FIFTH FIVE-YEAR REVIEW REPORT FOR DENVER RADIUM SUPERFUND SITE DENVER COUNTY, COLORADO

Prepared by

U.S. Environmental Protection Agency
Region 8
Denver, Colorado

Betsy Smidinger
Assistant Regional Administrator
Office of Ecosystems Protection
and Remediation

Date

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LIST OF ABBREVIATIONS AND ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
AROD	Rod Amendment
CCR	Code of Colorado Regulations
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Contaminant of Concern
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
FYR	Five-Year Review
HQ	Hazard Quotient
IC	Institutional Control
ICRP	International Commission on Radiological Protection
LUCIP	Land Use Control Implementation Plan
MCL	Maximum Contaminant Level
mg/kg	Milligram Per Kilogram
mrem	Millirem
NCP	National Contingency Plan
NPL	National Priorities List
O&M	Operation and Maintenance
OU	Operable Unit
pCi/g	Picocuries Per Gram
PRP	Potentially Responsible Party
PRG	Preliminary Remediation Goal
RAO	Remedial Action Objective
RfD	Reference Dose
ROBCO	Robinson Brick and Tile Company
ROD	Record of Decision
RPM	Remedial Project Manager
RSL	Regional Screening Level
UMTRCA	Uranium Mill Tailings Radiation Control Act
µR/h	Microroentgens Per Hour
UU/UE	Unlimited Use and Unrestricted Exposure
TBC	To Be Considered
VOC	Volatile Organic Compound
WL	Working Level

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 document recommendations to address them.

The U.S. Environmental Protection Agency (EPA) 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 Code of Federal Regulations (CFR) Section 300.430(f)(4)(ii)), and considering EPA policy.

This is the fifth FYR for the Denver Radium Superfund site (the Site).[1] The triggering action for this statutory review is the completion date of the previous FYR. The FYR has been prepared because hazardous substances, pollutants or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure (UU/UE), specifically on the five operable units (OUs) where waste was left in place: OUs 2, 3, 4, 8 and 9B. This FYR addresses those OUs. The Site consists of 11 OUs; this FYR does not address OUs 1, 5, 6, 7, 9A, 10 or 11 because no waste was left in place in these areas. EPA published a Federal Register notice in 2010, partially deleting each of the 11 OUs at the Site from the Superfund program's National Priorities List (NPL). Groundwater contamination associated with OU8 remains on the NPL. Table 1 summarizes the OUs addressed by this FYR.

Table 1: OUs Addressed by 2018 FYR Report, by Area and Media

OU Number	Area	Media
2	11th and Umatilla properties/current Atlas Metal & Iron property	Radioactive soil contamination
3	1000 West Louisiana properties	Radioactive soil contamination
4	Former Robinson Brick and Tile Company (ROBCO)/current Home Depot property	Radioactive soil contamination
8	Shattuck Chemical property	Soil and groundwater contamination
9B	Former ROBCO/current Home Depot property	Metals-contaminated soil

EPA remedial project manager (RPM) Armando Saenz led the FYR. Participants included Mark Rudolph from the Colorado Department of Public Health and Environment (CDPHE) and Treat Suomi and Kelly MacDonald from Skeo (EPA FYR support contractor). The review began on 10/27/2017.

Site Background

The Site consists of over 65 properties spread across Denver, Colorado, in the South Platte River Valley (Figure 1). In 1913, the National Radium Institute was established in Denver as a domestic source of radium, which was used in cancer therapy and research. The radium, vanadium and uranium industry thrived in Denver until the early 1920s. Site properties throughout the area were contaminated by radioactive residues from the processing of radium ore, leading to soil and groundwater contamination.

The OUs addressed in this FYR are primarily in commercial and industrial use. OU2 is currently occupied by a scrapyard (Atlas Metal & Iron) and several other small businesses. OU3 is currently occupied by a packaging plant, a noodle shop, several other businesses and a rail line; it is also bordered to the south by Sanderson Gulch. OUs 4 and 9B are occupied by Home Depot. A new residential development is being constructed on OU8 on the former Shattuck property; groundwater wells for this OU extend onto the Overland Golf Course to the west.

[1] Six total FYRs have been conducted prior to the 2018 FYR. The 1993 FYR was conducted only for OUs 4 and 5. The 1999 FYR was conducted only for OU8.

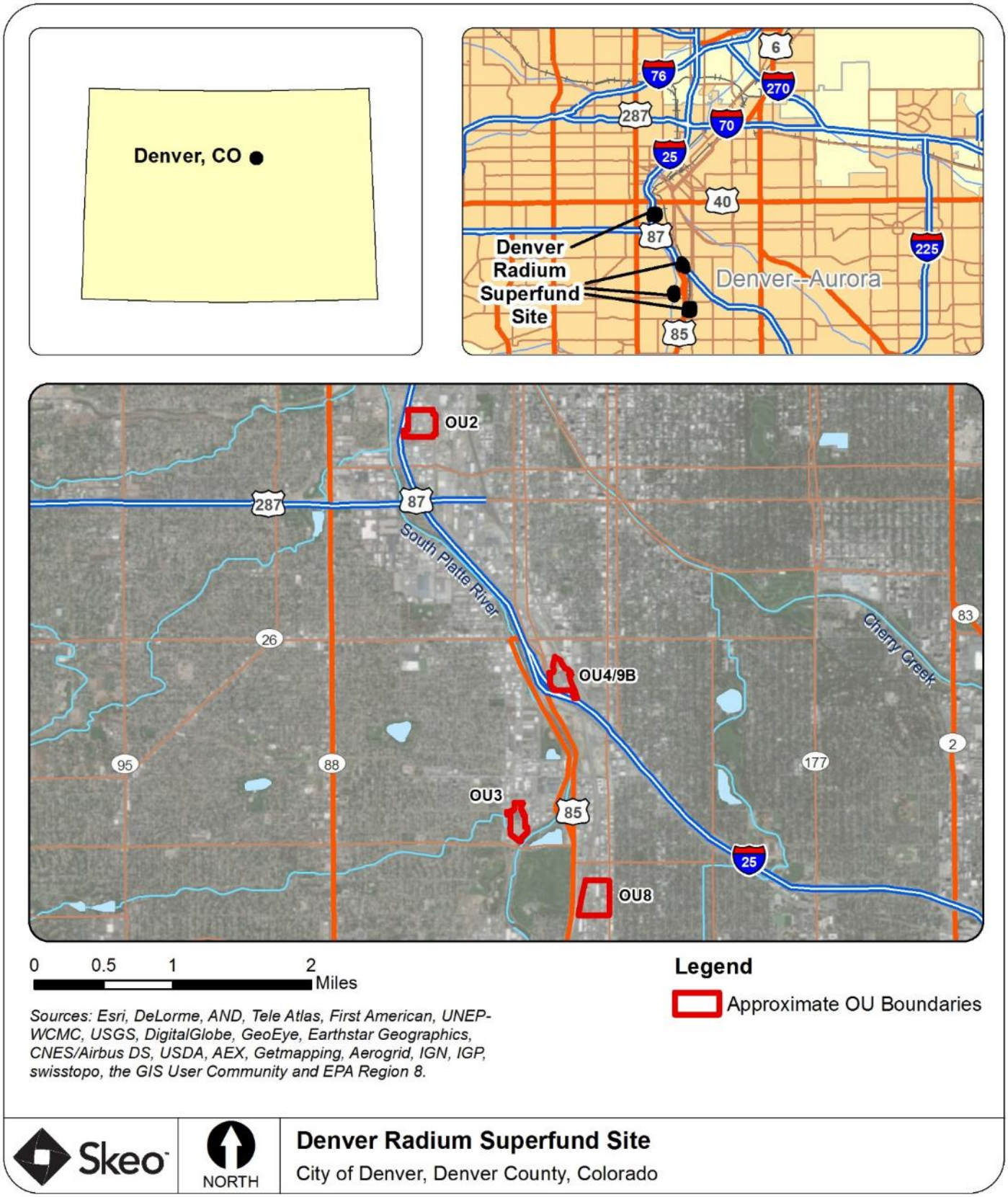
Surrounding land uses include commercial, industrial, residential and recreational areas. See Figure 2 for OUs and site features. Potable water at the Site is provided by a municipal water supply.

Refer to Appendix A for additional resources and to Appendix B for the Site's chronology of events.

FIVE-YEAR REVIEW SUMMARY FORM

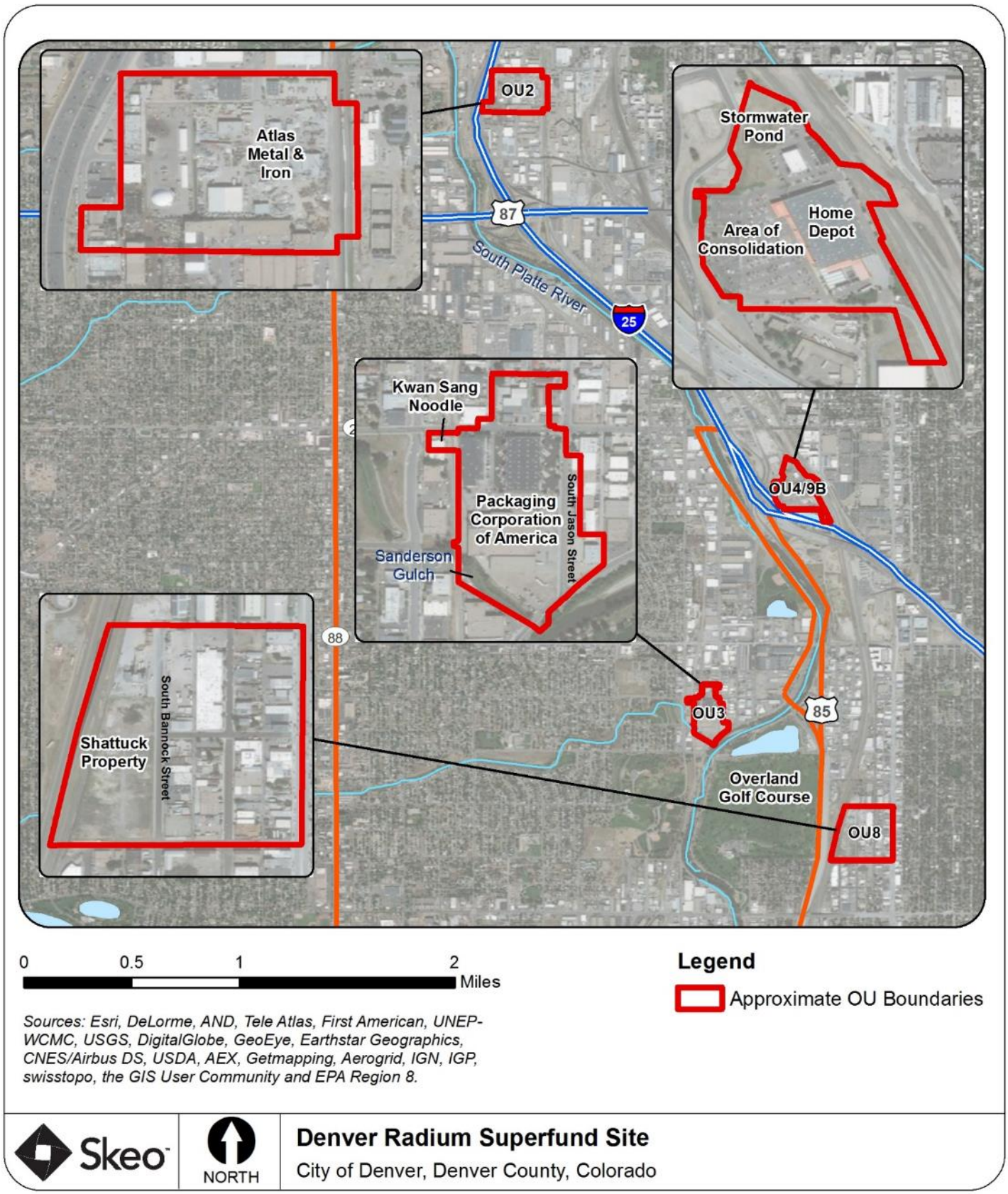
SITE IDENTIFICATION		
Site Name: Denver Radium		
EPA ID: COD980716955		
Region: 8	**State:** Colorado	**City/County:** Denver/Denver
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	**Has the Site achieved construction completion?** Yes	
REVIEW STATUS		
Lead agency: State		
Author name: Armando Saenz (EPA) with contractor support from Skeo		
Author affiliation: EPA Region 8 and Skeo		
Review period: 10/27/2017 – 8/22/2018		
Date of site inspection: 2/13/2018		
Type of review: Statutory		
Review number: 5		
Triggering action date: 9/24/2013		
Due date *(five years after triggering action date)*: 9/24/2018		

Figure 1: Vicinity Map



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

Figure 2: Detailed Site Map



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

EPA became aware of the Site in 1979 upon noting a reference to the National Radium Institute in a 1916 U.S. Bureau of Mines report. Subsequent field research identified 31 radioactive sites in the Denver metropolitan area. In August 1981, under a Cooperative Agreement with EPA, CDPHE assumed lead activities and initiated engineering assessments of the majority of the 31 radioactive sites. EPA listed the Site on the NPL in September 1983.

A 1986 site-wide remedial investigation focused on radium and uranium processing residues, including uranium, radium and thorium. The primary health risk associated with residues from processing facilities is radium-226 in soil, its associated radioactivity (gamma radiation and radon-decay products) and its tendency to decay to radon gas. Radium-226 was found across site properties above the site-specific background level of 2.0 picocuries per gram (pCi/g). Additional metals contamination, including radioactive lead-210, thorium-230 and uranium, as well as non-radioactive metals such as lead and arsenic, were identified in site soil. Most additional contaminants were co-located with the radium-226 contamination. The alluvial groundwater at OU8 was determined to be contaminated with gross alpha and beta radioactivity, uranium, metals and volatile organic compounds (VOCs). Potential inhalation, ingestion and direct exposure to radiological and metals contamination in soil and potential ingestion of OU8 contaminated groundwater presented risks to human health. The Site's Records of Decisions (RODs) did not identify any ecological risks for any OUs.

Response Actions

In 1989, EPA conducted an emergency removal action at OU8, which involved installation of an active radon reduction system to reduce excessively high levels of radon at the commercial property.

Remedial action objectives (RAOs) for the Site were developed as part of the site-wide remedial investigation to address the radium and uranium processing residues to:

- Prevent radiation exposure due to inhalation of radon gas and its daughter products.
- Prevent radiation exposure due to inhalation and ingestion of long-lived radionuclides.
- Prevent direct exposure to gamma radiation.

RAOs were also developed for metals contamination to:

- Prevent inhalation or ingestion of, and direct contact with, metals-contaminated soil.
- Monitor groundwater downgradient from the Site to verify the modeling predictions that contaminants from the Site will not degrade the South Platte River.

An RAO for OU8 groundwater was also developed to:

- Prevent ingestion of groundwater with contaminants in excess of Applicable or Relevant and Appropriate Requirements (ARARs) or health-based concentrations if no ARARs exist.

Eleven geographically-separated OUs were established to simplify the cleanup process. The remedies for the various OUs generally required excavation and off-site disposal of radiologically-contaminated soil, institutional controls for any residual waste, and monitored natural attention for OUs with groundwater contamination. The remedy for OU9B, where soil was contaminated with metals, included consolidation and capping, institutional controls and groundwater monitoring. The remedies were selected and updated in the following decision documents:

Table 2: OUs and Decision Documents

OU	Area	Decision Documents
2	11th and Umatilla properties/current Atlas Metal & Iron property	1987 ROD, 1993 ESD
3	1000 West Louisiana properties	1987 ROD, 1993 ESD
4	Former ROBCO/current Home Depot property (radiological contamination)	1986 ROD, 1994 ESD
8	Shattuck Chemical property	1992 ROD, 2000 AROD, 2007 ESD
9B	Former ROBCO/current Home Depot property (metals contamination)	1991 ROD
Notes: ESD = Explanation of Significant Differences		

OUs 2, 3 and 4

EPA selected excavation and off-site disposal as the remedy for OUs 2, 3 and 4. At the time the RODs were signed, there were no disposal facilities in the nation that accepted radium waste; therefore, the RODs included temporary on-site storage of the contaminated material. However, temporary on-site storage was not needed because a permanent disposal facility opened before excavation began. The remedies implemented at OUs 2, 3 and 4 differed from the remedies chosen in the respective RODs due to the larger volumes of contaminated material encountered and due to the inability to excavate around and under buildings, buried utilities and in groundwater. These changes were documented in Explanations of Significant Differences (ESDs) prepared and signed for each OU. Table 3 summarizes the remedial changes.

Table 3: Modifications to Remedies from ESDs

Document	Modifications
1993 OU2 ESD	• Temporary storage of contamination was not required. • Area of contamination and associated volume of contaminated soil increased. • Relatively small volumes of contaminated soil were left in place underneath structures and around public utilities on the DuWald property based on supplemental standards. • Due to the discovery of lead contamination during the remedial design, soils containing commingled radium and lead were solidified in a cement matrix prior to being shipped to the permanent off-site disposal facility. • Institutional controls were placed on these properties where waste was left in place to ensure that interested parties are aware of the presence of radiological contamination and may include deed restrictions and special zoning.
1993 OU3 ESD	• Temporary storage of contamination was not required. • Area of contamination and associated volume of contaminated soil increased. • Relatively small volumes of contaminated soil were left in place based on supplemental standards. • Creative Illumination building was demolished rather than decontaminated and restored. • Institutional controls were placed on these properties where waste was left in place to ensure that interested parties are aware of the presence of radiological contamination and may include deed restrictions and special zoning.
1994 OU4 ESD	• Area of contamination and associated volume of contaminated soil increased. • Relatively small volumes of contaminated soil were left in place based on supplemental standards. • Institutional controls were placed on these properties where waste was left in place to ensure that interested parties are aware of the presence of radiological contamination and may include deed restrictions and special zoning.
Notes: "Supplemental standards" are EPA criteria for determining that conditions in a given instance warrant a deviation from usual remedial action procedures. *Sources:* 1993 OU2 ESD, 1993 OU3 ESD, 1994 OU4 ESD	

Table 4 lists cleanup goals for contaminated soil at OUs 2, 3 and 4. The radium cleanup goals are based on ARARs (specifically, standards from 40 CFR Part 192 Uranium Mill Tailings Radiation Control Act, UMTRCA, which are for radium concentrations averaged over a land area of 100 square meters).

Table 4: Soil Contaminant of Concern (COC) Cleanup Goals for OUs 2, 3 and 4

OU	COC	Cleanup Goal	Unit
2, 3, 4	Radium-226 above background in the top 15 centimeters of soil	5	pCi/g
	Radium-226 above background in any layer below the top 15 centimeters of soil	15	pCi/g
2	Lead	1,000[a]	mg/kg

Notes:
a. The 1993 OU2 ESD did not formally list this value as a cleanup goal, but the value was used to identify contaminated soil areas requiring remediation.
pCi/g = picocuries per gram
mg/kg = milligrams per kilogram
Sources: 1987 OU2 ROD, 1993 OU2 ESD, 1987 OU3 ROD, 1986 OU4 ROD

OU8

The 1992 OU8 ROD selected on-site stabilization and solidification with institutional controls as the remedy for soil and natural attenuation with monitoring and institutional controls as the remedy for groundwater. In 1999, EPA conducted a discretionary OU8 FYR and found deficiencies in the solidified material cover design, the structural/chemical integrity, and the compliance program. Based on these findings, EPA modified the OU8 remedy in a 2000 ROD Amendment (AROD) that selected excavation and off-site disposal of the solidified soil along with any contaminants greater than cleanup levels, which were selected to allow for UU/UE (Table 5). A 2007 ESD documented that the costs of the amended remedy were substantially higher than estimated in the 2000 AROD, and the volume of waste had increased. See Table 5 for the cleanup goals selected in the 1992 ROD for determining the material to be excavated and in the 2000 AROD to allow for UU/UE.

Table 5: OU8 ROD Soil COC Cleanup Goals (from 1992 ROD and 2000 AROD)

Decision Document	COC	Cleanup Goal	Unit
1992 ROD	Radium-226 above background in the top 15 centimeters of soil	5	pCi/g
	Radium-226 above background in any layer below the top 15 centimeters of soil	15	pCi/g
	Thorium-230	42	pCi/g
	Natural uranium	75	pCi/g
	Arsenic	160	mg/kg
	Selenium	490	mg/kg
	Lead	540	mg/kg
2000 AROD	Radium-226 occurring in any 6-inch layer of the monolith from its top surface to its bottom surface, including any original soils not incorporated into the monolith that are above the groundwater table	5	pCi/g
	Thorium-230 occurring in any 6-inch layer of the monolith from its top surface to its bottom surface, including any original soils not incorporated into the monolith that are above the groundwater table	5	pCi/g
	Natural uranium	75	pCi/g

Notes:
pCi/g = picocuries per gram
mg/kg = milligrams per kilogram
Sources: 1992 OU8 ROD, Table 9-2 and 2000 OU8 AROD, Section H, Remedial Action Objectives

The 2000 AROD did not change the groundwater remedy. The alluvial groundwater was determined to be contaminated with gross alpha and beta radioactivity, uranium, metals and VOCs. The 1992 ROD specified that

groundwater monitoring would be performed to evaluate if concentrations exceeded ARARs and to be considered values (TBCs), which were identified as Safe Drinking Water Act maximum contaminant levels (MCLs), 5 Code of Colorado Regulations (CCR) 1002-8 Section 3.11.0, Basic Standards for Groundwater, and 5 CCR 1002-8 Section 3.12.0, Classifications and Water Quality Standards for Groundwater and 40 CFR 192.[2]

OU9B

OU9B was established after a substantial volume of metals-contaminated soil, resulting from mining wastes disposed of and used as fill, was discovered during the OU4 remedial action. This waste was not commingled with radioactive residues.

The RAOs identified in the ROD were to: 1) prevent inhalation or ingestion of, and direct contact with metals-contaminated soil; and 2) monitor groundwater downgradient from the Site to verify the modeling predictions that contaminants from the Site will not degrade the South Platte River.

The major components of the remedy at OU9B included consolidating and capping the metals-contaminated soil; conducting environmental monitoring necessary to ensure effectiveness of the remedial action; and implementing institutional controls to limit use of the Site, maintain the integrity of the cap and limit groundwater use.[3] The primary COCs affecting the soil are metals, including arsenic, lead, and zinc, with the cleanup goals based on health criteria (including prevention of exposure and direct contact with soil) (Table 6).

Table 6: OU9B Metals Soil COC Cleanup Goals

COC	Cleanup Goal (mg/kg)
Arsenic	79
Lead	1,000
Zinc	17,000
Notes: mg/kg = milligrams per kilogram *Source:* 1991 OU9B ROD	

Status of Implementation

OU2

Remedial actions at OU2 took place from August 1990 through August 1993. These actions resulted in the excavation and off-site disposal of 92,798 tons of radium-contaminated soil. A total of 14,211 tons of radiological- and lead-contaminated commingled material was excavated, stabilized and shipped off site. In a separate removal action in 1993, 933 tons of lead-contaminated soils from the 1100 Umatilla Street property (formerly the DuWald property, currently owned by Atlas Metal & Iron) were treated and shipped off site. A 1994 Supplemental Standards Report documented that 11,060 cubic yards of radiologically-contaminated soil were left in place on the Burlington Northern Railroad property and the 1100 Umatilla Street property. Appendix C provides a map depicting the location of contaminated soil left in place. This soil is currently capped by a parking lot on Atlas Metal & Iron's property.

OU3

Construction began in August 1989 and concluded in 1991. A total of 63,403 tons of contaminated material were excavated and shipped off site. Soil samples were collected and analyzed to verify that excavation activities achieved conformance with the applicable standards. A 1995 Supplemental Standards Report documented the

[2] The 1992 ROD did not list numeric values for these ARARs and TBCs.

[3] The 1991 OU9B ROD stated that ingestion of contaminated groundwater was not determined to be a significant exposure pathway due to past, current and likely future land uses, the availability of municipal water supplies, and the low potential for migration of contaminants. Groundwater monitoring was selected to verify remedy effectiveness. Since EPA determined that the aquifer was not a potential drinking water source and impacts to the South Platte River were unlikely, cleanup of groundwater was not part of the selected remedy.

5,868 cubic yards of radiologically-contaminated soil that remain on site under South Jason Street, around the Packaging Corporation of America building, and along South Platte River Drive. Appendix C provides a map depicting the location of contaminated soil left in place.

The Packaging Corporation of America building was verified as conforming to EPA standards for occupied or habitable buildings. Two areas of residual radioactive material were identified under the floor of the building. These areas were not remediated because gamma scan of the building ranged from 16 microroentgens per hour (μR/h) to 22 μR/h, which conforms to the EPA standard.

OU4

Construction began in August 1988 and concluded in March 1991. A total of 97,824 tons of radiologically-contaminated material was excavated and disposed of at an off-site disposal facility. About 2,100 tons of disposed material were contaminated with metals and radioactive material. A 1994 Supplemental Standards Report documented the 655 cubic yards of radiological-contaminated soil that remain on site. Appendix C provides a map depicting the location of contaminated soil left in place.

OU8

The 1992 ROD called for on-site stabilization and containment. The initial remedial action at OU8 began in September 1992 and finished in September 1998. It included the following activities:

- Demolition of radium-contaminated buildings.
- Excavation of radium-contaminated soil from vicinity properties, Bannock Street, the storm sewer located east of Santa Fe Drive, and the Shattuck Chemical property.
- On-site stabilization/solidification of radium-contaminated soil into a disposal cell with an approximate volume of 83,610 cubic yards.
- Capping of the stabilized material.
- Installation of monitoring wells to evaluate the effectiveness of the remedy.

During the excavation of radiologically-contaminated soils, oil-impacted soils were also found on site. The materials were below the action levels established in the 1992 ROD. About 2,000 cubic yards of oil-impacted soil were excavated and transported off site. Bioremediation was used for the oil-impacted soils that extended beneath the completed portion of the monolith. EPA approved a bio-system to treat remaining oil-impacted soils, and it was installed in September 1998.

Implementation of the amended remedy began in September 2002 and finished in September 2006. All waste material was removed from the property. About 243,872 tons of contaminated materials were excavated and disposed of as part of the combined work at both the Shattuck Chemical property and Bannock Street. Radiologically-contaminated material was sent off site.

Groundwater monitoring is ongoing.

OU9B

In September 1988, metals contamination was discovered on the ROBCO property during the OU4 cleanup. An investigation to characterize the nature and extent of metals contamination took place in 1989 and 1990. Soil containing elevated levels of arsenic, cadmium, chromium, copper, lead, selenium and zinc were identified. EPA and the state of Colorado entered into a Superfund State Contract for remedial implementation in July 1992. Excavations resulting from the radiological cleanup were backfilled and metals-contaminated soil was consolidated and capped.

Institutional Control (IC) Review

The ESDs for OUs 2, 3 and 4 all stated that institutional controls would be placed on properties where waste was left in place to ensure that interested parties are aware of the presence of radiological contamination. The ESDs

stated that institutional controls may include deed restrictions and special zoning. The 1992 OU8 ROD required institutional controls to restrict using groundwater beneath the Site. The 1991 OU9B ROD required implementation of institutional controls to limit groundwater use, to limit use of the Site, and to maintain integrity of the cap. Institutional controls are summarized below in Table 7, and institutional control documents are included in Appendix J.

Table 7: Summary of Planned and/or Implemented Institutional Controls (ICs)

OU	Media, Engineered Controls, and Areas That Do Not Support UU/UE Based on Current Conditions	ICs Needed	ICs Called for in the Decision Documents	Provisions of Implemented IC	Title of IC Instrument Implemented and Date (or planned)
2	Soil	Yes	Yes	• Prevents breach of concrete cap or disturbance of soils underneath the cap. • Inspection of concrete cap twice a year. • Groundwater use is limited to environmental monitoring. • Monitor and maintain indoor air quality to protect from radium exposures.	2006 Environmental Covenant
All	Soil	Yes	Yes	• Tracks locations with waste left in place and flags the Site when a building permit is pulled on that property under the City and County of Denver Building Permit program.	2008 Land Use Control Implementation Plan (LUCIP)
All	Soil	Yes	Yes	• Prohibits disposal of radium-contaminated materials in Denver without paying a fee and implements fees for contamination by or storage of radioactive waste, thus promoting removal and off-site disposal at an approved facility.	Denver Revised Municipal Code, Chapter 48, Article VIII (1996)
3, 8, and 9B	Groundwater	Yes	Yes	• Office of the State Engineer notifies any person seeking to drill a well into groundwater in this area that the groundwater is contaminated. • Office of the State Engineer notifies well seeker that they should contact EPA and CDPHE and that the State Engineer will send a copy of the well permit to EPA and CDPHE.	Colorado State Engineer Informational IC (July 2006 Letter)
4/9B	Soil	Yes	Yes	• Restricts future use of the areas where radiological contamination was left in place under supplemental standards. • Restricts use of the consolidated and capped metals-contaminated soil.	July 1995 Notice and Covenant

OU	Media, Engineered Controls, and Areas That Do Not Support UU/UE Based on Current Conditions	ICs Needed	ICs Called for in the Decision Documents	Provisions of Implemented IC	Title of IC Instrument Implemented and Date (or planned)

8	Groundwater	Yes	Yes	For the former Shattuck property:
				• Updated previous restrictions due to amended ROD and included the following restrictions:
				  • The construction of a dwelling or enclosed permanent structure on the property shall be prohibited.
				  • Use of the property for agricultural purposes shall be prohibited.
				  • The use of groundwater located beneath the property shall be prohibited.
					2002 Amendment of the Declaration of Covenants and Restrictions

Systems Operations/Operation and Maintenance (O&M)

The Atlas Metal & Iron facility is located on OU2. The company performs O&M activities, including cap inspections and repairs, as needed. Due to the presence of radium-contaminated soil beneath the Site, the 2006 Administrative Order on Consent between Atlas Metal & Iron and EPA requires that Atlas Metal & Iron conduct radon sampling in the occupied buildings. All available results from 2005 to 2016 were below the level of 4.0 pCi/L established by EPA as a guidance level for further testing and/or remedial action (See Appendix K for results).[4]

Home Depot conducts O&M for OU9B in accordance with the 2003 O&M Plan. The area of consolidation of metals-contaminated soil is maintained beneath the parking lots west of the store and beneath portions of the area next to and south of the stormwater management retention basin. Annual inspections of the area of consolidation are required and must be conducted by a professional engineer. Inspection reports note that, while no significant cracking or damage to the cap occurred, several minor issues were found including small cracks and caulking gaps between the building and concrete sidewalk. The 2017 Inspection Report suggested repaving the western portion of the west parking lot to address these cracks, re-caulking gaps, and implementing several other minor improvements to preserve the cap and address stormwater management.

CDPHE conducts groundwater monitoring for OUs 3 and 8. Groundwater was sampled once in the past five years in preparation of this FYR for these OUs and is summarized in the data review section of this report.

III. PROGRESS SINCE THE PREVIOUS REVIEW

This section includes the protectiveness determinations and statements from the previous FYR Report as well as the recommendations from the previous FYR Report and the status of those recommendations.

[4] 4.0 pCi/L is EPA's current action level, accessed on 5/4/18 at: https://www.epa.gov/sites/production/files/2016-02/documents/2012_a_citizens_guide_to_radon.pdf.

Table 8: Protectiveness Determinations/Statements from the 2013 FYR Report

OU #	Protectiveness Determination	Protectiveness Statement
2	Protective	The remedy at OU2 is protective of human health and the environment. Contaminated materials that remain on site are controlled under a protective cap with appropriate IC's in place. All exposure pathways that could result in an unacceptable risk are being controlled.
3	Protective	The remedy at OU3 is protective of human health and the environment. Contaminated materials that remain on site are controlled under a protective cap with appropriate IC's in place. All exposure pathways that could result in an unacceptable risk are being controlled.
4	Protective	The remedy at OU4 is protective of human health and the environment. Contaminated materials that remain on site are controlled under a protective cap with appropriate IC's in place. All exposure pathways that could result in an unacceptable risk are being controlled.
8	Protective	The remedy at OU8 is protective of human health and the environment. Contaminated ground water from the site is being monitored for natural attenuation and appropriate IC's in place. All exposure pathways that could result in an unacceptable risk are being controlled.
9B	Short-term Protective	The remedy at OU9B is currently protective of human health and the environment. Contaminated materials that remain on site are controlled under a protective cap with appropriate IC's in place. All exposure pathways that could result in an unacceptable risk are being controlled. To ensure future protectiveness, a new groundwater monitoring well network should be installed once the construction project at Interstate-25 is complete. Groundwater sampling should occur annually after the new wells are installed.
Sitewide	Protective	The remedial actions at all OUs are currently protective of human health and the environment. In order to ensure future protectiveness, a new groundwater monitoring well network should be installed and sampled annually at OU9B.

Table 9: Status of Recommendations from the 2013 FYR Report

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
9B	Groundwater monitoring wells were removed during construction project on Interstate-25.	A new groundwater monitoring well network should be installed once the Colorado Department of Transportation (CDOT) construction project at Interstate-25 is complete. Groundwater sampling should occur annually.	Addressed in Next FYR	CDOT construction is currently ongoing. CDPHE plans to install a set of groundwater monitoring wells and conduct annual monitoring after construction is complete.	N/A

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Community Involvement and Site Interviews

A public notice was made available by newspaper posting in the *Denver Post*'s online publication at *yourhub.com* on 2/1/2018 (Appendix D). It stated that the FYR was underway and invited the public to submit any comments to EPA. No one contacted CDPHE or EPA as a result of the notice. The FYR report will be made available at the Site's information repository, the CDPHE Records Center, located at 4300 Cherry Creek Drive South in Denver, Colorado.

During the FYR process, Mike Rosen of Atlas Metal & Iron was interviewed. Mr. Rosen commented that working with EPA and CDPHE has given him the comfort to do business on his property. He mentioned that there has been trespassing on his property but that it is not Site-related. Atlas Metal & Iron monitors and

maintains the OU2 cap, which appears to be in good condition. Radon is monitored in on-site buildings and has not exceeded relevant standards.

Data Review

Groundwater

OU3
OU3 groundwater has not been sampled since 2006. The City and County of Denver removed wastes in the public right-of-way in 2007. To monitor the effectiveness of this action, the 2013 FYR recommended additional groundwater sample collection for the 2018 FYR. CDPHE sampled groundwater in March 2018 for gross alpha, uranium 234 and 238, copper, manganese, molybdenum, uranium, zinc, and nitrates. Due to the lack of historical data, CDPHE did not conduct a trend analysis in 2018. Future data collection will assist in identifying trends. The full results and data evaluation of the OU3 groundwater are included in CDPHE's groundwater monitoring report, located in Appendix L.

OU8
CDPHE collected groundwater samples regularly during the past five-year period and analyzed them for gross alpha, uranium 234 and 238, copper, manganese, molybdenum, uranium, zinc, and nitrates. Samples were collected from a total of 10 monitoring wells and three storm sewer outfall locations to the South Platte River. Groundwater monitoring wells are located upgradient, downgradient, and cross gradient of OU8. The groundwater monitoring report in Appendix L analyzes the trends for uranium and molybdenum for each well. See Appendix L for the full groundwater evaluation.

OU9B
Construction is currently ongoing for a CDOT highway improvement project on Interstate-25 near OU9B, which resulted in the removal of all groundwater monitoring wells for OU9B. CDPHE plans to install a set of groundwater monitoring wells and conduct annual monitoring after construction of Interstate-25 is complete.

CDPHE should work with EPA to further evaluate and optimize the monitoring plan for the Site.

Site Inspection

The Site inspection took place on 2/13/2018. Participants included EPA RPM Armando Saenz, Mark Rudolph from CDPHE, and Treat Suomi and Kelly MacDonald from Skeo (EPA FYR support contractor). The purpose of the inspection was to assess the protectiveness of the remedy. The Site inspection checklist and Site photographs are included in Appendices F and G, respectively.

The team inspected OUs 2, 3, 4, 8 and 9B. The inspection began at OU4/9B. A Home Depot is on-Site, and its parking lot covers consolidated waste. The lot appeared to be in good condition, with minor cracks visibly repaired. There was also a small area of contamination left in place under the rail line behind the Home Depot and in a small area of vacant land next to the Home Depot on the northeast part of the OU. Mark Rudolph mentioned that the owner of this vacant land worked with CDPHE to develop a sewer line and not impact the contamination. CDOT construction around OU4/9B is ongoing, so no new OU9B wells have been installed.

The group then toured OU3, which is currently the location of Packaging Corporation of America and Kwan Sang Noodles facilities. Waste is currently under the packaging company, a rail right of way, and pavement in front of the noodle shop. The pavement was in good condition. The city and county of Denver are currently implementing a stormwater control project in Sanderson Gulch behind the packaging company; during a related excavation, they encountered radium-contaminated materials. They worked with CDPHE to develop a Materials Management Plan to address the materials, which provides monitoring, sampling and handling, and transportation and disposal protocols for regulated asbestos-contaminated soil as well as other potentially hazardous materials or contaminated soil that may be encountered during the construction phase. CDPHE approved this plan.

The inspection team inspected monitoring wells in OUs 3 and 8; several monitoring wells need new locks. The team then visited the Overland Golf Course and the newly developed Evans Station Lofts. The lofts are located on OU8; no soil waste is present there and the remedy consists of groundwater monitoring and institutional controls.

Lastly, the group inspected OU2, which continues to be used as a metal recycling facility. The remedy in this area includes the paved area of the business that acts as a cap for the contamination. The pavement was in good condition. The company also has a radon air exchange system in a building maintained by the company. The team met with Mike Rosen of Atlas Metal & Iron; his interview is included in this report's Community Notification, Community Involvement and Site Interviews Section.

V. TECHNICAL ASSESSMENT

QUESTION A: Is the remedy functioning as intended by the decision documents?

Question A Summary:

Yes, the remedies are functioning as intended by the decision documents. For OUs 2, 3 and 4, contaminated soils were excavated and disposed of off-Site. Soils left in place are consistent with supplemental standards previously determined for the Site; these are further evaluated in Question B. Contaminated soil at OU8 was ultimately excavated and disposed of off-Site. Metals-contaminated soil was consolidated and capped at OU9B.

Current O&M of the cap at OU9B appears adequate; inspections are conducted and repairs are made as necessary. Atlas Metal & Iron monitors and maintains the OU2 cap, which appears to be in good condition. Radon is monitored in on-Site buildings and has not exceeded relevant standards. During implementation of a Sanderson Gulch stormwater control project, the city and county of Denver encountered radium-contaminated material at OU3 and addressed it in accordance with a CDPHE-approved Materials Management Plan.

Groundwater monitoring is ongoing at OUs 3 and 8; the full evaluation of groundwater data is included in Appendix L. Groundwater monitoring is required at OU9B and will be resumed following the completion of the nearby CDOT project. CDPHE has identified opportunities to improve the efficiency of the groundwater monitoring program and should work with EPA to further evaluate, optimize and update the monitoring plan for the Site.

Institutional controls are in place for all OUs. For OU2, a 2006 Environmental Covenant limits groundwater use, prevents breach of the cap and requires monitoring of indoor air quality. The Land Use Control Implementation Plan (LUCIP) is also in place across Denver, which tracks locations with waste left in place and flags the Site when a building permit is pulled on that property under the City and County of Denver Building Permit Program. The Denver Municipal Code also prohibits disposal of radium-contaminated materials in Denver without paying a fee, thus promoting removal and off-Site disposal at an approved facility. In addition, for OUs 3, 8 and 9B, there is an institutional control with the Colorado State Engineer who will notify interested well drillers in areas of contaminated groundwater that the groundwater is contaminated and to contact EPA and CDPHE. At OU8, a 2002 Amendment of the Declaration of Covenants and Restrictions is in place that restricts construction of buildings on the property, use of the property for agricultural purposes, and the use of groundwater located beneath the property. Lastly, a 1996 Notice and Covenant at OU4/9B restricts future use of the areas where radiological contamination was left in place under supplemental standards and restricts use of the consolidated and capped metals-contaminated soil.

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

Question B Summary:

No. Although the ARARs and RAOs selected in the decision documents remain valid, the exposure assumptions and toxicity information used to develop the supplemental standards and OU8 soil cleanup goals may need further evaluation or updating. These items are discussed in further detail in the subsections below.

Under the current EPA Office of Land and Emergency Management policy, the soil lead screening level was established so that a typical child or similarly exposed group of children would have an estimated probability of no more than 5 percent of exceeding a blood lead level (BLL) of 10 micrograms per deciliter (µg/dL). The 10 µg/dL BLL target concentration is based (in part) on the 1991 Center for Disease Control's (CDC) blood lead "level of concern." In 2012, CDC accepted the recommendations of its Advisory Committee on Childhood Lead Poisoning Prevention that the "level of concern" be replaced by a reference value based on the 97.5th percentile of the National Health and Nutrition Examination Survey-generated BLL distribution in children 1-5 years old (currently 5 µg/dL).

EPA is in the process of updating its policy based on recent studies. The most recent scientific literature on lead toxicology and epidemiology provide evidence that adverse health effects are associated with BLL less than 10 µg/dL and there is no apparent threshold level for adverse effects. EPA Region 8 will continue to use the current EPA policy, until the Agency finalizes and updates its policy.

