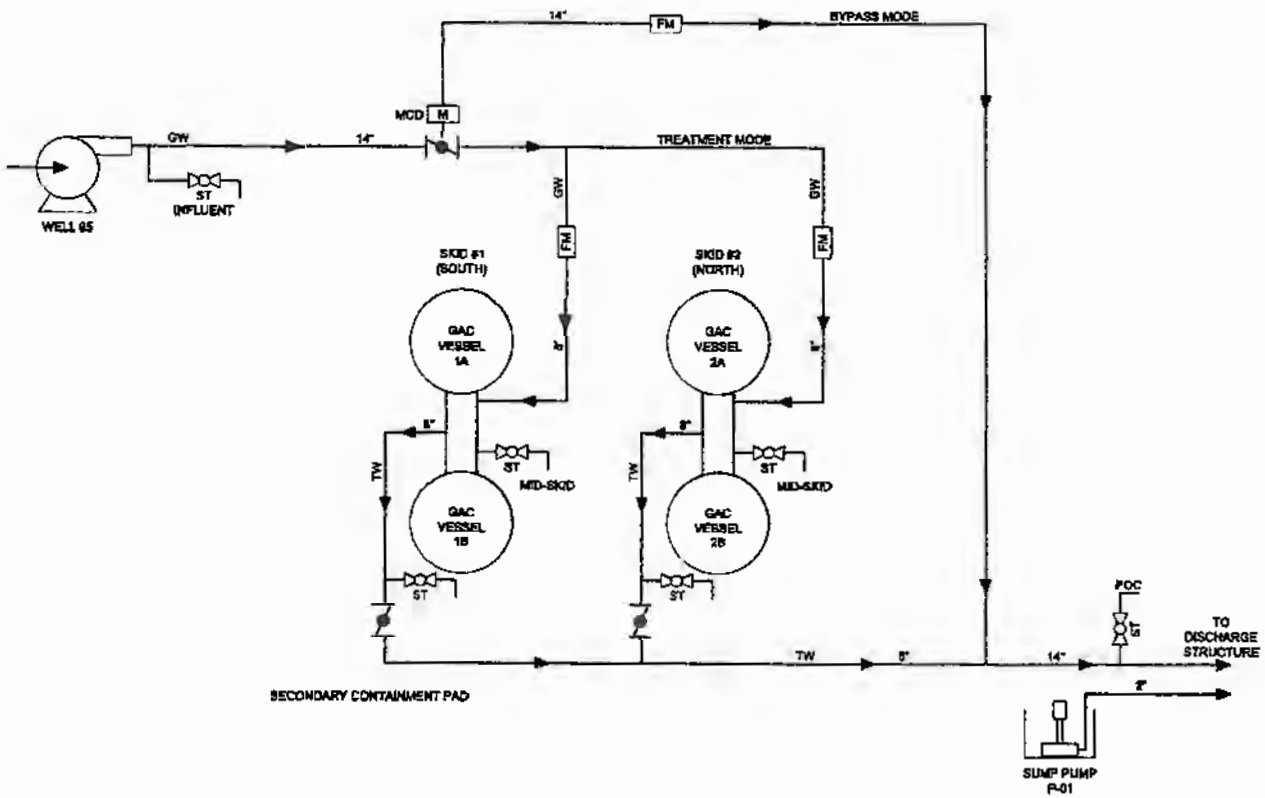
PROCESS FLOW DIAGRAM
RID-92 WELL HEAD TREATMENT SYSTEM
500 South 15th Street Facility
Phoenix, Arizona

FIGURE
2-2



LEGEND:

	CENTRIFUGAL PUMP		MANUAL VALVE
FM	FLOW METER	ST	SAMPLE TAP
M	MOTOR-OPERATED VALVE, MODULATING	GW	GROUNDWATER
		TW	TREATED WATER
		POC	POINT OF COMPLIANCE

ADAPTED FROM SYNERGY ENVIRONMENTAL, LLC FIGURE 4, DATED 10/03/13

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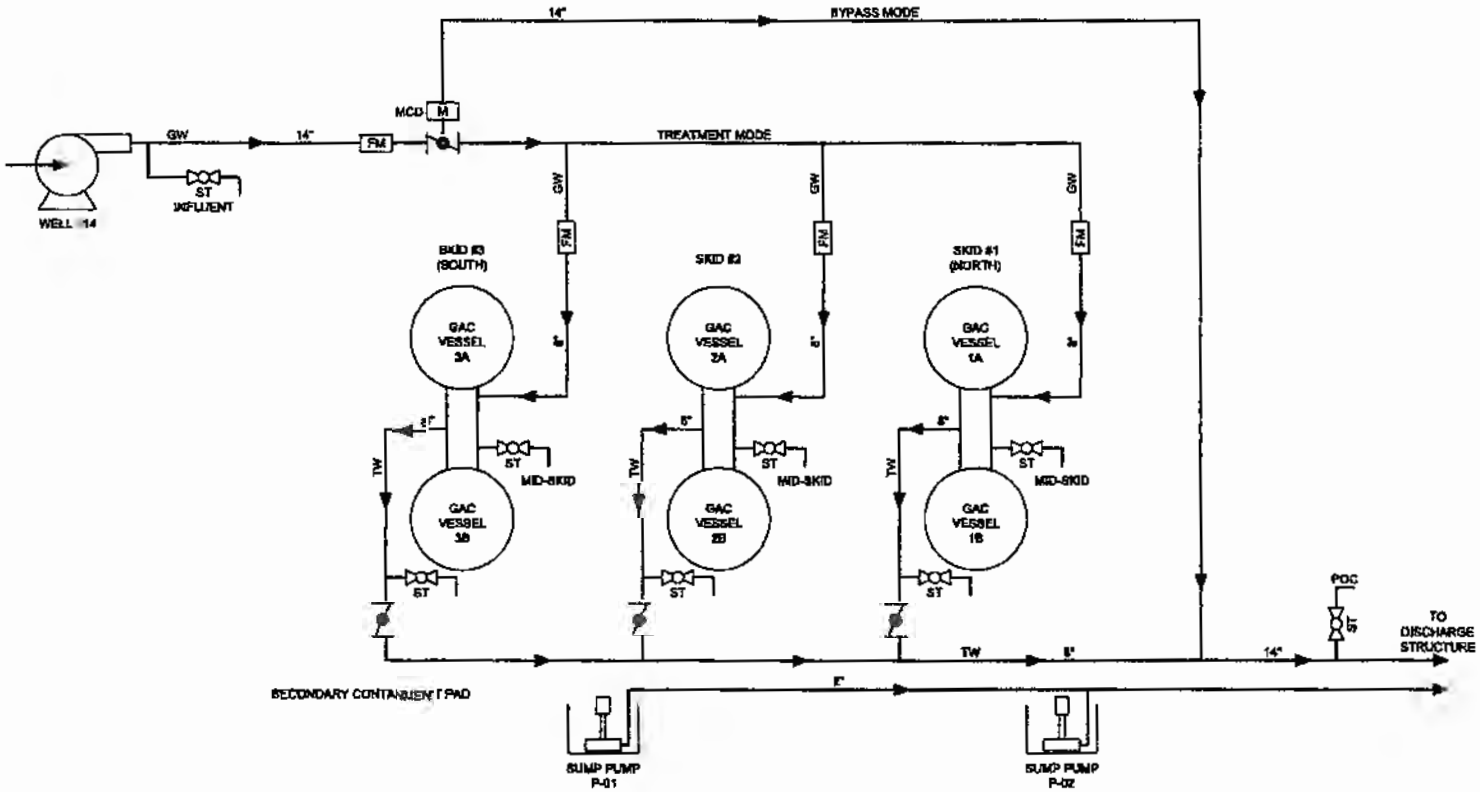
PROCESS FLOW DIAGRAM
RID-95 WELL HEAD TREATMENT SYSTEM
500 South 15th Street Facility
Phoenix, Arizona

