

**Fifth Five Year Review Report for
Chemical Sales Co. Superfund Site
Adams County/Denver County, Colorado**



Prepared by

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Date

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List of Acronyms

ARARS	Applicable or Relevant and Appropriate Requirements
CDPHE	Colorado Department of Public Health and the Environment
CERCLA	Comprehensive Environmental Response, Compensation, & Liability Act
CSC	Chemical Sales Company
COC	Contaminant of Concern
CT	Carbon tetrachloride
1,1-DCA	1,1-dichloroethane
1,2-DCE	cis-1,2-dichloroethylene
1,1,1-TCA	1,1,1-trichloroethane
EPA	Environmental Protection Agency
ESD	Explanation of Significant Differences
ISCO	In-Situ Chemical Oxidation
KWTF	Klein Water Treatment Facility
MC	Methylene chloride
MCLs	Maximum Contaminant Levels
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	Operation and Maintenance
OU _s	Operable Units
PCE	Tetrachloroethylene
POC	Point of Compliance
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RSL	Regional Screening Level
SACWSD	South Adams County Water and Sanitation District
SSC	Superfund State Contract
SVE	Soil Vapor Extraction
TCE	Trichloroethylene
UCL	Upper Confidence Limit
VC	Vinyl Chloride
VOC _s	Volatile Organic Compounds
WQCC	Water Quality Control Commission

I. INTRODUCTION

The purpose of a Five-Year Review (FYR) is to evaluate the implementation and performance of a remedy to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and provide recommendations to address them.

The Colorado Department of Public Health and Environment (CDPHE) is preparing this FYR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Contingency Plan (NCP)(40 CFR Section 300.430(f)(4)(ii)), and considering EPA policy.

This is the fifth FYR for the Chemical Sales Company Superfund site. The purpose of this statutory review is to evaluate the protectiveness of remedial action (CERCLA, 1980). The FYR has been prepared due to the fact that hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure.

The site consists of four Operable Units (OUs). All four of the OUs are addressed in this FYR. OU1 refers to contaminated subsurface soils and groundwater south of Sand Creek. OU2 addresses volatile organic compound (VOC) contaminated groundwater north of Sand Creek. OU3 addresses residential exposure to contaminated groundwater in OU2. OU4 addresses South Adams County Water Sanitation District (SACWSD) alluvial raw water supply wells 18, 21, and 47. The wells draw water from the alluvial aquifer within and north of OU2 and provide water to residents connected to SACWSD.

The Chemical Sales Company (CSC) Superfund site FYR was led by Ross Davis of CDPHE. Participants included Jeannine Natterman CDPHE Public Information Officer and Armando Saenz EPA Remedial Project Manager. The review began on June 26, 2017.

Site Background

In 1962, a warehouse was constructed at 4661 Monaco Street, Denver. Between 1962 and 1976, the warehouse was occupied by Samsonite and then by Gates Rubber Company. These companies reportedly used the facility as a product warehouse. CSC purchased and occupied the warehouse in October 1976. All surface and underground storage tanks, pipelines and appurtenances were installed between October 1976 and February 1977. In 1981, the EPA conducted a random national survey of drinking water systems. Organic compounds were identified within the SACWSD raw water supply groundwater wells. Additional sampling in 1982 and 1985 confirmed the presence of organic compounds. In 1985 soil gas survey and groundwater investigation identified the presence of VOCs in the vicinity of the CSC property. Additional gas surveys conducted in 1987 confirmed the presence of VOCs and groundwater wells were installed in preparation for a remedial investigation.

During the OU1 remedial investigation, completed February 1991, a groundwater contaminant plume was identified in the alluvial aquifer, emanating from the CSC property. The OU1 Record of Decision (ROD) was finalized in June 1991. The land use in OU1 is primarily industrial/commercial. The ROD for OU2 and OU3 was also finalized in June 1991. **Figure 1** illustrates the location of OU1 and OU2. OU2 land use consists of single and multi-family residences, small businesses and municipal facilities. OU3 addresses residential exposure to contaminated groundwater in OU2 and has the same boundaries as OU2. The ROD corresponding to OU4 was finalized in December 1992. The area that makes up OU4 refers to SACWSD potable supply wells 18, 21 and 47. These wells are part of a raw water supply network that provides water to residents connected to the water district.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Chemical Sales Company Superfund Site		
EPA ID: COD007431620		
Region: 8	State: CO	City/County: Denver/Adams
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	Has the site achieved construction completion? Yes	
REVIEW STATUS		
Lead agency: State of Colorado		
Author name (Federal or State Project Manager): Ross Davis		
Author affiliation: Colorado Department of Public Health and Environment		
Review period: 06/26/2017 – 9/29/2017		
Date of site inspection: March 16, 2017		
Type of review: Statutory		
Review number: 5		
Triggering action date: August 22, 2012		
Due date (<i>five years after triggering action date</i>): August 22, 2017		

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

The COCs for soil and groundwater, resulting from this remedial investigation, are listed in **Table 1** below.

Table 1: Sitewide Contaminants of Concern

Contaminant of Concern - Groundwater		
1,1-dichloroethylene	cis-1,2-dichloroethylene	1,1,1-trichloroethane
Trichloroethylene	Tetrachloroethylene	Methylene chloride
Carbon tetrachloride	Vinyl chloride	Benzene
Contaminant of Concern - Soil		
1,1-dichloroethylene	cis-1,2-dichloroethylene	1,1,1-trichloroethane
Trichloroethylene	Tetrachloroethylene	Methylene chloride

The site was listed on the National Priorities List (NPL) in August 1990 based on unacceptable risk to human health from exposure to VOCs in groundwater. Based on current and future land use, the highest potential exposure risk to human health is associated with current workers and down gradient users.

Risk based assessment of the COCs indicate that contaminants detected within OU1 pose an unacceptable potential risk to site workers. Risks posed to these populations exceed the 10^{-4} risk level. These risks represent hypothetical exposure scenarios for groundwater. However, groundwater is not currently used as drinking water within OU1.

The RI/FS for OU1 also identified potential risk associated with groundwater use downgradient of the CSC site. OUs 2, 3, and 4 were developed in order to address potential risk downgradient of the site.

Response Actions

OU1

In response to the listing of the site on the NPL, the OU1 ROD was signed in June 1991 and included the following components:

- Source area treatment of the contaminated groundwater with two air stripping towers.
- Re-injection of the treated groundwater.
- Soil vapor extraction (SVE) and air stripping for treatment of source contaminated soils.
- Catalytic oxidation for treatment of air emissions from the SVE system and air stripping unit plus recirculation of exhaust from the catalytic oxidation system.

The following remedial action objectives (RAOs) were established for OU1 groundwater and soil:

- Prevent ingestion and inhalation of groundwater 1) with carcinogens in excess of remediation levels identified in **Table 2** and, 2) which presents a total carcinogenic risk range greater than 1×10^{-6} thru 1×10^{-4} .
- Protect uncontaminated groundwater for current and future use by preventing migration of contaminants in excess of remediation levels.
- Restore contaminated groundwater to 1) remediation levels specified in **Table 2**, and 2) concentrations which present a total carcinogenic risk of 1×10^{-6} thru 1×10^{-4} .
- Prevent ingestion and inhalation and direct contact with soils above remediation levels.

In December 1995, an Explanation of Significant Differences (ESD) for OU1 was signed for the following modifications:

- Use of air sparging rather than air stripping,
- Use of resin adsorption rather than catalytic oxidation, and
- Elimination of treated exhaust recirculation from the catalytic oxidation system.

Construction of a soil vapor extraction/air sparge system for OU1 commenced in October 1998 and the remedy was considered to be operational and functional in March 2000. The vapor extraction system operated until February 2007. In March 2000, a second ESD for OU1 called for monitored natural attenuation rather than pump and treat for the plume area of OU1. In June 2007, a third ESD was signed for the decommissioning of the soil vapor extraction/air sparge system, and the remedy was changed to in-situ remediation of groundwater by chemical injection. In-situ remediation of VOCs in groundwater (ISCO injections) occurred between May 2006 and September 2013, consisting of nine separate injection events of Modified Fenton's Reagent.

OU2

OU2 is directly north of OU1 and is separated by Sand Creek. The ROD for OU2 was signed in June 1991. Two distinct groundwater plumes consisting of TCE and PCE were targeted for remediation. The major components of the remedy for OU2 included:

- Extraction of contaminated groundwater within the plumes,
- Treatment of groundwater by air stripping technology,
- Re-injection of treated groundwater through injection wells, and
- Monitoring of groundwater.

The following RAOs were established for OU2 groundwater:

- Prevent ingestion and inhalation of groundwater 1) with carcinogens in excess of remediation levels identified in **Table 2** and, 2) which presents a total carcinogenic risk range greater than 1×10^{-6} thru 1×10^{-4} .
- Restore the alluvial aquifer for COCs to levels specified in **Table 2** and to levels which pose a total carcinogenic risk of 1×10^{-6} thru 1×10^{-4} .
- Prevent migration of contaminants in excess of levels specified in **Table 2**.

In 1994, new information indicated that the PCE plume had dispersed and no longer required active treatment. An ESD for OU2 was signed in November 1994 that eliminated the requirement for active treatment. Groundwater monitoring facilitated by an existing groundwater monitoring network is still required to be conducted every two years. **Figure 3** illustrates the groundwater monitoring network.

OU3

The ROD for OU3 was signed in June 1991. Response actions for OU3 focused on reducing exposure pathways for residents in OU2. The major components of the remedy for OU3 included:

- Identification of 15 private alluvial wells within OU2.
- September 1992, 14 eligible residences were connected to SACWSD water distribution system.
- September 2008, a letter was sent to the remaining residence as notification of groundwater contamination (this resident refused to be connected to SACWSD).
- ICs are currently in place to prevent installation of new groundwater wells within OU2.

OU4

The ROD for OU4 was signed in December 1992. OU4 response actions address SACWSD potable water supply wells 18, 21 and 47. These wells draw water from the alluvial aquifer within and north of OU2 and distribute water to residents connected to SACWSD, **Figure 4**. Based on observed contaminant concentrations below Maximum Contaminant Levels (MCLs), a No-Action ROD was signed in September 1999. The three wells are scheduled for continued monitoring by SACWSD.

Clean-up Standards

Acceptable groundwater remediation levels and soil remediation levels as determined by chemical specific ARARs are presented in **Table 2**.

Table 2: Remediation Levels

Contaminant of Concern - Groundwater	Remediation Level (µg/L)	Operable Unit
1,1-dichloroethylene (1,1-DCE)	≤ 5.0	OU1 / OU2
cis-1,2-dichloroethylene (1,2-DCE)	≤ 7.0	OU1 / OU2
1,1,1-trichloroethane (1,1,1-TCA)	≤ 200	OU1 / OU2
Trichloroethylene (TCE)	≤ 5.0	OU1 / OU2
Tetrachloroethylene (PCE)	≤ 5.0	OU1 / OU2
Methylene chloride (MC)	≤ 10.0	OU1 / OU2
Carbon tetrachloride (CT)	≤ 5.0	OU1 / OU2
Vinyl chloride (VC)	≤ 2.0	OU1 / OU2
Benzene ²	≤ 5.0	OU2
Contaminant of Concern - Soil	Remediation Level (ppm)	Operable Unit
1,1-dichloroethylene (1,1-DCE)	≤ 0.105	OU1
cis-1,2-dichloroethylene (1,2-DCE)	≤ 0.090	OU1
1,1,1-trichloroethane (1,1,1-TCA)	≤ 4.400	OU1
Trichloroethylene (TCE)	≤ 0.115	OU1
Tetrachloroethylene (PCE)	≤ 0.150	OU1
Methylene chloride (MC)	≤ 0.140	OU1

Status of Implementation

Following the completion of the remedial investigation in 1991, RODs were signed for OU1, OU2, OU3 and OU4.

OU1 has undergone a number of remedial actions that include source area treatment of the contaminated groundwater with two air stripping towers and soil vapor extraction and air stripping for treatment of contaminated soils from October 1998 to March 2007. A June 2007 ESD, permitted the decommissioning of the soil vapor extraction/air sparge system and the remedy was changed to in-situ remediation of groundwater by chemical injection. Between May 2006 and September 2013 nine separate injection events of Modified Fenton's Reagent were completed to address VOC contamination. In 2012, the WQCC established a groundwater standard for emerging contaminant 1,4-D of 0.35µg/L. CDPHE decided to discontinue remedial injections in 2014 to conduct groundwater sampling to reassess the extent of the VOCs and the in-situ remedy.

OU2 was initially scheduled for a remedial action that included pumping and treating the groundwater, however, new information in 1994 indicated the contaminants had dispersed and that active treatment was no longer needed. A 1994 ESD removed active treatment components from the OU2 remedy. The other components of the OU2 remedy were unchanged. Groundwater monitoring is required every two years.

As a part of OU3 remedial action, 14 of 15 domestic groundwater wells within OU2 have been decommissioned and those properties have been connected to SACWSD water distribution network. The remaining property owner has been notified about the groundwater contamination in the area.

A ROD was signed for OU4 in 1992. A ROD Amendment was signed for OU4 in 1999 changing the remedy to no action. SACWSD potable water supply wells 18, 21 and 47 are scheduled for continued monitoring by SACWSD.

SACWSD provides ICs through its authority to establish/enforce use of groundwater within the district that includes OU1 and OU2. SACWSD has established restrictions on the installation and use of groundwater wells for the alluvial aquifer. Furthermore, the State Engineer's Office of the Department of Natural Resources has established informational ICs that notify well applicants of the groundwater contamination associated with the CSC property.

III. PROGRESS SINCE THE LAST REVIEW

This section includes the protectiveness determinations and statements from the **last** five-year review as well as the recommendations from the **last** five-year review and the current status of those recommendations (EPA, 2012).

Table 3: Protectiveness Determinations/Statements from the 2012 FYR

OU #	Protectiveness Determination	Protectiveness Statement
1	Protective	OU1 is currently protective of human health and the environment.
2	Protective	OU2 is currently protective of human health and the environment.
3	Protective	OU3 is currently protective of human health and the environment.
4	Protective	OU4 is currently protective of human health and the environment.
Sitewide	Short-term Protective	Because the remedies at all OUs are protective or protective in the short term, the site is currently protective of human health and the environment.

Table 4: Status of Recommendations from the 2012 FYR

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
1&2	VOC levels remain above remediation levels in source area groundwater.	Additional ISCO injections should be conducted in the vicinity of TMW-7/TMW-12 until VOC levels decrease to remediation levels or reach a steady state. Current sampling programs for OU1/OU2 should continue to monitor the performance and impacts of the ISCO injections.	Considered but not implemented	Implementation is currently suspended to review the effectiveness of ISCO injections.	Injections have not been resumed. ISCO injections June 2013 Sept. 2013 ISCO Suspension 2014
1&2	1,4-D is considered an “emerging contaminant” and may be present in groundwater at the site. The contaminant is currently not in the analytical suite for Monitoring.	Evaluate the presence of 1,4-D in groundwater and, if present, determine whether it should be added to the analytical suite for monitoring.	Completed	Groundwater has been sampled and analyzed for 1,4-D. The contaminant has been detected and the nature and extent of contamination has been evaluated. 1,4-D has been added to the analytical suite for monitoring.	Sampling dates: 8/29/2012 6/10/2013 6/3/2014 4/22/2015

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Interviews

A public notice was published on June 15, 2017 by a press release titled *Colorado Department of Public Health and Environment U.S. Environmental Protection Agency, Region 8 Announces Five-Year-Review Chemical Sales Company, Denver, Adams County, Colorado*. Within this announcement, EPA and CDPHE invited community participation in the five-year review process. The results of the review and the report will be made available at the CDPHE Hazardous Materials Management Records Center located at 4300 Cherry Creek South Drive, Denver, CO 80246, or online at <https://cumulis.epa.gov/supercpad/cursites/csinfo.cfm?id=0800866>.

During the FYR process, an interview was conducted to document any perceived problems or successes with the remedies that have been implemented to date. The results of this interview are summarized below.

Jen Rutter, Senior Environmental Analyst at Adams County, was interviewed in support of the Chemical Sales Company Superfund site FYR process. Although Ms. Rutter acknowledged to knowing very little about the site, she attributed much of this to having not received any complaints or inquiries about it. She

recommended regular updates, perhaps twice a year, in an electronic newsletter format to keep people informed about known and emergent contaminants. She expressed concern about the potential health implications for communities in the path of groundwater contamination coming from the site. Ms. Rutter also expressed concern for SACWSD and Commerce City in the event this issue becomes a frequent topic of discussion throughout the community.

Data Review

OUI

For analysis purposes, OUI is divided into two areas, the source area and the plume area. The division between these areas is approximately East 48th Avenue that trends east-west. The area south of 48th Ave. is considered the source area and the area north of 48th is the plume area. Furthermore, data for PCE and TCE are presented herein, as they are the COCs that occur in highest concentration in both areas. Other COCs are degradation daughter products of these two constituents. A table detailing the full analytical results for all COCs is provided in Appendix C.

A summary of analytical results is presented in **Table 5**. Sampling events from August 2012 (ISOTEC, 2012), June 2013 (ISOTEC, 2013), June 2014 (ISOTEC, 2014) and April 2015 (ISOTEC, 2015) all indicate the presence of COCs within groundwater at concentrations exceeding remediation levels and 1,4-D in groundwater exceeding the Colorado Groundwater Standard. A visual representation of the estimated April 2015 plume extent for TCE, PCE and 1,4-D are provided in **Figures 5, 6 and 7**, respectively. Consistent with the previous FYR, **Figure 5** and **Figure 6** show that TCE and PCE have crossed Sand Creek and are migrating in a northerly direction. **Figure 7** shows that 1,4-D has migrated ahead of TCE and PCE in the same northerly direction beyond the extent of OU2.