ARARs

UMTRCA standards from 40 CFR Part 192 were considered ARARs for the Site. Site soil was considered contaminated when radium-226 concentrations exceeded 5 pCi/g above background in the top 15 centimeters of soil or 15 pCi/g above background in any layer below the top 15 centimeters. These standards have not changed in the last five years.[5] Several other standards from 40 CFR Part 192 were also considered ARARs, were reviewed as part of this FYR and have not changed. See the full review in Appendix I.

OU8 groundwater standards are based on several ARARs. This FYR compared the current groundwater standards in use in the 2018 groundwater monitoring report to the current standards; all the standards in use by CDPHE are current. See Appendix I for this review.

Supplemental Standards

There are several areas where radiological contamination remains in place in OUs 2, 3, 4. Supplemental standards were issued in accordance with 40 CFR Part 192, which states that when specific criteria apply, agencies may select and perform remedial actions that come as close to meeting the otherwise applicable standard as is reasonable under the circumstances.[6] Based on the cost of removing contaminated material and the fact that the contamination was determined to not pose a threat to human health or the environment, OUs 2, 3 and 4 met the criteria to allow for the use of supplemental standards. Risk assessments conducted as part of the supplemental standards determinations (in 1994 and 1995) found no unacceptable risk. The exposure scenario for OU2 included a business employee (i.e., commercial use). The exposure scenarios for OUs 3 and 4 included a business employee or construction worker. These OUs all remain in commercial and industrial use.

This FYR evaluated the use of the supplemental standards and determined that they may no longer be valid. The supplemental standard documents for these three OUs adopted the International Commission on Radiological Protection (ICRP) 100 millirem (mrem)/year radiation dose criterion to evaluate potential risks to workers exposed to the localized areas of soil contamination at OU2, OU3 and OU4. The risk assessments established conservative exposure concentrations by selecting the maximum contaminant concentration, which in some cases

[5] Accessed at https://semspub.epa.gov/work/HQ/176323.pdf on 4/16/18.

[6] EPA criteria for determining that conditions in a given instance warrant a deviation from usual remedial action procedures are known as supplemental standards for remedial action.

were at a depth of 10 feet or located below groundwater. The risk assessments then compared the maximum exposure dose to the ICRP criteria of 100 mrem/year. For OU2, the risk assessment estimated the effective dose equivalent rate of 73 mrem/year for a business worker and 993 mrem/year for a construction worker. Similarly, for OU3 and OU4, the health risk assessment show estimated effective dose equivalents for a business worker of 19 mrem/year and 14.6 mrem/year, respectively, and 51.9 mrem/year and 29.7 mrem/year for a construction worker, respectively. Except for the construction worker scenario at OU2, all three risk assessments concluded that because the workers' dosages are less than that allowed by ICRP (100 mrem/year at the time), the workers would not incur unacceptable doses of ionizing radiation from contaminated soil left in place. For the OU2 construction worker scenario, the risk assessment determined that institutional controls were needed to protect human health and the environment by preventing uncontrolled excavations on the Site, which are in place via the 2006 Environmental Covenant.

Since the RODs were issued, EPA published guidance in 1997 that established a protective dose-based ARAR of 15 mrem/year.[7] The guidance indicates that if a dose assessment is conducted at a site, then the 15 mrem/year effective dose equivalent should generally be the maximum dose limit for humans. According to the guidance, this level equates to a 3×10^{-4} risk and is consistent with levels generally considered protective in other governmental actions and guidance developed by EPA in other radiation control programs. In 2014, EPA revised the dose-based ARAR from 15 mrem/year to 12 mrem/year based on recent scientific information reflected in EPA's Federal Guidance Report 13.[8] The 2014 guidance indicates that 12 mrem/year is now considered to correspond approximately to 3×10^{-4} excess lifetime cancer risk based on a residential land use. A value for commercial or industrial worker has not been established by EPA. However, the updated guidance suggests that the ICRP 100 mrem/year value may not necessarily represent a conservative screening value. Due to the change in EPA's risk assessment guidance since the supplemental criteria documents were published, the ICRP criteria of 100 mrem/year should be reviewed to determine if this value and the corresponding soil concentrations left in place remain valid and protective.

OU9B Soil Cleanup Goals

The OU9B metals soil cleanup goals were based on health criteria, including prevention of exposure and direct contact with soil, as ARARs have not been established for metals. To determine the cleanup goals' current validity, a screening-level risk evaluation was conducted by comparing the cleanup goals to EPA's composite worker regional screening levels (RSLs) and calculating corresponding risk values; the full evaluation is available in Appendix H. The cleanup goals for arsenic and zinc remain valid. The lead cleanup goal of 1,000 mg/kg exceeds the current composite worker RSL of 800 mg/kg. However, blood lead levels continue to decline in the U.S. population as documented in EPA's 2017 lead guidance and depending on specific demographic or geographic characteristics of a site, acceptable industrial-based soil lead can be as high as 1,050 mg/kg.[9] In addition, there is no current exposure to lead because this area is capped, preventing direct contact with soil. Home Depot conducts inspections and maintains the parking lot cap. If the capped area were to be disturbed for future development, it is recommended that lead exposure be re-evaluated at that time. However, this is unlikely, as O&M is agreed upon and conducted by Home Depot, and institutional controls are in place.

OU2 Soil Cleanup Goal

The OU2 lead cleanup goal of 1,000 mg/kg also exceeds the current composite worker RSL of 800 mg/kg. Therefore, lead potentially exists above the current composite worker RSL on the former DuWald property (and current Atlas Metal & Iron property). However, there is no current exposure to lead because this area is capped by a parking lot on Atlas Metal & Iron's property, preventing direct contact with soil. If this area were to be disturbed for future development, it is recommended that lead exposure be re-evaluated at that time.

[7] Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination. OSWER No. 9200-18. August 1997.
[8] Radiation Risk Assessment at CERCLA Sites: Q&A. OSWER No. 9285.6-20. June 2014.
[9] OLEM Directive 9285.6-56. May 17, 2017. Update to Adult Lead Methodology's Default Blood Lead Concentration and Geometric Standard Deviation Parameters.

OU8 Soil Cleanup Goals

The OU8 ROD and AROD also identified several soil cleanup goals beside the 40 CFR 192 radium-226 standards (discussed earlier in Question B and reviewed in full in Appendix I). This FYR evaluated the validity of the remaining OU8 cleanup goals, including for thorium-230, natural uranium, lead, arsenic and selenium. A residential scenario was evaluated due to residential development on OU8. The 2000 AROD's cleanup goal for thorium was based on Office of Solid Waste and Emergency Response Directive No. 9200.4-25, "Use of Soil Cleanup Criteria in 40 CFR Part 192 as Remediation Goals for CERCLA Sites." This remains the current guidance; therefore, the thorium cleanup goal remains valid. A screening level risk assessment was conducted for the natural uranium, lead, arsenic and selenium cleanup goals and is in Appendix H. The screening-level risk evaluation indicates that the cleanup goals for arsenic and natural uranium are equivalent to cancer risks greater than 1×10^{-4} or a noncancer hazard quotient (HQ) of 1. The cleanup goals for these two contaminants should be reviewed to determine if revisions are warranted based on a site-specific risk assessment.

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

No other information has come to light that could call into question the protectiveness of the remedy.

VI. ISSUES/RECOMMENDATIONS

<table>
<tr><th colspan="6">Issues/Recommendations</th></tr>
<tr><td colspan="6">OU(s) without Issues/Recommendations Identified in the FYR:</td></tr>
<tr><td colspan="6">None.</td></tr>
<tr><td colspan="6">Issues and Recommendations Identified in the FYR:</td></tr>
<tr><td rowspan="3">OU(s): 2, 3 and 4</td><td colspan="5">Issue Category: Changed Site Conditions</td></tr>
<tr><td colspan="5">Issue: The effective dose equivalent criterion (100 mrem/year) used by EPA to evaluate risk has become more stringent (12 mrem/year) since the supplemental standards reports were issued.</td></tr>
<tr><td colspan="5">Recommendation: Evaluate if the effective dose equivalent criterion used for the supplemental standards risk assessments is still valid based on new EPA guidance.</td></tr>
<tr><td>Affect Current Protectiveness</td><td>Affect Future Protectiveness</td><td>Party Responsible</td><td>Oversight Party</td><td colspan="2">Milestone Date</td></tr>
<tr><td>No</td><td>Yes</td><td>EPA/State</td><td>EPA</td><td colspan="2">9/24/2020</td></tr>
<tr><td rowspan="3">OU(s): 9B</td><td colspan="5">Issue Category: Monitoring</td></tr>
<tr><td colspan="5">Issue: Groundwater monitoring wells were removed during a CDOT construction project on Interstate-25.</td></tr>
<tr><td colspan="5">Recommendation: Update the monitoring plan and install a new groundwater monitoring well network once the CDOT construction project on Interstate-25 is complete.</td></tr>
<tr><td>Affect Current Protectiveness</td><td>Affect Future Protectiveness</td><td>Party Responsible</td><td>Oversight Party</td><td colspan="2">Milestone Date</td></tr>
<tr><td>No</td><td>Yes</td><td>State</td><td>EPA</td><td colspan="2">9/24/2020</td></tr>
</table>

OU(s): 8	Issue Category: Changed Site Conditions			
	Issue: Screening-level risk evaluations for OU8 arsenic and natural uranium soil cleanup goals are equivalent to a residential risk greater than 1 x 10^{-4} or a noncancer HQ of 1.			
	Recommendation: Determine if a site-specific risk assessment is needed for arsenic and natural uranium in soil.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA/State	EPA	9/24/2020

OTHER FINDINGS

Additional recommendations were identified during the FYR. These recommendations do not affect current and/or future protectiveness.

- Replace locks on monitoring wells.
- CDPHE has identified opportunities to improve the efficiency of the groundwater monitoring program and should work with EPA to further evaluate, optimize and update the monitoring plan for the Site.

VII. PROTECTIVENESS STATEMENT

Protectiveness Statement(s)	
Operable Unit:2	*Protectiveness Determination:* Short-term Protective
Protectiveness Statement: The remedy at OU2 currently protects human health and the environment because contaminated materials were excavated and disposed of off-Site, contamination that remains on-Site is capped, and institutional controls are in place. However, in order for the remedy to be protective in the long term, the following action needs to be taken to ensure protectiveness: • Evaluate if the effective dose equivalent criterion used for the supplemental standards risk assessments is still valid based on new EPA guidance.	
Protectiveness Statement(s)	
Operable Unit:3	*Protectiveness Determination:* Short-term Protective
Protectiveness Statement: The remedy at OU3 currently protects human health and the environment because contaminated materials were excavated and disposed of off-Site, contamination that remains on-Site is capped, and institutional controls are in place. However, in order for the remedy to be protective in the long term, the following action needs to be taken to ensure protectiveness: • Evaluate if the effective dose equivalent criterion used for the supplemental standards risk assessments is still valid based on new EPA guidance.	
Protectiveness Statement(s)	
Operable Unit:4	*Protectiveness Determination:* Short-term Protective
Protectiveness Statement: The remedy at OU4 currently protects human health and the environment because contaminated materials were excavated and disposed of off-Site, contamination that remains	

on-Site is capped, and institutional controls are in place. However, in order for the remedy to be protective in the long term, the following action needs to be taken to ensure protectiveness:

- Evaluate if the effective dose equivalent criterion used for the supplemental standards risk assessments is still valid based on new EPA guidance.

Protectiveness Statement(s)

Operable Unit: 8	*Protectiveness Determination:* Short-term Protective

Protectiveness Statement: The remedy at OU8 currently protects human health and the environment because contaminated materials were excavated and disposed of off-Site, groundwater monitoring and natural attenuation are ongoing, and groundwater institutional controls are in place. However, for the remedy to be protective in the long term, the following action needs to be taken to ensure protectiveness:

- Determine if a site-specific risk assessment is needed for arsenic and natural uranium in soil.

Protectiveness Statement(s)

Operable Unit:9B	*Protectiveness Determination:* Short-term Protective

Protectiveness Statement: The remedy at OU9B currently protects human health and the environment because contaminated materials were excavated and capped on-Site, and institutional controls are in place. However, for the remedy to be protective in the long term, the following action needs to be taken to ensure protectiveness:

- Install a new groundwater monitoring well network once the CDOT construction project on Interstate-25 is complete, and sample groundwater annually.

Sitewide Protectiveness Statement

Protectiveness Determination:
Short-term Protective

Protectiveness Statement: Because the remedies at OUs 2, 3, 4, 8 and 9B are currently protective of human health and the environment, the remedies at the Site currently protect human health and the environment. However, for the remedies to be protective in the long term, the following actions need to be taken to ensure protectiveness:

- Evaluate if the effective dose equivalent criterion used for the supplemental standards risk assessments is still valid based on new EPA guidance.
- Determine if a Site-specific risk assessment is needed for arsenic and natural uranium in soil.
- Install a new groundwater monitoring well network once the CDOT construction project on Interstate 25 is complete, and sample groundwater annually.

VIII. NEXT REVIEW

The next FYR Report for the Denver Radium Superfund Site is required five years from the completion date of this review.

APPENDIX A – REFERENCE LIST

Denver Revised Municipal Code, Article VIII Disposal Fees, Denver Radium Superfund Site, Denver, Colorado. Prepared by the City and County of Denver. September 1, 1982.

Record of Decision, Operable Unit 7, Denver Radium Superfund Site, Denver, Colorado. EPA Region 8. March 24, 1986.

Record of Decision, Operable Units 4 and 5, Denver Radium Superfund Site, Denver, Colorado. EPA Region 8. September 30, 1986.

Record of Decision, Operable Unit 10, Denver Radium Superfund Site, Denver, Colorado. EPA Region 8. June 30, 1987.

Record of Decision, Operable Unit 1, Denver Radium Superfund Site, Denver, Colorado. EPA Region 8. September 29, 1987.

Record of Decision, Operable Unit 2, Denver Radium Superfund Site, Denver, Colorado. EPA Region 8. September 29, 1987.

Record of Decision, Operable Unit 3, Denver Radium Superfund Site, Denver, Colorado. EPA Region 8. September 29, 1987.

Record of Decision, Operable Unit 9, Denver Radium Superfund Site, Denver, Colorado. EPA Region 8. December 23, 1991.

Record of Decision, Operable Unit 8, Denver Radium Superfund Site, Denver, Colorado. EPA Region 8. January 28, 1992.

Explanation of Significant Differences, Operable Unit 2, Denver Radium Superfund Site, Denver, Colorado. EPA Region 8. September 17, 1993.

Explanation of Significant Differences, Operable Unit 3, Denver Radium Superfund Site, Denver, Colorado. EPA Region 8. November 10, 1993.

Interim Closeout Report, Operable Units 4 and 5, Denver Radium Superfund Site, Denver, Colorado. Prepared by RUST Geotech Inc. for the U.S. Department of Energy and EPA Region 8. July 1994.

Supplemental Standards Report, Operable Unit 4, Denver Radium Superfund Site, Denver, Colorado. EPA Region 8. October 1994.

Supplemental Standards Report, Operable Unit 2, Denver Radium Superfund Site, Denver, Colorado. EPA Region 8. November 1994.

Explanation of Significant Differences, Operable Units 4 and 5, Denver Radium Superfund Site, Denver, Colorado. EPA Region 8. November 22, 1994.

Explanation of Significant Differences, Operable Units 6, 9 and 11, Denver Radium Superfund Site, Denver, Colorado. EPA Region 8. January 17, 1995.

Supplemental Standards Report, Operable Unit 3, Denver Radium Superfund Site, Denver, Colorado. EPA Region 8. June 1995.

Record of Decision Amendment, Operable Unit 8, Denver Radium Superfund Site, Denver, Colorado. EPA Region 8. June 16, 2000.

Amended Declaration of Covenants and Restrictions, Denver Radium Superfund Site, Denver, Colorado. Prepared by the Clerk and Recorder of the City and County of Denver. September 3, 2002.

Amended Operations and Maintenance Plan, Robinson Brick Company Site, Denver, Colorado. Prepared by Environmental Resources Management. May 6, 2003.

Environmental Covenant, Denver Radium Superfund Site, Denver, Colorado. Colorado Department of Public Health and the Environment. July 25, 2006.

Final Close Out Report, Denver Radium Superfund Site, Denver, Colorado. EPA Region 8. September 25, 2006.

Explanation of Significant Differences, Operable Unit 8, Denver Radium Superfund Site, Denver, Colorado. EPA Region 8. March 2007.

Third Five-Year Report, Denver Radium Superfund Site, Denver, Colorado. Prepared by Colorado Department of Public Health and the Environment. September 30, 2008.

Annual Report for 2012, Radon Sampling, Denver Radium Superfund Site, Denver, Colorado. Prepared by Engineering Management Support Inc. for Atlas Metal & Iron Corp. February 26, 2013.

Fourth Five-Year Report, Denver Radium Superfund Site, Denver, Colorado. Prepared by Colorado Department of Public Health and the Environment. September 24, 2013.

Annual Report for 2013, Radon Sampling, Denver Radium Superfund Site, Denver, Colorado. Prepared by Engineering Management Support Inc. for Atlas Metal & Iron Corp. March 10, 2014.

Comprehensive Report, Denver Radium Superfund Site, Denver, Colorado. Prepared by City and County of Denver Department of Environmental Health, Environmental Quality Division. October 2014.

2015 Annual Inspection Report, Robinson Brick Company Site, Denver, Colorado. Prepared by Environmental Resources Management. December 2015.

2016 Annual Inspection Report, Robinson Brick Company Site, Denver, Colorado. Prepared by Environmental Resources Management. December 2016.

2017 Annual Inspection Report, Robinson Brick Company Site, Denver, Colorado. Prepared by Environmental Resources Management. December 2017.

Annual Report for 2017, Radon Sampling, Denver Radium Superfund Site, Denver, Colorado. Prepared by Engineering Management Support Inc. for Atlas Metal & Iron Corp. March 19, 2018.

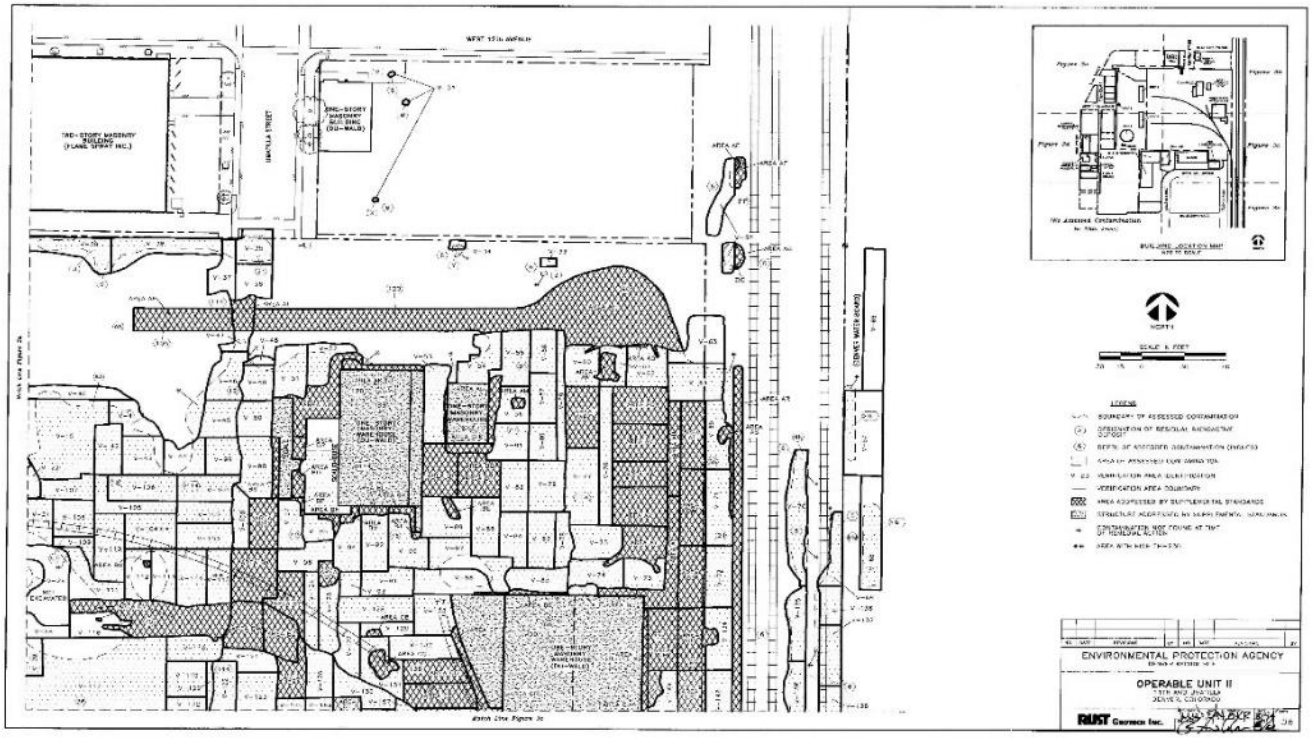
APPENDIX B – SITE CHRONOLOGY

Table B-1: Site Chronology

Event	Date
Radium, vanadium and uranium industry contaminated site properties during operation	1913 – early 1920s
CDPHE initiated assessments of majority of radioactive properties in Denver	August 1981
EPA listed the Site on the NPL	September 1983
EPA issued the "No Action" ROD for OU7	March 1986
EPA completed the site-wide remedial investigation	April 1986
EPA issued the ROD for OUs 4 and 5	September 1986
EPA issued the ROD for OU10	June 1987
EPA completed the site-wide feasibility study	July 1987
EPA issued the ROD for OUs 1, 2, 3, 6, 9A and 11	September 1987
EPA and the state of Colorado entered into Superfund State Contract for remedial action at the Site	May 1988
EPA conducted an emergency removal action to install an active radon reduction system at OU8	1989
CDPHE completed remedial actions at OU5	March 1991
CDPHE completed remedial actions at OU1	July 1991
CDPHE completed remedial actions at OU3	September 1991
EPA issued the ROD for OU9B	December 1991
EPA issued the ROD for OU8	January 1992
EPA issued the ESD for OU7	September 1992
CDPHE completed remedial actions at OU2	August 1993
EPA issued a Special FYR Report for OUs 4 and 5	September 30, 1993
EPA issued the ESD for OU2	September 1993
EPA issued the ESD for OU3 and CDPHE completed remedial actions for OU6, 9A and 11	December 1993
EPA issued the first site-wide FYR Report	September 12, 1994
EPA issued the Supplemental Standards Report for OU4	October 1994
EPA issued the Supplemental Standards Report for OU2	November 1994
EPA issued the ESD for OUs 4 and 5	December 1994
EPA issued the ESD for OUs 6, 9A and 11	January 1995
EPA issued the Supplemental Standards Report for OU3	June 1995
Home Depot filed and recorded Notice and Covenant at OUs 4 and 9B	July 1995
CDPHE completed remedial actions at OU9B	April 1996
EPA issued a Special FYR Report for OU8	November 12, 1999
EPA issued an Amended ROD for OU8	June 2000
EPA issued the second site-wide FYR Report	September 30, 2003
The city and county of Denver adopted an ordinance covering site-wide radioactive wastes left in place	August 2004
Colorado State Engineer established groundwater notification informational institutional control at OUs 3, 4, 8 and 9B and Atlas Umatilla, LLC recorded an Environmental Covenant for OU2	July 2006
EPA completed remedial actions at OU8 and EPA issued the site-wide Final Close Out Report	September 2006
EPA issued the ESD for OU8	March 2007
EPA issued the third site-wide FYR Report	September 30, 2008
EPA deleted all OUs except groundwater at OU8 from the NPL	September 2010
EPA issued the fourth site-wide FYR Report	September 24, 2013

APPENDIX C – SUPPLEMENTAL STANDARDS MAPS

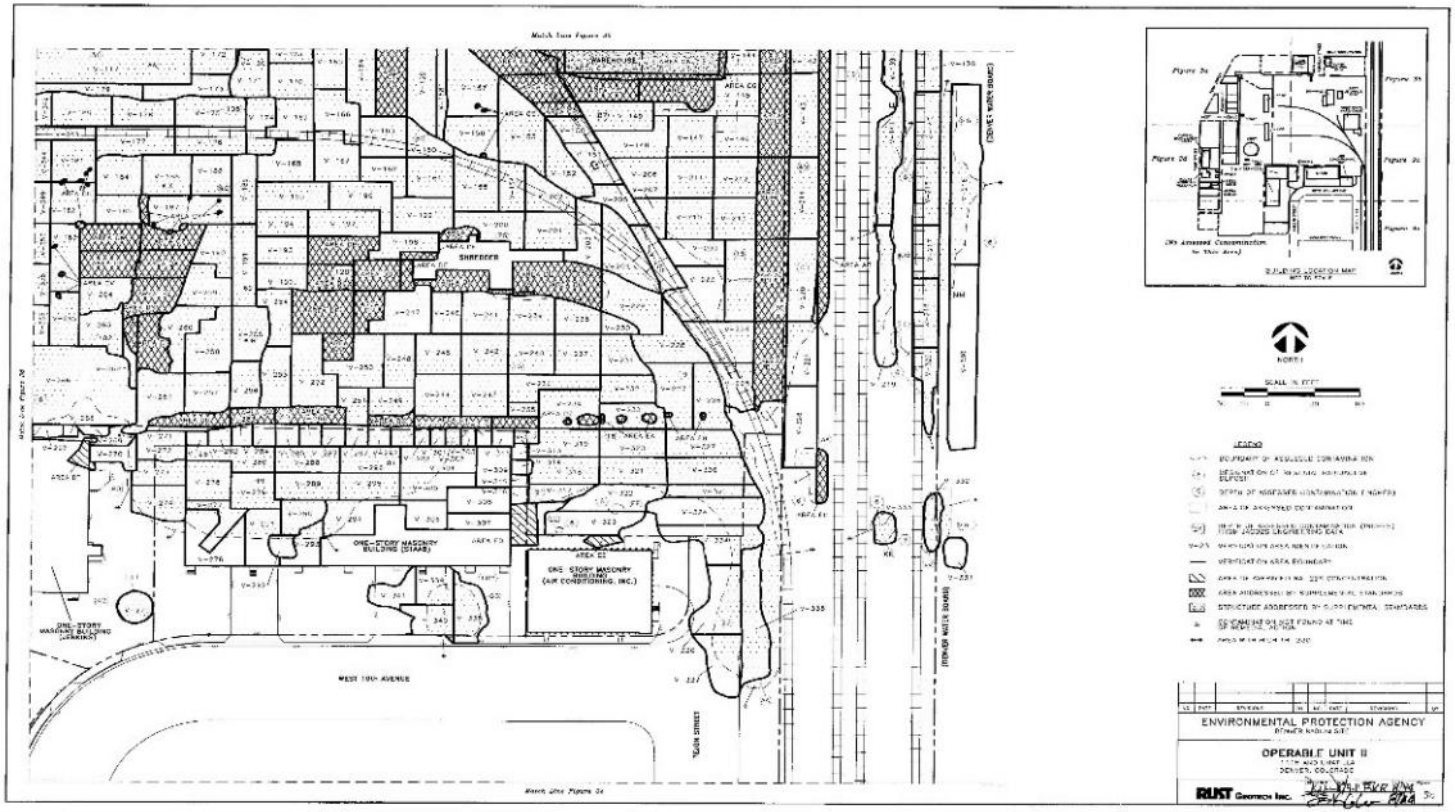
Supplemental Standards Maps from the 2013 FYR Report



Waste left in place under Supplemental Standards

Figure 2
Denver Radium Site – OU2

Source:OU2 Interim Closeout Report 1994

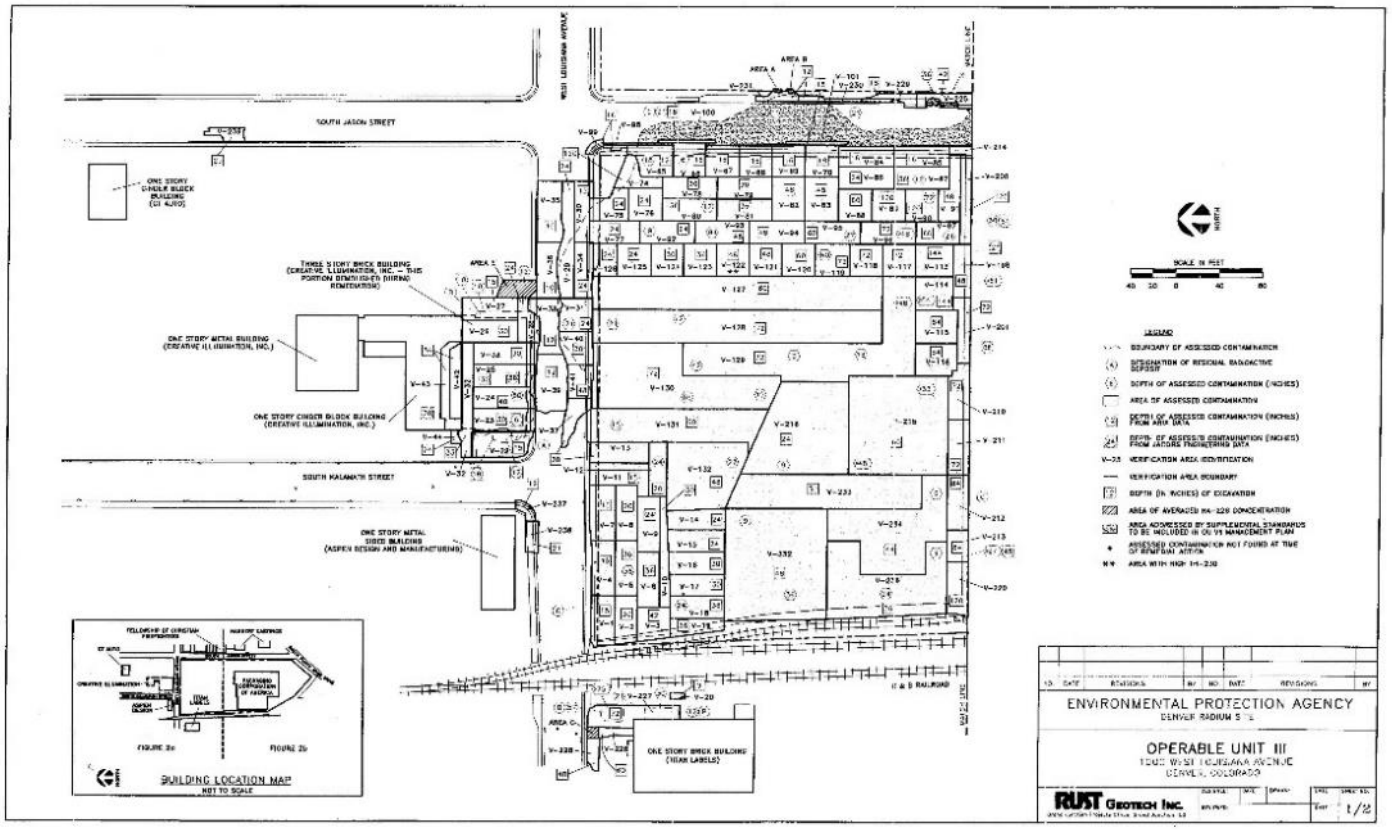


Waste left in place under Supplemental Standards

Waste left in place under Area Averaging

Figure 3
Denver Radium Site – OU2

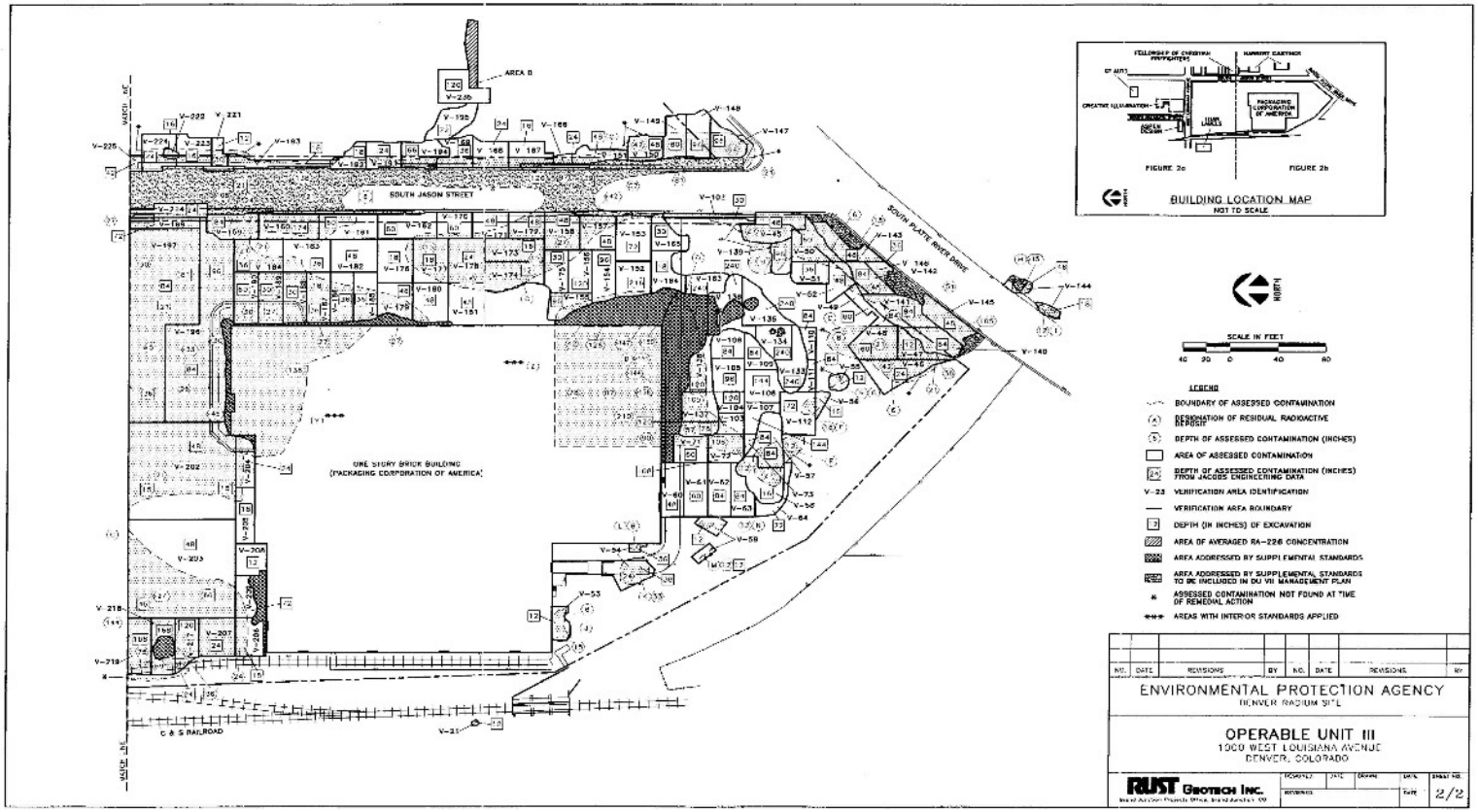
Source:OU2 Interim Closeout Report 1994



Waste left in place under Area Averaging

Figure 4
Denver Radium Site – OU3

Source:OU3 Interim Closeout Report 1994

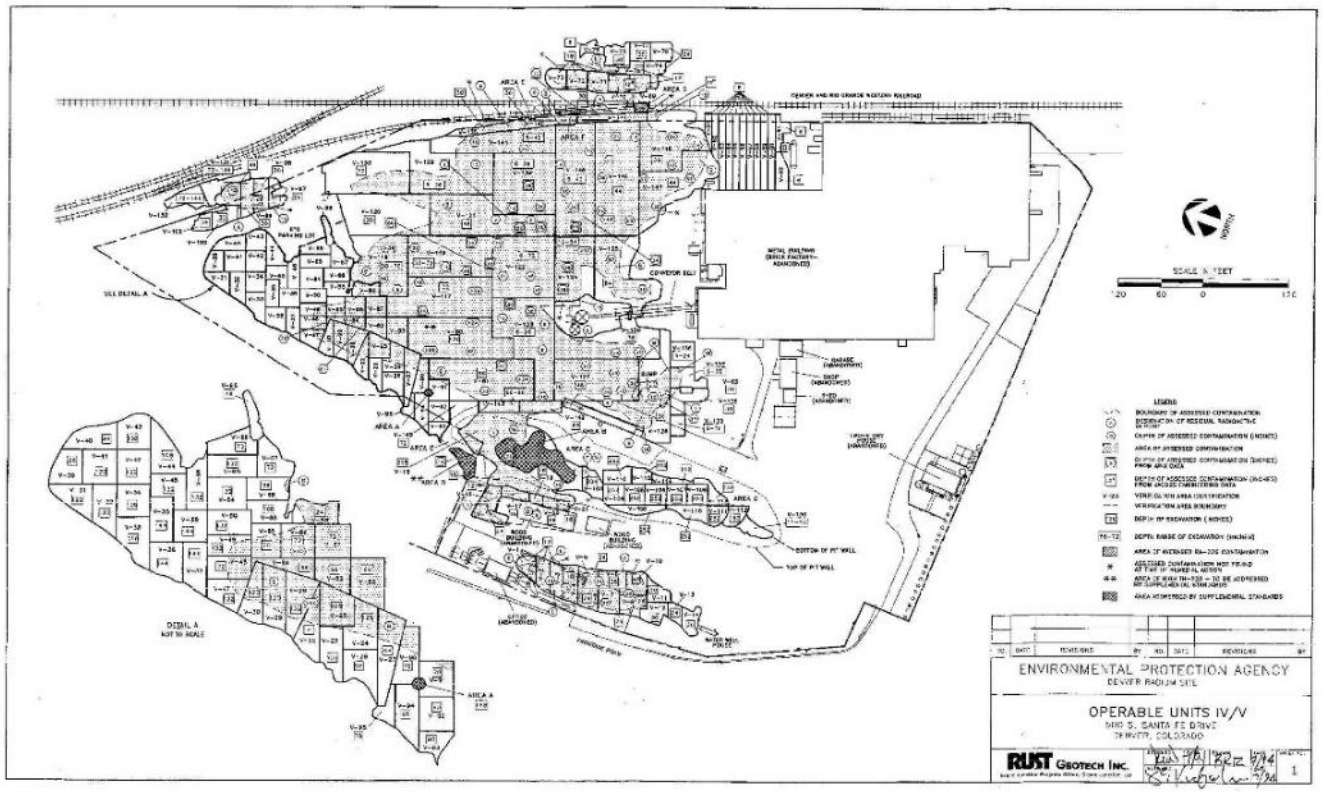


Waste left in place under Supplemental Standards

Waste left in place under Area Averaging

Figure 5
Denver Radium Site – OU3

Source:OU3 Interim Closeout Report 1994



Waste left in place under Supplemental Standards

Waste left in place under Area Averaging

Figure 6
Denver Radium Site – OU4

Source : Interim Closeout Report 1994

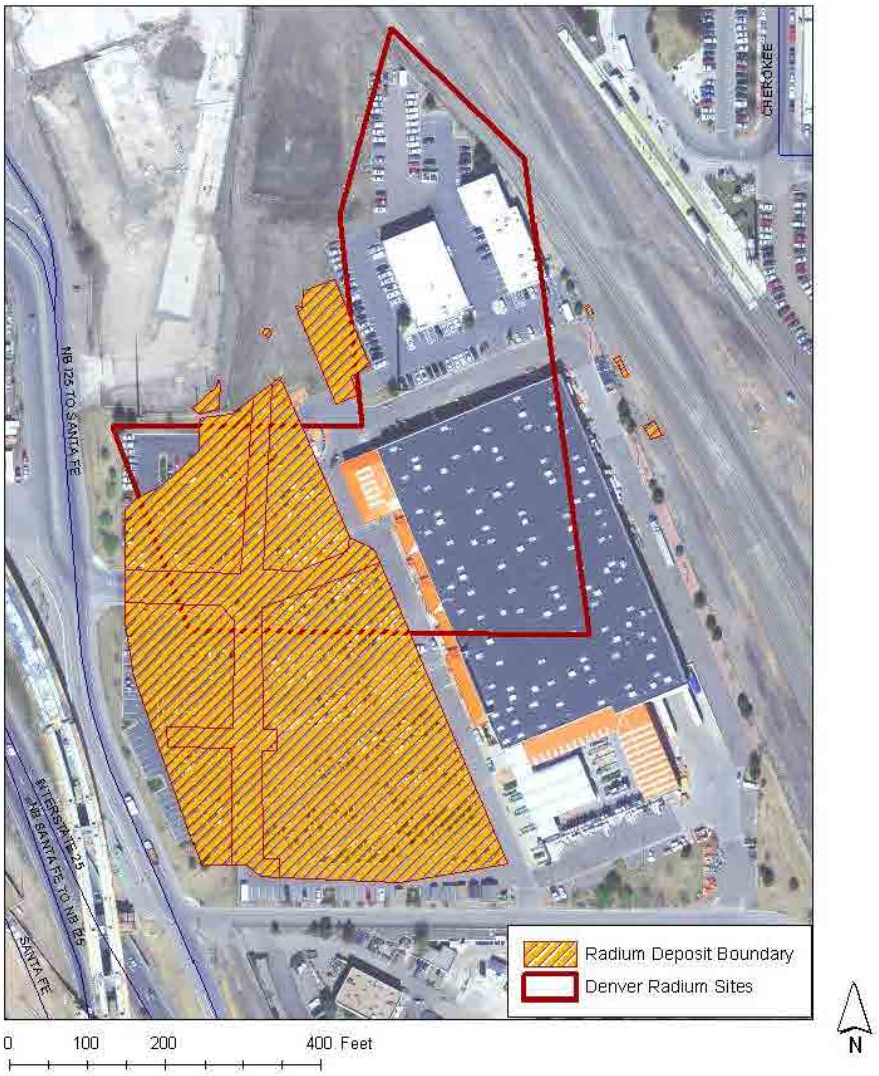
Operable Unit 2-
Areas Addressed by Supplemental Standards

Note: The radium contamination left in place is a result of averaged areas, areas addressed by supplemental standards, and residual radioactive deposits.