FIGURE
2-3



LEGEND:

	CENTRIFUGAL PUMP		MANUAL VALVE
FM	FLOW METER	ST	SAMPLE TAP
M	MOTOR-OPERATED VALVE, MODULATING	GW	GROUNDWATER
		TW	TREATED WATER
		POC	POINT OF COMPLIANCE

ADAPTED FROM SYNERGY ENVIRONMENTAL, LLC FIGURE 5, DATED 10/03/13

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PROCESS FLOW DIAGRAM
RID-114 WELL HEAD TREATMENT SYSTEM
500 South 15th Street Facility
Phoenix, Arizona

FIGURE
2-4

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Attachment 1

MODIFIED EARLY RESPONSE ACTION WORK PLAN

RECEIVED
OCT 22 2012
ADEQ

OCTOBER 2012

WEST VAN BUREN WQARF REGISTRY SITE
PHOENIX, ARIZONA

Prepared by: **Synergy Environmental, LLC**

On Behalf of: **Roosevelt Irrigation District**

Prepared for: **Arizona Department of Environmental Quality**

SYNERGY ENVIRONMENTAL, LLC

Registered Professional Engineer (Environmental)
CERTIFICATE NO.
31739
JOEL D.
PETERSON
Date Signed 10/19/12
ARIZONA, U.S.A.
Expires 09/30/2013

already present at concentrations below MCLs, to pass through the LGAC vessels will result in a significant reduction in O&M costs while achieving MCLs for all VOCs. This approach will enable much longer LGAC bed life compared to GAC replacement at the first detection of these deminimis VOCs in the treatment system effluent.

Table 2 has been revised to include mass removal estimates that include only target VOCs. The VOC concentrations in Table 2 have also been updated to include the latest ADEQ sampling results and the reduced flow rates due to treatment system head losses.

The Modified ERA Work Plan will be implemented in a two-phase approach as described in the following sections.

4.3.1 Phase 1

Phase 1 of the Modified ERA Work Plan consists of installation and operation of the four wellhead treatment systems included in the RID-95 Wellhead Pilot Treatment System Proposal (Synergy, 2011c). These four wells are among the most highly contaminated wells, and treatment of these wells has resulted in restoring the quality of the water supply from these wells to concentrations protective of all RID current and reasonably foreseeable end uses. One of these wells, RID-114, is located at the eastern end of the Salt Canal at 23rd Avenue and West Van Buren Street (Figure 14). The remaining three wells, the "southern-tier wells" (RID-89, RID-92 and RID-95), are all located approximately ¾ mile south of the Salt Canal that runs parallel to West Van Buren Street along the southern alignment. RID-89, -92 and -95 are located on 51st, 43rd and 35th Avenues, respectively.

Phase 1 design and construction has been completed and wellhead treatment at all four wells is currently underway. The most recent information regarding volumes of water treated and VOC mass removed from these Phase 1 wells is available in the August 2012 Monthly Progress Report - RID-95 Wellhead Pilot Treatment Systems (Synergy, 2012a).

Based on current VOC concentrations in the Phase 1 RID wells, the estimated total annual VOC mass removal during Phase 1 would be up to approximately 1,900 pounds, which would be more than the total pounds of VOCs removed in FY2011 at all other WQARF sites. (Table 2). System performance monitoring is being conducted to assess well operations and treatment effectiveness. The treated water from Phase 1 will be used for its highest beneficial use, which in addition to irrigation could include industrial supply and/or potable supply, in the reasonably foreseeable future.

Production capacity of these four wells decreased as a result of the additional head losses through the treatment systems. Reductions in pump output have been observed in each well with average losses of approximately 10%. Well RID-92 has the highest production

capacity loss of approximately 18%. RID intends to recover this lost capacity at each of these wells as part of this ERA through well equipment replacement and installation of an additional treatment skid at RID-92. Additional engineering assessment is needed to determine the most appropriate means of restoring the lost water production capacity that resulted from the wellhead treatment, and this assessment will occur as part of the Modified ERA Work Plan.

4.3.2 Phase 2

Phase 2 of the Modified ERA Work Plan consists of equipping four additional RID wells with high VOC concentrations with wellhead treatment. These additional wells (anticipated as RID-100, RID-106, RID-112, and RID-113) will be equipped with wellhead treatment systems similar to those constructed at the pilot treatment system sites, as illustrated in Figure 14. The objective is the restoration of the quality of the water supply from these additional contaminated RID wells to concentrations protective of all RID current and reasonably foreseeable end uses. Three of the Phase 2 wells are located along the Salt Canal that runs parallel to West Van Buren Street along the southern alignment. RID-106, -112 and -113 are located just east of 67th, at 32nd and just east of 28th Avenues, respectively. The remaining Phase 2 well, RID-100, is an additional southern-tier well located at 27th Avenue approximately ¾ mile south of Van Buren Street.

Phase 2 wellhead treatment systems installation is anticipated to begin in late 2013, upon availability of project funds. These installations will be designed consistent with the Phase 1 treatment systems as detailed in the RID-95 Wellhead Pilot Treatment System Proposal, dated August 18, 2011, whose implementation was agreed to by ADEQ by letter dated September 2, 2011.

Phase 2 implementation may require access to, or acquisition of, additional land for siting of wellhead treatment units at the targeted RID well sites. Information obtained during Phase 2 planning and design concerning land availability, site access, and well and water quality conditions will dictate final decisions concerning treatment system installation and/or may necessitate alternative siting for wellhead treatment, particularly associated with RID wells on the Salt Canal.

Based on current VOC concentrations in the Phase 2 wells, the estimated total annual contaminant VOC mass removal following implementation of Phase 2 would be approximately 440 pounds (Table 2). The treated water from Phase 2 would be used for its highest beneficial use, which in addition to irrigation could include industrial supply and/or potable supply in the reasonably foreseeable future.

The total annual volume of water pumped during the ERA would be nominally equivalent to the current annual volume pumped by RID from this area and future groundwater levels will be unaffected by the ERA.

As discussed in Phase 1, the production capacity of these Phase 2 wells will also be reduced due to head losses through the treatment systems. RID intends to recover this lost capacity at each well as part of this ERA and installation of an additional treatment skid at RID-106.

TABLE 2
MODIFIED ERA WELL FLOW RATES AND CONTAMINANT DATA
WEST VAN BUREN AREA WATER QUALITY ASSURANCE REVOLVING FUND SITE

PHASE DESCRIPTION	WELL NAME	PUMPING RATE (gpm)[1]	TOTAL VOCs (ug/l)[2]	TOTAL TARGET VOCs (ug/l)[3]	ESTIMATED MASS OF TOTAL TARGET VOCs CAPTURED (pounds per year)[4]
PHASE 1 - PILOT WELLHEAD TREATMENT SYSTEMS INITIATIVE	RID-89	3,100	44	34	468
	RID-92	1,300	93	76	436
	RID-95	1,700	88	68	504
	RID-114	2,500	60	44	484
	TOTAL:	8,600	--	--	1,892
PHASE 2 - ADDITIONAL WELLHEAD TREATMENT SYSTEMS	RID-100	2,100	30	16	146
	RID-106	1,500	35	29	189
	RID-112	1,700	12	6.3	47
	RID-113	2,300	11	5.3	54
	TOTAL:	7,600	--	--	436
COMBINED PHASE 1 AND PHASE 2 MASS CAPTURED:					2,328

EXPLANATION:

RID = Roosevelt Irrigation District
gpm = gallons per minute
VOCs = Volatile Organic Compounds
ug/l = micrograms per liter
MCL = Maximum Contaminant Level
TCE = Trichloroethene
PCE = Tetrachloroethene
1,1-DCE = 1,1-Dichloroethene

[1] Phase 1 pumping rates are based on actual data obtained from wells in treatment mode. Phase 2 pumping rates are based on RID production data with an estimated 10% derating for future treatment system head losses. Pumping rate loss based on empirical data obtained during Phase 1 work.