ISCO injections have had varying success in treating COCs. Bench scale treatability studies had shown that Modified Fenton's Reagent is very effective in treating TCE, PCE and 1,4-D. However, concentration assessment of COCs and 1,4-D between injection events was inconclusive and did not present a strong trend. ISCO injections were suspended in 2014 to reassess the extent of VOCs in groundwater and investigate the nature and extent of 1,4-D.

To provide statistical interpretation of the data and gain a better understanding of ISCO effectiveness, EPA's groundwater statistics tool (EPA, 2014) was used to evaluate COC concentration trends on a well-by-well basis. The tool evaluates a single COC at a single well. At a minimum, four data points are required to complete trend analysis. To evaluate the effectiveness of remedial techniques, time dependent trend lines have been established for wells that meet data requirements. A summary of the trend analysis is provided in **Table 6**.

Analytical results in **Table 5** and trend analysis summarized in **Table 6** indicate that ISCO appears to have been effective/successful in reducing overall TCE contamination within the source area. Statistical analysis of the source area identified eight wells with decreasing concentrations and four wells with increasing trends. There was insufficient data to carryout statistical analysis of the plume area, however, inspection of the available data indicates four wells with decreasing concentrations and two wells with increasing. Overall, the data suggests ISCO has been moderately effective in treating TCE. The estimated extent, as of April 2015, of the TCE contaminant plume is presented in **Figure 5**.

Analytical results in **Table 5** and trend analysis summarized in **Table 6** indicate PCE concentrations have significantly decreased in the source area as a result of ISCO remediation. Within the source area, there are 11 wells with statistically significant decreasing concentrations and two wells with increasing trends. Assessment of the plume area data offers mixed results for PCE. Three wells have decreasing and three wells have increasing concentrations. Overall, the data suggest ISCO has been an effective tool in reducing

PCE concentration within the source area. The estimated extent, as of April 2015, of the PCE contaminant plume is presented in **Figure 6**.

It is difficult to determine the effect of ISCO on 1,4-D within OU1. The majority of the wells provided insufficient data to carryout statistical analysis. Two wells (LSS-MW-13 and LSS-MW-14) have enough data to conduct statistical analysis. These two source area wells indicate a statistically significant decrease in 1,4-D concentration with time. Visual inspection of the remaining well data indicate the source area contains nine wells with concentration decrease and six wells with concentration increase. The plume area provides a more revealing story. One well showed a concentration decrease while seven wells showed concentration increase. This is likely due to the ability of 1,4-D to migrate faster than COCs. The rapid migration of 1,4 D ahead of other contaminants likely occurs due to its weak sorption to soil particles. 1,4-D is difficult to treat due to its miscibility in groundwater. According to the trend analysis, source area concentrations appear to be slightly decreasing while the plume area concentrations are increasing. Overall, source area ISCO injections appear to be marginally effective to ineffective in treating 1,4-D. The estimated extent, as of April 2015, of the 1,4-D contaminant plume is presented in **Figure 7**, which also presents SACWSD raw water supply wells.

Appendix D includes trend analysis results for individual wells within OU1 that meet data requirements. A summary of trend analysis results is presented in **Table 6**.

Analytical assessment of soil was not conducted during the data period for this FYR. It is recommended that soil samples be collected to evaluate the presence of COCs and compare concentrations to soil remediation levels.

Table 5: OUI Analytical Results Summary 2012-2015

Well ID	Area	TCE				PCE				1,4-D			
Date		Aug. 2012	June 2013	June 2014	Apr. 2015	Aug. 2012	June 2013	June 2014	Apr. 2015	Aug. 2012	June 2013	June 2014	Apr. 2015
Standard (µg/L)		≤ 5.0				≤ 5.0				≤ 0.35			
TMW-1	Source	470	500	450	240	2000	2200	590	620	-	3500	1500	2100
TMW-2	Source	88	140	170	45	370	620	480	68	-	460	390	530
TMW-3	Source	50	36	17	16	250	230	76	57	-	200	150	140
TMW-4	Source	91	110	110	100	460	940	980	220	-	96	180	210
TMW-5	Source	690	200	190	390	3400	2300	390	1200	-	360	360	540
TMW-6	Source	330	250	160	110	1800	3000	2200	300	-	240	180	160
TMW-7	Source	1100	450	140	100	6100	2100	5700	3100	-	95	670	540
TMW-8	Source	12	ND	4.6	4.3	160	260	120	33	-	18	3.9	12
TMW-9	Source	25	41	29	22	880	940	420	290	-	14	12	14
TMW-11	Source	260	390	490	340	1300	1400	1400	1000	-	1400	840	550
TMW-12	Source	57	770	110	980	1400	2600	2800	7000	-	67	240	210
LSS-MW-11	Source	-	640	610	-	-	400	420	-	-	2.2	0.8	-
LSS-MW-12	Source	-	160	110	130	-	180	150	160	-	30	27	28
LSS-MW-13	Source	200	460	65	120	1400	2000	330	520	21	160	6	38
LSS-MW-14	Source	14	29	33	32	94	400	300	330	180	120	110	130
CDM-PZ-5	Source	110	100	150	-	-	560	630	-	77	30	39	-
CDM-MW-4	Plume	-	17	19	-	-	24	22	-	-	1.3	1.4	-
CDM-MW-34-1A	Plume	-	ND	ND	ND	-	ND	ND	ND	-	ND	0.37	0.36
CDM-MW-34-1B	Plume	-	130	-	96	-	12	-	15	-	4.3	-	7.8
CDM-MW-34-1C	Plume	-	13	ND	8.8	-	ND	20	ND	-	4.8	6.2	ND
CDM-PZ-2	Plume	-	12	ND	ND	-	24	ND	ND	-	ND	0.46	4.5
FIT-MW-5	Plume	-	ND	12	-	-	ND	18	-	-	11	9.4	-
LSS-MW-20A	Plume	-	8.2	7.5	7.1	-	18	12	15	-	10	12	12
LSS-MW-20B	Plume	-	13	11	12	-	15	11	17	-	11	12	12
LSS-MW-22B	Plume	-	6.4	24	18	-	12	31	37	-	2.8	3.8	11

ND – Non-detect

– Sample not collected

BOLD indicates exceedance of Remediation Level

Table 6: OUI Trend Analysis

Well	Area	COC	Trend	Comment
TMW-1	Source	1,4-D	-	Insufficient data
		TCE	-0.230	Statistical decreasing trend of concentration with time
		PCE	-1.80	Statistical decreasing trend of concentration with time
TMW-2	Source	1,4-D	-	Insufficient data
		TCE	-0.032	Statistical decreasing trend of concentration with time
		PCE	-0.035	Statistical decreasing trend of concentration with time
TMW-3	Source	1,4-D	-	Insufficient data
		TCE	-0.037	Statistical decreasing trend of concentration with time
		PCE	-0.227	Statistical decreasing trend of concentration with time
TMW-4	Source	1,4-D	-	Insufficient data
		TCE	0.007	Trend expresses increasing concentration
		PCE	-0.226	Statistical decreasing trend of concentration with time
TMW-5	Source	1,4-D	-	Insufficient data
		TCE	-0.264	Statistical decreasing trend of concentration with time
		PCE	-2.611	Statistical decreasing trend of concentration with time
TMW-6	Source	1,4-D	-	Insufficient data
		TCE	-0.229	Statistical decreasing trend of concentration with time
		PCE	-1.688	Statistical decreasing trend of concentration with time
TMW-7	Source	1,4-D	-	Insufficient data
		TCE	Negative*	Negative concentrations are predicted by linear regression
		PCE	-1.495	Statistical decreasing trend of concentration with time
TMW-8	Source	1,4-D	-	Insufficient data
		TCE	-	Insufficient data
		PCE	-0.165	Statistical decreasing trend of concentration with time
TMW-9	Source	1,4-D	-	Insufficient data
		TCE	-0.007	Statistical decreasing trend of concentration with time
		PCE	-0.715	Statistical decreasing trend of concentration with time
TMW-11	Source	1,4-D	-	Insufficient data
		TCE	0.101	Trend expresses increasing concentration
		PCE	-0.281	Statistical decreasing trend of concentration with time
TMW-12	Source	1,4-D	-	Insufficient data
		TCE	0.620	Trend expresses increasing concentration
		PCE	5.216	Trend expresses increasing concentration
LSS-MW-13	Source	1,4-D	-0.038	Statistical decreasing trend of concentration with time
		TCE	-0.209	Statistical decreasing trend of concentration with time
		PCE	-1.369	Statistical decreasing trend of concentration with time
LSS-MW-14	Source	1,4-D	-0.047	Statistical decreasing trend of concentration with time
		TCE	0.017	Trend expresses increasing concentration
		PCE	0.176	Trend expresses increasing concentration
Totals	Source	1,4-D	11 insufficient 2 decreasing	Data requirements have not been established to evaluate trends for 1,4-D.
		TCE	8 decreasing 4 increasing	In general, the number of negative trending wells is greater than the number of positive trending.
		PCE	11 decreasing 2 increasing	In general, the number of negative trending wells is greater than the number of positive trending.

* Trend calculations cannot be performed because negative concentrations are predicted by linear regression (Steep trend in data).

OU2

Groundwater monitoring for OU2 occurred in September 2012 (CDPHE, 2012b). Samples were collected from eight wells throughout the area. A summary of the analytical results is presented in **Table 7**. Concentrations of TCE and PCE in well FIT-IM-WP-02 were elevated. FIT-IM-WP-02 is located near OU1 on the north side of Sand Creek, refer to **Figure 3**. This is the only well in OU2 with reported concentrations of TCE and PCE above remediation levels. All other monitoring locations reported non-detects or detections below groundwater remediation levels. 1,4-D analysis was not included in the analytical suite for this groundwater monitoring event.

Due to the absence of more recent data, data analysis for OU2 was based on data collected in 2011. There is a general decline in TCE and PCE concentrations within OU2, with the exception of monitoring well FIT-IM-WP-02. This is the only location where TCE and PCE remain above the groundwater remediation level and expresses increasing concentration. **Figure 5** and **Figure 6** show TCE and PCE plumes within the southern portion of OU2.

Figure 3 not only presents the groundwater monitoring wells for OU2, but also illustrates the location of SACWSD shallow alluvial aquifer raw water supply wells. Furthermore, **Figure 7** illustrates the approximate April 2015 extent 1,4-D groundwater contamination with reference to SACWSD raw water supply wells.

Table 7: OU2 Analytical Results Summary September 2012

Well ID	Benzene	1,1-DCA	1,1-DCE	1,2-DCE	1,1,1-TCA	TCE	PCE	VC
Standard (µg/L)	≤ 5.0	≤ 5.0	≤ 7.0	≤ 70	≤ 200	≤ 5.0	≤ 5.0	≤ 5.0
CMW-05	-	-	-	-	-	(4.9) 1.7	(8.4) 4.1	-
CME-06	-	-	-	-	-	-	-	-
CMW-17	-	-	-	-	-	-	-	-
CDM-198-605	-	-	-	-	-	(2.2) 1.2	(5.2) 3.3	-
CDM-198-614	-	-	-	-	-	-	0.94	-
FIT-IM-WP-01	-	-	-	-	-	-	3.4	-
FIT-IM-WP-02	-	3.3	2.0	4.5	-	(6.0) 8.5	(11) 15	-
FIT-IM-WP-03	-	1.9	-	-	-	0.57	-	-

- Indicates non-detect

(##) indicates 2011 concentration

BOLD indicates exceedance of Remediation Level

OU3

OU3 addresses residential exposure to contaminated groundwater and has the same boundaries as OU2. ICs are in place to reduce the risk of residential exposure to COCs. SACWSD has established restrictions on the installation and use of groundwater wells for the alluvial aquifer. Furthermore, the Division of Water Resources maintains a notification process for well applications within the contaminated groundwater plumes (OU1 and OU2) associated with the Chemical Sales Superfund site (DWR, 2009). The notice specifies that the applicant should contact the EPA or CDPHE for information regarding groundwater quality. The Colorado Decision Support System EPA Notification Area map is presented along with the notification letter in Appendix E.

OU4

SACWSD provided shallow alluvial raw water supply well data for OU4 that includes wells 18, 21 and 47. This data is comprised of monthly sampling for VOCs and 1,4-D from 2012 through 2016. The data revealed that TCE and PCE were not detected in Wells 18, 21 and 47 above groundwater remediation levels. However, 1,4-D has been observed above the Colorado Groundwater Standard in Wells 18 and 47. A summary of the analytical results is presented in **Table 8**. Trend analysis using EPA's groundwater statistics tool was conducted on all three wells. A summary of the statistical analysis is in **Table 9** and described below.

Well 18 demonstrates an increasing trend in 1,4-D concentration that is above the groundwater standard. Well 21 demonstrates a decreasing trend where every concentration observation has been below the groundwater standard. Well 47 demonstrates decreasing concentration of 1,4-D. Only recently (October 2016) has the concentration of 1,4-D been observed below the groundwater standard within Well 47.

As mentioned in the data review for OU2, **Figure 3** illustrates the location of SACWSD shallow alluvial aquifer raw water supply wells. Furthermore, **Figure 7** presents the approximate April 2015 extent 1,4-dioxane groundwater contamination with reference to SACWSD raw water supply wells.

Table 8: OU4 1,4-D Analytical Results Summary

Date	1,4-dioxane		
	Well 18	Well 21	Well 47
SACWSD Raw Water Well			
Groundwater Standard (µg/L)	0.35		
Jun-12	0.57	0.16	0.45
Dec-12	1.00	0.17	0.74
Feb-13	0.96	0.20	0.54
Apr-13	0.89	0.23	0.39
Aug-13	0.79	-	0.49
Oct-13	0.98	0.07	0.45
Mar-14	0.81	0.13	0.33
Apr-14	0.87	0.18	0.33
Jun-14	0.70	0.12	0.22
Aug-14	0.76	0.11	0.29
Jun-15	0.92	0.09	0.67
Aug-15	0.63	0.10	0.44
Oct-15	1.04	0.11	-
Dec-15	0.72	-	-
Apr-16	1.22	-	-
Jun-16	0.96	-	-
Sep-16	1.50	-	-
Oct-16	2.15	0.08	0.18

Table 9: OU4 Trend Analysis June 2012 - October 2016

Well	Area	COC	Trend	Comment
Well 18	Potable well	1,4-D	0.00038	Increasing trend. All data (June 2012 – October 2016) are above groundwater standard of 0.35µg/L.
Well 21	Potable well	1,4-D	-5.370E ⁻⁵	Decreasing trend. All data (June 2012 – October 2016) are below groundwater standard of 0.35µg/L.
Well 47	Potable well	1,4-D	-0.00020	Decreasing trend. Since August 2016, concentrations have been below groundwater standard of 0.35µg/L.
Totals	Potable wells	1,4-D	2 decreasing 1 increasing	The rate of increasing concentration in well 18 is greater than the rate of decreasing concentration for well 21 and 47. In addition, all of the observations from Well 18 are above the groundwater standard.

To further address the presence of 1,4-D with respect to OU4, risk calculations were conducted by an EPA Toxicologist for Wells 18, 21 and 47 (EPA, 2017). This calculation utilized monitoring data from June 2012 through October 2016 to establish 95 percent upper confidence limits (UCL) for this time period. A summary of these results are presented in **Table 10** along with 95 percent UCL risk results. 1,4-D 95 percent UCL concentrations reveal that well 18 exceeds the EPA regional screening level (RSL) for residential tap water, while wells 21 and 47 are under this limit. However, well 18 is a raw water supply well that is pumped to the Klein Water Treatment Facility.

1,4-D risk results from wells 18, 21 and 47 are within the Superfund Risk range of 1×10^{-6} to 1×10^{-4} . The EPA RSL of 0.46 µg/L for 1,4-D in tap water is an advisory level and is not an enforceable cleanup standard, however it provides a useful gauge to evaluate potential unacceptable exposures.

As mentioned, supply well 18 contains 1,4-D concentrations above the EPA RSL. Water from well 18 is pumped to the Klein Water Treatment Facility. After treatment, this water is distributed to supply reservoirs 1, 2, 3, 5, 9, and 10. Furthermore, reservoirs 6, 7 and 8 receive well 18 water indirectly from distribution water that is added to dilute fluoride levels in deeper, non-alluvial, supply wells that fill these reservoirs. Reservoir 4 receives water from supply wells 21, 47 and 88.

Since water from well 18 is distributed to 9 of the 10 supply reservoirs for SACWSD, 95 percent UCL concentration and risk calculations were conducted on all 10 reservoirs. SACWSD supplied 1,4-D data from all 10 reservoirs from May 2013 through December 2016, that was used to conduct EPA UCL calculations. A summary of the concentrations and risk is presented against EPA RSL and Superfund Risk range for 1,4-D in **Table 11**. This table shows that all of the supply reservoirs exceed the EPA RSL of 0.46µg/L for residential tap water, but are within the Superfund risk range.

A memorandum from the EPA containing risk calculations for 1,4-D is included in Appendix E.