Operable Unit 3-
Radium Contamination Left in Place

Note: The radium contamination left in place is a result of averaged areas, areas addressed by supplemental standards, and residual radioactive deposits.
*Jason Street was remediated from Louisiana to South Platte Drive in 2007-2008.

Operable Unit 4, 5, 9-B
Radium Contamination Left in Place



Note: The radium contamination left in place is a result of averaged areas, areas addressed by supplemental standards, and residual radioactive deposits.

APPENDIX D – PRESS NOTICE

Legal/Public Notice DenverPost.com

Colorado Department of Public Health and Environment
Announces Five-Year Review
Denver Radium Superfund Site
Denver, CO

Purpose/Ojective: The state health department is conducting the fifth Five-Year Review of the remedies for the Denver Radium Superfund Site. The purpose of the Five-Year Review is to make sure that selected cleanup actions where waste remains in place effectively protect human health and the environment.

Site Background: Denver Radium Site properties were contaminated by radioactive residues derived from processing radium in the 1900s. The remedies for the various operable units of the Denver Radium Superfund Site generally required excavation and off-site disposal of radiologically contaminated soil, institutional controls for any residual waste, and monitored natural attention for those Operable Units (OUs) where groundwater is contaminated.

Five-Year Review Schedule: The National Contingency Plan requires review of remedial actions that result in any hazardous substances, pollutants or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure every five years to ensure the protection of human health and the environment. This is the fifth Five-Year Review for the site. It will be completed by September 2018.

Community members who have questions about the site or the Five-Year Review process, or who would like to participate in a community interview, are asked to contact: Mark Rudolph, Project Manager, CO Dept of Public Health and Environment, 303-692-3362, mark.rudolph@state.co.us

Site information is also available:
Colorado Department of Public Health and Environment Records Center
4300 Cherry Creek Drive South, Denver, CO
Open normal business hours. Call 303-692-3331
Online: https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0800247

APPENDIX E – INTERVIEW FORMS

Denver Radium Superfund Site Five-Year Review Interview Form

Site Name: Denver Radium **EPA ID No.:** COD980716955

Interviewer Name: Treat Suomi **Affiliation:** Skeo
Subject Name: Mike Rosen **Affiliation:** Atlas Metal & Iron Corporation

Subject Contact Information: mrosen@atlasmetal.com
Time: 12:00 p.m. **Date:** 02/13/2018
Interview Location: Atlas Metal & Iron Corporation

Interview Format (circle one): (In Person) Phone Mail Other:

Interview Category: Local Business responsible for O&M

1. Are you aware of the former environmental issues at the Site and the cleanup activities that have taken place to date?

   Yes.

2. What is your overall impression of the project, including cleanup, maintenance and reuse activities (as appropriate)?

   Other than the amount of time, it has been great. We worked well with EPA and CDPHE. Working with them has given us the comfort to do business here on this piece of property.

3. What have been the effects of the Site on the surrounding community, if any?

   None. We fit into this neighborhood.

4. Have there been any problems with unusual or unexpected activities at the Site, such as emergency response, vandalism or trespassing?

   Yes; it is a scrap yard. The trespassing has not been Superfund-related, though.

5. Has EPA kept involved parties and surrounding neighbors informed of activities at the Site? How can EPA best provide site-related information in the future?

   Yes. Email is best.

6. Do you own a private well in addition to or instead of accessing city/municipal water supplies? If so, for what purpose(s) is your private well used?

   No.

7. Have there been any significant changes in site O&M requirements, maintenance schedules or sampling routines since start-up or in the last five years? If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.

   No.

8. Have there been unexpected O&M difficulties or costs at the Site since start-up or in the last five years? If so, please provide details.

No.

9. Have there been opportunities to optimize O&M activities or sampling efforts? Please describe changes and any resulting or desired cost savings or improved efficiencies.

   No. It is a simple remedy.

10. Do you have any comments, suggestions or recommendations regarding any aspects of the project?

    No.

11. Do you consent to have your name, affiliation, and responses included in this form and the FYR Report?

    Yes.

APPENDIX F – SITE INSPECTION CHECKLIST

FIVE-YEAR REVIEW SITE INSPECTION CHECKLIST

I. SITE INFORMATION

Site Name: Denver Radium	**Date of Inspection: 2/13/18**
Location and Region: Denver, Colorado 8	**EPA ID: COD980716955**
Agency, Office or Company Leading the Five-Year Review: EPA	**Weather/Temperature: 50 degrees and sunny**

Remedy Includes: (Check all that apply)

- ☒ Landfill cover/containment
- ☐ Access controls
- ☒ Institutional controls
- ☐ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☒ Other: radon air exchange system in OU2
- ☒ Monitored natural attenuation
- ☐ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (check all that apply)

1. **O&M Site Manager** Mike Rosen (Name) | Atlas Metal & Iron Corporation (Title) | 2/13/18 (Date)
   Interviewed ☒ at site ☐ at office ☐ by phone Phone: _____
   Problems, suggestions ☐ Report attached: _____

2. **O&M Staff** _____ (Name) | _____ (Title) | _____ (Date)
   Interviewed ☐ at site ☐ at office ☐ by phone Phone: _____
   Problems/suggestions ☐ Report attached: _____

3. **Local Regulatory Authorities and Response Agencies** (i.e., state and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices). Fill in all that apply.

   Agency _____
   Contact _____ (Name) _____ (Title) _____ (Date) _____ (Phone No.)
   Problems/suggestions ☐ Report attached: _____

4. **Other Interviews** (optional) ☐ Report attached: _____

III. ON-SITE DOCUMENTS AND RECORDS VERIFIED (check all that apply)

1. **O&M Documents**

☐ O&M manual	☐ Readily available	☐ Up to date	☒ N/A
☐ As-built drawings	☐ Readily available	☐ Up to date	☒ N/A
☐ Maintenance logs	☐ Readily available	☐ Up to date	☒ N/A

Remarks: _____

2. **Site-Specific Health and Safety Plan** ☐ Readily available ☐ Up to date ☒ N/A
   ☐ Contingency plan/emergency response plan ☐ Readily available ☐ Up to date ☒ N/A

Remarks: _____

3.	**O&M and OSHA Training Records**	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: _____			
4.	**Permits and Service Agreements**			
	☐ Air discharge permit	☐ Readily available	☐ Up to date	☒ N/A
	☐ Effluent discharge	☐ Readily available	☐ Up to date	☒ N/A
	☐ Waste disposal, POTW	☐ Readily available	☐ Up to date	☒ N/A
	☐ Other permits: _____	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: _____			
5.	**Gas Generation Records**	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: _____			
6.	**Settlement Monument Records**	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: _____			
7.	**Groundwater Monitoring Records**	☒ Readily available	☒ Up to date	☐ N/A
	Remarks: _____			
8.	**Leachate Extraction Records**	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: _____			
9.	**Discharge Compliance Records**			
	☐ Air	☐ Readily available	☐ Up to date	☒ N/A
	☐ Water (effluent)	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: _____			
10.	**Daily Access/Security Logs**	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: _____			

IV. O&M COSTS

1.	**O&M Organization**	
	☒ State in-house	☐ Contractor for state
	☐ PRP in-house	☐ Contractor for PRP
	☐ Federal facility in-house	☐ Contractor for Federal facility
	☒ Home Depot and Atlas Metal & Iron Corporation	
2.	**O&M Cost Records**	
	☐ Readily available	☐ Up to date
	☐ Funding mechanism/agreement in place	☒ Unavailable
3.	**Unanticipated or Unusually High O&M Costs during Review Period**	
	Describe costs and reasons: _____	

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1.	**Fencing Damaged**	☐ Location shown on site map	☐ Gates secured	☒ N/A

Remarks: _____

B. Other Access Restrictions

1. **Signs and Other Security Measures** ☐ Location shown on site map ☒ N/A

Remarks: _____

C. Institutional Controls (ICs)

1. **Implementation and Enforcement**

Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A

Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A

Type of monitoring (e.g., self-reporting, drive by): _____

Frequency: _____

Responsible party/agency: _____

Contact _____ _____ _____ _____

Name Title Date Phone no.

Reporting is up to date ☐ Yes ☐ No ☒ N/A

Reports are verified by the lead agency ☐ Yes ☐ No ☒ N/A

Specific requirements in deed or decision documents have been met ☒ Yes ☐ No ☐ N/A

Violations have been reported ☐ Yes ☒ No ☐ N/A

Other problems or suggestions: ☐ Report attached

2. **Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A

Remarks: _____

D. General

1. **Vandalism/Trespassing** ☐ Location shown on site map ☒ No vandalism evident

Remarks: _____

2. **Land Use Changes On Site** ☒ N/A

Remarks: _____

3. **Land Use Changes Off Site** ☒ N/A

Remarks: _____

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. **Roads Damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A

Remarks: _____

B. Other Site Conditions

Remarks: _____

VII. LANDFILL COVERS ☒ Applicable ☐ N/A

A. Landfill Surface

1. **Settlement** (low spots) ☐ Location shown on site map ☒ Settlement not evident

Area extent: _____ Depth: _____

Remarks: _____

2. **Cracks** ☐ Location shown on site map ☐ Cracking not evident

Lengths: _____ Widths: _____ Depths: _____

Remarks: Small cracks on Home Depot parking lot that are repaired.

3. **Erosion** ☐ Location shown on site map ☒ Erosion not evident

Area extent: _____ Depth: _____

Remarks: _____

4. **Holes** ☐ Location shown on site map ☒ Holes not evident

Area extent: _____ Depth: _____

Remarks: _____

5. **Vegetative Cover** ☐ Grass ☐ Cover properly established

☐ No signs of stress ☐ Trees/shrubs (indicate size and locations on a diagram)

Remarks: _____

6. **Alternative Cover** (e.g., armored rock, concrete) ☐ N/A

Remarks: Pavement covers are in good condition.

7. **Bulges** ☐ Location shown on site map ☒ Bulges not evident

Area extent: _____ Height: _____

Remarks: _____

8. **Wet Areas/Water Damage** ☒ Wet areas/water damage not evident

☐ Wet areas	☐ Location shown on site map	Area extent: _____
☐ Ponding	☐ Location shown on site map	Area extent: _____
☐ Seeps	☐ Location shown on site map	Area extent: _____
☐ Soft subgrade	☐ Location shown on site map	Area extent: _____

Remarks: _____

9. **Slope Instability** ☐ Slides ☐ Location shown on site map

☒ No evidence of slope instability

Area extent: _____

Remarks: _____

B. Benches ☐ Applicable ☒ N/A

(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

C. Letdown Channels ☐ Applicable ☒ N/A

(Channel lined with erosion control mats, riprap, grout bags or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

D. Cover Penetrations ☐ Applicable ☒ N/A

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

F. Cover Drainage Layer ☐ Applicable ☒ N/A

G. Detention/Sedimentation Ponds ☒ Applicable ☐ N/A

1. **Siltation** Area extent: _____ Depth: _____ ☒ N/A

   ☐ Siltation not evident

   Remarks: _____

2. **Erosion** Area extent: _____ Depth: _____

   ☒ Erosion not evident

   Remarks: _____

3. **Outlet Works** ☐ Functioning ☒ N/A

   Remarks: _____

4. **Dam** ☐ Functioning ☒ N/A

   Remarks: _____

H. Retaining Walls ☐ Applicable ☒ N/A

I. Perimeter Ditches/Off-Site Discharge ☐ Applicable ☒ N/A

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps and Pipelines ☐ Applicable ☒ N/A

B. Surface Water Collection Structures, Pumps and Pipelines ☐ Applicable ☒ N/A

C. Treatment System ☐ Applicable ☒ N/A

D. Monitoring Data

1. **Monitoring Data**

   ☒ Is routinely submitted on time ☒ Is of acceptable quality

2. **Monitoring Data Suggests:**

   CDPHE analysis of the groundwater results are presented in Appendix L. CDPHE has identified opportunities to improve the efficiency of the groundwater monitoring program and should work with EPA to further evaluate, optimize and update the monitoring plan for the Site.

E. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)

   ☐ Properly secured/locked ☒ Functioning ☐ Routinely sampled ☒ Good condition

   ☐ All required wells located ☐ Needs maintenance ☐ N/A

   Remarks: Wells need new locks.

X. OTHER REMEDIES

If there are remedies applied at the site and not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is designed to accomplish (e.g., to contain contaminant plume, minimize infiltration and gas emissions). The remedy has been effective in reducing exposures to contaminated soil through excavation and leaving waste in place that is protected by pavement, buildings or railroads. Groundwater monitoring is ongoing.
B.	**Adequacy of O&M**
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. O&M appears adequate; waste left in place has not been disturbed and is protected either by pavement, buildings, or railroads. The pavement appeared adequate and was repaired as necessary.
C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future. N/A.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. CDPHE expressed interest in reducing or eliminating nitrate/nitrite sampling on the golf course. CDPHE also suggested reducing the frequency of annual groundwater monitoring to every other year.

APPENDIX G – SITE INSPECTION PHOTOS

Repaired sections of the parking lot at Home Depot OUs 4 and 9B

The Home Depot capped area at OUs 4 and 9B

The parking lot cap at Home Depot OUs 4 and 9B

Radium remediation occurring at OU3

Radium remediation occurring at OU3

Area of radium discovery at OU3

Capped area at OU3

Flush-mounted monitoring well at OU3

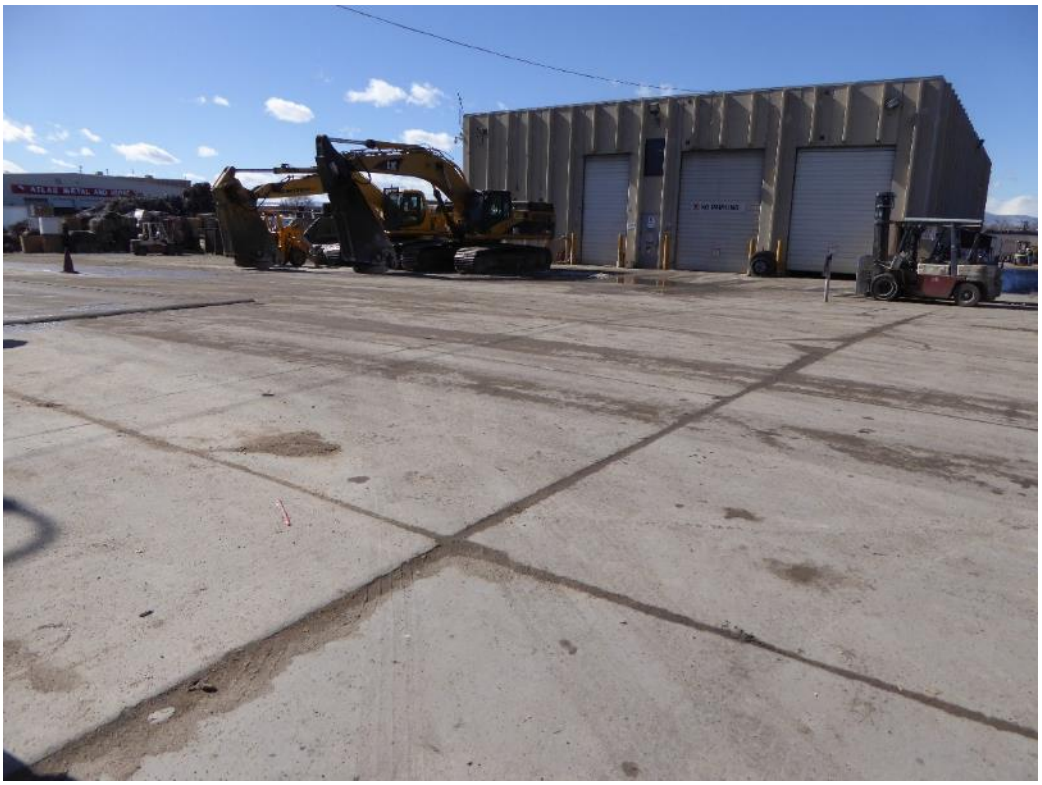
Railroad tracks at OU3

Monitoring well on golf course at OU8

Golf course at OU8

OU8 monitoring well

OU2 Atlas Metal & Iron



OU2 Atlas Metal & Iron capped area

Building at OU2 Atlas Metal & Iron with mitigation system

Monitoring equipment at OU2 Atlas Metal & Iron

APPENDIX H – SCREENING LEVEL RISK ASSESSMENTS

The validity of the OU9B soil cleanup goals for arsenic, lead and zinc and the OU8 soil cleanup goals for natural uranium, lead, arsenic, and selenium were evaluated as part of this FYR by conducting screening level risk assessments, which estimate risks associated with cleanup goals based on current toxicity information. The results of the assessments are summarized below.

OU9B

The OU9B metals soil cleanup goals were based on health criteria, including prevention of exposure and direct contact with soil as ARARs have not been established for metals. To determine the cleanup goals' current validity, a screening-level risk evaluation was conducted by comparing the cleanup goals to EPA's composite worker RSLs and calculating corresponding risk values (Table H-1). The arsenic and zinc cleanup goals correspond to noncarcinogenic HQs below EPA's threshold value of 1, and the arsenic cleanup goal corresponds to a carcinogenic risk estimate within EPA's carcinogenic risk range, indicating that these cleanup goals remain valid. The lead cleanup goal of 1,000 mg/kg exceeds the current composite worker RSL of 800 mg/kg. However, blood lead levels continue to decline in the U.S. population as documented in EPA's 2017 lead guidance and depending on specific demographic or geographic characteristics of the site, acceptable industrial-based soil lead can be as high as 1,050 mg/kg.[10] In addition, there is no current exposure to lead because this area is capped, preventing direct contact with soil. Home Depot currently conducts inspections and maintains the parking lot cap. If the capped area were to be disturbed for future development, it is recommended that lead exposure be re-evaluated at that time. However, this is unlikely, as O&M is agreed upon and conducted by Home Depot, and institutional controls are in place.

Table H-1: OU9B Metals Soil Cleanup Goal Screening Level Risk Assessment

COC	Cleanup Goal[a] (mg/kg)	Composite worker RSL[b] (mg/kg)		Risk Evaluation[c]	
		1 x 10^{-6} Risk	HQ = 1.0	Carcinogenic Risk	Noncarcinogenic HQ
Arsenic	79	3	480	*3 x 10^{-5}*	0.2
Lead	1,000	800[d]		-	
Zinc	17,000	-	350,000	-	0.1

Notes:
a. Cleanup goals are from the 1991 OU9B ROD.
b. Current EPA RSLs are available at https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017 (accessed 4/17/2018).
c. Screening level risk calculations were performed as follows:
cancer risk = (cleanup goal/risk-based RSL) x 1 x 10^{-6}
noncancer hazard index = (cleanup goal/HQ-based RSL)
d. EPA has no consensus reference dose or cancer slope factor for inorganic lead, so it is not possible to calculate RSLs as it is for other chemicals. EPA considers lead to be a special case because of the difficulty in identifying the classic "threshold" needed to develop a reference dose. Therefore, a risk estimate could not be calculated for lead, and the screening value is based on acceptable blood lead concentrations.
Italic = within EPA's risk range of 1 x 10^{-4} to 1 x 10^{-6}
- = no RSL available/unable to calculate risk

OU8

Carcinogenic uranium
The screening-level risk assessment for carcinogenic uranium risk compared the cleanup goal to EPA's radionuclide preliminary remediation goals (PRGs) for residential exposure for the soil ingestion, external

[10] OLEM Directive 9285.6-56. May 17, 2017. Update to Adult Lead Methodology's Default Blood Lead Concentration and Geometric Standard Deviation Parameters.

exposure and total pathways (the 2000 AROD included the uranium cleanup goal to prevent direct contact with or ingestion of contaminated soil). The residential scenario was used because the Shattuck property is currently being redeveloped as an apartment complex. As seen in Table H-2, the cleanup goal currently corresponds to carcinogenic risk above EPA's acceptable risk range (1×10^{-4} to 1×10^{-6}) for all pathways. This indicates that the cleanup goal for uranium may require further evaluation to ensure long-term protectiveness.

Table H-2: OU8 ROD Soil Uranium Cleanup Goal Carcinogenic Screening Level Risk Assessment

COC	Cleanup Goal[a] (pCi/g)	Residential PRG (pCi/g)[b]			Cancer Risk[c]		
		Ingestion	External Exposure	Total	Ingestion	External Exposure	Total
Natural uranium[d]	75	0.144	0.0136	0.00176	**5×10^{-4}**	**6×10^{-3}**	**4×10^{-2}**

Notes:

a. Cleanup goal from 1992 OU8 ROD, Table 9-2 and 2000 OU8 ROD Amendment, Section H. Remedial Action Objectives.

b. EPA PRGs accessed on 5/4/18 at: https://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search. Secular equilibrium scenario (no decay) used. PRGs correspond to a risk of 1×10^{-6}.

c. The cancer risks were calculated using the following equation:
Cancer risk = (cleanup goal ÷ cancer-based PRG) × 10^{-6}

d. Natural uranium is considered uranium containing the relative concentrations of isotopes found in nature (0.7 percent uranium-235, 99.3 percent uranium-238, and a trace amount of uranium-234 by mass). Accessed at https://www.nrc.gov/reading-rm/basic-ref/glossary/natural-uranium.html on 5/4/18. PRG for uranium-238 used for this assessment.

Bold – indicates risk exceeds the upper bound of EPA's risk management range of 1×10^{-6} to 1×10^{-4}.

Noncancer uranium

Since the selection of the natural uranium cleanup goal, the noncancer toxicity value (the oral reference dose or RfD) for uranium has become more stringent as outlined in an EPA December 2016 memorandum.[11] This memorandum provides information and recommendations about an oral RfD for non-radiological, noncancer toxicity of soluble uranium that EPA regions should consider during various stages of response selection and implementation at CERCLA sites to include FYRs. Although the revised toxicity value has not yet been published in EPA's Integrated Risk Information System, EPA has updated the RSL calculator with the more stringent RfD to support screening-level risk evaluations.

To estimate the noncancer impacts of the new RfD, this FYR compared the cleanup goal to the time-weighted residential RSL based on the most current RfD. Because the cleanup goal is in pCi/g, it was converted to mg/kg to compare to the noncancer-based RSL (Table H-3). As seen in Table H-4, the cleanup goal currently corresponds to noncancer risk above EPA's target HQ of 1. This underscores the need to further evaluate the long-term protectiveness of the OU8 soil cleanup goal for uranium.

[11] Memorandum to Superfund Policy Managers. Considering a Noncancer Oral Reference Dose for Uranium for Superfund Human Health Risk Assessments. Prepared by EPA's Office of Land and Emergency Management. December 21, 2016.

Table H-3: Uranium Cleanup Goal Unit Conversion

COC	Cleanup Goal[a] (pCi/g)	Atomic Weight[b] (grams/mole)	Radionuclide Half-life[b] in years ($T^{1/2}$)	Cleanup Goal[c] (mg/kg)
Uranium-238[d]	75	238	4.5×10^9	225

Notes:

a. Cleanup goal from 1992 OU8 ROD, Table 9-2 and 2000 OU8 ROD Amendment, Section H. Remedial Action Objectives.

b. Value obtained from the Risk Assessment Information System at https://rais.ornl.gov/cgi-bin/tools/TOX_search (accessed 5/16/18).

c. Conversion of pCi/g to mg/kg as outlined in EPA's Soil Screening Guidance for Radionuclides: Technical Background Document, Appendix B. EPA/540-R-00-006. October 2000:
Uranium in mg/kg = 2.8×10^{-12} conversion factor x atomic weight (grams/mole) x $T^{1/2}$ x uranium in pCi/g

d. Natural uranium is considered uranium containing the relative concentrations of isotopes found in nature (0.7 percent uranium-235, 99.3 percent uranium-238, and a trace amount of uranium-234 by mass). Accessed at https://www.nrc.gov/reading-rm/basic-ref/glossary/natural-uranium.html on 5/4/18. Uranium-238 used for this assessment.

Table H-4: OU8 ROD Soil Uranium Cleanup Goal Noncancer Screening Level Risk Assessment

COC	Cleanup Goal (mg/kg)	Residential RSL[a] (mg/kg) HQ = 1.0	Residential Risk Evaluation[b] Noncarcinogenic HQ
Natural uranium[c]	225	16	**14**

Notes:

a. Current EPA RSLs are available at https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables (accessed 5/4/2018).

b. Screening level risk calculation was performed as follows:
noncancer hazard index = (cleanup goal /HQ-based RSL)

c. Natural uranium is considered uranium containing the relative concentrations of isotopes found in nature (0.7 percent uranium-235, 99.3 percent uranium-238, and a trace amount of uranium-234 by mass). Accessed at https://www.nrc.gov/reading-rm/basic-ref/glossary/natural-uranium.html on 5/4/18. Uranium-238 used for this assessment.

mg/kg = milligram per kilogram
Bold = exceeds EPA's acceptable risk values

Lead, Selenium and Arsenic

The screening-level risk assessment for lead, selenium and arsenic compared the cleanup goals to EPA's RSLs for residential exposure. As seen in Table H-5, the cleanup goal for arsenic currently corresponds to carcinogenic risk above EPA's acceptable risk range (1×10^{-4} to 1×10^{-6}) and noncarcinogenic risk above EPA's target HQ of 1. This indicates that the arsenic cleanup goal should be evaluated to determine if revisions are warranted to ensure long-term protectiveness.

EPA has updated the lead risk assessment guidance and associated adult and child lead exposure models several times and as recently as 2017 based on updated toxicity information released by the Centers for Disease Control and Prevention.[12] Based on this new information, EPA is in the process of evaluating its lead policy; in the interim, use of the current policy is recommended until it is formally updated.[13] The OU8 lead cleanup goal exceeds the residential RSL (Table H-5). Generally, EPA recommends utilizing the average lead concentration across the site to assess lead exposure risk. Therefore, lead potentially exists above the current residential RSL at OU8. However, considering the extensive remediation that has occurred on site with the solidification and

[12] Transmittal of Update to the Adult Lead Methodology's Default Baseline Blood Lead Concentration and Geometric Standard Deviation Parameters. Office of Land and Emergency Management Directive 9285.6-56. May 17, 2017. Accessed on 4/10/2018 at https://semspub.epa.gov/work/HQ/196766.pdf.

[13] Updated Scientific Considerations for Lead in Soil Cleanups. Office of Land and Emergency Management Memorandum. December 22, 2016. Accessed on 4/10/2018 at https://www.documentcloud.org/documents/3525442-EPA-Memo-Updated-Scientific-Considerations-for.html.

stabilization of contamination into a monolith and the removal of the monolith and any additional soil contamination, it is unlikely that average lead concentrations would exceed the residential RSL of 400 mg/kg.

Table H-5: OU8 ROD Soil Lead, Selenium and Arsenic Cleanup Goals Screening Level Risk Assessment

COC	ROD Cleanup Goal (mg/kg)[a]	Residential RSL[b] (mg/kg)		Residential Risk Evaluation[c]	
				Carcinogenic Risk	Noncarcinogenic HQ
		1 x 10^{-6} Risk	HQ = 1.0		
Lead[d]	540	400		-	
Arsenic	160	0.68	35	**2 x 10^{-4}**	**5**
Selenium	490	-	390	-	1

Notes:

d. Cleanup goal from 1992 ROD, Table 9-2

e. Current EPA RSLs are available at https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables (accessed 5/4/2018).

f. Screening level risk calculations were performed as follows:
cancer risk = (cleanup goal/risk-based RSL) x 1 x 10^{-6}
noncancer hazard index = (cleanup goal /HQ-based RSL)

g. EPA has no consensus reference dose or cancer slope factor for inorganic lead, so it is not possible to calculate RSLs as it is for other chemicals. EPA considers lead to be a special case because of the difficulty in identifying the classic "threshold" needed to develop a reference dose. EPA evaluates lead exposure by using blood-lead modeling, such as the Integrated Exposure-Uptake Biokinetic Model. The EPA Office of Solid Waste has also released a detailed directive on risk assessment and cleanup of residential soil lead. The directive recommends that soil lead levels less than 400 mg/kg are generally safe for residential use. Above that level, the document suggests collecting data and modeling blood-lead levels with the Integrated Exposure-Uptake Biokinetic Model. For the purposes of screening, therefore, 400 mg/kg is recommended for residential soils.

- = no RSL available/unable to calculate risk
mg/kg = milligram per kilogram
Bold = exceeds EPA's acceptable risk values

APPENDIX I – DETAILED ARARS REVIEW TABLES

The OU 2, 3, and 4 RODs identified standards from 40 CFR 192 as ARARs and selected the radium-226 soil standards as cleanup goals. The ESDs did not change the ARARs. These values were compared to current ARARs to determine if these values remain valid (Table I-1). No ARARs changes have occurred.

Table I-1: ARARs Review

OU	Contaminant	ROD ARAR	Current ARAR	ARAR change
2, 3, 4	Radium-226	5 pCi/g above background within 15 centimeters of the surface measured over a 100 square meter area	5 pCi/g above background within 15 centimeters of the surface measured over a 100 square meter area	None
2, 3, 4	Radium-226	15 pCi/g above background within subsequent 15-centimeter layers over a 100 square meter area	15 pCi/g above background within subsequent 15-centimeter layers over a 100 square meter area	None
2, 3, 4	Gamma radiation	20 µR/h above background	20 µR/h above background	None
2, 3, 4	Radon decay product concentration	0.02 working level (WL) annual average 0.03 WL maximum	0.02 WL annual average 0.03 WL maximum	None
Notes: 40 CFR 192 accessed at https://www.gpo.gov/fdsys/pkg/CFR-2000-title40-vol17/pdf/CFR-2000-title40-vol17-part192.pdf on 5/4/18.				

The 1992 OU8 ROD specified that groundwater monitoring would be performed to evaluate if concentrations exceeded ARARs and TBCs, which were identified as MCLs, 5 CCR 1002-8 Section 3.11.0, Basic Standards for Groundwater, and 5 CCR 1002-8 Section 3.12.0, Classifications and Water Quality Standards for Groundwater and 40 CFR 192. The 1992 ROD did not list numeric values for these ARARs and TBCs. This FYR compares the standards used in CDPHE's groundwater monitoring report to current standards to ensure the most up-to-date standards are in use. See Table I-2 for this comparison; all standards in use are current.

Table I-2: OU8 Groundwater ARARs

Contaminant	Unit	Groundwater Standard in 2018 CDPHE Groundwater Monitoring Report[a]	2018 Groundwater Standard	
			ARAR	Value
Gross Alpha- Total	pCi/L	15	MCL[b]	15
Uranium-234	pCi/L	27	MCL[b]	0.03 mg/L[c]
Uranium-238	pCi/L	27	MCL[b]	0.03 mg/L[c]
Copper	mg/L	1	CCR Regulation 41[d]	1
Manganese	mg/L	0.05	CCR Regulation 41[d]	0.05
Molybdenum	mg/L	0.1	40 CFR 192[e]	0.1
Uranium	mg/L	0.03	MCL[b]	0.03
Zinc	mg/L	5	CCR Regulation 41[d]	5
Nitrate as Nitrogen	mg/L	10	MCL[b] and CCR Regulation 41[d]	10
Nitrate as NO3	mg/L	45	Conversion of MCL[b] and CCR Regulation 41[df]	45

Notes:

a. Standards taken from Table 2 of the 2018 Groundwater Monitoring report.
b. MCLs accessed on 6/29/2018 at https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations.
c. The 0.030 mg/L value is equivalent to about 27 pCi/L of radioactivity. Accessed at 6/29/18 at https://www.wqa.org/Portals/0/Technical/Technical%20Fact%20Sheets/2014_Uranium.pdf.
d. CCR Regulation 41, Domestic water supply – Drinking water standards accessed 6/29/2018 at http://www.sos.state.co.us/CCR/GenerateRulePdf.do?ruleVersionId=6942&fileName=5%20CCR%201002-41.
e. 40 CFR 192 accessed on 6/29/2018 at https://www.ecfr.gov/cgi-bin/text-idx?SID=486334ade49603d46156f2e933cc5446&node=pt40.25.192&rgn=div5#ap40.27.192_104.1.
f. Conversion between nitrate as nitrogen and nitrate as NO3.

APPENDIX J – INSTITUTIONAL CONTROL DOCUMENTS

Attachment 1: 2006 Environmental Covenant

(accessed 7/26/18 Colorado.gov/pacific/cdphe/hmcovenants)

Atlas Metals Environmental Covenant Summary

Covenant ID: HMCOV00029

Covenant Information:

Covenant Date: July 25, 2006
Self Reporting: Yes
Media of Concern:
- Surface Water: No
- Groundwater: No
- Air: No
- Soil: Yes
- Other: No

Contaminants of Concern:
Property Restrictions:
1. No breach of concrete cap or soils underneath pursuant to materials management plan
2. Inspect concrete cap twice annually
3. Except for groundwater monitoring, groundwater usage is forbidden
4. Indoor air quality for enclosed buildings shall be monitored and maintained

Site Information:

ID: NA
Name: Atlas Metals
Address: 1100 Umatilla Street
City: Denver
State: CO
Zip Code: 80204
Legal Description:
County: Denver

Site Contact Information:

Atlas Metals
Name: Mike Rosen
Address: 1100 Umatilla Street
City: Denver
State: CO Zip Code: 80204

DENVER RADIUM U2

2006119412
Page: 1 of 16
07/25/2006 02:30P

This property is subject to an Environmental Covenant held by the Colorado Department of Public Health and Environment pursuant to section 25-15-321, C.R.S.

ENVIRONMENTAL COVENANT

By this deed, Atlas Umatilla, LLC ("Atlas") grants an Environmental Covenant ("Covenant") this 25th day of July 2006 to the Hazardous Materials and Waste Management Division of the Colorado Department of Public Health and the Environment ("the Department") pursuant to § 25-15-321 of the Colorado Hazardous Waste Act, § 25-15-101, *et seq.* The Department's address is 4300 Cherry Creek Drive South, Denver, Colorado 80246-1530.

WHEREAS, Atlas is the owner of certain real property located at 1100 Umatilla, more particularly described in Attachment A, attached hereto (hereinafter referred to as "the Property"); and

WHEREAS, prior to Atlas' ownership, the Property has been the subject of United States Environmental Protection Agency ("EPA") remedial action pursuant to the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§ 9601, et seq. ("CERCLA"); and

WHEREAS, the purpose of this Covenant is to ensure continued protection of human health and the environment by implementing the institutional controls called for in the Denver Radium Superfund Site Record of Decision for Operable Unit II for the Property ("ROD"); and

WHEREAS, Atlas desires to subject the Property to certain covenants and restrictions as provided in Article 15 of Title 25, Colorado Revised Statutes, which covenants and restrictions shall burden the Property and bind Atlas and all parties having any right, title or interest in the Property, or any part thereof, their heirs, successors and assigns, and any persons using the land, as described herein, for the benefit of the Department.

NOW, THEREFORE, Atlas hereby grants this Environmental Covenant to the Department, and declares that the Property as described in Attachment A shall hereinafter be bound by, held, sold, and conveyed subject to the following requirements set forth in paragraphs 1 through 10 below, which, except as provided in paragraph 3, shall run with the Property in perpetuity and be binding on all parties having any right, title or interest in the Property, or any part thereof, their heirs, successors and assigns, and any persons using the land, as described herein. As used in this Environmental Covenant, the term OWNER means the record owner of the Property and, if any, any other person or entity otherwise legally authorized to make decisions regarding the transfer of the Property or placement of encumbrances on the Property, other than by the exercise of eminent domain.

1. Purpose of this covenant. The purpose of this Covenant is to ensure protection of human health and the environment by minimizing the potential for exposure to any radium-

contaminated soil that remains at the Property. EPA remedial action did not remove all the radium-contaminated soils from the Property. Attachment B is a schematic of the Property, which depicts where radium-contaminated soils were left in place at the conclusion at the EPA remedial action. As of the date of this Covenant, nearly the entire surface of the Property is covered with a concrete pavement cap. The Covenant will ensure protection of human health and the environment and mitigate hazards associated with human exposure to the remaining radium-contaminated soil by minimizing activities which will disturb soil or groundwater underneath the concrete cap and by assuring protective indoor air quality is maintained within fully enclosed buildings above radium-contaminated soil on the property.

2. Use restrictions applicable to the Property.

A. No person shall breach the concrete cap or disturb the subsurface soils underneath the concrete cap except pursuant to a Materials Management and Health and Safety Plan (the "Plan"). The current Plan approved by the Department is on file with the Department at the address indicated in paragraph 10, below. In the event that any person breaches the concrete cap or disturbs the subsurface soils underneath the concrete cap in accordance with the Plan, no radium-contaminated materials, as defined by the Plan, shall be replaced in any location not denoted on Attachment B as "addressed by supplemental standards" without first amending this Environmental Covenant pursuant to paragraph 3, below, to indicate where such materials will be located.

B. The Owner shall inspect the concrete cap at least twice each calendar year and perform sufficient maintenance of the concrete cap to assure the concrete cap restricts human exposure to radium-contaminated soils.

C. Except for the purpose of environmental monitoring, groundwater beneath the Property shall not be used for any purpose.

D. The Owner shall monitor and maintain indoor air quality within fully enclosed buildings on the Property to protect human health from radium exposures, to include compliance with 40 CFR Section 192.12(b).

3. Modifications. This Covenant runs with the land and is perpetual, unless modified or terminated pursuant to this paragraph. OWNER may request that the Department approve a modification or termination of the Covenant. The request shall contain information showing that the proposed modification or termination shall, if implemented, ensure protection of human health and the environment. The Department shall review any submitted information, and may request additional information. If the Department determines that the proposal to modify or terminate the Covenant will ensure protection of human health and the environment, it shall approve the proposal. No modification or termination of this Covenant shall be effective unless the Department has approved such modification or termination in writing. Information to support a request for modification or termination may include one or more of the following:

A. A proposal to perform additional remedial work;
B. New information regarding the risks posed by the residual contamination;
C. Information demonstrating that residual contamination has diminished;
D. Information demonstrating that the proposed modification would not adversely impact the remedy and is protective of human health and the environment; and

E. Other appropriate supporting information.

4. Conveyances. OWNER shall notify the Department at least fifteen (15) days in advance of any proposed grant, transfer or conveyance of any ownership in any or all of the Property.

5. Notification to Holders of Interest in Property. OWNER agrees to incorporate either in full or by reference the restrictions of this Covenant in any leases, licenses, or other instruments granting a right to use the Property.

6. Notification for proposed construction and land use. OWNER shall notify the Department simultaneously when submitting any application to a local government for a building or utility permit or change in land use.

7. Inspections. The Department shall have the right of entry to the Property at reasonable times with prior notice to OWNER for the purpose of determining compliance with the terms of this Covenant. Nothing in this Covenant shall impair any other authority the Department may otherwise have to enter and inspect the Property.

8. No Liability. The Department does not acquire any liability under State law by virtue of accepting this Covenant.

9. Enforcement. The Department may enforce the terms of this Covenant pursuant to §25-15-322 C.R.S.

10. Notices. Any document or communication required under this Covenant shall be sent or directed to:

State Superfund Officer, Denver Radium Superfund Site
Hazardous Materials and Waste Management Division
Colorado Department of Public Health and the Environment
4300 Cherry Creek Drive South
Denver, Colorado 80246-1530

With a courtesy copy to:

Assistant Attorney General, Denver Radium Superfund Site
Colorado Department of Law
Natural Resources and Environment Section
1525 Sherman Street, 5th Floor
Denver, Colorado 80203

11. Annual Reports. Each year OWNER shall submit a report describing any activities at the Property which relate to the use restrictions of paragraph 2, above.

12. Incorporation of Attachments. Attachments A and B, attached to this Covenant, are incorporated herein by reference as though fully set forth.

Atlas has caused this instrument to be executed this 27th day of June, 2006.

Atlas Umatilla, LLC
A Colorado Limited Liability Company

By: _____
Michael E. Rosen, Manager

STATE OF COLORADO)
) ss:
COUNTY OF DENVER)

The foregoing instrument was acknowledged before me this 27 day of June, 2006 by Michael E. Rosen, Manager, on behalf of Atlas Umatilla, LLC.

_____
Notary Public
1929 S. Malachite
Address
Aurora, CO 80014

My commission expires: 6/29/2009

BETH A ROSEN NOTARY PUBLIC STATE OF COLORADO

Attachments:
Attachment A
Attachment B

Accepted by the Colorado Department of Public Health and Environment this 25th day of July, 2006.

By: Gary W. Baughman

Title: Director, HMWMD

STATE OF COLORADO)
) ss:
COUNTY OF DENVER)

The foregoing instrument was acknowledged before me this 25 day of July, 2006 by Gary Baughman on behalf of the Colorado Department of Public Health and Environment.

Claudette M. Fenn
Notary Public
4300 Cherry Creek Dr So
Address
Denver, CO 80246

My commission expires: October 21, 2007

Attachment 2: Denver Revised Municipal Code, Section 112 of Chapter 48, Article VIII
(accessed at library.municode.com/co/denver/codes/code_of_ordinances 7/26/2018)

Sec. 48-112. - Radioactive waste disposal fee.