[2] Sum of concentrations for all VOCs, including those VOCs currently below MCLs (see Table 1).

[3] Sum of concentrations for TCE, PCE and 1,1-DCE (where 1,1-DCE exceeds the MCL) (see Table 1).

[4] Mass removal assumes 100% duty for Phase 1 and Phase 2 wells.

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Attachment 2

Attachment 2
Table 2-1:
Summary of Available Monthly Progress Report Data

Wellhead Treatment System	Year	Monthly Report Date	Volume of Groundwater Treated (acre-ft)	Cumulative Volume of Groundwater Treated (acre-ft)	Operating Hours (hours)	Flow Rate (Period Average) (gpm)	INFLUENT (Monthly Average) TCE (µg/L)	INFLUENT PCE (µg/L)	INFLUENT 1,1-DCE (µg/L)	EFFLUENT (Monthly Average) TCE (µg/L)	EFFLUENT PCE (µg/L)	EFFLUENT 1,1-DCE (µg/L)	Target VOC Mass Removed (pounds)	Target VOC Mass Removed (Cumulative) (pounds)	MASS REMOVED - VERIFICATION TCE (pounds)	MASS REMOVED - VERIFICATION PCE (pounds)	MASS REMOVED - VERIFICATION 1,1,DCE (pounds)	MASS REMOVED - VERIFICATION Target VOC Mass Removed (pounds)	MASS REMOVED - VERIFICATION Target VOC Mass Removed (Cumulative) (pounds)	Percent Difference (%)
RID-89	2012	Jan-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Feb-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Mar-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Apr-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		May-12	106	106	164	3,129	32	9.4	2.6	0.50	0.50	0.50	12	12	9.2	2.7	0.8	12.7	12.7	-5.9%
		Jun-12	408	514	720	3,077	31	8.5	2.1	0.50	0.50	0.50	46	59	34.4	9.5	2.4	46.3	59	0.1%
		Jul-12	385	899	696	3,004	29	8.3	2.0	0.50	0.50	0.50	41	100	30.2	8.7	2.1	41.0	100	0.1%
		Aug-12	397	1,296	739	2,918	30	9.0	2.2	0.50	0.50	0.50	44	144	32.0	9.7	2.3	44.0	144	0.0%
		Sep-12	382	1,678	NA	NA	NA	NA	NA	NA	NA	NA	41	185	NA	NA	NA	41.0	185	0.0%
		Oct-12	359	2,037	734	2,858	28	8.8	1.9	0.50	0.50	1.7	38	221	27.7	8.4	0.2	38.3	221	-0.1%
		Nov-12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Dec-12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2013	Jan-13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Feb-13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Mar-13	338	2,375	621	2,958	32	9.1	2.3	0.80	0.50	2.2	37	258	28.2	8.4	0.1	36.7	258	0.0%
		Apr-13	390	2,766	720	2,942	31	9.5	2.3	4.6	0.50	2.2	39	296	28.3	10.1	0.1	38.5	296	-0.1%
		May-13	387	3,153	744	2,825	30	9.6	1.9	2.7	0.50	1.2	40	336	29.0	10.1	0.7	39.8	336	-0.1%
		Jun-13	354	3,507	720	2,670	31	9.6	2.4	4.4	0.50	1.5	36	372	25.7	9.2	0.8	35.7	372	0.0%
		Jul-13	288	3,795	646	2,414	32	9.7	2.3	1.0	0.50	1.3	32	404	24.0	7.6	0.8	32.5	404	-0.1%
		Aug-13	14	3,809	33	2,304	30	8.8	2.1	NS	NS	NS	1	405	NS	NS	NS	NS	NS	NS
		Sep-13	0	3,809	0	0	OFFLINE	OFFLINE	OFFLINE	OFFLINE	OFFLINE	OFFLINE	0	405	OFFLINE	OFFLINE	OFFLINE	OFFLINE	OFFLINE	OFFLINE
		Oct-13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Nov-13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Dec-13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2014	Jan-14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Feb-14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Mar-14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Apr-14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		May-14	283	4,072	575	2,484	27.9	8.3	2.4	7.3	0.50	2.5	26	432	16.1	5.9	0.8	22.9	427	1.08%
		Jun-14	0	4,072	0	0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		Jul-14	0	4,072	0	0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		Aug-14	0	4,072	0	0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		Sep-14	0	4,072	0	0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
RID-92	2012	Jan-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Feb-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Mar-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Apr-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		May-12	50	50	208	1,306	69	14	3.6	0.50	0.50	0.50	12	12	9.4	1.9	0.5	11.8	12	1.5%
		Jun-12	162	211	698	1,250	71	13	3.5	0.50	0.50	0.50	38	50	31.1	5.5	1.5	38.1	50	0.2%
		Jul-12	168	379	744	1,226	71	12	3.8	0.50	0.50	0.54	39	89	32.3	5.7	1.5	39.4	89	-0.3%
		Aug-12	29	408	126	1,250	NS	NS	NS	NS	NS	NS	7	96	NS	NS	NS	7.0	96	-0.3%
		Sep-12	60	468	NA	NA	NA	NA	NA	NA	NA	NA	16	112	NA	NA	NA	16.0	112	-0.3%
		Oct-12	139	607	709	1,065	72	13	4.0	0.65	0.50	0.50	33	145	26.8	4.8	1.5	33.2	145	-0.5%
		Nov-12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Dec-12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2013	Jan-13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Feb-13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Mar-13	141	748	577	1,327	72	14	4.2	6.4	0.50	2.2	31	176	25.1	5.5	0.8	31.4	177	-0.5%
		Apr-13	161	910	718	1,218	73	14	4.7	0.50	0.50	0.94	40	216	31.9	5.9	1.6	39.5	216	-0.2%
		May-13	161	1,071	755	1,190	73	14	3.8	0.50	0.50	2.9	38	254	31.8	6.0	0.4	38.3	255	-0.2%
		Jun-13	157	1,228	714	1,194	74	15	4.4	0.83	0.50	6.0	37	291	31.3	5.7	-0.7	36.4	291	0.0%
		Jul-13	159	1,387	725	1,191	75	14	5.1	3.7	0.50	4.8	37	328	30.8	6.0	0.1	36.8	328	0.1%
		Aug-13	134	1,521	813	1,187	77	12	4.6	0.54	0.50	3.6	33	361	28.0	4.5	0.4	32.9	361	0.1%
		Sep-13	0	1,521	0	0	OFFLINE	OFFLINE	OFFLINE	OFFLINE	OFFLINE	OFFLINE	0	361	OFFLINE	OFFLINE	OFFLINE	OFFLINE	OFFLINE	OFFLINE
		Oct-13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Nov-13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Dec-13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2014	Jan-14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Feb-14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Mar-14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Apr-14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		May-14	124	1,645	584	1,194	69.4	10.3	4.6	2.2	0.5	7.00	25	386	22.66	3.47	-0.81	25.3	386	-0.02%