Table 10: OU4 1,4-D Raw Water Supply Risk June 2012 - October 2016

Well	Reservoir	95% UCL Concentration (µg/L)	EPA RSL Residential Tap Water (µg/L)	95% UCL Risk	Superfund Risk Range	Comment
Well 18	1, 2, 3, 5, 6, 7, 8, 9, 10	1.05	0.46	2.29E ⁻⁶	1.0E ⁻⁶ – 1.0E ⁻⁴	Concentration exceeds EPA Regional Screening Level for residential tap water, but is within Superfund risk range.
Well 21	4	0.14	0.46	NC	1.0E ⁻⁶ – 1.0E ⁻⁴	Concentration is less than EPA regional screening level, therefore risk calculations are not conducted.
Well 47	4	0.458	0.46	NC	1.0E ⁻⁶ – 1.0E ⁻⁴	Concentration is less than EPA regional screening level, therefore risk calculations are not conducted.

Table 11: Treated Water Reservoirs 1,4-D Risk May 2013 - December 2016

Reservoir	95% UCL Concentration (µg/L)	EPA RSL Residential Tap Water (µg/L)	95% UCL Risk	Superfund Risk Range
1	2.455	0.46	5.35E ⁻⁶	1.0E ⁻⁶ – 1.0E ⁻⁴
2	1.76	0.46	3.83E ⁻⁶	1.0E ⁻⁶ – 1.0E ⁻⁴
3	1.556	0.46	3.39E ⁻⁶	1.0E ⁻⁶ – 1.0E ⁻⁴
4	1.085	0.46	2.35E ⁻⁶	1.0E ⁻⁶ – 1.0E ⁻⁴
5	1.834	0.46	4.00E ⁻⁶	1.0E ⁻⁶ – 1.0E ⁻⁴
6	1.138	0.46	2.48E ⁻⁶	1.0E ⁻⁶ – 1.0E ⁻⁴
7	0.82	0.46	1.79E ⁻⁶	1.0E ⁻⁶ – 1.0E ⁻⁴
8	0.561	0.46	1.22E ⁻⁶	1.0E ⁻⁶ – 1.0E ⁻⁴
9	2.085	0.46	4.54E ⁻⁶	1.0E ⁻⁶ – 1.0E ⁻⁴
10	2.222	0.46	4.84E ⁻⁶	1.0E ⁻⁶ – 1.0E ⁻⁴

Groundwater RAOs are presented in Section II. In general, ICs for OU1, OU2 and OU3 reduce risk from ingestion and inhalation exposure pathways to within the acceptable risk range (**Table 2**). Since ISCO injections were suspended for 2014, there are currently no controls or operating remedies in place (except natural attenuation) to reduce COC concentrations. A point of compliance was not established for the site and contaminants have migrated from the source area. The previous remedies along with the most recent remedy (ISCO injection) do not have a mechanism, other than reducing COC concentrations, to protect uncontaminated groundwater for current and future use.

The previous remedies have not addressed contaminant migration from the source area. Contaminant migration and protection of uncontaminated groundwater for current and future use is an established RAO for OU1 and OU2 that is potentially not being achieved.

Considering the maximum concentration of TCE (980 µg/L) and PCE (7,000 µg/L) in the source area of OU1, achievement of remediation levels of 5µg/L for these constituents will either take a very long time or is impracticable under the current remedy.

Colorado Groundwater Standards that existed at the time of the RODs for this site are identified as ARARs for OU1 and OU2. As previously mentioned, the WQCC established a Colorado Groundwater Standard for emerging contaminant 1,4-D of 0.35 µg/L in 2012. Results from sampling conducted since the last FYR show exceedances of the 1,4-D State groundwater standard throughout the site. It is recommended that EPA and the State consider 1,4-D as a COC, establish a cleanup level for 1,4-D, and, if necessary, consider and analyze remedial alternatives to address 1,4-D at this site.

Site Inspection

An inspection of the site was conducted on March 16th 2017. In attendance were Ross Davis, Fonda Apostolopoulos and Kyle Sandor – CDPHE. The purpose of the inspection was to assess protectiveness of the remedy, in particular observing site access, source area conditions and groundwater monitoring well network viability.

David Bird is the Plant Manager at Acme Manufacturing Company and the point of contact for property access. David grants access to the property and notifies CDPHE of any activity within the OU1 source area. The source area is accessed through a locked gate located on the Acme property. Source area groundwater monitoring wells are located on an undeveloped portion of the property. Inspection of the wells confirmed that the monitor wells have not been damaged and are viable for future sampling.

OU1 plume area wells were also inspected. Since the last FYR, a number of wells have been damaged and are no longer available for groundwater sample collection. CDM-4 is a flush mounted well that could not be located. The well may have been buried under asphalt during roadwork near the well. Wells CDM-MW-34-1A, CDM-MW-34-1B and CDM-MW-34-1C were damaged by flooding events associated with Sand Creek. These wells were determined to be unusable for future groundwater monitoring. Continued groundwater data collection associated with these damaged wells is not an issue due to the location of newly installed wells. 17 newly installed plume area wells were also inspected. These wells are intact and scheduled for dedicated pump installation for long-term monitoring.

V. TECHNICAL ASSESSMENT

QUESTION A: Is the remedy functioning as intended by the RODs?

Question A Summary:

No, the remedy is not functioning as intended by the ROD. The selected remedy addresses groundwater contamination in OU1. Remedial techniques have changed throughout the project lifecycle. The most recent technique utilized ISCO of VOCs to address groundwater contamination. Remediation levels have not been achieved.

Remedial Action Performance

Performance of remedial action indicates progress toward achievement of groundwater remediation levels. The majority of wells within the source area demonstrate a statistically decreasing trend for TCE (8 of 12 well decreasing) and PCE (11 of 13 wells decreasing) concentrations. Lack of data availability limited statistical analysis for the plume area. Preliminary evaluation indicates that several wells show a decreasing concentration trend for TCE (4 of 6 wells decreasing) and PCE (3 of 6 wells decreasing).

1,4-D is not a COC in the ROD. However, data indicates that ISCO weakly affects 1,4-D. Furthermore, 1,4-D is migrating down gradient at a faster rate than TCE and PCE due to its miscibility in groundwater.

The RAO for OU1 that states “protect uncontaminated groundwater for current and future use by preventing migration of contaminants in excess of remediation levels” is potentially not being met. Groundwater with contaminants in excess of remediation levels has historically and is currently migrating. It is for this reason the remedy is evaluated not to be functioning as intended in the decision document.

System Operations

ISCO injections were suspended in 2014 to evaluate its effectiveness in treating VOCs, as well as, investigate the presence of 1,4-D. ISCO injections have not resumed.

Institutional Controls

ICs are maintained within OU1 to reduce site personnel’s risk of exposure to COCs. SACWSD has established restrictions on the installation and use of groundwater wells for the alluvial aquifer within OU1 and OU2. Furthermore, the Division of Water Resources maintains a notification process to inform groundwater well permit applicants of potential groundwater contamination within the OU1 and OU2.

QUESTION B: Are the exposure assumptions, toxicity data and cleanup levels, and RAOs used at the time of the remedy selection still valid?

Question B Summary:

No, exposure assumptions, toxicity data, cleanup levels and RAOs established at the time of remedy selection require updating. Currently exposure assumptions and toxicity data for 1,4-D are not established in a ROD. Colorado Groundwater Standards are referenced as a chemical specific ARAR for OU1 & OU2.

RAOs also require attention, specifically the requirement for prevention of contaminant migration. Prevention of contaminant migration above remediation levels is likely to be unachievable until concentrations in the source area are below remediation levels.

Exposure Assumptions and Toxicity Data

Exposure assumptions for on-site personnel are still valid and ICs are in place to prevent ingestion and inhalation of groundwater within OU1, OU2, & OU3. However, down gradient users, OU4 - SACWSD, and residential areas provide potential exposure pathways to 1,4-D that are not addressed by the present ICs. Risk based calculations for 1,4-D indicate that SACWSD raw water supply wells contain concentrations of 1,4-D within the acceptable risk range established by CERCLA. However, the concentration of 1,4-D at the raw water supply wells is above the Colorado Groundwater Standard as well as the EPA RSL for residential tap water.

Remedial Action Objectives

The protection of uncontaminated groundwater for current and future use by preventing migration of contaminants in excess of remediation levels is an RAO in the ROD for OU1. There is data from 2011 & 2012 to suggest that source area remediation is not meeting this RAO. Groundwater with COC concentrations above remediation levels may be migrating beyond OU1.

Expected Progress Toward Meeting RAOs

TCE and PCE are trending towards achievement of remediation levels. However, in the OU1 source area, it may be technically impracticable to achieve remediation goals for TCE and PCE.

QUESTION C: Has any other information come to light that could call into question the protectiveness of the remedy?

Question C Summary:

No, there is no additional information that has come to light that could call into question the protectiveness of the remedy.

VI. ISSUES/RECOMMENDATIONS

Issues and Recommendations Identified in the Five-Year Review:				
OU(s): OU1	Issue Category: Remedy Performance			
	Issue: VOCs are present in groundwater but no active remediation is occurring.			
	Recommendation: Additional ISCO injections should be conducted in the vicinity of TMW-7/TMW-12 until VOC levels decrease to remediation levels or reach a steady State. Current sampling programs for OU1/OU2 should continue to monitor the performance and impacts of the ISCO injections.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
Yes	Yes	EPA/State	EPA/State	5/1/2018
OU(s): OU1	Issue Category: Remedy Performance			
	Issue: VOCs may be migrating in excess of remediation levels.			
	Recommendation: Reestablish monitoring within OU2 to confirm whether migration of COCs from OU1 in excess of remediation levels is occurring.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
Yes	Yes	State	EPA	5/1/2018

OU(s): OU1, OU2, OU4	Issue Category: Remedy Performance			
	Issue: 1,4-dioxane is not currently a contaminant of concern.			
	Recommendation: Include 1,4-D as a COC, establish a remediation level, and, if determined necessary, analyze potential remedial alternatives to address 1,4-D.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
Yes	Yes	State	EPA	5/1/2018
OU(s): OU1	Issue Category: Remedy Performance			
	Issue: Recent soil sampling has not been completed.			
	Recommendation: Soil samples be collected to evaluate the presence of COCs and compare concentrations to soil remediation levels			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
Yes	Yes	State	EPA	5/1/2018

VII. PROTECTIVENESS STATEMENT

Protectiveness		
Operable Unit:1	Protectiveness Determination: Short-term Protective	
Protectiveness Statement: The remedy at OU1 protects human health and the environment because institutional controls are in place to prohibit the use of groundwater within OU1. However, in order for the remedy to be protective in the long-term, potential migration of contaminants above remediation levels needs to be determined.		
Operable Unit:2	Protectiveness Determination: Short-term Protective	
Protectiveness Statement: The remedy at OU2 protects human health and the environment because institutional controls are in place to prohibit the use of groundwater within OU2. However, in order for the remedy to be protective in the long-term, potential migration of contaminants above remediation levels from OU1 needs to be determined		
Operable Unit:3	Protectiveness Determination: Protective	
Protectiveness Statement: The remedy at OU3 is protective of human health and the environment.		
Operable Unit:4	Protectiveness Determination: Protectiveness Deferred	Planned Addendum Completion Date:
Protectiveness Statement: A protectiveness determination of the remedy at OU4 cannot be made at this time until further information is obtained. Further information will be obtained by including 1,4-D as a COC, establishing a remediation level, and, if determined necessary, analyzing potential remedial alternatives to address 1,4-D. It is expected that these actions will take approximately 9 months to establish a preliminary remediation goal, at which time a protectiveness determination will be made.		

Sitewide Protectiveness Statement	
Protectiveness Determination: Protectiveness Deferred	Planned Addendum Completion Date: May 1, 2018
<i>Protectiveness Statement: The Sitewide protectiveness determination is deferred. This is because the protectiveness of the remedy for OU4 is deferred. Further information will be obtained by including 1,4-D as a COC, establishing a remediation level, and, if determined necessary, analyzing potential remedial alternatives to address 1,4-D. It is expected that these actions will take approximately 9 months to establish a preliminary remediation goal, at which time a protectiveness determination will be made.</i>	

VIII. NEXT REVIEW

The next five-year review report for the Chemical Sales Superfund site is required five years from the completion date of this review.

APPENDIX A – REFERENCE LIST

EPA, 1991 – Record of Decision Chemical Sales Superfund Site, 1991, United States Environmental Protection Agency.

CERCLA, 1980 – Comprehensive Environmental Response, Compensation and Liability Act, 1980, §121(c) United States Environmental Protection Agency.

CDPHE, 2012 – Fourth Five-Year Review Report for Chemical Sales Company Superfund Site – Denver and Adams County, 2012, Colorado Department of Public Health and Environment.

ISOTEC, 2012 – In-Situ Chemical Oxidation Remediation Program Progress Report – Former Chemical Sales Facility, 2012, Is-Situ Oxidative Technologies, Inc.

ISOTEC, 2013 – Remediation Program Groundwater Monitoring and Sampling – Former Chemical Sales Facility. June 2013 Sapling Event, Is-Situ Oxidative Technologies, Inc.

ISOTEC, 2014 – Remediation Program Groundwater Monitoring and Sampling – Former Chemical Sales Facility. June 2014 Sampling Event, Is-Situ Oxidative Technologies, Inc.

ISOTEC, 2015 – Remediation Program Groundwater Monitoring and Sampling – Former Chemical Sales Facility. April 2015 Sampling Event, Is-Situ Oxidative Technologies, Inc.

EPA, 2014 – Groundwater Statistics Tool User Guide, 2014, United States Environmental Protection Agency.

CDPHE, 2012b – Biennial Groundwater Monitoring Report for the Chemical Sales Superfund Site Operable Unit 2 – September 2012 Sampling event, 2012, Colorado Department of Public Health and Environment.

DWR, 2009 – Procedure to Notify Potential Groundwater Users – Sand Creek and Chemical Sales Company Water Quality Notification Program, 2009, Division of Water Resources.

EPA, 2017 – Memorandum – Chemical Sales Superfund Site 1,4 Dioxane Risk Calculations – United States Environmental Protection Agency, Region 8.