Any person who disposes of or implements a remedial action to control radioactive waste or radium contaminated material shall be charged a fee of five dollars and ten cents ($5.10) per cubic foot of radioactive waste or radium contaminated material that remains on property within the City and County of Denver with no intention of and provision for subsequent removal.

a. Permanent disposal and control of radioactive waste and radium contaminated material are not permitted uses of property pursuant to chapter 59 of the Revised Municipal Code and nothing contained herein shall be deemed to authorize disposal or control of radioactive waste or radium contaminated material. This fee shall apply if, notwithstanding the prohibition, a person disposes or controls radioactive waste or radium contaminated material on property within the city.

b. The fee imposed by this section shall not apply to persons who dispose of or control radioactive waste or radium contaminated material incidental to installation, maintenance, repair, improvement or replacement of utilities, streets, sidewalks and alleys in public rights-of-way regulated pursuant to chapter 49 of the Revised Municipal Code and pursuant to the manager's regulations titled "Management Plan Denver Radium Site, Operable Unit 7 Denver Streets."

(Ord. No. 549-96, § 1, 7-1-96; Ord. No. 145-97, § 1, 3-3-97; Ord. No. 590-04, § 2, 8-23-04)

Attachment 3: Denver Revised Municipal Code, Section 378 b. of Article XIII of Chapter 49
(accessed at library.municode.com/co/denver/codes/code_of_ordinances 7/26/2018)

Sec. 49-378. - Contamination by or storage of radioactive waste.

a. Definitions.

(1) *Control* shall mean any remedial action intended to stabilize, inhibit future exposure to or misuse of, or reduce emissions or effluents from radium contaminated materials, including leaving radium contaminated material in place pursuant to the application of supplemental standards as specified in Subpart C of 40 CFR Part 192.

(2) *Disposal* or *disposes* shall mean dumping, burial or placing of radium contaminated material into or on any land, release through a sanitary sewerage system, incineration, or long-term storage with no intention of or provision for subsequent removal.

(3) *Radioactive waste* shall mean all radioactive materials which have no useful purpose and are to be or have been discarded and for which the United States Environmental Protection Agency or the Colorado Department of Public Health and Environment has determined remedial action is required to control the harmful effects to public health or the environment of radioactive emissions from the materials.

(4) *Radium contaminated material* shall mean any material in which the concentration of radium-226 in land averaged over any area of one hundred (100) square meters exceeds the background level by more than: a) five (5) picocuries per gram, averaged over the first fifteen (15) centimeters of soil below the surface, and b) fifteen (15) picocuries per gram, averaged over fifteen-centimeter thick layers of soil more than fifteen (15) centimeters below the surface.

b. Any person who disposes of or implements a remedial action to control or to attempt to control radioactive waste or radium contaminated material shall be charged a fixed fee of twelve thousand dollars ($12,000.00) for each separate geographic location where radioactive waste or radium contaminated material is disposed of or controlled plus a variable fee of thirty dollars and six cents ($30.06) per cubic foot of radium contaminated material that remains beneath public rights-of-way or other property owned by the city.

c. Any fees paid pursuant to this section shall be deducted from the fees assessed for the same waste pursuant to section 48-112 of the Revised Municipal Code.

d. Any revenues generated by this fee shall be credited to the radioactive waste management fund established pursuant to section 48-113.

e. Permanent disposal and control of radioactive waste and radium contaminated material are not permitted uses of property pursuant to chapter 59 of the Revised Municipal Code and nothing contained herein shall be deemed to authorize permanent disposal or control of radioactive waste or radium contaminated material. This fee shall apply if, notwithstanding the prohibition, a person disposes of or controls radioactive waste or radium contaminated material on property within the city.

f. The fees imposed by this section shall not apply to persons who dispose of or control radium contaminated material incidental to installation, maintenance, repair, improvement or replacement of utilities, streets, sidewalks and alleys in public rights-of-way regulated pursuant to chapter 49 of the Revised Municipal Code and pursuant to the manager's regulations titled "Management Plan Denver Radium Site, Operable Unit 7 Denver Streets."

(Ord. No. 549-96, § 1, 7-1-96; Ord. No. 145-97, § 2, 3-3-97)

Attachment 4: 2002 Amendment of the Declaration of Covenants and Restrictions

JOHN FAUGHT & ASSOCIATES
PROFESSIONAL CORPORATION
ATTORNEYS AT LAW

John D. Faught
jdfaught@earthlink.net

379 Detroit Street, Denver, CO 80206

Telephone (303) 333-5659
Facsimile (303) 333-8081

November 18, 2002

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

James E. Hanley, P.E.
EPA Region VIII
999 Eighteenth Street, Suite 500
Mail Code: EPR-SR
Denver, Colorado 80202-2466

Re: Amended Declaration of Covenants and Restrictions

Dear Mr. Hanley:

By letter of September 4, 2002, we submitted to you a file stamped copy of the Amended Declaration of Covenants and Restrictions filed with the Clerk and Recorder of the City and County of Denver on the same date. Enclosed is a copy of the "Recorded" Amended Declaration of Covenants and Restrictions.

Very truly yours,

John D. Faught

cc: Jerel L. Ellington, Esq. (w/encl.)
Richard Sisk, Esq. (w/encl.)
Robert J. Eber, Esq. (w/encl.)

2002153416 2002/09/04 14:23:29 1/ 4 COV
DENVER COUNTY CLERK AND RECORDER 20.00 .00 MGA

AMENDED DECLARATION OF COVENANTS AND RESTRICTIONS

THIS AMENDED DECLARATION is made this 3RD day of SEPT., 2002, by THE S.W. SHATTUCK CHEMICAL COMPANY, INC., a Colorado corporation (hereinafter "Shattuck").

WITNESSETH:

WHEREAS, Shattuck is the owner of certain real property located at 1805 S. Bannock Street, situated in the City and County of Denver and State of Colorado, more particularly described in Exhibit "A" attached hereto and incorporated herein by reference (hereinafter called the "Property");

WHEREAS, pursuant to a unilateral "Administrative Order for Remedial Design/Remedial Action" issued by the U.S. Environmental Protection Agency dated August 21, 1992 and effective August 31, 1992 (hereinafter the "Order") the Property, which is included in Operable Unit VIII of the Denver Radium Site (hereinafter "OU VIII"), was the subject of a remedial action under the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§ 9601 *et. seq.* ("CERCLA");

WHEREAS, pursuant to the Order and the Record of Decision for OU VIII, dated January 28, 1992, Shattuck recorded a Declaration of Covenants and Restrictions, dated March 24, 1999, instrument recorded March 25, 1999, under Reception No. 9900053712, of the records of the Clerk and Recorder, City and County of Denver;

WHEREAS, on June 16, 2000, the U.S. Environmental Protection Agency amended its original remedial decision for the Property in an Amended Record of Decision; and

WHEREAS, the U.S. Environmental Protection Agency has required Shattuck by letter of July 1, 2002 and pursuant to the 1992 Order to amend the Declaration of Covenants and Restrictions to allow for use of the Property consistent with the remedial action to be completed pursuant with the Amended Record of Decision.

NOW THEREFORE, Shattuck hereby declares that the Property described in Exhibit "A" shall be held, sold, and conveyed subject to the following covenants and restrictions:

USE COVENANTS AND RESTRICTIONS

1. The Property described in Exhibit "A" shall be used only for purposes consistent with the CERCLA remediation and shall be subject to the following restrictions:

    a. The construction of a dwelling or enclosed permanent structure on the Property shall be prohibited; and

    b. Use of the Property for agricultural purposes shall be prohibited; and

    c. The use of groundwater located beneath the Property shall be prohibited.

2. The covenants and restrictions herein shall run with the Property and be binding on all parties having any right, title or interest in the described Property, or any part thereof, their heirs, successors and assigns, and shall inure to the benefit of Shattuck, its successors and assigns, and to any grantees of the Property and their heirs, successors, assigns and grantees.

3. The covenants and restrictions provided in 1.a. and 1.b., above, may be modified or deleted by Shattuck, its successors or assigns, or grantees of the Property, or their heirs, successors, assigns or grantees, upon completion of the remedial action selected in the June 16, 2000 Amendment to the Record of Decision and upon written approval of the U.S. Environmental Protection Agency.

4. This AMENDED DECLARATION OF COVENANTS AND RESTRICTIONS shall supercede and replace the DECLARATION OF COVENANTS AND RESTRICTIONS, dated March 24, 1999, in all respects.

IN WITNESS WHEREOF, THE S.W. SHATTUCK CHEMICAL COMPANY, INC., a Colorado corporation, has caused this instrument to be executed this 3RD day of SEPTEMBER, 2002.

THE S.W. SHATTUCK CHEMICAL COMPANY, INC.

By: _____
Robert H. Oliver
Executive Vice President

STATE OF COLORADO)
) ss:
CITY AND COUNTY OF DENVER)

The foregoing instrument was acknowledged before me this 3rd day of September, 2002 by Robert H. Oliver, Executive Vice President of The S.W. Shattuck Chemical Company, Inc., a Colorado corporation, on behalf of the corporation.

Sidney L. Whatley

MY COMMISSION EXPIRES OCTOBER 26, 2002

APPROVED: FOR THE U.S. ENVIRONMENTAL PROTECTION AGENCY

James E. Hanley

James E. Hanley
Project Manager

EXHIBIT A

All of Blocks "A" and "B", Overland Park Subdivision
City and County of Denver
State of Colorado

Attachment 5: Colorado State Engineer Informational IC (July 2006 Letter)

STATE OF COLORADO

ICE OF THE STATE ENGINEER
...ion of Water Resources
Department of Natural Resources

1313 Sherman Street, Room 818
Denver, Colorado 80203
Phone (303) 866-3581
FAX (303) 866-3589

www.water.state.co.us

July 17, 2006

Mr. Mark Rudolph
Environmental Protection Specialist
CDPHE
HMWMD-RP-B2
4300 Cherry Creek Drive
Denver CO 80246

Re: Denver Radium Site

Dear Mr. Rudolph,

This is in reply to your letter of July 5, 2006, addressed to Kevin Rein concerning notification for well permitting activities at the site you have identified as the Denver Radium Site. In the letter you state that ground water contamination exists at the site and will be monitored for natural attenuation. You have asked that we implement a notification process similar to that used for other ground water contamination sites.

We agree to include on each well permit application correspondence, each well permit, and each acknowledgement for a Monitoring Hole Notice of Intent, for the affected area a notice that the applicant should contact the Colorado Department of Public Health and Environment ("CDPHE") and the U.S. Environmental Protection Agency ("EPA") for information regarding ground water quality. We also agree to provide copies of such correspondence or well permits containing the notice to the CDPHE and the EPA. The affected area you have identified in Township 4 South, Range 68 West is: the west ½ of Section 15, the east ½ of Section 16, the east ½ of Section 21, and the west ½ of Section 22.

We will implement this agreement immediately. If any changes to the notice are necessary, please contact Kevin Rein.

Please contact me if you have questions in this matter.

Sincerely,

Hal D. Simpson
State Engineer

STATE OF COLORADO

OFFICE OF THE STATE ENGINEER
Division of Water Resources
Department of Natural Resources

1313 Sherman Street, Room 818
Denver, Colorado 80203
Phone (303) 866-3581
FAX (303) 866-3589

www.water.state.co.us

July 17, 2006

TO: Denver Basin Team Staff Members
CC: Dick Wolfe
FROM: Kevin Rein, Chief of Water Supply
SUBJECT: Procedure to Notify Potential Ground Water Users, Denver Radium Site

The State Engineer by his letter dated July 17, 2006 to Mr. Mark Rudolph, Environmental Specialist, CDPHE, has agreed to include on each well permit application correspondence, each well permit, and each acknowledgement for a Monitoring Hole Notice of Intent, for the affected area a notice that the applicant should contact the Colorado Department of Public Health and Environment ("CDPHE") and the U.S. Environmental Protection Agency ("EPA") for information regarding ground water quality. The State Engineer has also agreed to provide copies of such correspondence or well permits containing the notice to the CDPHE and the EPA. The affected area has been delineated by Mr. Rudolph.

Effective immediately, the following procedural requirements shall apply to implement this agreement:

1. The boundary of the affected area is plotted on the Division of Water Resources work maps with a note to refer to this memorandum for details of the notification requirements. The affected area in Township 4 South, Range 68 West is: the west ½ of Section 15, the east ½ of Section 16, the east ½ of Section 21, and the west ½ of Section 22.

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 hole notice of intent.

4. The notice on each well permit shall read as follows:

NOTICE: THIS WELL IS WITHIN THE DENVER RADIUM SITE WHERE CONTAMINATION MAY BE ENCOUNTERED. CONTACT THE COLORADO DEPARTMENT OF HEALTH AND ENVIRONMENT AT 303-692-3311 OR THE EPA AT 303-312-6552 FOR DETAILS PRIOR TO DRILLING THIS WELL.

5. The notice on each well permit application correspondence and each acknowledgement of monitoring and observation hole notice of intent shall read as follows:

NOTICE: THIS PROPOSED WELL OR SUBJECT AREA IS WITHIN THE DENVER RADIUM SITE WHERE GROUND WATER CONTAMINATION MAY BE ENCOUNTERED. PRIOR TO PROCEEDING WITH THIS APPLICATION YOU SHOULD CONTACT THE COLORADO DEPARTMENT OF HEALTH AND ENVIRONMENT AT 303-692-3311 OR THE EPA AT 303-312-6552 FOR MORE DETAILS CONCERNING THE LIKELIHOOD OF ENCOUNTERING THIS CONTAMINATION, OR PROCEDURE AND PRECAUTIONS NEEDED DURING WELL CONSTRUCTION.

6. A copy of each well permit or any correspondence containing the notice prescribed in Items 4. and 5. Above shall be mailed to the following entities:

   a) Mr. Mark Rudolph
   CDPHE
   HMWMD-RP-B2
   4300 Cherry Creek Drive
   Denver CO 80246

   b) Ms. Rebecca Thomas
   U.S. Environmental Protection Agency, Region VIII
   8 EPR-SA, 6S-407
   999 18th Street, Suite 500
   Denver, CO 80202

Please contact me if you have questions in this matter.

Copy: Mark Rudolph, CDPHE

STATE OF COLORADO

Bill Owens, Governor
Dennis E. Ellis, Executive Director

Dedicated to protecting and improving the health and environment of the people of Colorado

4300 Cherry Creek Dr. S.
Denver, Colorado 80246-1530
Phone (303) 692-2000
TDD Line (303) 691-7700
Located in Glendale, Colorado

http://www.cdphe.state.co.us

Laboratory Services Division
8100 Lowry Blvd.
Denver, Colorado 80230-6928
(303) 692-3090

Colorado Department
of Public Health
and Environment

July 25, 2006

Mr. Mike Holmes
EPA Denver Radium Project Manager
EPA Region VIII, 8 EPR-SA, 5T-412
999 18th Street, Suite 500
Denver, CO 80202

Dear Mr. Holmes,

Enclosed please find copies of the *Monitoring Hole Notice Of Intent* for all ground water well permits located within the boundaries that have been documented with ground water contamination at Denver radium OU8, OU3 and OU9B. This form of an Institutional Control will allow for control and communication with applicants prior to any proposed installation of any type ground water well within the plumes of these sites.

If you have any questions, please feel free to contact me at (303) 692-3311.

Sincerely,

Mark Rudolph
Environmental Protection Specialist
Hazardous Materials and Waste Management Division

Cc:		
	Dan Scheppers	CDPHE
	Russ Leclerc	EPA
	Rebecca Thomas	EPA
	Ali Sogue	City and County of Denver
	Gerry Kelly	Overland Neighborhood Environmental Watch
	Jane Bral	Overland Neighborhood Environmental Watch
	Site File	CDPHE Superfund Records Center

Attachment 6: Memorandum of Understanding Land Use Control Implementation Plan (LUCIP)

MEMORANDUM OF UNDERSTANDING
Land Use Control Implementation Plan (LUCIP) between the Colorado Department of Public Health and Environment and the City and County of Denver

THIS MEMORANDUM OF UNDERSTANDING is made and entered into this 18th day of November, 2008, by and between the CITY AND COUNTY OF DENVER, a municipal corporation of the State of Colorado, hereinafter referred to as "Denver", and the Colorado Department of Public Health and Environment, hereinafter referred to as the "CDPHE".

WITNESSETH:

WHEREAS, this MOU is a non-binding agreement developed and executed between Denver and the CDPHE hereinafter referred to as "the parties".

WHEREAS, the parties desire to coordinate their efforts to ensure the effectiveness of land use controls designed to protect human health and the environment on properties where remaining contamination does not allow for unrestricted use.

NOW THEREFORE, the parties set forth the following understandings.

I. Purpose.

This memorandum of understanding (MOU) is a Land Use Control Implementation Plan (LUCIP) that describes the roles and responsibilities of the state environmental regulators and local government officials involved in the long-term administration and management of land use controls in the City and County of Denver. The LUCIP acts as an umbrella to ensure that land use controls are monitored over time by a responsible government entity to ensure that owners and operators of property subject to land use controls comply with their terms.

II. Definitions:

- **Colorado Environmental covenants and restrictive notices**—Specific to the Colorado Hazardous Waste Act, §25-15-101, *et seq*. C.R.S., the CDPHE is authorized to require land use restrictions through the creation of environmental covenants and notices of environmental use restrictions (also called "restrictive notices"). Colorado's environmental covenants and restrictive notices apply to environmental remediation projects selected on or after July 1, 2001. Section 25-15-324 of the Act requires coordination between CDPHE and the affected local government. This coordination includes notification by CDPHE to the affected local government regarding the creation, modification or termination of environmental covenants and restrictive notices, and notification by the local government and property owner regarding any changes in the property that could affect the covenant or notice.
- **Decision Document**—State and federal environmental statutes and regulations generally provide for a final decision on the environmental remedy and cleanup of contaminated sites. These final regulatory decisions are memorialized in different types of decision

documents, based on the state program with cleanup approval and oversight responsibilities. These documents all identify Land Use Controls (LUCs) when they are part of the remedy. Decision documents include but are not limited to Superfund Records of Decision, Voluntary Cleanup and Redevelopment Program approval letters, Resource Conservation and Recovery Act Corrective Action Plan approval letters, consent decrees, and administrative orders.

- **Engineering Controls**—Controls such as caps and fences that create physical barriers between contamination and potential receptors.
- **Institutional Controls (ICs)**—Legal or administrative mechanisms for restricting exposures to residual contamination.
- **Land Use Controls (LUCs)**—Both legal and physical measures that limit human exposure by restricting activities, use and access to properties with residual contamination. LUCs include both ICs and engineering controls.

III. Scope

This LUCIP includes all property within the jurisdictional boundaries of Denver. A property comes under the scope of this LUCIP once a LUC has been selected for that property and incorporated in a cleanup decision document. The LUCIP covers all properties with LUCs, even those where the LUC was selected before the signing of this LUCIP. Properties that could be subject to this LUCIP include, but are not limited to those regulated by the following programs and authorities:

- Voluntary Cleanup and Redevelopment Act (VCRA);
- Colorado Hazardous Waste Act (CHWA), including corrective action sites;
- Solid Waste Disposal sites;
- Comprehensive Environmental Restoration, Compensation, and Liability Act (CERCLA) sites, including Superfund sites and Removal Action sites;
- Petroleum Storage Tank (PST) Sites
- Federal facilities, including Base Realignment and Closure (BRAC) and Formerly Used Defense sites (FUDS) (e.g., Lowry Air Force base).

IV. Roles and Responsibilities

The parties have agreed that they have the regulatory authority for LUC enforcement, monitoring, reporting, tracking, and maintenance within Denver in order to protect human health and the environment. This section identifies the roles and responsibilities of the parties and identifies the processes involved in data management, information exchange, notification, monitoring, and enforcement.

A. Information Exchange and Data Management

The parties have agreed that proper data management is essential for accurate tracking of LUCs. As required by statute, CDPHE must keep a registry of all environmental covenants and

restrictive notices. In addition, CDPHE maintains information on all sites regulated by its programs, including any LUCs applicable to those sites. CDPHE has agreed to continue to maintain and refine these databases. The CDPHE agrees to share all necessary information with Denver in order to create and maintain the database of LUC information at existing sites. The CDPHE will provide Denver with all information regarding environmental covenants and restrictive notices and other sites as it becomes available. This shall be accomplished by sending an updated copy of the Environmental Covenant ESRI GIS shape file to Denver, monthly if changes have been made. An additional (non-spatial) database containing more detailed information is maintained by the CDPHE\HMWMD Records Center is available and can be linked to the shape file using the unique key: "PGM_SYS_ID". This detailed data is currently maintained in a MS Access database. This too can be made available in a similar manner if desired.

The parties will establish a standard format for the data registry to ensure that the information in these databases is sufficient for Denver's use in properly identifying these properties and the associated LUCs and is compatible with the parties' computer applications. Data will be broken into two meta-categories, essential information (e.g., legal description, parcel number, address, latitude/longitude of site, point of contact, nature of LUC, type of medium, type of contaminant) and supplemental information (e.g., location of related documents, site history). This coordination will occur between the Denver GIS Technology Services Group, and the CDPHE Hazardous Materials and Waste Management Division GIS Coordinator. Appendix D describes the detail regarding the data transfer and format.

If maintaining a database and tracking of sites with environmental covenants becomes financially burdensome, Denver and the CDPHE will revisit this agreement.

B. Notification Procedures and Responses

The CDPHE agrees to notify Denver regarding any land use control that is approved, modified, or terminated by the agency. This notification will be transmitted to Denver Environmental Health, who will be responsible for communicating the information to other programs within Denver City and County government as necessary.

Denver agrees to inform the CDPHE of activities that may impact LUCs on specific properties based on permit applications. The CDPHE shall evaluate whether the activity is consistent with the LUC and shall notify Denver and the applicant of the CDPHE's determination in a timely fashion, considering the time frame for Denver's review of the application.

A key component of this LUCIP is a list of detailed instructions that explains what action needs to be taken when an LUC has the potential to be violated, including how to notify the correct authorities. A "trigger" refers to an event (e.g., submission of an application for a permit) that, when entered into the database, triggers a response (e.g., notification of a state agency) according to this LUCIP. Appendix A details the protocols used by the parties to make notification when an event occurs.

C. Monitoring

The parties agree to a layered approach to the monitoring of LUCs under this LUCIP.

LAYER 1: Property owners and potentially responsible parties (PRPs) shall report any changes to a site that might affect LUCs. For sites with environmental covenants or restrictive notices, this is required in the covenant or notice.

LAYER 2: The CDPHE, as part of its normal duties, will be responsible for monitoring compliance with LUCs, environmental covenants and restrictive notices at VCRA sites, those subject to the CHWA, federal facilities, solid waste facilities, and Superfund sites (in coordination with EPA).

LAYER 3: Through permit applications and notifications, Denver will monitor LUCs and report to the CDPHE any activity it becomes aware of on properties subject to LUCs.

LAYER 4: Members of the community will report on LUCs through neighborhood organizations and other citizen involvement. The community will report to the local and/or state government any activity that might have gone unnoticed by the previous tiers.

D. Enforcement

If an owner or operator of a property fails to comply with a land use control or other environmental regulation or restriction, the parties have the authority to enforce the LUCs under all regulatory programs or to revoke approval on VCRA sites. The parties agree to notify the owner or operator of the violation, and the CDPHE will request or order compliance and, if necessary, take action to enforce the LUC or environmental regulation. Examples of enforcement actions the parties may take include:

State Enforcement Authority:

- **Environmental covenants and restrictive notices** – (25-15-322, C.R.S.) In the event of an actual or threatened failure to comply with an environmental covenant, the CDPHE may issue an order requiring compliance with the terms of the environmental covenant or restrictive notice and may request the attorney general to bring suit in district court to enforce the terms of the environmental covenant. The grantor of an environmental covenant, and the person requesting creation of a restrictive notice, may file suit. Any third party beneficiary specifically named in the environmental covenant or restrictive notice may also file suit.
- **VCRA** – In cases of violation of the VCRA agreement, the CDPHE has the authority to notify the applicant that the approval letter has been revoked.
- **CHWA** – Where a violation of LUCs at a CHWA site presents imminent and substantial endangerment, or where a consent decree or order have been violated, the CDPHE has the authority to take action against the party responsible.
- **RCRA** –Subtitle C of RCRA (CRS 30-20-113) may be employed to allege violations of Colorado's hazardous waste program
- **CERCLA** – The US Environmental Protection Agency has the authority to order compliance when violation of a LUC presents imminent and substantial endangerment.

Local Government Authority

- **Environmental covenants and restrictive notices** – Denver, as an affected local government (as defined in section 25-15-324, CRS), may file suit requiring compliance with the terms of the environmental covenant or restrictive notice.
- **Permitting** – Denver may require compliance with an LUC in order to obtain building, construction, and other permits if within the purposes for which the permit was granted.

V. Cost of the LUCIP

Since the costs of LUC implementation are largely unknown by any local government, the parties agree to keep track of costs through the life-cycle of this document. To the best of their abilities, each year Denver and the CDPHE will estimate the costs in terms of personnel hours, training and education, community outreach and technology overhead that this LUCIP has created. Personnel costs to be considered include:

- LUC monitoring, including tracking property ownership and transfers, processing changes in and technical review of changes to land use activities, property inspections, and other information management activities.
- Enforcement of LUCs, including legal defense against those wishing to change existing uses to one restricted by the LUC.

These estimates will help in determining the level of funding needed for future agreements between the parties. The parties may establish a checklist to make it easier to track costs.

VI. LUCIP Working Group and Dispute Resolution

The parties agree to establish a LUCIP Working Group to modify this document as necessary, including the continued development of detailed responses to triggers and identification of best practices and on-going concerns. The Working Group shall establish a regular meeting schedule. The CDPHE assumes responsibility for organizing Working Group meetings. Issues to be addressed at meetings include the following:

- Discussion about specific agencies' LUCIP responsibilities.
- Discussion of enforcement options for LUC violations (e.g., alternative dispute resolution, consent decrees or orders)
- Updates about data management and tracking of LUCs.
- Additions, deletions and modifications to the properties and LUCs addressed in LUCIP and reasons for the changes.
- Overall effectiveness of LUCIP, including data management.

IN WITNESS WHEREOF, the parties have executed this MOU as of the day and year first above written.

CITY AND COUNTY OF DENVER

APPROVED AS TO FORM:
Attorney for the City and County of Denver

By: _____
Assistant City Attorney

By: _____
Manager of Environmental Health

By: _____
Manager of Community
Planning and Development

By: _____
Manager of Development Services

"CITY"

STATE OF COLORADO, DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT

APPROVED AS TO FORM:

By: _____
Assistant Attorney General

By: _____
Director of Hazardous Materials and
Waste Management Division

"STATE"

Appendix A

The following is a list of some of the triggers and responses initially identified by the parties.

1. **CDPHE issues/approves a cleanup that includes an environmental covenant or restrictive notice, or LUCs (for sites that are not subject to environmental covenant and restrictive notice requirements).**
    a. CDPHE adds site to database.
    b. CDPHE notifies DEH and provides DEH with a copy of the environmental covenant or restrictive notice, or information on the site and LUC.
    c. DEH adds site and LUC information to GIS system.
    d. DEH notifies CDPHE when site has been added.

2. **CDPHE takes further actions (e.g., change in remedy, modification or termination of an environmental covenant or restrictive notice).**
    a. CDPHE checks site on database to see if there are any LUCs that might be affected.
    b. If there are LUCs that will be affected, CDPHE notifies DEH of any LUC modifications.
    c. CDPHE provides DEH with revised copies of the environmental covenant or restrictive notice, or a copy of the termination letter.
    d. DEH revises LUC information in GIS system (or deletes site).
    e. DEH notifies CDPHE when information has been modified.

3. **CDPHE observes a LUC violation**
    a. CDPHE will notify the property owner that the activities on the site have violated the LUC. CDPHE will also notify DEH.
    b. CDPHE will take enforcement action or will use enforcement discretion to work with the property owner to modify the site activities to be compliant with the LUC. The LUC will be amended as necessary to conform to these new conditions, and the database will be updated as appropriate.
    c. CDPHE will notify DEH regarding the return of the property to compliance, and of any change in the LUC and database.

4. **Denver Community Planning and Development Department (CPD) receives a permit application for any activity that is logged in the Building Permitting Database, including Building Permits or Zoning Construction Permits (Form 21).**
    a. Denver reviews LUC report monthly to see if there are any LUCs that might be affected.
    b. If site is state-regulated (e.g., environmental covenant, VCRA, RCRA, CERCLA), DEH notifies CDPHE of application.
    c. DEH sends notice to Site Owner of the presence of LUCs on the site and the need for the Site Owner to contact the CDPHE.
    d. CDPHE will review the permit application to determine whether the LUC will be violated by the planned activity.

e. CDPHE will notify the property owner that the planned activity will violate the LUC, and work with the property owner to modify the planned activities to be compliant with the LUC. CDPHE will also notify DEH.

In response to permit applications submitted to Denver for activities to be performed on properties with LUCs, Denver will submit to CDPHE a report (see Appendix C) of permit activity related to LUCs identified by the CDPHE. This report will be automatically generated based on LUC addresses submitted to Denver by the CDPHE and permits entered into the Denver database by Denver's Community Planning and Development. The report at a minimum will include the following:

- Site Owner
- Site Address
- Contractor Name, Address, Phone
- Permit Type
- Stat Code
- Permit Description
- Date of Application

Denver will submit the report monthly to the CDPHE. If there is no activity related to sites with LUCs, Denver will submit a notification to the CDPHE indicating that there was no activity and will not submit a report in that month.

Appendix B: Agency Contact Information

The following are a list of contacts for each agency. The contact listed below is the person to contact in response to a trigger (see Section IV.B. *Notification Procedures and Responses* for a list of triggers and responses). This appendix will need to be updated as contacts change.

Organization: Colorado Attorney General's Office
Name: David Kreutzer
Title: Senior Assistant Attorney General, Natural Resources and Environment Section
Telephone: 303-866-5667
E-mail: david.kreutzer@state.co.us
Address: 1525 Sherman St., 5th floor, Denver, CO 80203
When to notify: Violation of environmental covenant or restrictive notice

Organization: Colorado Department of Public Health and the Environment (CDPHE)
Name: Jeffrey Deckler
Title: Program Manager, Hazardous Materials and Waste Management Division
Telephone: 303-692-3387
E-mail: jeff.deckler@state.co.us
Address: 4300 Cherry Creek Drive South, Denver, Colorado 80246-1530
When to notify: Triggers related to sites with LUCs, environmental covenants or restrictive notices or under the VCRA, CERCLA, RCRA, or CHWA at all sites or facilties

Organization: Denver City Attorney's Office
Name: Shaun Sullivan
Title: Assistant City Attorney, Municipal Operations Section
Telephone: 720-913-3261
E-mail: Shaun.Sullivan@denvergov.org
Address: 201 W. Colfax Avenue, Dept. 1207; Denver, Colorado 80202
When to notify: Disputes under the LUCIP

Organization: Denver Department of Environmental Health (DEH)
Name: Alice Nightengale Luhan
Title: Environmental Public Health Manager
Telephone: 720-865-5431
E-mail: alice.luhan@denvergov.org
Address: 201 W. Colfax Avenue, Dept. 1009; Denver, Colorado 80202
When to notify: City-owned properties, questions about City process under LUCIP

Appendix C: Example of LUC Report

env_lucip_report_vw 2_1page.pdf

Appendix D: Data Requirements

EnvConvDesc.xls

As the State is statutorily required (under 25-15-323) to create and track a registry of sites with environmental covenants, they will provide the data that identifies the sites and LUCs associated with those sites in the following format:

Data submitted by the CDPHE will be a shapefile that contains the same attributes as the original shapefile (those attributes from sample of features are in the attached Excel file).

The CDPHE shall submit the data to Denver monthly or upon relevant additions to the CDPHE's database.

Colorado Department of Public Health and Environment

Hazardous Materials and Waste Management Division Policies

Policy Title:	**Timing of Environmental Covenants**
Program(s) Initiating the Policy:	**All**
Program(s) Subject to the Policy:	**All**
Statutory & Regulatory Citations:	**CRS 25-15-317 thru 327**

Policy Summary:

The purpose of this policy is to maximize the protectiveness of the environmental covenant by ensuring it is created promptly after the environmental remediation decision. Prompt creation and recordation of the environmental covenant furthers the goals of the environmental covenant statute by:

- ensuring the environmental use restrictions are immediately enforceable against any person, including subsequent transferees of the affected property;
- ensuring the need to create the covenant is not overlooked due to passage of time, change of personnel, or administrative oversight; and
- providing notice of the existence of the covenant by including it in the appropriate land records and the Division's registry of environmental covenants.

Policy:

1) SB 01-145 created a statutory environmental covenant. Section 25-15-320, C.R.S., enacted as part of SB 01-145, requires the execution of an environmental covenant whenever an environmental remediation project implemented pursuant to a cleanup decision reached on or after July 1, 2001, does not achieve unrestricted use due to residual contamination that is not safe for all uses and/or the incorporation of an engineered structure requiring monitoring, maintenance, or operation. This policy sets forth how, as of January 9, 2006, the Division will implement the requirement for environmental covenants in relation to the timing of the remedy selection, construction,

Date Issued: 01/09/06
Date of Last Review: 01/09/06
Date of Last Revision: 01/09/06

and achievement of unrestricted use.[1]

2) The Division will require an environmental covenant for any remedy that is not designed to achieve unrestricted use upon completion of remedy construction (not including operation and maintenance). Environmental use restrictions shall be specified in the remedial decision document. The remedial decision document shall also include a requirement and a schedule for submission to the Division of a signed environmental covenant. For remedies that involve physical work, the signed environmental covenant will be submitted within 30 days of completion of remedy construction. For remedies that rely solely on institutional controls, the signed environmental covenant will be submitted within 30 days of the remedial decision.

3) In cases where the remedy is designed to reach unrestricted use upon completion of remedy construction, but requires monitoring to confirm this, the remedial decision shall contain a condition noting that additional response action, potentially including a covenant, will be required if the monitoring (or other information) shows that the cleanup has not met the anticipated goal of unrestricted use.

4) Paragraphs 1-3 above shall apply to large sites with multiple environmental remediation projects (as defined in § 25-15-101, C.R.S.), except as provided below:

a) The Division will work with the facility to determine which of the following is most appropriate:

   i) A single site-wide covenant that would be modified to incorporate all subsequent decisions on other environmental remediation projects;
   ii) One environmental covenant per environmental remediation project; or
   iii) Multiple environmental covenants covering one or more environmental remediation project decisions.

---

1 Unrestricted use can be achieved when residual contaminant concentrations: a) are equal to or less than natural background levels, b) do not exceed an excess cancer risk of $1x10^{-6}$ for individual constituents and the cumulative (total) excess upper bound lifetime risk from all contaminants does not exceed $1x10^{-5}$, assuming a residential exposure scenario, c) have a hazard quotient for each noncarcinogen less than or equal to one or a cumulative hazard quotient (hazard index) equal to or less than one for all those constituents with similar critical endpoints, assuming a residential exposure scenario, d) will be incapable of degrading water quality in excess of State standards or other health-based levels during post-cleanup releases, e) ground water concentrations do not exceed State standards or other health-based levels in the absence of State standards, and f) result in a dose from residual radioactivity (TEDE to the average member of the critical group) of less than 25 mrem/yr. Remedies incorporating engineered structures (caps, barrier walls, etc.) are not considered to achieve unrestricted use.

b) If there are multiple environmental remediation projects scheduled for final decisions within a year, the Division may exercise its discretion to defer the timing of the covenant execution so that a single covenant or modification to an existing covenant may be executed that encompasses all of the environmental remediation project decisions for that year. In choosing to exercise its discretion, the Division may consider relevant factors, including the facility's ability and willingness to execute the covenant (or modification) at the end of the year.

This policy is: (check one)
New: __x__ Replacement:

Approvals:

Title	Signature	Date
Compliance Program Manager		1/9/06
Radiation Program Manager		09 Jan. 2006
Remediation Program Manager		1/9/06
Division Director		1/9/2006

Date Issued: 01/09/06
Date of Last Review: 01/09/06
Date of Last Revision: 01/09/06

Attachment 7: 1996 Notice and Covenant Ous 4 and 9B

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
1595 Wynkoop Street
DENVER, CO 80202-1129
Phone 800-227-8917
http://www.epa.gov/region08

Nina Nichols
625 East 16th Ave., Suite 202
Denver, CO 80203-2052

NOV 2 2009

To whom it may concern:

I am writing with respect to the property located at 490 South Santa Fe Drive, Unit E, Denver, CO, 80223. This property is part of the Denver Radium Superfund Site, Operable Units (OUs) 4 and 9B, known as the ROBCO site. The Superfund cleanup at the ROBCO site has been completed.

Operable Unit 4 dealt with radioactive contamination and Operable Unit 9B dealt with metals contamination. All identified radioactive contamination, except for several small areas of residual radioactive contamination at depth or below groundwater, was excavated and disposed offsite. Metals contamination above commercial use action levels was excavated and consolidated under the Home Depot parking lot. As part of the cleanup, Home Depot placed a Notice and Covenant on the property which restricts future use of the ROBCO site, see enclosed copy of the Notice and Covenant. None of the residual radioactive contamination or the consolidated metals contamination is located at 490 South Santa Fe Drive.

As you may know, cleanup at the Denver Radium Superfund Site generally, is now complete. The Final Close Out Report (FCOR) for the Denver Radium Superfund Site was completed on September 25, 2006, and concluded that the Site is ready for reuse. I have enclosed a copy of the pages from the FCOR specifically related to OUs 4 and 9B.

The Environmental Protection Agency (EPA) conducted a Five-Year Review in September 2008, and determined that all remedial actions remain protective of human health and the environment. A copy of the Five-Year Review dated September 30, 2008, can be found at: http://www.epa.gov/superfund/sites/fiveyear/f2008080002506.pdf. The next Five-Year Review will be completed by September 2013. EPA intends to proposed deletion of OUs 4 and 9B from the National Priorities List (NPL) in the near future.

Please contact me at (303) 312-6493 if you have any questions or concerns about this property.

Sincerely,

Kerri Fiedler

Kerri Fiedler
Remedial Project Manager

Enclosures

cc: Richard Sisk, ENF-L
Mark Rudolph (CDPHE)

BERENBAUM, WEINSHIENK & EASON, P.C.
ATTORNEYS AT LAW

26TH FLOOR, REPUBLIC PLAZA
370 SEVENTEENTH STREET
DENVER, COLORADO 80202-5626

PHONE (303) 825-0800
TELECOPIER (303) 629-7610

JAMES L. KURTZ-PHELAN
DIRECT DIAL (303) 592-8323

May 15, 1996

Richard Sisk, Esq.
Assistant Regional Counsel
U.S. Environmental Protection Agency
Region VIII
999 18th Street, Suite 500
Denver, Colorado 80202-2466

Dear Richard:

Enclosed is a copy of the recorded Notice and Covenant which was recorded by Home Depot in connection with its acquisition of the Robinson Brick Company property. I believe that is the last obligation to be performed by Home Depot at this time pursuant to the Prospective Purchaser Agreement.

Please give me a call if you have any questions or comments. Thank you again for all of the good work which you and Rebecca have done on this project.

Sincerely,

James L. Kurtz-Phelan

JKP/clg
Enclosure

cc: Rob Eber, Esq.
Assistant Colorado Attorney General

Rebecca J. Thomas
U.S. Environmental Protection Agency

Lawrence J. Bruskin, P.E.
Hazardous Materials and Waste Management Division
Colorado Department of Public Health and Environment

c:\wp51\jimmay6\sisk.ltr (clg)

(3)

9600058480 1996/05/03 12:26:27 1/ 6 NOT
ELBRA WEDGEWORTH - DENVER COUNTY 31.00 .00 AWE

NOTICE AND COVENANT

Notice is hereby given that the real property located in the City and County of Denver, State of Colorado, described in Exhibit A attached hereto and incorporated herein by this reference (the "Property"), with an address of 500 South Santa Fe Drive, Denver, Colorado, has upon it certain hazardous substances that were permitted to remain on the Property in connection with the remedial actions taken by the United States Environmental Protection Agency pursuant to the Declaration for the Record of Decision for the Denver Radium, Operable Unit IX, Robinson Brick Company Property, and that EPA and the State of Colorado make no representations as to the appropriate use of the Property.

Notice is further given that the Property is subject to that certain Agreement and Covenant Not to Sue re: Denver Radium Site Operable Units IV and IX, with an effective date of November 3, 1995 (the "Agreement") as described herein, and that such Agreement shall inure to the benefit of and be binding upon all purchasers of any interest in the Property after the date of such Agreement provided such purchaser enters into certain agreements and the consent of EPA and the State of Colorado is given in accordance with the terms of the Agreement.

In furtherance of the objectives and provisions of the Agreement, Home Depot U.S.A., Inc. ("Home Depot"), as owner of the Property, covenants and agrees that the Property shall be owned, conveyed, held and used subject to all of the following covenants, conditions, restrictions and easements:

1. The development and use of the Property shall be subject to the following provisions:

A. The owner and/or lessee of the Property shall grant to The United States Environmental Protection Agency ("EPA") and the State of Colorado ("State"), their employees, authorized representatives, contractors, agents, and all other persons performing response actions under EPA's or the State's oversight, an irrevocable immediate right of access at all reasonable times to the Property for the purpose of monitoring compliance with the terms of the Agreement and performing and overseeing response actions selected in the Records of Decision ("ROD") for OU IV and IX at the Site and conducting five-year reviews as provided in Section 121(c) of CERCLA, 42 U.S.C. § 9621(c). EPA or the State agree to provide the owner and/or lessee of the Property with reasonable advance notice of the performance of response actions at the Property. Notwithstanding any provision of the Agreement, EPA and the State retain all of their access authorities and rights,

ACL D5047

including enforcement authorities related thereto, under CERCLA, the Resource Conservation and Recovery Act ("RCRA"), 42 U.S.C. § 6901, et seq., or any other applicable federal or state statute or regulation.