		Jun-14	0	1,645	0	0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		Jul-14	0	1,645	0	0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		Aug-14	0	1,645	0	0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		Sep-14	0	1,645	0	0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
RID-95	2012	Jan-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Feb-12	195	195	565	1,674	41	3.0	6.1	0.50	0.50	0.50	26	26	21.7	1.6	3.2	26.6	27	-4.3%
		Mar-12	240	435	744	1,752	50	3.7	7.4	0.50	0.50	0.50	40	65	32.6	2.4	4.8	39.9	66	-1.6%
		Apr-12	220	656	702	1,702	52	3.8	8.0	0.50	0.50	0.50	38	104	31.2	2.3	4.8	38.3	106	-0.7%
		May-12	186	841	602	1,678	64	4.2	8.2	0.50	0.50	0.50	33	137	27.1	2.1	4.1	33.3	138	-0.8%
		Jun-12	220	1,061	720	1,659	56	4.0	6.5	0.50	0.50	0.58	41	178	34.4	2.4	3.5	40.3	178	-0.2%
		Jul-12	224	1,284	742	1,630	59	4.1	6.7	0.50	0.50	0.98	41	220	36.0	2.5	3.5	42.0	220	-0.2%
		Aug-12	218	1,503	743	1,593	63	4.4	7.7	0.50	0.50	2.1	43	262	37.3	2.6	3.3	43.2	264	-0.6%
		Sep-12	202	1,705	NA	NA	NA	NA	NA	NA	NA	NA	38	300	NA	NA	NA	38.0	302	-0.5%
		Oct-12	91	1,796	346	1,428	65	4.2	7.4	0.50	0.50	5.4	18	318	16.1	1.0	0.5	17.6	319	-0.4%
		Nov-12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Dec-12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2013	Jan-13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Feb-13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Mar-13	175	1,971	553	1,719	35	2.6	5.1	0.50	0.50	2.9	19	336	15.6	1.2	1.0	16.9	338	-0.6%
		Apr-13	218	2,189	713	1,660	54	4.0	7.6	0.50	0.50	2.0	38	374	31.8	2.3	3.3	37.6	376	-0.4%
		May-13	223	2,412	744	1,628	56	4.2	7.5	0.95	0.50	6.8	36	410	33.0	2.5	0.4	36.0	412	-0.4%
		Jun-13	204	2,616	696	1,592	56	4.1	6.6	2.5	0.50	5.8	32	442	29.8	2.3	0.5	32.6	444	-0.5%
		Jul-13	200	2,816	666	1,553	56	4.1	7.2	2.9	0.50	5.2	33	475	30.0	2.2	1.1	33.3	477	-0.5%
		Aug-13	10	2,826	33	1,646	57	3.5	7.2	NS	NS	NS	1	477	NS	NS	NS	NS	NS	NS
		Sep-13	0	2,826	0	0	OFFLINE	OFFLINE	OFFLINE	OFFLINE	OFFLINE	OFFLINE	0	477	OFFLINE	OFFLINE	OFFLINE	OFFLINE	OFFLINE	OFFLINE
		Oct-13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Nov-13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Dec-13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2014	Jan-14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Feb-14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Mar-14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Apr-14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		May-14	169	2,994	577	1,591	48.5	3.2	7.7	8.7	0.5	8.2	20	496	18.3	2.2	-0.2	20.3	498	-0.35%
		Jun-14	0	2,994	0	0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		Jul-14	0	2,994	0	0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		Aug-14	0	2,994	0	0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		Sep-14	0	2,994	0	0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
RID-114	2012	Jan-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Feb-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Mar-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Apr-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		May-12	97	97	200	2,634	49	3.0	3.5	0.50	0.50	0.50	15	15	12.9	0.8	0.9	14.7	15	2.3%
		Jun-12	232	329	510	2,471	47	2.6	2.6	0.50	0.50	0.50	33	48	29.9	1.7	1.6	33.1	48	0.4%
		Jul-12	337	666	744	2,460	43	2.5	2.5	0.50	0.50	0.50	44	91	39.2	2.3	2.3	43.8	92	-0.8%
		Aug-12	326	992	743	2,363	44	2.8	2.6	0.50	0.50	0.50	44	135	39.0	2.5	2.3	43.8	136	-0.3%
		Sep-12	315	1,307	NA	NA	NA	NA	NA	NA	NA	NA	39	174	NA	NA	NA	39	174	-0.2%
		Oct-12	320	1,627	729	2,384	40	2.7	2.4	0.50	0.50	1.9	37	211	34.5	2.3	0.4	37.2	212	-0.3%
		Nov-12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Dec-12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2013	Jan-13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Feb-13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Mar-13	171	1,798	379	2,450	47	2.7	3.0	0.67	0.50	2.2	23	234	21.7	1.3	0.4	23.3	235	-0.4%
		Apr-13	317	2,115	711	2,421	47	2.9	3.1	1.9	0.50	2.3	42	276	38.8	2.5	0.7	42.0	277	-0.4%
		May-13	318	2,432	726	2,382	43	3.9	2.7	3.8	0.50	2.7	37	314	34.1	3.4	0.0	37.4	314	-0.1%
		Jun-13	316	2,747	719	2,379	43	2.8	3.0	4.1	0.50	2.5	36	350	33.2	2.4	0.4	36.1	350	-0.1%
		Jul-13	321	3,069	744	2,343	38	2.7	2.5	1.1	0.50	2.2	35	384	32.2	2.4	0.2	34.8	385	-0.3%
		Aug-13	286	3,354	689	2,254	37	2.4	2.3	4.2	0.50	2.2	27	412	25.5	1.9	0.1	27.4	413	-0.2%
		Sep-13	83	3,437	189	2,385	35	2.5	2.1	5.7	0.50	2.8	7	419	6.7	0.6	-0.2	7.1	420	-0.2%
		Oct-13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Nov-13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Dec-13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2014	Jan-14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Feb-14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Mar-14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Apr-14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		May-14	230	3,668	574	2,176	33.7	2.3	2.2	7.3	0.5	2.6	18	437	16.5	1.44	-0.16	7.1	427	2.3%
		Jun-14	0	3,668	0	0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		Jul-14	0	3,668	0	0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		Aug-14	0	3,668	0	0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		Sep-14	0	3,668	0	0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