APPENDIX B – FIGURES

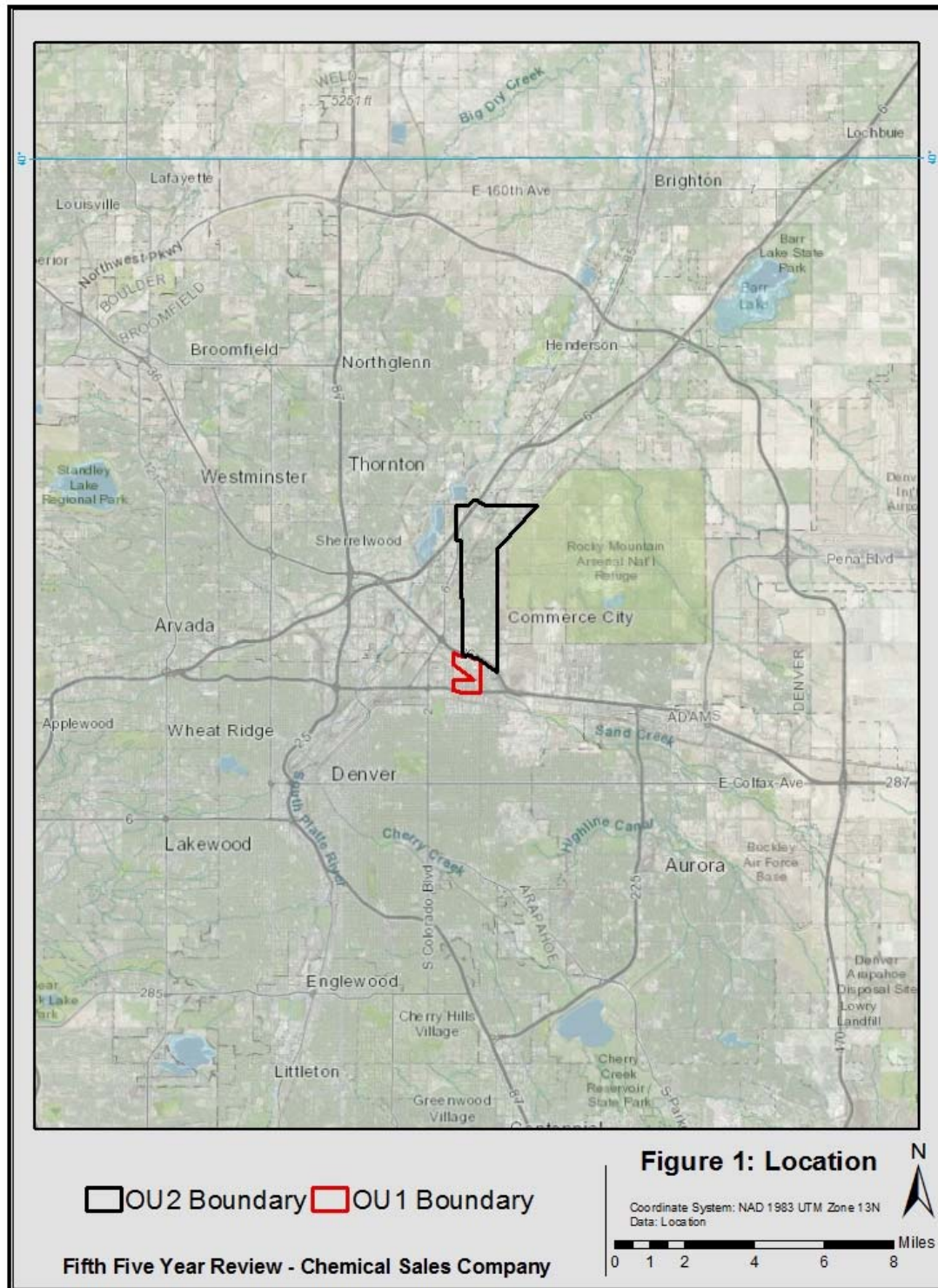


Figure 1: Location

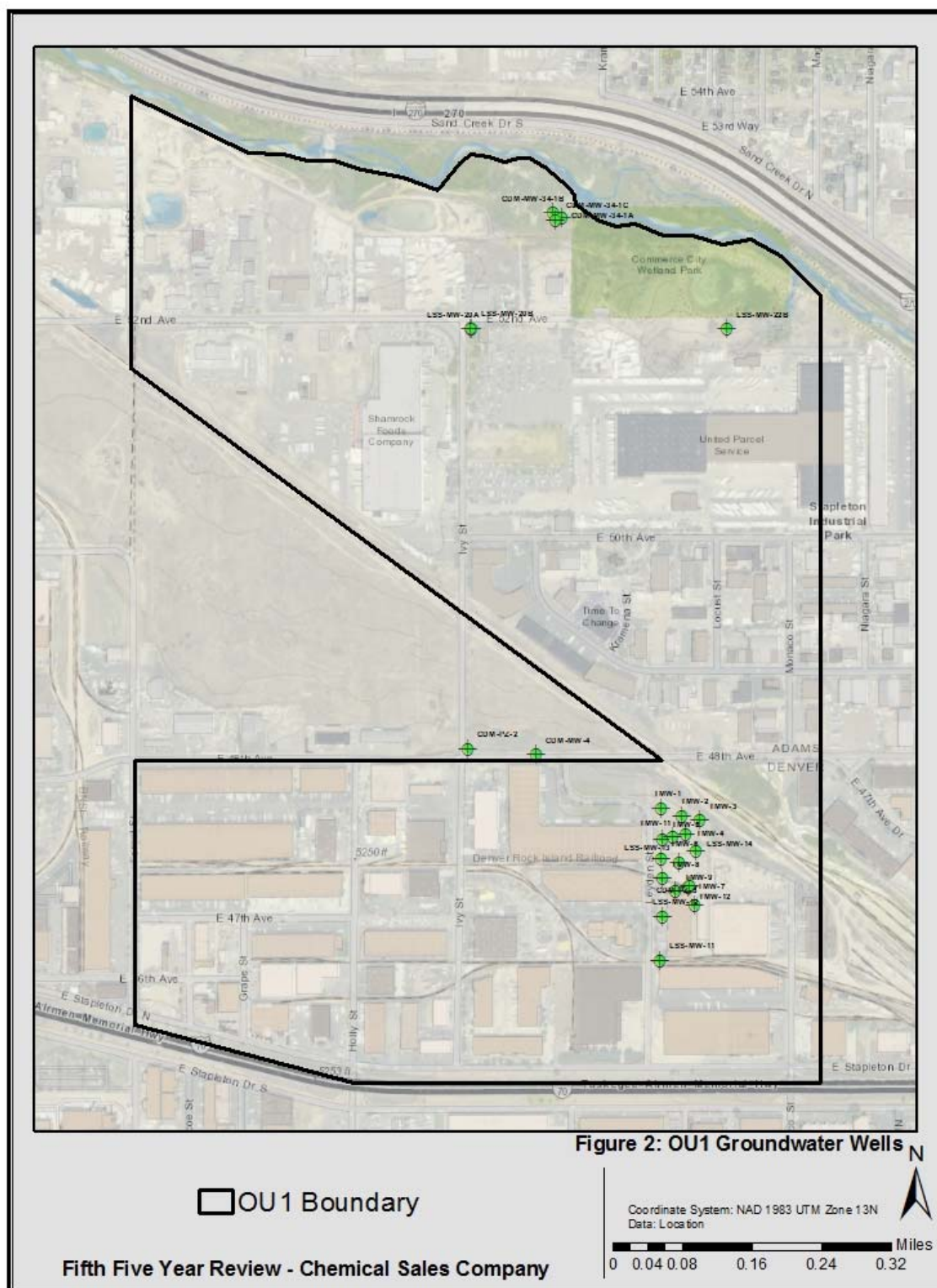


Figure 2: OU1 Groundwater Wells

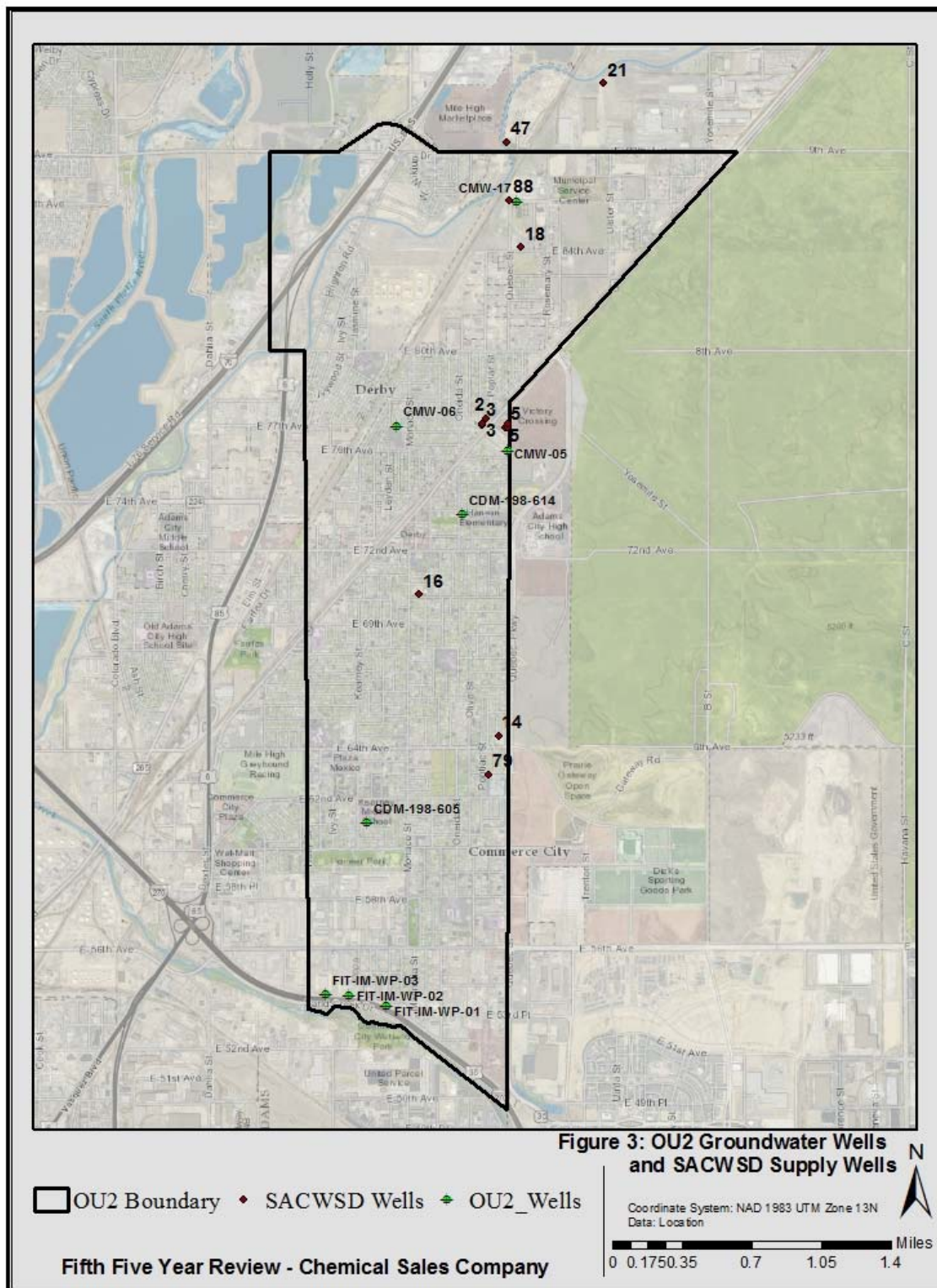


Figure 3: OU2 Groundwater Wells

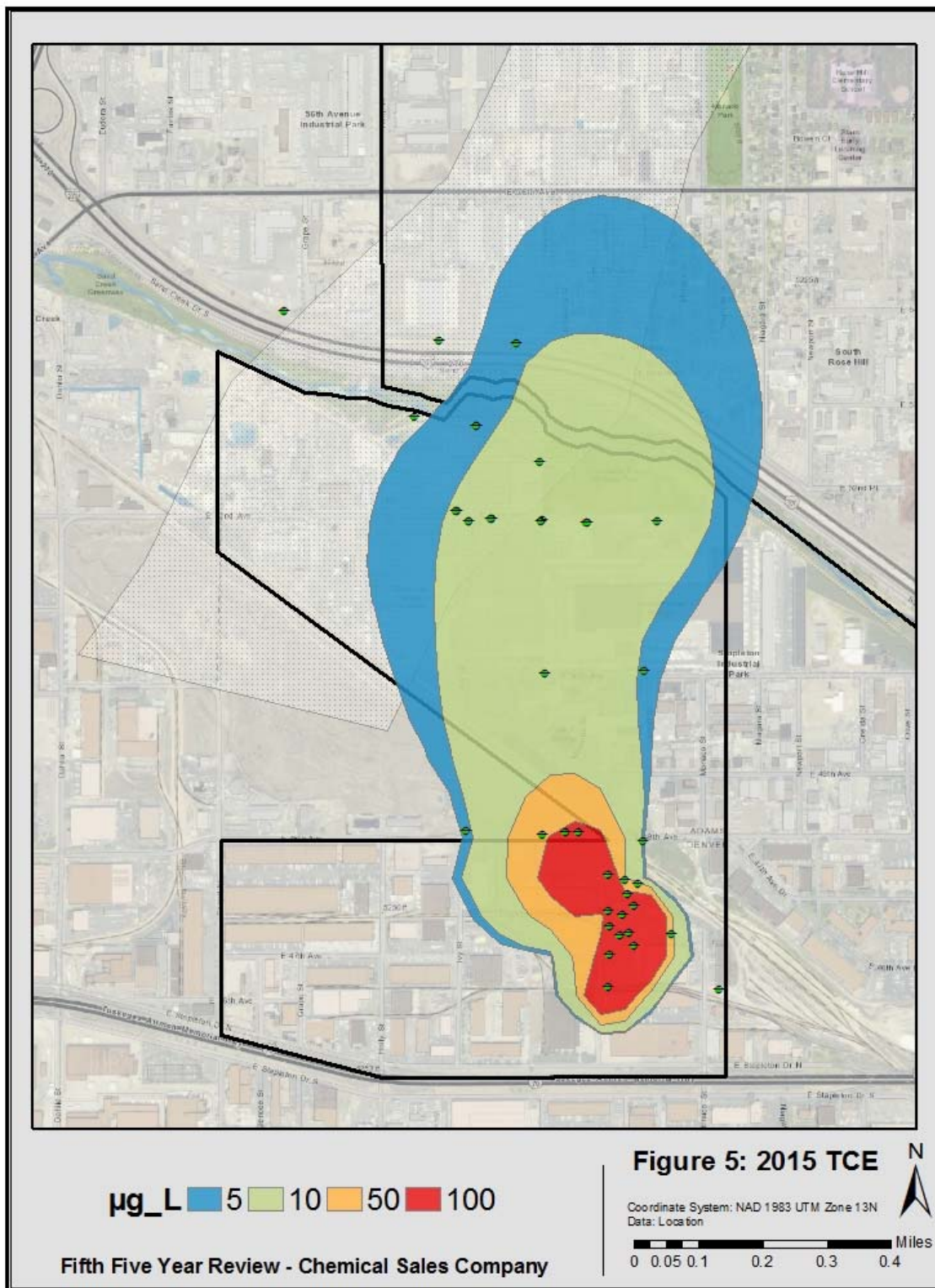


Figure 5: OU1 2015 TCE

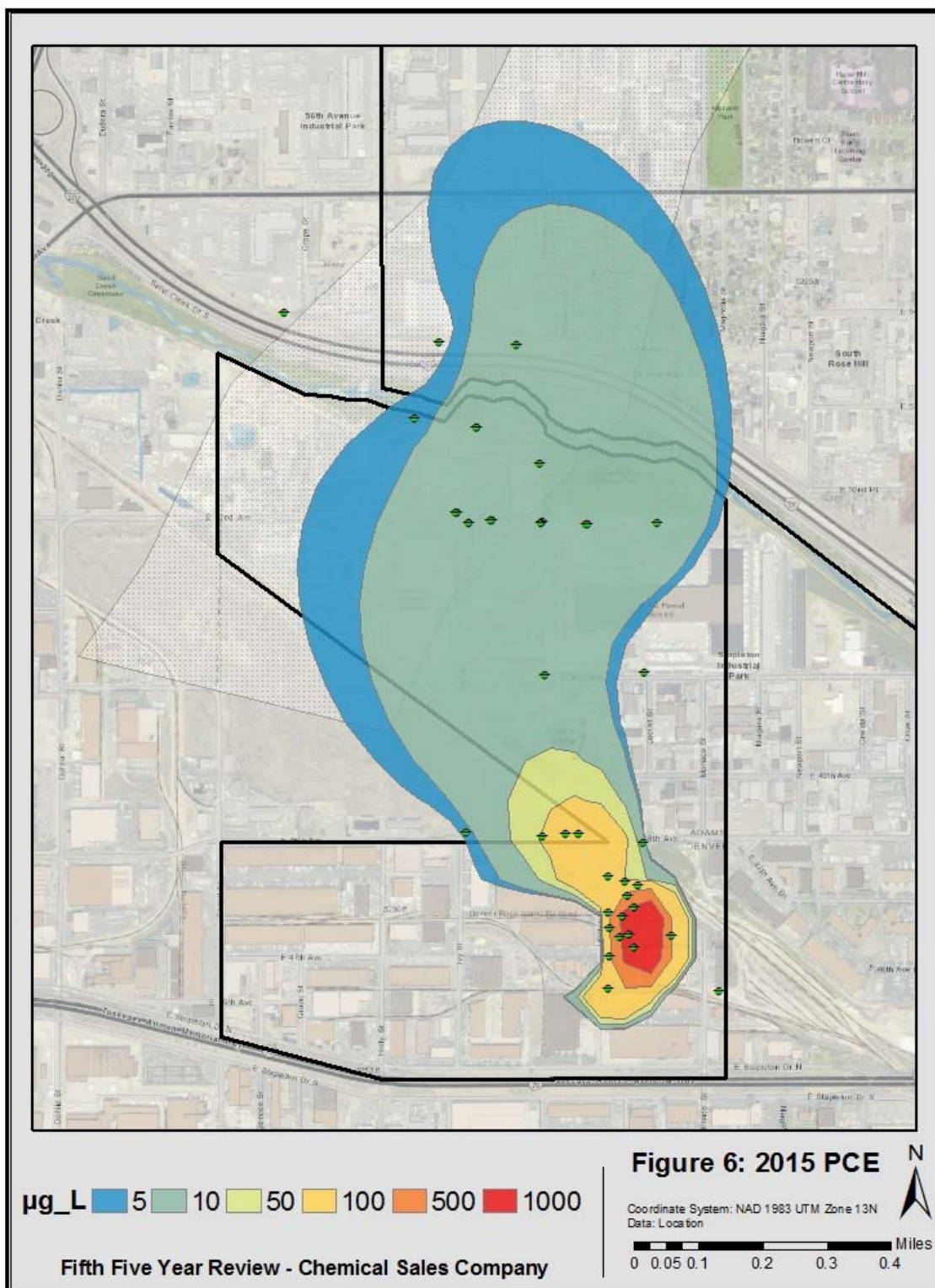


Figure 6: 2015 PCE

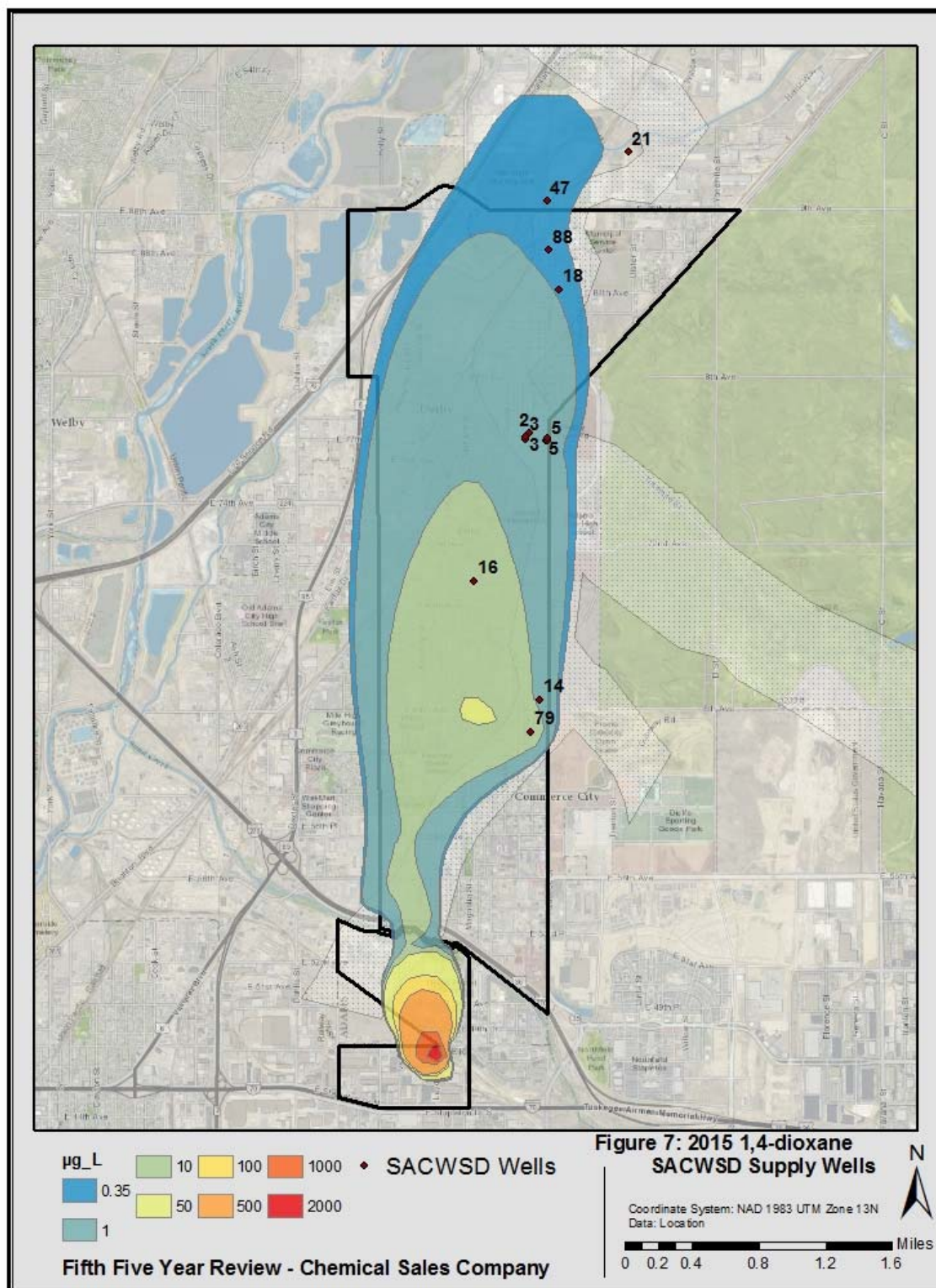


Figure 7: 2015 1,4-dioxane

APPENDIX C – 2012 – 2015 Groundwater Analytical Results

Well ID	8/29/2012										5/29/2013									
	1,1- dichloroethylene (1,1-DCE)	dis-1,2- dichloroethylene (1,2-DCE)	1,1,1- trichloroethane (1,1,1-TCA)	Trichloroethene (TCE)	Tetrachloroethene (PCE)	Methylene chloride (MC)	Carbon tetrachloride (CT)	Vinyl chloride (VC)	1,4-dioxane ¹ (1,4-D)		1,1- dichloroethylene (1,1-DCE)	dis-1,2- dichloroethylene (1,2-DCE)	1,1,1- trichloroethane (1,1,1-TCA)	Trichloroethene (TCE)	Tetrachloroethene (PCE)	Methylene chloride (MC)	Carbon tetrachloride (CT)	Vinyl chloride (VC)	1,4-dioxane ¹ (1,4-D)	
	µg/L											µg/L								
TMW-1	190	-	38	470	2000	-	6.4	-	NS		150	3.5	28	500	2200	-	4.9	-	3500	
TMW-2	80	7.3	12	88	370	-	-	-	NS					140	620				460	
TMW-3	58	-	-	50	250	-	-	-	NS		38	3.4	3.4	36	230	-	-	-	200	
TMW-4	100	12	22	91	460	-	3.1	-	NS		100	13	22	110	940	-	4.9	-	96	
TMW-5	260	4.9	77	690	3400	3.9 ¹	13	-	NS		57	-	-	200	2300	-	-	-	360	
TMW-6	100	3.2	9.9	330	1800	-	-	-	NS		74	-	-	250	3000	-	-	-	240	
TMW-7	410		43	1100	6100	2.6 ¹	10		NS		190	-	42	450	2100	-	-	-	95	
TMW-8	6.1	-	-	12	160	-	-	-	NS		-	-	-	-	260	-	-	-	18	
TMW-9	29	-	-	25	880	-	1.7 ¹	-	NS		28	-	-	41	940	-	-	-	14	
TMW-10	NS	NS	NS	NS	NS	NS	NS	NS	NS		NS	NS	NS	NS	NS	NS	NS	NS	NS	
TMW-11	150	2.7	38	260	1300	0.76 ¹	-	-	NS		220	-	28	390	1400	-	-	-	1400	
TMW-12	27	-	13	57	1400	-	-	-	NS		250	-	-	770	2600	-	-	-	67	
LSS-MW-11	62	2.5	13	-	-	-	-	-	NS		53	-	-	640	400	-	-	-	2.2	
LSS-MW-12	9.5	7.2	-	-	100	-	-	-	NS		9.1	8.8	-	160	180	-	-	-	30	
LSS-MW-13	86	-	24	200	1400		1.3 ¹	200	21		230	-	-	460	2000	-	-	-	160	
LSS-MW-14	13	-	6.8	14	94	-	-	-	180		31	-	-	29	400	-	-	-	120	
CDM-PZ-5	10	460	-	110	1400	-	-	-	77		25	130	-	100	560	-	-	-	30	
CDM-MW-4	NS	NS	NS	NS	NS	NS	NS	NS	NS		3.1	4	-	17	24	-	-	-	1.3	
CDM-MW-34-1A	NS	NS	NS	NS	NS	NS	NS	NS	NS		-	-	-	-	-	-	-	-	-	
CDM-MW-34-1B	NS	NS	NS	NS	NS	NS	NS	NS	NS		6	6.7	-	130	12	-	-	-	4.3	
CDM-MW-34-1C	NS	NS	NS	NS	NS	NS	NS	NS	NS		3.3	19	-	13	-	-	-	-	4.8	
CDM-PZ-2	NS	NS	NS	NS	NS	NS	NS	NS	NS		4.4	3.3	-	12	24	-	-	-	-	
FIT-MW-5	NS	NS	NS	NS	NS	NS	NS	NS	NS		-	-	-	-	-	-	-	-	11	
LSS-MW-20A	NS	NS	NS	NS	NS	NS	NS	NS	NS		2.1	4.4	-	8.2	18	-	-	-	10	
LSS-MW-20B	NS	NS	NS	NS	NS	NS	NS	NS	NS		4.9	4.6	1.9 ¹	13	15	-	-	-	11	
LSS-MW-22B	NS	NS	NS	NS	NS	NS	NS	NS	NS		1.8 ¹	1.2 ¹	-	6.4	12	-	-	-	2.8	

"-" non-detect

1 Not a COC in the decision document

J Laboratory estimated value

NS = not sampled

Well ID	6/3 - 6/4/2014									4/22 - 4/23/2015								
	1,1-dichloroethylene (1,1-DCE)	ds-1,2-dichloroethylene (1,2-DCE)	1,1,1-trichloroethane (1,1,1-TCA)	Trichloroethene (TCE)	Tetrachloroethene (PCE)	Methylene chloride (MC)	Carbon tetrachloride (CT)	Vinyl chloride (VC)	1,4-dioxane ¹ (1,4-D)	1,1-dichloroethylene (1,1-DCE)	ds-1,2-dichloroethylene (1,2-DCE)	1,1,1-trichloroethane (1,1,1-TCA)	Trichloroethene (TCE)	Tetrachloroethene (PCE)	Methylene chloride (MC)	Carbon tetrachloride (CT)	Vinyl chloride (VC)	1,4-dioxane ¹ (1,4-D)
	µg/L									µg/L								
TMW-1	250	-	49	450	590	-	-	-	1500	95	-	16	240	620	-	-	-	2100
TMW-2	130	-	-	170	480	-	-	-	390	56	7.4	7	45	68	-	-	-	530
TMW-3	26	2.8	2.4	17	76	-	-	-	150	21	2.7	-	16	57	-	-	-	140
TMW-4	120	-	-	110	980	-	-	-	180	120	22	17	100	220	-	-	-	210
TMW-5	100	-	-	190	390	-	-	-	360	160	-	25	390	1200	-	-	-	540
TMW-6	-	-	-	160	2200	-	-	-	180	43	-	9.6	110	300	-	-	-	160
TMW-7	79	-	99	140	5700	-	-	-	670	-	-	-	100	3100	-	-	-	540
TMW-8	3.2	-	-	4.6	120	-	-	-	3.9	-	2.6	-	4.3	33	-	-	-	12
TMW-9	24	-	-	29	420	-	-	-	12	20	-	-	22	290	-	-	-	14
TMW-10	NS	NS	NS	NS	NS	NS	NS	NS	NS	-	-	-	11	10	-	-	-	-
TMW-11	350	-	-	490	1400	-	-	-	840	200	-	24	340	1000	-	-	-	550
TMW-12	200	-	-	640	2800	-	-	-	240	320	-	-	980	7000	-	-	-	210
LSS-MW-11	43	-	6.6	610	420	-	-	-	0.8	NS	NS	NS	NS	NS	NS	NS	NS	NS
LSS-MW-12	8.6	5.9	-	110	150	-	-	-	27	8.7	7	-	130	160	-	-	-	28
LSS-MW-13	26	-	-	65	330	-	-	-	6	58	-	-	120	520	-	-	-	38
LSS-MW-14	43	3.9	20	33	300	-	2.1	-	110	24	-	33	32	330	-	-	-	130
CDM-PZ-5	34	130	-	150	630	-	-	-	39	NS	NS	NS	NS	NS	NS	NS	NS	NS
CDM-MW-4	3	3.4	-	19	22	-	-	-	1.4	NS	NS	NS	NS	NS	NS	NS	NS	NS
CDM-MW-34-1A	-	-	-	-	-	-	-	-	0.37	-	-	-	-	-	-	-	-	0.36
CDM-MW-34-1B	NS	NS	NS	NS	NS	NS	NS	NS	-	5.2	11	-	96	15	-	-	-	7.8
CDM-MW-34-1C	9.4	11	-	190	20	-	-	-	6.2	-	2.9	-	8.8	-	-	-	-	-
CDM-PZ-2	-	-	-	-	-	-	-	-	0.46	-	-	-	-	-	-	-	-	4.5
FIT-MW-5	2.8	2.9	-	12	18	-	-	-	9.4	NS	NS	NS	NS	NS	NS	NS	NS	NS
LSS-MW-20A	2.1	3.3	-	7.5	12	-	-	-	12	-	2.8	-	7.1	15	-	-	-	12
LSS-MW-20B	3.2	3.4	-	11	11	-	-	-	12	2.6	3.4	-	12	17	-	-	-	12