B. Each deed, lease, or other instrument conveying an interest in the Property shall contain a notice stating that the Property is subject to the Agreement and to this Notice and Covenant.

C. Uses of the Property shall be restricted to non-residential uses which are compatible with maintaining the integrity of the cap. The owner and/or lessee of the Property shall not seek to have the Property zoned or designated for residential use, recreational use, or any other uses inconsistent with the remedy selected in the ROD for OU IX or incompatible with maintenance of the integrity of the cap.

D. The owner and/or lessee of the Property shall not drill or allow others to drill water wells on the Property, with the exception of groundwater monitoring wells. The owner and/or lessee of the Property shall not use groundwater or allow others to use groundwater from beneath the Property for any purpose.

E. Development and use of the Property, including development within either the Pre-Consolidation Area of Contamination or the Post-Consolidation Area of Contamination (collectively, the "AOC"), as defined in the ROD and the Agreement, will be permitted in compliance with the Agreement. All Metals-Contaminated Soil (as defined in the Agreement) excavated from within the AOC during development of the Property, or otherwise, shall either be redeposited within the Post-Consolidation AOC and capped, or if not redeposited within the Post-Consolidation AOC, shall be disposed of at a Resource Conservation and Recovery Act Subtitle C permitted facility in compliance with EPA's Off-Site Rule, 40 C.F.R. § 300.440. Prior to redepositing such soils within the Post-Consolidation AOC or shipment off-site for disposal, the owner or lessee of the Property shall notify EPA and the State.

F. The owner or any subsequent purchaser or lessee of the Property acknowledges that it is purchasing or using property where response actions have been implemented pursuant to the RODs for OUs IV and IX. The owner and/or lessee of the Property further acknowledge and agree that the implementation of response actions may interfere with the use of the Property, and may require temporary closure of its operations or a part thereof. EPA and the State have agreed that, if Metals-Contaminated Soils with contamination levels in excess of EPA action levels are

removed from beneath a building foundation, they will use every reasonable effort to avoid performing any response actions which might jeopardize or undermine such building foundation and the ground level floor supported by such foundation. The owner and/or lessee of the Property agree to cooperate with EPA and the State in the implementation of response actions selected in the RODs for OU IV and OU IX at the Site, and further agree not to interfere with such response actions. Consistent with EPA's responsibilities under federal law and consistent with the State's responsibilities under state and federal law, EPA and the State have agreed to use reasonable efforts under the circumstances to minimize any interference with the owner's and/or lessee's operations by such response actions.

G. Any leases or deeds for sale or use of the Property shall provide that all current and future owners, lessees, sublessees, transferees, and assignees of the Property must provide the same access, use restrictions, and cooperation as Home Depot provides to EPA and the State under the Agreement, and that any such lease or deed for sale is subject to the Agreement. The owner of the Property shall ensure that any subsequent leases, subleases, sales, assignments or transfers of the Property by such owner are consistent with and subject to the Agreement.

H. The owner and/or lessee of the Property is not obligated under the Agreement to provide funds, materials, supplies, or personnel for completion of the remedy set forth in the Agreement, except for implementing and maintaining institutional controls and maintenance of the permanent cap, as described in Exhibit B to this Notice and Covenant.

I. The owner and/or lessee of the Property agree that it and/or they shall not use the Property in any way which may aggravate, exacerbate, or contribute to Present Contamination at the Property.

2. The EPA and the Colorado Department of Public Health and Environment shall have the right to enforce the provisions of this Notice and Covenant by an action at law brought in the United States District Court for the District of Colorado located in Denver, Colorado.

3. All terms used herein which are defined in the Agreement shall have the same meaning herein as is set forth in the Agreement.

4. This Notice and Covenant shall be deemed to touch and concern the Property and shall run with the land as an equitable servitude and restrictive covenant encumbering the

Property. This Notice and Covenant shall be construed and enforced in accordance with the laws of the State of Colorado.

IN WITNESS WHEREOF, the foregoing Notice and Covenant was executed on the 29TH day of April, 1996.

ATTEST:

HOME DEPOT U.S.A., INC., a Delaware corporation

JKP

_____
_____ Secretary

By: _____
Its: Senior Corporate Counsel

STATE OF CALIFORNIA)
) ss.
COUNTY OF _____)

see attached

The foregoing Notice was acknowledged before me this _____ day of _____, 1996, by _____ as _____ and _____ as _____ Secretary of HOME DEPOT U.S.A., INC., a Delaware corporation.

WITNESS my hand and official seal.

My commission expires: _____

_____
Notary Public

c:\wp51\jimapr65\homdep.ntc (clg) April 26, 1996

STATE OF CALIFORNIA)
) ss.
COUNTY OF ORANGE)

On April 29, 1996, before me, D Perkins, a Notary Public in and for said state, personally appeared Daniel R. Hatch, personally known to me to be the person whose name is subscribed to the within instrument, and acknowledged to me that he executed the same in his authorized capacity, and that by his signature on the instrument the person, or the entity upon behalf of which the person acted, executed the instrument.

WITNESS my hand and official seal.

D PERKINS
COMM. # 985068
Notary Public — California
ORANGE COUNTY
My Comm. Expires FEB 15, 1997

SIGNATURE OF NOTARY PUBLIC

EXHIBIT A
TO
NOTICE AND COVENANT

THAT PORTION OF SECTION 15, TOWNSHIP 4 SOUTH, RANGE 68 WEST, OF THE SIXTH PRINCIPAL MERIDIAN IN THE CITY AND COUNTY OF DENVER, STATE OF COLORADO, DESCRIBED AS FOLLOWS:

COMMENCING AT THE NORTHWEST CORNER OF SAID SECTION 15; THENCE ALONG THE WEST LINE OF SAID SECTION 15 SOUTH 00°0'37" EAST 1320.54 FEET TO THE SOUTHWEST CORNER OF THE NORTHWEST QUARTER OF THE NORTHWEST QUARTER OF SAID SECTION 15; THENCE ALONG THE SOUTH LINE OF SAID NORTHWEST QUARTER OF THE NORTHWEST QUARTER OF SECTION 15 NORTH 89°54'41" EAST 361.50 FEET TO THE TRUE POINT OF BEGINNING; THENCE CONTINUING ALONG SAID SOUTH LINE NORTH 89°54'41" EAST 173.27 FEET; THENCE LEAVING SAID SOUTH LINE NORTH 08°25'08" EAST 134.19 FEET; THENCE NORTH 21°26'19" WEST 104.81 FEET; THENCE NORTH 11°34'41" EAST 395.00 FEET; THENCE SOUTH 38°29'19" EAST 30.00 FEET; THENCE SOUTH 44°28'38" EAST 404.48 FEET; THENCE SOUTH 31°56'30" EAST 155.45 FEET; THENCE SOUTH 22°53'19" EAST 187.20 FEET; THENCE SOUTH 22°51'04" EAST 678.32 FEET TO THE BEGINNING OF A NON-TANGENT CURVE CONCAVE SOUTHWESTERLY, HAVING A RADIUS OF 3794.33 FEET, A RADIAL LINE FROM SAID POINT BEARS SOUTH 67°48'09" WEST; THENCE SOUTHERLY 358.89 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 05°25'10"; THENCE NON-TANGENT TO SAID CURVE SOUTH 89°19'27" WEST 141.65 FEET; THENCE NORTH 12°42'33" WEST 311.89 FEET; THENCE SOUTH 89°56'45" WEST 673.82 FEET; THENCE NORTH 00°34'15" WEST 70.00 FEET; THENCE SOUTH 89°56'45" WEST 70.00 FEET; THENCE NORTH 26°12'42" WEST 194.92 FEET; THENCE NORTH 01°03'00" EAST 385.61 FEET; THENCE SOUTH 89°54'41" WEST 40.00 FEET; THENCE NORTH 00°34'15" WEST 30.00 FEET TO THE TRUE POINT OF BEGINNING.

CONTAINING 738,339 SQUARE FEET (16.950 ACRES), MORE OR LESS.

EXHIBIT B
TO
NOTICE AND COVENANT

OPERATIONS AND MAINTENANCE PLAN REQUIREMENTS

The Operations and Maintenance Plan ("O&M Plan") will be implemented, monitored and recorded in accordance with this agreement. Except as noted, the implementation of the O&M Plan will be performed by HOME Depot U.S.A. The O&M Plan will include the following:

- EPA Region 8 or the State will perform off-site ground water monitoring and reporting;
- An annual inspection and professional engineer's certification that the closure caps are being maintained and operated in accordance with this Agreement and the Record of Decision ("ROD");
- Any breach of the soil cap system over the Post-Consolidation Area of Contamination, exposure of the surface of the Post-Consolidation Area of Contamination, release of contaminated soils, or off-site not-permitted discharge of surface waters that has come into contact with contaminated soils on the property will be reported to EPA Region 8 and the Colorado Department of Public Health and Environment as prescribed by the O&M Plan and the ROD;
- Construction of surface water management systems on the ROBCO Property Site in such a manner as not to provide a hydraulic influence to the Post-Consolidation Area of Contamination;
- New construction, remodeling, and site repair generally will not be conducted in the Post-Consolidation Area of Contamination for soils that exceed the site screening criteria (risk-based clean-up standard);
- Repair work, new construction, or remodeling that may come into contact with the Post-Consolidation Area of Contamination will be performed in accordance with the ROBCO Site Specifications, CQA Plan, Work Plans, and Health and Safety Plans, or as modified, with the approval of EPA Region 8 and the Colorado Department of Public Health and Environment;
- The management of soils that exceed the site screening criteria encountered during repair work, new construction, or remodeling will done be done in accordance with this Agreement and the Record of Decision by placing and effectively managing those soils that exceed the site screening criteria on-site in the Post-Consolidation Area of Contamination or by transportation and management at a

permitted Resource Conservation and Recovery Act (RCRA) Facility, and:

- Records of inspections, professional engineer's certifications, work activities in or near the Post-Consolidation Area of Contamination will be maintained by Home Depot on accordance with this agreement.

- Several small areas of radium and thorium contamination were left on-site at depth. These remaining pockets of radiological contamination present little or no health risk if left undisturbed. These areas are identified in the Supplemental Standards Report for Operable Units IV/V (March 1994). Should Home Depot's activities at the Site require excavation of one or more of these areas, any radioactive material above the action levels identified in the OU IV/V ROD would be required to be managed in accordance with appropriate health and safety regulations. "Management" could mean re-burial at depth.

APPENDIX K – OU2 ATLAS METAL & IRON RADON RESULTS[14]

Table 1: Summary of Radon Activity in Indoor Air, 1100 Umatilla St.

Location	Radon activity (pCi/L)												
	July 1-6, 2005	December 23-29, 2005	January 13-17, 2007	December 22-26, 2007	December 24-29, 2008	December 18-22, 2009	December 23-28, 2010	December 14-19, 2011	December 17-21, 2012	December 27-30, 2013	November 21-25, 2014	December 24-28, 2015	December 22-27, 2016
Mike's office	0.7	0.9	< 0.5	0.9	0.5	1.1	1.3	2.4	1.0	0.5	1.2	1.4	1.5
Mike's office (duplicate)													1.6
Receptionist's desk	0.6	1.1	-	1.7		1.1	1.9	1.8	1.4	1.0	1.7	1.5	1.3
Kevin's office	0.8	1.2	0.5	1.3	0.6	1.3	1.8	2.4	1.5	1.1	1.3	1.4	1.4
Shop office	< 0.5	0.8	< 0.5	< 0.5	1.0	0.9	1.5	2.0	1.2	1.5	0.8	2.6	0.8
Shop office (duplicate)	-	-	0.6	< 0.5	-	-	-	1.7	1.1	1.6	0.9	2.2	0.6
Shop	-	-	0.8	-	-	0.8	-	-	-	-	-	-	-
Warehouse - north closet (electrical room #10)	1.1	0.7	0.7	-	-	-	-	-	-	-	-	-	-
Warehouse - south closet	1.1	-	-	-	-	-	-	-	-	-	-	-	-
Warehouse office	-	1.1	0.5	1.0	1.0	1.7	1.5	2.7	0.8	1.1	0.9	2.3	< 0.5

[14] Engineering Management Support Inc., Results of Monitoring Activities, Umatilla St. Facility, 2016 Annual Report.

APPENDIX L – CDPHE REVIEW OF SHATTUCK GROUNDWATER DATA FOR 2018 FYR

COLORADO
Hazardous Materials
& Waste Management Division
Department of Public Health & Environment

Dedicated to protecting and improving the health and environment of the people of Colorado

INTEROFFICE COMMUNICATION

TO: Mark Rudolph

FROM: Kyle Sandor

DATE: June 15, 2018

SUBJECT: Review of Shattuck Groundwater Data for 2018 Five Year Review

Introduction

The purpose of this report is to evaluate and interpret groundwater monitoring data collected near the Shattuck (Denver Radium Operable Unit 8) Superfund Site in Denver, Colorado. Groundwater monitoring has been conducted at the Site under several different sampling programs since 1981. Quarterly samples were collected between 2006 and 2008. Beginning in 2009 sampling has been conducted either semi-annually or annually. This report evaluates both the long-term trends that can be evaluated for wells that have large data sets and a detailed analysis of the more recent data.

The groundwater remedy for the Site is natural attenuation after source removal. This remedy is similar to the "natural flushing" remedy being applied at many of the Colorado Uranium Mill Tailings Remedial Action Sites (UMTRA) Sites. The objective of the groundwater monitoring program is to document that natural attenuation/flushing of Site related contaminants is occurring.

The Site is located in southwest Denver, northeast of the intersection of Evans Avenue and Santa Fe Drive. Overland Park Golf Course lies to the west of the Site. The South Platte River forms the western boundary of the golf course. The topography of the area surrounding the Site is relatively flat and generally slopes to the north and west toward the South Platte River.

The Shattuck Site is located within the drainage basin of the South Platte River, which is located approximately 3000 feet west of the Site. The Site is located on an alluvial terrace which is topographically higher than the modern floodplain of the South Platte River. A shallow, unconfined aquifer exists below the Site. The shallow aquifer is perched on bedrock and merges with the alluvial aquifer beneath the floodplain of the South Platte River. The groundwater in the area is not used as a drinking water source and controls have been placed with the state engineers office at the Department of Natural Resources to prevent and notify people attempting to do so.

Groundwater in the area of the Site generally flows west across the Site and then northwest toward the South Platte River. Figure 1a shows the Site vicinity and the groundwater monitoring network. Three of the monitor wells (MW-1, MW-3, and VMW-06) are located on the terrace, while the remaining wells are in the floodplain. VMW-06 is located upgradient from the Site. The floodplain wells are located on or adjacent to the Overland Park Golf

Course. High concentrations of Site-related contaminants occur in the terrace wells, with floodplain wells exhibiting better water quality. Previous investigations identified groundwater infiltrating a subsurface storm sewer line located along South Santa Fe Drive, west and downgradient of the Site. A portion of the sewer was lined with an epoxy-based liner in 1997. Infiltration of contaminated groundwater into the storm sewer resulted in elevated concentrations of Site related contaminants in the storm sewer discharge. Samples of water from the storm water outfall at the South Platte River are collected at the same time as the groundwater samples.

The groundwater samples collected during the past five year period have been analyzed for total copper, manganese, molybdenum, uranium and zinc. Additionally, the samples were analyzed for Gross Alpha, Uranium 234, Uranium 238 and nitrate. Samples were collected from a total of 10 monitoring wells and three storm sewer outfall locations to the South Platte River. Groundwater monitoring wells are located upgradient, downgradient, and cross gradient of the Shattuck Site.

Source removal for uranium occurred during the original remedial action in the 1990's. Later it was discovered that soils containing molybdenum still remained at the Site that had not been removed during the original cleanup. Source removal for the molybdenum-contaminated soils was completed in 2006. As such, the uranium plume has had a longer time-frame for natural flushing to take place. Molybdenum, on the other hand, occurs in groundwater in very high concentrations, up to 200 times the 40 CFR 192 standard for molybdenum of 0.1 mg/l. Natural flushing for molybdenum is expected to take longer than uranium because of the higher concentrations and the more recent removal of the molybdenum source.

Results of the Monitoring Program

Water Level Data

The Site has wells two groups of wells; the terrace wells which are characterized by casing elevations greater than 5252 feet above sea level (asl) and floodplain wells which have casing elevations between 5241 and 5245 feet asl. Terrace wells show little variation with throughout the year. Floodplain wells show more variation, with well BH-3 showing the highest degree of variation in water level. BH-3 is located adjacent to both the Aqua Golf pond and the South Platte River, therefore the wells is more affected by changes in the surface water regime. Water levels in the flood plain wells during the time covered by the 2018 Five Year Review are shown below in Figure 1. Water levels in the terrace wells are shown in Figure 2.

Well APM-5 and PZ-2 was removed from the sampling list since the last Five Year Review. APM-5 well was inferred to be screened too shallow, and therefore, not intersecting the alluvial aquifer. This lead to anomalous analytical results and its removal from the sampling list. Well PZ-2 was buried and damaged between 2009 and 2010 and is no longer part of the sampling regime.

A comparison of groundwater flow directions from sampling events in 2007, 2010, and 2014-2018 indicates that even though variations do occur in the water table, these variations do not cause a significant change in groundwater flow directions. The variations do however, appear to affect the groundwater flow velocity as shown in Figures 3-9.

Gross Alpha

The Gross Alpha measurement is typically used a screening tool to determine if alpha emitting contamination is present on a Site. Since uranium is a known contaminant of concern and already included in the sampling program, monitoring for Gross Alpha can be discontinued. This recommendation was also made during the last Five Year Review.

Uranium

Analysis for uranium at the Site has consisted of both an isotopic and mass-based methods since August 2006. Historically, there has not been good agreement between the uranium data from the two different analytical methods. The regulatory limit from the Basic Standards for Groundwater (40 CFR 192) for uranium is based on dissolved uranium measured by mass in milligram per liter (mg/l). Due to the higher result found with the mass method, and the regulatory limit being reported in mass units, future analysis should be limited to the mass-based analytical method.

Wells that continue to exhibit uranium concentrations above the groundwater standard of 30 µg/l (0.030 mg/l) include: APM -3, APM-4, APM-6, BH-3, MW-1, MW-3, MW-6, VMW-03, VMW-04, and VMW-06. These wells exceeded standards 116 of the 160 times they were sampled between March 2007 and March 2018. Wells APM-4, APM-6, and MW-1 have had exceedances in recent years after periods of compliance. Concentrations of uranium in VMW-06 (background well) appear to be decreasing after several years of increasing concentrations. The result being a stabilization of the uranium concentration trend for VMW-06.

Molybdenum

The terrace wells (MW-1, MW-3, and VMW-06) continue to exhibit higher concentrations of molybdenum than the wells in the floodplain. Concentrations of molybdenum in wells MW-1 and MW-3 continue to be several orders of magnitude above all other wells sampled at the Site. Data collected from Sewer Outfall S-133-E provides evidence that infiltration into the storm sewer is still taking place and the storm sewer is still impacted by elevated concentrations of molybdenum.

Wells that continue to exhibit molybdenum concentrations above the groundwater standard of 0.100 mg/l include: APM-4, APM-6, BH-3, MW-1, MW-3, VMW-03, VMW-04, and VMW-06. These wells exceeded standards 64 of the 160 times they were sampled between March 2007 and March 2018. Of the wells with detections over the standard, APM-4, BH-3, VMW-03, and VMW-04 had detections 4 or less times over the last 16 sampling events. Also of note, wells APM-6, MW-1 and MW-3 had detections above the standard 16 of 16 times they were sampled.

It should be noted that there are two different groundwater standards for molybdenum that are considered ARARs for the Site: The Colorado's Basic Standards for Groundwater (Regulation 41) and the CFR 192 groundwater standards from former uranium milling facilities. The 40 CFR 192 standard for molybdenum of 0.100 mg/l continues to be the more stringent and most appropriate value to compare data to for the Site.

Seasonal Trends

Water level data was plotted against the uranium/molybdenum concentrations in order to determine if seasonal trends are occurring in the groundwater. Seasonal trends were evident in some wells and were indicated by elevated concentrations corresponding with a rise in the water table. The highest water table elevations typically occur from May through September, and most likely are a response to the summer irrigation season. Graphs of molybdenum and uranium concentrations plotted against water level are exhibited in Figures 10 through 29 below.

Mann-Kendall Test for Trends

The remedy outlined in the Record of Decision for groundwater is natural attenuation. In order to determine if natural attenuation is occurring at the Site it is necessary to check for declining concentration trends. One method

used for determining trends in monitoring data is the nonparametric Mann-Kendall test for trend. This review utilized EPA's Groundwater Statistics Tool, August 2014, to determine if trends were present on a well-by-well.

Uranium and Molybdenum continue to be the primary contaminants of concern at the Site. Concentrations of the two primary contaminants of concern from 10 wells were test for trends. Nitrate was not tested for trend because nitrate can undergo geochemical transformation, which could invalidate the test results. For all wells, with the exception of BH-3, the past 16 data points (March 2007 to March 2018) were evaluated for trend analysis. All 16 data points include data from after the 1990's uranium and 2006 molybdenum source removals.

The Mann-Kendall results for the most recent 16 data points are summarized in Table 1. Decreasing trends for molybdenum are present in three wells, including APM-6, BH-3, and MW-1. The molybdenum trends for all wells are shown below in Figures 30-39. Decreasing trends are evident for uranium in well MW-3. The uranium trends for all wells are shown below in Figures 40-49.

The 2013 Mann-Kendall trend results for uranium and molybdenum share few similarities to the 2018 trend results. During the 2013 review, some wells did not have 16 data points for all analytes. It is possible performing the trend analysis on more data points has resulted in the shift in trends that we see between the 2013 and 2018. A comparison between the 2013 and 2018 trend results is shown in Table 1 below. Wells that exhibited the same trend for uranium during the 2013 and 2018 review include MW-1, MW-3, MW-6, VMW-03, and VMW-04. The number of wells that exhibit the same trend for molybdenum is fewer than uranium and include MW-3 and VMW-04. This is most likely due to the more recent source removal of molybdenum relative to uranium.

Other Contaminants

Copper and zinc have not been detected in exceedance of the groundwater standards, of 1 mg/l and 5 mg/l respectively, during the review period of March 2007 through March 2018. Manganese continues to be detected above the groundwater standard of 0.05 mg/l in wells MW-1 and MW-3. Well MW-1 exceeded the manganese standard 16 of 16 times and well MW-3 exceeded the standard 15 of 16 times during the review period. Nitrate continues to be detected above the groundwater standard of 10 mg/l in several wells on Site. However, due to potential sources of nitrate in the environment (i.e. fertilizer, leaking sewer lines, and septic tanks), the difficulty of collecting necessary sample volumes, and the variability in data, it is recommended that sampling for nitrate be discontinued.

OU 3 Wells

During the March 2018 sampling event the OU 3 wells were sampled and analyzed for the same parameter list as the Shattuck wells. The results of the sampling event can be found in Tables 2-7. Groundwater standards for gross alpha, manganese, and uranium were exceeded during the most recent sampling event. Wells GW-4 and GW-5 are the only two wells with detections of uranium of above groundwater standards. Historic data for a number of wells in OU3 contains data that was qualified as "U" by the laboratory. U qualified data indicates that the compound was no detected above the Method Detection Limit. Due to these data gaps trend analysis was not performed on the OU3 wells. Additional data collection is recommended in order to perform trend analyzes in the future. The groundwater in the area is not used as a drinking water source and controls have been placed with the state engineer's office at the Department of Natural Resources to prevent and notify people attempting to do

Tables

Table 1 - Summary of Uranium/Molybdenum Trends

	2013	2018	2013	2018
	Uranium	Uranium	Molybdenum	Molybdenum
APM-3	Decreasing	Stable/No Trend	Decreasing	Stable/No Trend
APM-4	Stable/No Trend	Increasing	Stable/No Trend	Increasing
APM-6	Decreasing	Stable/No Trend	Decreasing	Decreasing
BH-3	Stable/No Trend	Increasing	Stable/No Trend	Decreasing
MW-1	Stable/No Trend	Stable/No Trend	Stable/No Trend	Decreasing
MW-3	Decreasing	Decreasing	Stable/No Trend	Stable/No Trend
MW-6	Stable/No Trend	Stable/No Trend	Decreasing	Stable/No Trend
S-1333-E		Stable/No Trend		Decreasing
SPR-1		Increasing		Decreasing
SPR-2		Increasing		Decreasing
VMW-03	Stable/No Trend	Stable/No Trend	Decreasing	Stable/No Trend
VMW-04	Stable/No Trend	Stable/No Trend	Stable/No Trend	Stable/No Trend
VMW-06	Increasing	Stable/No Trend	Stable/No Trend	Increasing

Table 2 Analytical History of Monitoring Well HSS-GW1																							
Well ID	Date Sampled	Gross Alpha-Total (pCi/L)		Error (+/-)	Uranium-234-Dissolved (pCi/L)		Error (+/-)	Uranium-238-Dissolved (pCi/L)		Error (+/-)	Copper-Dissolved (mg/L)		Manganese-Dissolved (mg/L)		Molybdenum-Dissolved (mg/L)		Uranium-Dissolved (mg/L)		Zinc-Dissolved (mg/L)		Nitrate as Nitrogen-Dissolved (mg/L)		Nitrate as NO3-Dissolved (mg/L)
Drinking Water MCL		15			27			27			1		0.05		0.1		0.03		5		10		45
HSS-GW1	7/15/2003	4	U		NA			NA			0.000627		1.33		0.0139		0.00137		0.00188		NA		NA
HSS-GW1	2/11/2004	3	U		NA			NA			0.000404		0.885		0.0171		0.001	U	0.000749		NA		NA
HSS-GW1	6/22/2006	2.9		2.9							0.01	U	1.09		0.01	U	0.0007		0.01	U	NA		NA
HSS-GW1	3/8/2018	2.3		2.5	1.3		0.91	1.08		0.91	0.0004	U	0.615		0.0056		0.0003	B	0.002	B	0.11		NA

Table 3																			
Analytical History of Monitoring Well HSS-MW4																			
Well ID	Date Sampled	Gross Alpha-Total (pCi/L)	Error (+/-)	Uranium-234-Dissolved (pCi/L)	Error (+/-)	Uranium-238-Dissolved (pCi/L)	Error (+/-)	Copper-Dissolved (mg/L)		Manganese-Dissolved (mg/L)		Molybdenum-Dissolved (mg/L)		Uranium-Dissolved (mg/L)		Zinc-Dissolved (mg/L)		Nitrate as Nitrogen-Dissolved (mg/L)	Nitrate as NO3-Dissolved (mg/L)
Drinking Water MCL		15		27		27		1		0.05		0.1		0.03		5		10	45
HSS-MW4	12/6/2001	297	45	NA		NA		0.01	U	2.5		0.015		0.0000334		0.02	U	NA	NA
HSS-MW4	7/15/2003	4	U	NA		NA		0.000695		2.06		0.0104		0.0000012		0.00213		NA	NA
HSS-MW4	2/11/2004	4	U	NA		NA		0.000518		2.34		0.0188		0.001	U	0.000612		NA	NA
HSS-MW4	6/22/2006	1.1	3.1	NA		NA		0.01	U	2.28		0.01	U	0.0008		0.01	U	NA	NA
HSS-MW4	3/8/2018	4.1	3.1	-0.79	1.2	-0.19	1.2	0.0004	U	1.06		0.0118		0.0004	B	0.002	U	NA	NA

Table 4 Analytical History of Monitoring Well GW-3																					
Well ID	Date Sampled	Gross Alpha-Total (pCi/L)	Error (+/-)	Uranium-234-Dissolved (pCi/L)	Error (+/-)	Uranium-238-Dissolved (pCi/L)	Error (+/-)	Copper-Dissolved (mg/L)		Manganese-Dissolved (mg/L)		Molybdenum-Dissolved (mg/L)		Uranium-Dissolved (mg/L)		Zinc-Dissolved (mg/L)		Nitrate as Nitrogen-Dissolved (mg/L)		Nitrate as NO3-Dissolved (mg/L)	
Drinking Water MCL		15		27		27		1		0.05		0.1		0.03		5		10		45	
GW-3	7/16/2003	7	U	NA		NA		0.000501		3.21		0.00089		0.001	U	0.00131		NA		NA	
GW-3	2/10/2004	5	U	NA		NA		0.0001	U	3.4		0.000639		0.001	U	0.00109		NA		NA	
GW-3	6/22/2006	12	5.7	NA		NA		0.01	U	2.87		0.01	U	0.0015		0.01	U	NA		NA	
GW-3	3/8/2018	21	8.2	7.4	3.1	2.72	3.1	0.0005	B	2.89		0.0008	B	0.003		0.04	U	NA		NA	

Table 5 Analytical History of Monitoring Well GW-4																			
Well ID	Date Sampled	Gross Alpha-Total (pCi/L)	Error (+/-)	Uranium-234-Dissolved (pCi/L)	Error (+/-)	Uranium-238-Dissolved (pCi/L)	Error (+/-)	Copper-Dissolved (mg/L)		Manganese-Dissolved (mg/L)		Molybdenum-Dissolved (mg/L)		Uranium-Dissolved (mg/L)		Zinc-Dissolved (mg/L)		Nitrate as Nitrogen-Dissolved (mg/L)	Nitrate as NO3-Dissolved (mg/L)
Drinking Water MCL		15		27		27		1		0.05		0.1		0.03		5		10	45
GW-4	7/16/2003	17	7	NA		NA		0.00176		0.0126		0.0017		0.036		0.0015		NA	NA
GW-4	2/10/2004	7	4	NA		NA		0.000457		0.000817		0.00763		0.0204		0.000614		NA	NA
GW-4	6/22/2006	17	6.3	NA		NA		0.01	U	0.005	U	0.01	U	0.0353		0.0353		NA	NA
GW-4	3/8/2018	16	5.9	12	2.7	13.2	2.9	0.0009	B	0.0004	U	0.0029	B	0.0319		0.002	U	NA	NA

Table 6 Analytical History of Monitoring Well GW-5																							
Well ID	Date Sampled	Gross Alpha-Total (pCi/L)	Error (+/-)	Uranium-234-Dissolved (pCi/L)	Error (+/-)	Uranium-238-Dissolved (pCi/L)	Error (+/-)	Copper-Dissolved (mg/L)		Manganese-Dissolved (mg/L)		Molybdenum-Dissolved (mg/L)		Uranium-Dissolved (mg/L)		Zinc-Dissolved (mg/L)		Nitrate as Nitrogen-Dissolved (mg/L)		Nitrate as NO3-Dissolved (mg/L)	
Drinking Water MCL		15		27		27		1		0.05		0.1		0.03		5		10		45	
GW-5	7/16/2003	42	12	NA		NA		0.00276		0.777		0.0388		0.084		0.00514		NA		NA	
GW-5	2/10/2004	26	8	NA		NA		0.00117		0.749		0.0252		0.0477		0.00117		NA		NA	
GW-5	6/22/2006	33	8.7	NA		NA		0.01	U	0.972		0.03	B	0.0742		0.01	U	NA		NA	
GW-5	6/8/2018	22	6.9	19	3	13.5	2.7	0.0012	B	0.200		0.007		0.0433		0.002	U	NA		NA	

Table 7 Analytical History of Monitoring Well GW-6																					
Well ID	Date Sampled	Gross Alpha-Total (pCi/L)	Error (+/-)	Uranium-234-Dissolved (pCi/L)	Error (+/-)	Uranium-238-Dissolved (pCi/L)	Error (+/-)	Copper-Dissolved (mg/L)		Manganese-Dissolved (mg/L)		Molybdenum-Dissolved (mg/L)		Uranium-Dissolved (mg/L)		Zinc-Dissolved (mg/L)		Nitrate as Nitrogen-Dissolved (mg/L)		Nitrate as NO3-Dissolved (mg/L)	
Drinking Water MCL		15		27		27		1		0.05		0.1		0.03		5		10		45	
GW-6	7/16/2003	5	4	NA		NA		0.0078		0.785		0.0444		0.012		0.00397		NA		NA	
GW-6	2/11/2004	9	5	NA		NA		0.00772		1.41		0.0248		0.019		0.00181		NA		NA	
GW-6	6/22/2006	3.7	2.6	NA		NA		0.01	B	0.541		0.02	B	0.007		0.01	U	NA		NA	
GW-6	3/8/2018	14	4.7	8.7	2.2	4.1	1.5	0.0041		0.640		0.0228		0.0114		0.002	U	NA		NA	

Figures

Figure 1a
Shattuck Denver Radium OU8
Ground Water Well Location Map

Legend

- Surface Water Storm Outfall Locations
- Ground Water Well
- Shattuck Site Boundary

N

0 550 1,100 2,200 3,300 4,400 Feet

Figure 1

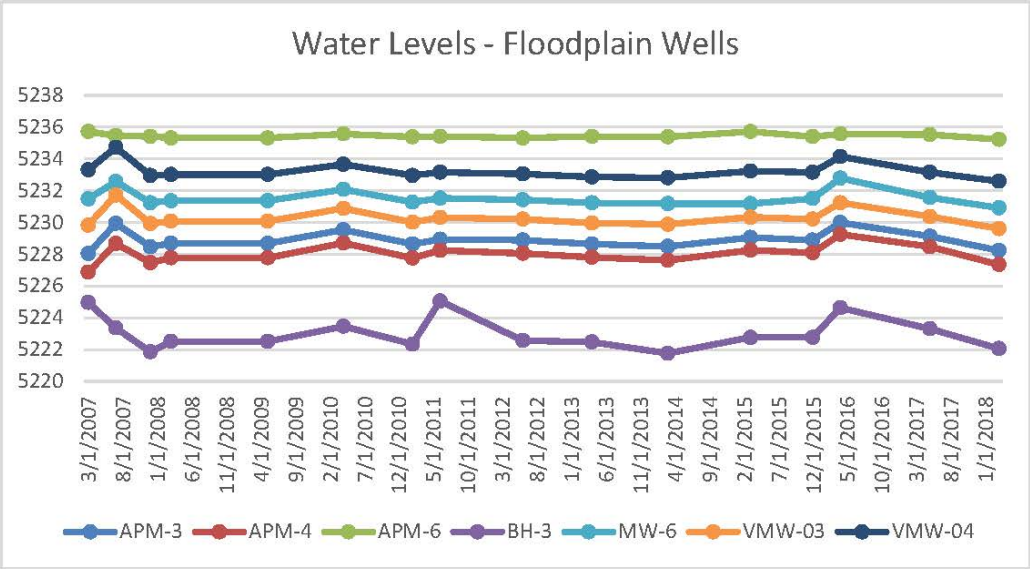
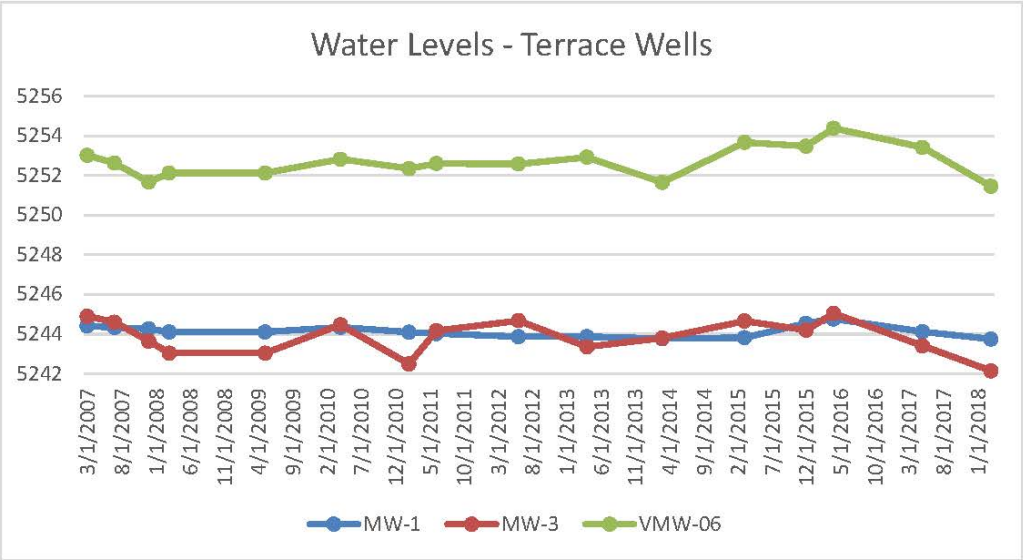
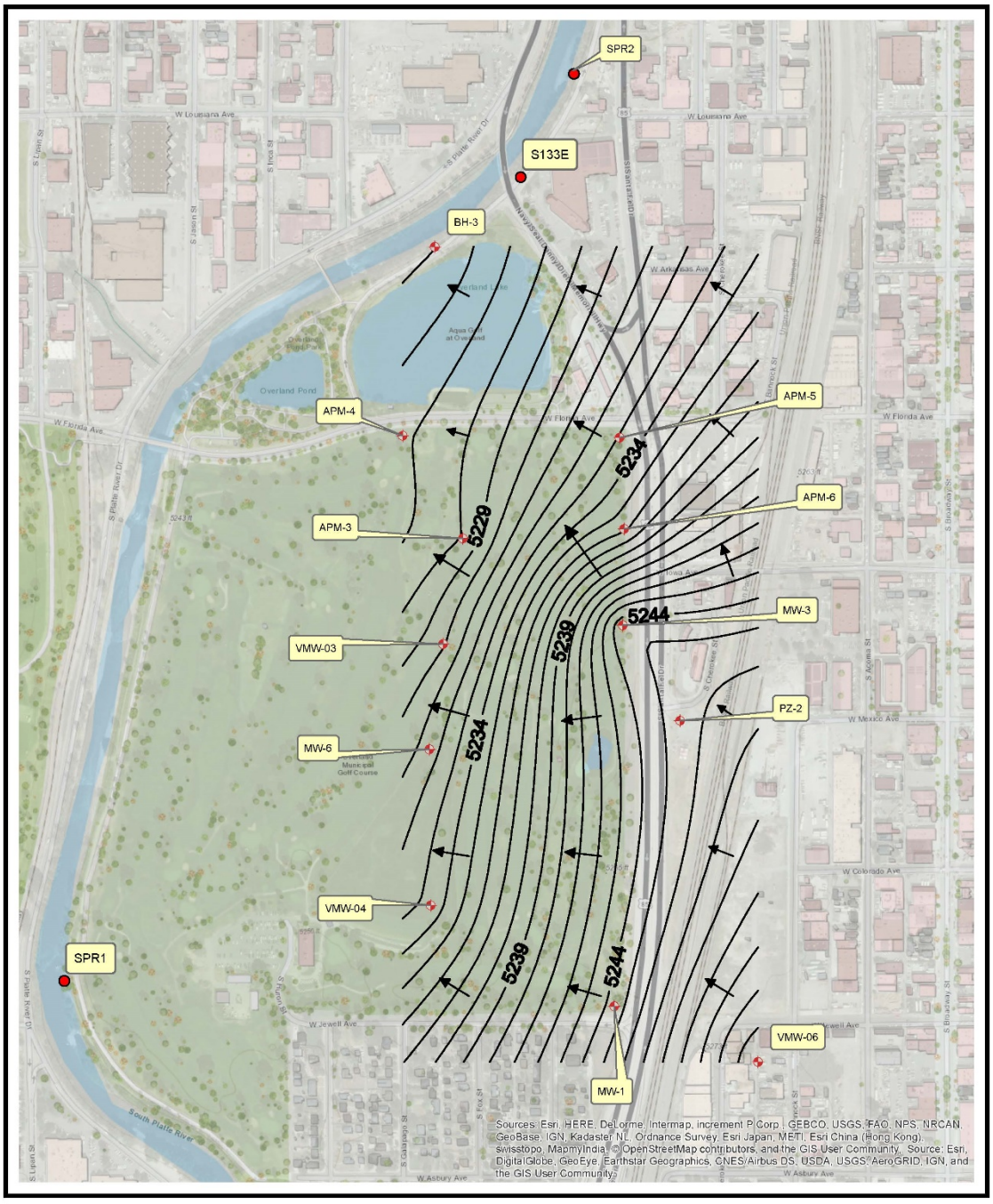

Water Levels - Floodplain Wells
5238
5236
5234
5232
5230
5228
5226
5224
5222
5220
3/1/2007
8/1/2007
1/1/2008
6/1/2008
11/1/2008
4/1/2009
9/1/2009
2/1/2010
7/1/2010
12/1/2010
5/1/2011
10/1/2011
3/1/2012
8/1/2012
1/1/2013
6/1/2013
11/1/2013
4/1/2014
9/1/2014
2/1/2015
7/1/2015
12/1/2015
5/1/2016
10/1/2016
3/1/2017
8/1/2017
1/1/2018
APM-3
APM-4
APM-6
BH-3
MW-6
VMW-03
VMW-04