	Target VOC Mass Removed (Cumulative) (pounds)		MASS REMOVED - VERIFICATION Target VOC Mass Removed (Cumulative) (pounds)	Percent Difference (%)
2012 Subtotal	895	2012 Subtotal	898	-0.30%
2013 Subtotal	768	2013 Subtotal	765	0.40%
2014 Subtotal	89	2014 Subtotal	68	22.60%
Total	1,761	Total	1,731	1.16%

Notes:
Data obtained from Monthly Data Reports - http://www.wvgroundwater.org/project-documents

-	No data. Data precede wellhead treatment system start-up.
NS	Not Sampled. Treatment system operated in bypass mode.
NA	Not Available. Monthly Progress Report is not available.
OFFLINE	Not Sampled. Treatment system offline for the reporting period.
382	Value derived using available data from August 2012 and October 2012 Monthly Progress Reports
7	System was not sampled during reporting period. It is unclear what concentration data the reported removed mass is based on. The estimate could be based on the previous month's data.

EXHIBIT "5"

TABLE 7. ESTIMATED COSTS OF REMEDIAL ALTERNATIVES

West Van Buren Area WQARF Site

Costs Summary:	Capital Cost	Annual O&M
Reference Remedy	$13,645,000	$2,956,900
Less Aggressive	$9,445,000	$2,049,500
More Aggressive	$14,623,000	$2,192,600
Most Aggressive	$19,460,000	$4,169,900
MERA	$5,930,000	$1,390,000

~~Less Aggressive~~ **MERA Estimated Costs (RID 89,92,95,114)**

Well	Description	Capital Cost	Annual O&M	Comments/Explanation
89	3 skids GAC treatment	$1,500,000	$300,000	Modified ERA
92	1 skid GAC treatment	$1,000,000	$100,000	Modified ERA
95	2 skids GAC treatment	$1,000,000	$250,000	Modified ERA (increased O&M with higher concentration of 1,1-dichloroethene, resulting in quicker breakthrough)
114	3 skids GAC treatment	$1,500,000	$300,000	Modified ERA
~~106~~	~~3 skids GAC treatment~~	~~$1,500,000~~	~~$300,000~~	~~Modified ERA + supplemental action~~
~~109~~	~~2 skids GAC treatment~~	~~$1,000,000~~	~~$200,000~~	~~Modified ERA~~
84	off-season injection	TBD	TBD	operation of pumps and filtration (contingengy; If > MCLs after 2 years of remedy)
	volatilization control	$180,000		sealing wellhead discharge boxes @ sites with COCs greater than MCLs & enclose open lateral south of RID-92
	groundwater monitoring		$134,000	based on Fiscal Year 2015 budget estimate by Terranext
	Salt Canal improvements	$750,000		2 open section + manholes (1,500 feet @ $500/foot)
	~~restore lost production capacity~~	~~$615,000~~		~~1) re-drill, new pump, new motor at RID-106~~ ~~2) new pump, same motor at RID-114~~
	power penalty		~~$140,000~~ $90,000	estimated offset for increased pumping cost through wellhead treatment from increase in operating pressure ($10,000/skid/year)
	equipment repair/replacement		~~$225,000~~ $150,000	3% of capital equipment costs
	~~real estate acquisition~~	~~$400,000~~		~~106, 109 ($200,000/site)~~
	project administration/reporting		~~$100,000~~ $66,000	6.0% of annual O&M (excludes power penalty and groundwater monitoring)
	TOTALS:	**$9,445,000**	**$2,049,500**	
	TOTALS MERA:	**$5,930,000**	**$1,390,000**	

TABLE 5. WELLHEAD TREATMENT SYSTEMS ANALYSIS PER ALTERNATIVE

West Van Buren Area WQARF Site

REFERENCE REMEDY

WELL ID	ORIGINAL PRODUCTION CAPACITY (gpm)	REVISED PRODUCTION CAPACITY (gpm)	REASON FOR REVISION	# OF LGAC SKIDS	% LOSS	TOTAL PRODUCTION (capacity through skids)	% SKID CAPACITY (based on 1,000 gpm/skid)	CAPACITY LOSS/GAIN (compared to original)	
RID-84	2,400	---		2	10.0%	2160	108%	-240	
RID-89	3,400	---		3	13.1%	2955	98%	-445	
RID-92	1,500	2,000	Re-drill, new pump, same motor	2	10.0%	1800	90%	300	
RID-95	1,850	---		2	14.6%	1580	79%	-270	
RID-100	2,100	---		2	10.0%	1890	95%	-210	
RID-106	1,500	3,000	Re-drill, new pump, new motor	3	10.0%	2700	90%	1200	
RID-109	2,400	---		2	10.0%	2160	108%	-240	% of Original Capacity
RID-112	1,700	---		2	10.0%	1530	77%	-170	
RID-114	2,500	3,000	New pump, same motor	3	10.0%	2700	90%	200	
	19,350					Net Loss/Gain		125	100.6%

LESS AGGRESSIVE ALTERNATIVE REMEDY

WELL ID	ORIGINAL PRODUCTION CAPACITY (gpm)	REVISED PRODUCTION CAPACITY (gpm)	REASON FOR REVISION	# OF LGAC SKIDS	% LOSS	TOTAL PRODUCTION (capacity through skids)	% SKID CAPACITY (based on 1,000 gpm/skid)	CAPACITY LOSS/GAIN (compared to original)	
RID-89	3,400	---		3	13.1%	2955	98%	-445	
RID-92	1,500	---		1	20.7%	1190	119%	-311	
RID-95	1,850	---		2	14.6%	1580	79%	-270	
RID-106	1,500	3,000	Re-drill, new pump, new motor	3	10.0%	2700	90%	1200	% of Original Capacity
RID-109	2,400	—		2	10.0%	2160	108%	-240	
RID-114	2,500	3,000	New pump, same motor	3	10.0%	2700	90%	200	
	13,150					Net Loss/Gain		134	101.0%

SYNERGY ENVIRONMENTAL LLC

REVISED TABLE 10. GROUNDWATER REMEDIAL ACTIONS - COMPARATIVE ANALYSIS
West Van Buren Area WQARF Site

Site	Treatment Technology	Required Treatment Levels[1]	End Use of Remediated Water	Remedy Capital Cost (in years completed)	Remedy Capital Cost (2014 dollars)[2]	Design Treatment Capacity	Design Treatment Capacity (with loss) (Four MERA wells)	Normalized[3] Capital Costs/ Treatment Capacity ($/gpm)	Normalized Capital Costs/Treatment Capacity (with loss) ($/gpm) (Four MERA wells)	Amount of Groundwater Extracted Through 2013	Amount of VOC Mass Removed Through 2013	Amount of VOC Removed Through 2014 (ARCADIS)[t]	Average Annual Groundwater Pump & Treat Rate (ARCADIS)[u]	Average Annual Groundwater Pump & Treat Rate	Annual VOC Mass Removal Rate	Annual Remedy O&M Costs	Routine O&M Cost ($/lb$_{VOC}$)	Routine O&M Cost ($/Kgal)
															ARCADIS			
WVBA Site Proposed Less Aggressive Alternative Remedy	LGAC (lead/lag)	Primary Drinking Water Standards	Irrigation Drinking Water[a]	~ $9.4 MM[f]	~ $9.4 MM	~13,300 gpm[f,j]	----	~ $707	----	----	----	----	----	~ 11,758 gpm[n]	~ 2,503 pounds/year[o]	~ $1.7 MM/year[f,p]	~ $670	~ $0.27
WVBA Site Proposed Reference Remedy	LGAC (lead/lag)	Primary Drinking Water Standards	Irrigation Drinking Water[a]	~ $13.6 MM[f]	~ $13.6 MM	~19,500 gpm[f,j]	----	~ $697	----	----	----	----	----	~ 16,071 gpm[n]	~ 2,820 pounds/year[o]	~ $2.5 MM/year[f,p]	~ $883	~ $0.29
WVBA Site Proposed More Aggressive Alternative Remedy	LGAC (lead/lag)	Primary Drinking Water Standards	Irrigation Drinking Water[a]	~ $14.6 MM[f]	~ $14.6 MM	~13,300 gpm[f,j]	----	~ $1,098	----	----	----	----	----	~ 12,142 gpm[n]	~ 2,569 pounds/year[o]	~ $1.8 MM/year[f,p]	~ $708	~ $0.28
WVBA Site Proposed Most Aggressive Alternative Remedy	LGAC (lead/lag)	Primary Drinking Water Standards	Irrigation Drinking Water[a]	~ $19.5 MM[f]	~ $19.5 MM	~29,100 gpm[f,j]	----	~ $670	----	----	----	----	----	~ 23,047 gpm[n]	~ 3,164 pounds/year[o]	~ $3.5 MM/year[f,p]	~ $1,120	~ $0.29
MERA RID-89 RID-92 RID-95 RID-114	LGAC (lead/lag)	Primary Drinking Water Standards	Irrigation Water[a]	$1.5MM $1.0MM $1.0MM $1.5MM ~$5.93MM[w]	$1.5MM $1.0MM $1.0MM $1.5MM ~$5.93MM[w]	3,400 1,500 1,850 2,500 ~9,250gpm	2,955 1,190 1,580 2,700 ~8,425gpm[s]	---	$5.93MM 8,425 gpm = ~ $704[s]	----	----	2012 895 lbs[t] 2013 767 lbs[t] 2014 89 lbs[t]	1,963 gpm[u] 859 gpm[u] 1,237 gpm[u] 1,831 gpm[u]	----	~ 1,446 pounds/year (ARCADIS)	~$1.39MM/year[v] (Revised Table 7)	$1.39MM 1446 pounds/year ~$961[w]	~$0.36