LSS-MW-22B	7	-	-	24	31	-	-	-	3.8	5.5	-	-	18	37	-	-	-	11

"-" non-detect

1 Not a COC in the decision document

J Laboratory estimated value

NS = not sampled

APPENDIX D – Inter Groundwater Well Trend Analysis

Groundwater Statistics Tool

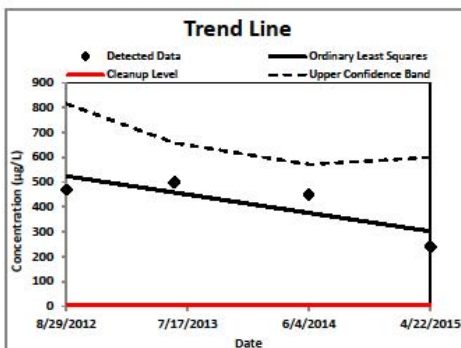
UCL calculations and summary statistics for nonparametric data sets

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	TCE
Well Name/Number	TMW-1
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	420
Standard deviation of concentration	120

95% Upper Confidence Limit (UCL)	680
Method for calculating UCL	Chebyshev UCL
Value of 95% Upper Confidence Band value at final sampling event	509
Trend calculation method	Ordinary Least Squares
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes



When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Random Seed Used	0
Message: None.	

Groundwater Statistics Tool

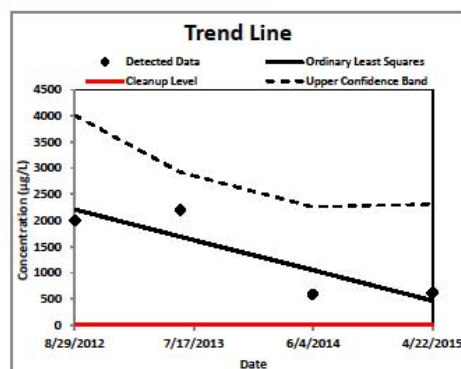
UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	PCE
Well Name/Number	TMW-1
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	1400
Standard deviation of concentration	870
t-value for UCL calculation	2.353

95% Upper Confidence Limit (UCL)	2400
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	2310
Trend calculation method	Ordinary Least Squares
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes



When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Random Seed Used	0
Message: None.	

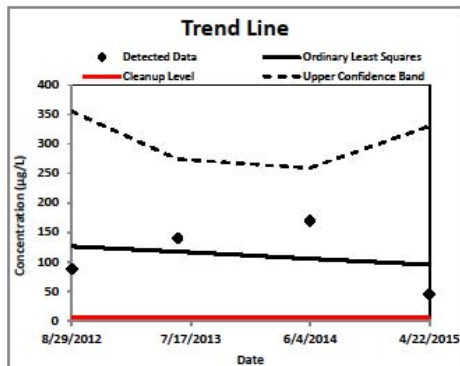
Groundwater Statistics Tool

UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	TCE
Well Name/Number	TMW-2
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	110
Standard deviation of concentration	55
t-value for UCL calculation	2.353



95% Upper Confidence Limit (UCL)	170
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	330
Trend calculation method	Ordinary Least Squares
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes

When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Message: None.	

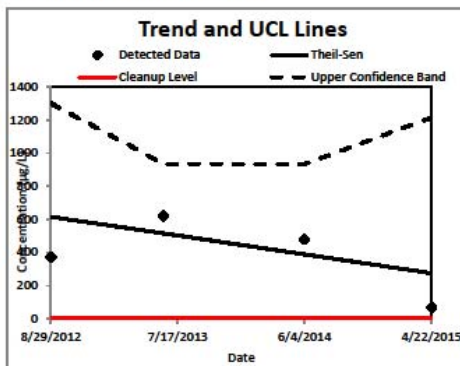
Groundwater Statistics Tool

UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	PCE
Well Name/Number	TMW-2
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	380
Standard deviation of concentration	230
t-value for UCL calculation	2.353



95% Upper Confidence Limit (UCL)	650
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	1210
Trend calculation method	Theil-Sen/Mann-Kendall
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes

When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Message: None.	

Groundwater Statistics Tool

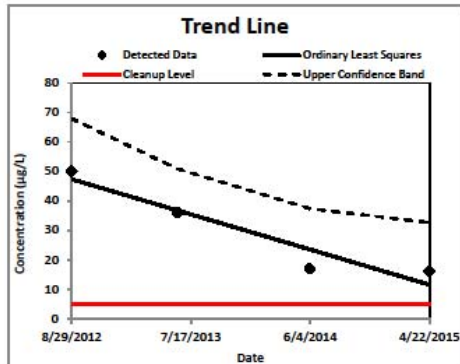
UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	TCE
Well Name/Number	TMW-3
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	30
Standard deviation of concentration	16
t-value for UCL calculation	2.353

95% Upper Confidence Limit (UCL)	49
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	32.6
Trend calculation method	Ordinary Least Squares
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes



When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Message: None.	

Groundwater Statistics Tool

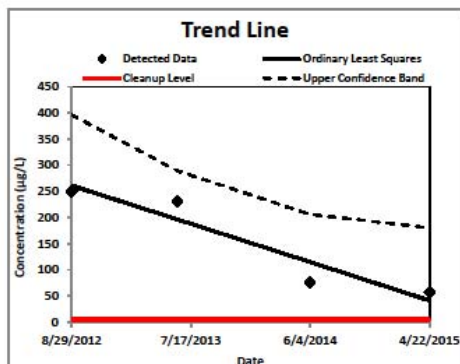
UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	PCE
Well Name/Number	TMW-3
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	150
Standard deviation of concentration	100
t-value for UCL calculation	2.353

95% Upper Confidence Limit (UCL)	270
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	180
Trend calculation method	Ordinary Least Squares
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes



When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Message: None.	

Groundwater Statistics Tool

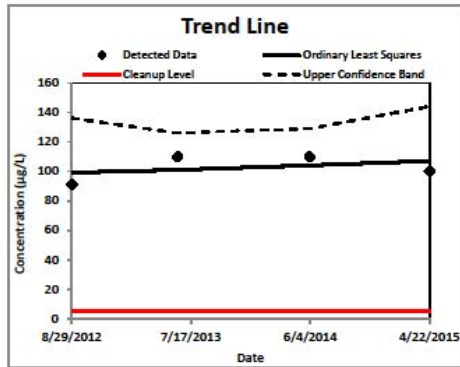
UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	TCE
Well Name/Number	TMW-4
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	100
Standard deviation of concentration	9.1
t-value for UCL calculation	2.353

95% Upper Confidence Limit (UCL)	110
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	144
Trend calculation method	Ordinary Least Squares
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes



When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Message: None.	

Groundwater Statistics Tool

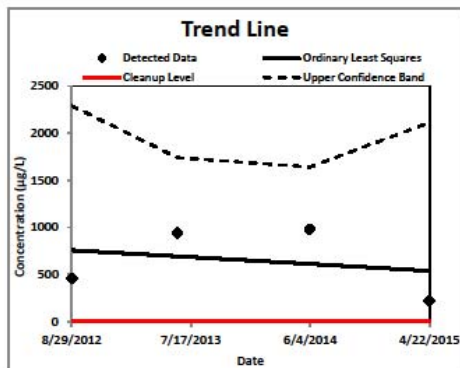
UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	PCE
Well Name/Number	TMW-4
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	650
Standard deviation of concentration	370
t-value for UCL calculation	2.353

95% Upper Confidence Limit (UCL)	1100
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	2110
Trend calculation method	Ordinary Least Squares
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes



When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Message: None.	