Figure 2


Water Levels - Terrace Wells
5256
5254
5252
5250
5248
5246
5244
5242
3/1/2007
8/1/2007
1/1/2008
6/1/2008
11/1/2008
4/1/2009
9/1/2009
2/1/2010
7/1/2010
12/1/2010
5/1/2011
10/1/2011
3/1/2012
8/1/2012
1/1/2013
6/1/2013
11/1/2013
4/1/2014
9/1/2014
2/1/2015
7/1/2015
12/1/2015
5/1/2016
10/1/2016
3/1/2017
8/1/2017
1/1/2018
MW-1
MW-3
VMW-06

Denver Radium - Shattuck



Legend

- Surface Water Storm Outfall Locations
- ShattuckWells
- Countours

0 0.04 0.08 0.16 0.24 0.32 Miles

N W E S

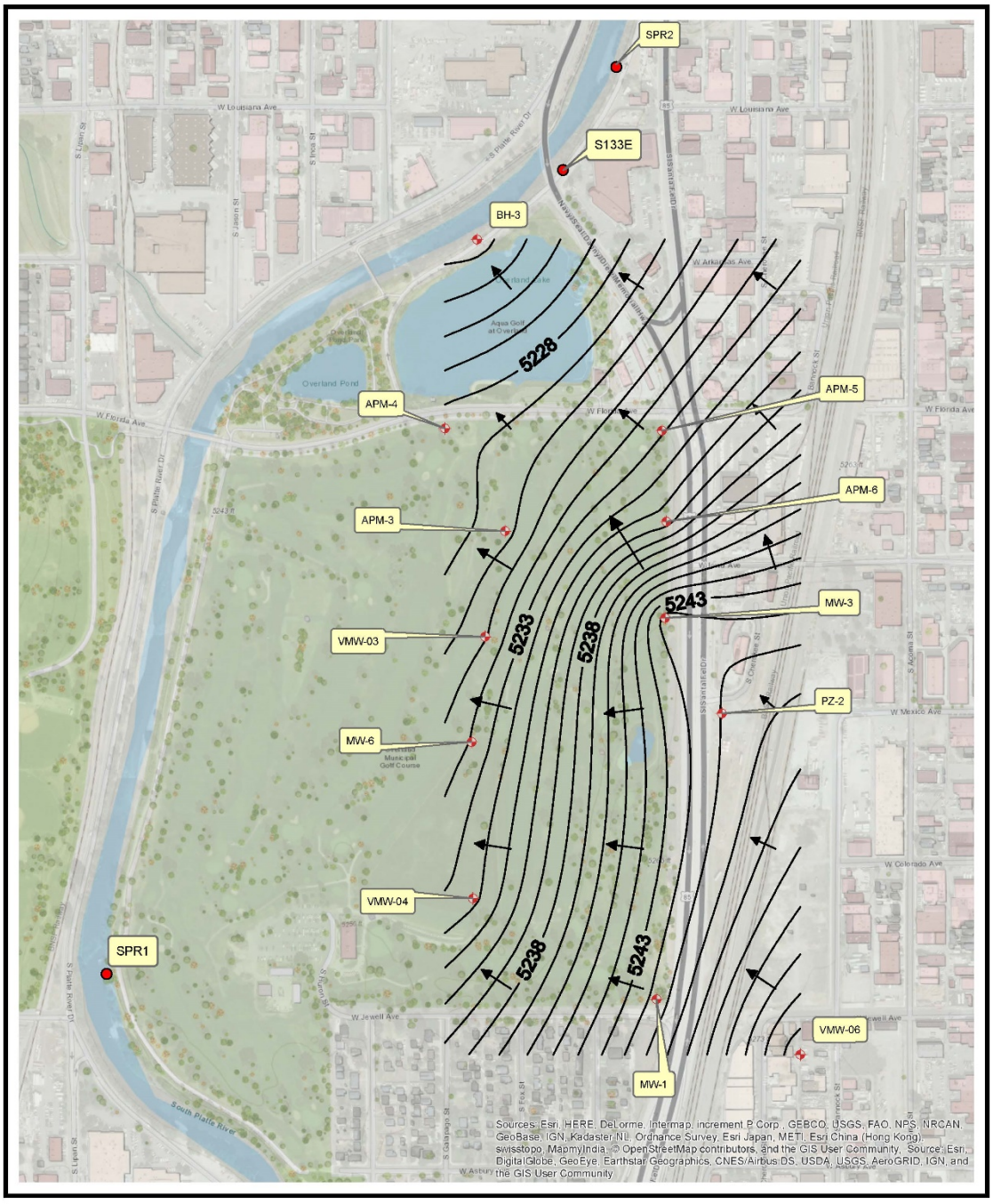
COLORADO
Department of Public Health & Environment

3/27/2007 Groundwater Contour Map
Denver Radium - Shattuck
Figure 3

Denver, Colorado

By: Kyle S. Sandor Date: 5/31/2018

Denver Radium - Shattuck

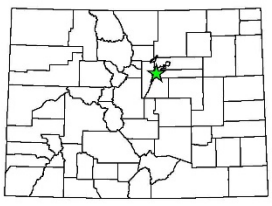


Legend

- Surface Water Storm Outfall Locations
- ShattuckWe...
- Contours

0 0.04 0.08 0.16 0.24 0.32 Miles

N
W E
S



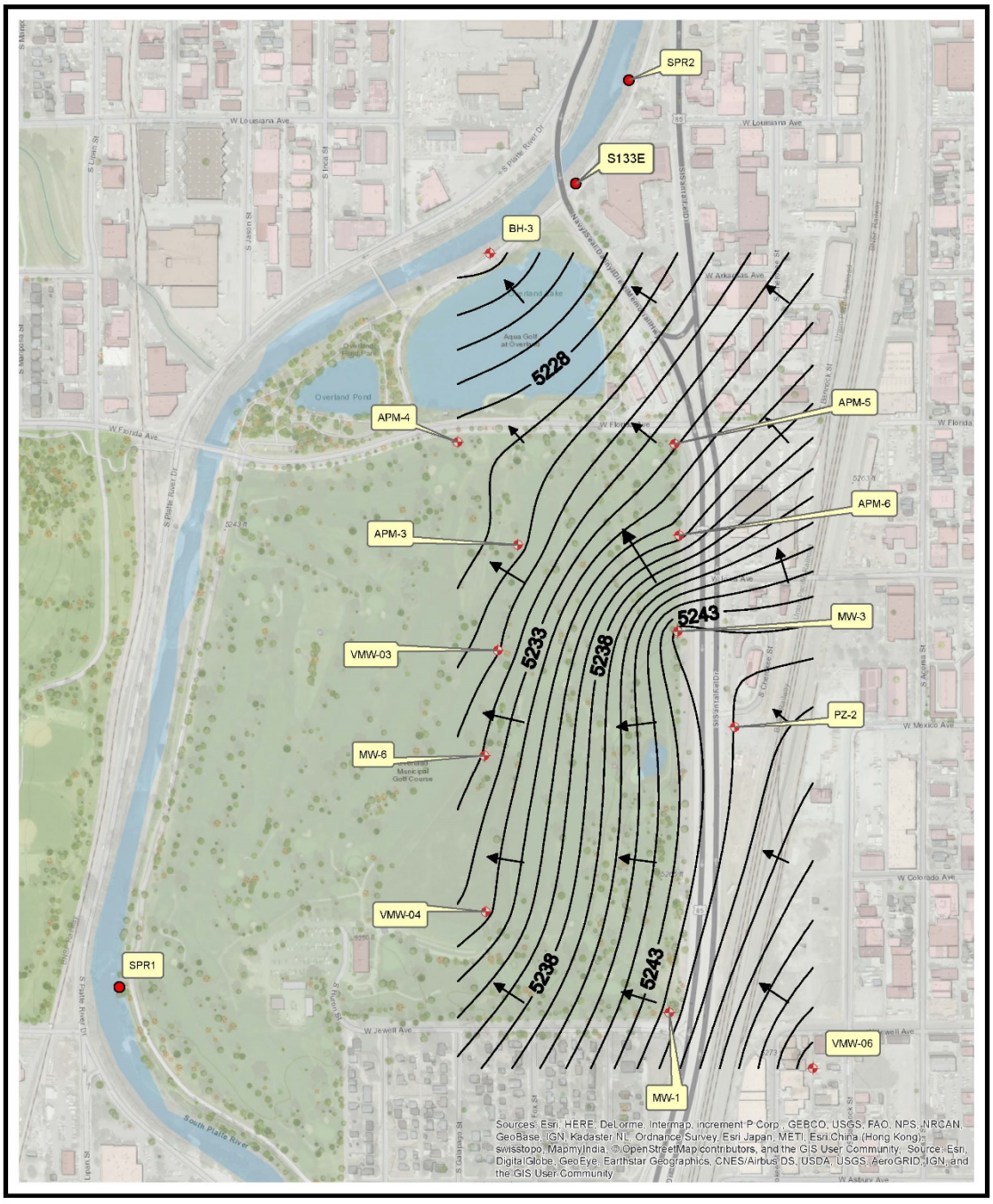
COLORADO
Department of Public Health & Environment

4/20/2010 Groundwater Contour Map
Denver Radium - Shattuck
Figure 4

Denver, Colorado

By: Kyle S. Sandor Date: 5/31/2018

Denver Radium - Shattuck



Legend

- Surface Water Storm Outfall Locations
- ShattuckWe...
- Contours

0 0.04 0.08 0.16 0.24 0.32 Miles

N W E S

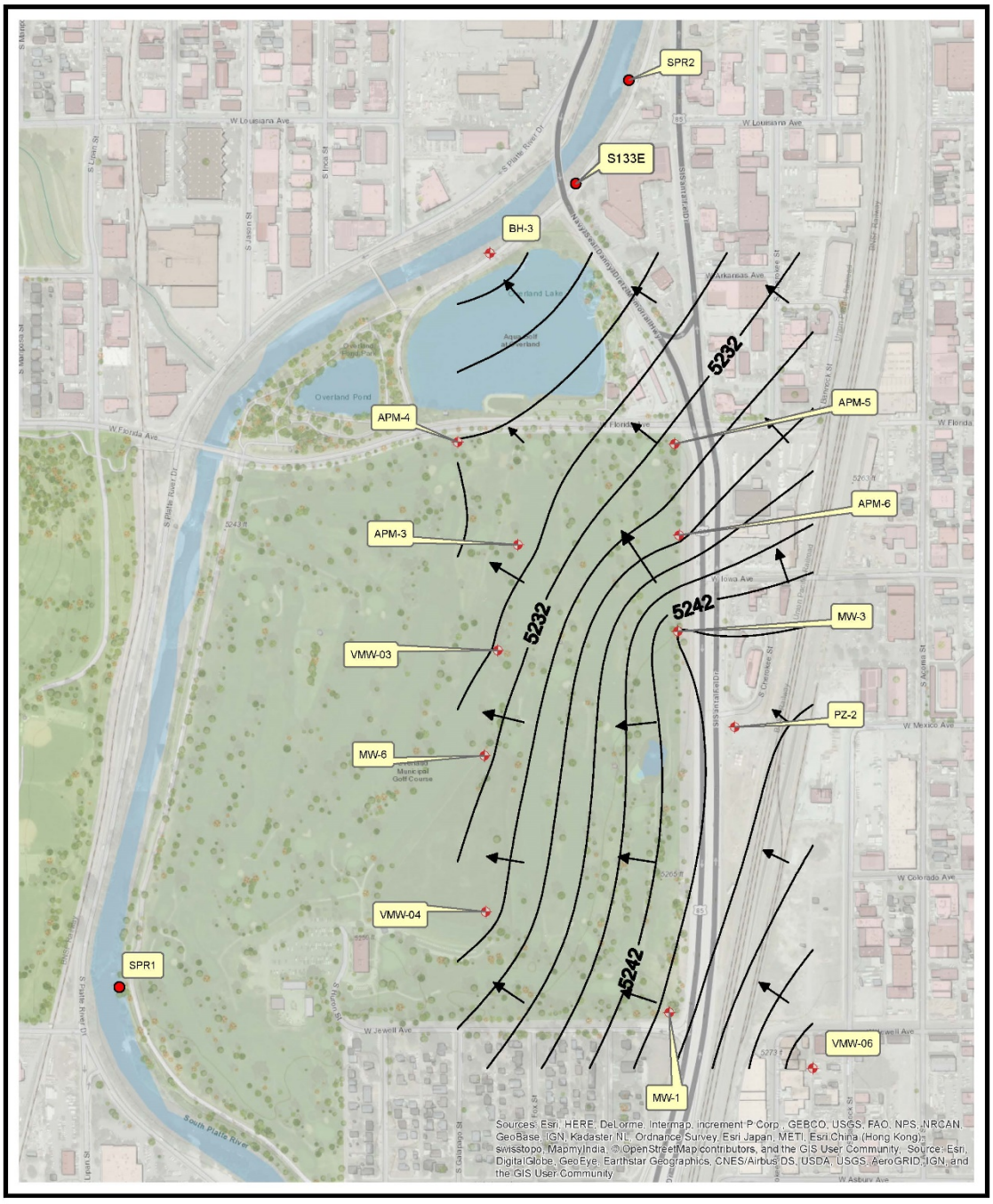
COLORADO
Department of Public Health & Environment

3/3/2014 Groundwater Contour Map
Denver Radium - Shattuck
Figure 5

Denver, Colorado

By: Kyle S. Sandor Date: 5/31/2018

Denver Radium - Shattuck



Legend

- Surface Water Storm Outfall Locations
- ShattuckWe...
- Contours

0 0.04 0.08 0.16 0.24 0.32 Miles

N W E S

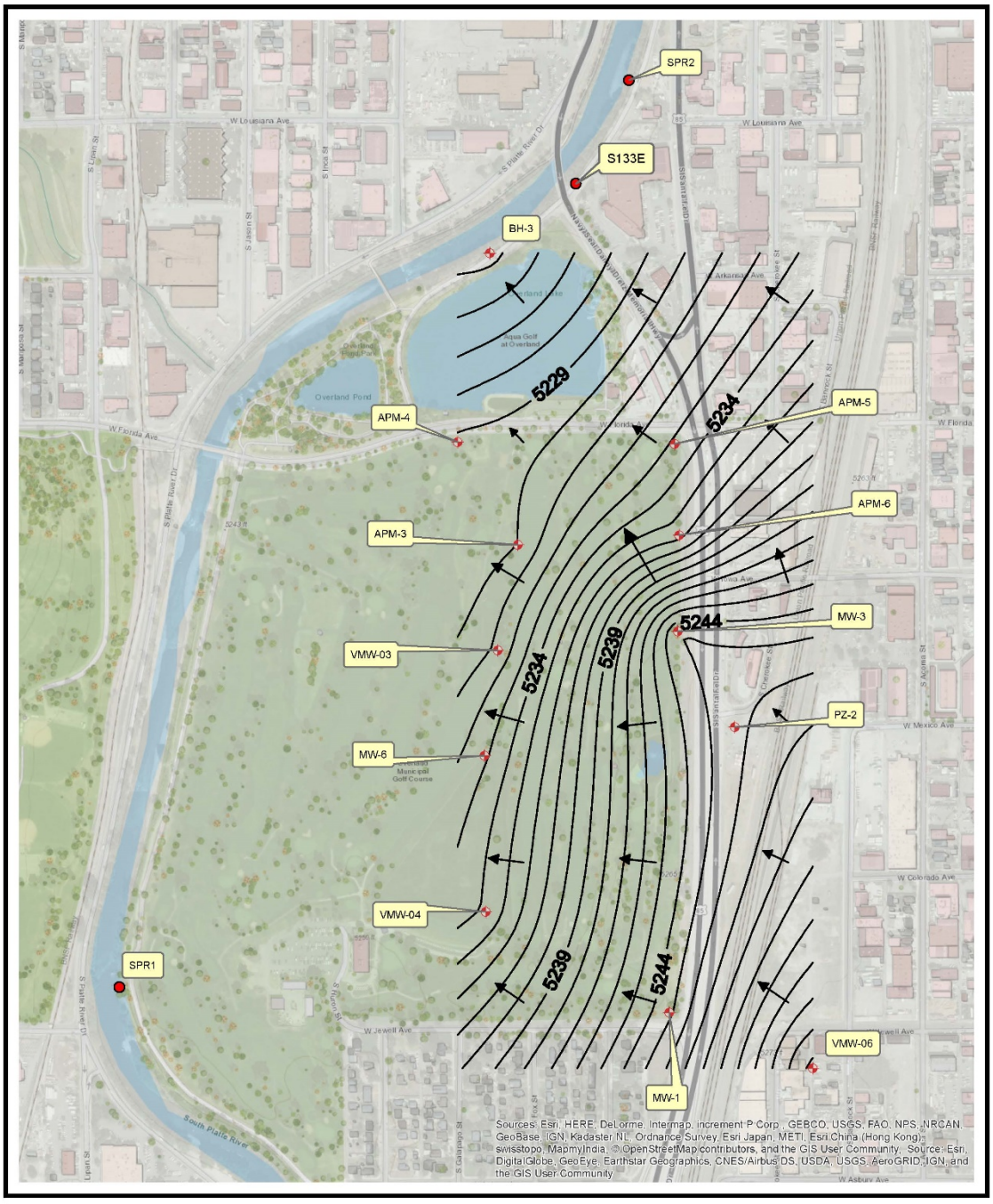
COLORADO
Department of Public Health & Environment

12/21/2015 Groundwater Contour Map
Denver Radium - Shattuck
Figure 6

Denver, Colorado

By: Kyle S. Sandor Date: 5/31/2018

Denver Radium - Shattuck



Legend

- Surface Water Storm Outfall Locations
- ShattuckWells
- Contours

0 0.04 0.08 0.16 0.24 0.32 Miles

N W E S

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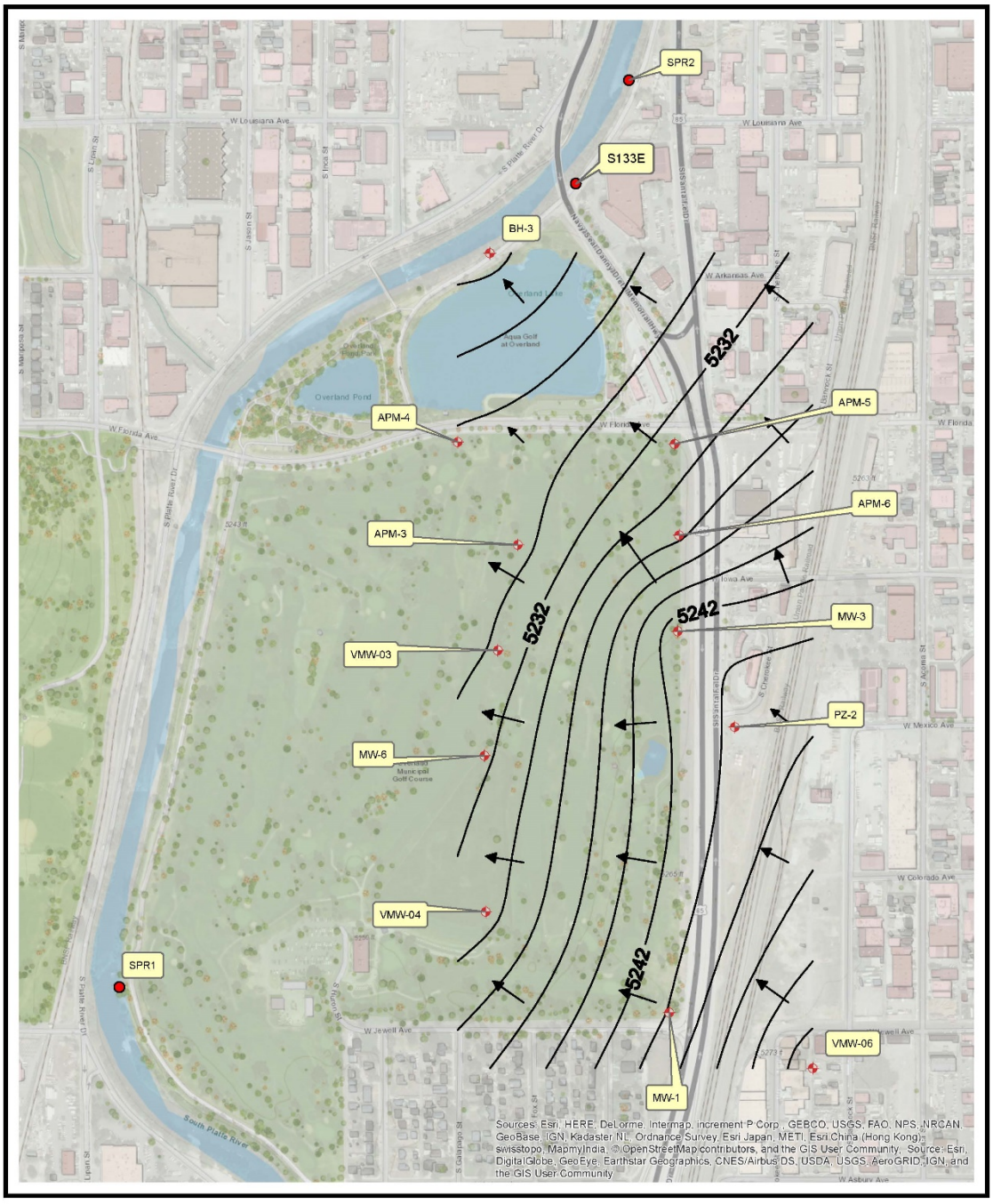
4/21/2016 Groundwater Contour Map
Denver Radium - Shattuck
Figure 7

Denver, Colorado

By: Kyle S. Sandor Date: 5/31/2018

Denver Radium - Shattuck



Legend

- Surface Water Storm Outfall Locations
- ShattuckWells
- Contours

0 0.04 0.08 0.16 0.24 0.32 Miles

N W E S

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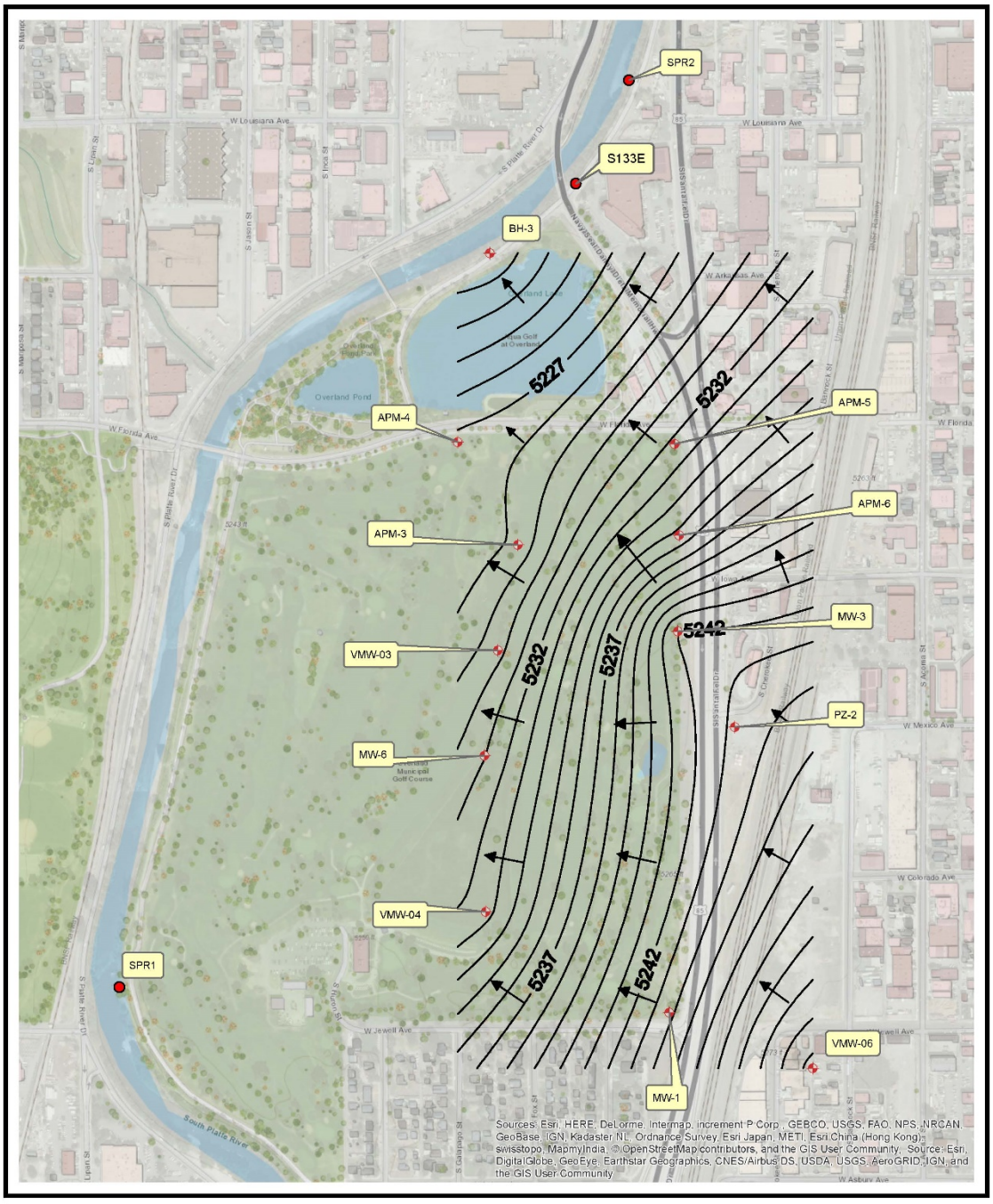
Department of Public Health & Environment

5/11/2017 Groundwater Contour Map
Denver Radium - Shattuck
Figure 8

Denver, Colorado

By: Kyle S. Sandor Date: 5/31/2018

Denver Radium - Shattuck



Legend

- Surface Water Storm Outfall Locations
- ShattuckWells
- Contours

0 0.04 0.08 0.16 0.24 0.32 Miles

N W E S

COLORADO
Department of Public Health & Environment

3/7/2018 Groundwater Contour Map
Denver Radium - Shattuck
Figure 9

Denver, Colorado

By: Kyle S. Sandor Date: 5/31/2018

Figure 10

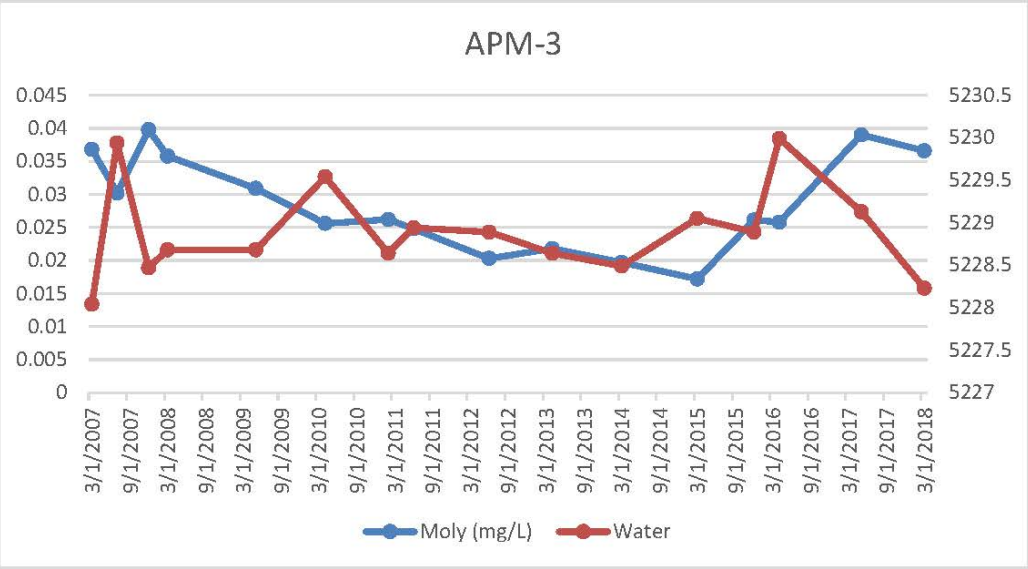

APM-3
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
5230.5
5230
5229.5
5229
5228.5
5228
5227.5
5227
3/1/2007
9/1/2007
3/1/2008
9/1/2008
3/1/2009
9/1/2009
3/1/2010
9/1/2010
3/1/2011
9/1/2011
3/1/2012
9/1/2012
3/1/2013
9/1/2013
3/1/2014
9/1/2014
3/1/2015
9/1/2015
3/1/2016
9/1/2016
3/1/2017
9/1/2017
3/1/2018
Moly (mg/L)
Water

Figure 11

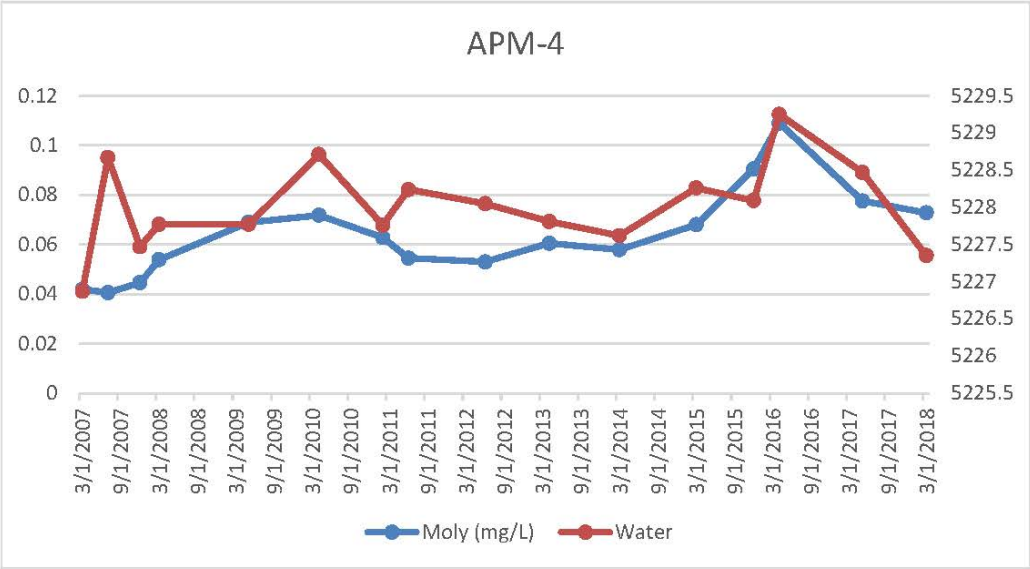

APM-4
0.12
0.1
0.08
0.06
0.04
0.02
0
5229.5
5229
5228.5
5228
5227.5
5227
5226.5
5226
5225.5
3/1/2007
9/1/2007
3/1/2008
9/1/2008
3/1/2009
9/1/2009
3/1/2010
9/1/2010
3/1/2011
9/1/2011
3/1/2012
9/1/2012
3/1/2013
9/1/2013
3/1/2014
9/1/2014
3/1/2015
9/1/2015
3/1/2016
9/1/2016
3/1/2017
9/1/2017
3/1/2018
Moly (mg/L)
Water

Figure 12

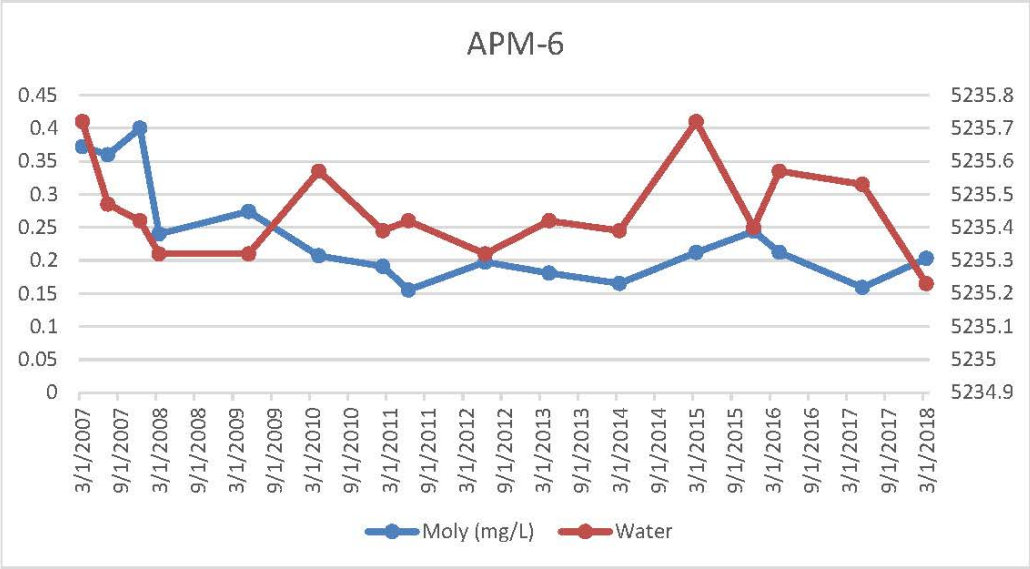

APM-6
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
5235.8
5235.7
5235.6
5235.5
5235.4
5235.3
5235.2
5235.1
5235
5234.9
3/1/2007
9/1/2007
3/1/2008
9/1/2008
3/1/2009
9/1/2009
3/1/2010
9/1/2010
3/1/2011
9/1/2011
3/1/2012
9/1/2012
3/1/2013
9/1/2013
3/1/2014
9/1/2014
3/1/2015
9/1/2015
3/1/2016
9/1/2016
3/1/2017
9/1/2017
3/1/2018
Moly (mg/L)
Water

Figure 13

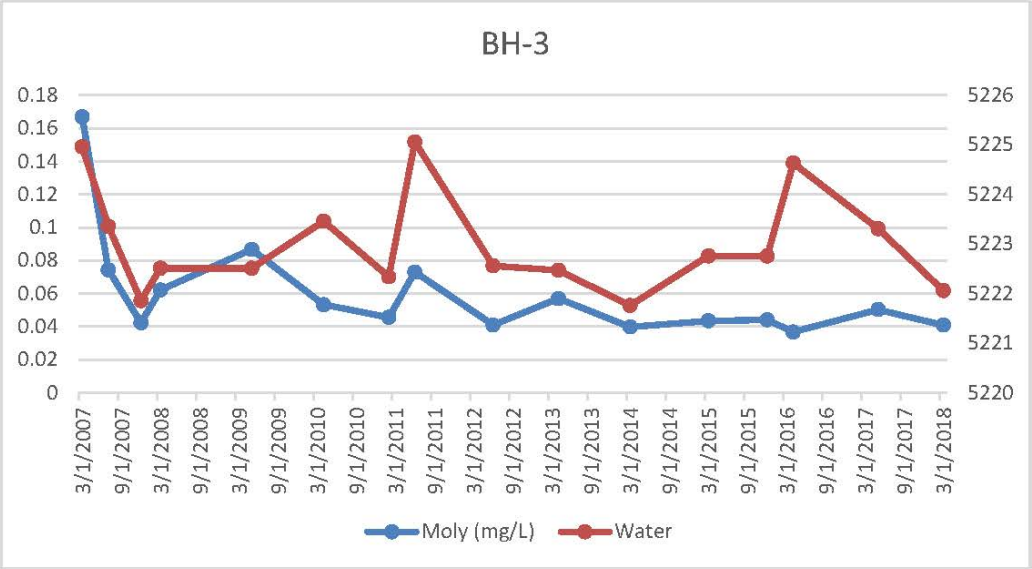

BH-3
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
5226
5225
5224
5223
5222
5221
5220
3/1/2007
9/1/2007
3/1/2008
9/1/2008
3/1/2009
9/1/2009
3/1/2010
9/1/2010
3/1/2011
9/1/2011
3/1/2012
9/1/2012
3/1/2013
9/1/2013
3/1/2014
9/1/2014
3/1/2015
9/1/2015
3/1/2016
9/1/2016
3/1/2017
9/1/2017
3/1/2018
Moly (mg/L)
Water

Figure 14

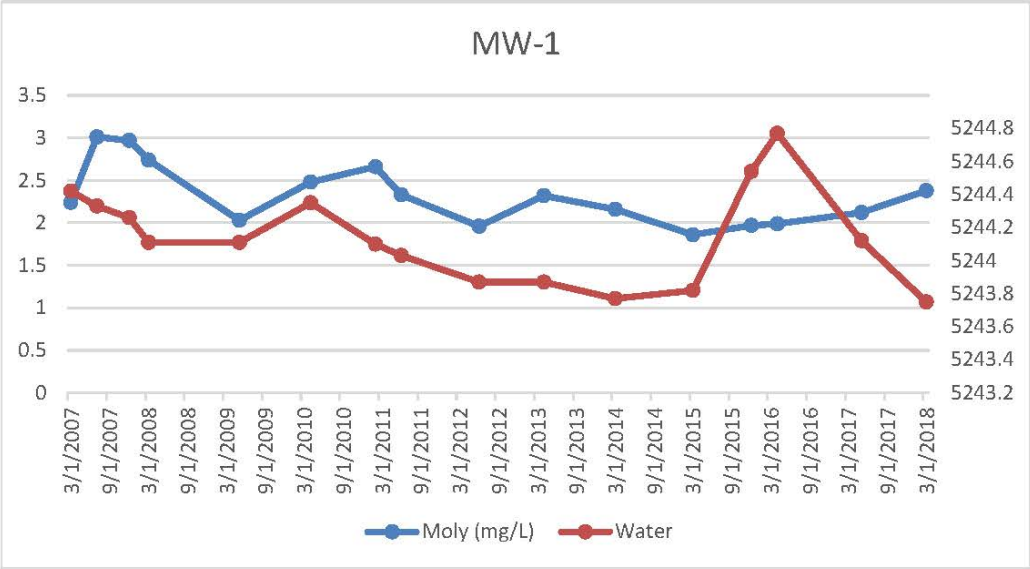

MW-1
3.5
3
2.5
2
1.5
1
0.5
0
5244.8
5244.6
5244.4
5244.2
5244
5243.8
5243.6
5243.4
5243.2
3/1/2007
9/1/2007
3/1/2008
9/1/2008
3/1/2009
9/1/2009
3/1/2010
9/1/2010
3/1/2011
9/1/2011
3/1/2012
9/1/2012
3/1/2013
9/1/2013
3/1/2014
9/1/2014
3/1/2015
9/1/2015
3/1/2016
9/1/2016
3/1/2017
9/1/2017
3/1/2018
Moly (mg/L)
Water

Figure 15

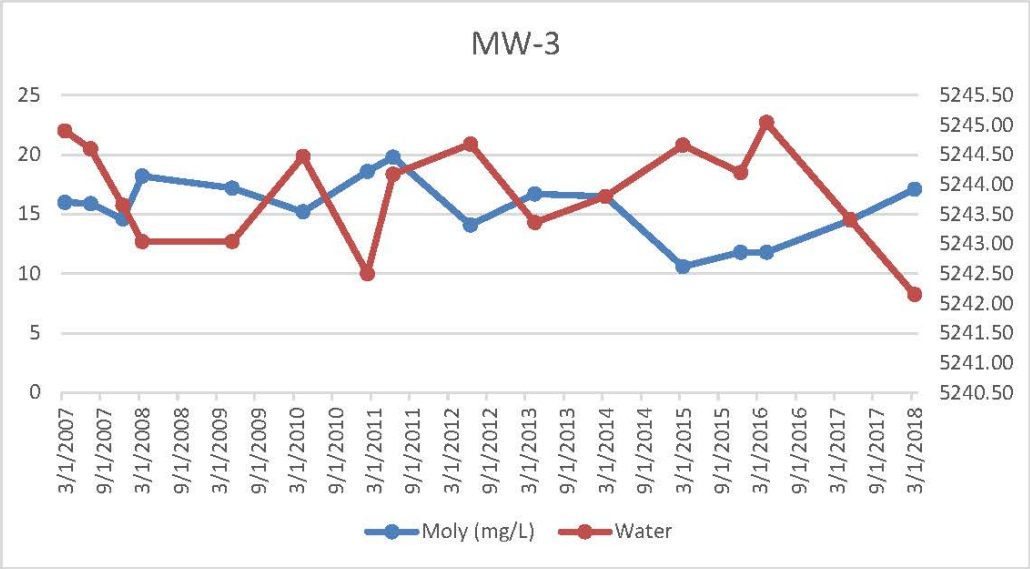

MW-3
25
20
15
10
5
0
5245.50
5245.00
5244.50
5244.00
5243.50
5243.00
5242.50
5242.00
5241.50
5241.00
5240.50
3/1/2007
9/1/2007
3/1/2008
9/1/2008
3/1/2009
9/1/2009
3/1/2010
9/1/2010
3/1/2011
9/1/2011
3/1/2012
9/1/2012
3/1/2013
9/1/2013
3/1/2014
9/1/2014
3/1/2015
9/1/2015
3/1/2016
9/1/2016
3/1/2017
9/1/2017
3/1/2018
Moly (mg/L)
Water