REVISED TABLE 10. GROUNDWATER REMEDIAL ACTIONS - COMPARATIVE ANALYSIS

West Van Buren Area WQARF Site

Notes:

1) Treatment Levels applicable to site Contaminants of Concern
2) Based on percentage increase in Consumer Price Index (CPI) from dates of construction completion through May 2014.
3) Capital Cost in 2014 dollars relative to design treatment capacity in gpm.
* Values in red denote ARCADIS calculations based *RID Phase 1 Wellhead Treatment System Annual VOC Mass Removal Evaluation.*

Abbreviations:

M52 = Motorola 52nd Street Superfund Siti
NIBW = North Indian Bend Wash
TIAA = Tucson International Airport Area
WVBA = West Van Buren Area
VGAC = vapor-phase GAC
Compensation, and Liability Act (Superfund)

LGAC = liquid-phase GAC
lb = pound
Kgal = thousand gallons
MM = million
gpm = gallons per minute

O&M = operation and maintenance
VOC = volatile organic compound
TCE = trichloroethene
~ = values are estimates
CERCLA = Comprehensive Environmental Response,

Explanation:

a) A major portion of remediated water is planned for municipal use pending RID construction of a separate conveyance pipeline from the WVBA Site to District land.
b) *Letter of Determination for Motorola 52nd Street Facility* , Phoenix, dated September 30, 1988.
c) *Final Remedial Action Report for Motorola 52nd Street Superfund Site, Operable Unit 2 Area* , Phoenix, Arizona, prepared by Black & Veatch Corporation, dated September 12, 2003.
d) *Final Feasibility Study Addendum* , North Indian Bend Wash Superfund Site, Scottsdale, Arizona, prepared by the NIBW Participating Companies, dated November 15, 2000 (*See* Table M5 in Appendix M, Volume 5).
e) Verbal communication: Mr. Jeff Biggs, Project Coordinator, Tucson Airport Remediation Project, Tucson Water.
f) *Draft Feasibility Study Report* , West Van Buren Area WQARF Site, Phoenix, Arizona, prepared by Synergy Environmental (*See* Table 5 for design treatment capacity and Table 7 for capital and D&M costs).
g) *2011 Sitewide Five-Year Review Report, Motorola 52nd Street Superfund Site* , Phoenix, Arizona, prepared by URS Corporation, September 2011 (See Sections 4.1 and 4.2; Tables 4-1 and 4-2).
h) *First Five-Year Report for Tucson International Airport Area Superfund Site* , Pima County, Arizona, prepared by U.S. Environmental Protection Agency, September 2013 (*See* Section 4.2.1 for pounds of VOCs removed and volume of groundwater extraction over 216 month period, and Section 4.3.1 for O&M costs (2001)).
i) The proposed remedy provides remediation of up to 26,800 gpm water supply when including blending of other contaminated supply wells that would operate according to an approved remedial action plan.
j) Information pertaining to amount of groundwater treated and mass removed is from annual Operable Unit No. 1 Effectiveness Reports prepared by Clear Creek Associates.
k) Information pertaining to amount of groundwater treated and mass removed is from annual Effectiveness Reports for 20th Street Groundwater Treatment Facility, Operable Unit 2 Area prepared by Connestoga-Rovers & Associates.
l) Information pertaining toamount of groundwater treated and mass removed is from annual Site Monitoring Reports, NIBW Superfund Site prepared by the NIBW Participating Companies.
m) Information pertaining to amount of groundwater treated and mass removed is from annual Water Quality Reports prepared by Tucson Water.
n) Estimated pumping rate is based on assigned pumping of remedy wells developed for the FS Model (see Appendix F).
o) Based on reported 2013 concentrations of PCE, TCE, and 1,1-DCE and projected pumping in groundwater modeling scenarios (see Appendix F).
p) *Motorola 52nd St. Superfund Site, Five-Year Review Completed Fact Sheet* , prepared by Environmental Protection Agency and Arizona Department of Environmental Quality (*See* page 2 for average VOC mass removed and average volume of groundwater extracted for 2006-2010).
q) *First Five-Year Review, Indian Bend Wash Superfund Site* , Scottsdale and Tempe, Maricopa County, Arizona, prepared by U.S. Environmental Protection Agency, September 2011 (*See* Table 4-8; periodic rehabilitation costs not included in O&M Costs Summary).
r) Excluding line item costs for area-wide groundwater monitoring and capital equipment costs from Table 7 *Draft Feasibility Study Report* , West Van Buren Area WQARF Site, Phoenix, Arizona, prepared by Synergy Environmental.
s) Design Treatment Capacity with loss obtained from Table 5 *Wellhead Treatment Systems Analysis Per Alternative, West Van Buren Area WQARF Site, Phoenix, Arizona, prepared by Synergy Environmental.*
t) Amount of VOC Removed from 2012 through 2014 obtained from ARCADIS *RID Phase 1 Wellhead Treatment Sytem Annual VOC Mass Removal Evaluation.*
u) Average Annual Groundwater Pump & Treat Rate obtained from Table 2-1 *Summary of Available Monthly Progress Report Data* from *ARCADIS RID Phase 1 Wellhead Treatment System Annual VOC Mass Removal Evaluation.*
v) Maximum amount of VOC Mass Removal Rates from 2012 through 2014 from ARCADIS *RID Phase 1 Wellhead Treatment Sytem Annual VOC Mass Removal Evaluation.*
w) For cost estimate breakdown for Capital Cost and O&M please refer to Revised Table 7: *Estimated Costs for Remedial Alternatives, MERA Estimated Costs (RID 89,92,95,114).* Capital costs include volatilization control and Salt Canal Improvements. O&M costs include groundwater monitoring, power penalty, equipment repair/replacement and project administration.