Groundwater Statistics Tool

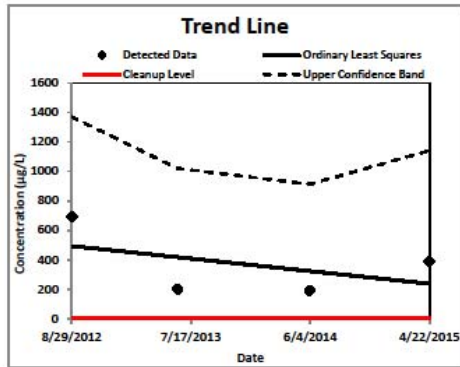
UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	TCE
Well Name/Number	TMW-5
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	370
Standard deviation of concentration	230
t-value for UCL calculation	2.353

95% Upper Confidence Limit (UCL)	640
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	1140
Trend calculation method	Ordinary Least Squares
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes



When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Message: None.	

Groundwater Statistics Tool

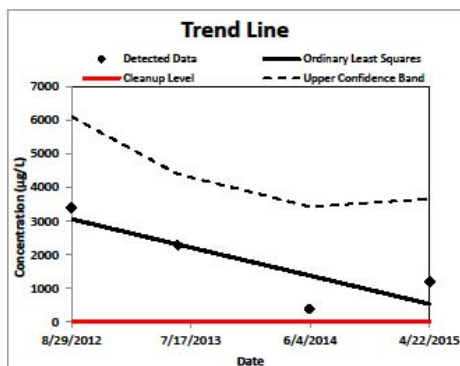
UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	PCE
Well Name/Number	TMW-5
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	1800
Standard deviation of concentration	1300
t-value for UCL calculation	2.353

95% Upper Confidence Limit (UCL)	3300
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	3660
Trend calculation method	Ordinary Least Squares
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes



When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Message: None.	

Groundwater Statistics Tool

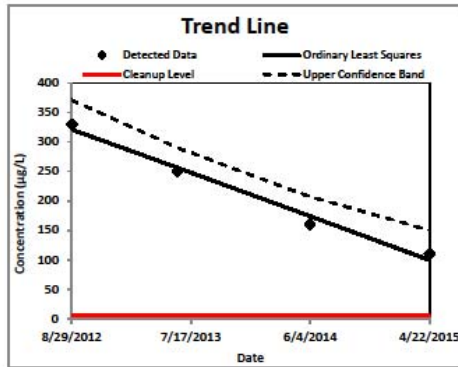
UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	TCE
Well Name/Number	TMW-8
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	210
Standard deviation of concentration	97
t-value for UCL calculation	2.353

95% Upper Confidence Limit (UCL)	320
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	150
Trend calculation method	Ordinary Least Squares
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes



When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Message: None.	

Groundwater Statistics Tool

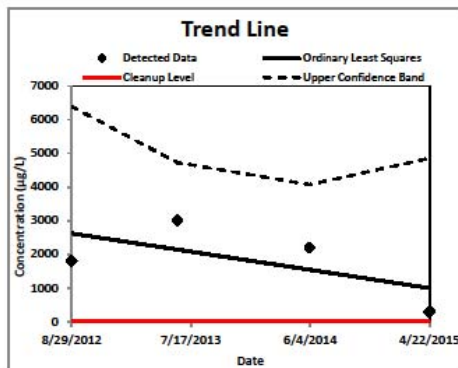
UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	PCE
Well Name/Number	TMW-8
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	1800
Standard deviation of concentration	1100
t-value for UCL calculation	2.353

95% Upper Confidence Limit (UCL)	3100
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	4850
Trend calculation method	Ordinary Least Squares
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes



When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Message: None.	

Groundwater Statistics Tool

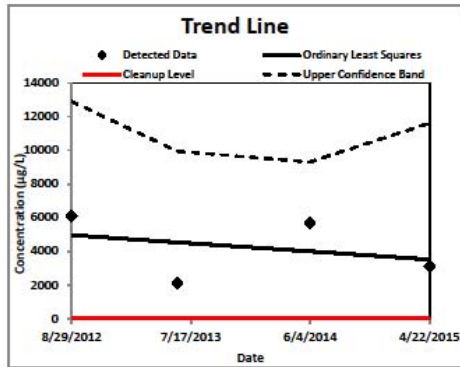
UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	PCE
Well Name/Number	TMW-7
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	4300
Standard deviation of concentration	2000
t-value for UCL calculation	2.353

95% Upper Confidence Limit (UCL)	6700
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	11600
Trend calculation method	Ordinary Least Squares
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes



When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Message: None.	

Groundwater Statistics Tool

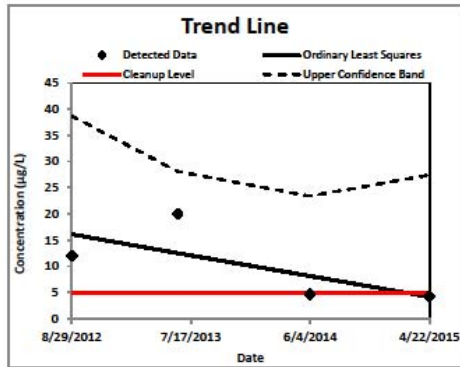
UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	TCE
Well Name/Number	TMW-8
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	2
Are any potential outliers present?	No
Mean of concentration	10
Standard deviation of concentration	7.4
t-value for UCL calculation	2.353

95% Upper Confidence Limit (UCL)	19
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	27.4
Trend calculation method	Ordinary Least Squares
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes



When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Message: None.	

Groundwater Statistics Tool

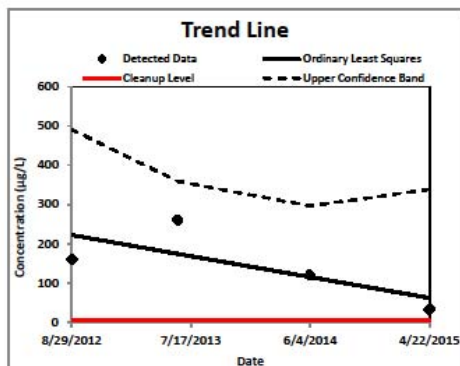
UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	PCE
Well Name/Number	TMW-8
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	140
Standard deviation of concentration	94
t-value for UCL calculation	2.353

95% Upper Confidence Limit (UCL)	250
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	338
Trend calculation method	Ordinary Least Squares
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes



When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Message: None.	

Groundwater Statistics Tool

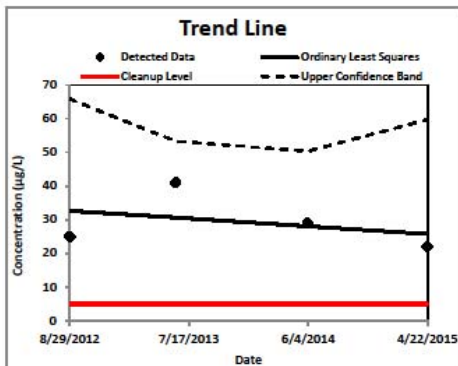
UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	TCE
Well Name/Number	TMW-9
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	29
Standard deviation of concentration	8.3
t-value for UCL calculation	2.353

95% Upper Confidence Limit (UCL)	39
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	59.7
Trend calculation method	Ordinary Least Squares
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes



When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Message: None.	

Groundwater Statistics Tool

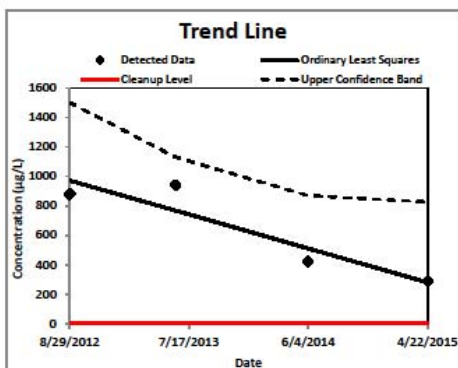
UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	PCE
Well Name/Number	TMW-9
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	830
Standard deviation of concentration	330
t-value for UCL calculation	2.353

95% Upper Confidence Limit (UCL)	1000
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	826
Trend calculation method	Ordinary Least Squares
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes



When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Message: None.	

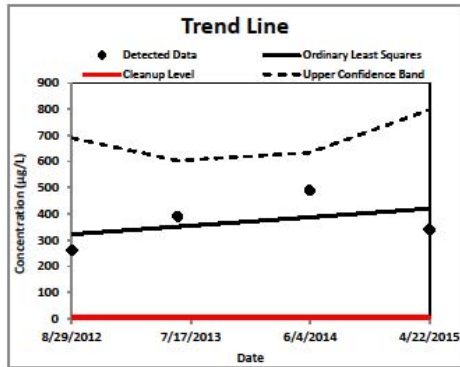
Groundwater Statistics Tool

UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	TCE
Well Name/Number	TMW-11
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	370
Standard deviation of concentration	96
t-value for UCL calculation	2.353



95% Upper Confidence Limit (UCL)	480
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	797
Trend calculation method	Ordinary Least Squares
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes

When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Message: None.	

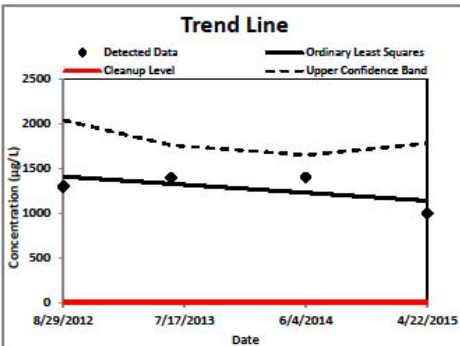
Groundwater Statistics Tool

UCL calculations and summary statistics for nonparametric data sets

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	PCE
Well Name/Number	TMW-11
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	1300
Standard deviation of concentration	190



95% Upper Confidence Limit (UCL)	1700
Method for calculating UCL	Chebyshev UCL
Value of 95% Upper Confidence Band value at final sampling event	1780
Trend calculation method	Ordinary Least Squares
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes

When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Random Seed Used	40358.05469
Message: None.	

Groundwater Statistics Tool

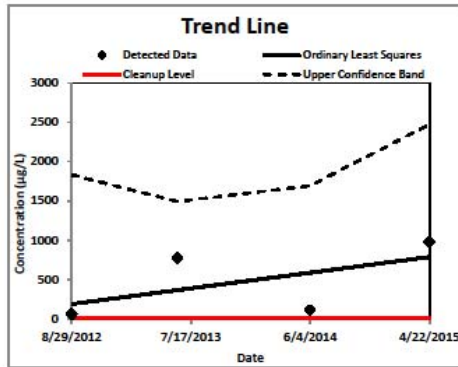
UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	TCE
Well Name/Number	TMW-12
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	480
Standard deviation of concentration	470
t-value for UCL calculation	2.353

95% Upper Confidence Limit (UCL)	1000
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	2470
Trend calculation method	Ordinary Least Squares
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes



When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Message: None.	

Groundwater Statistics Tool

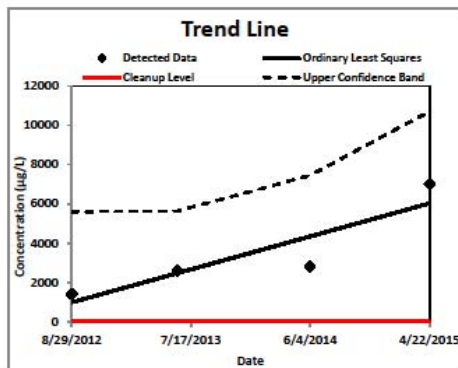
UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	PCE
Well Name/Number	TMW-12
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	3500
Standard deviation of concentration	2400
t-value for UCL calculation	2.353

95% Upper Confidence Limit (UCL)	6300
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	10700
Trend calculation method	Ordinary Least Squares
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes



When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Message: None.	

Groundwater Statistics Tool

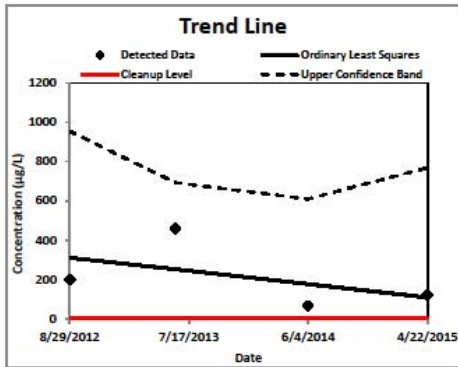
UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	TCE
Well Name/Number	LSS-MW-13
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	210
Standard deviation of concentration	170
t-value for UCL calculation	2.353

95% Upper Confidence Limit (UCL)	410
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	768
Trend calculation method	Ordinary Least Squares
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes



When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Message: None.	

Groundwater Statistics Tool

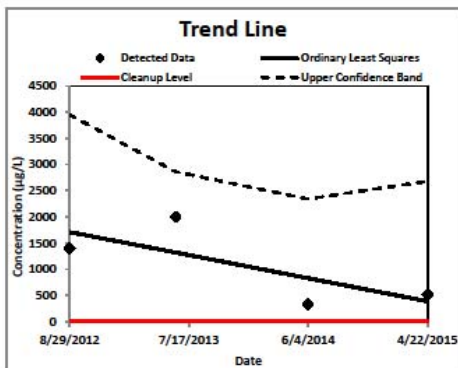
UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	PCE
Well Name/Number	LSS-MW-13
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	1100
Standard deviation of concentration	780
t-value for UCL calculation	2.353

95% Upper Confidence Limit (UCL)	2000
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	2680
Trend calculation method	Ordinary Least Squares
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes



When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Message: None.	

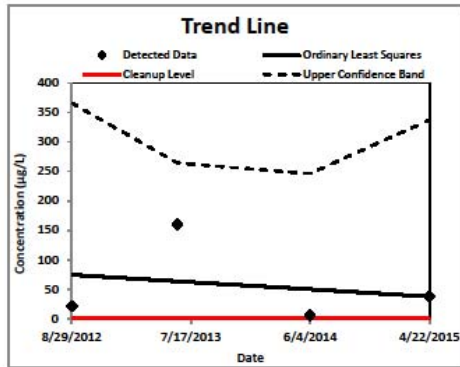
Groundwater Statistics Tool

UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	1,4-D
Well Name/Number	LSS-MW-13
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	56
Standard deviation of concentration	70
t-value for UCL calculation	2.353



95% Upper Confidence Limit (UCL)	140
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	337
Trend calculation method	Ordinary Least Squares
Cleanup level	0.32
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes

When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Message: None.	

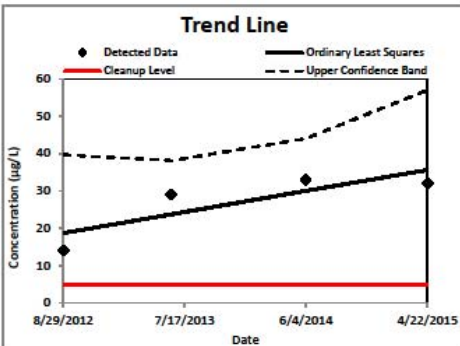
Groundwater Statistics Tool

UCL calculations and summary statistics for nonparametric data sets

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	TCE
Well Name/Number	LSS-MW-14
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	27
Standard deviation of concentration	8.8



95% Upper Confidence Limit (UCL)	46
Method for calculating UCL	Chebyshev UCL
Value of 95% Upper Confidence Band value at final sampling event	57
Trend calculation method	Ordinary Least Squares
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes

When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Random Seed Used	40358.05469
Message: None.	

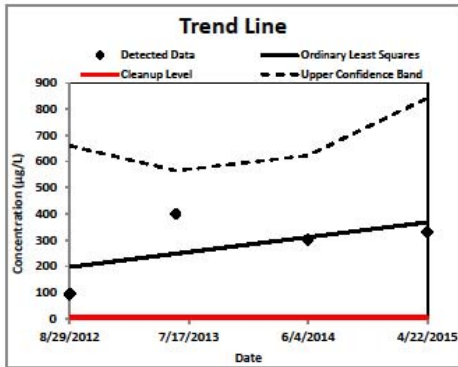
Groundwater Statistics Tool

UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	PCE
Well Name/Number	LSS-MW-14
Date Units	Date
Concentration Units	µg/L

Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	280
Standard deviation of concentration	130
t-value for UCL calculation	2.353



95% Upper Confidence Limit (UCL)	430
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	842
Trend calculation method	Ordinary Least Squares
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes

When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Message: None.	