Figure 16

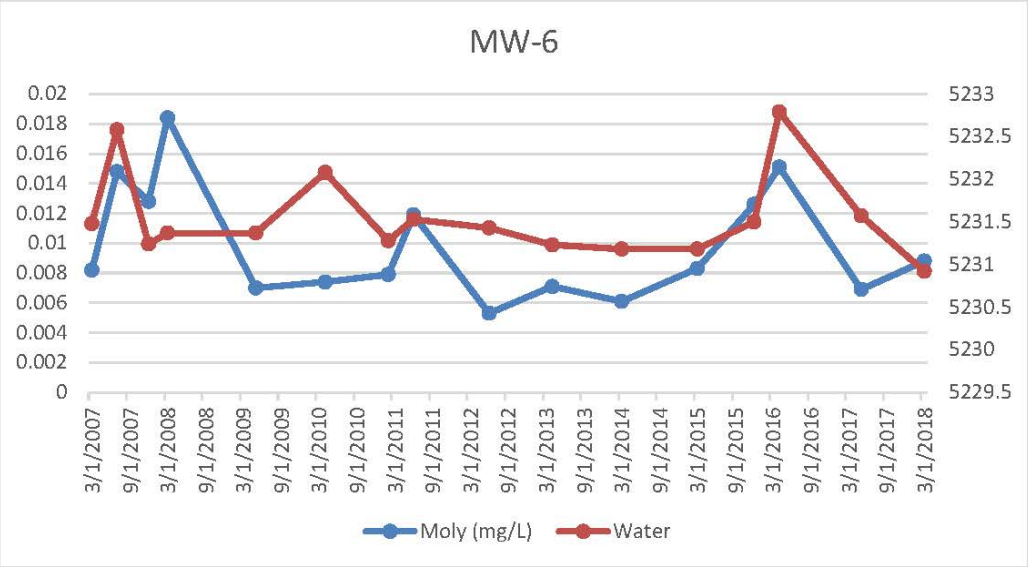

MW-6
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
5233
5232.5
5232
5231.5
5231
5230.5
5230
5229.5
3/1/2007
9/1/2007
3/1/2008
9/1/2008
3/1/2009
9/1/2009
3/1/2010
9/1/2010
3/1/2011
9/1/2011
3/1/2012
9/1/2012
3/1/2013
9/1/2013
3/1/2014
9/1/2014
3/1/2015
9/1/2015
3/1/2016
9/1/2016
3/1/2017
9/1/2017
3/1/2018
Moly (mg/L)
Water

Figure 17

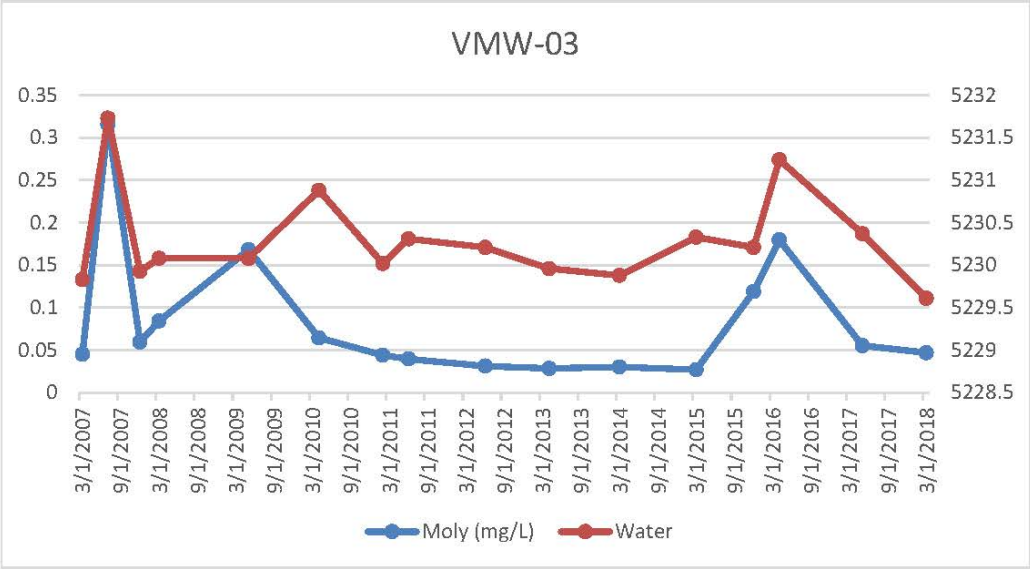

VMW-03
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
5232
5231.5
5231
5230.5
5230
5229.5
5229
5228.5
3/1/2007
9/1/2007
3/1/2008
9/1/2008
3/1/2009
9/1/2009
3/1/2010
9/1/2010
3/1/2011
9/1/2011
3/1/2012
9/1/2012
3/1/2013
9/1/2013
3/1/2014
9/1/2014
3/1/2015
9/1/2015
3/1/2016
9/1/2016
3/1/2017
9/1/2017
3/1/2018
Moly (mg/L)
Water

Figure 18

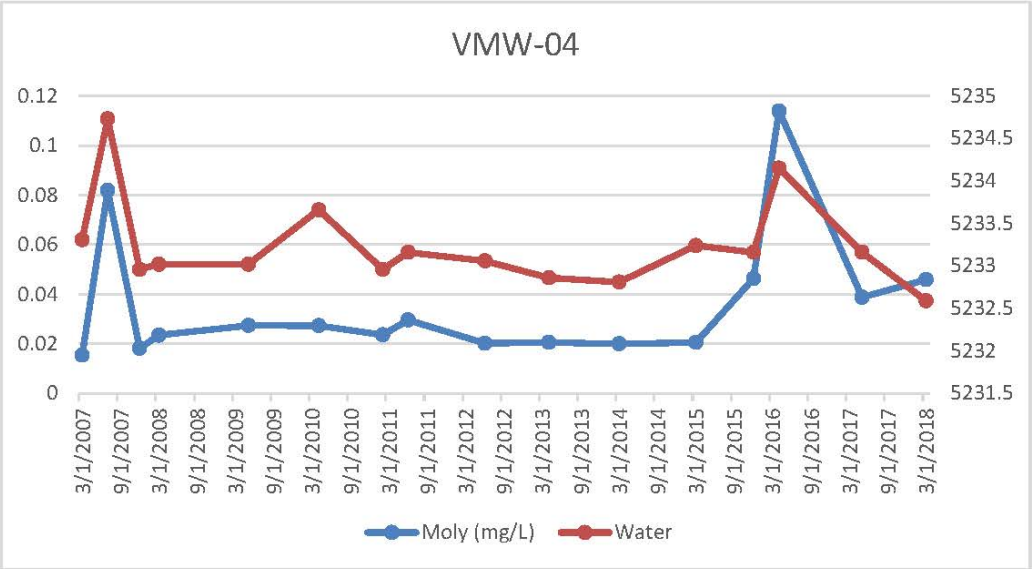

VMW-04
0.12
0.1
0.08
0.06
0.04
0.02
0
5235
5234.5
5234
5233.5
5233
5232.5
5232
5231.5
3/1/2007
9/1/2007
3/1/2008
9/1/2008
3/1/2009
9/1/2009
3/1/2010
9/1/2010
3/1/2011
9/1/2011
3/1/2012
9/1/2012
3/1/2013
9/1/2013
3/1/2014
9/1/2014
3/1/2015
9/1/2015
3/1/2016
9/1/2016
3/1/2017
9/1/2017
3/1/2018
Moly (mg/L)
Water

Figure 19

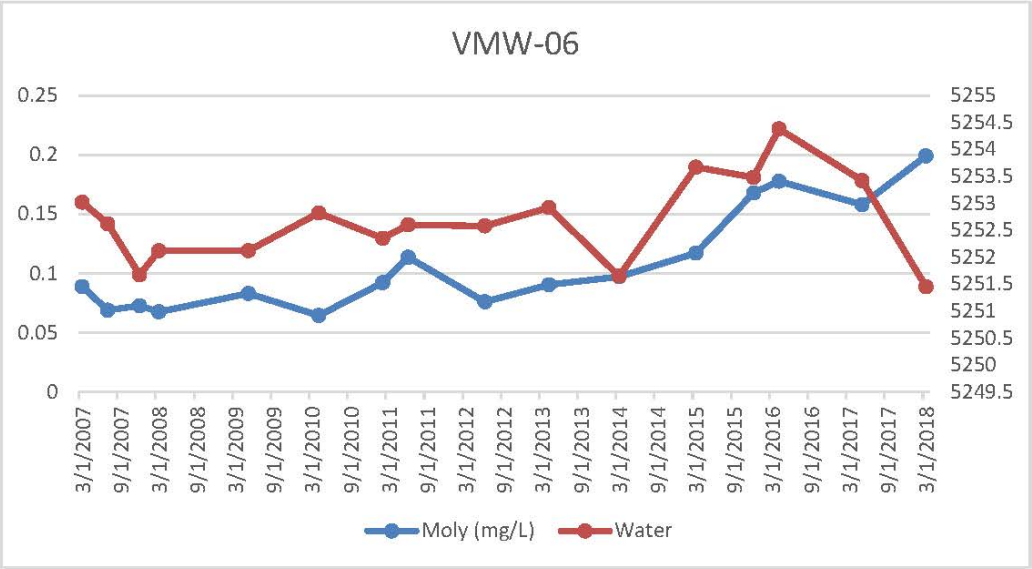

VMW-06
0.25
0.2
0.15
0.1
0.05
0
5255
5254.5
5254
5253.5
5253
5252.5
5252
5251.5
5251
5250.5
5250
5249.5
3/1/2007
9/1/2007
3/1/2008
9/1/2008
3/1/2009
9/1/2009
3/1/2010
9/1/2010
3/1/2011
9/1/2011
3/1/2012
9/1/2012
3/1/2013
9/1/2013
3/1/2014
9/1/2014
3/1/2015
9/1/2015
3/1/2016
9/1/2016
3/1/2017
9/1/2017
3/1/2018
Moly (mg/L)
Water

Figure 20

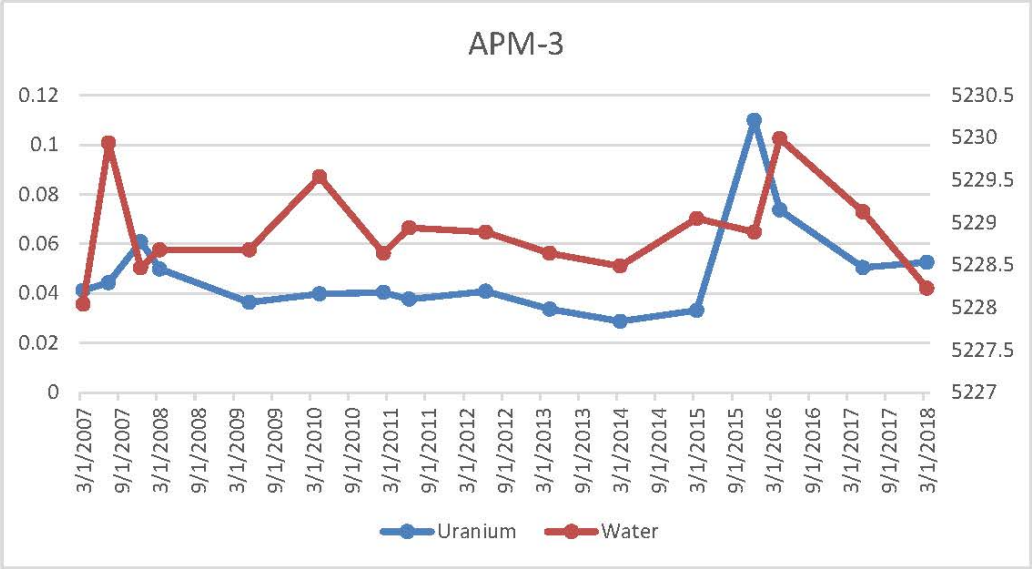

APM-3
0.12
0.1
0.08
0.06
0.04
0.02
0
5230.5
5230
5229.5
5229
5228.5
5228
5227.5
5227
3/1/2007
9/1/2007
3/1/2008
9/1/2008
3/1/2009
9/1/2009
3/1/2010
9/1/2010
3/1/2011
9/1/2011
3/1/2012
9/1/2012
3/1/2013
9/1/2013
3/1/2014
9/1/2014
3/1/2015
9/1/2015
3/1/2016
9/1/2016
3/1/2017
9/1/2017
3/1/2018
Uranium
Water

Figure 21

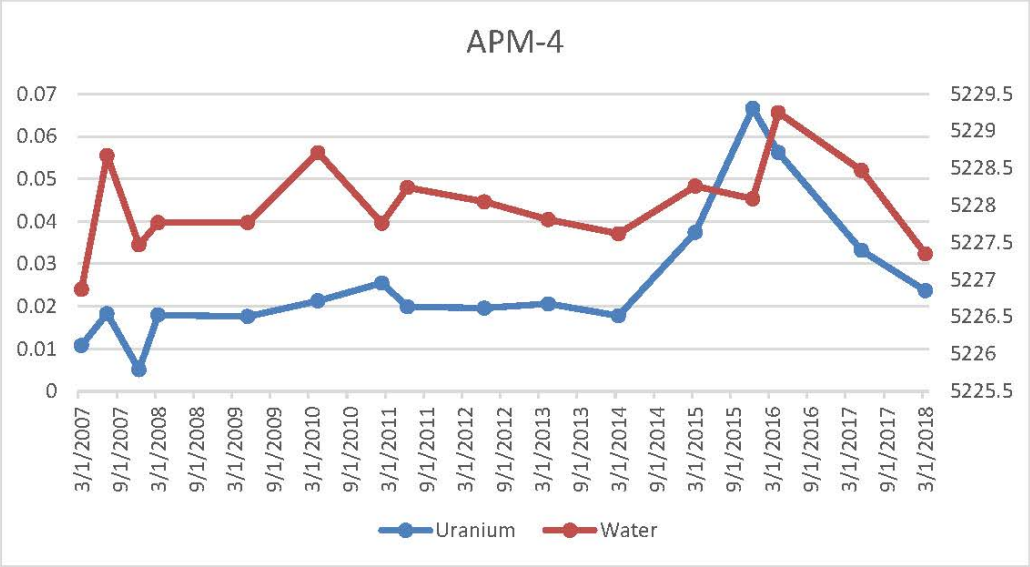

APM-4
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
5229.5
5229
5228.5
5228
5227.5
5227
5226.5
5226
5225.5
3/1/2007
9/1/2007
3/1/2008
9/1/2008
3/1/2009
9/1/2009
3/1/2010
9/1/2010
3/1/2011
9/1/2011
3/1/2012
9/1/2012
3/1/2013
9/1/2013
3/1/2014
9/1/2014
3/1/2015
9/1/2015
3/1/2016
9/1/2016
3/1/2017
9/1/2017
3/1/2018
Uranium
Water

Figure 22

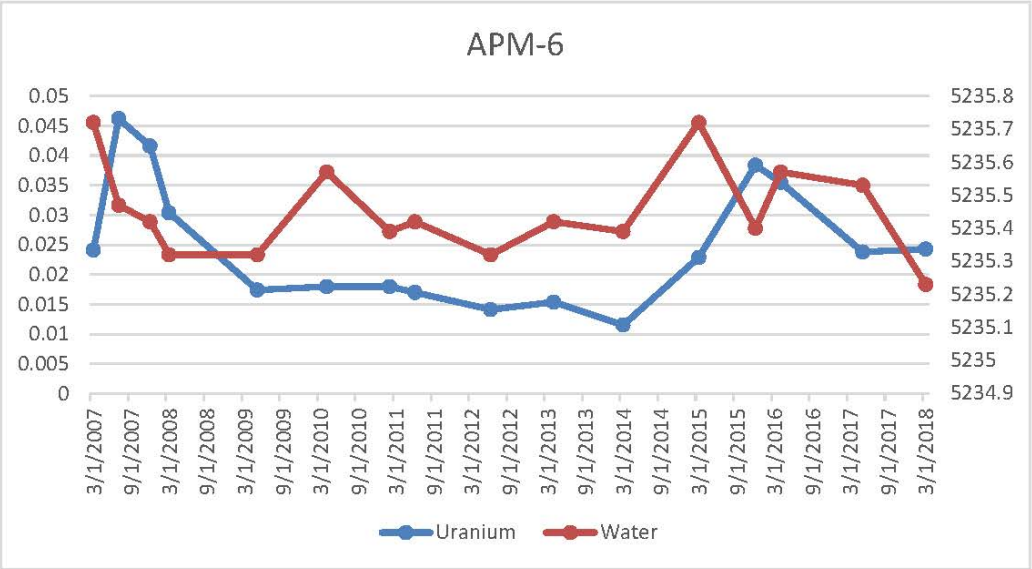

APM-6
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
5235.8
5235.7
5235.6
5235.5
5235.4
5235.3
5235.2
5235.1
5235
5234.9
3/1/2007
9/1/2007
3/1/2008
9/1/2008
3/1/2009
9/1/2009
3/1/2010
9/1/2010
3/1/2011
9/1/2011
3/1/2012
9/1/2012
3/1/2013
9/1/2013
3/1/2014
9/1/2014
3/1/2015
9/1/2015
3/1/2016
9/1/2016
3/1/2017
9/1/2017
3/1/2018
Uranium
Water

Figure 23

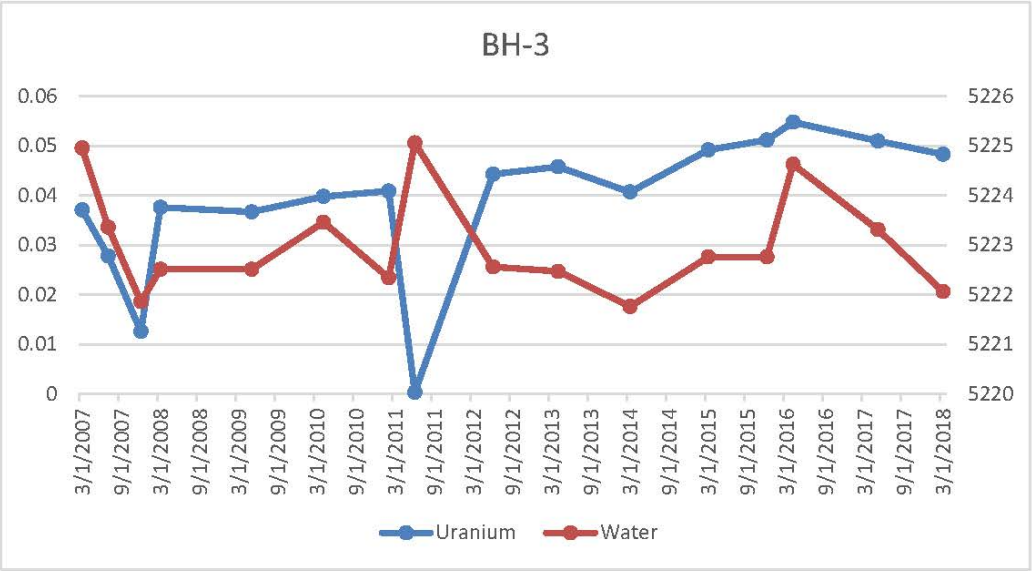

BH-3
0.06
0.05
0.04
0.03
0.02
0.01
0
5226
5225
5224
5223
5222
5221
5220
3/1/2007
9/1/2007
3/1/2008
9/1/2008
3/1/2009
9/1/2009
3/1/2010
9/1/2010
3/1/2011
9/1/2011
3/1/2012
9/1/2012
3/1/2013
9/1/2013
3/1/2014
9/1/2014
3/1/2015
9/1/2015
3/1/2016
9/1/2016
3/1/2017
9/1/2017
3/1/2018
Uranium
Water

Figure 24

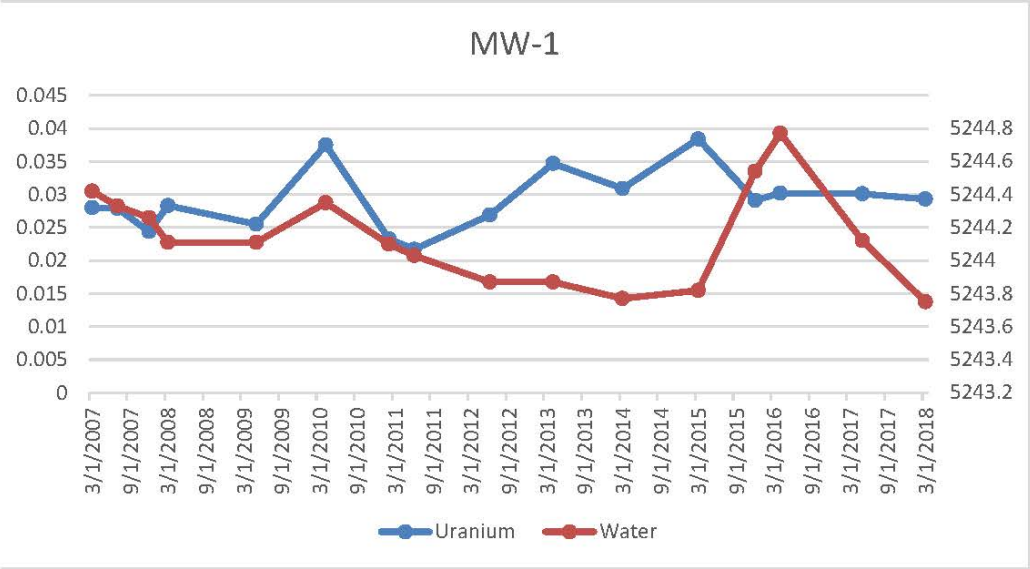

MW-1
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
5244.8
5244.6
5244.4
5244.2
5244
5243.8
5243.6
5243.4
5243.2
3/1/2007
9/1/2007
3/1/2008
9/1/2008
3/1/2009
9/1/2009
3/1/2010
9/1/2010
3/1/2011
9/1/2011
3/1/2012
9/1/2012
3/1/2013
9/1/2013
3/1/2014
9/1/2014
3/1/2015
9/1/2015
3/1/2016
9/1/2016
3/1/2017
9/1/2017
3/1/2018
Uranium
Water

Figure 25

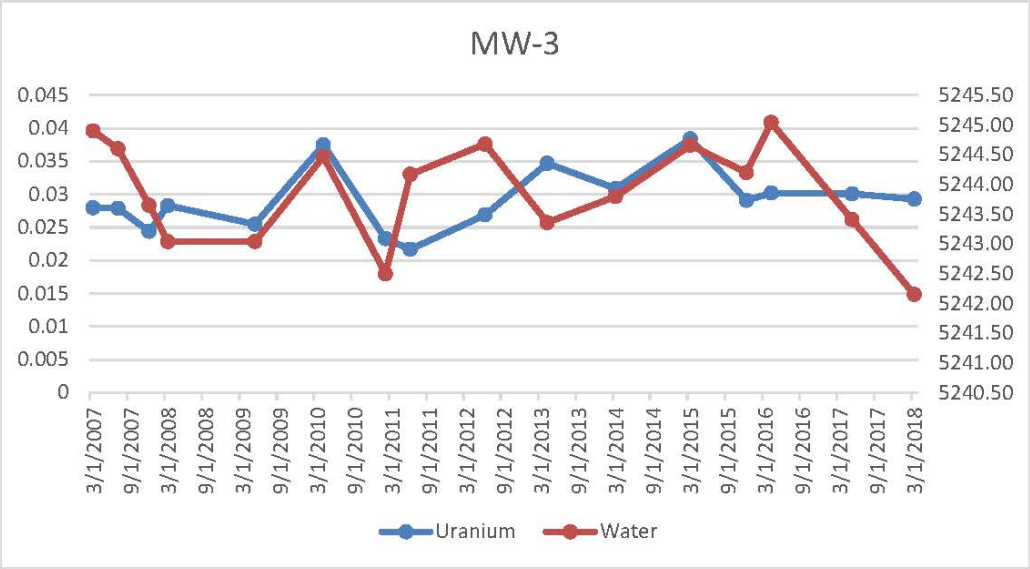

MW-3
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
5245.50
5245.00
5244.50
5244.00
5243.50
5243.00
5242.50
5242.00
5241.50
5241.00
5240.50
3/1/2007
9/1/2007
3/1/2008
9/1/2008
3/1/2009
9/1/2009
3/1/2010
9/1/2010
3/1/2011
9/1/2011
3/1/2012
9/1/2012
3/1/2013
9/1/2013
3/1/2014
9/1/2014
3/1/2015
9/1/2015
3/1/2016
9/1/2016
3/1/2017
9/1/2017
3/1/2018
Uranium
Water

Figure 26

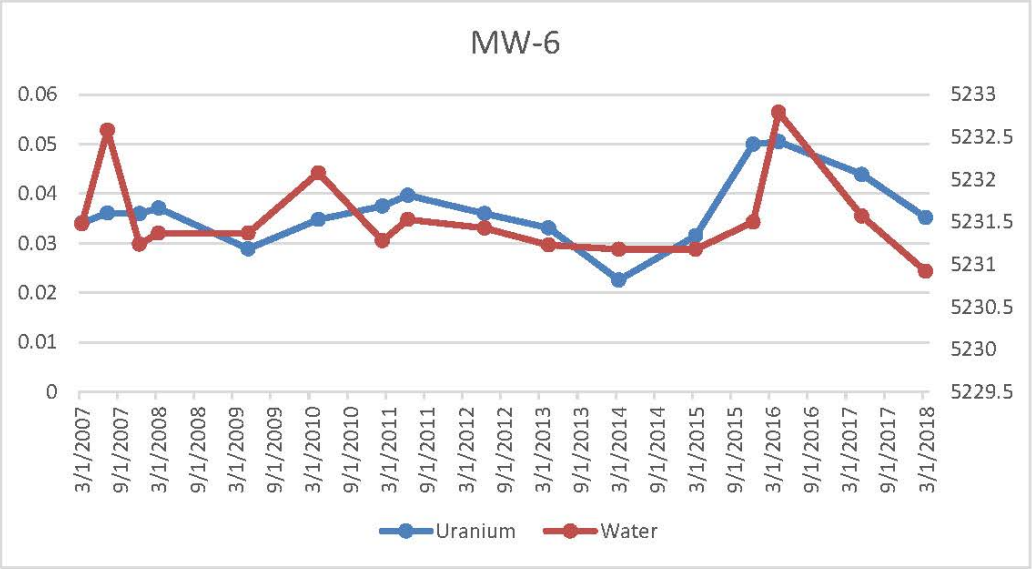
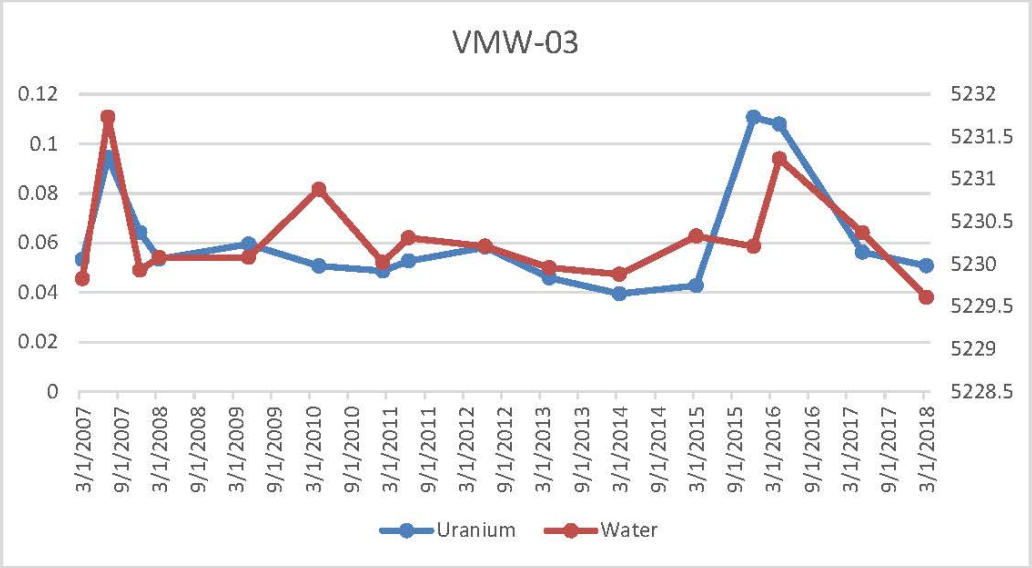

MW-6
0.06
0.05
0.04
0.03
0.02
0.01
0
5233
5232.5
5232
5231.5
5231
5230.5
5230
5229.5
3/1/2007
9/1/2007
3/1/2008
9/1/2008
3/1/2009
9/1/2009
3/1/2010
9/1/2010
3/1/2011
9/1/2011
3/1/2012
9/1/2012
3/1/2013
9/1/2013
3/1/2014
9/1/2014
3/1/2015
9/1/2015
3/1/2016
9/1/2016
3/1/2017
9/1/2017
3/1/2018
Uranium
Water

Figure 27


VMW-03
0.12
0.1
0.08
0.06
0.04
0.02
0
5232
5231.5
5231
5230.5
5230
5229.5
5229
5228.5
3/1/2007
9/1/2007
3/1/2008
9/1/2008
3/1/2009
9/1/2009
3/1/2010
9/1/2010
3/1/2011
9/1/2011
3/1/2012
9/1/2012
3/1/2013
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3/1/2014
9/1/2014
3/1/2015
9/1/2015
3/1/2016
9/1/2016
3/1/2017
9/1/2017
3/1/2018
Uranium
Water

Figure 28

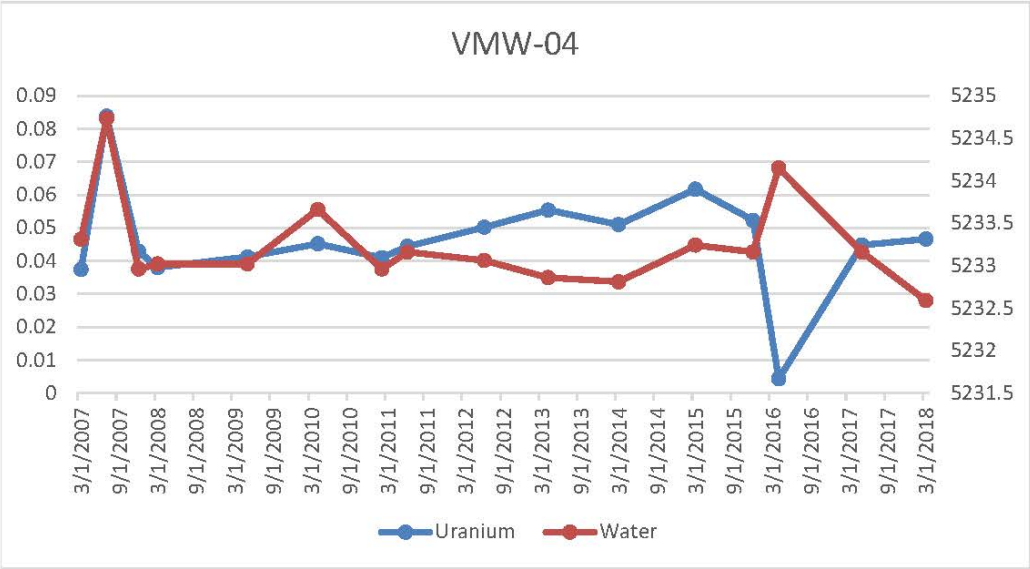
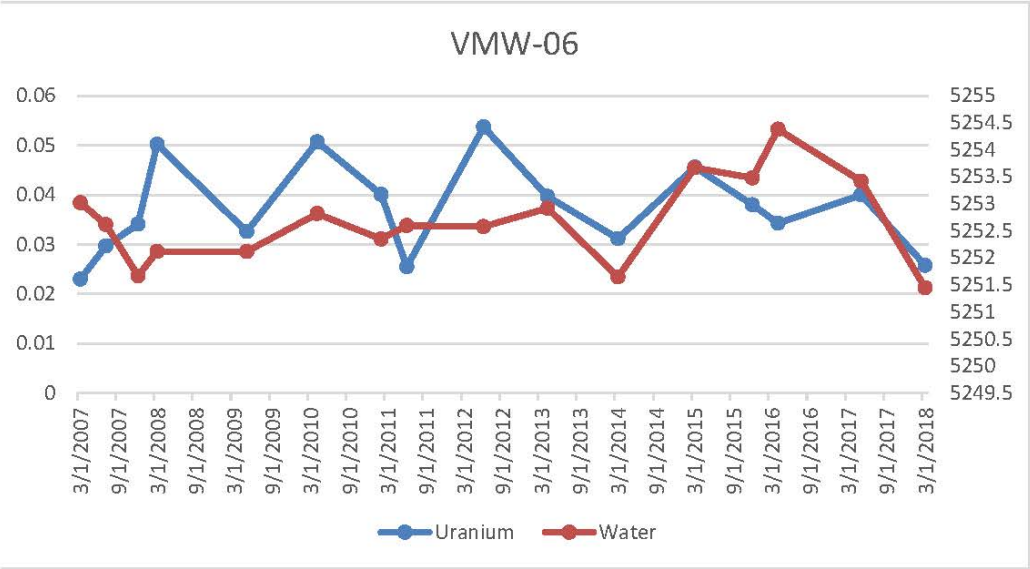

VMW-04
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
5235
5234.5
5234
5233.5
5233
5232.5
5232
5231.5
3/1/2007
9/1/2007
3/1/2008
9/1/2008
3/1/2009
9/1/2009
3/1/2010
9/1/2010
3/1/2011
9/1/2011
3/1/2012
9/1/2012
3/1/2013
9/1/2013
3/1/2014
9/1/2014
3/1/2015
9/1/2015
3/1/2016
9/1/2016
3/1/2017
9/1/2017
3/1/2018
Uranium
Water

Figure 29


VMW-06
0.06
0.05
0.04
0.03
0.02
0.01
0
5255
5254.5
5254
5253.5
5253
5252.5
5252
5251.5
5251
5250.5
5250
5249.5
3/1/2007
9/1/2007
3/1/2008
9/1/2008
3/1/2009
9/1/2009
3/1/2010
9/1/2010
3/1/2011
9/1/2011
3/1/2012
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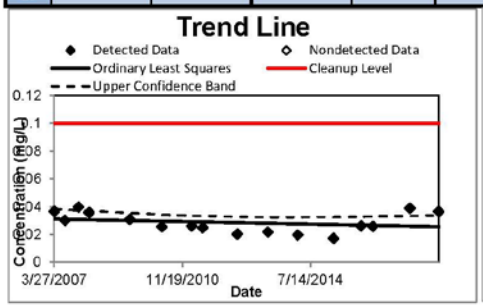
3/1/2013
9/1/2013
3/1/2014
9/1/2014
3/1/2015
9/1/2015
3/1/2016
9/1/2016
3/1/2017
9/1/2017
3/1/2018
Uranium
Water

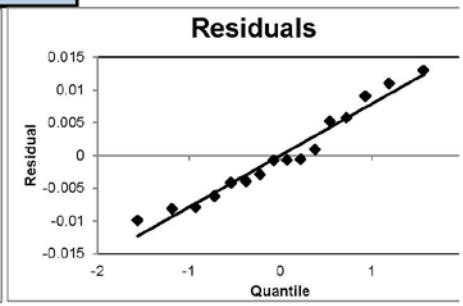
Groundwater Statistics Tool

Trend test results for datasets with normally distributed residuals (with our without transformation)

i	t (Date)	C (mg/L)	C Predicted	Fit residual	Upper Confidence Band
1	3/27/2007	0.0368	0.0311	0.0057	0.0384
2	7/17/2007	0.0302	0.0309	-0.0007	0.038
3	12/4/2007	0.0398	0.0307	0.0091	0.0374
4	3/25/2008	0.0358	0.0306	0.0052	0.037
5	5/20/2009	0.0309	0.03	0.0009	0.0355
6	4/20/2010	0.0256	0.0295	-0.0039	0.0344
7	2/23/2011	0.0262	0.0291	-0.0029	0.0335
8	6/20/2011	0.0248	0.0289	-0.0041	0.0333
9	6/12/2012	0.0203	0.0284	-0.0081	0.0327
10	4/25/2013	0.0218	0.028	-0.0062	0.0324
11	3/3/2014	0.0197	0.0276	-0.0079	0.0324
12	3/11/2015	0.0172	0.0271	-0.0099	0.0326
13	12/21/2015	0.0261	0.0267	-0.0006	0.0328
14	4/21/2016	0.0258	0.0265	-0.0007	0.033
15	5/11/2017	0.039	0.026	0.013	0.0334
16	3/7/2018	0.0366	0.0256	0.011	0.0338
17					
18					
19					
20					

Ordinary Least Squares	
Slope	-1.3713E-06
Intercept	0.084765757
Correlation, R^2	0.0637
Test Result	No trend
Test Statistic	-0.976
Critical Value	1.761
When is the concentration predicted to exceed the cleanup level?	Not applicable - slope is not statistically increasing





APM-3 - Molybdenum - Figure 30

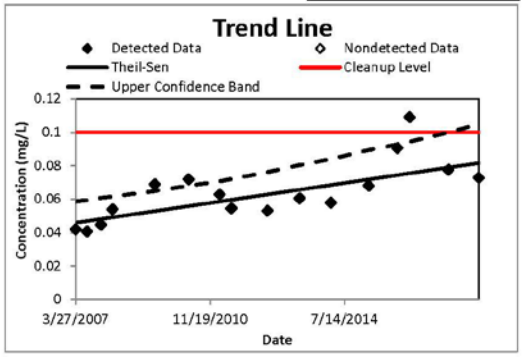
Groundwater Statistics Tool

Trend test results for datasets nonparametrically distributed residuals

i	t (Date)	C (mg/L)	C Predicted	Residual	Upper Confidence Band
1	3/27/2007	0.0419	0.0458	-0.0039	0.0585
2	7/17/2007	0.0406	0.0468	-0.0062	0.0595
3	12/4/2007	0.0446	0.048	-0.0034	0.0607
4	3/25/2008	0.0539	0.049	0.0049	0.0615
5	5/20/2009	0.0689	0.0528	0.0161	0.0648
6	4/20/2010	0.0718	0.0558	0.016	0.068
7	2/23/2011	0.0628	0.0585	0.0043	0.0707
8	6/20/2011	0.0545	0.0596	-0.0051	0.072
9	6/12/2012	0.053	0.0628	-0.0098	0.0761
10	4/25/2013	0.0605	0.0656	-0.0051	0.0803
11	3/3/2014	0.0579	0.0684	-0.0105	0.084
12	3/11/2015	0.068	0.0717	-0.0037	0.0893
13	12/21/2015	0.0905	0.0743	0.0162	0.0927
14	4/21/2016	0.109	0.0754	0.0336	0.0944
15	5/11/2017	0.0776	0.0788	-0.0012	0.0998
16	3/7/2018	0.0728	0.0815	-0.0087	0.105
17					
18					
19					
20					

Mann-Kendall	
Test Result	Increasing
Test Statistic (S)	70
Normalized S	3.107
Critical Value	1.645

Theil-Sen	
Slope	0.00000893
Intercept	-0.304
When is the concentration predicted to exceed the cleanup level?	45200



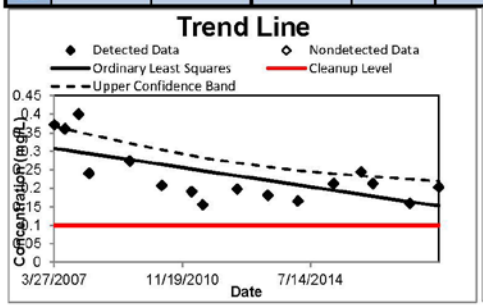
APM-4 - Molybdenum - Figure 31

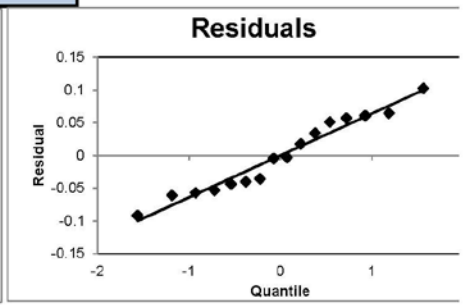
Groundwater Statistics Tool

Trend test results for datasets with normally distributed residuals (with our without transformation)

i	t (Date)	C (mg/L)	C Predicted	Fit residual	Upper Confidence Band
1	3/27/2007	0.372	0.307	0.065	0.367
2	7/17/2007	0.36	0.303	0.057	0.36
3	12/4/2007	0.4	0.297	0.103	0.352
4	3/25/2008	0.24	0.293	-0.053	0.345
5	5/20/2009	0.274	0.277	-0.003	0.321
6	4/20/2010	0.207	0.264	-0.057	0.303
7	2/23/2011	0.191	0.252	-0.061	0.288
8	6/20/2011	0.1554	0.247	-0.0916	0.282
9	6/12/2012	0.1975	0.233	-0.0355	0.268
10	4/25/2013	0.1809	0.221	-0.0401	0.257
11	3/3/2014	0.1653	0.209	-0.0437	0.248
12	3/11/2015	0.212	0.194	0.018	0.239
13	12/21/2015	0.244	0.183	0.061	0.233
14	4/21/2016	0.2125	0.178	0.0345	0.231
15	5/11/2017	0.159	0.163	-0.004	0.224
16	3/7/2018	0.203	0.152	0.051	0.219
17					
18					
19					
20					

Ordinary Least Squares	
Slope	-3.89141E-05
Intercept	1.831475082
Correlation, R^2	0.4549
Test Result	Decreasing
Test Statistic	-3.418
Critical Value	1.761
When is the concentration predicted to exceed the cleanup level?	Not applicable - slope is not statistically increasing