EXHIBIT “6”

FEASIBILITY STUDY REPORT
WEST VAN BUREN WQARF SITE
PHOENIX, ARIZONA

by

Haley & Aldrich, Inc.
Tucson, Arizona

for

The West Van Buren WQARF Site Working Group

File No. 37503-204
July 2014

REGISTERED GEOLOGIST
CERTIFICATE NO.
46379
ERIC
MICHAEL
PIGATI
Date Signed 7/14/14
ARIZONA, U.S.A.
Expires: 6/30/16

HALEY
ALDRICH

TABLE 10
REMEDIAL ALTERNATIVE COST SUMMARY
WEST VAN BUREN AREA WQARF SITE
PHOENIX, ARIZONA

Investment Return Rate= 5%
Inflation Rate= 3%
Discount Rate= 6%

					Non Disc., w/ 3% Inflation			NPV @ 5% Disc. Rate		
	Remedy	Backup Reference	Year (Period)	Trigger	Capital	Total O&M	Total	Capital	Total O&M	Total
Less Aggressive Remedy										
Base										
1	Groundwater Monitoring Program	Module A	2014-2044	N/A	$ -	$10.33	$10.33	$ -	$ 2.90	$ 2.90
2	Connect five (5) impaired private wells within the WVBA to COP municipal system	Module B	2014	N/A	$ 0.05	$ -	$ 0.05	$ 0.05	$ -	$ 0.05
	Base Total				$ 0.05	$10.33	$10.38	$ 0.05	$ 2.90	$ 2.95
Contingencies										
1	Drill and construct five (5) new sentinel monitoring wells	Module H	2026	As necessary based on post-2025 plume conditions	$ 0.36	$ -	$ 0.36	$ 0.13	$ -	$ 0.13
2	Quarterly sentinel well monitoring at twelve (12) monitoring wells and eleven (11) SRP wells	Module J	2026-2044	As necessary based on post-2025 plume conditions	$ -	$ 1.49	$ 1.49	$ -	$ 0.23	$ 0.23
3	Replace four (4) SRP wells with new, collocated LAU wells	Module F	2030	Based on quarterly sentinel well monitoring results	$10.74	$ -	$10.74	$ 2.64	$ -	$ 2.64
4	Connect five (5) private wells outside of WVBA to COP municipal system	Module K	2026	Based on quarterly sentinel well monitoring results	$ 0.07	$ -	$ 0.07	$ 0.02	$ -	$ 0.02
5	Replace RID-114 with a new UAU production well at different location	Module G	2019	Imminent change in end use to potable and water quality not fit for intended use at that time	$ 1.23	$ -	$ 1.23	$ 0.79	$ -	$ 0.79
Reference Remedy										
Base										
1	Groundwater Monitoring Program	Module A	2014-2044	N/A	$ -	$10.33	$10.33	$ -	$ 2.90	$ 2.90
2	Connect five (5) impaired private wells within the WVBA to COP municipal system	Module B	2014	N/A	$ 0.05	$ -	$ 0.05	$ 0.05	$ -	$ 0.05
3	One (1) plume core extraction well at 500 gpm	Module E (500 gpm)	2016-2026	N/A	$ 2.60	$ 6.57	$ 9.17	$ 2.18	$ 3.44	$ 5.62
	Base Total				$ 2.65	$16.90	$19.55	$ 2.23	$ 6.34	$ 8.57
Contingencies										
1	Drill and construct nine (9) new sentinel monitoring wells	Module H	2026	As necessary based on post-2025 plume conditions	$ 0.85	$ -	$ 0.85	$ 0.23	$ -	$ 0.23
2	Quarterly sentinel well monitoring at sixteen (16) monitoring wells and eleven (11) SRP wells	Module L	2026-2044	As necessary based on post-2025 plume conditions	$ -	$ 1.61	$ 1.61	$ -	$ 0.28	$ 0.28
3	Replace two (2) SRP wells with new, collocated LAU wells	Module F	2030	Based on quarterly sentinel well monitoring results	$ 5.37	$ -	$ 5.37	$ 1.32	$ -	$ 1.32
4	Connect five (5) private wells outside of WVBA to COP municipal system	Module K	2026	Based on quarterly sentinel well monitoring results	$ 0.07	$ -	$ 0.07	$ 0.02	$ -	$ 0.02
5	Replace RID-114 with a new UAU production well at different location	Module G	2019	Imminent change in end use to potable and water quality not fit for intended use at that time	$ 1.23	$ -	$ 1.23	$ 0.79	$ -	$ 0.79
6	Continue operating one (1) plume core extraction well at 500 gpm	Module E (500 gpm)	2026-2044	If deemed necessary based on post-2025 plume conditions and cost-benefit analysis	$ -	$18.03	$18.03	$ -	$ 2.82	$ 2.82
6a	Reinject 500 gpm treated water	Module C (500 gpm)	2026-2044		$ 3.76	$ 1.50	$ 5.26	$ 1.31	$ 0.24	$ 1.54
7	Add one (1) plume core extraction well at 1,000 gpm	Module E (1 @ 1,000 gpm)	2026-2044	If deemed necessary based on post-2025 plume conditions and cost-benefit analysis	$ 3.67	$24.43	$28.10	$ 1.28	$ 3.82	$ 5.10
7a	Reinject 1,000 gpm treated water	Module C (1 @ 1,000 gpm)	2026-2044		$ 5.98	$ 2.53	$ 8.51	$ 2.08	$ 0.40	$ 2.48
More Aggressive Remedy										
Base										
1	Groundwater Monitoring Program	Module A	2014-2044	N/A	$ -	$10.33	$10.33	$ -	$ 2.90	$ 2.90
2	Connect five (5) impaired private wells within the WVBA to COP municipal system	Module B	2014	N/A	$ 0.05	$ -	$ 0.05	$ 0.05	$ -	$ 0.05
3	Two (2) plume core extraction wells at 1,000 gpm each	Module E (2 @ 1,000 gpm)	2016-2026	N/A	$ 5.32	$16.36	$21.68	$ 4.46	$ 8.55	$13.02
	Base Total				$ 5.37	$26.69	$32.06	$ 4.51	$11.45	$15.97
Contingencies										
1	Drill and construct five (5) new sentinel monitoring wells	Module H	2026	As necessary based on post-2025 plume conditions	$ 0.36	$ -	$ 0.36	$ 0.13	$ -	$ 0.13
2	Quarterly sentinel well monitoring at twelve (12) monitoring wells and eleven (11) SRP wells	Module J	2026-2044	As necessary based on post-2025 plume conditions	$ -	$ 1.49	$ 1.49	$ -	$ 0.23	$ 0.23
3	Replace two (2) SRP wells with new, collocated LAU wells	Module F	2030	Based on quarterly sentinel well monitoring results	$ 5.37	$ -	$ 5.37	$ 1.32	$ -	$ 1.32
4	Connect five (5) private wells outside of WVBA to COP municipal system	Module K	2026	Based on quarterly sentinel well monitoring results	$ 0.07	$ -	$ 0.07	$ 0.02	$ -	$ 0.02
5	Replace RID-114 with a new UAU production well at different location	Module G	2019	Imminent change in end use to potable and water quality not fit for intended use at that time	$ 1.23	$ -	$ 1.23	$ 0.79	$ -	$ 0.79
6	Continue operating two (2) plume core extraction wells at 1,000 gpm each	Module E (2 @ 1,000 gpm)	2026-2044	If deemed necessary based on post-2025 plume conditions and cost-benefit analysis	$ -	$44.90	$44.90	$ -	$ 7.03	$ 7.03
6a	Reinject 2,000 gpm treated water	Module C (2,000 gpm)	2026-2044		$11.96	$ 5.06	$17.02	$ 4.17	$ 0.79	$ 4.95

Cost in Millions. Capped at 30yrs

HALEY & ALDRICH

Community Advisory Board
West Van Buren WQARF Site
WVB Working Group -
Draft Final Feasibility Study

December 1, 2014

Haley & Aldrich, Inc.