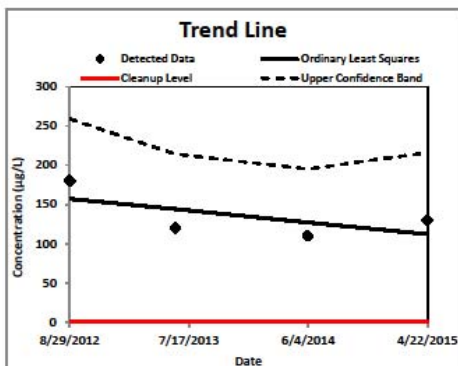
Groundwater Statistics Tool

UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Chem Sales
Operating Unit (OU)	1
Type of Evaluation	Remediation
Date of Evaluation	5/2/2017
Person performing analysis	Ross Davis

Chemical of Concern	1,4-D
Well Name/Number	LSS-MW-14
Date Units	Date
Concentration Units	µg/L

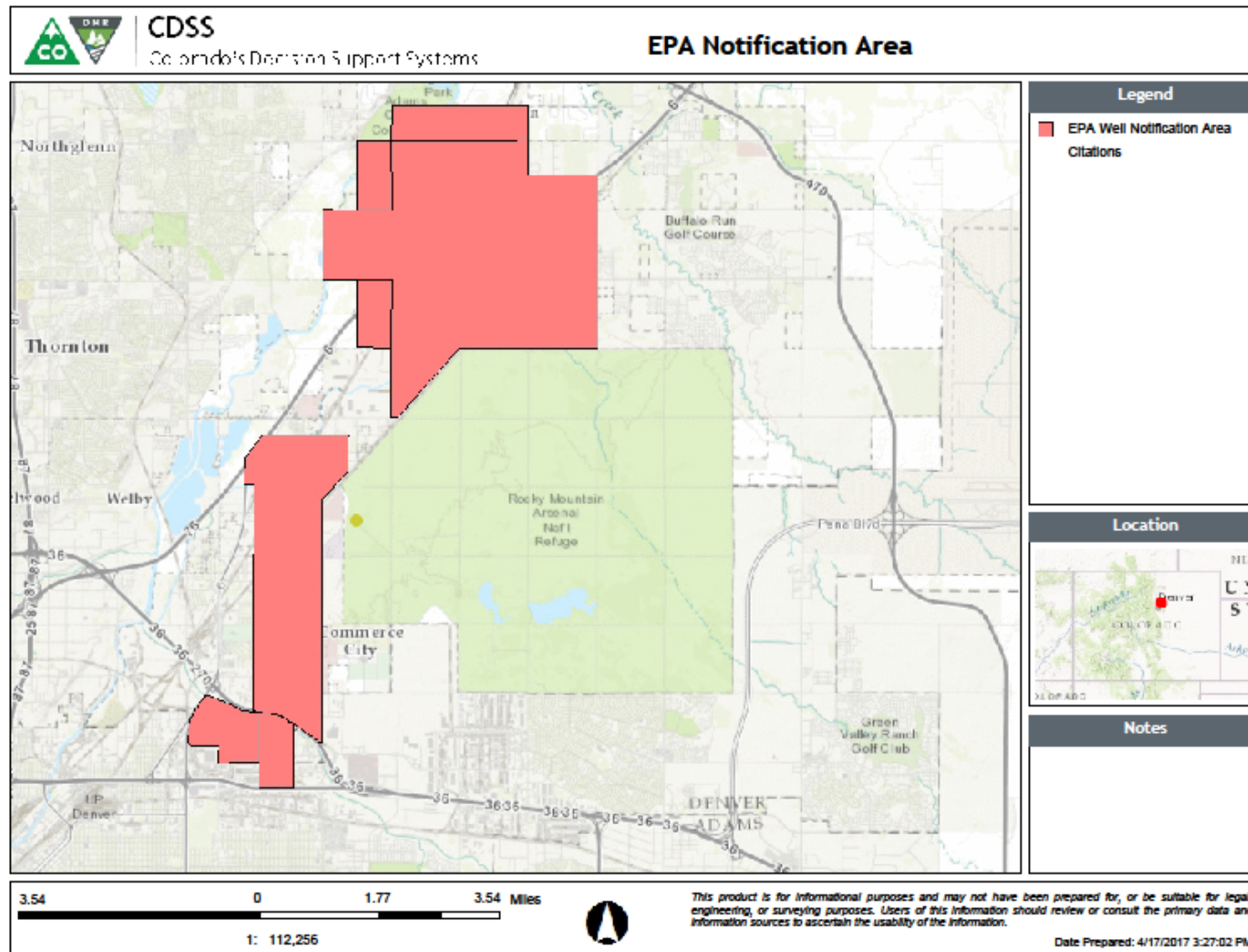
Confidence Level	95%
Number of results	4
Number < cleanup level	0
Are any potential outliers present?	No
Mean of concentration	140
Standard deviation of concentration	31
t-value for UCL calculation	2.353



95% Upper Confidence Limit (UCL)	180
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	216
Trend calculation method	Ordinary Least Squares
Cleanup level	0.32
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes

When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Message: None.	

APPENDIX D – EPA Notification Area and Letter



June 8, 2009

TO: Denver Basin Team Staff Members
CC: Kevin Rein
FROM: Joanna Williams
SUBJECT: Procedure to Notify Potential Ground Water Users
Sand Creek and Chemical Sales Company Water Quality Notification Program

By letter dated May 29, 2009 the Colorado Department of Public Health and Environment has requested the State Engineer's assistance in implementing a notification process for well applications within the contaminated ground water plumes associated with the Sand Creek Superfund Site and the Chemical Sales Company Superfund Site. Pursuant to that request the State Engineer's Office will provide notice on all well permits and well permit application correspondence received within the affected areas. That notice will specify that the applicant should contact the U.S. Environmental Protection Agency (EPA) and Colorado Department of Public Health and Environment (CDPHE) for information regarding ground water quality. The State Engineer's Office will also provide copies of such correspondence, or well permit containing the notice, to EPA and CDPHE. The affected area was provided and is shown on attached Figures 3 and 4. CDPHE has also provided the affected areas as a GIS shape file that can be accessed in the AquaMap system.

The following procedural requirements shall apply to implement this agreement:

1. The boundary of the affected area is shown as the "EPA Well Notification Area" layer in AquaMap. The affected area is generally located in portions of Sections 28, 29, 30 and 32, Township 2 South, Range 67 West and Sections 5, 8, 17, 18 and 20, Township 3 South, Range 67 West.
2. This procedure shall apply to all ground water within the affected area, including ground water found in the Denver Basin bedrock aquifers.
3. The notice shall apply to each well permit application correspondence, each well permit, and each acknowledgement letter for a monitoring and observation hole notice. In addition, the notice should appear on correspondence to county planning departments in regard to subdivision referrals.
4. The notice on each well permit shall read as follows:

NOTICE: THIS WELL IS WITHIN THE CHEMICAL SALES COMPANY SUPERFUND SITE AND/OR THE SAND CREEK INDUSTRIAL SUPERFUND SITE WHERE CONTAMINATION MAY BE ENCOUNTERED. CONTACT THE EPA (ARMANDO SAENZ, EPA REGION 8, EPR-SR, 1595 WYNKOOP, DENVER COLORADO 80202) OR THE CDPHE (FONDA APOSTOLOPOULOS, CDPHE, HMWMD-RP-B2, 4300 CHERRY CREEK DRIVE, DENVER COLORADO 80246) FOR DETAILS PRIOR TO DRILLING THIS WELL.

APPENDIX E –1,4-dioxane Risk Calculation for SACWSD



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 8

1595 Wynkoop Street
Denver, CO 80202-1129
Phone 800-227-8917

July 17, 2017

MEMORANDUM

SUBJECT: Chemical Sales Superfund Site 1,4 Dioxane Risk Calculation

FROM: Charles Partridge, PhD.
Toxicologist
USEPA, Denver, CO

A handwritten signature in blue ink, reading "Charlie Partridge", is placed next to the typed name and title.

TO: Stan Christensen
Unit Chief, Remedial Unit B
USEPA, Denver CO

Background

As part of the five-year review process, Colorado Department of Public Health and Environment, requested that USEPA Region 8 review data for 1,4 dioxane for the Chemical Sales Company Superfund site. (Figure 1).

<https://cumulis.epa.gov/supercpad/cursites/csinfo.cfm?id=0800866>

The five-square-mile Chemical Sales Co. site is located in Denver, Colorado. Operations at the site included storage and repackaging of bulk chemicals from rail cars and drums. Historical waste disposal practices contaminated groundwater with volatile organic compounds (VOCs). Following cleanup, operation and maintenance activities are ongoing. EPA placed the site on the Superfund Program's National Priorities List (NPL) in August 1990.

The site consists of four areas, referred to by EPA as operable units (OUs). OU-1 addresses contaminated subsurface soils on the Chemical Sales Co. property and groundwater contamination south of Sand Creek. OU-2 addresses VOC-contaminated groundwater north of Sand Creek. OU-3 addresses residential exposure to contaminated groundwater in OU-2. OU-4

addresses South Adams County Water Supply District wells 18, 21 and 47 (Figure 2). The wells provide water to residents connected to the water district.

This is the fifth five year review conducted by the Colorado Department of Public Health and Environment, with EPA oversight. These reviews ensure that the remedies put in place protect public health and the environment, and function as intended by site decision documents. Long-term protectiveness requires evaluation of 1,4-dioxane, an emerging contaminant.

Data

1,4 dioxane data from wells 18, 21, and 47 were provided to USEPA (Attachment 1). Data from the South Adams Country Water and Sanitation District was also provided for review (Attachment 2). Wells 18, 21, and 47 provide raw water that is sent to the Klein Water Treatment Facility. After treatment, water is stored in reservoirs 1 through 10 prior to entering the delivery system. The water from reservoirs 1-10 is provided as treated water and is supplied to water district customers for consumption without further treatment.

1,4 dioxane data from 2012-2016 were reviewed for this memo. Data reviewed for this memo and summary statistical analysis of the data are provided in attachment 3 and attachment 4.

Toxicity and Risk Assumptions

Risks and pathways for 1,4 dioxane addressed by this data review include health risks from people ingesting, touching or inhaling contaminants in groundwater/tapwater.

1,4-dioxane is a likely human carcinogen and has been found in groundwater at the Chemical Sales Company Superfund site. The physical and chemical properties and behavior of 1,4-dioxane create challenges for its characterization and treatment. It is highly mobile and has not been shown to readily biodegrade in the environment.

EPA's Integrated Risk Information System (IRIS) database includes a chronic oral reference dose (RfD) of 0.03 milligrams per kilogram per day (mg/kg/day) based on liver and kidney toxicity in animals and a chronic inhalation reference dose (RfC) of 0.03 milligrams per cubic meter (mg/m³) based on atrophy and respiratory metaplasia inside the nasal cavity of animals (EPA IRIS 2013).

EPA has calculated a screening level of 0.46 µg/L for 1,4-dioxane in tap water, based on a 1 in 10⁻⁶ lifetime excess cancer risk hereafter referred to as the RSL.
(<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-june-2017>),

RSLs are developed using risk assessment guidance from the EPA Superfund program. These risk-based concentrations are derived from standardized equations combining exposure information assumptions with EPA toxicity data. These calculated RSLs are generic and not enforceable cleanup standards but provide a useful gauge of relative toxicity.

Standard exposure assumptions were used in calculating residential risk from exposure to tapwater (Attachment 5).

Analysis

Risk was calculated using the Risk Assessment Information System (RAIS) Contaminated Media Risk Calculator. https://rais.ornl.gov/cgi-bin/prg/RISK_search?select=chem

Risk was calculated three different ways:

- 1) Maximum-Risk was calculated using the highest level of 1,4 dioxane detected during the monitoring period.
- 2) 95% UCL-Risk was calculated using the 95% Upper Confidence Level of 1,4 dioxane detected during the monitoring period. 95%UCL was calculated from the data set provided using PRO-UCL version 5.1? (USEPA 20??)
- 3) Mean-Risk was calculated using the mean of the data set provided.

The levels of 1,4 dioxane detected and the associated risks are presented in Tables 1-3. A bold number represents a 1,4 dioxane level that was above the USEPA screening level of 0.46 ug/L. Wells 18, 21 and 47 represent shallow alluvial wells. These wells represent raw water supplies (untreated) for South Adams County Water and Sanitation District. (Table 1)

Table 1

	Well 18	Well 21	Well 47
Maximum (ug/L)	2.15	0.231	0.75
Maximum Risk	4.68E-06	NC	1.63E-06
95%UCL (ug/L)	1.05	0.14	0.458
95%UCL Risk	2.29E-06	NC	NC
Mean (ug/L)	0.969	0.122	0.412
Mean Risk	2.11E-06	NC	NC

Bold measured levels exceed USEPA RSL screening level of 0.46ug/L for residential tapwater

NC Risk not calculated because measured levels were below USEPA RSL for residential tapwater

Reservoirs 1-10 represent treated water supplies. This is blended water from KWTF and Denver water, representing what is supplied to customers of SACWD. Reservoirs 1-5 are presented in Table 2 and reservoirs 6-10 are presented in Table 3.

Table 2 -

	Reservoir 1	Reservoir 2	Reservoir 3	Reservoir 4	Reservoir 5
Maximum (ug/L)	3.2	2.15	1.75	1.26	2.64
Maximum Risk	6.97E-06	4.68E-06	3.81E-06	2.74E-06	5.75E-06
95%UCL (ug/L)	2.455	1.76	1.556	1.085	1.834
95%UCL Risk	5.35E-06	3.83E-06	3.39E-06	2.35E-06	4.00E-06
Mean (ug/L)	2.028	2.006	1.485	0.854	1.523
Mean Risk	4.42E-06	4.37E-06	3.23E-06	1.86E-06	3.32E-06

Bold-measured levels exceed USEPA RSL screening level of 0.46ug/L for residential tapwater

Table 3

	Reservoir 6	Reservoir 7	Reservoir 8	Reservoir 9	Reservoir 10
Maximum (ug/L)	1.42	1.29	1.2	2.47	2.4
Maximum Risk	3.09E-06	2.81E-06	2.61E-06	5.38E-06	5.23E-06
95%UCL (ug/L)	1.138	0.82	0.561	2.085	2.222
95%UCL Risk	2.48E-06	1.79E-06	1.22E-06	4.54E-06	4.84E-06
Mean (ug/L)	0.998	0.609	0.346	1.823	1.976
Mean Risk	2.17E-06	1.33E-06	NC	3.97E-06	4.30E-06

Bold-measured levels exceed USEPA RSL screening level of 0.16ug/L for residential tapwater

NC Risk not calculated because measured levels were below USEPA RSL for residential tapwater

Conclusion

For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual within EPA's acceptable risk range of 10^{-4} and 10^{-6} using information on the relationship between dose and response.

All calculated risks for 1,4 dioxane for wells 18, 21, 47 and reservoirs 1-10 fall within the acceptable risk range. Risks ranged from a maximum of 6.96E-06 to not calculated because levels detected fell below the USEPA screening level for 1,4 dioxane. If, at any time, the portion of groundwater delivered by the South Adams County Water Supply District increases or if additional wells are considered, the risks associated with any such changes should be re-evaluated.

Attachment 1

Shirkon Akzoel Wdg			
1	Unit	Met 10	Met 21
2	Calculated	Met 10	Met 21
3	6470-2	0.08	0.01
4	6470-2	0.08	0.01
5	6470-2	0.08	0.01
6	6470-2	0.08	0.01
7	6470-2	0.08	0.01
8	6470-2	0.08	0.01
9	6470-2	0.08	0.01
10	6470-2	0.08	0.01
11	6470-2	0.08	0.01
12	6470-2	0.08	0.01
13	6470-2	0.08	0.01
14	6470-2	0.08	0.01
15	6470-2	0.08	0.01
16	6470-2	0.08	0.01
17	6470-2	0.08	0.01
18	6470-2	0.08	0.01
19	6470-2	0.08	0.01
20	6470-2	0.08	0.01
21	6470-2	0.08	0.01
22	6470-2	0.08	0.01
23	6470-2	0.08	0.01
24	6470-2	0.08	0.01
25	6470-2	0.08	0.01
26	6470-2	0.08	0.01
27	6470-2	0.08	0.01
28	6470-2	0.08	0.01
29	6470-2	0.08	0.01
30	6470-2	0.08	0.01
31	6470-2	0.08	0.01
32	6470-2	0.08	0.01
33	6470-2	0.08	0.01
34	6470-2	0.08	0.01
35	6470-2	0.08	0.01
36	6470-2	0.08	0.01
37	6470-2	0.08	0.01
38	6470-2	0.08	0.01
39	6470-2	0.08	0.01
40	6470-2	0.08	0.01
41	6470-2	0.08	0.01
42	6470-2	0.08	0.01
43	6470-2	0.08	0.01
44	6470-2	0.08	0.01
45	6470-2	0.08	0.01

1	Unit	Met 10
2	Calculated	Met 10
3	6470-2	0.08
4	6470-2	0.08
5	6470-2	0.08
6	6470-2	0.08
7	6470-2	0.08
8	6470-2	0.08
9	6470-2	0.08
10	6470-2	0.08
11	6470-2	0.08
12	6470-2	0.08
13	6470-2	0.08
14	6470-2	0.08
15	6470-2	0.08
16	6470-2	0.08
17	6470-2	0.08
18	6470-2	0.08
19	6470-2	0.08
20	6470-2	0.08
21	6470-2	0.08
22	6470-2	0.08
23	6470-2	0.08
24	6470-2	0.08
25	6470-2	0.08
26	6470-2	0.08
27	6470-2	0.08
28	6470-2	0.08
29	6470-2	0.08
30	6470-2	0.08
31	6470-2	0.08
32	6470-2	0.08
33	6470-2	0.08
34	6470-2	0.08
35	6470-2	0.08
36	6470-2	0.08
37	6470-2	0.08
38	6470-2	0.08
39	6470-2	0.08
40	6470-2	0.08
41	6470-2	0.08
42	6470-2	0.08
43	6470-2	0.08
44	6470-2	0.08
45	6470-2	0.08

