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

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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: ADHS 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..

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

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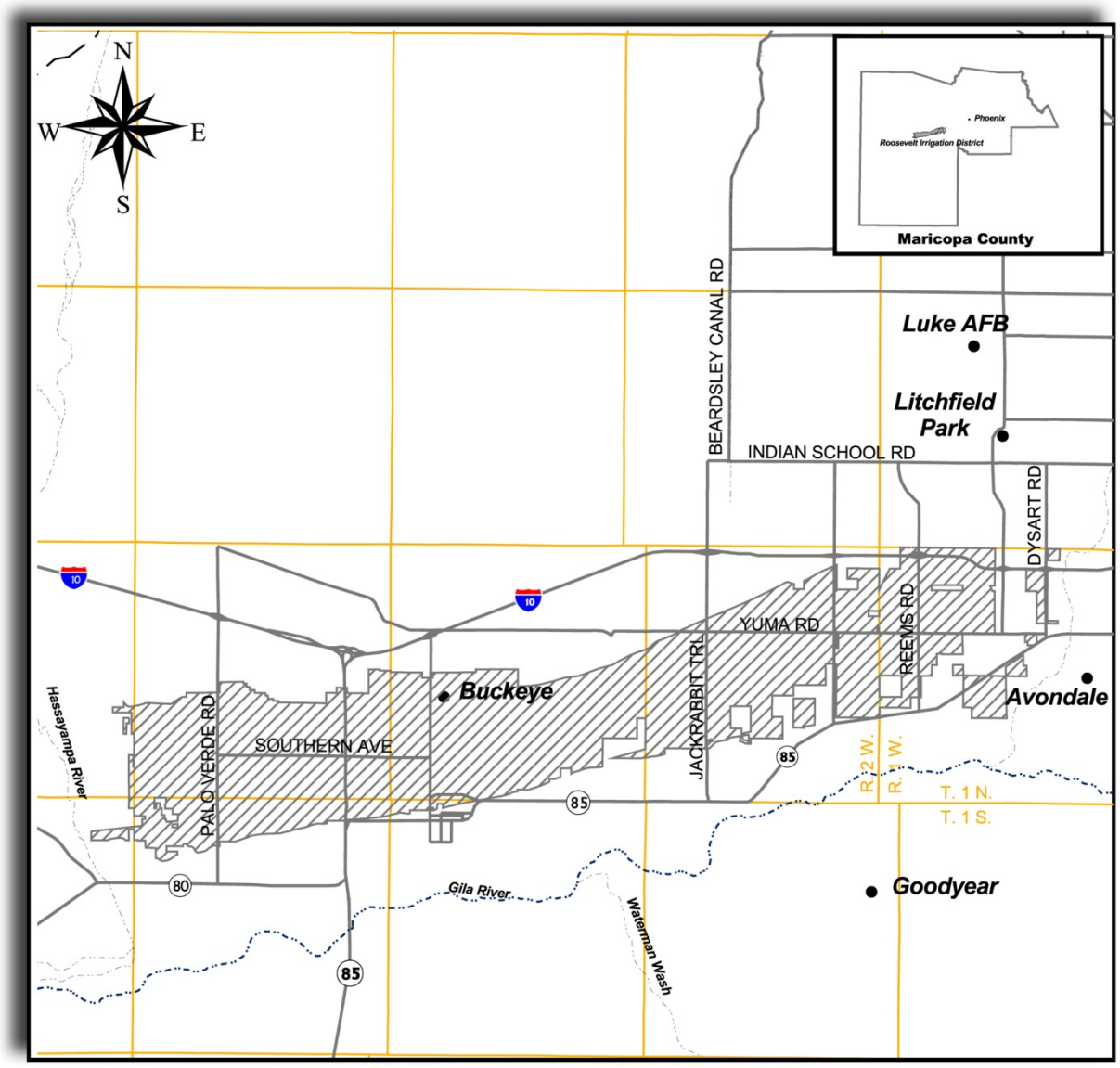
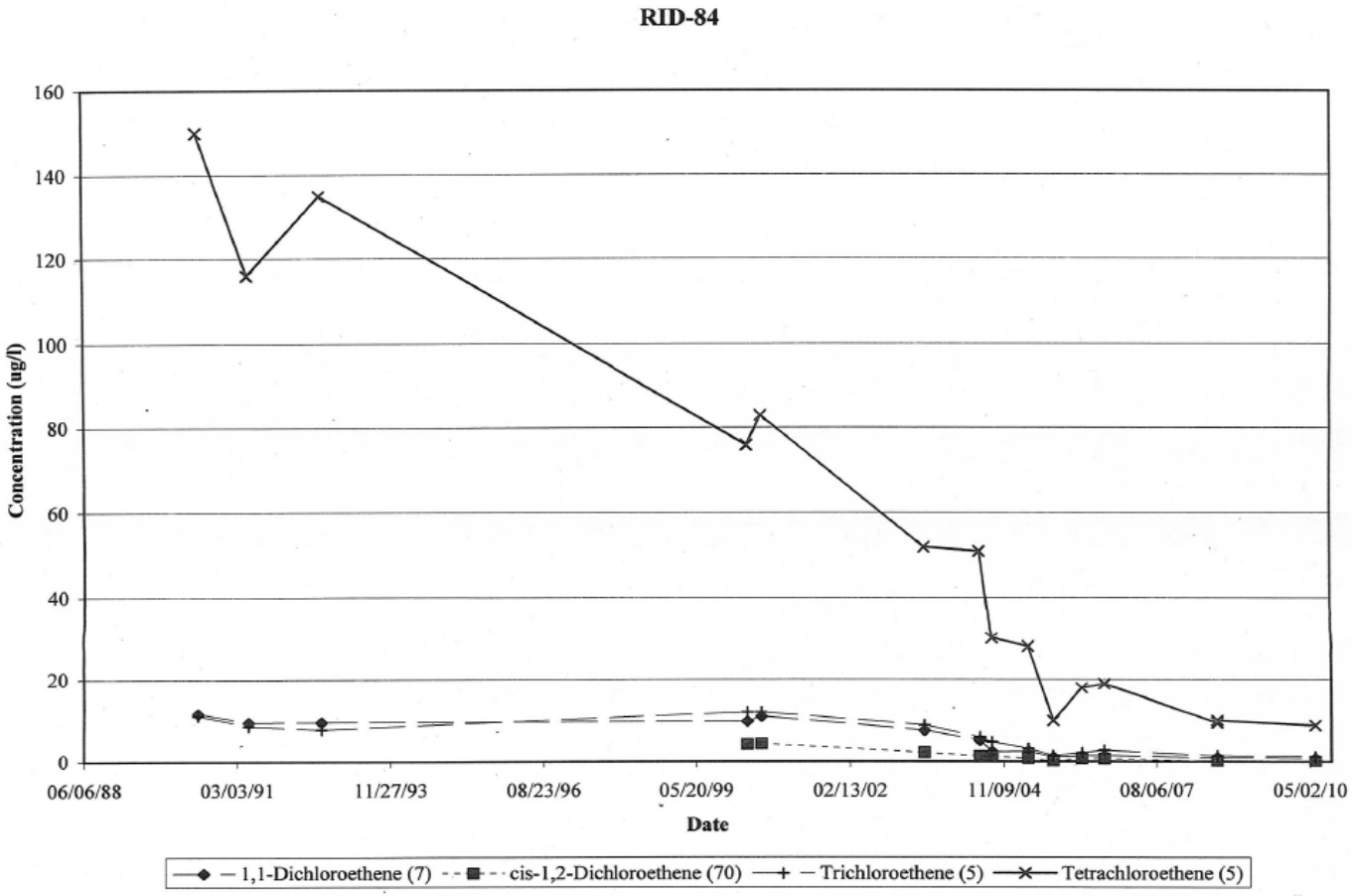
Appendix A: Roosevelt Irrigation District Map

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