Alternatives Costs

Remedy	NPV Capital Cost ($MM)	NPV O&M Cost ($MM)	NPV Total Cost ($MM)
Less Aggressive	$0.15	$2.90	$3.05
Reference	***$2.33***	***$6.34***	***$8.67***
More Aggressive	$4.51	$11.45	$15.97

Contingencies	NPV Capital Cost Range ($MM)	NPV O&M Cost Range ($MM)	NPV Total Cost Range ($MM)
Less Aggressive	$0.07-2.64	$0.23	$0.07-2.64
Reference	$0.02-2.08	$0.24-3.82	$0.02-5.10
More Aggressive	$0.02-4.17	$0.23-7.03	$0.02-7.03

Costs Assume:

- **6% Discount Rate**
- **9% Investment Rate of Return**
- **3% Inflation Rate**
- **30 Year project lifecycle**
- **Many different Contingencies exist-See Table 10**

DRAFT
FEASIBILITY STUDY REPORT

July 2014
West Van Buren Area WQARF Site
Phoenix, Arizona

Prepared for:
Arizona Department of Environmental Quality

On behalf of:
Roosevelt Irrigation District

Prepared by:
Synergy Environmental

and

Montgomery & Associates

REGISTERED GEOLOGIST
CERTIFICATE NO.
26393
DENNIS H.
SHIRLEY
Date Signed 7/9/14
ARIZONA, U.S.A.
Expires 09/30/2016

Registered Professional Engineer (Environmental)
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REGISTERED GEOLOGIST
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TIMOTHY P.
LEO
Date Signed 7-11-14
ARIZONA, U.S.A.
Expires 12/31/16

SYNERGY ENVIRONMENTAL, LLC

MONTGOMERY & ASSOCIATES

TABLE 8. COMPARATIVE COST OF REMEDIAL ALTERNATIVES - NET PRESENT VALUE ANALYSIS

West Van Buren Area WQARF Site

Less Aggressive Remedy

Discount Factor to Present Value = *3%*

Year	Year	Capital Costs	Annual O&M Costs	Total Costs	Annual Discount Factor	Total Present Value Cost	Cumulative Present Value Cost
2015	0	$ 9,445,000	$ 2,049,500	$ 11,494,500	1	$ 11,494,500	$ 11,494,500
2016	1		$ 2,049,500	$ 2,049,500	0.971	$ 1,989,806	$ 13,484,306
2017	2		$ 2,049,500	$ 2,049,500	0.943	$ 1,931,850	$ 15,416,156
2018	3		$ 2,049,500	$ 2,049,500	0.915	$ 1,875,583	$ 17,291,739
2019	4		$ 2,049,500	$ 2,049,500	0.888	$ 1,820,954	$ 19,112,693
2020	5		$ 2,049,500	$ 2,049,500	0.863	$ 1,767,917	$ 20,880,610
2021	6		$ 2,049,500	$ 2,049,500	0.837	$ 1,716,424	$ 22,597,034
2022	7		$ 2,049,500	$ 2,049,500	0.813	$ 1,666,431	$ 24,263,465
2023	8		$ 2,049,500	$ 2,049,500	0.789	$ 1,617,894	$ 25,881,359
2024	9		$ 2,049,500	$ 2,049,500	0.766	$ 1,570,771	$ 27,452,130
2025	10		$ 2,049,500	$ 2,049,500	0.744	$ 1,525,020	$ 28,977,151
2026	11		$ 2,049,500	$ 2,049,500	0.722	$ 1,480,602	$ 30,457,753
2027	12		$ 2,049,500	$ 2,049,500	0.701	$ 1,437,478	$ 31,895,231
2028	13		$ 2,049,500	$ 2,049,500	0.681	$ 1,395,610	$ 33,290,841
2029	14		$ 2,049,500	$ 2,049,500	0.661	$ 1,354,961	$ 34,645,802
2030	15		$ 2,049,500	$ 2,049,500	0.642	$ 1,315,496	$ 35,961,298
2031	16		$ 2,049,500	$ 2,049,500	0.623	$ 1,277,181	$ 37,238,479
2032	17		$ 2,049,500	$ 2,049,500	0.605	$ 1,239,981	$ 38,478,460
2033	18		$ 2,049,500	$ 2,049,500	0.587	$ 1,203,865	$ 39,682,325
2034	19		$ 2,049,500	$ 2,049,500	0.570	$ 1,168,801	$ 40,851,126
2035	20		$ 2,049,500	$ 2,049,500	0.554	$ 1,134,758	$ 41,985,885
2036	21		$ 2,049,500	$ 2,049,500	0.538	$ 1,101,707	$ 43,087,592
2037	22		$ 2,049,500	$ 2,049,500	0.522	$ 1,069,619	$ 44,157,211
2038	23		$ 2,049,500	$ 2,049,500	0.507	$ 1,038,465	$ 45,195,675
2039	24		$ 2,049,500	$ 2,049,500	0.492	$ 1,008,218	$ 46,203,894
2040	25		$ 2,049,500	$ 2,049,500	0.478	$ 978,853	$ 47,182,746
2041	26		$ 2,049,500	$ 2,049,500	0.464	$ 950,342	$ 48,133,089
2042	27		$ 2,049,500	$ 2,049,500	0.450	$ 922,662	$ 49,055,751
2043	28		$ 2,049,500	$ 2,049,500	0.437	$ 895,789	$ 49,951,540
2044	29		$ 2,049,500	$ 2,049,500	0.424	$ 869,698	$ 50,821,238
2045	30		$ 2,049,500	$ 2,049,500	0.412	$ 844,367	$ 51,665,605
2046	31		$ 2,049,500	$ 2,049,500	0.400	$ 819,774	$ 52,485,378
2047	32		$ 2,049,500	$ 2,049,500	0.388	$ 795,897	$ 53,281,275
2048	33		$ 2,049,500	$ 2,049,500	0.377	$ 772,715	$ 54,053,990
2049	34		$ 2,049,500	$ 2,049,500	0.366	$ 750,209	$ 54,804,199
2050	35		$ 2,049,500	$ 2,049,500	0.355	$ 728,358	$ 55,532,558
2051	36		$ 2,049,500	$ 2,049,500	0.345	$ 707,144	$ 56,239,701

TABLE 8. COMPARATIVE COST OF REMEDIAL ALTERNATIVES - NET PRESENT VALUE ANALYSIS

West Van Buren Area WQARF Site

Less Aggressive Remedy (Continued)

Discount Factor to Present Value = 3%

Year	Year	Capital Costs	Annual O&M Costs	Total Costs	Annual Discount Factor	Total Present Value Cost	Cumulative Present Value Cost
2052	37		$ 2,049,500	$ 2,049,500	0.335	$ 686,548	$ 56,926,249
2053	38		$ 2,049,500	$ 2,049,500	0.325	$ 666,551	$ 57,592,800
2054	39		$ 2,049,500	$ 2,049,500	0.316	$ 647,137	$ 58,239,937
2055	40		$ 2,049,500	$ 2,049,500	0.307	$ 628,288	$ 58,868,225
2056	41		$ 2,049,500	$ 2,049,500	0.298	$ 609,989	$ 59,478,214
2057	42		$ 2,049,500	$ 2,049,500	0.289	$ 592,222	$ 60,070,436
2058	43		$ 2,049,500	$ 2,049,500	0.281	$ 574,973	$ 60,645,408
2059	44		$ 2,049,500	$ 2,049,500	0.272	$ 558,226	$ 61,203,634
2060	45		$ 2,049,500	$ 2,049,500	0.264	$ 541,967	$ 61,745,601
2061	46		$ 2,049,500	$ 2,049,500	0.257	$ 526,182	$ 62,271,783
2062	47		$ 2,049,500	$ 2,049,500	0.249	$ 510,856	$ 62,782,639
2063	48		$ 2,049,500	$ 2,049,500	0.242	$ 495,977	$ 63,278,615
2064	49		$ 2,049,500	$ 2,049,500	0.235	$ 481,531	$ 63,760,146
TOTALS		**$ 9,380,000**	**$ 102,475,000**	**$111,920,000**		**$ 63,760,146**	