1	Unit	Met 10
2	Calculated	Met 10
3	6470-2	0.08
4	6470-2	0.08
5	6470-2	0.08
6	6470-2	0.08
7	6470-2	0.08
8	6470-2	0.08
9	6470-2	0.08
10	6470-2	0.08
11	6470-2	0.08
12	6470-2	0.08
13	6470-2	0.08
14	6470-2	0.08
15	6470-2	0.08
16	6470-2	0.08
17	6470-2	0.08
18	6470-2	0.08
19	6470-2	0.08
20	6470-2	0.08
21	6470-2	0.08
22	6470-2	0.08
23	6470-2	0.08
24	6470-2	0.08
25	6470-2	0.08
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27	6470-2	0.08
28	6470-2	0.08
29	6470-2	0.08
30	6470-2	0.08
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41	6470-2	0.08
42	6470-2	0.08
43	6470-2	0.08
44	6470-2	0.08
45	6470-2	0.08

1	Unit	Met 10
2	Calculated	Met 10
3	6470-2	0.08
4	6470-2	0.08
5	6470-2	0.08
6	6470-2	0.08
7	6470-2	0.08
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40	6470-2	0.08
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42	6470-2	0.08
43	6470-2	0.08
44	6470-2	0.08
45	6470-2	0.08

Attachment 2

SOUTH ADAMS COUNTY WATER and SANITATION DISTRICT

1,4-Dioxane

5/18/2017

Rising Water Treatment Facility

EPA Method 822 ug/l - ppb

Date Collected	Reservoir 1	Reservoir 2	Reservoir 3	Reservoir 4	Reservoir 5	Reservoir 6	Reservoir 7	Reservoir 8	Reservoir 9	Reservoir 10
02/20/2013 ^A	2.30	2.15	1.15	0.98	0.86	1.42	1.29	0.426	0.20	2.25
04/20/13 ^A	2.25									
11/4/2015		1.51	1.53	0.77	1.58	1.13	0.18	0.05	1.88	2.40
11/4/2015 ^A		1.77	1.53	0.945	1.71	1.07	0.159	0.0490	1.83	2.29
6/20/2016	1.14	0.59	0.53	0.39	0.34	0.65	0.57	0.37		1.36
7/11/2016									1.40 (F)	
8/8/2016 ^A	1.0	1.0	1.0	1.2	1.2	1.1	0.57	1.2	1.5	1.0
9/12/2016	1.30	1.25	0.90	1.14	0.96	0.75	0.51	0.34	1.10	1.41
10/10/2016	1.88	1.59	1.42	1.18	1.47	0.90	0.73	0.75	1.89	1.80
11/7/2016	2.36	2.10	0.75	1.20	1.35	1.02	0.73	0.15	2.17	2.33
12/5/2016	1.97	2.15	off-line	1.14	1.48	0.94	0.78	0.15	2.08	2.18
1/9/2017	2.89	2.25	off-line	1.21	1.67	1.20	0.60	0.01	2.29	2.31
2/13/2017	2.34	2.38	off-line	1.21	1.51	1.18	0.57	BDL	2.21	2.29
3/27/2017	2.48	2.34	off-line	1.17	1.79	1.12	0.73	BDL	2.28	2.50

UCL = 4.00 ug/L - ppb

^A Analyzed by Frontier Prawn Analytical

F Analyzed post 20 day holding time

MPI 0.17 ug/l

MDL 0.015 ug/L

E:\water\167_168\167_168_169_170_171_172_173_174_175_176_177_178_179_180_181_182_183_184_185_186_187_188_189_190_191_192_193_194_195_196_197_198_199_200_201_202_203_204_205_206_207_208_209_210_211_212_213_214_215_216_217_218_219_220_221_222_223_224_225_226_227_228_229_230_231_232_233_234_235_236_237_238_239_240_241_242_243_244_245_246_247_248_249_250_251_252_253_254_255_256_257_258_259_260_261_262_263_264_265_266_267_268_269_270_271_272_273_274_275_276_277_278_279_280_281_282_283_284_285_286_287_288_289_290_291_292_293_294_295_296_297_298_299_300_301_302_303_304_305_306_307_308_309_310_311_312_313_314_315_316_317_318_319_320_321_322_323_324_325_326_327_328_329_330_331_332_333_334_335_336_337_338_339_340_341_342_343_344_345_346_347_348_349_350_351_352_353_354_355_356_357_358_359_360_361_362_363_364_365_366_367_368_369_370_371_372_373_374_375_376_377_378_379_380_381_382_383_384_385_386_387_388_389_390_391_392_393_394_395_396_397_398_399_400_401_402_403_404_405_406_407_408_409_410_411_412_413_414_415_416_417_418_419_420_421_422_423_424_425_426_427_428_429_430_431_432_433_434_435_436_437_438_439_440_441_442_443_444_445_446_447_448_449_450_451_452_453_454_455_456_457_458_459_460_461_462_463_464_465_466_467_468_469_470_471_472_473_474_475_476_477_478_479_480_481_482_483_484_485_486_487_488_489_490_491_492_493_494_495_496_497_498_499_500_501_502_503_504_505_506_507_508_509_510_511_512_513_514_515_516_517_518_519_520_521_522_523_524_525_526_527_528_529_530_531_532_533_534_535_536_537_538_539_540_541_542_543_544_545_546_547_548_549_550_551_552_553_554_555_556_557_558_559_560_561_562_563_564_565_566_567_568_569_570_571_572_573_574_575_576_577_578_579_580_581_582_583_584_585_586_587_588_589_590_591_592_593_594_595_596_597_598_599_600_601_602_603_604_605_606_607_608_609_610_611_612_613_614_615_616_617_618_619_620_621_622_623_624_625_626_627_628_629_630_631_632_633_634_635_636_637_638_639_640_641_642_643_644_645_646_647_648_649_650_651_652_653_654_655_656_657_658_659_660_661_662_663_664_665_666_667_668_669_670_671_672_673_674_675_676_677_678_679_680_681_682_683_684_685_686_687_688_689_690_691_692_693_694_695_696_697_698_699_700_701_702_703_704_705_706_707_708_709_710_711_712_713_714_715_716_717_718_719_720_721_722_723_724_725_726_727_728_729_730_731_732_733_734_735_736_737_738_739_740_741_742_743_744_745_746_747_748_749_750_751_752_753_754_755_756_757_758_759_760_761_762_763_764_765_766_767_768_769_770_771_772_773_774_775_776_777_778_779_780_781_782_783_784_785_786_787_788_789_790_791_792_793_794_795_796_797_798_799_800_801_802_803_804_805_806_807_808_809_810_811_812_813_814_815_816_817_818_819_820_821_822_823_824_825_826_827_828_829_830_831_832_833_834_835_836_837_838_839_840_841_842_843_844_845_846_847_848_849_850_851_852_853_854_855_856_857_858_859_860_861_862_863_864_865_866_867_868_869_870_871_872_873_874_875_876_877_878_879_880_881_882_883_884_885_886_887_888_889_890_891_892_893_894_895_896_897_898_899_900_901_902_903_904_905_906_907_908_909_910_911_912_913_914_915_916_917_918_919_920_921_922_923_924_925_926_927_928_929_930_931_932_933_934_935_936_937_938_939_940_941_942_943_944_945_946_947_948_949_950_951_952_953_954_955_956_957_958_959_960_961_962_963_964_965_966_967_968_969_970_971_972_973_974_975_976_977_978_979_980_981_982_983_984_985_986_987_988_989_990_991_992_993_994_995_996_997_998_999_1000

Attachment 3

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Column 1	Col 1	Col 2	Col 4	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9	Column 10	Column 11
2	Parameter 1	2.15	0.02	0.45										
3	Parameter 10	4.11E-4	0.1	1.11E-4										
4	Parameter 100	1.05	0.1	0.45										
5	Parameter 1000	0.0001	0.1	0.45										
6	Parameter 10000	0.00001	0.1	0.45										
7	Parameter 100000	0.000001	0.1	0.45										
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Attachment 4

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17	Total Number of Observations	33	Number of Deleted Observations	18
18			Number of Missing Observations	9
19	Minimum	0.000	Maximum	3.720
20	Maximum	0.775	Minimum	0.000
21	SD	0.623	95% Conf. Int. Lower	0.331
22	Confidence Interval	0.41	Maximum	0.811
23				
24	Source of Data:			
25	Source of Data	0.000	Source of Data	0.000
26	Source of Data	0.000	Source of Data	0.000
27	Source of Data	0.000	Source of Data	0.000
28	Source of Data	0.000	Source of Data	0.000
29	Source of Data	0.000	Source of Data	0.000
30	Source of Data	0.000	Source of Data	0.000
31	Source of Data	0.000	Source of Data	0.000
32	Source of Data	0.000	Source of Data	0.000
33	Source of Data	0.000	Source of Data	0.000
34	Source of Data	0.000	Source of Data	0.000
35	Source of Data	0.000	Source of Data	0.000
36	Source of Data	0.000	Source of Data	0.000
37	Source of Data	0.000	Source of Data	0.000
38	Source of Data	0.000	Source of Data	0.000
39	Source of Data	0.000	Source of Data	0.000
40	Source of Data	0.000	Source of Data	0.000
41	Source of Data	0.000	Source of Data	0.000
42	Source of Data	0.000	Source of Data	0.000
43	Source of Data	0.000	Source of Data	0.000
44	Source of Data	0.000	Source of Data	0.000
45	Source of Data	0.000	Source of Data	0.000
46	Source of Data	0.000	Source of Data	0.000
47	Source of Data	0.000	Source of Data	0.000
48	Source of Data	0.000	Source of Data	0.000
49	Source of Data	0.000	Source of Data	0.000
50	Source of Data	0.000	Source of Data	0.000

	A	B	C	D	E	F	G	H	I	J	K	L
245						95% Fractile (95% UCL)	2.485				95% Lognormal UCL (95% UCL)	2.46
246						95% Fractile (95% UCL)	2.485				95% Lognormal UCL (95% UCL)	2.46
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240	Appendix 10: 2019-2020														
241	BTS, Site and 3D														
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1257		Operating Expenses: Total labor			
1258		WV's AGG	2,203	WV's Distribution (FF201) AGG	2,108
1259		WV's Employee (VAR) AGG	2,803	WV's Distribution (FF201) AGG	2,679
1260		WV's Contract (VAR) AGG	1,400		
1261		Supplies and Materials: Total (FF) Contract			
1262		Deliverables: Labor & Materials: Non-union (FF) Supplies Contract			
1263		Accounting: Supplies: Total (FF) Contract			
1264		WV's AGG	8,800	WV's AGG	8,800
1265		WV's Distribution (FF) AGG	2,108	WV's Distribution (FF) AGG	2,108
1266		WV's Contract (FF) AGG	2,679	WV's Contract (FF) AGG	2,679
1267		WV's AGG	2,303	WV's AGG	2,303
1268		WV's Distribution (FF) AGG	2,108	WV's Distribution (FF) AGG	2,108
1269		WV's Contract (FF) AGG	2,679	WV's Contract (FF) AGG	2,679
1270		WV's AGG	2,303	WV's AGG	2,303
1271		WV's Distribution (FF) AGG	2,108	WV's Distribution (FF) AGG	2,108
1272		WV's Contract (FF) AGG	2,679	WV's Contract (FF) AGG	2,679
1273		WV's AGG	2,303	WV's AGG	2,303
1274		WV's Distribution (FF) AGG	2,108	WV's Distribution (FF) AGG	2,108
1275		WV's Contract (FF) AGG	2,679	WV's Contract (FF) AGG	2,679
1276		WV's AGG	2,303	WV's AGG	2,303
1277		WV's Distribution (FF) AGG	2,108	WV's Distribution (FF) AGG	2,108
1278		WV's Contract (FF) AGG	2,679	WV's Contract (FF) AGG	2,679
1279		WV's AGG	2,303	WV's AGG	2,303
1280		WV's Distribution (FF) AGG	2,108	WV's Distribution (FF) AGG	2,108
1281		WV's Contract (FF) AGG	2,679	WV's Contract (FF) AGG	2,679
1282		WV's AGG	2,303	WV's AGG	2,303
1283		WV's Distribution (FF) AGG	2,108	WV's Distribution (FF) AGG	2,108
1284		WV's Contract (FF) AGG	2,679	WV's Contract (FF) AGG	2,679
1285		WV's AGG	2,303	WV's AGG	2,303
1286		WV's Distribution (FF) AGG	2,108	WV's Distribution (FF) AGG	2,108
1287		WV's Contract (FF) AGG	2,679	WV's Contract (FF) AGG	2,679
1288		WV's AGG	2,303	WV's AGG	2,303
1289		WV's Distribution (FF) AGG	2,108	WV's Distribution (FF) AGG	2,108
1290		WV's Contract (FF) AGG	2,679	WV's Contract (FF) AGG	2,679
1291		WV's AGG	2,303	WV's AGG	2,303
1292		WV's Distribution (FF) AGG	2,108	WV's Distribution (FF) AGG	2,108
1293		WV's Contract (FF) AGG	2,679	WV's Contract (FF) AGG	2,679
1294		WV's AGG	2,303	WV's AGG	2,303
1295		WV's Distribution (FF) AGG	2,108	WV's Distribution (FF) AGG	2,108
1296		WV's Contract (FF) AGG	2,679	WV's Contract (FF) AGG	2,679
1297		WV's AGG	2,303	WV's AGG	2,303
1298		WV's Distribution (FF) AGG	2,108	WV's Distribution (FF) AGG	2,108
1299		WV's Contract (FF) AGG	2,679	WV's Contract (FF) AGG	2,679
1300		WV's AGG	2,303	WV's AGG	2,303
1301		WV's Distribution (FF) AGG	2,108	WV's Distribution (FF) AGG	2,108
1302		WV's Contract (FF) AGG	2,679	WV's Contract (FF) AGG	2,679

Only use these tags: [link](#),

Attachment 5

Figure 1

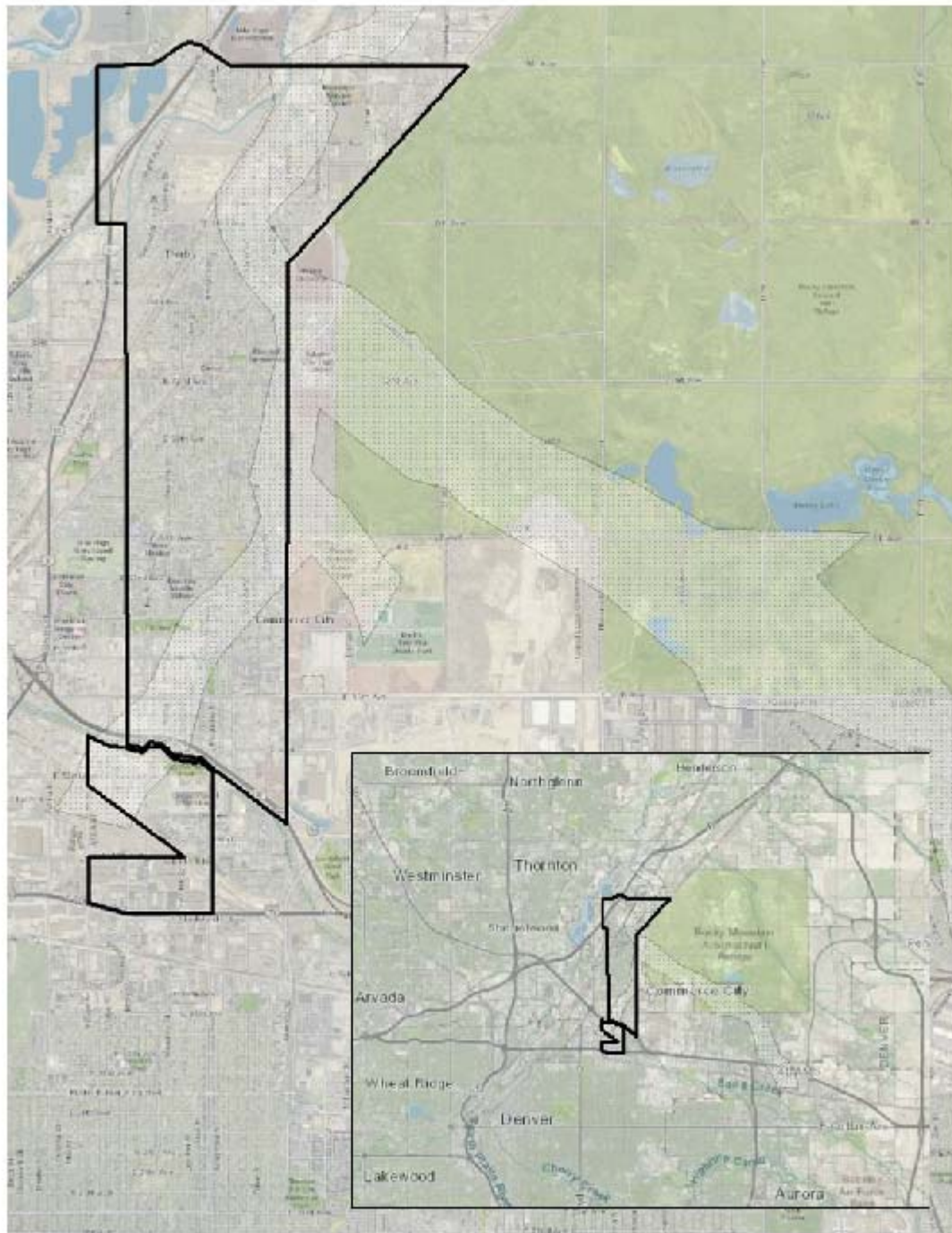


Figure 2