APM-6 - Molybdenum - Figure 32

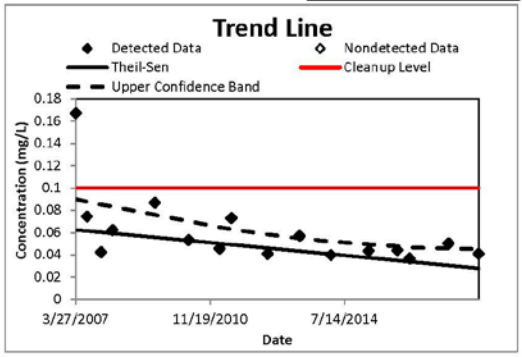
Groundwater Statistics Tool

Trend test results for datasets nonparametrically distributed residuals

i	t (Date)	C (mg/L)	C Predicted	Residual	Upper Confidence Band
1	3/27/2007	0.167	0.0624	0.1046	0.09
2	7/17/2007	0.0744	0.0614	0.013	0.0875
3	12/4/2007	0.0423	0.0602	-0.0179	0.085
4	3/25/2008	0.0622	0.0592	0.003	0.0833
5	5/20/2009	0.0867	0.0556	0.0311	0.0758
6	4/20/2010	0.0533	0.0527	0.0006	0.0701
7	2/23/2011	0.0456	0.0501	-0.0045	0.0648
8	6/20/2011	0.073	0.049	0.024	0.0628
9	6/12/2012	0.041	0.046	-0.005	0.0582
10	4/25/2013	0.057	0.0432	0.0138	0.0548
11	3/3/2014	0.0398	0.0405	-0.0007	0.0519
12	3/11/2015	0.0435	0.0373	0.0062	0.0495
13	12/21/2015	0.0441	0.0349	0.0092	0.0476
14	4/21/2016	0.0368	0.0338	0.003	0.0466
15	5/11/2017	0.0503	0.0305	0.0198	0.0456
16	3/7/2018	0.0409	0.0279	0.013	0.045
17					
18					
19					
20					

Mann-Kendall	
Test Result	Decreasing
Test Statistic (S)	-60
Normalized S	-2.656
Critical Value	1.645

Theil-Sen	
Slope	-0.00000862
Intercept	0.4
When is the concentration predicted to exceed the cleanup level?	Not applicable - slope is not statistically increasing



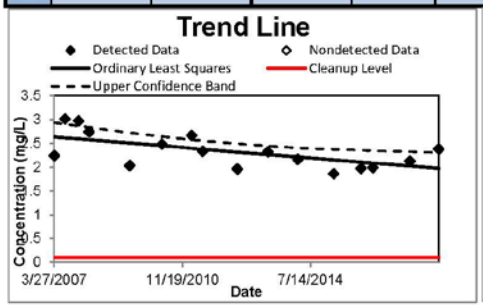
BH-3 - Molybdenum - Figure 33

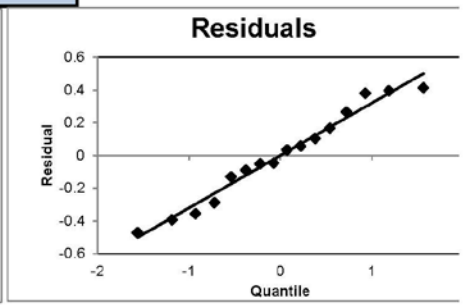
Groundwater Statistics Tool

Trend test results for datasets with normally distributed residuals (with our without transformation)

i	t (Date)	C (mg/L)	C Predicted	Fit residual	Upper Confidence Band
1	3/27/2007	2.24	2.63	-0.39	2.93
2	7/17/2007	3.01	2.61	0.4	2.9
3	12/4/2007	2.97	2.59	0.38	2.86
4	3/25/2008	2.74	2.57	0.17	2.83
5	5/20/2009	2.03	2.5	-0.47	2.72
6	4/20/2010	2.48	2.45	0.03	2.64
7	2/23/2011	2.66	2.39	0.27	2.57
8	6/20/2011	2.33	2.37	-0.04	2.55
9	6/12/2012	1.96	2.31	-0.35	2.49
10	4/25/2013	2.32	2.26	0.06	2.44
11	3/3/2014	2.16	2.21	-0.05	2.4
12	3/11/2015	1.86	2.15	-0.29	2.37
13	12/21/2015	1.97	2.1	-0.13	2.35
14	4/21/2016	1.99	2.08	-0.09	2.34
15	5/11/2017	2.12	2.02	0.1	2.32
16	3/7/2018	2.38	1.97	0.41	2.3
17					
18					
19					
20					

Ordinary Least Squares	
Slope	-0.000166767
Intercept	9.164333165
Correlation, R^2	0.3830
Test Result	Decreasing
Test Statistic	-2.948
Critical Value	1.761
When is the concentration predicted to exceed the cleanup level?	Not applicable - slope is not statistically increasing





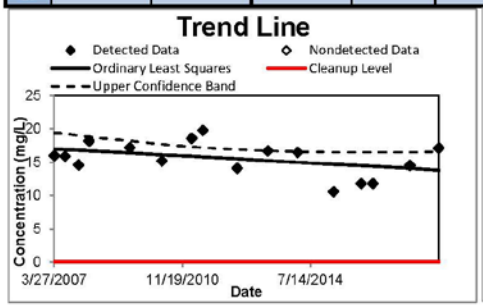
MW-1 - Molybdenum - Figure 34

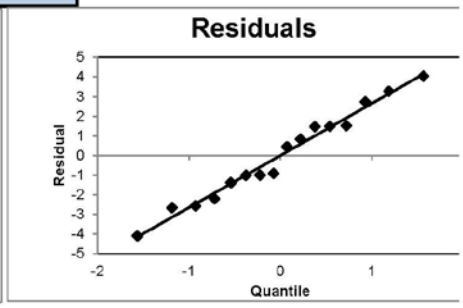
Groundwater Statistics Tool

Trend test results for datasets with normally distributed residuals (with our without transformation)

i	t (Date)	C (mg/L)	C Predicted	Fit residual	Upper Confidence Band
1	3/27/2007	16	17	-1	19.4
2	7/17/2007	15.9	16.9	-1	19.3
3	12/4/2007	14.6	16.8	-2.2	19
4	3/25/2008	18.2	16.7	1.5	18.8
5	5/20/2009	17.2	16.4	0.8	18.2
6	4/20/2010	15.2	16.1	-0.9	17.7
7	2/23/2011	18.6	15.9	2.7	17.3
8	6/20/2011	19.8	15.8	4	17.2
9	6/12/2012	14.1	15.5	-1.4	16.9
10	4/25/2013	16.7	15.2	1.5	16.7
11	3/3/2014	16.5	15	1.5	16.6
12	3/11/2015	10.6	14.7	-4.1	16.5
13	12/21/2015	11.8	14.5	-2.7	16.5
14	4/21/2016	11.8	14.4	-2.6	16.5
15	5/11/2017	14.5	14.1	0.4	16.5
16	3/7/2018	17.1	13.8	3.3	16.6
17					
18					
19					
20					

Ordinary Least Squares	
Slope	-0.000793835
Intercept	48.08770114
Correlation, R^2	0.1709
Test Result	No trend
Test Statistic	-1.699
Critical Value	1.761
When is the concentration predicted to exceed the cleanup level?	Not applicable - slope is not statistically increasing





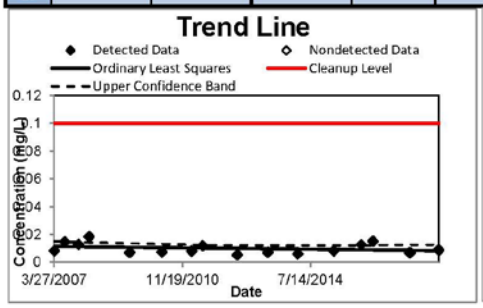
MW-3 - Molybdenum - Figure 35

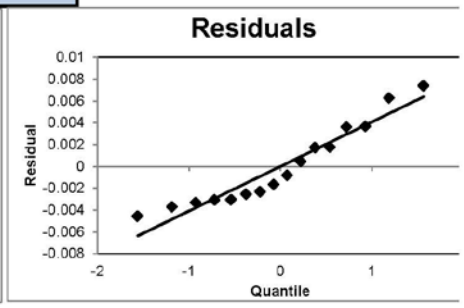
Groundwater Statistics Tool

Trend test results for datasets with normally distributed residuals (with our without transformation)

i	t (Date)	C (mg/L)	C Predicted	Fit residual	Upper Confidence Band
1	3/27/2007	0.0082	0.0113	-0.0031	0.0152
2	7/17/2007	0.0148	0.0112	0.0036	0.0149
3	12/4/2007	0.0128	0.0111	0.0017	0.0146
4	3/25/2008	0.0184	0.011	0.0074	0.0144
5	5/20/2009	0.007	0.0107	-0.0037	0.0136
6	4/20/2010	0.0074	0.0104	-0.003	0.013
7	2/23/2011	0.0079	0.0102	-0.0023	0.0126
8	6/20/2011	0.0119	0.0101	0.0018	0.0124
9	6/12/2012	0.0053	0.00986	-0.00456	0.0121
10	4/25/2013	0.0071	0.00963	-0.00253	0.012
11	3/3/2014	0.0061	0.0094	-0.0033	0.0119
12	3/11/2015	0.0083	0.00913	-0.00083	0.012
13	12/21/2015	0.0126	0.00892	0.00368	0.0122
14	4/21/2016	0.0151	0.00883	0.00627	0.0122
15	5/11/2017	0.0069	0.00854	-0.00164	0.0125
16	3/7/2018	0.0088	0.00832	0.00048	0.0127
17					
18					
19					
20					

Ordinary Least Squares	
Slope	-7.35669E-07
Intercept	0.040077671
Correlation, R^2	0.0658
Test Result	No trend
Test Statistic	-0.993
Critical Value	1.761
When is the concentration predicted to exceed the cleanup level?	Not applicable - slope is not statistically increasing





MW-6 - Molybdenum - Figure 36

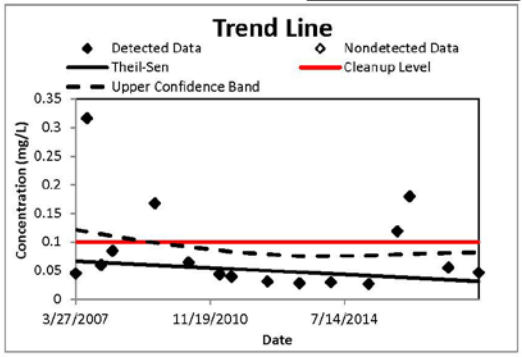
Groundwater Statistics Tool

Trend test results for datasets nonparametrically distributed residuals

i	t (Date)	C (mg/L)	C Predicted	Residual	Upper Confidence Band
1	3/27/2007	0.0454	0.0664	-0.021	0.122
2	7/17/2007	0.316	0.0654	0.2506	0.118
3	12/4/2007	0.0596	0.0642	-0.0046	0.114
4	3/25/2008	0.0845	0.0633	0.0212	0.11
5	5/20/2009	0.168	0.0596	0.1084	0.0989
6	4/20/2010	0.0645	0.0567	0.0078	0.0913
7	2/23/2011	0.0441	0.054	-0.0099	0.0858
8	6/20/2011	0.0397	0.053	-0.0133	0.0831
9	6/12/2012	0.0313	0.0499	-0.0186	0.0788
10	4/25/2013	0.0285	0.0472	-0.0187	0.0755
11	3/3/2014	0.0302	0.0445	-0.0143	0.076
12	3/11/2015	0.027	0.0412	-0.0142	0.0762
13	12/21/2015	0.119	0.0387	0.0803	0.0786
14	4/21/2016	0.1797	0.0377	0.142	0.0796
15	5/11/2017	0.0553	0.0344	0.0209	0.0812
16	3/7/2018	0.047	0.0318	0.0152	0.0819
17					
18					
19					
20					

Mann-Kendall	
Test Result	No trend
Test Statistic (S)	-28
Normalized S	-1.216
Critical Value	1.645

Theil-Sen	
Slope	-0.00000867
Intercept	0.406
When is the concentration predicted to exceed the cleanup level?	Not applicable - slope is not statistically increasing



VMW-03 - Molybdenum - Figure 37

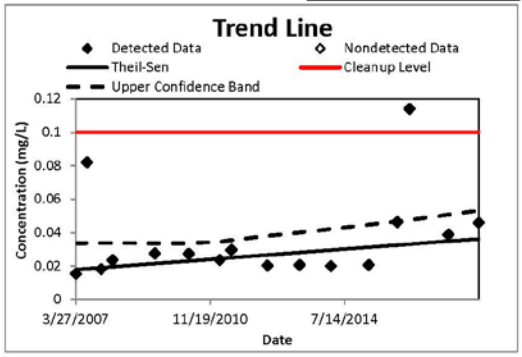
Groundwater Statistics Tool

Trend test results for datasets nonparametrically distributed residuals

i	t (Date)	C (mg/L)	C Predicted	Residual	Upper Confidence Band
1	3/27/2007	0.0154	0.0178	-0.0024	0.0336
2	7/17/2007	0.0819	0.0183	0.0636	0.0337
3	12/4/2007	0.0182	0.0189	-0.0007	0.0337
4	3/25/2008	0.0235	0.0195	0.004	0.0338
5	5/20/2009	0.0274	0.0214	0.006	0.0335
6	4/20/2010	0.0273	0.0229	0.0044	0.0336
7	2/23/2011	0.0236	0.0243	-0.0007	0.0345
8	6/20/2011	0.0296	0.0249	0.0047	0.0354
9	6/12/2012	0.0202	0.0265	-0.0063	0.038
10	4/25/2013	0.0206	0.028	-0.0074	0.0399
11	3/3/2014	0.02	0.0294	-0.0094	0.0422
12	3/11/2015	0.0206	0.0311	-0.0105	0.0446
13	12/21/2015	0.0463	0.0324	0.0139	0.0466
14	4/21/2016	0.114	0.033	0.081	0.0475
15	5/11/2017	0.0388	0.0348	0.004	0.0507
16	3/7/2018	0.0459	0.0361	0.0098	0.0532
17					
18					
19					
20					

Mann-Kendall	
Test Result	No trend
Test Statistic (S)	35
Normalized S	1.532
Critical Value	1.645

Theil-Sen	
Slope	0.00000459
Intercept	-0.162
When is the concentration predicted to exceed the cleanup level?	Not applicable - slope is not statistically increasing



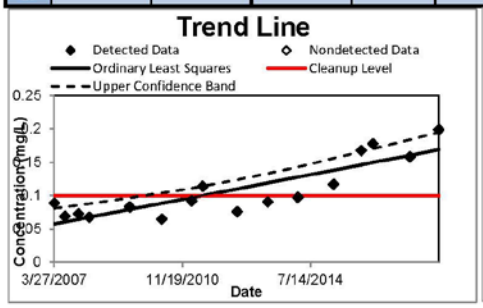
VMW-04 - Molybdenum - Figure 38

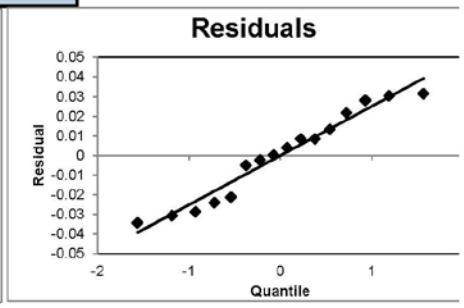
Groundwater Statistics Tool

Trend test results for datasets with normally distributed residuals (with our without transformation)

i	t (Date)	C (mg/L)	C Predicted	Fit residual	Upper Confidence Band
1	3/27/2007	0.0889	0.0573	0.0316	0.0808
2	7/17/2007	0.0689	0.0604	0.0085	0.083
3	12/4/2007	0.0728	0.0643	0.0085	0.0857
4	3/25/2008	0.0676	0.0675	1E-04	0.0879
5	5/20/2009	0.0831	0.0792	0.0039	0.0966
6	4/20/2010	0.0645	0.0885	-0.024	0.104
7	2/23/2011	0.0921	0.0971	-0.005	0.111
8	6/20/2011	0.1137	0.1	0.0137	0.114
9	6/12/2012	0.076	0.11	-0.034	0.124
10	4/25/2013	0.0905	0.119	-0.0285	0.133
11	3/3/2014	0.0972	0.128	-0.0308	0.143
12	3/11/2015	0.117	0.138	-0.021	0.156
13	12/21/2015	0.1678	0.146	0.0218	0.166
14	4/21/2016	0.1777	0.15	0.0277	0.17
15	5/11/2017	0.158	0.16	-0.002	0.184
16	3/7/2018	0.199	0.169	0.03	0.195
17					
18					
19					
20					

Ordinary Least Squares	
Slope	2.78379E-05
Intercept	-1.033033742
Correlation, R^2	0.7346
Test Result	Increasing
Test Statistic	6.225
Critical Value	1.761
When is the concentration predicted to exceed the cleanup level?	MCL is already exceeded





VMW-06 - Molybdenum - Figure 39

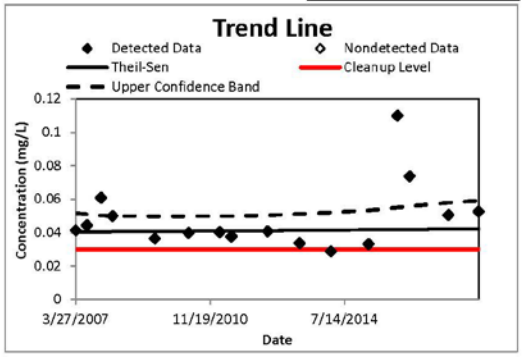
Groundwater Statistics Tool

Trend test results for datasets nonparametrically distributed residuals

i	t (Date)	C (mg/L)	C Predicted	Residual	Upper Confidence Band
1	3/27/2007	0.0413	0.0403	0.001	0.0515
2	7/17/2007	0.0444	0.0403	0.0041	0.0509
3	12/4/2007	0.0609	0.0404	0.0205	0.0502
4	3/25/2008	0.0499	0.0404	0.0095	0.0499
5	5/20/2009	0.0364	0.0406	-0.0042	0.0497
6	4/20/2010	0.0399	0.0408	-0.0009	0.0498
7	2/23/2011	0.0404	0.0409	-0.0005	0.0499
8	6/20/2011	0.0377	0.041	-0.0033	0.0499
9	6/12/2012	0.0409	0.0411	-0.0002	0.0503
10	4/25/2013	0.0337	0.0413	-0.0076	0.051
11	3/3/2014	0.0288	0.0414	-0.0126	0.052
12	3/11/2015	0.0332	0.0416	-0.0084	0.0532
13	12/21/2015	0.1099	0.0417	0.0682	0.0549
14	4/21/2016	0.0737	0.0418	0.0319	0.0557
15	5/11/2017	0.0505	0.042	0.0085	0.0579
16	3/7/2018	0.0526	0.0421	0.0105	0.059
17					
18					
19					
20					

Mann-Kendall	
Test Result	No trend
Test Statistic (S)	2
Normalized S	0.045
Critical Value	1.645

Theil-Sen	
Slope	0.000000461
Intercept	0.0222
When is the concentration predicted to exceed the cleanup level?	Not applicable - slope is not statistically increasing



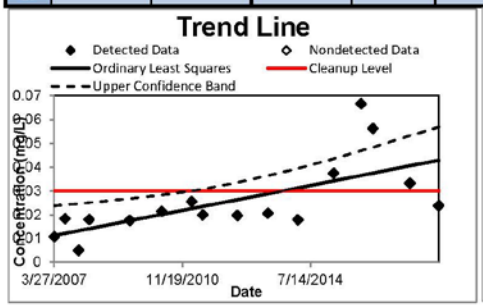
APM-3 - Uranium - Figure 40

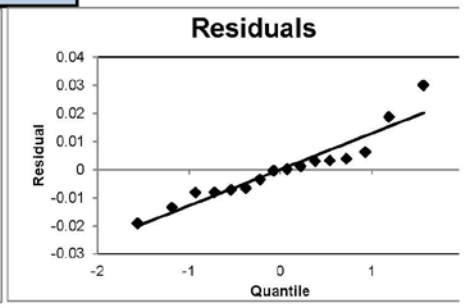
Groundwater Statistics Tool

Trend test results for datasets with normally distributed residuals (with our without transformation)

i	t (Date)	C (mg/L)	C Predicted	Fit residual	Upper Confidence Band
1	3/27/2007	0.0108	0.0112	-0.0004	0.0237
2	7/17/2007	0.0183	0.0121	0.0062	0.0241
3	12/4/2007	0.0051	0.0132	-0.0081	0.0246
4	3/25/2008	0.018	0.0141	0.0039	0.025
5	5/20/2009	0.0176	0.0174	0.0002	0.0267
6	4/20/2010	0.0213	0.0201	0.0012	0.0283
7	2/23/2011	0.0255	0.0225	0.003	0.03
8	6/20/2011	0.0199	0.0234	-0.0035	0.0308
9	6/12/2012	0.0196	0.0263	-0.0067	0.0335
10	4/25/2013	0.0206	0.0288	-0.0082	0.0363
11	3/3/2014	0.0178	0.0312	-0.0134	0.0394
12	3/11/2015	0.0374	0.0342	0.0032	0.0435
13	12/21/2015	0.0666	0.0364	0.0302	0.0469
14	4/21/2016	0.0562	0.0374	0.0188	0.0483
15	5/11/2017	0.0332	0.0405	-0.0073	0.0531
16	3/7/2018	0.0237	0.0428	-0.0191	0.0568
17					
18					
19					
20					

Ordinary Least Squares	
Slope	7.91139E-06
Intercept	-0.296671537
Correlation, R^2	0.4413
Test Result	Increasing
Test Statistic	3.326
Critical Value	1.761
When is the concentration predicted to exceed the cleanup level?	41500





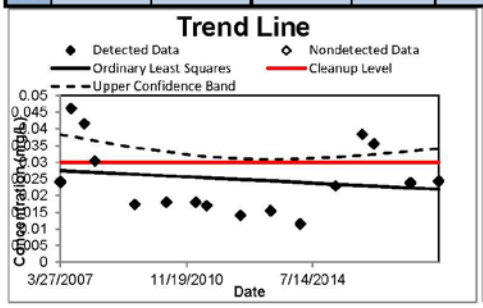
APM-4 - Uranium - Figure 41

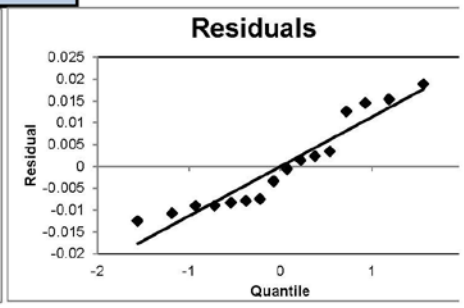
Groundwater Statistics Tool

Trend test results for datasets with normally distributed residuals (with our without transformation)

i	t (Date)	C (mg/L)	C Predicted	Fit residual	Upper Confidence Band
1	3/27/2007	0.0241	0.0275	-0.0034	0.0383
2	7/17/2007	0.0462	0.0273	0.0189	0.0377
3	12/4/2007	0.0416	0.0271	0.0145	0.037
4	3/25/2008	0.0304	0.027	0.0034	0.0364
5	5/20/2009	0.0174	0.0264	-0.009	0.0344
6	4/20/2010	0.018	0.0259	-0.0079	0.0331
7	2/23/2011	0.018	0.0255	-0.0075	0.032
8	6/20/2011	0.017	0.0253	-0.0083	0.0317
9	6/12/2012	0.0141	0.0248	-0.0107	0.0311
10	4/25/2013	0.0154	0.0244	-0.009	0.0309
11	3/3/2014	0.0115	0.0239	-0.0124	0.0311
12	3/11/2015	0.0229	0.0234	-0.0005	0.0316
13	12/21/2015	0.0384	0.023	0.0154	0.0321
14	4/21/2016	0.0355	0.0229	0.0126	0.0324
15	5/11/2017	0.0238	0.0223	0.0015	0.0333
16	3/7/2018	0.0243	0.0219	0.0024	0.0341
17					
18					
19					
20					

Ordinary Least Squares	
Slope	-1.38463E-06
Intercept	0.08168761
Correlation, R^2	0.0309
Test Result	No trend
Test Statistic	-0.668
Critical Value	1.761
When is the concentration predicted to exceed the cleanup level?	Not applicable - slope is not statistically increasing





APM-6 - Uranium - Figure 42

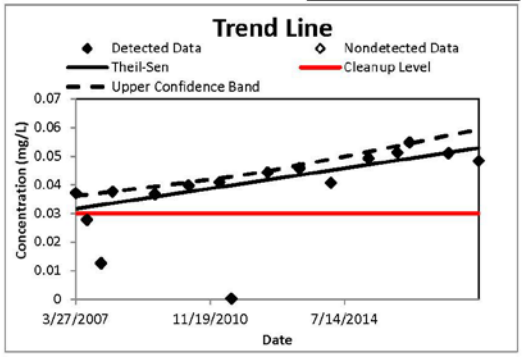
Groundwater Statistics Tool

Trend test results for datasets nonparametrically distributed residuals

i	t (Date)	C (mg/L)	C Predicted	Residual	Upper Confidence Band
1	3/27/2007	0.0371	0.0316	0.0055	0.0361
2	7/17/2007	0.0278	0.0322	-0.0044	0.0365
3	12/4/2007	0.0126	0.0329	-0.0203	0.0371
4	3/25/2008	0.0376	0.0335	0.0041	0.0376
5	5/20/2009	0.0367	0.0358	0.0009	0.0394
6	4/20/2010	0.0398	0.0375	0.0023	0.0409
7	2/23/2011	0.0409	0.0392	0.0017	0.0423
8	6/20/2011	0.0003	0.0398	-0.0395	0.0428
9	6/12/2012	0.0443	0.0417	0.0026	0.0447
10	4/25/2013	0.0458	0.0434	0.0024	0.0468
11	3/3/2014	0.0407	0.045	-0.0043	0.0489
12	3/11/2015	0.0492	0.047	0.0022	0.0515
13	12/21/2015	0.0512	0.0485	0.0027	0.0535
14	4/21/2016	0.0548	0.0491	0.0057	0.0544
15	5/11/2017	0.051	0.0512	-0.0002	0.0571
16	3/7/2018	0.0483	0.0528	-0.0045	0.0593
17					
18					
19					
20					

Mann-Kendall	
Test Result	Increasing
Test Statistic (S)	78
Normalized S	3.467
Critical Value	1.645

Theil-Sen	
Slope	0.0000053
Intercept	-0.176
When is the concentration predicted to exceed the cleanup level?	MCL is already exceeded



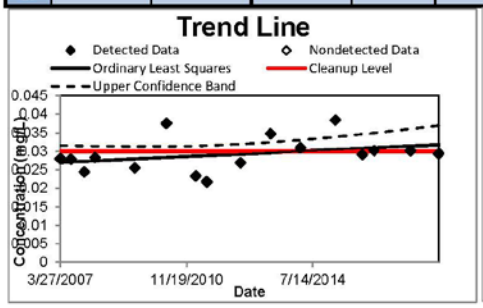
BH-3 - Uranium - Figure 43

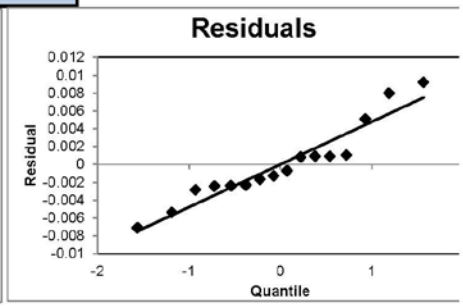
Groundwater Statistics Tool

Trend test results for datasets with normally distributed residuals (with our without transformation)

i	t (Date)	C (mg/L)	C Predicted	Fit residual	Upper Confidence Band
1	3/27/2007	0.028	0.0269	0.0011	0.0315
2	7/17/2007	0.0279	0.0271	0.0008	0.0315
3	12/4/2007	0.0244	0.0272	-0.0028	0.0314
4	3/25/2008	0.0283	0.0274	0.0009	0.0314
5	5/20/2009	0.0255	0.0279	-0.0024	0.0313
6	4/20/2010	0.0375	0.0283	0.0092	0.0313
7	2/23/2011	0.0233	0.0287	-0.0054	0.0314
8	6/20/2011	0.0217	0.0288	-0.0071	0.0315
9	6/12/2012	0.0269	0.0292	-0.0023	0.0319
10	4/25/2013	0.0347	0.0296	0.0051	0.0324
11	3/3/2014	0.0309	0.03	0.0009	0.033
12	3/11/2015	0.0384	0.0304	0.008	0.0338
13	12/21/2015	0.0291	0.0308	-0.0017	0.0346
14	4/21/2016	0.0302	0.0309	-0.0007	0.0349
15	5/11/2017	0.0301	0.0314	-0.0013	0.036
16	3/7/2018	0.0293	0.0317	-0.0024	0.0369
17					
18					
19					
20					

Ordinary Least Squares	
Slope	1.19716E-06
Intercept	-0.019950644
Correlation, R^2	0.1181
Test Result	No trend
Test Statistic	1.370
Critical Value	1.761
When is the concentration predicted to exceed the cleanup level?	Not applicable - slope is not statistically increasing





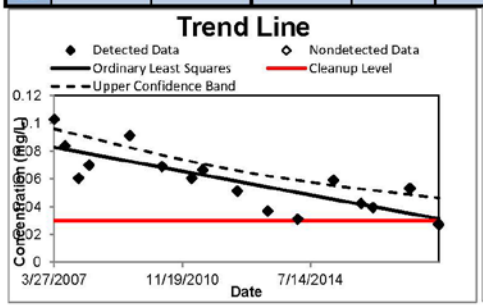
MW-1 - Uranium - Figure 44

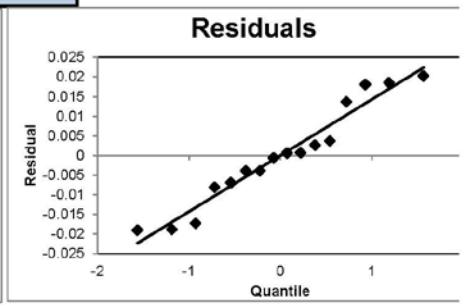
Groundwater Statistics Tool

Trend test results for datasets with normally distributed residuals (with our without transformation)

i	t (Date)	C (mg/L)	C Predicted	Fit residual	Upper Confidence Band
1	3/27/2007	0.103	0.0827	0.0203	0.0961
2	7/17/2007	0.0839	0.0813	0.0026	0.0941
3	12/4/2007	0.0607	0.0795	-0.0188	0.0917
4	3/25/2008	0.07	0.078	-0.008	0.0897
5	5/20/2009	0.0912	0.0726	0.0186	0.0826
6	4/20/2010	0.069	0.0683	0.0007	0.0771
7	2/23/2011	0.0605	0.0643	-0.0038	0.0724
8	6/20/2011	0.0665	0.0628	0.0037	0.0707
9	6/12/2012	0.0513	0.0582	-0.0069	0.0659
10	4/25/2013	0.0369	0.0541	-0.0172	0.0622
11	3/3/2014	0.0311	0.0501	-0.019	0.0589
12	3/11/2015	0.059	0.0453	0.0137	0.0553
13	12/21/2015	0.0423	0.0416	0.0007	0.0528
14	4/21/2016	0.0395	0.0401	-0.0006	0.0518
15	5/11/2017	0.0532	0.0351	0.0181	0.0486
16	3/7/2018	0.0274	0.0313	-0.0039	0.0463
17					
18					
19					
20					

Ordinary Least Squares	
Slope	-1.28749E-05
Intercept	0.587011443
Correlation, R^2	0.6452
Test Result	Decreasing
Test Statistic	-5.046
Critical Value	1.761
When is the concentration predicted to exceed the cleanup level?	Not applicable - slope is not statistically increasing





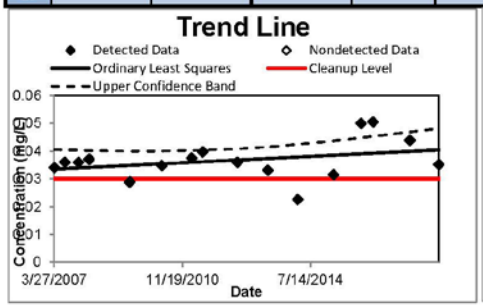
MW-3 - Uranium - Figure 45

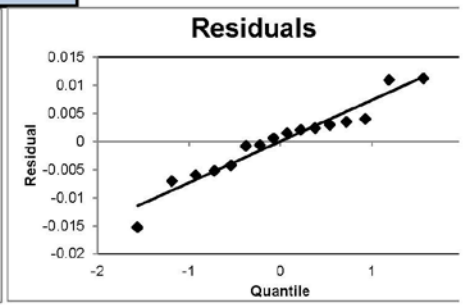
Groundwater Statistics Tool

Trend test results for datasets with normally distributed residuals (with our without transformation)

i	t (Date)	C (mg/L)	C Predicted	Fit residual	Upper Confidence Band
1	3/27/2007	0.0341	0.0335	0.0006	0.0405
2	7/17/2007	0.0361	0.0337	0.0024	0.0404
3	12/4/2007	0.036	0.0339	0.0021	0.0403
4	3/25/2008	0.0371	0.0341	0.003	0.0402
5	5/20/2009	0.0289	0.0349	-0.006	0.04
6	4/20/2010	0.0348	0.0354	-0.0006	0.04
7	2/23/2011	0.0375	0.036	0.0015	0.0402
8	6/20/2011	0.0397	0.0362	0.0035	0.0403
9	6/12/2012	0.036	0.0368	-0.0008	0.0408
10	4/25/2013	0.0331	0.0374	-0.0043	0.0415
11	3/3/2014	0.0226	0.0379	-0.0153	0.0425
12	3/11/2015	0.0315	0.0385	-0.007	0.0437
13	12/21/2015	0.05	0.039	0.011	0.0448
14	4/21/2016	0.0505	0.0392	0.0113	0.0453
15	5/11/2017	0.0439	0.0399	0.004	0.0469
16	3/7/2018	0.0352	0.0404	-0.0052	0.0482
17					
18					
19					
20					

Ordinary Least Squares	
Slope	1.73074E-06
Intercept	-0.034279191
Correlation, R^2	0.1082
Test Result	No trend
Test Statistic	1.303
Critical Value	1.761
When is the concentration predicted to exceed the cleanup level?	Not applicable - slope is not statistically increasing





MW-6 - Uranium - Figure 46

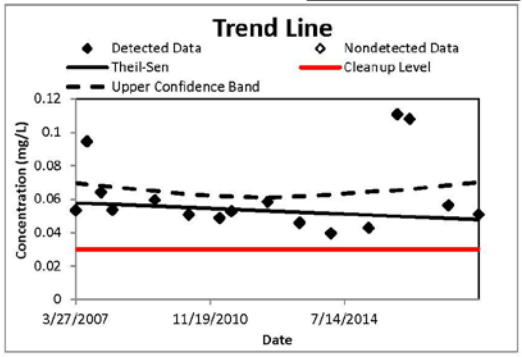
Groundwater Statistics Tool

Trend test results for datasets nonparametrically distributed residuals

i	t (Date)	C (mg/L)	C Predicted	Residual	Upper Confidence Band
1	3/27/2007	0.0533	0.0577	-0.0044	0.0696
2	7/17/2007	0.0945	0.0574	0.0371	0.0689
3	12/4/2007	0.0642	0.0571	0.0071	0.068
4	3/25/2008	0.0535	0.0568	-0.0033	0.0672
5	5/20/2009	0.0595	0.0557	0.0038	0.0648
6	4/20/2010	0.0507	0.0549	-0.0042	0.0628
7	2/23/2011	0.0487	0.0541	-0.0054	0.0618
8	6/20/2011	0.0527	0.0538	-0.0011	0.0616
9	6/12/2012	0.0583	0.0529	0.0054	0.0609
10	4/25/2013	0.0459	0.0521	-0.0062	0.0617
11	3/3/2014	0.0395	0.0513	-0.0118	0.0627
12	3/11/2015	0.0428	0.0504	-0.0076	0.0643
13	12/21/2015	0.1107	0.0497	0.061	0.0653
14	4/21/2016	0.1079	0.0494	0.0585	0.0659
15	5/11/2017	0.0563	0.0484	0.0079	0.0684
16	3/7/2018	0.0508	0.0477	0.0031	0.07
17					
18					
19					
20					

Mann-Kendall	
Test Result	No trend
Test Statistic (S)	-20
Normalized S	-0.855
Critical Value	1.645

Theil-Sen	
Slope	-0.00000251
Intercept	0.156
When is the concentration predicted to exceed the cleanup level?	Not applicable - slope is not statistically increasing



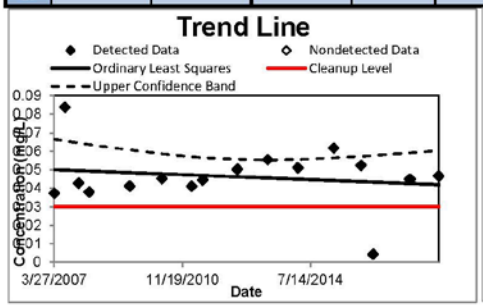
VMW-03 - Uranium - Figure 47

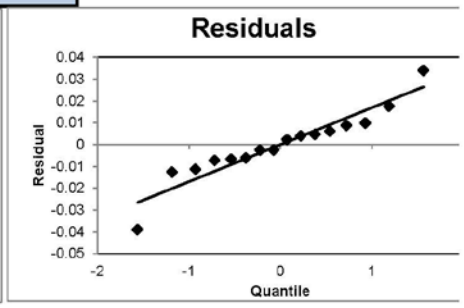
Groundwater Statistics Tool

Trend test results for datasets with normally distributed residuals (with our without transformation)

i	t (Date)	C (mg/L)	C Predicted	Fit residual	Upper Confidence Band
1	3/27/2007	0.0374	0.05	-0.0126	0.0664
2	7/17/2007	0.0838	0.0498	0.034	0.0655
3	12/4/2007	0.0429	0.0495	-0.0066	0.0644
4	3/25/2008	0.038	0.0492	-0.0112	0.0636
5	5/20/2009	0.0412	0.0484	-0.0072	0.0606
6	4/20/2010	0.0452	0.0477	-0.0025	0.0585
7	2/23/2011	0.041	0.0471	-0.0061	0.057
8	6/20/2011	0.0444	0.0468	-0.0024	0.0565
9	6/12/2012	0.0502	0.0461	0.0041	0.0556
10	4/25/2013	0.0554	0.0455	0.0099	0.0553
11	3/3/2014	0.051	0.0448	0.0062	0.0556
12	3/11/2015	0.0617	0.0441	0.0176	0.0564
13	12/21/2015	0.0523	0.0435	0.0088	0.0572
14	4/21/2016	0.0043	0.0433	-0.039	0.0576
15	5/11/2017	0.0448	0.0425	0.0023	0.0591
16	3/7/2018	0.0466	0.0419	0.0047	0.0603
17					
18					
19					
20					

Ordinary Least Squares	
Slope	-2.02683E-06
Intercept	0.129370302
Correlation, R^2	0.0291
Test Result	No trend
Test Statistic	-0.648
Critical Value	1.761
When is the concentration predicted to exceed the cleanup level?	Not applicable - slope is not statistically increasing





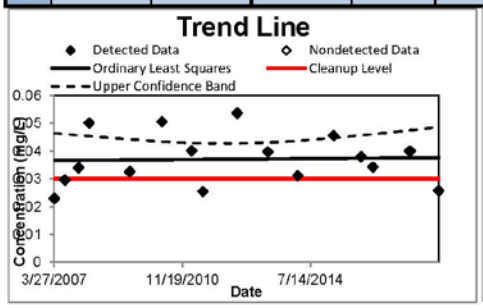
VMW-04 - Uranium - Figure 48

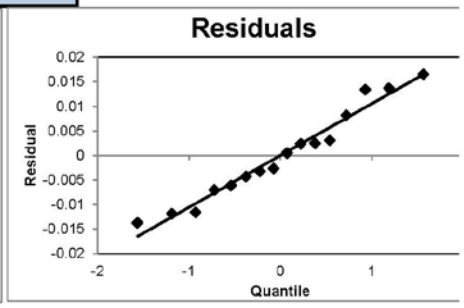
Groundwater Statistics Tool

Trend test results for datasets with normally distributed residuals (with our without transformation)

i	t (Date)	C (mg/L)	C Predicted	Fit residual	Upper Confidence Band
1	3/27/2007	0.023	0.0367	-0.0137	0.0465
2	7/17/2007	0.0297	0.0367	-0.007	0.0461
3	12/4/2007	0.0341	0.0368	-0.0027	0.0457
4	3/25/2008	0.0502	0.0368	0.0134	0.0454
5	5/20/2009	0.0326	0.0369	-0.0043	0.0442
6	4/20/2010	0.0507	0.037	0.0137	0.0434
7	2/23/2011	0.0401	0.037	0.0031	0.043
8	6/20/2011	0.0255	0.0371	-0.0116	0.0429
9	6/12/2012	0.0537	0.0372	0.0165	0.0428
10	4/25/2013	0.0397	0.0372	0.0025	0.0431
11	3/3/2014	0.0312	0.0373	-0.0061	0.0437
12	3/11/2015	0.0456	0.0374	0.0082	0.0447
13	12/21/2015	0.038	0.0375	0.0005	0.0457
14	4/21/2016	0.0343	0.0375	-0.0032	0.0461
15	5/11/2017	0.04	0.0376	0.0024	0.0475
16	3/7/2018	0.0258	0.0377	-0.0119	0.0487
17					
18					
19					
20					

Ordinary Least Squares	
Slope	2.391E-07
Intercept	0.027333504
Correlation, R^2	0.0012
Test Result	No trend
Test Statistic	0.128
Critical Value	1.761
When is the concentration predicted to exceed the cleanup level?	Not applicable - slope is not statistically increasing





VMW-06 - Uranium - Figure 49